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Genes Contributing to Variation in Fear-Related Behaviour

A thesis submitted for the degree of Doctor of Philosophy

Michaelmas Term 2013

My work is attributable to the interaction of three factors:

my family (thank you for the happy alleles)

my friends (for the happy environment)

and Jonathan (for the fear)

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Societal Impact Summary

Anxiety disorders and major depressive disorder are highly prevalent — estimated to affect a third and a quarter, respectively, of developed economy inhabitants at some point in their lives. In addition to being common, anxiety and depression are especially pernicious to society because of the debilitating impact they can have on an individual's quality of life, the strongest example being that the majority of suicide victims had depression. Yet, the causes and treatment of both disorders are poorly understood: Despite being heritable, few genes are convincingly linked to either disease; and up to two months are required to assess the effectiveness of pharmacological treatments, which only work half the time.

My research for this dissertation was carried out to better understand the genetic factors that cause anxiety and depression. To achieve this, a selection of recently-developed statistical techniques from genome research were applied to an animal model of these disorders, namely the wide range of fear-related behaviours exhibited by nearly two thousand genetically diverse mice. These analyses reveal particular candidate risk factors for fear-related behaviours: particular variations in genetic sequences as well as the interaction of genetic sequences with characteristics of the animals (such as their sex) and environmental features (such as the time of year). Additionally, I examined whether there are large-scale networks of hundreds of genes that act in concert to influence behaviour, and I applied a novel statistical technique to identify specific biological pathways by which genes might exert their effects on fear-related behaviours.

Understanding the molecular underpinnings of anxiety and depression could lead to the identification of therapeutic drug targets, while recognition of the aspects of an individual's environment that interact with genetics to cause the disorders can inform preventative measures. In the case of anxiety and depression, this translates to improved quality of life for those afflicted.

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Abstract

Anxiety and depression are highly prevalent diseases with common heritable elements, but the particular genetic mechanisms and biological pathways underlying them are poorly understood. Part of the challenge in understanding the genetic basis of these disorders is that they are polygenic and often context-dependent. In my thesis, I apply a series of modern statistical tools to ascertain some of the myriad genetic and environmental factors that underlie fear-related behaviours in nearly two thousand heterogenous stock mice, which serve as animal models of anxiety and depression.

Using a Bayesian method called Sparse Partitioning and a frequentist method called Bagphenotype, I identify gene-by-sex interactions that contribute to variation in fear-related behaviours, such as those displayed in the elevated plus maze and the open field test, although I demonstrate that the contributions are generally small. Also using Bagphenotype, I identify hundreds of gene-by-environment interactions related to these traits. The interacting environmental covariates are diverse; ranging from experimenter to season of the year.

With gene expression data from a brain structure associated with anxiety called the hippocampus, I generate modules of co-expressed genes and map them to the genome. Two of these modules were enriched for key nervous system components — one for dendritic spines, another for oligodendrocyte markers — but I was unable to find significant correlations between them and fear-related behaviours. Finally, I employed another Bayesian technique, Sparse Instrumental Variables, which takes advantage of conditional probabilities to identify hippocampus genes whose expression appears not just to be associated with variation in fear-related behaviours, but cause variation in those phenotypes.

Statement of Originality

I hereby declare that this submission is my own work and to the best of my knowledge it contains no materials previously published or written by another person, or substantial proportions of material which have been accepted for the award of any other degree or diploma at the University of Oxford or any other educational institution, except where due acknowledgement is made in the thesis.

Any contribution made to the research by others, with whom I have worked at the University of Oxford or elsewhere, is explicitly acknowledged in the thesis.

I also declare that the intellectual content of this thesis is the product of my own work, except to the extent that assistance from others in the project's design and conception or in style, presentation and linguistic expression is acknowledged.

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Jonathan Krohn
December 15, 2013
New York

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Dissemination

Peer-Reviewed Publications

Krohn J, Speed D, Flint J (in press) Genetic interactions with sex make a relatively small contribution to the heritability of complex traits in mice. *Public Library of Science ONE*

Randall JC et al. (2013) Sex-stratified genome-wide association studies in 270,000 individuals shows evidence for sexual dimorphism in genetic loci for anthropometric traits. *Public Library of Science Genetics 9*:e1003500

Agakov F, McKeigue P, Krohn J, Flint J (2011) Inference of causal relationships between biomarkers and outcomes in high dimensions. *Journal of Systemics, Cybernetics and Informatics 9*: 1-8

Chen C-M, Krohn J, Bhattacharya S, Davies B (2011) A comparison of exogenous promoter activity at the ROSA26 locus using a PhiC31 integrase mediated cassette exchange approach in mouse ES cells. *Public Library of Science ONE 6*: e23376

Orton S, Wald L, Confavreux C, Vukusic S, Krohn J, Ramagopalan S, Herrera B, Sadovnick A, Ebers G (2011) Association of UV radiation with multiple sclerosis prevalence and sex ratio in France. *Neurology 76*: 425-31

Agakov F, McKeigue P, Krohn J, Storkey A (2010) Sparse Instrumental Variables (SPIV) for genome-wide studies. *Advances in Neural Information Processing Systems 23* (Edited by: J Lafferty, C Williams, J Shawe-Taylor, R Zemel & A Culotta)

Limebeer C, Krohn J, Cross-Mellor S, Litt D, Ossenkopp K-P, Parker L (2008) Exposure to a context previously associated with nausea elicits conditioned gaping in rats: A model of anticipatory nausea. *Behavioral Brain Research 187*: 33-40

Dissemination

Conference Presentations

Krohn J, Agakov F, McKeigue P, Flint J (2011) Fine-Mapping QTL and Inferring Causal Pathways that Underlie Sixty Murine Phenotypes. Mouse Genetics, Washington, D.C. *(selected as "Outstanding Student Presentation" from a field of sixteen students)*

Krohn J, Flint J (2010) Gene-by-Environment Interactions Underlying Anxiety Across Six Murine Experiments. Complex Trait Community Meeting, Chicago

Krohn J, Flint J (2010) Sex-by-Gene Interactions in Murine Phenotypes Investigated by Resample Model Averaging. European Mathematical Genetics Meeting, Oxford

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Abbreviations

AIC	Akaike Information Criterion
BC	Back Cross
CC	Collaborative Cross
CD	Cluster of Differentiation
EPM	Elevated Plus Maze
EM	Expectation-Maximisation Algorithm
FDR	False Discovery Rate
FPS	Fear-Potentiated Startle
GWAS	Genome-Wide Association Study
HS	Heterogeneous Stock
LCMS	Likelihood-based Causality Model Selection
LD	Linkage Disequilibrium
MI	Mutual Information
OAD	Open Arm Distance
OAT	Open Arm Time
OFT	Open Field Test
PP	Posterior Probability
QTG	Quantitative Trait Gene
QTL	Quantitative Trait Locus
RI	Recombinant Inbred
RMA	Resample Model Averaging
SDP	Strain Distribution Pattern
SEM	Structural Equation Modelling
SP	Sparse Partitioning
SPIV	SParse Instrumental Variables
WGCNA	Weighted Gene Co-expression Network Analysis

CHAPTER 1

BACKGROUND

Finding genes for complex traits remains a challenge for biomedical research, and this is particularly true for behavioural disorders. In this thesis, I consider some new approaches to this old problem. It has become clear that the complexity of genetic architecture — i.e., the large number of contributing loci, the small contribution of each locus and the prevalence of context-dependent effects — frustrates many attempts to uncover the molecular underpinnings of psychiatric illness.

One hope is that the accumulation of data from multiple sources, from the level of the gene, through expression and epigenetic measures to detailed characterisation of phenotypes, will make it possible to construct models that explain disease. In the simplest example, it has been argued that incorporating expression data into genetic mapping experiments will substantially increase the chances of finding the relevant gene. A more complex approach is to consider the disease arising from, or being a reflection of, a network of correlated molecular phenotypes, such as variation in transcript abundance. A third approach is to consider the influence of genetic factors not alone, but as factors interacting with environmental covariates. My aim in this thesis is to explore the applicability of these ideas to identifying the molecular causes of anxiety, as modelled in mice.

The fundamental theme my thesis explores is how genetic variation, particularly sequence variation, impacts behaviour, as exemplified by anxiety-related behaviours in mice. The first section of this introductory chapter discusses the most straightforward mechanism of this relationship, where individual genes have a major impact on behaviour via direct molecular pathways. I describe evidence that this relatively simple model is only known to occur in a handful of circumstances, largely in invertebrates. In the second section, I expand my discussion to mammal behaviours, including ones relevant to psychiatry, for which single gene models have been ineffective and which may be influenced by a combination of myriad genes, networks of biological molecules, and interactions with the environment.

1.1 Monogenic influences on behaviour

The simplest mechanism by which genetic variants could impact behaviour is by a variant, say a sequence variant, within or near a single gene altering the structure of a protein or affecting transcription rates. There are indeed a few examples of such monogenically-determined behavioural phenotypes.

Of the widely-studied laboratory animals, the least neurologically complex is the flatworm *Caenorhabditis elegans*: It has a humble 302 neurons, and all their connections are known (Watts and Strogatz, 1998). In the early '70s, Sydney Brenner employed mutant strains of *C. elegans* to infer that 77 of the 95 genes he identified in the worm affect their behaviour (Brenner, 1998). Since Brenner's seminal paper, whole-genome sequencing has revealed the more than nineteen thousand protein-coding genes of his worm (*C. elegans* Sequencing Consortium, 1998) and some particular monogenic behaviours have been well-characterised.

As described by de Bono and Bargmann (1998), some wild strains of *C. elegans* aggregate when exposed to bacterial food while other strains disperse from each other. Whether the worm is an aggregating- or solitary-style feeder is attributable to a single nucleotide polymorphism (SNP) in the *npr-1* gene that codes for the receptor protein NPR-1. This SNP causes variation in the 215th amino acid of NPR-1, encoding it as either phenylalanine or valine in the aggregating or dispersing strains, respectively. It appears that this amino acid variation may impart its effects on *C. elegans* behaviour by affecting the connectivity of the sensory neurons to a particular neural circuit (Macosko et al., 2009).

In addition to feeding style, a number of aspects of male *C. elegans* mating behaviour have been shown to be affected by particular genetic sequence variations. There are two *C. elegans* sexes, male and hermaphrodite. The former display five defined steps of mating behaviour when they come into physical contact with the latter, the process culminating in sperm transfer enabled by the male's spicules (tail structures) being inserted into the vulva of the hermaphrodite (Liu and Sternberg, 1995). Mutations in several genes associated with synthesis or processing of the neurotransmitter serotonin (e.g., *cat-1*, Duerr et al., 1999; *cat-4*, *bas-1*, Nass and Blakely, 2003) reduce the male's tail curling, thereby reducing mating ability. These genetic effects can be attributed to the observation that exogenous serotonin causes tail curling in males, mimicking the male-only serotonergic motor neurons that transmit signals to particular tail muscles also found only in males (Loer and Kenyon, 1993).

As in *C. elegans*, the larvae of the fruit fly *Drosophila melanogaster* have variable feeding behaviour attributable to a particular SNP. "Rover" larvae tend to migrate short distances between food sources while "sitter" larvae tend to remain at one, and this naturally-occurring behavioural variation can largely be attributed to the gene *dg2* (Osborne et al., 1997; Fitzpatrick et al., 2007). Swapping the variant of this kinase encoding gene via genetic engineering results in the behaviour swapping as well, and this behaviour is not simply a function of locomotor ability: When no food is available, the larvae display no significant variation in locomotion. Relevant to much of my thesis, particularly the chapter on interactions of genetics with an organism's environment (Chapter 3), is that fly larva foraging behaviour is context-dependent: both rovers and sitters behave like sitters following food deprivation.

Also like *C. elegans*, there is a well-studied gene for *Drosophila* mating behaviour: *fru* is a necessary gene for male sexual behaviour that regulates several aspects of courting (Ito et al., 1996; Ryner et al., 1996). Wild-type male flies court females through a series of behaviours including using their legs to tap her, vibrating their wings to perform a "song", and bending their abdomen to copulate. This fixed series of activities can be modulated at any one of the stages in particular ways by mutations to particular sites of *fru*. For example, some mutations prevent the ability to perform the wing-vibration serenade but these mutants nevertheless have otherwise normal wing function and they fly and move equivalently to wild type *Drosophila* (Villella et al., 1996).

Even in the more neurologically-complex vertebrates, there are some instances of behaviours being largely influenced by single genes, such as nest provisioning in parrots (Dilger, 2010) and whether voles are monogamous or polygamous (Lim et al., 2004). In mice, almost twenty years of gene targeting and genetic manipulation have provided many examples of observing behavioural alteration associated with mutations. These range from a long tradition of work on learning and memory paradigms, relating genetically-mediated alterations in neurotransmission in the hippocampus to spatial memory (Zhao et al., 1999; Guzowski et al., 2001), to the more recent discovery that male mating, intermale aggression, maternal behaviour, and female sexual receptivity can be specifically altered through alteration of genes with sexually dimorphic expression patterns in particular structures of the brain: the hypothalamus and medial amygdala (Xu et al., 2012).

Genetic targeting has undoubtedly transformed our understanding of the molecular bases of many complex behaviours and begun to give insights into the neuronal circuitry that drives behaviour (e.g., Anderson, 2012). However there remain relatively few examples in any mammal of naturally occurring mutations that act on behaviour in highly penetrant Mendelian fashion. A few examples do exist, such as the discovery in the 1990s that a mutation in the monoamine oxidase A gene is associated with aggression (Brunner et al., 1993), and the type of nest built by mice (Dawson et al., 1988), but the failure of mutagenesis programmes in the mouse to identify such mutations indicates that, for at least some behaviours, genetic underpinnings are always complex. Indeed, assessing the effect size of engineered knockouts demonstrates that the average contribution to variation in behaviour is about 15% (Flint and Mott, 2008).

1.2 Polygenic influences on behaviour

Genetic effects on behaviour, particularly in mammals, act primarily in a complex fashion. The genetic architecture of behaviour can be simply described as involving multiple genes of small effect each acting in concert with each other and the environment to produce phenotypic variation. In this respect, the genetic architecture of behaviour is in many ways identical to the genetic architecture of other complex traits, including classic quantitative phenotypes such as height and weight, with the difference that large effect Mendelian mutations are rarely, if ever, found. I summarise next what is known about the genetic architecture of behaviour in mice.

The results on which this summary is based are derived from mapping quantitative trait loci (QTL) in inbred strain crosses and in experiments using quasi-outbred populations. A description of these experimental designs is given later in Chapter 2, although a detailed understanding of them is not germane to an appreciation of the experimental results, at least in so far as they relate to genetic architecture. However, an understanding of genetic architecture is critical for designing experiments that aim to find the genes involved in behaviour. This can be appreciated by considering two extreme situations. In one, the genetic basis of behaviour is entirely Mendelian: that is to say, due to large effect mutations. In this case, gene identification using classic recombination mapping would be sufficient. In the second case, the genetic basis of behaviour is entirely polygenic, due to the conjoint effect of tens of thousands of loci, whose action depends on the environmental and genetic context. In this case, the problem of gene identification will be almost intractable with current resources and approaches.

There are three relevant features of the genetic architecture of behaviour in mice. The first, the lack of Mendelian effects, was mentioned above, at the end of §1.1. The effect sizes of engineered inactivating mutations, including mutations aggressively induced by ENU (*N*-ethyl-*N*-nitrosourea), are typically about 15%. Second, naturally-occurring segregating variants have much smaller effects. In a study of two thousand quasi-outbred mice (Valdar et al., 2006b), with very few exceptions, the majority of QTL explain less than 3% of the variation. It should be noted that this effect is substantially larger than the average effects found in completely outbred populations like our own, but this does not reflect any differences between species in the biology of behaviour: Effect sizes (as measured as percentage of total variation attributable to a genetic locus) are relative measures, dependent on the population in which they are measured. The quasi-outbred population used for this mapping experiment has reduced genetic diversity compared to fully outbred populations.

A simple way to illustrate these effect size differences is to consider a population in which just one variant is segregating. In this case, all of the genetic variation is attributable to a single locus, i.e., the effect size is 100%, assuming there is no environmental contribution. If nine more variants are introduced into the population then, assuming that all ten equally influence the phenotype, the individual contribution (the effect size) will drop to 10%. Inbred strain crosses have even less genetic variation than the quasi-outbred population, so here the effect sizes are relatively larger, but still small: an average QTL effect size is about 5% (Flint and Mott, 2001). Importantly, there is a linear relationship between the heritability (the total genetic variance) of the phenotype and the number of loci. The implication of this finding is that highly heritable phenotypes just have more QTL, rather than that highly heritable phenotypes are evidence for the presence of large effect QTL.

The third feature of the genetic architecture of behaviour is that context-dependent effects are common (Valdar et al., 2006a). I will illustrate this concept with an example from a test of mouse behaviour, the elevated plus maze (EPM), which consists of four arms arranged in the shape of a cross. Two arms are open (i.e., they have no walls and are thus anxiogenic), while the other two arms are enclosed (therefore less anxiety provoking). The test is administered by placing the mouse into the centre of the apparatus, and observing the choices it makes. The number of entries an animal makes into the open arms of an elevated plus maze is used as an index of fear.

When a large number of animals are processed there may be many researchers involved in the experiment, and therefore one question we can ask is whether the results depend on who carries out the experiment. Figure 1.1 shows that there is indeed an effect. Some experimenters appear to frighten the animal more than others (or more accurately, when some of them test the animal it is less likely to venture out on to the open arms of the elevated plus maze). The effect of the experimenter is relatively small, however; accounting for about 5% of the variation.

Consider next the effect of the genotype. Figure 1.2 shows a locus in the genome with three genotypes: AA, AT and TT. There is no significant difference in the means associated with each genotype (the phenotype levels lie on a horizontal line in the figure), indicating that the genotype has no effect on the behaviour. However, if we divide up the data as in Figure 1.3 so that we show genotypes for those animals tested by each experimenter, then a very different picture emerges. For example, we can see that Experimenters 4 and 10 elicit large genetic effects but Experimenter 2 none at all. Note also that the direction of effect differs: At the hands of Experimenter 5 and 10, animals with one genotype become more anxious, while they appear less anxious at the hands of Experimenter 4. This is an example of another context-dependent genetic effect (like the food deprivation-dependent fly larva foraging behaviour described in §1.1): In this instance, the effect attributable to a genotype depends on who carried out the experiment.

Similar context-dependent effects are found for other phenotypes. In general, the contribution to the total phenotypic variation is large, typically much larger that of the main effect, as is shown in the example I have given here (Valdar et al., 2006a).

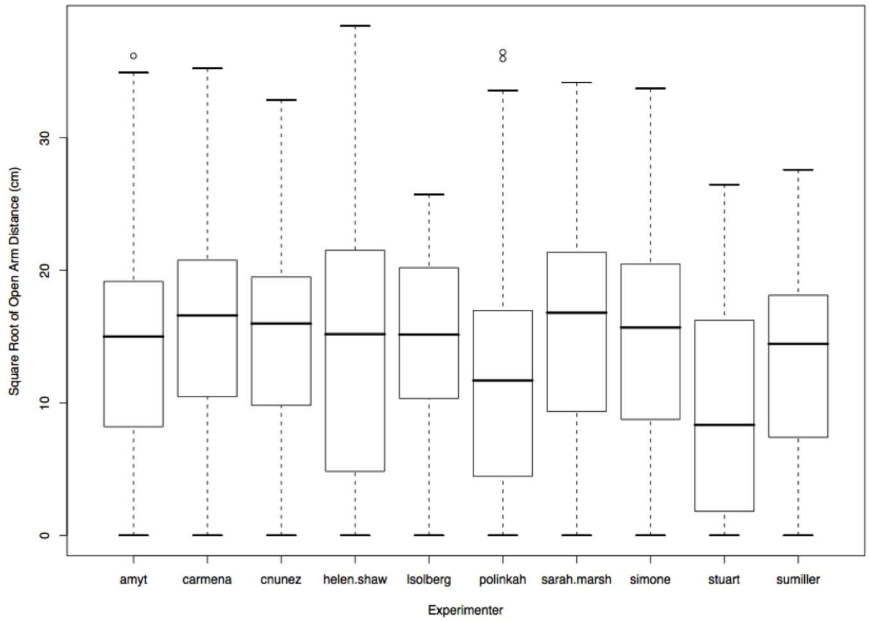


Figure 1.1: A box-and-whisker plot of the time mice spend in the open arms of the "elevated plus maze", a behavioural measure of anxiety in mice (more detail in §2.2.1.6). Some of the variation in the phenotype is explained by the experimenter that handled the mouse prior to testing. "Stuart", in particular, appears to induce anxiety in mice, as they spend less time in the open arms of the maze if they are handled by him prior to testing. More than 1800 heterogenous stock mice (see §2.1) were tested and the data were normalised by taking their square root (transformations of phenotypic data are discussed later in §2.2).

The small size of the effects, together with their context-dependency, are indications of the challenge facing attempts to identify quantitative trait genes in the mouse.

1.3 Anxiety and depression

In this section I describe the features of anxiety disorders in humans and the relevant animal models, whose use is a key part of my thesis work. My concern here is to explain how the animal tests are thought to reflect the same neurobiological processes that occur in anxiety in our own species.

Anxiety disorders are highly prevalent, estimated to affect a third of developed

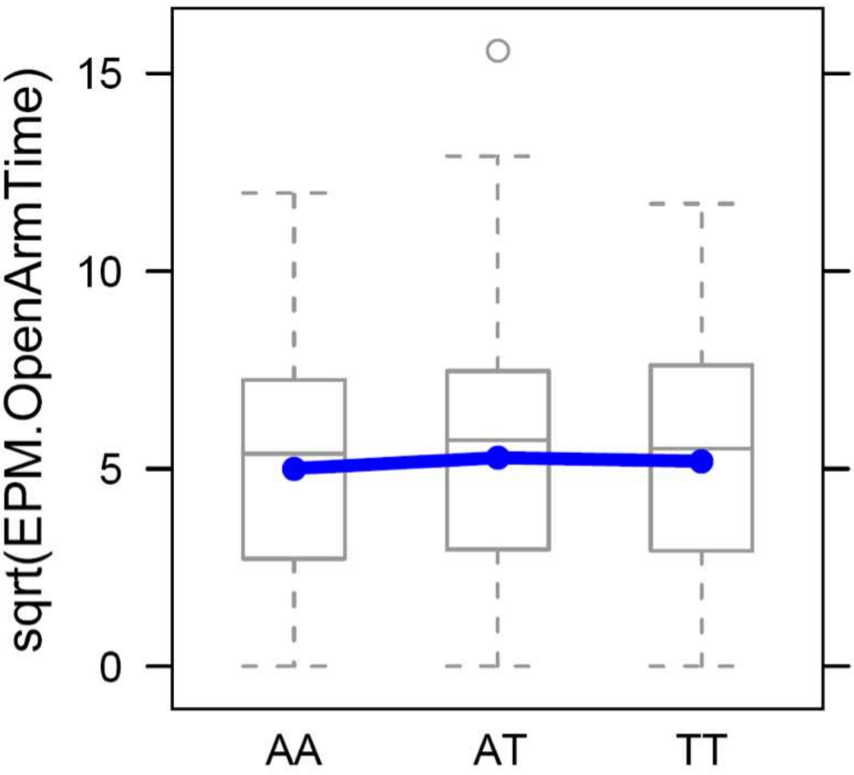


Figure 1.2: A box-and-whisker plot of the time mice spend in the open arms of the elevated plus maze, as in Figure 1.1, but in this instance the data are factored by genotype (rs3700012 on chromosome 12 at 56.8 Mbp as per Meyer et al., 2013) and we observe no genotype-dependent difference in the behaviour measure.

economy inhabitants at some point in their lives (Kessler et al., 2005). In addition to being common, anxiety is especially pernicious to society because of the debilitating impact they can have on an individual's quality of life (Mościcki, 2001). The causes of anxiety disorders are poorly understood and their treatment largely symptomatic. Up to two months are required to assess the effectiveness of pharmacological treatments, which only work half the time (Whooley and Simon, 2000).

Experiments using animal models suggest that several separate, but interacting, neural systems are involved in fear- and anxiety-related behaviours, and that these different systems are associated primarily with different aspects of these behaviours. The brain structure called the amygdala, for example, appears to be critical to the acquisition and storage of memories of fear conditioning, as well as to the fear response (Kapp et al., 1992; Fanselow and LeDoux, 1999; Maren, 2001; Med-

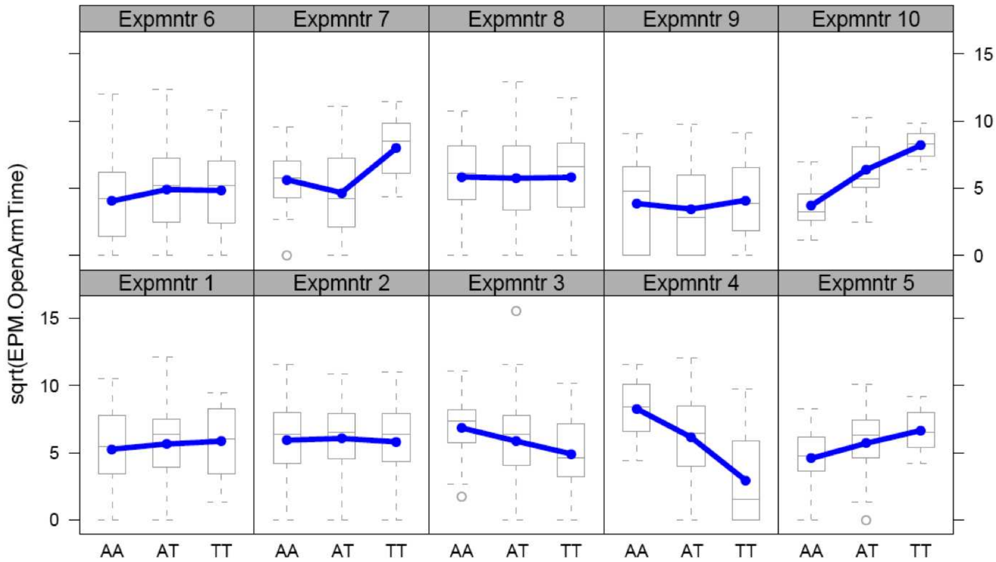


Figure 1.3: A box-and-whisker plot of the time mice spend in the open arms of the elevated plus maze, as in Figures 1.1 and 1.2, but now allowing for visualisation of the interaction of two factors: genotype and experimenter. Examining the data in this manner demonstrates that some genetic effects may manifest themselves under particular environmental conditions, such as being handled by an aggressive experimenter prior to being tested.

ina et al., 2002). In contrast to the association of the amygdala with fearful stimuli, another component of the vertebrate brain, the hippocampus, appears to be specialised for processing anxiogenic stimuli (Phillips and LeDoux, 1992; Richmond et al., 1999). More specifically, the ventral hippocampus seems to be crucial to animal models of anxiety-related behaviours, e.g., those displayed in the elevated plus maze (Kjelstrup et al., 2002; Bannerman et al., 2004; McHugh et al., 2004). This functional double dissociation in rodents (of the amygdalar role in fear and the hippocampal role in anxiety) is consistent with both the results of imaging studies on primates (Strange et al., 1999; Strange and Dolan, 2001) and Jeffrey Gray's theory of a behavioural inhibition system (Gray, 1990).

Rodent tests of anxiety-like behaviour fall into two groups. One group consists of tests in which the animal is given access to an anxiogenic situation (e.g., a novel object, an open fear-inducing space) and allowed to make a choice. Typically, these induce "approach-avoidance conflicts", the indecision we assume the mice experience when considering the benefits of approaching the novel object or situation (e.g., there may be food in a novel environment) versus the potential risks (the same environment may make them more vulnerable to predation).

The oldest of these anxiogenic tests is the open field test (OFT), devised by Calvin Hall in the 1930s. The simple idea here is that mice, as natural prey, will avoid an exposed open area. They will prefer to remain still, at the edge of the area. So time spent moving or total distance travelled, as well as time spent in the centre of the area (the most exposed region of the OFT) are indices of fear-related behaviour. One confound of the OFT is that any animal that is hyperactive will appear to be non-anxious (or, conversely, a hypoactive mouse will appear anxious). The test does not effectively deal with the consequences of high levels of endogenous locomotor activity, regardless of the animal's emotional state. It is possible, however, to use the OFT to take an independent measure of emotionality, the number of faecal boli produced, which is under separate neural control from motor activity. In fact, Hall developed the OFT on the basis of its face similarity to situations in which combat veterans defecated; due to intense fear under artillery bombardment (Hall, 1934).

In contrast to the OFT, the elevated plus maze (EPM, introduced above) allows for some control of the total activity of an animal, since there is a non-frightening region (the closed arms). By taking the ratio of time spent in the open arms, compared to time spent in the closed arms, it is possible to control for endogenous locomotor activity — though most investigators will want to test more specifically for activity using, for example, a measure of activity in a non-threatening home cage. Another test, the dark-light box again offers a choice between a threatening region (well lit, exposed) and a relatively safe, dark enclosure. As in the EPM, measures of fear in the dark-light box are related to the number of entries and time spent in the anxiogenic regions. The last commonly used approach-avoidance task to assess fear-related behaviour is the presentation of a new food. An animal is typically food deprived overnight and then presented with a foodstuff that it has not previously encountered. The measure taken here is the time taken to try the novel food: an anxious animal will take longer to try the food than a less anxious animal.

All of the above tests receive some validation as tests of anxiety in that the behaviours can be changed in a predictable fashion after the administration of anxiolytic drugs. Thus benzodiazepines — the class of drug that includes Valium and Librium commonly prescribed anxiolytics — increase the time spent in the open arms of the EPM, the distance travelled in the OFT, the number of entries into the light area of the dark-light box and reduce time to first trying a novel food. In addition, as alluded to earlier, these tests have been validated by lesion experiments implicating the involvement of the hippocampus and amygdala (data summarised in Gray and McNaughton, 2007).

The second group of tests that model anxiety-like behaviour in rodents are those involving fear-conditioning. In a fear-conditioning test, an animal is presented with a neutral stimulus (such as a tone or light) which is associated with a fear inducing stimulus (a footshock). After training, the animal is presented with the neutral stimulus and the amount of freezing induced is recorded. Conditioning to both the stimulus and the context in which the stimulus was presented (the training box) occur, and are due to overlapping but not independent neural systems, acting in the ventral hippocampus and amygdala. While fear-conditioning provides a measure of control over the phenotype that is not available with the ethological approach-avoidance tests described above, it is again not only a measure of anxiety (the animal has to learn to associate tone and footshock so that variation in memory and learning will appear as variation in emotional reactivity).

One approach that gets closer to being a purely psychological measure of anxiety is fear-potentiated startle (FPS). Here an animal is again subject to fear-conditioning, but this time, before the fear conditioning training, a measure is taken of the animal's response to a frightening stimulus, such as a loud noise. The rodent is placed in an accelerometer, exposed to a 100dB sound, and the amount of movement induced is taken as a measure of the startle response. After undergoing fear-conditioning training, the animal is placed back into the accelerometer, given the cue (which is now associated with an unpleasant footshock) and its response again measured to exposure to the 100dB sound. The increase in startle is taken to be a measure of the animal's expectation of a unpleasant event, or more simply, its anxiety. Fear-potentiated startle has been used in rats to delineate a fear-related neuronal pathway (Davis et al., 1993), but it has proved extremely difficult to apply in mice. For reasons that are not clear, robust fear-potentiated startle has been very hard to induce in mice. Therefore, for practical reasons, conditioned tests of anxiety in mice are limited to fear-conditioning.

Given that anxiety-related behaviour consistently involves the same neural system across different tests, it might be possible to identify predictive genes that are common to several of those behaviours. Indeed, previous genetic studies of anxiety-related behaviours have identified genetic loci that individually predict a range of the behaviours (Turri et al., 2001a,b; Fernandez-Teruel et al., 2002; Turri et al., 2004; Henderson et al., 2004). These findings in rodents could assist the understanding of anxiety and depression in humans because of the phenotypes the genetic variants predict, similarities between the behavioural effects of allelic differences and anxiolytic pharmaceuticals, as well as coincidences in the direction of allelic effects and genetic location (Fullerton, 2005).

1.4 Genetic analysis of anxiety in mice

Animals show individual variation in behaviour on the fear-related tests described above, differences that we know have in part a genetic basis. We know this from the analysis of mouse inbred strains that has been systematically carried out at the Jackson Laboratory mouse facility. A large database of phenotypes that differ among inbred strains has been set up (Bogue et al., 2007), and that catalogue contains many examples of behaviour, including the conditioned and unconditioned tests of anxiety just described in §1.3. Systematic collection of data for 178 strains has yielded over two thousand different measurements. The fact that differences are found between inbred strains is evidence of a genetic component. The problem is how to identify the molecular differences that are responsible.

1.4.1 Inbred strain crosses

Differences between inbred strains provide a justification for using inbred strains as a starting point for genetic mapping experiments: genetic loci must exist that contribute to phenotypic variation and their identification is a root into the biological characterisation of the phenotype. While most often founder strains will be chosen because they differ in the trait of interest, the phenotype of the progeny cannot be predicted from the phenotypes of the founders: New associations of alleles in the progeny are likely to increase the variance. Investigators starting an experiment using inbred strains often overlook this important point. It can be appreciated in the following way.

As pointed out above, the genetic basis of behavioural variation is due to the effect of many loci. Imagine that we score a fear-related behaviour on a quantitative scale so that the phenotype of an inbred strain can be considered as the result of summing the effects of all loci. At some loci, the alleles increase the score. At other loci alleles, decrease the score. Two inbred strains may obtain the same overall score from very different combinations of alleles. If these two strains are crossed, alleles at these loci will segregate, giving rise to a broad range of phenotypes in the offspring. Some offspring will by chance garner many increasing alleles, others decreasing alleles, so that the extent of variation in the phenotype of the offspring will exceed that found in the two inbred progenitor strains. Thus there may be strains that have identical phentoypic scores but whose progeny are both less, and more, anxious, due to the possession of differing combinations of alleles.

A cross between inbred strains is a common method for identifying the genetic loci contributing to genetic variation in mice. To start with, the cross generates genetically identical offspring, with one chromosome from one strain and one from the other (this is the F1 generation). For genetic mapping, these animals can either be intercrossed, to generate an F2, or backcrossed to one or other of the founders (BC). Genetic mapping using inbred strain crosses proceeds by determining where in the genome genetic variation is associated with phenotypic variation. This is done by genotyping a set of markers across the genome and identifying where there is a significant association between phenotypic and genetic variation.

Suppose that the two progenitor strains are called A and B. Using these names to refer to the progenitor genomes, then each position in the genomes of the F2 must be one of three genotypes: AA, AB, or BB. It follows that any variant contributing to phenotypic variation (a causal variant) must also be constrained to be one of these three genotypes. This means that genotyping markers at a sufficient density will capture the effect of the causal variant. Each chromosome undergoes only a few recombinations in each generation and the consequent relatively high level of linkage disequilibrium means that a few hundred markers are sufficient to accurately recreate the mosaic structure of each F2 genome. By contrast, in an outbred human population, there may be many alleles at a locus, there is no constraint on the relationship between causal and other variants, and linkage disequilibrium extends often over a few kilobases, requiring the use of hundreds of thousands of markers to test association between phenotypic and genetic variation.

1.4.2 Recombinant inbred strains

Each animal in a cross between two inbred strains is unique. It must be genotyped and it can only be used for a limited number of phenotypes. By inbreeding the F1 or F2 generation it is possible to overcome these limitations and produce a set of animals that need to be genotyped just once, and which can be phenotyped endlessly. These are recombinant inbred strains (RIs). It takes about twenty generations to inbreed mice, an expensive and long undertaking, which until recently limited the number of available RIs.

Mapping in RIs is carried out by comparing the phenotypes of all the strains and finding genomic regions associated with phenotypic variation in a way very similar to mapping in F2 crosses. When RI panels are descended from two inbred strains, their genomes are random mosaics of these founder haplotypes. An established RI panel needs to be genotyped only once, using markers to distinguish between the founder strains.

Mapping in an RI looks for an association between the strain distribution pattern (SDP) of genotypes and phenotypes. Suppose we have an RI of eight strains descended from two progenitors called A and B. At a given marker, the pattern of genotypes across the panel is the SDP. We could genotype a marker across the strains and obtain the genotypes AA, BB, AA, AA, BB, BB, BB and BB. We simplify by referring to the homozygous genotypes 'AA' and 'BB' as 'A' and 'B'. The SDP at the marker is thus ABAABBBB, meaning that the 1st, 3rd and 4th strains descend from strain A and the remainder from strain B (at least at this marker; we expect to find different SDPs at other markers). To map a QTL, RI animals across the panel are phenotyped and the values are correlated with the SDPs at each marker to identify markers with statistically significant associations (Wu et al., 2004). Mapping resolution depends on the size of the panel, but is roughly equivalent to that of an intercross.

Phenotyping different animals that have the same genotype allows repeated measurement of the same trait, minimising experimental variation and increased statistical power to identify QTL. Phenotyping in different laboratories is even possible, increasing the chances to accumulate phenotypic data for the mapping population, which then allows a systems genetics approach (see for example the wealth of data available for the mouse BxD RI panel in GeneNetwork; Wu et al., 2004). Finally, multiple environments can be tested to investigate context-dependent genetic effects, i.e., gene-by-environment interactions.

Limited genetic variation segregates in biparental recombinant inbred lines. A panel of mouse recombinant inbred lines derived from eight inbred strains was created by a collaborative effort: the Collaborative Cross (CC; The Complex Trait Consortium: Churchill et al., 2004). The aim of the consortium is to breed about half a thousand lines, which will be made available to the public. With an eye to maximising genotypic and thus phenotypic variation, the founder strains of the CC include three wild-derived strains representing the three *Mus musculus* subspecies.

A particularity of mapping in the CC results from using more than two progenitor inbred strains. Markers used for genotyping are usually SNPs and so have fewer alleles (two) than the number of haplotypes segregating in the cross (eight). Consequently, the alleles of a marker do not unambiguously identify the underlying strain haplotype. This means that QTL can be missed by single marker association analysis that ignores strain haplotypes. A solution to this problem is to reconstruct haplotypes in the mapping population based on the genotypes of the animals and those of the progenitors, and test for association between phenotypic variation and the progenitor haplotypes. The eight founder strains of the CC have now been sequenced at high coverage, allowing imputation of the segregating sequence variants in the CC lines and the search for causative variants.

1.4.3 Mapping using outbreds

Mapping using inbred crosses and using RIs provides limited mapping resolution. In inbred strains, typically the mapping resolution is more than ten megabases (Mb). On average a megabase contains about ten genes, so an F2 intercross is not going to deliver gene-level mapping resolution. Mapping with the genetically complex CC, with its large number of RIs, improves resolution but not to gene level.

To meet this challenge a number of investigators have turned to using outbred stocks, in which animals are allowed to accumulate large numbers of recombinantions over time. Continued intercrossing reduces the size of the unrecombined segments in the population. For instance, rather than mapping in an F2, map in an F10. Darvasi and Soller (1995) showed that doing so would increase mapping resolution fivefold in mice. The benefits from using further generations of intercrossing decrease exponentially.

Heterogeneous stock (HS) mice are outbred populations derived from inbred strains. The extant HS mice descend from eight "founder" inbred strains. The oldest is an eight-way cross of C57BL/6, BALB/c, RIII, AKR/J, DBA/2, I, A/J and C3H inbred mouse strains (McClearn et al., 1970). The more recent HS descends from A/J, AKR/J, BALBc/J, CBA/J, C3H/HeJ, C57BL/6J, DBA/2J and LP/J (Demarest et al., 2001). The strain origins are important since they are used in mapping. For this reason, the second HS is preferred since not all the progenitor strains of the first HS are still available. Small effect QTL have been mapped to subcentimorgan resolution using HS mice, demonstrating this mapping strategy's potential.

A complication of using HS animals is that they are not equally unrelated. The breeding structure that maintains the populations (typically about 40 mating pairs) inevitably introduces a degree of population structure. This means that the degree of genetic correlation between any two positions on the genome is not constant: it will be closer in some pairs of animals than others. To see the problem, suppose that we have a set of animals some of which are full siblings, some of which are unrelated. The full siblings share on average half their genetic material so that markers on different chromosomes will be correlated. When we compare phenotypes to genotypes, if there are causal variants on a chromosome, they could be falsely detected by markers on other chromosomes.

Such structured populations, like the HS, are harder to work with because genotype correlation causes (1) false positive loci in linkage disequilibrium with a causal variant ("ghost QTLs"); and (2) missed loci, because two genuine but correlated QTL could result in one going undetected. There are two statistical methods that can control for this problem. The most popular class of methods, which originated with the work of Henderson in the 1950s in animal breeding, uses mixed models (Henderson, 1953). Because they account for different degrees of relatedness between individuals, mixed models can be used to account for structure in populations that would otherwise be difficult to analyse, and moreover they allow one to combine several mapping populations with different degrees of relationship.

The second class of methods involve resample model averaging (RMA), also known as bootstrap aggregation. In this approach, the individuals are resampled, and a multiple QTL model is generated additively. The procedure is repeated, resampling the data each time, and the proportion of models that contain a QTL measures the support for that QTL. Although this works quite well, it is necessary to calibrate the threshold for establishing significance by simulations (in contrast, mixed model approaches use classical frequentist criteria to determine significance thresholds).

Successful mapping in an HS poses two demands: first, the analytical method has to take into account population structure. Second, since HS are derived from more than two progenitor strains, phenotypic variation needs to be mapped to the progenitor haplotypes. If this is not done, then association may be missed when a typed variant is not in phase with a progenitor QTL. Thus, in HS analyses, the method of detection is haplotypic association.

1.4.4 Gene identification

Refining from QTL to individual gene identification remains challenging in any organism. In mice, the host of genetic engineering tools allow experimental approaches impossible in some organisms but mouse genetics still nevertheless suffers from a lack of resources for high resolution (gene-level) mapping. This is the main reason why there are still relatively few examples where mapping has led to the unambiguous identification of a genetic variant that influences behaviour.

One approach to the problem of gene identification has been to turn to gene expression data as a key resource. Gene expression profiling is not by itself a method for QTL detection, but when combined with genetic mapping data, can help identify candidates. Suppose that we have mapped a locus in a cross between two inbred strains. Finding genes that are differentially expressed between the two progenitor strains will identify genes for further consideration (possibly considerably reducing the number of candidates). One of the first indications of the power of this strategy was expression profiling to identify CD36 gene as a quantitative trait gene (QTG) affecting insulin fatty acid metabolism (Aitman et al., 1999). Gene expression profiling has been used now in a large number of cases, for example pointing to lipoxygenase (Alox15) as a QTG for bone mass (Klein et al., 2004), and complement factor 5 as involved in susceptibility to a model of asthma (Karp et al., 2000).

Nevertheless, despite these findings, there are a number of reasons why the approach might not work. First, some variants may alter protein structure. Consequently there may be no effect on expression levels (in other words, differential gene expression is not a necessary marker of QTL action). Second, expression differences may be restricted to certain tissues, or developmental stages. For example, expression of 5HT1a receptors in the forebrain is required to modulate anxiety during embryonic and foetal life, but it is not required for that task in adult animals (Bonnin et al., 2006). Third, the QTL may have an effect on expression which is hidden through the effect of redundant, compensatory mechanisms. Fourth, physical coincidence of gene expression and QTL mapping data does not guarantee that the two are causally related.

One method that has been proposed to deal with the fourth limitation is the application of causality modelling. By simultaneously considering several categories of variables that are correlated with each other (e.g., a SNP g, the expression of a gene x, and a quantitative trait y) and then conditioning the correlation between a pair of these variables (e.g., x and y) upon the correlation of another pair (e.g., g and x, where we know one of these, g, could not reasonably be systematically influenced by the other variables in the system), we can in some instances infer the causal direction of the relationship between x and y.

The most popular of the causality modelling methods in gene expression research is "likelihood-based causality model selection" (LCMS Schadt et al., 2005; Chen et al., 2008). Among other issues detailed later, LCMS does not adequately account for the third limitation, namely the influence of other variables in the biological system under observation upon x and/or y. In this thesis, I introduce a novel causality modelling technique that addresses the shortcomings of LCMS. By successfully applying the method to known causal systems, I provide evidence that it is a valid computational technique. Subsequently, I present my findings from using the technique to search for genes that are causal for anxiety-related behaviours in mice.

1.5 Dissertation overview

My work makes extensive use of a large HS experiment in which 100 phenotypes were mapped in nearly two thousand mice. I adapted an RMA technique to identify regions of the genome that interact with environmental covariates to influence variation in the anxiety-related phenotypes of the Oxford HS mice, i.e., to produce context-dependent effects. I similarly employed this RMA technique to identify gene-by-sex interactions, which I compare with gene-by-sex interactions obtained using a purpose-developed Bayesian technique, Sparse Partitioning. These interaction effects are covered in Chapter 3.

In addition to looking for interactions, I took advantage of hippocampus gene expression data obtained from the HS mice by meticulously preprocessing the data (Chapter 2) and then identifying networks of co-expressed genes and associating these networks with the mouse genome and anxiety-related phenome (Chapter 4). Finally, I used a novel Bayesian computational technique to identify genes whose expression appears to cause variation in fear-related phenotypes, as distinguished from simply being associated with those phenotypes (Chapter 5).

CHAPTER 2

General Methodology

This chapter summarises the Heterogeneous Stock mouse project carried out in Oxford, including particulars of the animals, phenotyping, study design, genotyping, and gene expression assays. Any data processing in this chapter — notably the preprocessing of gene expression data in §2.6 — is my work, but I did not personally run the experiments from which the data were derived.

2.1 Animals

As detailed in Solberg et al. (2006), Original Northport Heterogeneous Stock mice were obtained from Robert Hitzemann of the Oregon Health Sciences Unit (Portland, Oregon). At the time the animals arrived, they had passed 50 generations of pseudorandom breeding (Demarest et al., 2001). The ancestors of the Heterogeneous Stock mice (i.e., prior to pseudorandom breeding) were eight inbred strains of *Mus musculus*: A/J, AKR/J, BALBc/J, CBA/J, C3H/HeJ, C57BL/6J, DBA/2J, and LP/J (Demarest et al., 2001). The animals were bred for phenotyping in a colony established at the University of Oxford. Animals were housed at a maximum of six per cage (mean of four) and maintained on a 12:12 light:dark cycle with *ad libitum* access to food and water.

As listed in Figure 2.1, depending on the phenotype, data from up to 1929 HS mice were available. For most results chapters in this thesis, mice could be included if they had genetic marker and phenotypic data (μ_n = 1618.9 ± 88.4, range = 427 to 1929). However, for Chapters 4 and 5, hippocampus gene expression data were required in addition to genetic marker and phenotypic data, resulting in smaller sample sizes (μ_n = 386.5 ± 95.9, range = 113 to 457). Approximately half the mice were male for all phenotypes except the stress steroid experiment (females were not phenotyped for this trait because of the high variance in their blood corticosterone readings attributable to their oestrus cycle).

2.2 PHENOTYPES

Following a published protocol (Solberg et al., 2006), the phenotypes were all assessed quantitatively by automated machines in order to minimise variance attributable to employing multiple experimenters. The phenotypes were selected to assess genetic influences on mouse models of anxiety, diabetes, asthma, and obesity, as well as measures of biochemistry, haematology, and immunology. Figure 2.1 is a list of the 67 phenotype measures, and includes the transformations used to normalise each distribution of phenotype data to Gaussian. The Box-Cox procedure from the MASS add-on package (Venables and Ripley, 2002) for R (Team, 2010) was followed to guide the selection of a given transformation.

A brief description of each of the tests used to collect phenotypic data is provided here. Although phenotypes associated with anxiety-related behaviours (i.e., §2.2.1) are the focus of this thesis, it was fairly straightforward in the chapter focused on gene-by-sex interactions (i.e., Chapter 3) to extend analysis to additional phenotypes (§2.2.2). In that chapter, Oxford HS mouse phenotypes largely irrelevant to a doctorate in neuroscience are nevertheless reported and sometimes provide insight into the genetic basis of fear-related behaviours via contrasts in their patterns. Additionally, since the molecular bases of some non-behavioural phenotypes are better understood, in some instances (e.g., §5.1.3), they are used to demonstrate the efficacy of an analytical technique.

2.2.1 Phenotypes relevant to anxiety-related behaviour

Relevant tissue	Experiment	Phenotype measure	Transform to Gaussian	n_{gy}	n_{gxy}
Hippocampus	Activity in new home cage	Total beam breaks due to ambulation	$x^{1/2}$	1905	456
	Adrenal gland weight	Mean weight of adrenal glands (g)	$\log_{10}x$	1863	451
	Burrowed pellet weight	Burrowed pellet weight (g)	rank of x	1929	457
	Context freezing	Time freezing to context (sec)	$x^{1/2}$	1374	315
	Cue freezing	Time freezing during cue (sec)	x	1518	347
		Time freezing after cue (sec)	x	1518	347
		Fecal boli count	$x^{1/2}$	1504	341
	Elevated plus maze	Closed-arm distance (cm)	x	1850	439
		Open-arm distance (cm)	$x^{1/3}$	1882	445
	Fear-potentiated startle	Startle response	$x^{1/3}$	1642	385
	Faecal steroid	Corticosterone (ng/50 mg of faeces)	$\log_{10}x$	1090	268
	KI-67	KI-67 antigen	x	715	451
	Open field test	Fecal boli count	x	1925	457
		Time spent in centre	rank of x	1929	457
		Total activity (cm)	x	1924	455
	Stress steroid	Corticosterone after fearful cue (ng/mL)	x	437	113
Liver	Animal size	Body weight (g)	$x^{1/3}$	1873	258
		Body length (cm)	x	1885	251
		Body mass index	x	1869	247
	Biochemistry	Albumin (g/L)	x	1735	247
		Alkaline phosphatase (units/L)	$x^{1/2}$	1752	243
		Alanine transaminase (units/L)	$\log_{10}(x + 3)$	1651	230
		Aspartate transaminase (units/L)	$x^{-1/2}$	1690	233
		Calcium (mM)	x	1740	245
		Chloride (mM)	x	1791	248
		Creatinine (mg/dL)	rank of x	1929	258
		High-density lipoproteins (mM)	x	1653	227
		Low-density lipoproteins (mM)	$\log_{10}x$	1701	231
		Phosphorous (mM)	$\log_{10}(x + 1)$	1536	209
		Total protein (g/L)	x^2	1629	227
		Triglycerides (mM)	$\log_{10}x$	1503	205
		Urea (mM)	$\log_{10}(x + 1)$	1732	245
	IPGTT	Area Under Curve – Glucose (mg/dL)	x	1771	237
		Area Under Curve – Insulin (ng/mL)	$x^{1/2}$	1379	182
		Glucose at 0 min (mg/dL)	$x^{1/2}$	1849	248
		Glucose at 75 min (mg/dL)	$x^{1/2}$	1784	240
		Insulin at 0 min (ng/mL)	$\log_{10}x$	1447	192
		Insulin at 75 min (ng/mL)	$x^{1/3}$	1382	185
		K (glucose slope)	x	868	107
Lung	Ear punch	Mean area of hole in ear (mm^2)	$x^{-1/2}$	1823	258
	Full blood count	Basophil count	rank of x	1929	258
		Hematocrit (%)	x^3	1583	214
		Hemoglobin (g/dl)	x^3	1580	214
		Lymphocytes (1000/mm^3)	$x^{1/2}$	1554	211
		Mean cellular hemoglobin (g/dL)	x	1581	214
		Mean cellular volume (um^3)	x	1585	214
		Mean platelet volume (um^3)	rank of x	1929	258
		Monocyte count	rank of x	1929	258
		Neutrophil count	rank of x	1929	258
		Plateletcrit (%)	$x^{1/2}$	1552	209
		Platelets (units/microL)	x	1574	212
		RBC count (1000000/mm^3)	x^3	1580	213
		WBC count (1000/mm^3)	$\log_{10}(x + 1)$	1563	214
	Immunology	B220+ cells (%)	$x^{1/2}$	1516	196
		CD3+ cells in lymphocytes (%)	x^2	1515	196
		CD4+ cells in CD3 cells (%)	x^2	1514	196
		CD4+ cell intensity	x^2	1513	196
		CD4+ count	x	1269	168
		CD8+ cells in CD3 cells (%)	$x^{-1/3}$	1512	196
		CD8+ cell intensity	x	1509	195
		CD8+ count	x	1267	168
		CD4+:CD8+ ratio	$x^{-1/3}$	1510	195
	Plethysmography	PenH: a bronchoconstriction indicator	$x^{1/3}$	1622	228
		Respiratory rate (baseline)	x	1812	254
		Respiratory rate (metacholine)	$\log_{10}x$	1627	226
		Tidal volume (baseline) (mL)	$x^{1/3}$	1801	254
		Tidal volume (metacholine) (mL)	$x^{1/3}$	1630	229

Figure 2.1: This table lists the number of Oxford HS mice by phenotype. Phenotypes are subset into the experiments they were obtained from (described in §2.2) and the most relevant tissue (of the three tissues gene expression data were available from). n_{gy} is the number of mice for most chapters of this thesis, where only genetic marker (g) and phenotypic data (y) were required. n_{gxy} is the number of mice that, in addition to g and y, also had gene expression data (x) from the relevant tissue.

2.2.1.1 Adrenal weight

At ten weeks old, mice were euthanised and their adrenal glands removed. The mean weight of both glands is a physiological phenotype that is relevant to anxiety because the stress response is regulated by the hypothalamic-pituitary-adrenal axis, stress has been shown to increase adrenal gland size in mice (Kioukia-Fougia et al., 2002), and adrenal gland hypertrophy has been observed in patients with chronic major depression (Nemeroff et al., 1992).

2.2.1.2 Activity in new home cage

Individual mice were placed in a clean novel cage with their old bedding and their unconditioned anxiety was measured by a movement-sensitive infrared photobeam system manufactured by San Diego Instruments (San Diego, CA). The paradigm is that mice that move less in a foreign environment are more anxious (Tang et al., 2002). The test was run for 30 minutes and the total number of photobeam breaks over that period, as well as the number of breaks in the first five and final five minutes, were used as phenotypic measures. Photobeams were 1.5 cm above the cage floor, spaced 5.5 cm apart.

2.2.1.3 Burrowed pellet weight

In this test, mice are presented with a 20 cm-long plastic pipe of 68 mm diameter that lies horizontally, is filled with 200 grams of food pellets, and is accessible from one end. As natural burrowers, mice spontaneously remove the pellets from the pipe, a behaviour considered to be an "activity of daily living" (Deacon, 2009). Given this spontaneity and the utility of burrowing behaviour to mice in the wild (it facilitates the discovery of food and shelter), it has been suggested that reduced pellet removal may be analogous to the breakdown in human activities of daily living observed in neurodegenerative diseases such as Alzheimer's (Deacon, 2012). Alzheimer's disease is itself comorbid with anxiety and depression in the majority of patients (Teri et al., 1999; Ferretti et al., 2001).

2.2.1.4 Context freezing

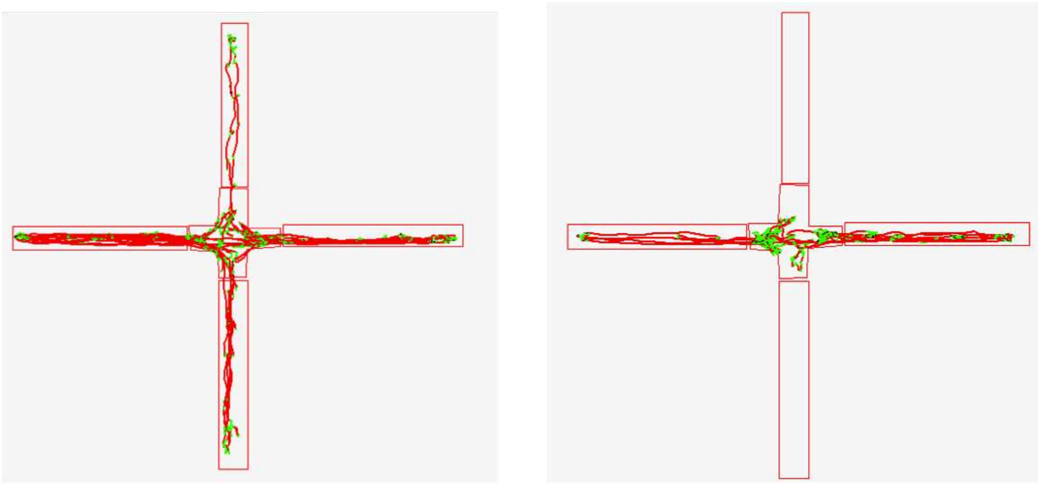
Mice were individually placed in an experimental chamber where, over a twelve minute period, they were exposed to three loud and timed-at-random 29.5 second long tones that were each followed immediately by a 0.5 second footshock. Four hours later, the mouse was returned to the context and, without administering any tones or footshocks, the amount of time they spent freezing over a five minute period was measured by a Videotrack system (vNT4.0, an automated tracking system from Viewpoint in Champagne Au Mont D'Or, France). The longer a mouse freezes for, the more anxious it theoretically is (Owen et al., 1997).

2.2.1.5 Cue freezing

The day after the context freezing test (§2.2.1.4), individual mice were placed in an open field (an empty circular arena with 60 cm diameter). Over a five minute period, the same tone that they heard during the context freezing test (i.e., a tone associated with footshock) was presented twice for thirty seconds each. As with context freezing, the time spent freezing was measured with Videotrack and freezing duration is presumed to correlate positively with anxiety (Valentinuzzi et al., 1998).

2.2.1.6 Elevated plus maze

In this paradigm, individual mice were placed in the centre of an arena shaped like a plus sign that is elevated 73 cm from the ground by a stand. Two of the 30 cm long arms of the arena were enclosed by 21 cm high walls, and the other two 30 cm long arms were framed by only 0.5 cm high walls. The four arms were connected by a junction. Over a five minute test period, the more time a mouse spends in the open arms relative to the closed arms appears to correlate with lower anxiety in the mouse, with administration of anxiolytic pharmaceuticals reducing time in the open arms and anxiogenic administration increasing it (Lister, 1987). Distance travelled and time spent in the arms were measured by Videotrack. See Figure 2.2.



(a) (b)

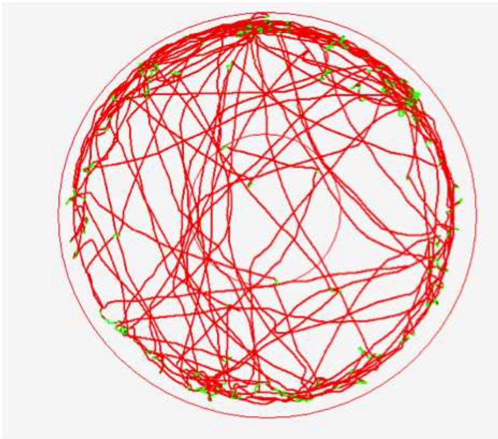
Figure 2.2: In the elevated plus maze, a mouse is free to move throughout the open arms (shown vertically in these figures) and the closed arms (shown horizontally) of the surface, which is elevated 73 cm from the ground by a stand. Videotrack cameras were employed to track mouse movement throughout the test. It appears that the mouse in Figure (a) was less anxious than the mouse in Figure (b) as the former travelled some distance in the open arms while the latter did not.

2.2.1.7 Faecal steroid

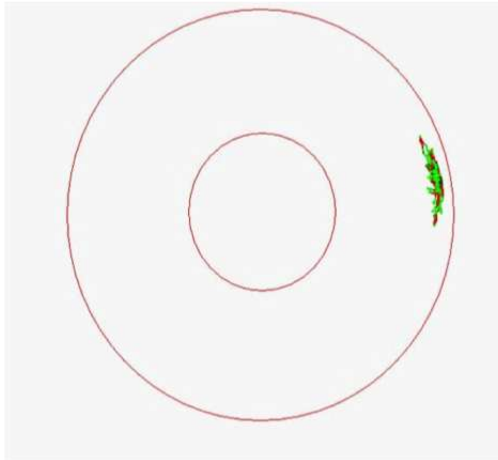
The concentration of corticosterone in mouse faeces — a non-invasive physiological measure of anxiety (Fuss et al., 2010) — was measured using a published protocol (Touma et al., 2003).

2.2.1.8 Ki-67 antigen

Ki-67 protein is an antigen whose expression is a reliable marker of cell proliferation (Scholzen and Gerdes, 2000). Thus, Ki-67 expression in the hippocampus of a mature mouse represents adult neurogenesis, a phenomenon that has been associated with psychiatric disease such as schizophrenia in humans (Reif et al., 2006) and, as is highly relevant to this thesis, anxiety behaviour in mice (Fuss et al., 2010). Hippocampal Ki-67 expression was assessed in the Heterogeneous Stock mice following the protocol described in Huang et al. (2010).



(a)



(b)

Figure 2.3: In the open field test, a mouse can ambulate freely anywhere in the open field. Although there is no physical barrier or indication of the centre in the actual field, the inner 20 cm of the 60 cm field are demarcated in these Videotrack images for reference. The mouse in Figure (a) appears to be less anxious relative to the mouse in Figure (b) because the first engaged in considerable locomotor activity during the five minute test while the second was essentially stationary.

2.2.1.9 Open field test

Individual mice were placed in a brightly lit white circular arena that was 60 cm in diameter. The innermost 20 cm of the arena were designated as the inner area. Over a five minute period, Videotrack was used to measure total activity, distance travelled in the inner and outer areas, and time spent in the inner and outer areas. The behavioural paradigm is that mice, natural prey, should be fearful in this brightly lit, open field. The more active mice — particularly if they are active in the inner area away from the relative security of the field walls — are theoretically less anxious than their peers (Hall, 1934). See Figure 2.3.

2.2.1.10 Startle response

On the first day of this three day test, an accelerometer was used to measure the startle response when a mouse was exposed to ten presentations of a 30 second, 70 decibel tone ending with a 50 millisecond, 100 decibel noise burst. These were followed by ten presentations of the noise burst alone. On day two, the mice were conditioned to fear the tone by pairing it, over ten 30 second trials, with painful footshock. On day three, the mice were put through the same procedure as on the first day. When this paradigm is applied to rats, their startle response is potentiated by the fear conditioning, but no significant potentiation was observed with the HS mice. It is assumed nevertheless that greater startle responses — whether on day one or three — tend to be displayed by more anxious mice (Davis et al., 1993).

2.2.1.11 Stress Steroid

Within a minute of fear conditioning (see §2.2.1.5), a cut to the tail was used to extract a blood sample. Corticosterone levels in this sample were assayed, providing a physiological marker of the mouse's stress response.

2.2.2 Additional phenotypes

As with the behavioural traits just described in §2.2.1, detailed protocols for these additional phenotypes — included in the analyses in Chapter 3 and §5.1.3 — were published previously (Solberg et al., 2006).

2.2.2.1 Biochemistry

Mice were euthanised by phenobarbitone injection preceded by cardiac puncture. Blood samples from the cardiac puncture were assessed in an automated clinical chemistry analyser. *In vitro* haemolysis ruined the majority of potassium samples, excluding that phenotype measure from analysis (erythrocytes contain high concentrations of potassium relative to blood plasma, so their lysis eliminates the accurate estimation of blood plasma potassium levels).

2.2.2.2 Ear punch

Using an ear punch (from Fisher Scientific), cartilage in the centre of both ears was perforated to create a two millimetre diameter hole. I report the mean size of the holes after two weeks. This provides an indication of a mouse's wound healing ability.

2.2.2.3 Full blood count

An automated haematology analyser (Coulter counter) examined the blood sample obtained from cardiac puncture that was also used for measuring biochemistry (§2.2.2.1).

2.2.2.4 Immunology

A small sample of blood was stained, washed, lysed and treated with monoclonal antibodies to permit white blood cell counting.

2.2.2.5 Intraperitoneal glucose tolerance test (IPGTT)

As an animal model of diabetes, glucose was injected intraperitoneally into mice, and blood samples were collected at intervals to assess both tolerance to glucose and stimulation of insulin secretion (Andrikopoulos et al., 2008). As shown in Figure 2.4, invasive procedures such as IPGTT and plethysmography (outlined next in §2.2.2.6) were carried out after behavioural phenotyping.

2.2.2.6 Plethysmography

Mice were injected intraperitoneally with ovalbumin once a week for two weeks, inducing an allergic sensitivity to ovalbumin. A week after the second injection, mice were exposed to aerosolized ovalbumin for five minutes a day over three consecutive days. On the fourth consecutive day, mice were placed in a plethysmograph chamber and a number of breathing measures were acquired. This procedure provides an animal model of asthma (Hamelmann et al., 1997).

2.3 Study Design

The HS mice (§2.1) were put through a battery of the tests just described (§2.2). Any particular phenotype test was carried out only once for each animal and the test was carried out on approximately the same day after each animal's birth (Figure 2.4). At

Phenotype test	Mean animal age (days)
Immunology	42
Open field test	45
Elevated plus maze	46
Activity in new home cage	48
Context freezing	55
Cue freezing	56
Plethysmography	63
Faecal Steroid	63
Intraperitoneal glucose tolerance test	68
Animal size	68
Full blood count	71
Adrenal gland weight	71
Biochemistry	71

Figure 2.4: Mean animal age for each experiment

death, body weight was recorded and organs relevant to phenotypic measures (e.g., adrenal gland) and gene expression data (i.e., hippocampus, liver, lung; see §2.5) were removed. Six experimenters phenotyped about 95% of the mice. An additional six experimenters phenotyped the remaining 5%.

2.4 GENOTYPING

From across the mouse genome, 13459 single nucleotide polymorphisms (SNPs) were genotyped per animal by Illumina (San Diego, California) using their BeadArray platform. Where possible, SNPs were selected that were polymorphic in at least some of the eight inbred HS founder strains. The mean inter-SNP interval is 167 kilobases (kb) with 99% of intervals under 500 kb and 81% below 250 kb. Genotype calls were made at a rate of 99.86% with 99.98% estimated accuracy. As published (Shifman et al., 2006), a total of 1940 HS mice (§2.1), including 1000 males, were genotyped.

2.5 RNA TRANSCRIPT COLLECTION

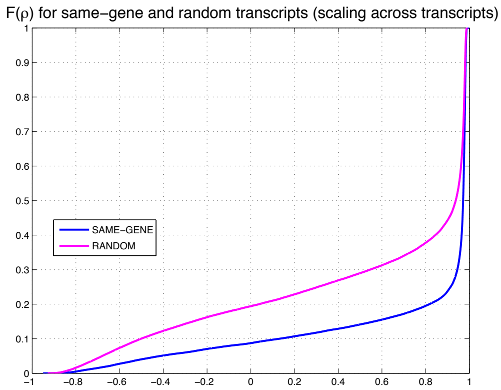
This paragraph is a summary of previously published work (Huang et al., 2009). From the pool of 1940 Oxford HS mice, the most unrelated animals (based on genome-wide genotyping of 13.5k SNPs using Illumina's BeadArray platform; Valdar et al., 2006b) were assayed for gene expression in three tissues, the liver ($n = 273$ with 139 males), lung ($n = 258$; 131 male) and hippocampus ($n = 468$; 252 male). The tissues were frozen in liquid nitrogen and homogenised. RNA was extracted from the tissue and mRNA was amplified. Labelled mRNA was hybridised to the Illumina Mouse WG-6 v1 BeadArray platform, which contains 47429 unique RNA probe sequences.

2.6 GENE EXPRESSION DATA PREPROCESSING

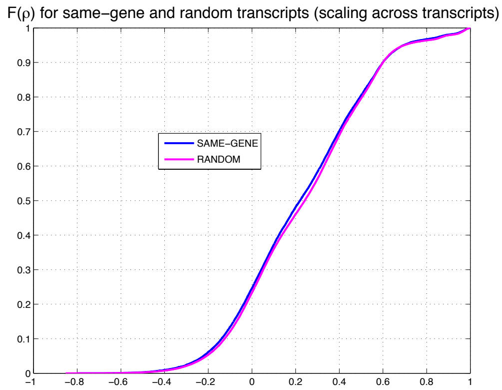
The gene expression data, as originally preprocessed in the Oxford HS mouse project (Huang et al., 2009), had critical shortcomings. The strongest example is that I determined that in this original preprocessing, RNA transcripts that map to the same gene were only highly correlated (i.e., $r \geq .8$) five percent of the time in the Huang et al. preprocessed data, while this figure is a dramatically higher 82% in the raw, un-preprocessed data — much closer to what one would expect given that these same gene transcripts are tightly related biologically. A large proportion of this discrepancy can be explained by transcripts being highly correlated in the raw data in general, but Figure 2.5 illustrates that in the raw data transcripts from the same gene are more highly correlated than random pairs of transcripts. Figure 2.5 also illustrates how the originally preprocessing by Huang and colleagues eliminated this biological signal from the data.

2.6.1 Extracting raw data from images

To extract data from the images produced by the BeadArray platform (§2.5), I imported the images into the Gene Expression module (V 1.6.0) of the Illumina GenomeStudio (V 2010.1) without invoking any data adjustment procedures. To facilitate preprocessing, I further imported these data to R (Team, 2010) using the Bioconductor (Gentleman et al., 2004) package lumi (Du et al., 2008). A cluster den-



(a)



(b)

Figure 2.5: Both of these plots are of the cumulative distributions of the correlation between pairs of gene expression probes, with the correlation r along the x-axis. The purple distribution used the correlation between random pairings of probes while the blue distribution only used pairs of probes that map to the same gene. The larger the area between the two distributions, the greater the presumed biological relevance of the data because we expect probes from the same gene to be highly correlated. Plot (a) uses raw hippocampus data while plot (b) uses the hippocampus data as processed by Huang and colleagues (2009). Although probes from the raw data are highly correlated in general, they contain the biological signal that was comprehensively eliminated by preprocessing.

drogram (Figure 2.6) comparing the relatedness of all 468 unprocessed hippocampus gene expression arrays allowed clear identification of four extremely outlying hippocampus arrays, which I excluded from further analysis.

2.6.2 Subtracting background intensity

I employed lumi to estimate each gene expression array's background intensity by calculating the mean intensity of about two thousand control probes that are scattered over the Illumina chips. This background noise level was subtracted from each array individually, bringing all of the arrays to approximately the same intensity. To see the effectiveness of this background adjustment technique, compare Figures 2.7 and 2.8.

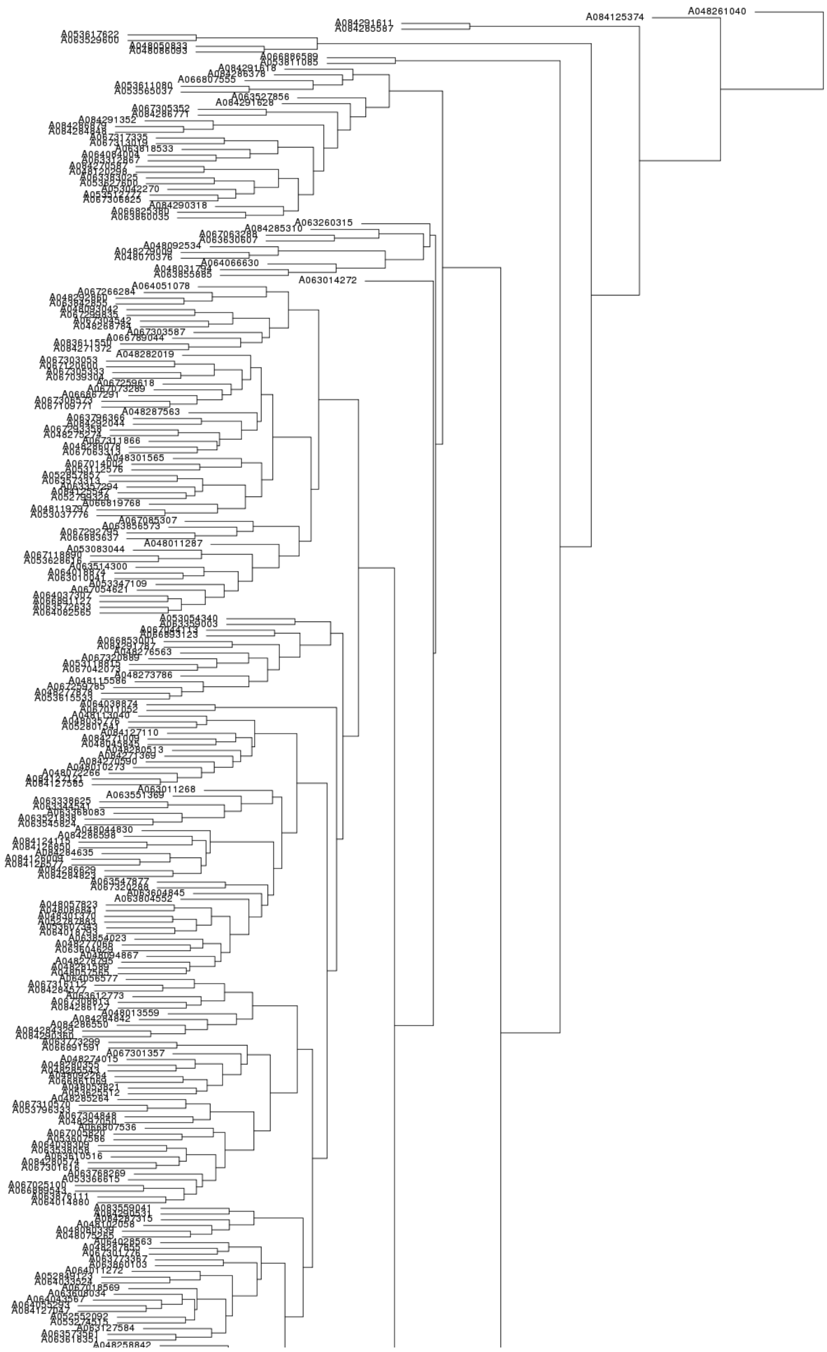


Figure 2.6: This cluster dendrogram enables identification of four gene expression arrays (the five at the top of the diagram) that are clearly outlying samples based on their relatedness to the other 468 hippocampus arrays. In the interest of readability, only the top half of the dendrogram is shown.

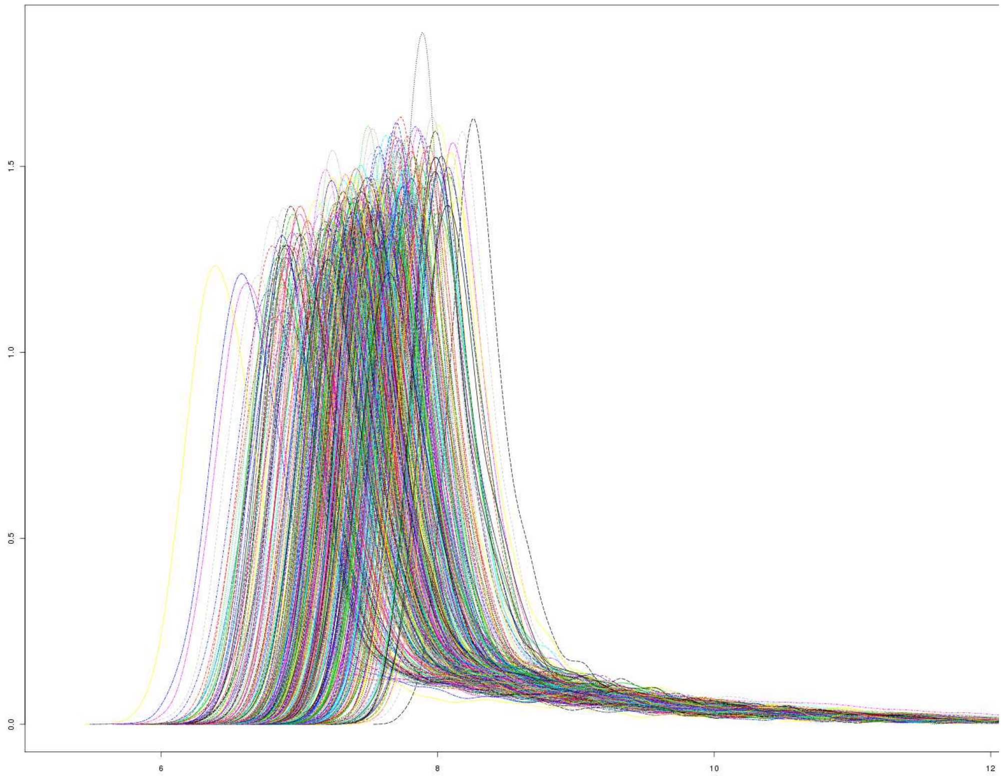


Figure 2.7: Distribution of the intensity of each of the unprocessed gene expression arrays obtained from the hippocampus. The *x* axis represents probe intensity while each array is represented by a uniquely-coloured histogram. Compare with Figure 2.8 to visualise the intensity normalising impact of background noise subtraction on the data. The image has been truncated at the right-hand side for clarity.

2.6.3 Standardisation

To standardise both the variance and mean of the gene expression probes across all remaining animals, I applied lumi's variance stabilising transformation and robust spline normalisation, respectively, to the data. Following these adjustments, the distributions of gene expression probe intensity were similar across all arrays, as illustrated by Figure 2.9. Following these adjustments, the tenth-most outlying array in the raw data (Figure 2.6), became an extreme outlier (Figure 2.10) and so was removed from further preprocessing. Following this, another extreme outlier emerged and so was itself removed (Figure 2.11).

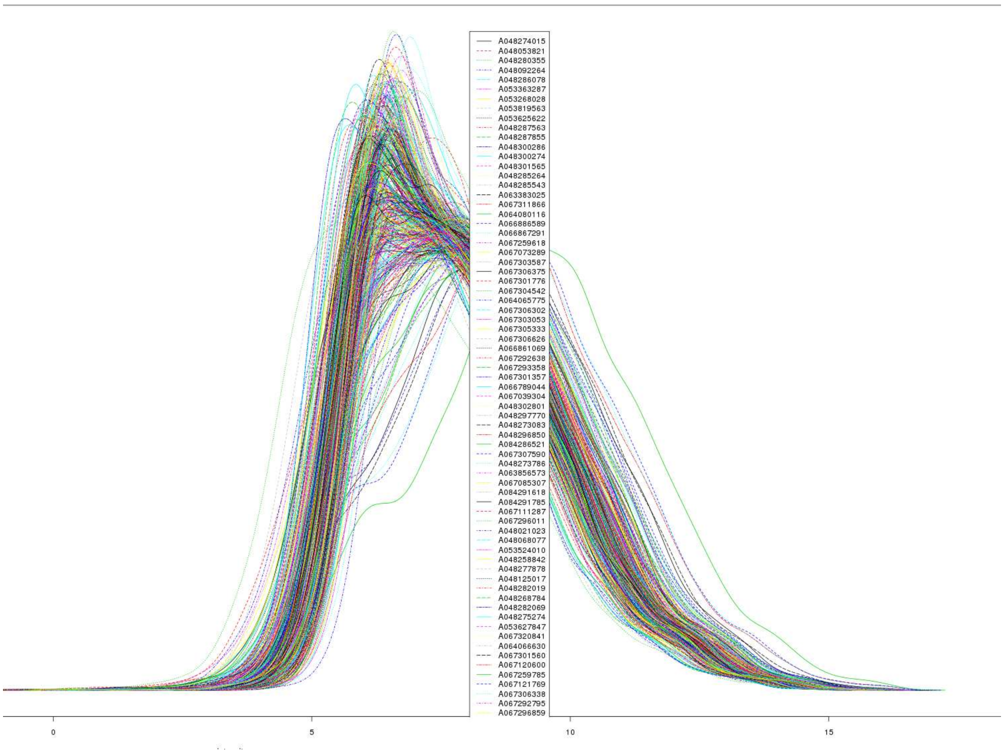


Figure 2.8: Distribution of the intensity of the hippocampus gene expression arrays after background noise subtraction. Compared with Figure 2.7, the data now have relatively the same mean intensity. The image has been truncated at both sides for clarity.

2.6.4 Probe selection

I used a series of filters to eliminate unreliable or unnecessary probes, which could act as confounders or noise, respectively, in the data. First, following the pipeline developed by Barbosa-Morais and colleagues (2010), I removed probes that were not rated as “perfect” or “good” matches to the genome. Perfect probes were those for which all fifty of its constituent nucleotides matched its target genomic sequence, while good probes had 48 or 49 matching nucleotides. Probes with 47 or fewer matching nucleotides were discarded, as they were likely to have less than half the signal strength of perfect matches (He et al., 2005).

Second, I eliminated probes that mapped to more than one genomic location according to BLAST queries (Altschul et al., 1997) because any of these probes are ambiguous and therefore potential confounding variables.

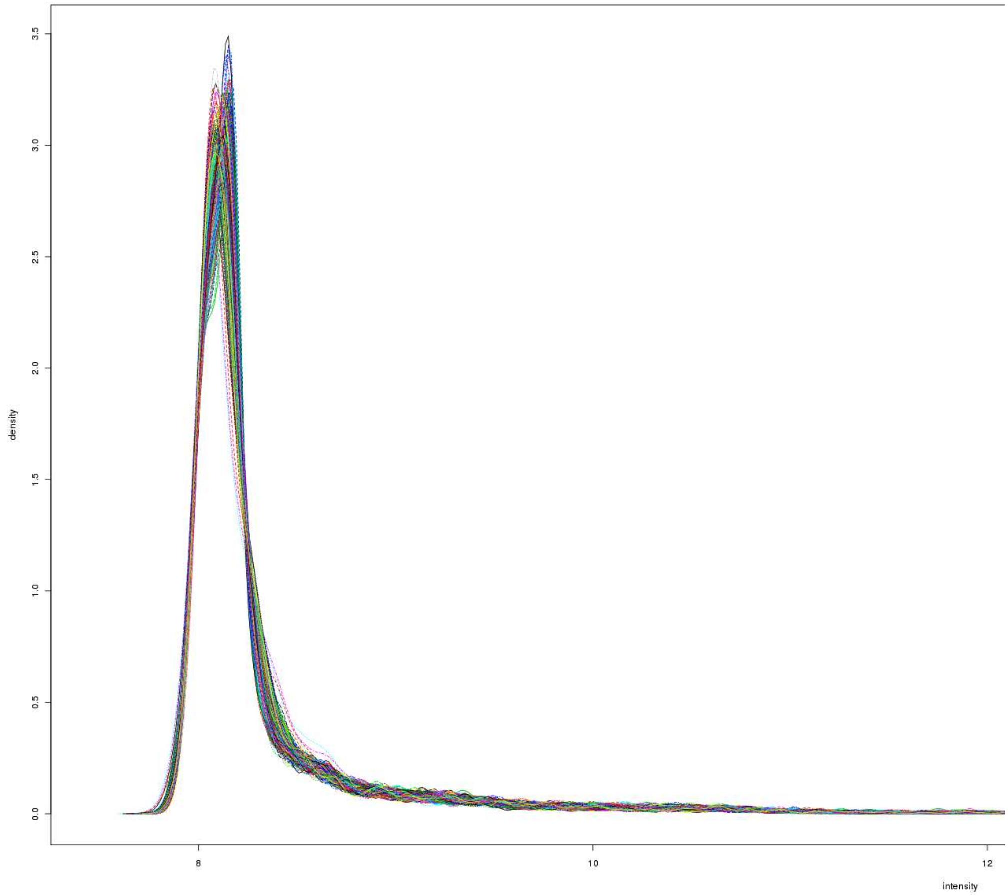


Figure 2.9: Distribution of gene expression data after variance stabilising transformation and robust spline normalisation. The distributions of probe intensity are very similar across all arrays relative to the previous stage of preprocessing (Figure 2.7). The image is truncated on the right.

Third, I excluded probes that included a SNP as these are prone to erroneously producing eQTL. This effect is straightforward: If a probe maps perfectly to the wild type variant of a SNP, it will only map to 49 nucleotides in the mutant. Thus, the probe will bind more readily to the wild type mRNA than it will to mutant mRNA, creating the appearance of a cis-eQTL that is in reality a technical issue.

Finally, I only retained probes that were expressed in at least 5% of the animals at a 0.95 detection level (as per GenomeStudio). As illustrated in Figure 2.12, a large proportion of probes met this criterion (42% to be precise). I decided upon this 5% threshold because I endeavoured to eliminate the peak at the left of the histogram, which includes the probes expressed in none or very few of the 468 animals.

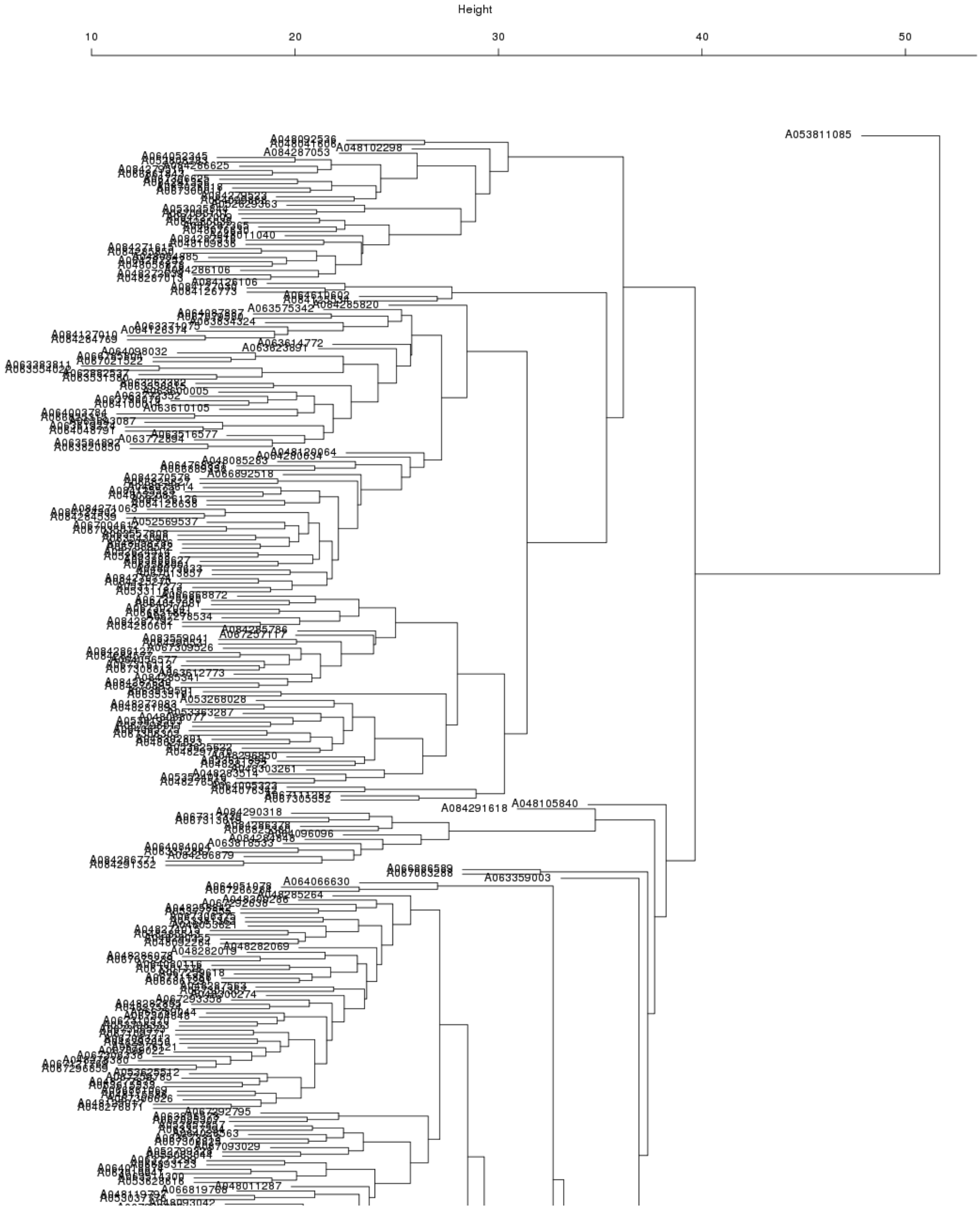


Figure 2.10: Cluster dendrogram of gene expression arrays after normalisation. The array for animal A053811085 was a clear outlier and so removed from further preprocessing. For clarity, only the top half of the dendrogram is shown.

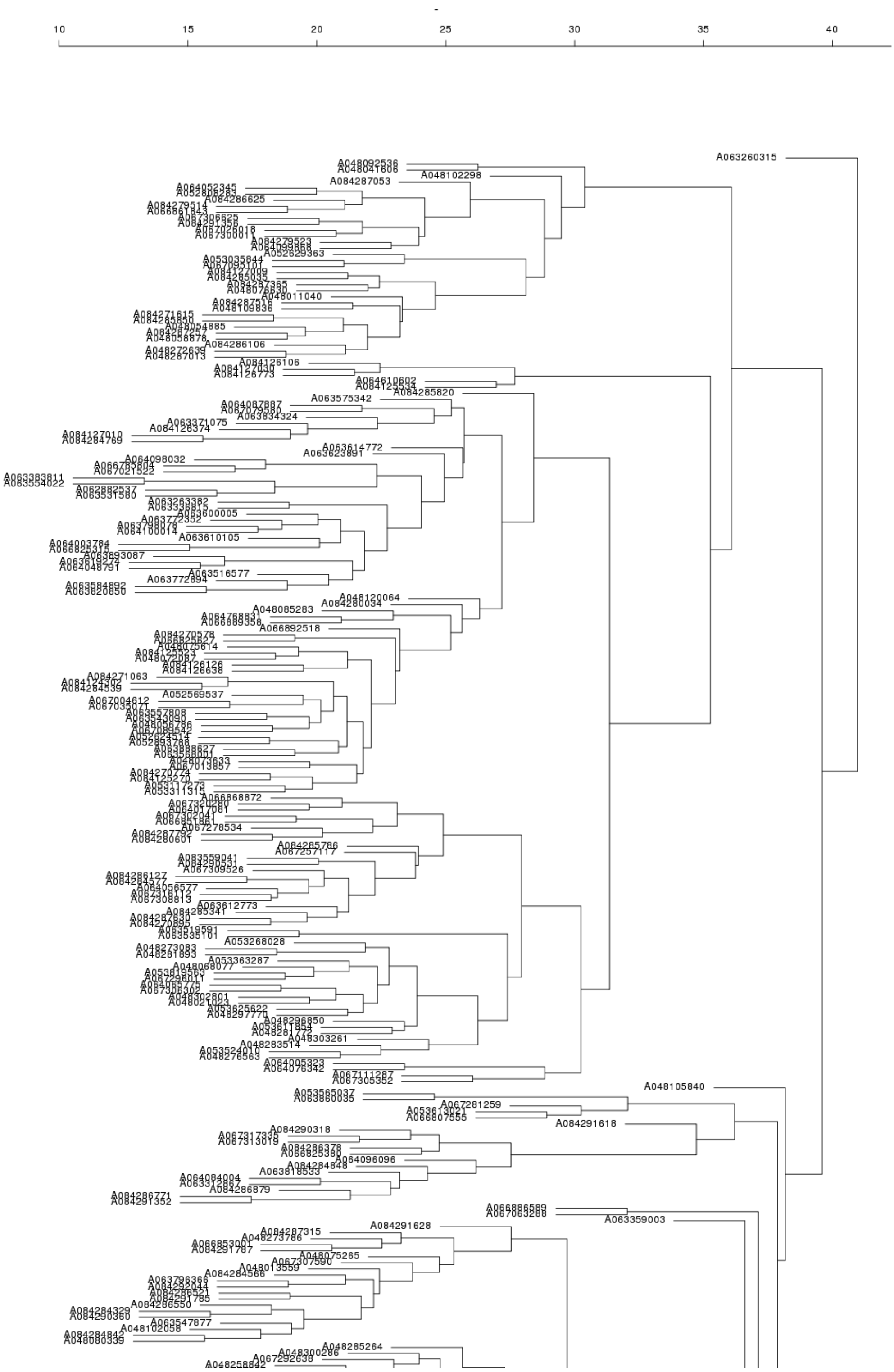


Figure 2.11: A further extreme outlying array, representing A063260315, emerged as a result of normalising and standardising procedures, and so was removed from further preprocessing.

Following the application of these four filters, 10704 liver, 12857 lung and 12113 hippocampus probes remained from the original 47k sets.

It might have been ideal to also remove probes located within regions of small structural abnormalities on the microarrays, but Illumina software does not allow for this and I was unable to find a third-party package for doing so. The lack of availability of such a tool may have been unnecessary given the repeated number of probes (mean $n = 20$) that are spread at random over the wells of a given Illumina microarray. This is an advantage of Illumina gene expression microarrays over alternative platforms such as Affymetrix.

2.6.5 Controlling for batch effects

Gene expression data were assayed over several months because of the sheer number of animals involved and because assays that turned out poorly on a macro level (i.e., those with artefacts visible to the naked eye) were re-run. Given the large number of assays taken at different time points, batch effects were present in the data, as illustrated in Figure 2.13a.

I used an empirical Bayes method called ComBat (Johnson et al., 2001) to control for the batch effects. Other tools for adjusting microarray expression data required relatively large batch sizes of 25 or more, while ComBat allowed me to use individual Illumina chips as batches (each chip contains only six arrays). Figure 2.13b illustrates the data after batch effects were controlled for.

2.6.6 Quality control

At each stage of gene expression data preprocessing, I ensured the quality of the data by examining a series of plots: a density plot of the intensity of each animal's gene expression probes (as in Figure 2.9); a density plot of *the variance of* the intensity of each animal's probes; a cluster dendrogram comparing the relatedness of the data from animal to animal (as in Figure 2.11); and a boxplot of the intensity of each animal's probes (as in Figure 2.14). This quality control informed my decision making at several stages of preprocessing. For example, this allowed me to be reassured in selecting variance stabilising transformation and robust spline nor-

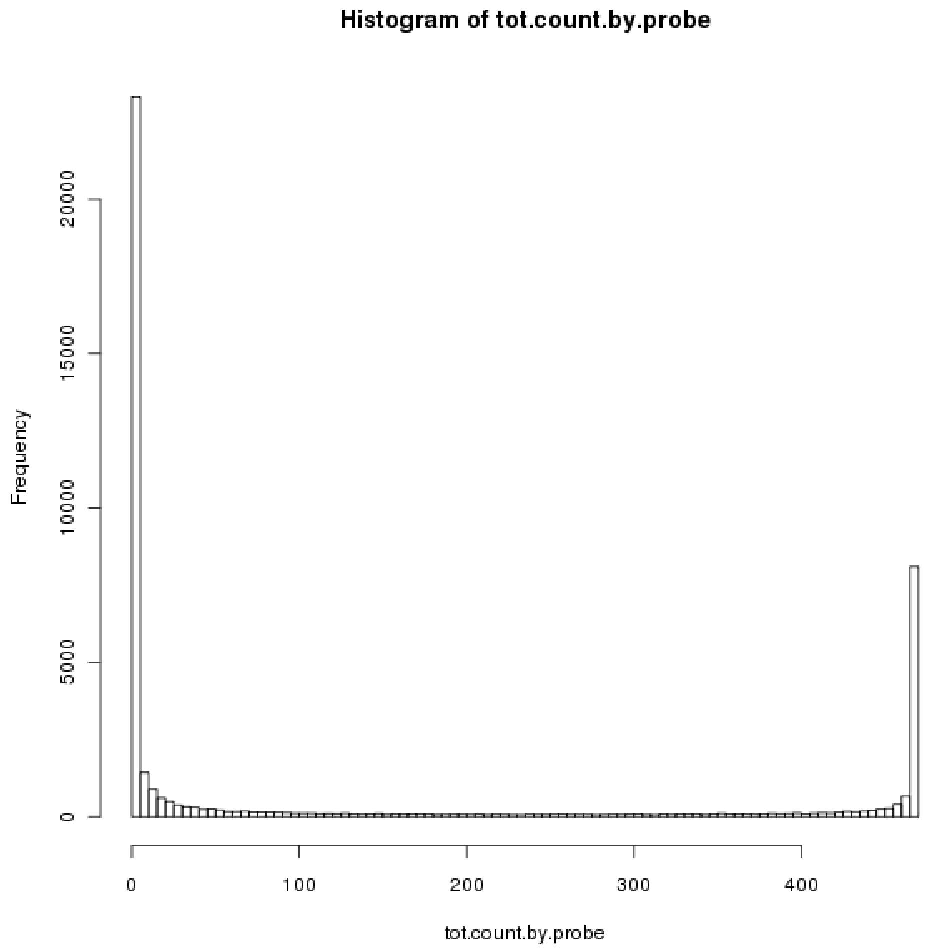
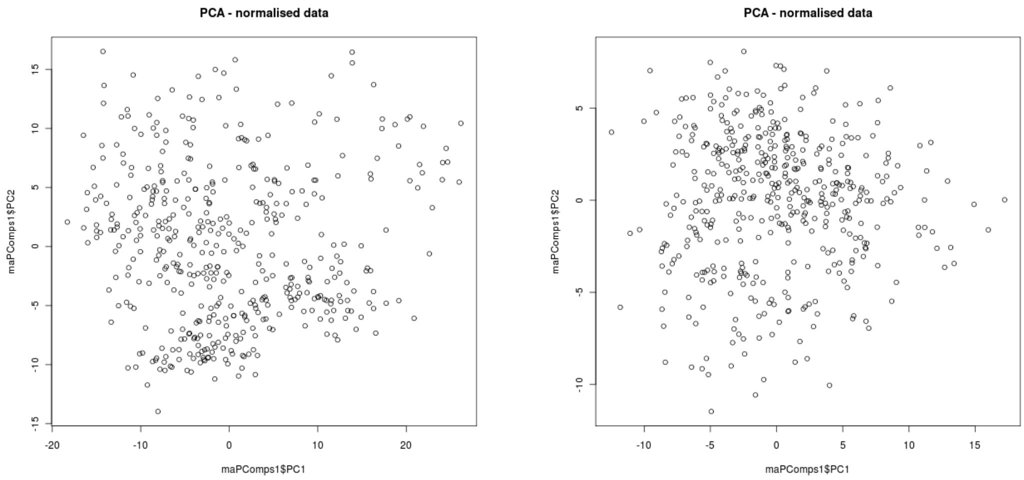


Figure 2.12: This histogram illustrates the number of animals that have significant levels of a hippocampus gene expression probe, i.e., where the detection level is greater than 0.95 for that probe. There are two peaks. The left-hand peak corresponds to probes that were expressed in zero or very few animals, while the right-hand peak corresponds to probes that were expressed in all or nearly all of the 468 mice. To eliminate data that primarily provide noise, I elected to retain only probes expressed in more than 5% of animals, i.e., in at least 24 of them. 42% of probes were above this threshold and thus retained.



(a) (b)

Figure 2.13: Both plots show the first two principal components of the hippocampus gene expression data, with each point corresponding to an animal. Plot (a) uses data prior to controlling for batch, while plot (b) uses data after. Clusters of data points associated with batch effects are visible in plot (a) but do not feature prominently in plot (b).

malisation to standardise the mean and variance of the probe data (§2.6.3) instead of a simpler method such as quantile normalisation that would have been a safer, more traditional option, but also would have discarded more of the data's structure.

Additionally, upon completion of preprocessing, I performed two additional checks of data quality. Recall from Figure 2.5 that the original, published (Huang et al., 2009) preprocessing of these gene expresion data removed a large proportion of the biological relevance of the data by removing the correlation between probes that map to the same gene. Production of a similar cumulative distribution to those shown in Figure 2.5 using my preprocessed gene expression data illustrates that biological information in the data, exemplified by same-gene correlations, was retained. See Figure 2.15. In addition to a cumulative distribution function, I evaluated my final preprocessing by ensuring the strong presence of cis-eQTL in the data – an evaluation that has been referred to as a "bronze standard" for ensuring gene expression data quality (Listgarten et al., 2010). A clear cis-eQTL diagonal was indeed present in the final preprocessing; see Figure 2.16.

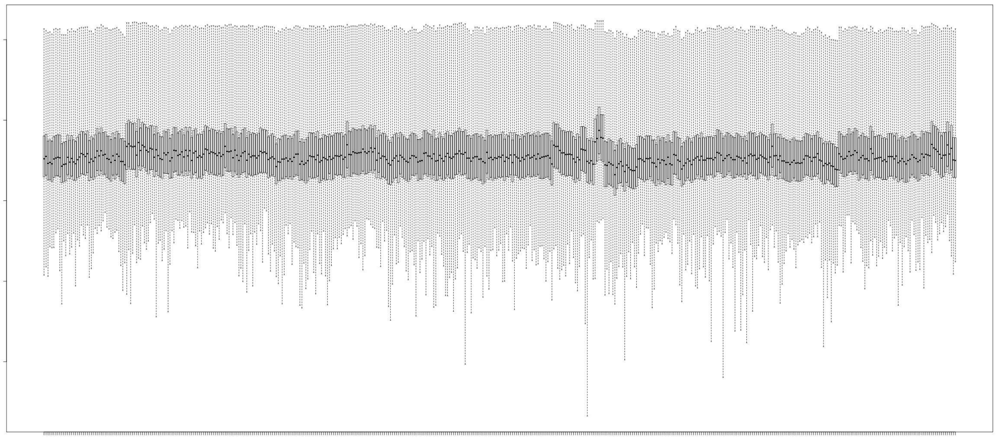


Figure 2.14: This is a sample boxplot of hippocampus gene expression data, with intensity on the y axis (in arbitrary units) and individual animals represented by categorical variables upon the x axis. The particular data shown here had passed the background subtraction phase (§2.6.2), but had not yet been standardised (§2.6.3).

2.6.7 Gene expression data from the liver and lung

Although not the primary focus of this dissertation, I preprocessed gene expression data from the liver and the lung tissues following the same procedure that I just outlined for the hippocampal data. These come in handy on a few occasions, e.g., for validating a novel statistical technique in §5.1.3.1 and §5.1.3.2. Figures 2.17 and 2.18 show the final cumulative distribution functions and first chromosome eQTL plot for the liver data, while Figures 2.19 and 2.20 show the same plots for the lung.

2.6.8 The effect of sex

The gene expression data preprocessed by the method just described are analysed in two results chapters: one on causal pathways (Chapter 5) and another on networks of gene expression data (Chapter 4). In the pathways chapter, sex is explicitly accounted for as a covariate in all models. In the networks chapter, I either work with data from a single sex or I use linear regression to remove the effect of sex.

As is clear from Figure 2.21a, sex is a highly significant predictor of the second principal component (PC) of the gene expression data obtained from the liver, -log$P > 16$. Looking at the first twenty PCs of the hippocampus data and Bonferroni-correcting for multiple comparisons, the tenth PC is the first that is significantly pre-

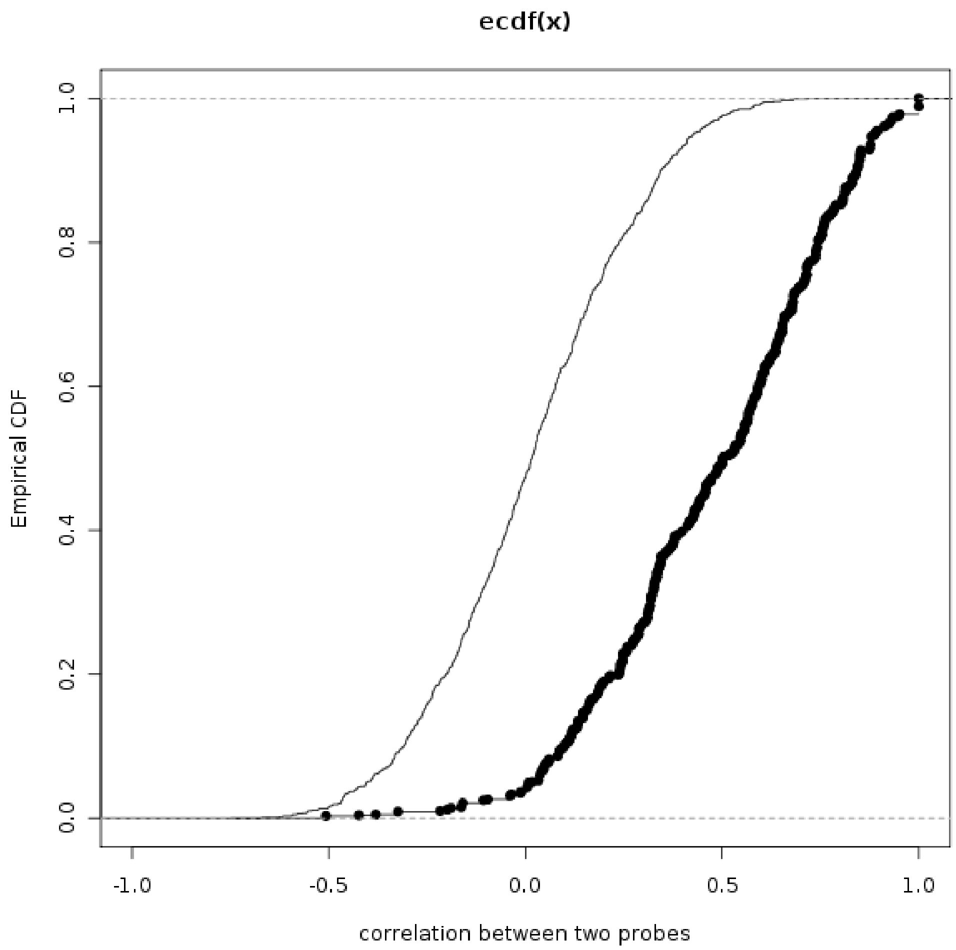


Figure 2.15: Similar to Figure 2.5b, this is a cumulative distribution of the hippocampus gene expression data, where the thin curve represents the correlation between random pairs of gene expression probes while the thicker curve represents the correlation between pairs of probes that map to the same gene. The present plot uses my preprocessing of the data instead of the preprocessing as originally published (Huang et al., 2009) and plotted in Figure 2.5b. In my version, the large area between the two curves suggests that the biological relevance of the data, lost by Huang and colleagues, has been retained, even improved, relative to the raw data (Figure 2.5b).

Figure 2.16: This is a plot of the hippocampus eQTL on the first chromosome of the HS mice, using my final preprocessing of the gene expression data. Only eQTL with a -log$P$ > 4 are shown. The "warmer" the colour of the eQTL, the stronger the association between a given SNP (x axis, in Mbp from zero to 197) and gene expression probe (y axis, also in Mbp from zero to 197), with red representing eQTL with -log$P$ > 14. SNPs and probes are arranged in ascending order of their location in the genome, so the clear diagonal line represents the overwhelming presence of cis-eQTL in the data.

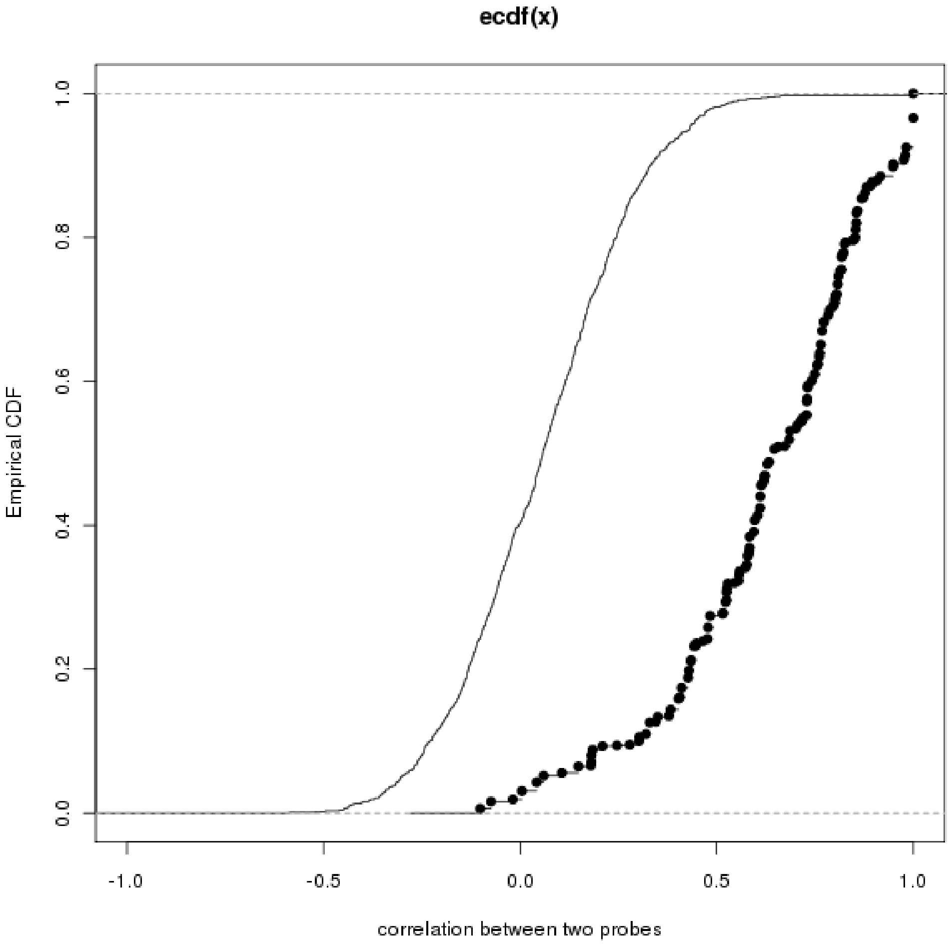


Figure 2.17: Cumulative distribution of correlation of same-gene pairs in final preprocessing of liver data, illustrating the retention of biologically meaningful information. Equivalent to Figure 2.15, except for the tissue type.

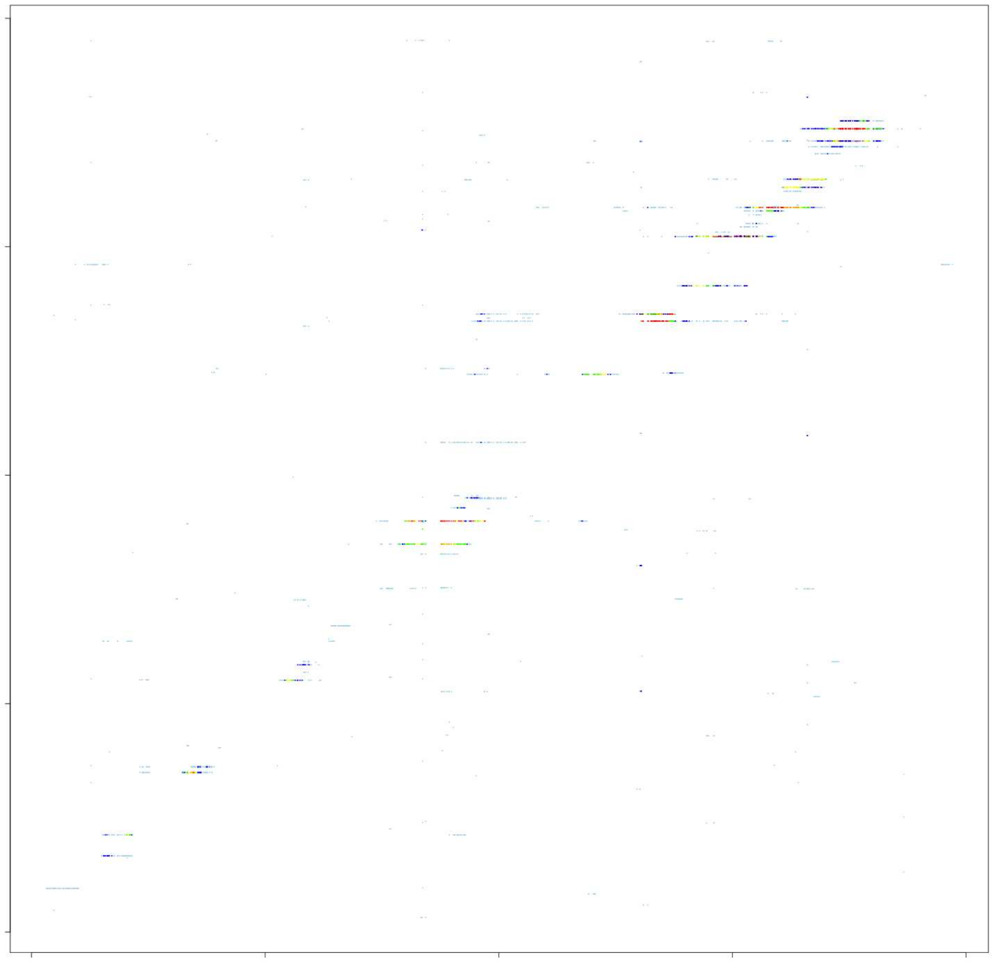


Figure 2.18: Cis-eQTL diagonal in final preprocessing of liver data, equivalent to Figure 2.16 except for the tissue type. The relatively low quantity of eQTL relative to Figure 2.16 likely reflects the sample sizes available; $n = 468$ for the hippocampus data, while $n = 258$ for the liver. Refer to Figure 2.16 for a detailed explanation of this plot format.

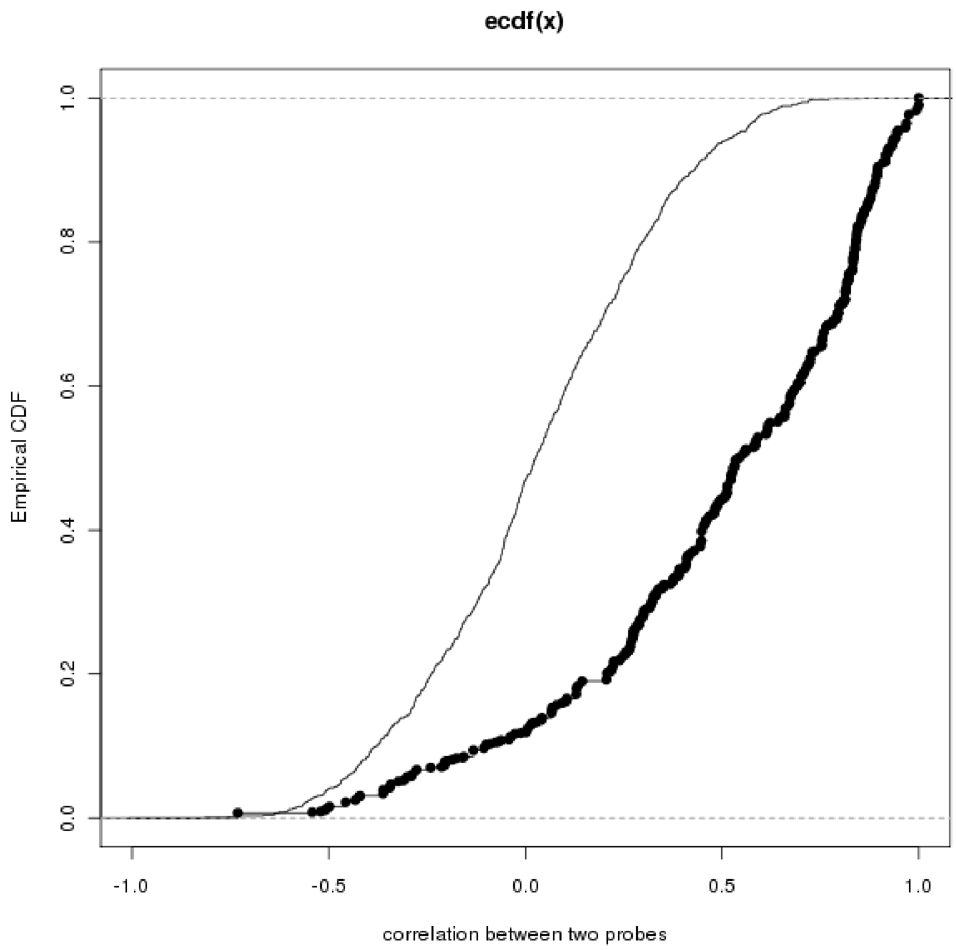
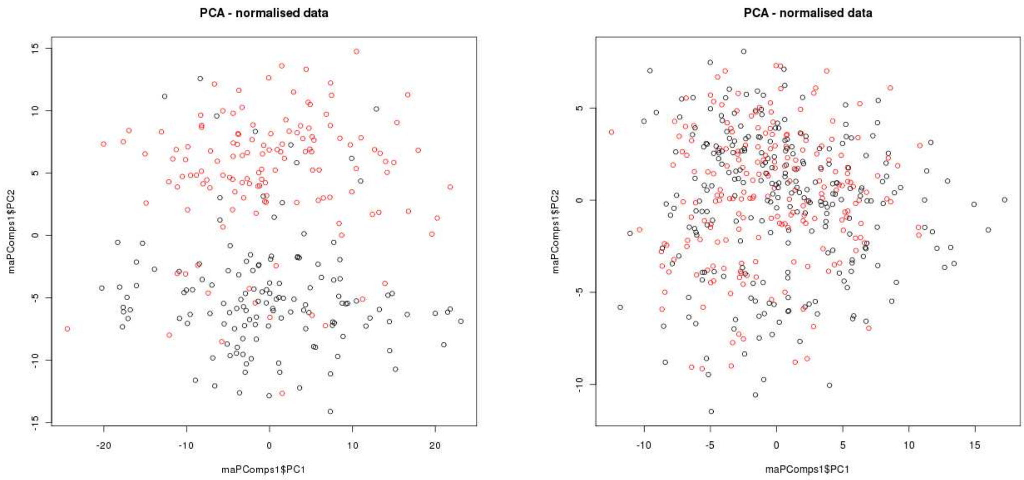


Figure 2.19: Cumulative distribution of correlation of same-gene pairs in final preprocessing of lung data, illustrating the retention of biologically meaningful information. Equivalent to Figures 2.15 and 2.17, except for the tissue type.

Figure 2.20: Cis-eQTL diagonal in final preprocessing of lung data, equivalent to Figures 2.16 and 2.18 except for the tissue type. Refer to Figure 2.16 for a detailed explanation of this plot format.

dicted by sex (-log$P$ = 4) though the fifteenth PC is much more strongly predicted by sex, at -log$P$ = 13. Like the hippocampus data, sex does not appear to be as important in the structure of the gene expression data from the lung: The seventh PC is the first significantly predicted by sex with p = .001.



(a) (b)

Figure 2.21: In both plots, females are represented by red points and males by black. Plot (a) is of gene expression data from the liver, while plot (b) is from the hippocampus. Clearly, sex is a significant predictor of the second principal component (the y axis) of the liver data, -log$P$ > 16. On the other hand, sex is not significantly associated with either axis in the plot of hippocampus data – indeed, the tenth PC is the highest-ranked PC that is significantly predicted by sex in those data.

CHAPTER 3

GENETIC INTERACTIONS

Genome-wide association studies (GWAS) typically seek only main effects of genetic variation on phenotypes. While this methodology has succeeded in identifying quantitative trait loci (QTL) in countless experiments, these main effect QTL are rarely sufficient to explain the majority of the heritability of a given trait (McCarthy et al., 2008; Manolio et al., 2009). Some of this missing heritability may be accounted for by the interaction of genetics with other factors such as sex and aspects of the organism's environment. In this chapter, I apply recently-developed analytical techniques to the identification of locations of the mouse genome that contribute to variation in anxiety-related behaviours via their interaction with sex and environmental factors.

There are two reasons for being interested in interactions of genetics with other factors, such as sex and aspects of the animal's environment. First, some main effect QTL might not be detected without taking interactions into account. Lander and colleagues (Zuk et al., 2012) have recently suggested that missing heritability in human GWAS is not due to the failure to detect sequence variants that contribute to phenotypic variation, but is hidden within unacknowledged interactions. Second, identifying QTL involved in interactions might be important for understanding specific mechanisms, such as the biology of sex differences. It is possible that sex or environmental effects are manifest in a subset of the main effect QTL, but it is also possible that they represent a completely different set of loci whose biological function is restricted to the context-specific specific features of the phenotype.

3.1 Gene-by-Sex Interactions

Some of the heritability missing from the generally main effect QTL-focused GWAS (McCarthy et al., 2008; Manolio et al., 2009) may be accounted for by gene-by-sex (GxS) interaction QTL, which are genetic contributions to phenotypic variation that manifest themselves differently depending on the organism's sex. In contrast to sex as a main effect, which may induce sex-based dimorphism via broadly acting mechanisms like sex hormones, GxS interactions are associated with a specific locus of the genome and can account for phenotypic variance left unaccounted for by main effects alone. Observations from several species suggest that sex-specific genetic architecture (Ober et al., 2008) plays a key role in the sex-based dimorphism of many traits, from sensory bristle number in Drosophila (Dilda and MacKay, 2002) to alcohol preference in mice (Melo et al., 1996; Peirce et al., 1998) to hypertension in rats (Mattson et al., 2007) and humans (Seda et al., 2008) to major depressive disorder in humans (Kendler et al., 2006).

Using crosses between inbred mouse lines, GxS interaction QTL have previously been identified for body weight (Brockmann et al., 1998, 2004), fat deposition (Taylor et al., 1999), immunity and mean platelet volume (Valdar et al., 2006b), autoimmunity (Wanstrat and Wakeland, 2001), hypertension (Herrera et al., 2005), and cancer (Fijneman et al., 1996; van Wezel et al., 1999). However, the poor mapping resolution inherent in designs that use inbred lines, and the relatively small number of phenotypes examined, leaves open the question of the extent to which GxS QTL contribute to phenotypic variation. Specifically, it is not clear to what extent GxS and main effect loci coincide, nor whether the contribution of GxS varies among phenotypes.

We set out to answer these questions using more than 60 phenotypes mapped at high resolution in heterogeneous stock (HS) mice. As detailed in §2.1, the HS mice are descended from eight inbred progenitors (A/J, AKR/J, BALB/cJ, C3H/HeJ, C57BL/6J, CBA/J, DBA/2J and LP/J), each HS animal consisting of a fine-grained mosaic of the founder chromosomes, hence providing mapping of quantitative traits to an average resolution of about 3 Mb.

3.1.1 Sparse Partitioning: a Bayesian method

Mapping GxS loci in the HS has to deal with two problems. First, the degree of relatedness varies between individual HS mice so that mapping is more complicated than in classical inbred strain crosses; mapping in an HS has to take into account this population structure. Second, power to detect interactions is limited by the need to search through many possible combinations of predictors. Both problems involve finding appropriate models, which is difficult to do with frequentist methods because of the large number of parameters that need to be fitted. Bayesian methods can be designed to deal with this situation by starting with more parameters than can be included in a frequentist approach. The final parameters selected are those retained following an iterative improvement in the model fit.

One method that overcomes the limitations of mapping genetic interaction effects by iteratively refining a set of parameters is a Bayesian analytical tool called Sparse Partitioning (SP; Speed and Tavaré, 2011). SP was employed in this chapter to seek GxS interaction QTL that explain variation in anxiety-related behaviours §2.2.1 in the HS mice. To facilitate comparison of anxiety GxS with more general GxS findings, a total of 66 phenotypes were assessed from categories as diverse as biochemistry and asthma (see §2.2.2).

Sparse Partitioning allows for models in which multiple predictors and their interactions influence outcome. This enables us to consider the contributions of GxS and also gene-by-gene interactions (GxG), or epistasis, on the phenotypes in the HS. Epistatic interactions have not been implicated in the behavioural phenotype literature as frequently as GxS, but there are some examples such as odour-guided activity in *Drosophila* (Anholt et al., 2003) and anxiety-related behaviours in mice, the latter assessed by some of the same tests that we used for the HS mice (e.g., OFT, EPM; see Gale et al., 2009).

Bayesian methods like SP are particularly useful in analytical situations like the one here where the number of parameters being considered for fit into the model greatly exceed the number of test subjects. This is a “large p, small n” scenario. Although several Bayesian techniques exist for fitting regression models to $p \gg n$ data sets (e.g., Ruczinski et al., 2003, Hans et al., 2007), SP is unique in its ability to follow an exclusively data-driven procedure that does not require restrictions to the types of functions that are fitted.

3.1.2 Bagphenotype: a frequentist method

In addition to SP, I employed a second method called Bagphenotype to map GxS interactions across the same 66 HS phenotypes. The reasoning for using a second method was two-fold. First, unlike SP, Bagphenotype is already an established tool for carrying out GWAS in HS animals (Valdar et al., 2006b), so I can compare the main effect QTL results from Bagphenotype with those obtained by SP to confirm that SP is more than just theoretically fit for data from a structured population. Second, Bagphenotype and SP seek QTL in drastically different ways, so it will be interesting to see how congruent their respective GxS results are. While SP is a Bayesian method that iteratively removes predictor variables from the models it fits, Bagphenotype is a frequentist method that iteratively adds predictors to the models it fits.

Bagphenotype is based on resample model averaging (Valdar et al., 2009). Bagphenotype runs many (e.g., one hundred) bootstrapped multiple QTL regression models and outputs, for each predictive peak across the genome, a statistic called the resample model inclusion probability (RMIP). A peak's RMIP represents the proportion of the multiple QTL models in which the peak's addition to the model both (1) improves the model fit and (2) does not increase the model's adjusted p-value above the significance threshold. So, if I set Baphenotype to calculate one hundred multiple QTL models and a particular QTL was included in seventy of those models, the QTL would be assigned an RMIP of .70. The technique underlying Bagphenotype has previously been applied to genome-wide analyses using the HS mice to identify 156 main effect QTLs contributing to 25 anxiety-related behavioural phenotypes (Valdar et al., 2006b).

3.2 Gene-by-Environment Interactions

Phenotypic variation is due not just to genetic main effects, sex and GxS interactions, but also to environmental factors (as introduced earlier in §1.2). In particular, mouse behaviour has been shown to vary significantly by testing site even when as many aspects of experimentation as possible are explicitly controlled for. John Crabbe and his colleagues (1999) examined six mouse behaviours, including anxiety-related behaviour by using the OFT and the EPM, at three geographically distant locations (New York, Oregon and Alberta) but strained to otherwise hold all environmental variables constant, such as apparatus, protocol and breeding. Some behaviours they examined, such as preference for alcohol versus water, were not significantly different depending on laboratory location. Anxiety-related behaviours, however, whether measured by the OFT or the EPM, showed significant effects of testing site, genotype (the authors tested eight different inbred strains) and the interaction of testing site with genotype.

Further research has sought to identify the most important environmental covariates for particular phenotypes. For example, Chesler and coworkers (2002) carried out a meta-analysis of more than eight thousand observations of the mouse's thermal nociception, i.e., its response to the pain induced by exposure to heat. They found that experimenter accounted for more variation than genotype, and they identified a number of other significant environmental covariates including season, time of day, and the number of mice a given animal shares its cage with. Through experimentation and the subsequent analysis, the researchers estimated that only 27% of the variation in thermal nociception was attributable to genetic main effects while 42% was due to environmental main effects and 18% was due to gene-by-environment interactions (GxE).

In particular, for anxiety-related behaviours in HS mice, strong GxE interactions have previously been identified. William Valdar and his colleagues (2006a) determined that the interaction of the family an animal is a member of with environmental covariates can in many cases account for a large proportion of the variance of measures of anxiety-related behaviours. Indeed, these GxE interactions often accounted for a greater proportion of phenotypic variation than the main effect of a given covariate. A striking example of this is with the activity of heterogeneous stock mice when placed in a new home cage, a phenotype where the paradigm is that more active mice are less anxious (this test is described in more detail in §2.2.1.2). Neither of two of the key environmental covariates, season of the year and experimenter, explain a significant proportion of phenotypic variance as a main effect. Yet as interacting terms with a coarse marker of heridity (the family of the mouse), these environmental factors explain a highly significant 18% (-log$P$ = 6.5) and 16% (-log$P$ = 4.9), respectively. This interaction of heritability with environmental covariates suggests that there may be QTL representing the interaction effect of the genome with these environmental covariates, i.e., GxE QTL. An exemplar of such a GxE QTL was addressed earlier in Figure 1.2, where the EPM phenotype "open arm time" is

$$y_i = \mu + \sum_{c \in C} \mathbf{a}_c^{\mathrm{T}} \mathbf{x}_{c[i]} + e_i$$

Figure 3.1: This equation represents the regression models I fit with Bagphenotype, where: y_i is the phenotype for mouse i; μ is the overall mean of the data; C is the set of covariates selected for the model; a_c is the vector of fixed effects for covariate c that is being estimated by the model; $x_{c[i]}$ is the vector of contrasts indicating the covariate c for mouse i; and e_i is a random intercept for mouse i where $e_i \sim N(0, \sigma^2)$ with σ^2 being the residual variance. While C includes covariates representing genetic variance at a given inter-SNP interval for both the control and the test model, only the test model has an additional term representing the interaction (i.e., the product) of the genetic variance and one of the other covariates (e.g., sex, weight, experimenter). Genetic variance is more specifically eight probabilities, each of which represents the likelihood that the genetic interval being modelled descended from a particular founder strain and thus by-and-large corresponds to that founder strain's haplotype.

illustrated to be predicted by a genetic locus-by-experimenter interaction.

SP is presently not able to accommodate predictor variables with more than three categorical levels. As the environmental covariates for the HS mice had more levels than this, I employed Bagphenotype alone to map GxE QTL.

3.3 Method

3.3.1 Identifying QTL with Bagphenotype

To identify QTL for a given phenotype, Bagphenotype (Valdar et al., 2009) started by using a single QTL technique called HAPPY (Mott et al., 2000) to: (1) convert SNPs into inter-SNP intervals of founder haplotype probabilities, and (2) fit a pair of single QTL linear regression models for each inter-SNP interval across the genome. One model was the control and the other was the test model, but both can be represented by the equation in Figure 3.1.

For each inter-SNP interval, a -log$P$ value was calculated by running an F-test that compared the nested control model with the test model. Across the genome, the local -log$P$ maxima that exceeded a 5% significance threshold (adjusted for genome-wide multiple testing) and were separated by at least 8 Mb were included as candidate QTL for the next phase of Bagphenotype: multiple QTL fitting.

Because of the family structure associated with HS mice, the single QTL modelling procedure just described often identifies dozens of apparently significant QTL that together would (impossibly) account for more than 100% of phenotypic variance. By multiple QTL modelling, simulations indicate that one is able to remove ghost QTL that are associated with true QTL via linkage disequilibrium (Valdar et al., 2009). Bagphenotype highlights a subset of the candidate QTL (identified, as above, by HAPPY) through many (in my case, 100) resampled iterations of multiple QTL model fitting. For each iteration, a bootstrapped sample (n = 1940) was created by resampling with replacement from the original sample (also n = 1940). Within a given iteration, candidate QTL were forward-selected for inclusion within a multiple QTL model by consecutively adding in the candidate QTL with the highest -log$P$ — as per an F-test — until no candidate QTL remained that could significantly (at a 5% genome-wide analysis-adjusted threshold) improve the fit of the multiple QTL model. The F-test compared (1) a nested control model like the equation in Figure 3.1 that contains in C all of the manually-specified covariates as well as the GxE QTL already forward-selected with (2) a test model that has an extra parameter in C, a candidate GxE interaction. It is worth noting here that, for simplicity, I only fit additive models so QTL with alleles that would have better fit a dominance or full model may have had their signals attenuated or ignored.

The key statistic output by Bagphenotype's multiple QTL modelling is the Resample Model Inclusion Probability (RMIP), which indicates the proportion of bootstrapped iterations that a given QTL was selected for. For example, a QTL assigned an RMIP of .70 was included in 70% of the iterations. Theoretically QTL with higher RMIPs are more important in predicting the phenotype. Based on simulations, an RMIP of .25 corresponds to an FDR of 0.25 false QTL per genome scan, so at an RMIP threshold of .25, we would expect just one false QTL for every four scans. That RMIP = FDR = 0.25 here is coincidental.

For all scans with Bagphenotype, I included in C of the equation in Figure 3.1 all of the covariates that were available and that accounted for at least 1% of the variance in the phenotype y. These covariates are listed in Appendix A.

For genetic main effect scans, multiple QTL modelling was executed in the same manner as interaction QTL scans except that no interacting term was ever included in C from Equation 1. Instead, the test model at a given locus included a term for the additive genetic main effect of that locus (once again, expressed as HAPPY-derived founder probabilities; Mott et al., 2000) within C that was not included in the control model. Except sex (obviously), the covariates included in these single-sex analyses are the same as for the GxS scans and so are also listed in Appendix A.

Confidence intervals for QTL were estimated via a bootstrapping method (Visscher et al., 1996). I used the National Center for Biotechnology Information's Build 37 as the reference mouse genome (Meyer et al., 2013).

3.3.2 Identifying GxE interaction QTL with Bagphenotype

For gene-by-environment interaction (GxE) analyses other than GxS, five variables were considered as potential interacting covariates with genes: the apparatus a given animal was tested in, its body weight, its coat colour, the date of the test, and the particular experimenter who handled the animal and ran the test. Body weight was the only one of these always included in the model, and sex was always included as a predictor variable but not as an interacting covariate. Any of the other four covariates were added into the model if they accounted for more than 1% of phenotype variance as a main effect or as an interactor with the family of the mice (Valdar et al., 2006a). For each phenotype, all of the selected interacting covariates were always included as main effects but a separate genome scan was run for each of the covariates as an interactor with genetics. Thus, the model for each genome scan included several main effects and a single interacting term. See Figure 3.2 for details of the interacting covariates considered for each phenotype.

3.3.3 Identifying interaction QTL with Sparse Partitioning

For our journal article on GxS (Krohn et al., submitted), I worked with Doug Speed to apply to the HS mouse data a Bayesian method he developed, Sparse Partitioning (SP; Speed and Tavaré, 2011), to detect both main effects and interactions simultaneously. Our predictor set consisted of the 13k SNPs from across the whole HS mouse genome, plus sex. I regressed out of phenotypes any other known covari-

Experiment	Phenotype	Variable used as interacting covariate with gene: Apparatus	Body Weight	Coat Colour	Date*	Experi-menter
Activity in new home cage	Beam breaks in first five min.		yes		season	yes
	Beam breaks in last five min.		yes		study hour	yes
	Beam breaks in full 30 min.		yes		season	yes
	Fine movement in full 30 min.		yes		study day	yes
Context freezing	Time spent freezing upon exposure to context	yes	yes	yes	month	yes
Cue freezing	Activity before cue		yes	yes	study day	
	Change in activity before & after cue		yes			yes
	Fecal boli after cue		yes		month	
	Time spent freezing during cue	yes	yes	yes		
	Time spent freezing after cue	yes	yes		month	
Elevated plus maze	Distance travelled in closed arms		yes		study day	yes
	Number of entries into closed arms		yes		month	yes
	Time spent in closed arms		yes		study day	
	Distance travelled in junction		yes	yes	study day	yes
	Number of entries into junction		yes	yes	study day	yes
	Time spent in junction		yes		study day	yes
	Distance travelled in open arms		yes	yes	study day	yes
	Number of entries into open arms		yes	yes	study day	
	Time spent in open arms		yes	yes	study day	yes
Fear-potentiated startle	Startle response (without tone)	yes	yes		study day	
	Startle response (with tone)	yes	yes		study day	
	Change in startle response (without tone) after cue conditioning		yes	yes	study day	
	Change in startle response (with tone) after cue conditioning		yes		study day	
Open field test	Time spent in centre		yes			yes
	Latency to entering centre		yes			yes
	Total activity		yes		season	yes

Figure 3.2: Table of the variables that were included as the interacting covariate in GxE scans across all behavioural phenotypes. *Whenever Date was selected, only one calendar-related predictor was used: the one that explained the most variance in the phenotype, as indicated by Valdar et al. (2006a)

ates, such as weight, age and relevant environmental covariates (see Appendix A) prior to analysis. To increase computational efficiency, wherever there were SNPs on the same chromosome with 99% concordance, only one of the SNPs was used for analysis, resulting in the retention of 5332 SNPs.

SP defines models according to which predictors are associated with the phenotype and which of these predictors interact. SP was set to consider models containing up to ten predictors with at most two three-way interactions. SP models were iteratively fit over two thousand iterations of Markov Chain Monte Carlo. The first 500 iterations were discarded and the final 1500 used to calculate posterior probabilities. Thus, the posterior probability of association for each predictor is a fraction of 1500 representing the proportion of models in which that predictor was included. The posterior probability of two predictors interacting equals the proportion of models in which these two predictors are included and interact.

For our primary SP analysis, any two predictors could interact (allowing both GxS and GxG interactions). To specifically assess the contribution of GxS interactions, we performed a secondary analysis in which only SNPs were allowed to interact (GxG). Because main effects were permitted in both analyses, the difference in phenotypic variance explained between these two analyses is an estimate of the proportion of phenotypic variance explained by GxS.

3.4 RESULTS

3.4.1 Validating Sparse Partitioning

We applied a Bayesian method (Sparse Partitioning, or SP) that is designed to detect both main effects and first-order interactions simultaneously. We included sex as a sole physiological interacting term in the model (any other known significant covariates, as per Valdar et al., 2006a, were regressed out of phenotypes prior to analysis), as well as permitting all genetic markers (single nucleotide polymorphisms, or SNPs) to interact. Figure 3.3 shows the 60 strongest main effect QTL (posterior probability > .2) we found across the 66 phenotypes.

To demonstrate SP's ability to identify QTL in the HS mice, as well as to justify our posterior probability threshold, we compared our SP main effect results with those

Phenotype	SNP	Chr	Location (Mbp)	Posterior Probability
Adrenal Gland Weight	CEL-7_13089324	7	25.14	0.29
Serum Alkaline Phosphatase	rs13478006	4	137.28	0.85
Serum Alanine Transaminase	rs13483757	X	50.44	0.43
Serum Chloride	rs13479859	8	84.57	0.25
Serum Chloride	rs13481037	11	55.61	0.20
Serum High-Density Lipoprotein	UT_1_175.440644	1	173.51	0.75
Serum High-Density Lipoprotein	UT_4_114.441786	4	110.21	0.43
Serum High-Density Lipoprotein	CEL-13_85845037	13	89.33	0.28
Serum Phosphorous	rs3164088	16	96.54	0.30
Serum Triglycerides	rs13481078	11	67.00	0.21
Serum Triglycerides	rs4213015	16	86.16	0.37
Serum Triglycerides	rs6249251	18	81.92	0.40
Serum Urea	rs6283871	17	3.48	0.58
CD4+ Cell Count	rs3694208	8	146.96	0.21
CD8+ Cell Count	rs13482751	15	102.78	0.30
CD8+ Cell Count	mCV22965443	17	35.28	0.63
Freeze Time to Fear-Associated Context	CEL-13_27061395	13	27.78	0.53
Freeze Time to Fear-Associated Cue	rs3719988	6	73.68	0.20
Freeze Time to Fear-Associated Cue	rs6326790	15	90.38	1.00
Ear Hole Area Six Weeks After Ear Punch	rs6213614	7	89.43	0.95
Body Weight	mCV23386455	5	64.58	0.25
Body Weight	rs13483825	X	71.45	0.94
Body Weight	rs13484003	X	130.14	0.69
Faecal Corticosterone	rs3708913	7	25.94	0.24
Startle Response	CEL-11_120628029	11	120.82	0.85
Startle Response	rs6326790	15	90.38	1.00
Area Under Curve of Glucose Levels	mCV24984125	3	90.46	0.76
Area Under Curve of Glucose Levels	gnf12.073.387	12	76.40	0.30
Glucose Levels After 75 Minutes	rs13477814	4	84.52	0.25
Basophils	rs13479465	7	120.05	0.20
Basophils	rs3089065	11	93.03	0.29
Basophils	rs13481991	13	106.11	0.30
Hematocrit	rs3653651	11	102.01	0.37
Mean Corpuscular Haemoglobin	rs3724826	1	133.40	0.42
Mean Corpuscular Haemoglobin	rs6248193	1	157.31	1.00
Mean Corpuscular Haemoglobin	rs8249856	8	125.49	0.23
Mean Corpuscular Haemoglobin	rs6366991	9	107.92	0.89
Mean Corpuscular Haemoglobin	rs6393401	11	5.77	0.93
Mean Corpuscular Haemoglobin	UT_14_62.125092	14	74.52	0.79
Mean Cellular Volume	rs13476111	1	133.65	0.40
Mean Cellular Volume	rs6248193	1	157.34	0.58
Mean Cellular Volume	rs4222040	11	56.85	0.40
Mean Platelet Volume	rs8237062	1	173.15	0.99
Mean Platelet Volume	rs6357939	11	96.94	0.20
White Blood Cell Count	CEL-X_94143306	X	99.93	0.44
CD4+:CD8+ Cell Ratio	rs13482957	17	34.17	0.98
CD4+ Cell Intensity	rs13481288	12	77.94	0.22
CD4+ Cell Intensity	rs13481816	13	54.78	0.21
CD4+ Cell Intensity	rs3686467	19	16.96	0.97
CD8+ Cell Intensity	rs3674782	16	87.32	0.24
B220+ Cell %	rs13475989	1	95.91	0.21
CD3+ Cell %	rs13476242	1	175.30	0.87
CD3+ Cell %	rs4223448	2	126.93	0.22
CD4+ Cell % in CD3+ Cells	mCV22965443	17	35.28	0.97
CD8+ Cell % in CD3+ Cells	mCV22965443	17	35.28	0.98
Area Under Curve of IR Insulin Response	rs6309331	9	92.17	0.31
KI-67 Antigen	rs13479023	6	127.39	0.33
Body Mass Index	rs13459165	2	128.96	0.44
Boli Produced in Open Field Test	rs6163111	5	74.22	0.27
Plethysmography Tidal Volume Baseline	rs3089065	11	93.03	0.24

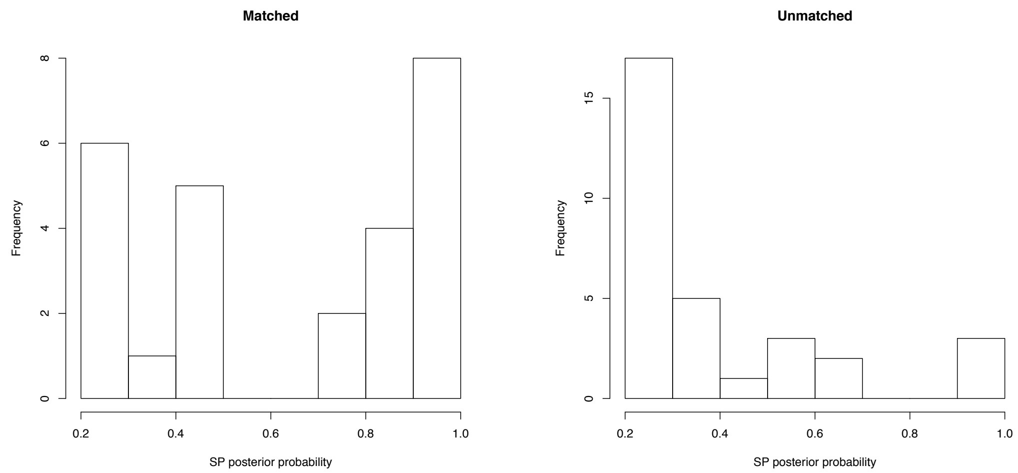
Figure 3.3: The 60 main effect QTL with posterior probabilities above .20 as identified using Sparse Partitioning across 66 HS mouse phenotypes

		Bagphenotype QTL			SP QTL			
Phenotype	Chr	Start (Mbp)	End (Mbp)	RMIP	Start (Mbp)	Location (Mbp)	Posterior Probability	Phenotypic Variance Explained (%)
Adrenal Gland Weight	7	26.53	26.70	0.37	CEL-7_13089324	25.14	0.29	3.21
Serum Alkaline Phosphatase	4	136.59	137.03	1.00	rs13478006	137.28	0.85	20.68
Serum Alanine Transaminase	X	49.66	50.44	0.59	rs13483757	50.44	0.43	2.18
Serum High-Density Lipoprotein	1	173.51	173.63	1.00	UT_1_175.440644	173.51	0.75	18.98
	4	109.54	109.91	0.95	UT_4_114.441786	110.21	0.43	4.88
CD4+ Cell Count	8	14.78	15.15	0.44	rs3694208	146.96	0.21	7.70
Freeze Time to Fear-Associated Cue	15	91.15	91.72	1.00	rs6326790	90.38	1.00	9.51
Ear Hole Area Six Weeks After Ear Punch	7	89.22	89.63	1.00	rs6213614	89.43	0.95	6.06
Startle Response	11	116.53	116.91	0.96	CEL-11_120628029	120.82	0.85	4.62
	15	91.99	92.38	1.00	rs6326790	90.38	1.00	7.48
Glucose Levels After 75 Minutes	4	84.52	84.74	0.92	rs13477814	84.52	0.25	4.95
Mean Corpuscular Haemoglobin	1	133.56	133.66	0.31	rs3724826	133.40	0.42	6.39
	8	123.16	123.72	0.47	rs8249856	125.49	0.23	3.06
	9	108.96	109.16	1.00	rs6366991	107.92	0.89	3.51
	11	5.77	6.15	0.84	rs6393401	5.77	0.93	3.89
	14	70.79	70.97	1.00	UT_14_62.125092	74.52	0.79	7.95
Mean Platelet Volume	1	132.52	132.75	1.00	rs13476111	133.65	0.40	10.62
	1	172.98	173.16	1.00	rs8237062	173.15	0.99	14.93
CD4+:CD8+ Cell Ratio	17	34.42	34.52	1.00	rs13482957	34.17	0.98	24.34
B220+ Cell %	1	95.93	96.42	0.73	rs13475989	95.91	0.21	5.43
CD3+ Cell %	1	173.68	174.15	0.84	rs13476242	175.30	0.87	4.69
	2	125.13	125.36	0.99	rs4223448	126.93	0.22	4.57
CD4+ Cell % in CD3+ Cells	17	34.42	34.52	1.00	mCV22965443	35.28	0.97	22.37
CD8+ Cell % in CD3+ Cells	17	34.42	34.52	1.00	mCV22965443	35.28	0.98	24.69
KI-67 Antigen	6	127.12	127.54	0.27	rs13479023	127.39	0.33	10.72
Body Mass Index	2	127.97	128.30	1.00	rs13459165	128.96	0.44	3.52

Figure 3.4: The 26 SP-identified main effect QTL that matched with Bagphenotype-identified main effect QTL across 66 HS mouse phenotypes, and the phenotypic variance explained by each QTL

from the resample model averaging approach Bagphenotype, which is specifically designed for use with structured populations like the HS mice (Valdar et al., 2009). Conservatively, we included only strictly overlapping QTL in our comparison of the two methods. The summary statistic for Bagphenotype is called a Resample Model Inclusion Probability (RMIP; detailed in §3.3.1). B displays the 294 strongest QTL (RMIP > .25 threshold) found by applying Bagphenotype across the same 66 phenotypes as analysed with SP. Twenty-six (26/60 = 43.3%) of our SP-identified main effect QTL fell within 2 Mb of the 95% confidence interval (CI) of the Bagphenotype-identified main effect QTL, as summarised in Figure 3.4.

Figure 3.5 illustrates the difference between the posterior probabilities of SP-identified main-effect QTL that matched ($n = 26$) to Bagphenotype-identified main-effect QTL and those that did not ($n = 31$). The posterior probabilities of the matched QTL ($\mu = .64$) were significantly higher than unmatched probes ($\mu = .40$), according to the Wilcoxon rank sum test, $W = 581$, $p < .005$. Similarly, the RMIPs of Bagphenotype QTL that matched ($n = 26$, $\mu = .84$) to SP QTL were significantly higher than



(a) (b)

Figure 3.5: (a) Histogram of the posterior probabilities of SP-identified main effect QTL that match with Bagphenotype-identified main effect QTL. (b) Similar to (a) except that it displays the posterior probabilities of SP-identified main effect QTL that *do not* match with Bagphenotype-identified QTL. As detailed in the text, the posterior probabilities of the matched QTL are significantly higher than those of the unmatched QTL, $p < .005$.

those that did not ($n = 268$, $\mu = .51$), $W = 6236$, $p < .0001$. The Wilcoxon test is used in situations where one might employ a t-test but are working with input variables that have non-parametric distributions.

This result is expected, given that both the SP and Bagphenotype QTL lists include only QTL above a threshold, a threshold that is particularly conservative for SP (only 0.91 QTL per phenotype). So, the QTL with the highest posterior probabilities according to SP, those QTL that we have the most confidence in being true, are likely to correspond to QTL in the Bagphenotype list. Meanwhile, QTL with lower posteriors are those that we have less confidence in being true, so these are less likely to be identified by Bagphenotype above the RMIP threshold.

I assumed that if the methods were detecting the same loci and weighing their importance in explaining the phenotype to the same extent, we would observe a positive correlation between the SP posterior probabilities and Bagphenotype RMIPs. That is, the strongest loci detected by SP should also tend to be the strongest loci detected by Bagphenotype. Both the SP and Bagphenotype distributions were highly non-Gaussian (Figure 3.6), so prior to analysis by the Pearson correlation test, the relative ranks of the data were used to correct both distributions to Gaussian normal. Figure 3.7 illustrates the highly significant positive correlation between the matched SP posterior probabilities and Bagphenotype RMIPs, $r = .64$, $t(24) = 4.0$, $p < .0005$, suggesting that the former technique can identify QTL in structured populations like the HS in a manner similar to the latter, more widely-used technique.

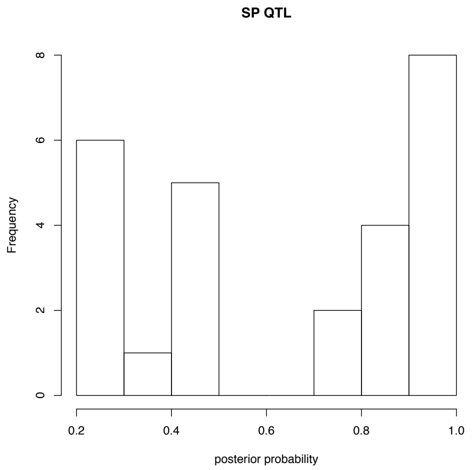
As shown in Figure 3.8, the posterior probabilities of SP marginal effect QTL also had a significant positive correlation with the percentage of phenotypic variance accounted for by those QTL, $r = .39$, $t(24) = 2.1$, $p < .05$. Details are included in Figure 3.4. As shown in Figures 3.6a, 3.6c and 3.9, the distributions of both variables are highly non-Gaussian and so required normalisation prior to further analysis.

3.4.2 Gene-by-sex interactions identified by Sparse Partitioning

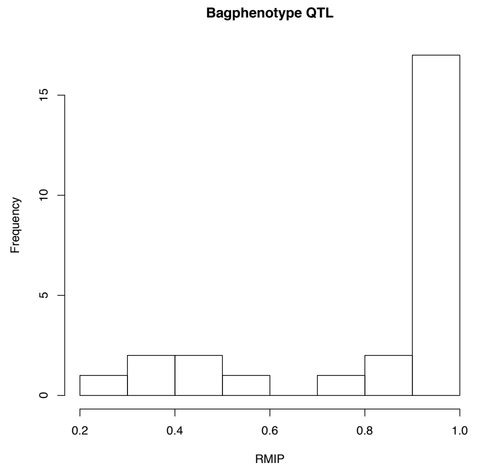
Setting the same posterior probability threshold for detecting interactions as main effects (.20), I used SP to find 18 GxS interaction QTL (as detailed in Figure 3.10 and summarised by a histogram of posterior probabilities in Figure 3.11). These effects were associated with 17 of the 66 phenotypes investigated, with two GxS QTL for high-density lipoproteins (HDL); and one for each of adrenal gland weight, alkaline phosphatase (ALP), alanine transaminase (ALT), chloride, triglycerides, time spent frozen before moving in a context associated with a fearful stimulus, time spent frozen after cue associated with a fearful stimulus, stress steroid levels obtained from faeces, startle response, area of the glucose response curve, hematocrit (HCT), mean platelet volume (MPV), CD4+ T-cell intensity, CD8+ T-cell intensity, B220+ cell percentage, and number of boli produced in the open field test (OFT). The highest GxS interaction posterior probability (.53) involved the anxiety-related “time spent frozen in fearful context” phenotype and is located at 27.7 Mbp on chromosome 13.

3.4.3 Gene-by-gene interactions identified by Sparse Partitioning

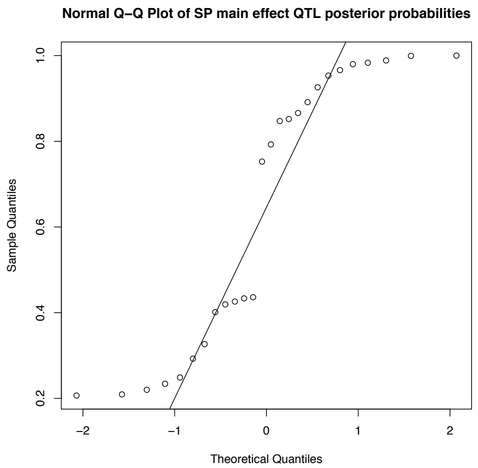
In addition to fitting GxS interactions, SP was configured to simultaneously permit fitting of first-order gene-by-gene (GxG) interactions between two QTL to explain variance in a phenotype. Seven such GxG interactions were identified above the .20



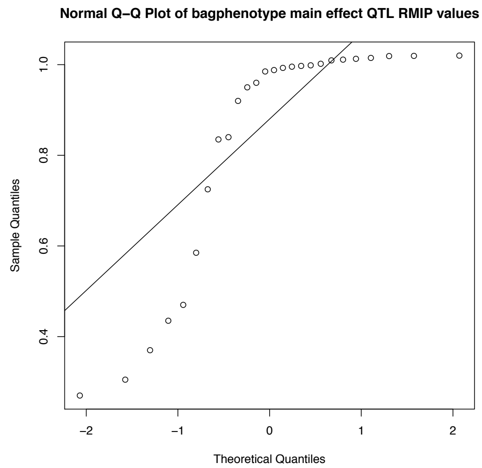
(a)



(b)



(c)



(d)

Figure 3.6: (a) Identical to Figure 3.5a, re-drawn again here for a new comparison, it is a histogram of the posterior probabilities of SP-identified main effect QTL that match with Bagphenotype-identified main effect QTL. (b) Corresponding histogram of the RMIPs of the Bagphenotype-identified QTL that match SP-identified ones. Both distributions are highly non-Gaussian, as clearly illustrated by Q-Q plots (c) and (d), so require correction prior to parametric analyses.

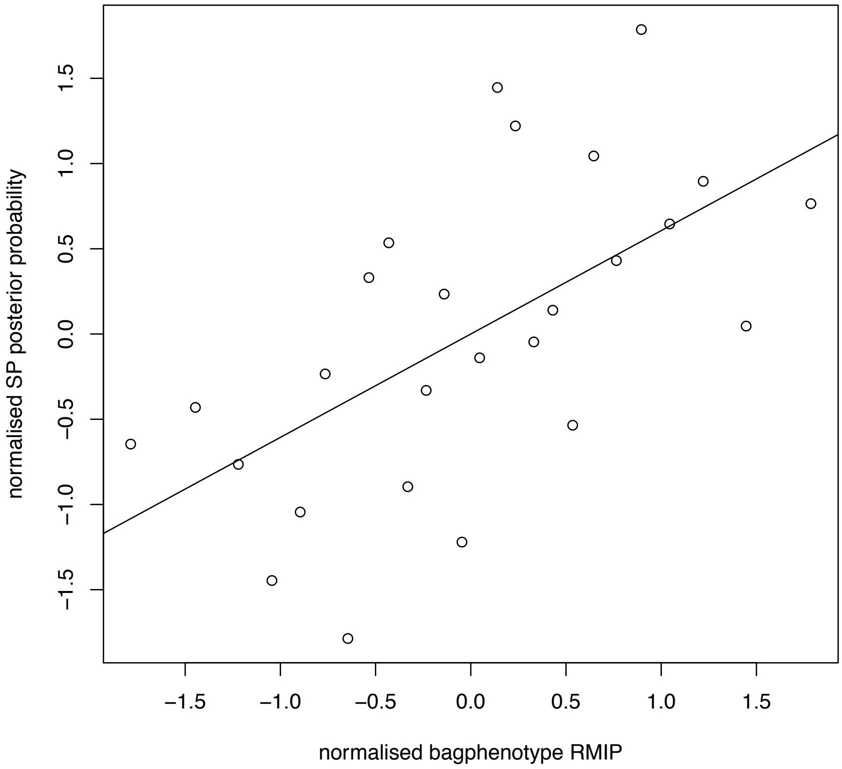


Figure 3.7: For main effect QTL that were identified by both SP and Bagphenotype, there is a highly significant positive correlation between the rank-normalised summary metrics of the two methods (posterior probability and RMIP, respectively), $p <$ .0005. See text for details.

posterior probability threshold. As detailed in Figure 3.12, each of the seven interactions is associated with a different one of the 66 HS mouse phenotypes; two that also had GxS interactions (triglycerides and area of the glucose response curve) and four that did not (CD8+ T-cell count; blood glucose level; mean corpuscular hemoglobin, MCH; and mean corpuscular volume, MCV). The GxG interactions with the highest posterior probabilities (.45) were associated with CD8+ count and MCH.

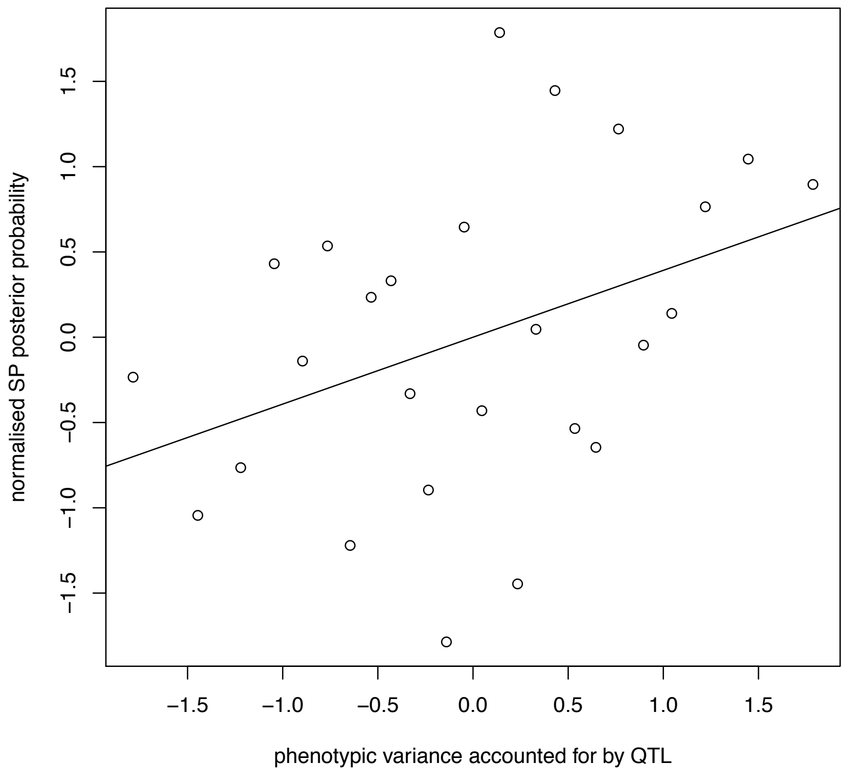
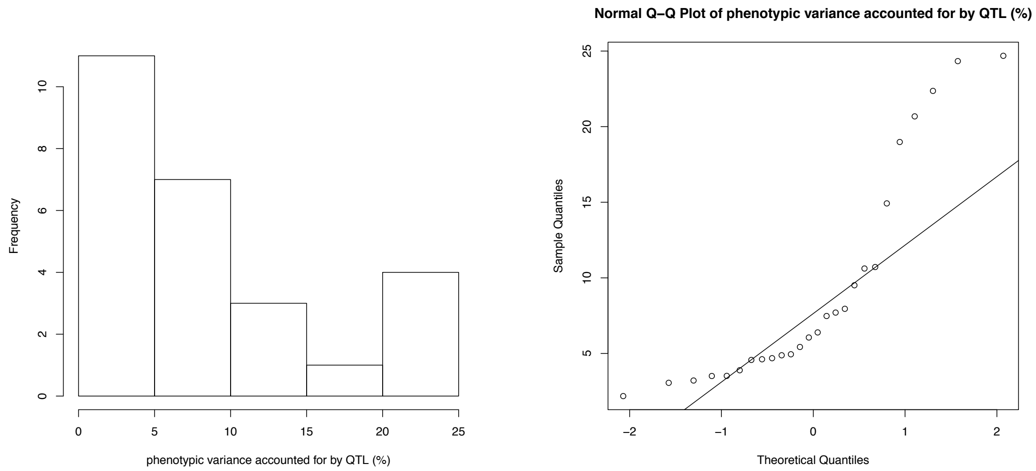


Figure 3.8: There is a significant positive correlation between the normalised posterior probabilities of SP-identified QTL and the normalised percentage of phenotypic variance explained by those QTL, $p < .05$

3.4.4 Phenotypic variance attributable to GxS interactions

To estimate how much phenotypic variance was attributable to GxS interactions, cross-validation was employed. Cross-validation randomly selects a proportion of the data with which the model is trained and subsequently tests how well this model fit the unselected data. Here, we divided the data into ten evenly-sized tranches. Nine tranches were used to fit predictors to the data and then the quality of this fit was tested in the tenth tranche. This was repeated ten times, allowing us to rotate through each of the ten tranches as the test tranche.

Cross-validation was performed twice with each of the 17 phenotypes that included a GxS interaction: first while allowing sex to act as both a marginal effect and



(a) (b)

Figure 3.9: (a) Histogram of the percentage of phenotypic variance accounted for by main effect QTL identified by both SP and Bagphenotype. (b) Q-Q plot illustrating that the distribution is highly non-Gaussian, therefore requiring normalisation prior to parametric analysis

Phenotype	SNP	Chr	Location (Mbp)	Posterior Probability
Adrenal Gland Weight	rs3692711	7	20.63	0.29
Serum Alkaline Phosphatase	rs3719891	4	142.10	0.52
Serum Alanine Transaminase	CEL-X_113373391	X	50.44	0.32
Serum Chloride	rs13481037	11	55.61	0.20
Serum High-Density Lipoprotein	mCV24303778	4	115.92	0.43
Serum High-Density Lipoprotein	CEL-13_85845037	13	89.33	0.28
Serum Triglycerides	rs6299418	11	66.99	0.21
Freeze Time to Fear-Associated Context	CEL-13_27061395	13	27.77	0.53
Freeze Time to Fear-Associated Cue	rs3719988	6	73.68	0.20
Faecal Corticosterone	rs3708913	7	25.94	0.23
Startle Response	CEL-11_120628029	11	120.82	0.35
Area Under Curve of Glucose Levels	mCV24984125	3	90.46	0.38
Hematocrit	rs3653651	11	102.01	0.37
Mean Platelet Volume	rs6357939	11	96.94	0.20
CD4+ Cell % in CD3+ Cells	rs13481288	12	7.79	0.21
CD8+ Cell % in CD3+ Cells	rs3674782	16	87.32	0.24
B220+ Cell %	rs13475989	1	95.91	0.21
Boli Produced in Open Field Test	rs6163111	5	74.22	0.27

Figure 3.10: The 18 gene-by-sex interaction QTL identified by SP across 66 HS mouse phenotypes

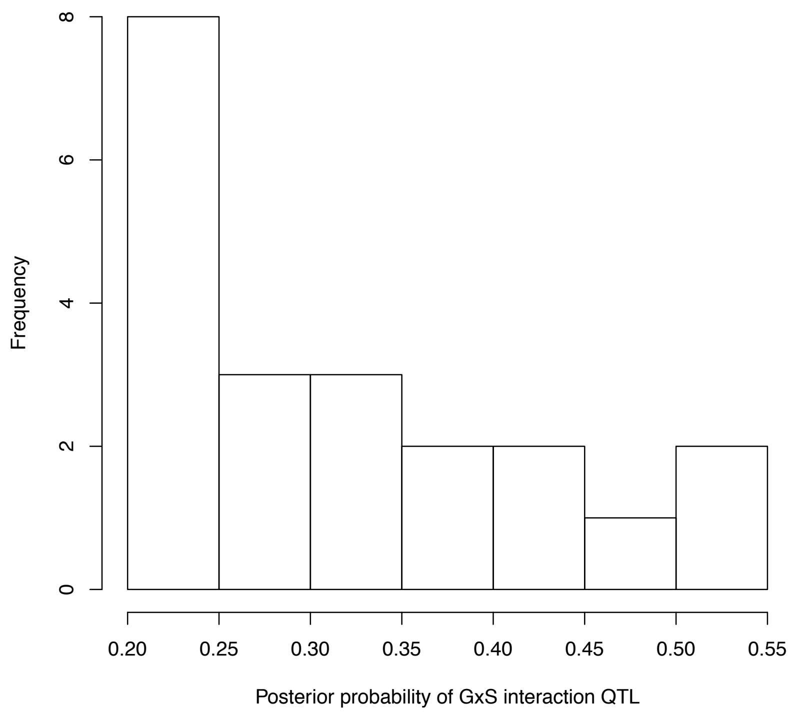


Figure 3.11: Histogram of the posterior probabilities of the SP GxS interaction QTL identified by SP

	QTL 1			QTL 2			
Phenotype	SNP	Chr	Location (Mbp)	SNP	Chr	Location (Mbp)	Posterior Probability
Serum Triglycerides	rs4213015	16	86.16	rs6249251	18	81.92	0.38
CD4+ Cell Count	rs13482751	15	102.78	mCV22965443	17	35.28	0.45
Body Weight	mCV23586427	1	191.63	rs13476524	2	58.51	0.27
AUC of Glucose Levels	mCV24984125	3	90.46	gnf12.073.387	12	76.40	0.31
Glucose Level After 0 Min.	rs3657255	1	35.09	rs3090050	11	95.21	0.31
Mean Corpuscular Haemoglobin	rs13482242	14	71.18	rs13482258	14	76.82	0.45
Mean Cellular Volume	rs6360170	14	69.28	rs13482239	14	70.17	0.32

Figure 3.12: The seven gene-by-gene interactions identified by SP across 66 HS mouse phenotypes

Phenotype	% of Phenotypic Variance Explained		
	Main and Interaction Effects Permitted	Only Main Effects Permitted	Difference
Adrenal Gland Weight	13.88	12.31	1.57
Serum Alkaline Phosphatase	6.09	5.88	0.21
Serum Alanine Transaminase	0.86	0.70	0.16
Serum Chloride	0.84	0.67	0.17
Serum High-Density Lipoprotein	9.37	8.83	0.54
Serum Triglycerides	3.31	3.02	0.29
Freeze Time to Fear-Associated Context	-0.05	-0.37	0.32
Freeze Time to Fear-Associated Cue	6.34	6.24	0.10
Faecal Corticosterone	7.92	8.13	-0.22
Startle Response	5.26	5.05	0.21
AUC of Glucose Levels	0.50	0.35	0.14
Hematocrit	0.14	-0.39	0.53
Mean Platelet Volume	5.85	5.91	-0.06
CD4+ Cell % in CD3+ Cells	3.05	2.82	0.23
CD8+ Cell % in CD3+ Cells	0.40	-0.13	0.54
B220+ Cell %	0.81	0.40	0.41
Boli Produced in Open Field Test	-0.15	-0.48	0.33

Figure 3.13: For each of the 17 phenotypes that included a GxS interaction QTL, cross-validation was carried out to estimate the proportion of variance explained by two different models: one allowing sex to act as both an interacting term with SNPs and as a main effect, the other only allowing sex to act as a main effect. Tabulated here are the percentage of phenotypic variance explained by the predictors for both model types, as well as the difference between the two percentages. These data are plotted in Figure 3.14

as an interacting term with SNPs, then while allowing sex to act only as a marginal effect. In both models, SNPs were able to interact (i.e., epistasis). The proportion of variance left unexplained under these two scenarios is summarised in Figure 3.13 and illustrated in Figure 3.14.

The best fitting models are for adrenal weight, where the GxS interaction-prohibited and -permitted models leave 87.7% and 86.1% of the phenotypic variance unexplained, respectively. For all but two phenotypes (MPV and faecal steroid levels), the proportion of variance explained by the GxS interaction-permitted models was higher than in their GxS interaction-prohibited counterparts, ranging from 0.14% (area of the glucose response curve) to 4.30% (body weight) higher.

Other than adrenal weight (1.57%), allowing GxS interactions did not account for more than about half a percent of the phenotypic variance. In a few circumstances, we observe proportions of variance explained that are just below zero (5/36 models

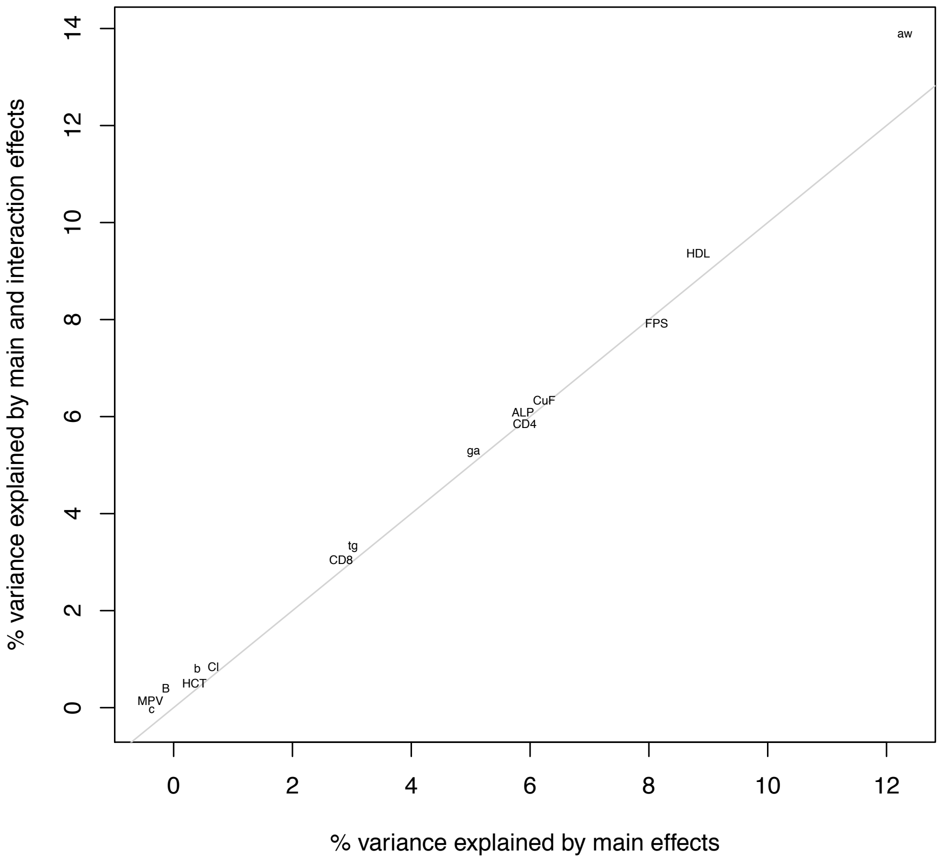


Figure 3.14: For the 17 phenotypes that had a GxS QTL, this plot depicts the percentage of phenotypic variance explained by models where sex was permitted to act as a main effect only relative to when it could act as a both main effect and interaction term. As detailed in Figure 3.13, allowing GxS interaction effects in the model at least marginally improved the amount of phenotypic variance explained by predictors except in two cases: mean platelet volume ("MPV") and faecal steroid levels ("fs"). Thus, all points except those two fall above the grey line $x = y$. It is clear from the figure that adrenal gland weight ("aw") had the greatest improvement in its variance explained by allowing interacting predictors (difference of 1.6%). Additional non-trivial abbreviations are as follows: chloride ("Cl"), triglycerides ("tg"), time spent frozen in fearful context ("c"), time spent frozen after fearful cue ("CuF"), startle response ("FPS"), area of glucose response curve ("ga"), B220+ cell percentage ("B"), and boli produced in the open field test ("b"). ALT occupied nearly the same position as chloride so is represented by the same symbol ("Cl")

= 13.9%) or allowing interactions reduces the proportion of variance explained (2/18 phenotypes = 11.1%). These unintuitive results are attributable to the stochasticity of cross-validation. The effects are so weak for some of the phenotypes (~0% of phenotypic variance explained) that the models may only be picking up noise. When these noise-explaining predictors are included, their predicted fit will be worse than the null model.

3.4.5 Relationship between variance explained by sex and by GxS

Across the 17 phenotypes with a GxS QTL identified by SP, the proportion of phenotypic variance explained by sex as a main effect (determined by a simple linear model) was not found to correlate with the proportion of phenotypic variance explained by GxS (the "difference" column of Figure 3.14), $r = .30$, $t(15) = 1.2$, $p = .23$. See Figure 3.15. Both variables were highly non-Gaussian (as illustrated in Figure 3.16) so were normalised prior to Pearson correlation testing.

3.4.6 Gene-by-sex interactions identified by Bagphenotype

Looking across 90 phenotypes (see Figure 2.1 for a full list) collected in the Oxford HS mouse project (Solberg et al., 2006), I identified 206 (detailed in Appendix C) GxS interaction QTL (2.3 QTL per phenotype). Across the 25 anxiety-related behavioural phenotypes, however, only 17 QTL (detailed in Figure 3.4) were found, i.e., 0.7 QTL per phenotype.

With the hope of garnering further information from regions identified as containing a GxS interaction QTL, I also carried out single-sex scans looking for main effects of gene across the 90 phenotypes. Despite having half the sample size for these scans, many QTL were nevertheless discovered: 438 and 475 for females and males, respectively. Figure 3.17 is a histogram illustrating the RMIP distribution of the 1119 QTL identified by all three scan types: genetic main effect QTL among females (n = 940) and males (n = 1000), as well as GxS interaction QTL among all animals (n = 1940). Appendix C details the particular phenotypes and physical locations of these 1119 QTL. For reference, Figure 3.17 also contains the 785 unisex, genetic main effect QTL identified by Valdar and colleagues (Valdar et al., 2006b) using the same data (n = 1940). For each of the phenotypes, the results of all

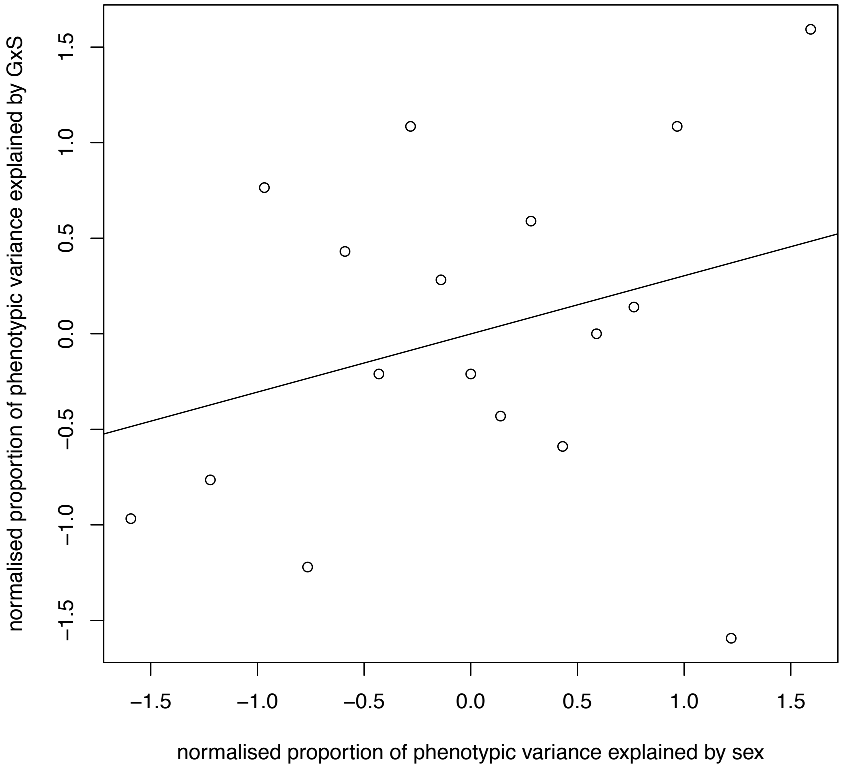
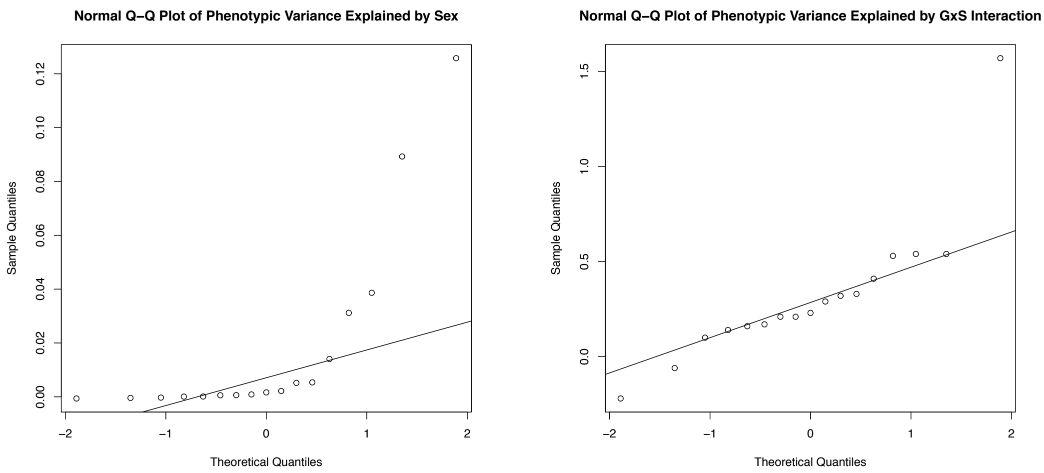


Figure 3.15: The proportion of phenotypic variance explained by sex as a main effect does not correlate significantly with the proportion of phenotypic variance explained by GxS effects, $p = .23$

four types of scan are publicly available in an interactive graphical user interface at http://gscan.well.ox.ac.uk/gsBleadingEdge/wwwqtl.cgi.

Figure 3.18 categorises the number of QTL identified per phenotype by the type of scan through which the QTL was found as well as by phenotype category (i.e., whether the phenotype was collected as part of a mouse model of anxiety, asthma or diabetes; or it was an anatomical, biochemical or immunological measurement). All of the anxiety-related behavioural phenotypes fit into the category of mouse models of anxiety. The results in Figure 3.18 are also grouped depending upon which of the four types of genome-wide scan the QTL were identified in. As in Figure 3.17, standard, unisex main effect of gene QTL scans (Valdar et al., 2006b) are shown in green; main effect of gene QTL identified in single sex scans are shown in blue and



(a) (b)

Figure 3.16: The skew illustrated by these Q-Q plots for (a) proportion of phenotypic variance explained by sex and (b) by GxS interactions was corrected by rank normalisation prior to the correlation analysis shown in Figure 3.15

red for males and females, respectively; and GxS interaction effect QTL are purple.

Figures 3.19 and 3.20 provide a genome-wide perspective of the QTL identified for the phenotype of the amount of fine movement over the thirty minutes in which a mouse is tracked while in a new home cage. Four GxS interaction QTL were identified for this trait, more than for any of the other anxiety-related phenotypes. As in Figures 3.17 and 3.18, unisex main effect scans are shown in green; single-sex main effect scans are shown in blue and red for male and female mice, respectively; and GxS interaction effects in purple. Between the scans and the x-axis, the locations of QTL are denoted by horizontal bars in corresponding colours, where darker hues represent QTL with RMIPs closer to one. As detailed in Appendix C, there are GxS interaction QTL for this phenotype located on chromosomes 7, 14, 18 and 19 with RMIPs of .70, .66, .60 and .76, respectively.

Figure 3.21 offers a magnified version of the scans from chromosome seven shown in Figures 3.19 and 3.20, where there is a strong example of a GxS interaction QTL for the fine movement phenotype. As detailed in Appendix C, there is a GxS interaction QTL (RMIP = 0.70) located at 3.7 to 4.3 Mb overlapping with a larger, female-only main effect of gene QTL (RMIP = 0.25) at 3.7 to 10.7 Mb.

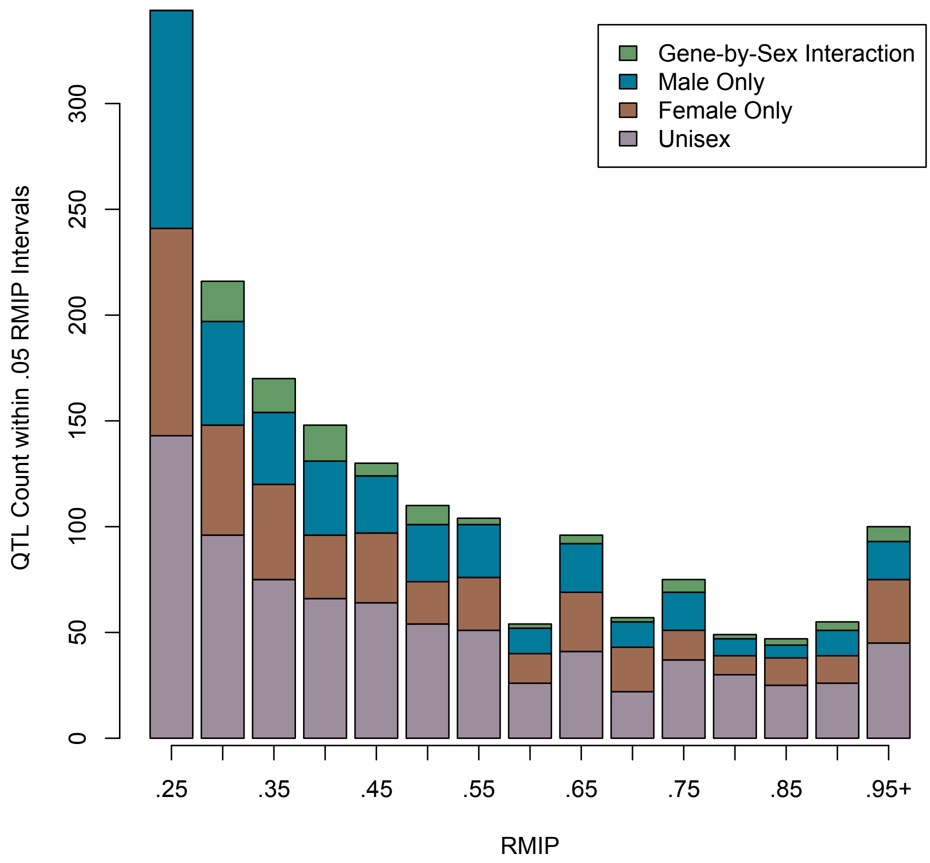


Figure 3.17: Histogram of the RMIPs of main effect and GxS QTL

3.4.7 Gene-by-environment interactions

For analysing GxE QTL, five variables were considered as potential interacting covariates with genes: the apparatus a given animal was tested in, its body weight, its coat colour, the date of the experiment, and the particular experimenter running the test. Coat colour stands out in this list because of its obvious genetic basis, but it can also act as an environmental covariate because automated video trackers were used for phenotyping all of the behaviours in this report and some coat colours are more readily tracked in this manner than others. Across six behavioural experiments — accounting for a total of 25 phenotypes and 85 separate genome scans (one per selected covariate; see Figure 3.2) — I identified 539 QTL (listed in Appendix D). Figure

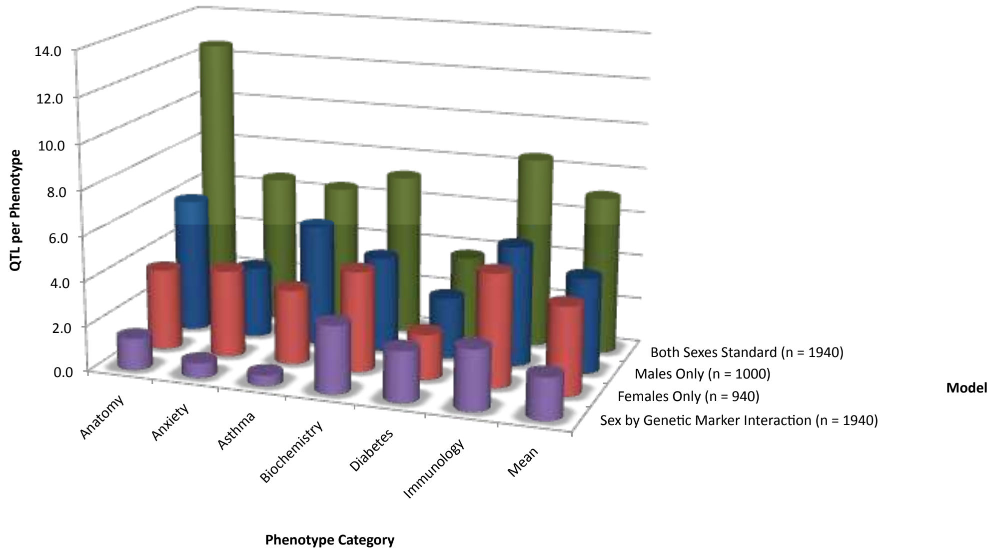


Figure 3.18: Three-dimensional bar chart of main effect and GxS QTL. Along the x axis is a summary of the number of QTL identified per phenotype across six broad categories of phenotype (anatomy, anxiety behaviour, biochemistry, diabetes, and immunology) as well as the mean. Along the z axis is a summary of the number of QTL identified by four different types of genome-wide scan: GxS, females only, males only, and the standard, both-sexes-together scan.

3.22 depicts how these QTL are distributed across the six experiments and interacting covariates. For example, scans across the three open field test phenotypes using experimenter as the interacting covariate found 67 GxE QTL (23.3 QTL per phenotype), while scans across the nine elevated plus maze phenotypes using date as the interacting covariate found 128 GxE QTL (14.2 QTL per phenotype). Particular QTL from these two examples are described next.

As shown in Figure 3.23, for the "distance travelled in the open arms" phenotype of the elevated plus maze experiment, a gene-by-date scan (shown in red) identified 32 QTL across the genome. Here is an example of one with an RMIP of 1.0 on chromosome six from 17.7 to 17.9 Mb, a region that contains five genes. The gene-by-date scan is, for reference, overlain on a standard scan for main effect of gene (shown in black).

Similarly, as shown in Figure 3.24, for the "total activity" phenotype of the open field test, a gene-by-experimenter scan identified 39 QTL across the genome. Here is an example of two QTL with RMIPs of .95 and .88 on chromosome ten from 57.7

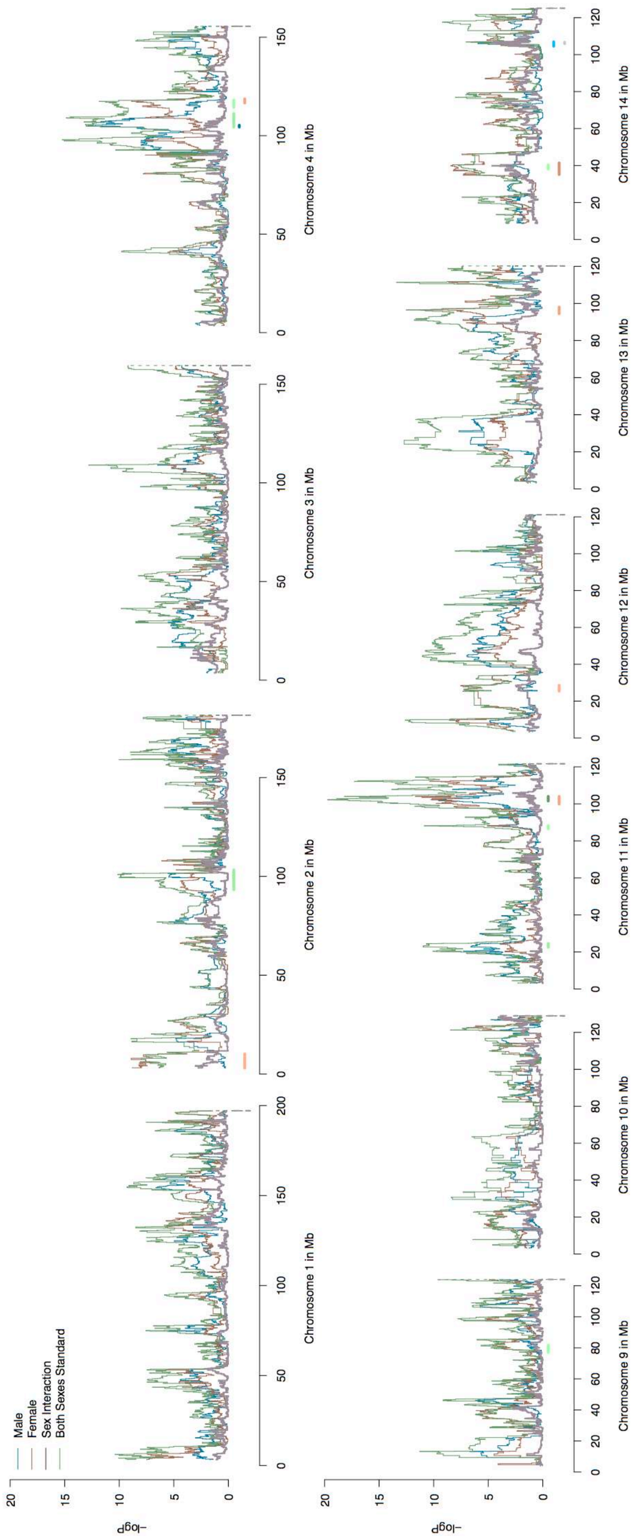


Figure 3.19: Genome-wide QTL scan for movement in a new home cage. Separate scans are overlain for males (blue), females (red), GxS (purple) and standard (green).

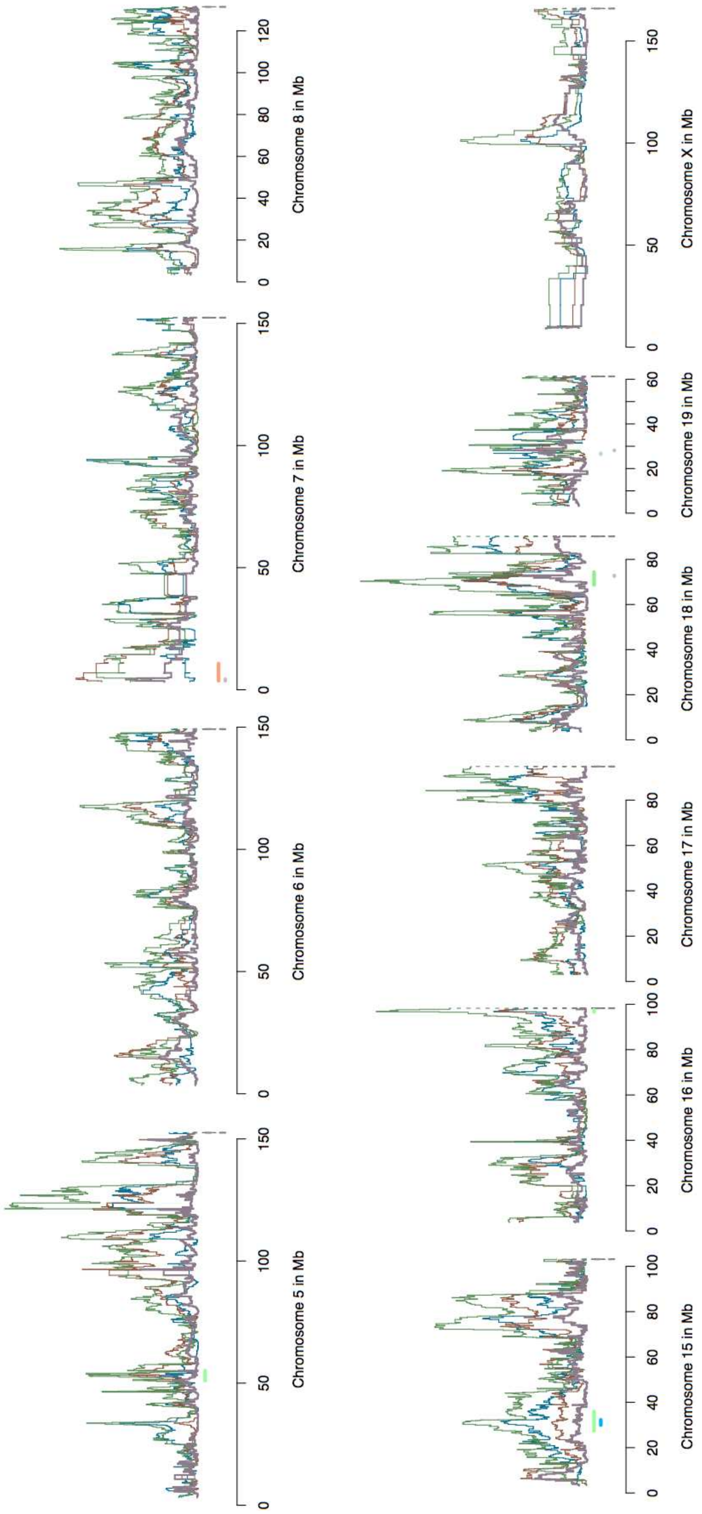


Figure 3.20: Genome-wide QTL scan for movement in a new home cage, continued

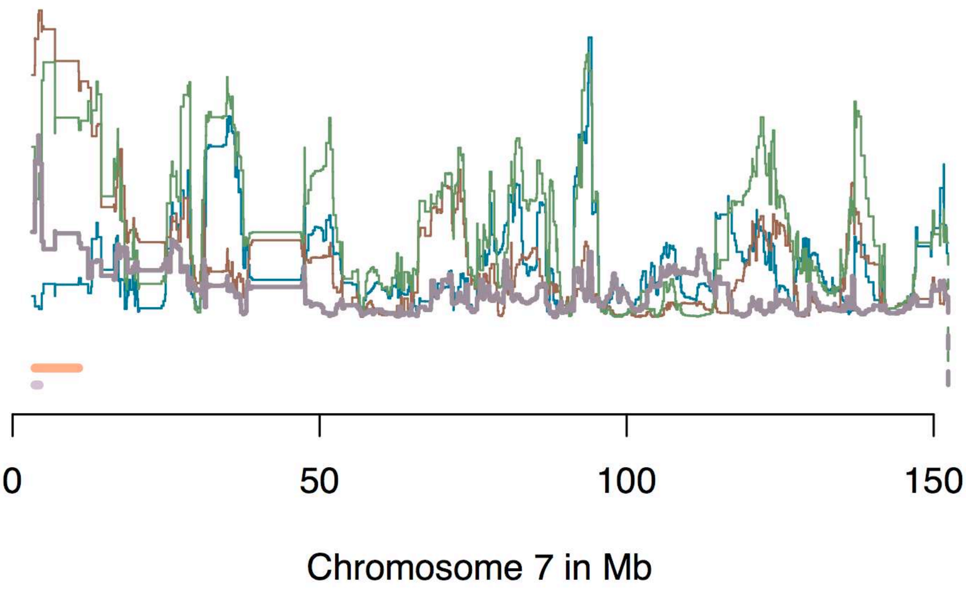


Figure 3.21: Chromosome 7 QTL scan for movement in a new home cage, following the same legend as Figure 3.19

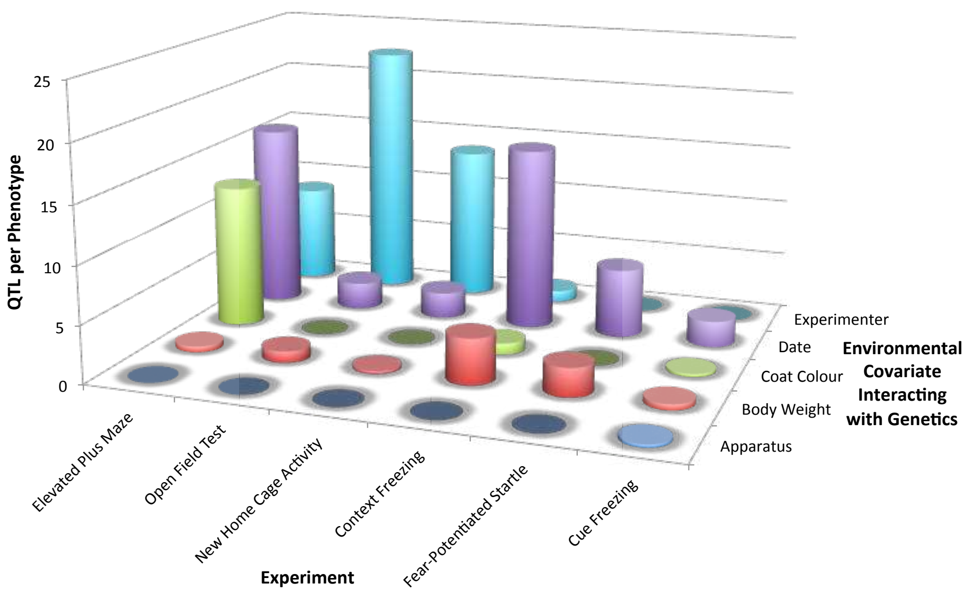


Figure 3.22: This three-dimensional bar chart illustrates the average number of GxE QTL, organised by experiment along the x axis and the environmental covariate on the z axis.

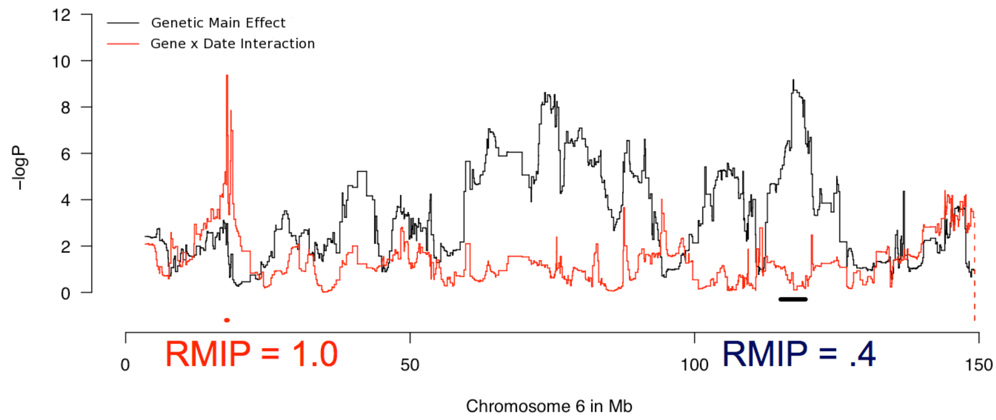


Figure 3.23: Gene-by-date QTL for distance travelled in the open arms of the elevated plus maze.

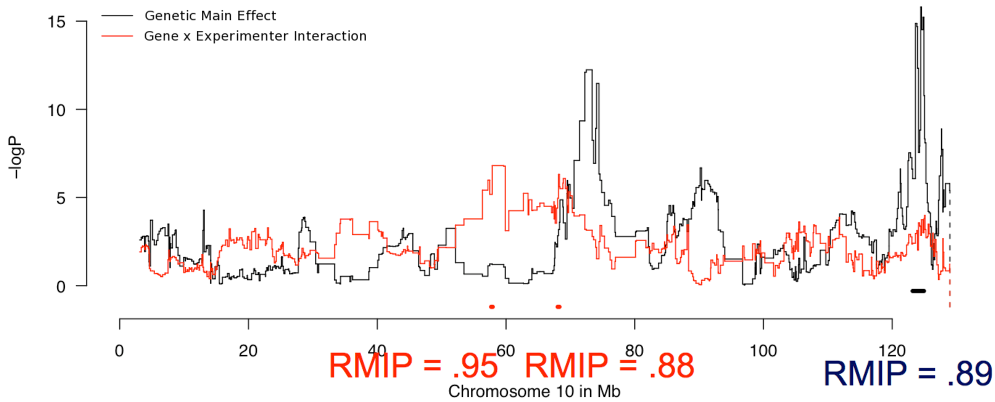


Figure 3.24: Two gene-by-experimenter QTL for total distance travelled in the open field test.

to 57.9 Mb and 68.0 to 68.3 Mb, respectively. Ten genes underlie the first QTL while one underlies the second. Once again, a standard scan for main effect of gene is shown in black.

3.5 Discussion

3.5.1 GxS and GxG QTL identified by Sparse Partitioning

The principal finding from my analysis of GxS and GxG with the Bayesian technique Sparse Partitioning is that interactions contributed little to phenotypic variation in addition to that attributable to main effect QTL. From the analysis of 66 phenotypes, 18 loci with a GxS effect were identified (see Figure 3.10). Each of the 18 coincided with one of the 60 main effect QTL that were found (Figure 3.3). Relative to main effect QTL, GxS effects make a much smaller contribution to phenotypic variance. The median percentage of variation accounted for by GxS was 0.23% (maximum = 1.57%, as per Figure 3.13) while genetic main effects had a median contribution of 6.2% (maximum = 24.7%). Only one phenotype had more than one GxS QTL: High-density lipoprotein cholesterol had two.

Since every GxS QTL identified coincides with one of the 60 main effect QTL (Figure 3.3), the data indicate that the GxS effect does not arise from biological pathways independent of those of the main effect QTL.

The search for GxG interactions yielded an even smaller list of loci. Seven epistatic interactions were found and each of them was for a different phenotype (Figure 3.12). Some of the GxG interactions coincided with main effect QTL: both of the loci interacting to predict triglyceride levels and both loci for area under the curve of glucose levels. Both epistatic loci for CD4+ cell count coincided with main effect QTL predicting CD8+ cell count, but not with any marginal QTL for CD4+ cell count itself. This is not, however, an especially surprising find given that these cell count phenotypes are very highly correlated, $r = .83$, $t(1256) = 53.6$, $p < 10^{-15}$. Both of the GxG loci for mean corpuscular haemoglobin (MCH) and mean cellular volume were very nearby (range = 69.2-76.8 Mbp) of an MCH main effect QTL on chromosome 14 at 74.5 Mbp.

Attempts to find sex-specific effects have met with varying success, partly because of methodological limitations. A review of the literature on human genetic association studies, despite identifying 432 claims for sex-specificity, concluded that the majority of claims were spurious (Patsopoulos et al., 2007). Yet there is evidence from twin and genetic linkage studies that, for some phenotypes, a considerable proportion of the genetic variance is sex specific. Thus, in two independent twin studies of the heritability of depression, Kendler and colleagues (2001; 2006) estimate genetic correlation in risk factors for major depression in men and women to be approximately 0.6. In an analysis of 17 quantitative phenotypes, subject to genetic linkage analysis, Weiss and coworkers reported that eleven were sexually dimorphic, twelve showed evidence of differences between the sexes in heritability or linkage, and all three genome-wide significant linkage peaks were significant when tested for an interaction between sex and genotype (Weiss et al., 2006). These GxS results obtained from HS mice using SP add to this debate by finding evidence for GxS at just over a quarter of phenotypes, suggesting that GxS QTL are relatively common, in agreement with the genetic linkage analyses of human phenotypes (Weiss et al., 2006).

Although the correlation between proportion of phenotypic variance accounted for by sex and by GxS effects was insignificant (Figure 3.15), one (nearly outlying) data point may be considered solely responsible for this insignificance. After fitting "phenotypic variance accounted for by sex" in a linear model that predicts "phenotypic variance accounted for by GxS", the residual representing faecal corticosterone, as depicted in Figure 3.25, sits at -2.4 standard deviations below the mean. This low value is far further from the mean than any other residual and approaches the "±3 standard deviations" outlying residual exclusion threshold that is commonly used in statistics. If this one data point were excluded, then we would indeed find a significant positive correlation between proportion of variance explained by sex and by GxS interactions, $r = .57$, $t(14) = 2.6$, $p < .05$. Figure 3.26 illustrates this relationship.

So, save this near outlier (whose impact may have been diminished if I had more data points), we observe a linear relationship between sex effects and GxS: The larger the main effect of sex, the larger the effect of the interaction loci. This justifies the reasonable assumption that it will be worth examining highly sexually dimorphic phenotypes for GxS effects. This linear relationship between sex effects and GxS might be interpreted to mean that the genetic basis of sex differences arise from the conjoint effect of many loci, rather than being due to a specific and relatively constrained biological pathway. However, it is important to realise that the distribution of the effect sizes is skewed. This may indicate that in some phenotypes the sex effect arises from a few key loci. One example might be the GxS interaction based at 21 Mbp on chromosome seven that explains 1.5% of adrenal gland weight.

An important caveat to my use of SP is that I found relatively few main effect QTL. Compared to the 294 main effect QTL found with Bagphenotype, SP found

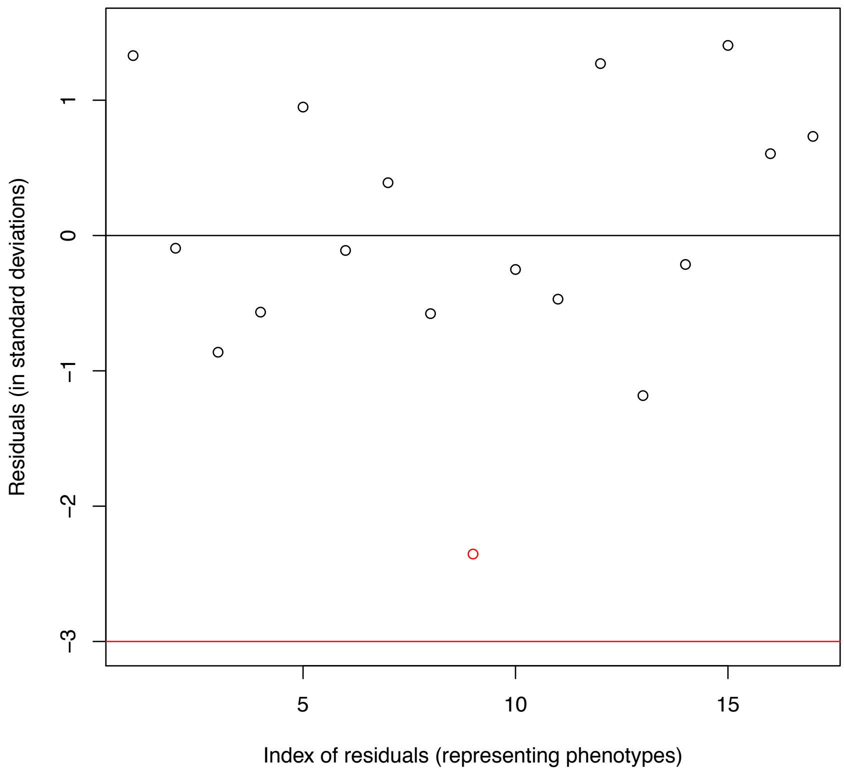


Figure 3.25: The residual representing faecal corticosterone is shown in red. Its value of -2.4 approaches the ±3 outlier exclusion threshold often used in statistics, which is depicted as a red horizontal line

just 60, of which 43% were common to the two methods. This raises the question as to whether reliance on SP for QTL mapping might be biasing our results. It is surprising, for example, that we found no GxS for weight, even though this phenotype has by far the largest sex effect of any phenotype we measured (58%). This is most likely due to our relatively low power, given the expected small effects of each GxS QTL.

While the smaller numbers of main effects found with SP suggests that more interacting loci might exist, it does not invalidate the principal finding of the paucity of interacting loci and their small effect size, relative to main effect loci. For example, reducing the posterior probability threshold for SP results would not identify sufficient additional GxS effects to alter our conclusion that this set of loci makes

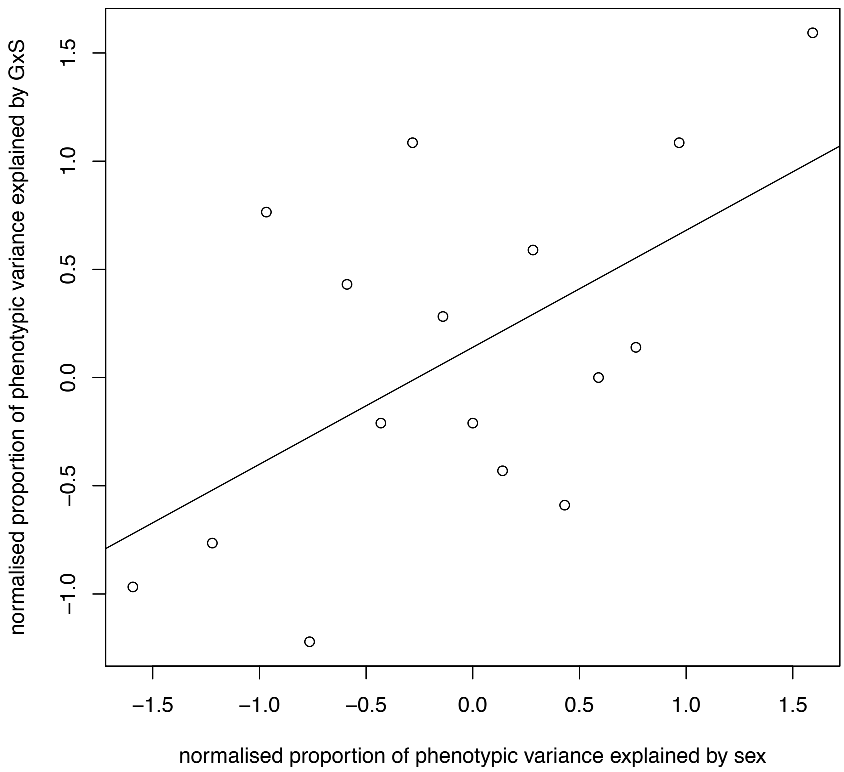


Figure 3.26: This plot is similar to Figure 3.15 except that the nearly-outlying data point representing faecal corticosterone (see Figure 3.25 has been removed. With it gone, there is a significant positive correlation between the proportion of phenotypic variance explained by sex and by GxS interaction effects, $p < .05$

only a small contribution to the total genetic variance (Figure 3.14).

The advantage of using SP is that it is less subject to the problem of multiple testing. Like other sparse Bayesian methods, SP allows for very complicated models defined by a very large number of parameters. It does this by assuming most parameters are zero (i.e., that most predictors do not influence the outcome either marginally or through interactions). This type of approach is particularly effective in situations where the number of predictors in a model greatly exceeds the sample size (the large p, small n problem introduced in §3.1.1). For GxG interactions, where a genome scan would involve testing pairwise interactions between thousands of loci, identifying significant effects would otherwise require extremely large sample sizes, too large to be feasible.

Finally, although it appears that first-order interactions contribute little to phenotypic variation beyond main effect QTL and other covariates, it is important to emphasise that this does not imply that they can be ignored. One example is the GxS interaction based at 21 Mbp on chromosome seven influencing adrenal gland weight. While GxS rarely make a large overall contribution to the missing heritability of phenotypes, there are cases where they will be individually important.

3.5.2 GxS QTL identified by Bagphenotype

As an alternative to the Bayesian Sparse Partitioning, I employed the frequentist Bagphenotype to identify 17 novel GxS QTL across 25 anxiety phenotypes. This rate of 0.7 QTL per anxiety phenotype is much lower than the number of QTL per phenotype that I found across all of the 90 phenotypes I examined: 2.3. This QTL frequency difference, as illustrated in Figures 3.17 and 3.18, is likely due to sex accounting for much more variability in physiological measures than behavioural phenotypes collected from the HS mice (Valdar et al., 2006a).

By following along the genome in Figures 3.19 and 3.20, one can visualise the value of running single-sex scans for genetic main effects and scans for GxS interactions, in this case for the phenotype of fine movement in a new home cage. For example, on the fourth chromosome, we see two lengthy unisex genetic main effect QTL adjacent to each other at 104.4 to 111.2 Mb (RMIP = .45) and 114.3 to 118.1 Mb (RMIP = .31). Through carrying out single-sex scans, however, we are proffered evidence that the first QTL is likely attributable only to male mice as, between 104 and 111 Mb, the female scan has low -log*P* values relative to the male scan and this range includes a male-only QTL from 104.4 to 105.3 Mb (RMIP = .94). Similarly, the second QTL appears attributable only to female mice, as between 114 and 118 Mb, the male scan has low -log*P* values relative to the females scan and this range has considerable overlap with a female-only QTL that runs from 116.6 to 118.7 Mb (RMIP = .47). Not only are these single-sex QTL stronger (in terms of RMIP values) despite having half the sample size of the unisex scans, which suggests they are better fits for the phenotype, but they are also smaller and contain fewer genes: a strikingly lower count of five genes as opposed to 77 within the first QTL, and 63 genes as opposed to 97 within the second QTL. These reduced gene counts should make identification of the causal gene(s) within the QTL easier, whether this is done by experiment with genetically-modified mice or by a computational method like SPIV (Chapter 5).

Across Figures 3.19 and 3.20, one can see instances where regions of the genome appear to be much more influential in one sex than in another, i.e., where the red (representing the female-only scan) and the blue (male-only scan) signals diverge. These regions are where one would expect to detect a GxS interaction and, at some loci, that is indeed what I find. For example, in one of these divergent regions on chromosome 14 just above 100 Mb, where males have a much higher -log*P* value than females, I identified a male-only QTL from 104.6 to 106.9 Mb (RMIP = .43) that contains a GxS interaction QTL from 105.9 to 106.7 Mb (RMIP = .66). This interaction QTL contains just six genes and presumably one of these affects fine movement in a new home cage, but to a greater extent (perhaps exclusively) in male mice. Similarly, as illustrated in detail in Figure 3.21, at the start of chromosome seven, I identified a female-only QTL from 3.7 to 10.7 Mb (RMIP = .25) that contains a GxS interaction QTL from 3.7 to 4.3 Mb (RMIP = .70). Given the near-zero -log*P* value in the male-only scan within this same range, it appears that one of the twelve genes between 3.7 and 4.3 Mb impacts this anxiety-related behavioural phenotype only in females. It is noteworthy that near the ranges of both of the examples in this paragraph, the standard, unisex genetic main effect scan did not pick up a QTL, indicating that GxS interaction scans and single-sex genetic main effect scans are useful for identifying QTL driven by a single sex, QTL that would otherwise have gone unnoticed.

There are a number of aspects of my GxS interaction project that merit further investigation. It might be informative to investigate whether related phenotypes (e.g., anxiety-related behavioural traits) have QTL in overlapping physical locations, which could lead to the identification of sex QTL hotspots, perhaps on the X chromosome. In order to get a handle on the relationship between a given phenotype and a sex QTL that predicts variance in it, it would also be interesting to see if the QTL can be explained by copy number variation or parent of origin effects. It might also be illuminating to examine whether related gene ontology annotation networks underlie multiple QTLs for a phenotype or combination of related phenotypes. In the next section, I compare the GxS QTL identified with Bagphenotype to those found with SP.

3.5.3 Gene-by-sex interactions in anxiety-related phenotypes

There are three key differences between the Sparse Partitioning and Bagphenotype. First, as I mentioned in the previous section, SP is Bayesian while Bagphenotype is frequentist. Second, SP starts with myriad possible predictors included in a model and then iteratively reduces the importance of the vast majority of these predictors to nil, retaining only the most important predictors. Bagphenotype, meanwhile, does the reverse: It starts with no genetic predictors and then gradually adds more until the addition of further predictors no longer contributes to the model. Finally, SP was configured to model main and interaction genetic effects simultaneously, while Bagphenotype was only used to model either main *or* interaction effects, never both at the same time.

As mentioned in §3.5.1 with respect to main effect QTL, one of the ways these methodological differences manifest themselves in the results is the relative paucity of QTL identified by SP relative to Bagphenotype. For GxS QTL, this frequency difference is extreme: While I identified 2.3 per phenotype with Bagphenotype, I only found 0.3 per phenotype with SP.

Of the 18 SP GxS QTL from across 66 phenotypes (Figure 3.10), five are for fear-related phenotypes; one for each of adrenal gland weight, faecal corticosterone levels, time freezing to few-associated context, time freezing to fear-associated cue, startle response, and number of boli produced in the open field test (OFT). The latter four of these are measures of fear-related behaviour and none of them is affected by the different ambulation rates between male and female mice, as many other fear-related phenotypes are (e.g., distance travelled in the OFT or in the arms of the elevated plus maze).

While neither the freeze time nor the OFT boli rate SP GxS QTL coincide with sex-related Bagphenotype QTL (Appendix C), the other three SP GxS QTL do. The startle response SP GxS QTL (posterior probability = .35) lies within a Bagphenotype QTL on chromosome 11 (116.5-121.5 Mbp; RMIP = 1.00) found only in male mice. The faecal corticosterone SP GxS QTL (PP = .23) lies within a Bagphenotype interaction QTL on chromosome 7 (25.7-26.1 Mbp; RMIP = .23), while the adrenal gland weight SP GxS QTL on chromosome 7 at 20.6 Mbp (PP = .29) lies near a Bagphenotype interaction QTL on the same chromosome at 17.2 to 17.5 Mbp (RMIP = .93). Given that corticosterone is produced by the adrenal glands to regulate the stress response, it seems unlikely to be a coincidence that these GxS QTL are within a few Mbp of each other on the mouse's seventh chromosome. Despite their biological association, adrenal gland weight and faecal corticosterone are not correlated (r = -.05, $t(430)$ = -1.0, p = .30) so this does not account for these QTL mapping to the same genomic location.

3.5.4 Gene-by-environment QTL

I identified 539 GxE QTL across 25 anxiety-related behavioural phenotypes that were collected from six experiments involving the Oxford HS mice. As Figure 3.22 summarises and Appendix D catalogues, the number of QTL found per phenotype-covariate pair varies greatly, with many environmental covariates not interacting with genetics to any appreciable extent for many of the phenotypes, while for other phenotypes, upwards of a dozen GxE QTL were located. For example, 67 gene-by-experimenter QTL were identified across the three behavioural phenotypes collected from the OFT (23.3 QTL/phenotype) and 128 gene-by-date QTL were found across the nine behavioural traits of the elevated plus maze (14.2 QTL/phenotype).

Figure 3.23 illustrates a particular instance of a gene-by-date interaction QTL for an elevated plus maze phenotype widely used to assess anxiety-related behaviours: distance travelled in the open arms of the maze. At this QTL on chromosome six from 17.7 to 17.9 Mb (RMIP = 1.0), I would expect that there would be a gene that influences open arm activity depending on some seasonal factor that was not controlled for in the Oxford HS mouse project, such as humidity. There are only five genes within the QTL, one of which — *Cappa2* — codes for a protein involved in muscle anabolism (Nigro et al., 1995), so that seems sensibly related to a movement-related phenotype like this one.

Figure 3.24 depicts an example of two gene-by-experimenter QTL for total activity of mice in the OFT on the tenth chromosome from 57.7 to 57.9 Mb (RMIP = .95) and 68.0 to 68.3 Mb (RMIP = .88). At both of these QTL, I would expect that there would be a gene that influences anxiety depending on some factor related to the experimenter, like aggressiveness. Ten genes underlie the 57 Mb peak the most interesting of which — *LIMS1* — codes for a protein that affects a growth factor-signalling pathway (Desgrosellier and Cheresh, 2010). Only one gene underlies the 68Mb peak. It codes for Transmembrane Protein 26, which is not well characterised.

As demonstrated by these three GxE examples, interaction QTL tend to have particularly short 95% CIs (mean for behavioural phenotypes of 0.4 Mb) relative to the main effect QTLs (mean of 3 Mb) identified by Valdar and colleagues (Valdar et al., 2006b) using the same data, meaning that — if the CI estimates are accurate — it should be easier in most instances to identify the causal gene within an interaction effect QTL than a main effect one simply because fewer genes are likely to be contained within the interaction variety.

The interacting covariates are simply placeholders for some other, unknown variables (e.g., aggressiveness of experimenter, variations in humidity by season), so the intent of my GxE analyses is in most cases not to uncover the specific factor that interact with genetics to affect anxiety-related behaviours, but rather to identify these interactions so that: (1) the most significant of them can be controlled for in the experimental design of future studies or incorporated as covariates into the statistical models of the study data; (2) researchers studying environmental effects can themselves design experiments to explicitly search for the specific environmental factor (e.g., aggressiveness, humidity) that is responsible; (3) investigators who find a QTL for genetic main effects can check with my database of GxE QTL as to whether a covariate they have not controlled for might be responsible for their finding. I have uploaded my QTL results to a publicly available, interactive QTL database (http://gscan.well.ox.ac.uk/gsBleadingEdge/wwwqtl.cgi) so that researchers can seek out whether a genomic region or phenotype they are interested in contains sex-specific genetic main effect QTLs, GxS interaction QTLs, or unisex main effect QTLs.

CHAPTER 4

GENE EXPRESSION NETWORKS

In this chapter, I use hippocampus gene expression data to generate networks of co-expressed genes, enabling a systems-level perspective of these vast biological data. I investigate whether the modules in these networks are enriched for gene ontology terms or markers of particular types of brain tissue. I also treat the modules as quantitative traits that I map to the genome and correlate with fear-related behaviours.

4.1 INTRODUCTION

By having genome-wide information about gene expression in the brain, as we do for the Heterogeneous Stock mice, we can look not only for the relationship of individual mRNA transcripts with other types of data (e.g., comparing gene expression with SNPs to identify eQTL), but we can also attempt to examine the transcriptome more holistically by identifying groups of mRNA transcripts that appear to vary in concert with each other. Such groups, or modules, of transcripts might have properties that provide a broader understanding of the molecular architecture underlying traits, including fear-related behaviours. These modules of co-expressed genes can then be studied in relationship to each other as part of a network of modules. Metrics that represent the modules can also be compared with other biological variables to see if the transcripts that make up those modules have a relationship with the biological system that only emerges when the transcripts are considered in aggregate.

Previous work with gene co-expression networks has identified modules of mRNA transcripts that are particular to the progressive neurodegenerative disorder Amyotrophic Lateral Sclerosis across blood samples from three separate patient-control data sets, and thereby illuminated the molecular pathways underpinning the disease (Saris et al., 2009). Similarly, separate brain tissue data sets have been used to elucidate aspects of the transcriptomic network associated with Alzheimer's disease (Miller et al., 2010). Using data from a total of more than a thousand microarrays, Jeremy Miller and his coworkers identified unexpected genes that appear to act as hubs in the Alzheimer's gene expression network; found a strong correlation between presenilin-1 (a gene already associated with Alzheimer's) and a module enriched for oligodendrocyte markers; and uncovered microglia-enriched modules that were also enriched for genes known to be related to neurodegenerative disease. Critical to my use of data from mice, Miller and colleagues also quantified a great deal of similarity between human and mouse brain transcriptomes.

To study network modules associated with fear-related behaviours, Christopher Park and his colleagues (Park et al., 2011) worked with one hundred mice, each from a different inbred strain from the Hybrid Mouse Diversity Panel (Ghazalpour et al., 2012). They obtained gene expression data from the hippocampus as well as measures of behaviour in context- (§2.2.1.4) and cue-dependent (§2.2.1.5) fear-conditioning tests similar to those used with the HS mice. Although they did not find any correlations between their hippocampus gene network modules and cue-conditioned fear, they did find significant correlations between context-conditioned fear and two modules, underscoring the importance of the hippocampus in regulating fear-related behaviour (Fanselow and LeDoux, 1999).

In this chapter, I chronicle several approaches I used to attempt to generate high-quality hippocampus gene co-expression networks, including removing population structure from the data, removing principal components, and working only with highly varying probes. Upon generating a satisfactory network, I sought gene ontology enrichments and mapped QTL for the network modules. I also did some work with eigengenes that represent the aggregate correlation of the modules. Akin to eigenvectors for any matrix of data, an eigengene for a given gene co-expression network module can be generated from its probes-by-animals matrix. There is evidence that the first eigengene of network modules is a biologically useful metric that represents consensus gene expression variation for the probes contained within the module (Langfelder and Horvath, 2007). With eigengenes, broad perspective transcriptomic relationships are thus summarised within a single vector, each unit of which represents an animal. In this chapter, I use eigengenes to look for relationships between hippocampus gene co-expression network modules and behavioural phenotypes, as well as to map module QTL.

4.2 Method

Prior to applying any of the methods described in the present section, I preprocessed the gene expression data following the protocol I developed and detailed in §2.6. Only HS mouse phenotypes related to hippocampus tissue were analysed in this chapter. A full description of these phenotypes is provided in §2.2.1, but for reference here, this includes measures of fear-related behaviour as well as KI-67, a marker of new neuron growth that has been associated with fear-related behaviour.

4.2.1 Generating gene co-expression networks

I generated gene co-expression networks from hippocampus gene expression data using Peter Langfelder and Steve Horvath's (2008) weighted gene co-expression network analysis (WGCNA) software package for Bioconductor (Gentleman et al., 2004) in R (Du et al., 2008). I carried this out three separate times: with data from males alone; from females alone; and with both sexes together, with sex regressed out. For each of the three data sets, I followed the same protocol.

Finding it impossible to generate meaningful gene co-expression networks when I used all of the hippocampus probes I retained during data preprocessing, I surmised that many of the 12 113 probes might be little more than noise. This is problematic because noise would obfuscate WGCNA's network generation algorithm as it attempts to group correlated probes. I expected that the probes with the most meaningful information above noise would be those with the highest variance. As exemplified by Figure 4.1, I set a threshold of $\log_{10} = -2.6$ (N.B. units have no practical meaning here) that included about half of the probes for each of the data sets, resulting in my inclusion of 6527 (53.9%) of probes for the both-sexes-together data, 6312 (52.1%) for the female data, and 6665 (55.0%) for the male data. The vari-

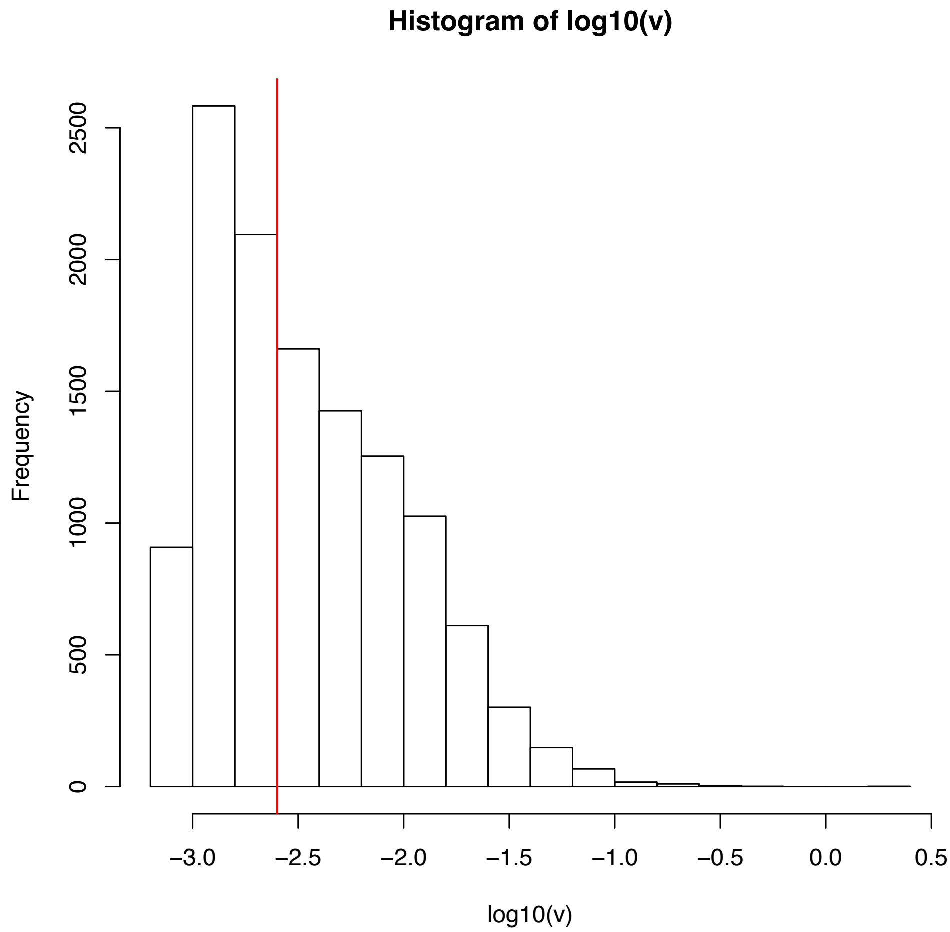


Figure 4.1: This is a histogram of the base 10 logarithm of the variance of the both-sexes-together hippocampus gene expression data. To reduce the proportion of noisy probes in the data, I only included the higher-variance probes, i.e., those above the threshold represented by the vertical red line at $\log_{10} = -2.6$, in network analysis. For the both-sexes-together data, this meant including 54% of the 12 113 hippocampus probes.

ance of probes in the both-sexes-together and the female-only data were very highly correlated, just as they were between the both-sexes-together and male-only data; in both cases, $p < 10^{-16}$.

To construct networks using WGCNA, the user needs to provide guidance to the software on a number of parameters. Perhaps the most important of these parameters is the “soft thresholding power”, β. A low β would result in network nodes (gene expression probes) having an enormous number of edges (connections between pairs of probes). A very high β would result in nodes having hardly any edges at all. Between these extremes lies a β that permits the network to have a "scale-free topology" (Barabási and Réka, 1999). In a network with a scale-free topology, whether one zooms in closely or observes it from a distance, the network will appear similar, analogous to Benôit Mandlebrot's (1975) fractals. In practice, this means that particular probes will be represented by nodes that are pivotal to the broader co-expression networks I generate, but there will be probes that act as regional hubs as well. Histograms of scale-free networks have a power law distribution: a few nodes have the bulk of the edges, most nodes have just a few edges, and there are a moderate number of nodes with a moderate number of edges.

Many biological networks, including gene co-expression networks, appear to have the scale-free property (Zhang and Horvath, 2005), thus I endeavoured to provide WGCNA with a β that enables the formation of a hippocampus gene expression network that is itself scale-free. Fitting a spectrum of candidate β values with a subset of the hippocampus data enabled me to determine the optimum beta, as evaluated by the scale independence and mean connectivity metrics illustrated in Figure 4.2. Using the method, I selected a β of four, five, and four for the both-sexes-together, female-only and male-only data, respectively. It is this β that gives weighted gene co-expression network analysis its "weighted" prefix. It is a weighting that provides relatively highly correlated pairs of genes with an exaggerated correlation in the network.

Beyond the β, there were a couple of other parameters I specified for WGCNA. I selected a minimum network module size of twenty probes. I also required any modules below a cluster dendrogram height of .25 to be merged together as these modules should be very highly correlated with each other. It does not appear that using alternatives to standard frequentist correlation, such as mutual information, in the WGCNA framework make much of a difference (Song et al., 2012), so I selected Pearson correlation for its computational efficiency.

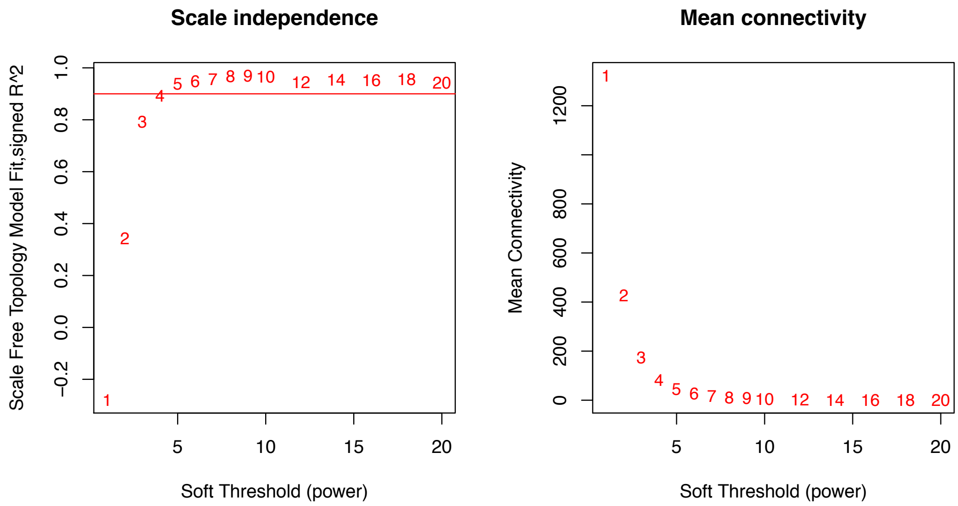


Figure 4.2: The two metrics I considered when selecting the soft threshold power (the β) for use in my gene co-expression networks were scale independence and mean connectivity. The plots shown here used the both-sexes-together hippocampus gene expression data. Using a subset of these data, I tested a range of candidate soft threshold powers from one to twenty. Following Zhang and Horvath (2005), I considered a scale-free topology model fit greater than 0.9 to generate a sufficiently scale-free network. Thus, as illustrated by the left-hand plot, a β of four is adequate. The right-hand plot illustrates the peril of selecting even a higher β than this. Although the networks have even better scale-free model fit, the average number of edges (connections) between nodes (gene expression probes) plummets rapidly toward zero, which would leave us with a network so sparse that it would not be at all informative.

4.2.2 Removing population structure from the gene expression data

As described earlier in §1.4.3, data from heterogeneous stock animals have a complex population structure that must be accounted for else spurious QTL may arise during GWAS. In my chapter on causality analysis (Chapter 5), multiple QTL analysis is employed to control for population structure in both phenotypic and gene expression data. In the present chapter, no QTL association analysis is taking place so it may be unnecessary to account for population structure, but I nevertheless examined how the networks differ when population structure is controlled for relative to when it is not.

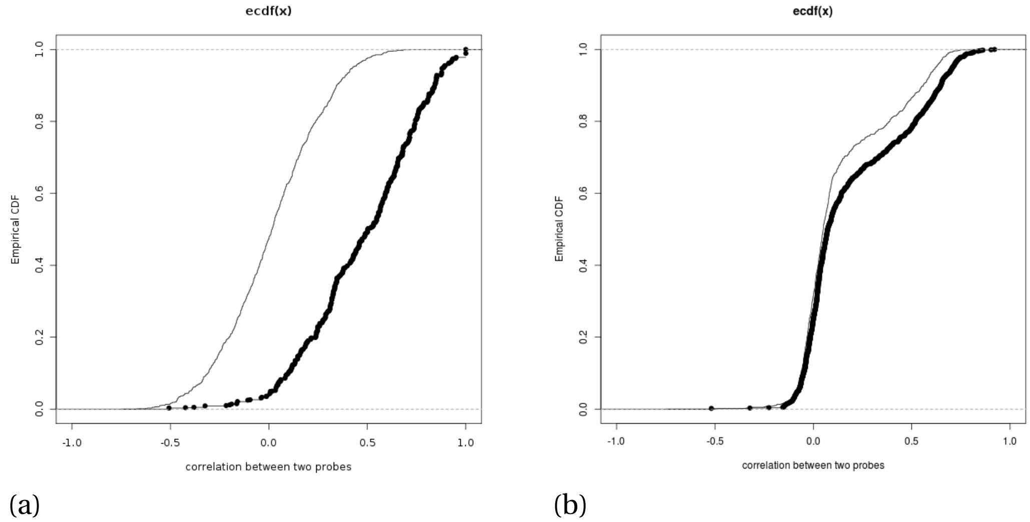


Figure 4.3: These plots are cumulative distribution functions of the correlation between pairs of gene expression probes from hippocampal tissue. In both plots, the thin curve represents the correlation between pairs of probes chosen at random, while the thicker curve represents the correlation between pairs of probes that map to the same gene. The area between the thin and thick curves is thus an indicator of the quantity of biological information present in the data. Plot (a) uses data prior to accounting for the population structure inherent in heterogeneous stock animals, and plot (b) uses data after. It appears clear that controlling for population structure removes an excess of biological information from the data, and this is reflected in the poor quality of the gene expression networks created using the data in plot (b); see Figure 4.4.

I employed EMMAX (Kang et al., 2010) to control for population structure in the gene expression data prior to network analysis. As explained in the captions of Figures 4.3 and 4.4, it appears that doing so removes an excessive proportion of meaningful biological information from the data, so I decided to only carry out gene expression network analysis with data that retained population structure.

4.2.3 Removing principal components from the gene expression data

Adjusting for population structure as just described was not the only means by which I attempted to reduce noise in the hippocampus gene expression data in or-

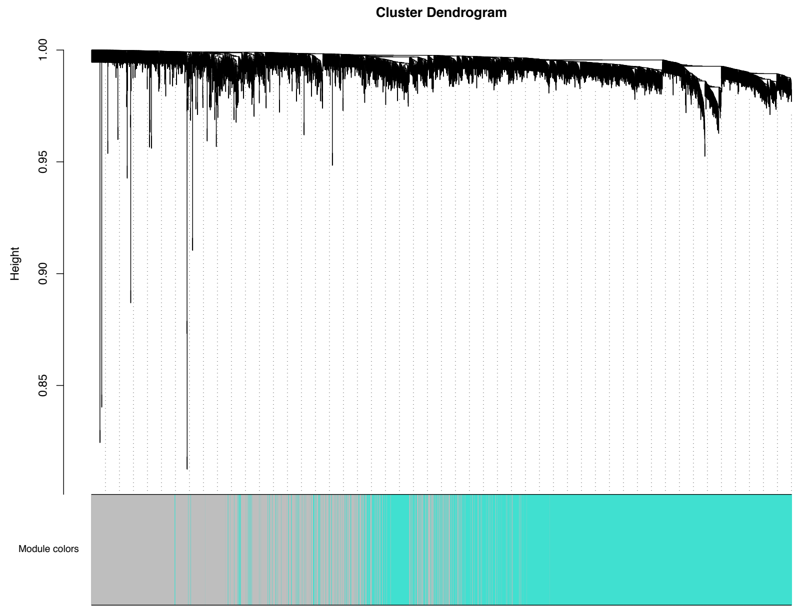


Figure 4.4: This style of figure is the most common method I use to visualise gene expression networks throughout this chapter. The top section of the plot is a cluster dendrogram with vertical black lines each representing a gene expression probe in the data set. Probes that are co-expressed are clustered together and connected to all the other probes in the network by horizontal lines. A set of probes that are highly co-expressed to each other, but not co-expressed with probes from outside the set, form distinct clusters. Based on thresholds that I set (see §4.2.1), the network modelling software assigns the probes to modules, which are represented by distinct colours along the bottom of the figure. In this instance of hippocampus gene expression data, where population structure has been accounted for, only one module was defined, and it is shown in teal (grey was used for probes that were not assigned to any particular module). This sparse network structure can be explained by the apparent removal of biological information that resulted from accounting for population structure (see Figure 4.3).

der to increase the number of distinct gene co-expression networks in the data. With the same goal in mind, I also tried removing principal components. My reasoning was that principal components might largely represent confounding variables. By identifying a version of the data that has more biological information (exemplified by cis-eQTL) through principal component removal, some noise might be removed from the data, thereby improving network analysis results.

Figure 4.5 shows the number of cis-eQTL I identified on the first chromosome, depending on how many principal components I regressed out of the hippocampus gene expression data. The plot shows that removing about 16 principal components produces data with the greatest number of cis-eQTL (27007 of them). Using these data to produce networks, however, was nevertheless ineffective, as the cluster dendrogram in Figure 4.6 demonstrates. Given these poor results, I decided to carry out all further network analysis using gene expression data that had neither been adjusted for population structure nor had principal components regressed out of it.

4.2.4 Gene ontology enrichment

Gene ontology (GO) enrichment for network modules was assessed using GOEAST (Zheng and Wang, 2008). Within GOEAST's interface, I used Fisher's exact test to assess whether GO terms were enriched in any of the hippocampus gene co-expression network modules. More specifically, the test was used to determine whether a given module had significantly more probes associated with a given GO term than would be expected by chance.

Instead of using GOEAST's existing GO term database for the particular Illumina gene expression array that we used (with 47k probes; see §2.5), I used GO terms for the specific subset of 12 113 hippocampus probes that I retained after applying a series of quality control filters (§2.6.4). This step was essential because the GO term reference data set would otherwise have consisted of GO term counts for both retained and excluded probes, distorting GO enrichment results if GO terms differ systematically between probes that were retained relative to those that were not. I obtained GO terms for my retained subset of probes from Ensembl Biomart (Kinsella et al., 2011) on October 24th, 2012.

With so many GO enrichment tests to carry out (31408 in total across eleven

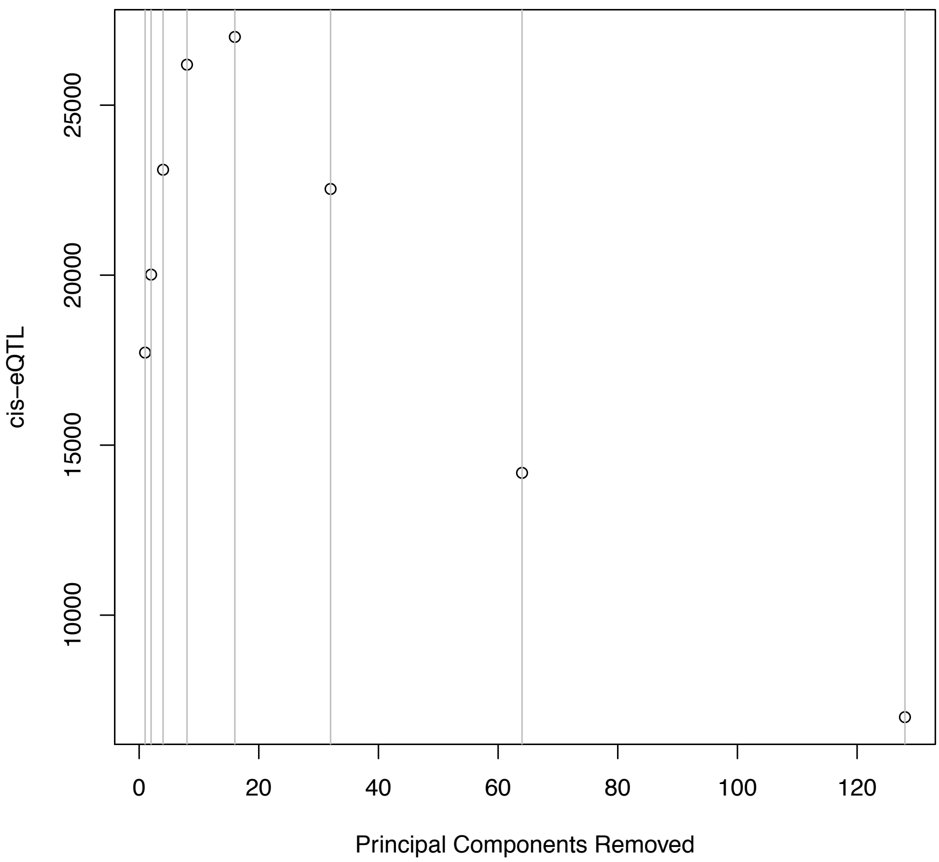


Figure 4.5: The number of cis-eQTL on chromosome one using hippocampus gene expression data are a function of the number of principal components removed from the data. I removed one to 128 principal components from the data, moving up incrementally by powers of two. Removing sixteen principal components produced data with the most cis-eQTL. Reasoning that these data may have more biological signal relative to confounding noise, I attempted to produce a gene co-expression network; see Figure 4.6.

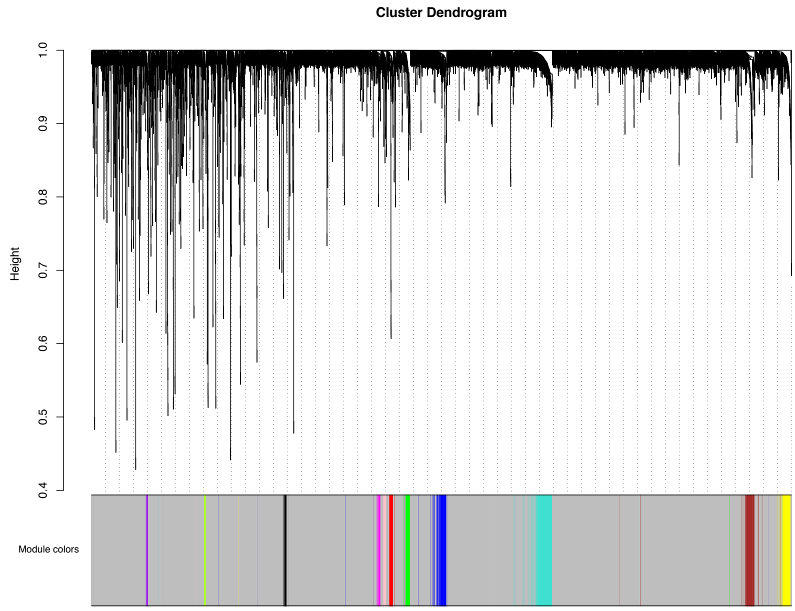


Figure 4.6: Hippocampus gene co-expression network generated from data with 16 principal components removed. Nearly all probes end up very highly correlated with each other, making it difficult to distinguish distinct clusters of co-expressed probes.

modules), adjusting for multiple comparisons would have yielded an excessively strict p-value of, by Bonferroni correction for example, 1.6×10^{-6}. Instead, given that this is a largely exploratory analytical tool, I chose to display any GO terms that were enriched below a $p = .001$ threshold.

4.2.5 Module QTL mapping

The first eigengene for each gene co-expression network module was considered as representative of the module and used as a phenotype for mapping module QTL. Bagphenotype (Valdar et al., 2009) was employed for main effect QTL mapping by resample model averaging, as in §3.3.1. Namely, I used Build 37 of the mouse genome, one hundred independent resamplings of the data (each using 80% of animals, sampled without replacement), and one hundred permutations of the data to determine significant peaks. Unlike in Chapter 3, I did not include any covariates in the models here: Sex was regressed out of the data and other covariates — such as batch effects, animal weight and environmental measures — were already

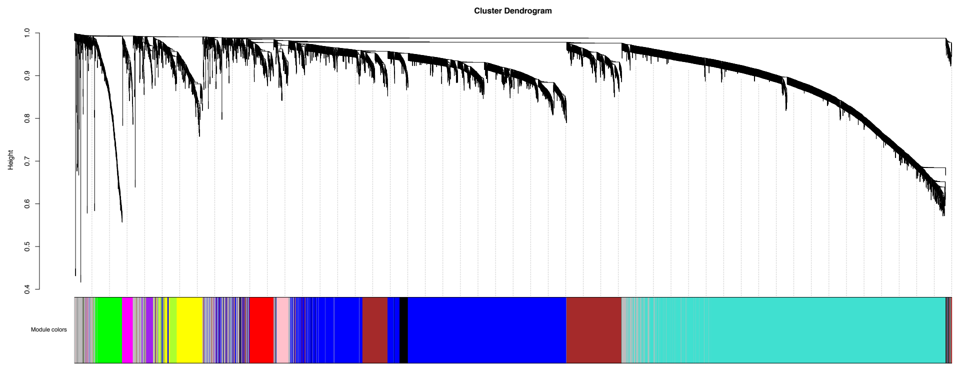


Figure 4.7: This cluster dendrogram is identical in style to Figure 4.4 (where a more detailed description of the figure format is given). The top of the plot shows the broad connectivity of the hippocampus gene expression probes, while the bottom shows the modules that probes were assigned to, as represented by colours. Data from both males and females were used to generate the data for this network.

accounted for during gene expression data preprocessing (§2.6).

4.3 Results

Gene co-expression networks, summarised by cluster dendrograms, are provided using data from both sexes of mice, female mice only and males only, respectively, in Figures 4.7, 4.8, and 4.9. Note how the three dendrograms are remarkably similar. In the next section (§4.3.1), I explore in more detail the effects of sex on these hippocampus data.

4.3.1 Sex and the hippocampus gene expression networks

Although some tissues appear to have strong sex effects in their gene expression data, sex does not appear to manifest itself substantially in the hippocampus gene expression data, as demonstrated by three separate analytical perspectives. First, sex is not correlated with any of the top principal components for hippocampus like it is for liver (see §2.6.8, particularly Figure 2.21). Second, there is a remarkable degree of similarity in module membership between the both-sexes-together, male and female modules identified using WGCNA (see Figures 4.10, 4.12, 4.13). And, third, the eigengenes of comparable modules between the both-sexes-together data

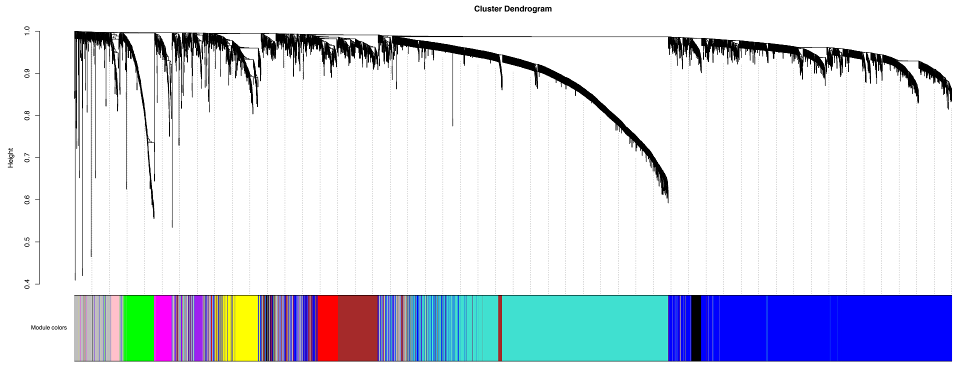


Figure 4.8: The network represented by this cluster dendrogram was generated using hippocampus gene expression probes from female mice only.

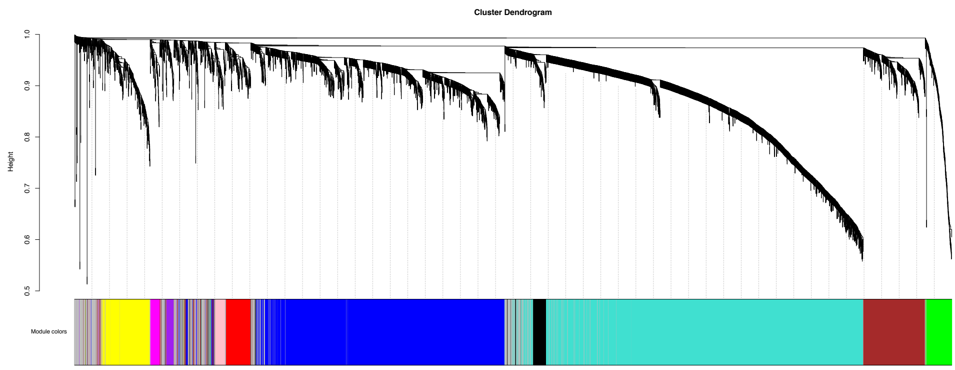


Figure 4.9: The network represented by this cluster dendrogram was generated using hippocampus gene expression probes from male mice only.

and the single-sex data are very highly correlated with each other (see heat maps of correlations in Figures 4.14 and 4.15; testing eigengene correlations between the male and female data was not possible because there is no overlap in subjects between these two data sets).

Given the striking similarity between comparable modules across all three data sets, any further analyses involving gene expression networks will employ only the both-sexes-together data. Appendix E rather heftily details the both-sexes-together module designations for all 6527 hippocampus probes included in gene co-expression network analysis.

Module for **both-sexes-together** hippocampus probes (# of probes in module)	Module for **male-only** hippocampus probes (# of probes in module)									
	turquoise (2453)	blue (1877)	brown (563)	yellow (359)	green (194)	red (189)	black (144)	pink (76)	magenta (75)	purple (68)
turquoise (2248)	2162/2248 (96%) $p < .00001$									
blue (1863)		1601/1863 (86%) $p < .00001$								
brown (687)			446/563 (79%) $p < .00001$							
yellow (243)				233/243 (96%) $p < .00001$						
green (203)					184/194 (95%) $p < .00001$					
red (180)						155/180 (86%) $p < .00001$				
black (105)							86/105 (82%) $p < .00001$			
pink (94)								67/76 (88%) $p < .00001$		
magenta (87)									70/75 (93%) $p < .00001$	
purple (79)				67/79 (85%) $p < .00001$						
greenyellow (65)										52/65 (80%) $p < .00001$

Figure 4.10: Overlap of both-sexes-together and male-only gene co-expression modules as assessed by a permutation test (overlaps below Bonferroni-corrected p-value threshold of .0004 shown; median p-value of .9966). The permutation test simply involved shuffling probe module membership at random ten thousand times to assess how likely the proportion of overlap between the real modules would be by chance. Figure 4.11 displays the clear difference between module overlaps that were found to be significant relative to those that were not significant.

4.3.2 Gene ontology enrichment

The top thirty (i.e., lowest p-value) GO term enrichments are provided in Figure 4.16. Only the top two are significant after correcting for multiple (31408) comparisons. Details of significant GO term enrichments are provided in Appendix F.

For all of the top thirty GO terms listed in Figure 4.16, I used GOEAST (Zheng and Wang, 2008) to produce directed acyclic graphs that illustrate their relationships to other hierarchically-associated GO terms. Ordered by the highest-ranked GO terms in Figure 4.16 they contain, these figures represent cellular component terms for the brown module (Figure 4.17); cellular component (Figure 4.18), molecular function (Figure 4.19), and biological process terms (Figure 4.20) for the magenta module; cellular component terms for the pink module (4.21); molecular function terms for the yellow module (4.22); biological process terms for the purple (4.23) and greenyellow modules (4.24); molecular function terms for pink (4.25); and cellular component terms for red (4.26). There was rather a lot of information to fit into some of these figures, so it may be challenging to read some of them in physical thesis copies, but the electronic (.pdf) version is zoomable.

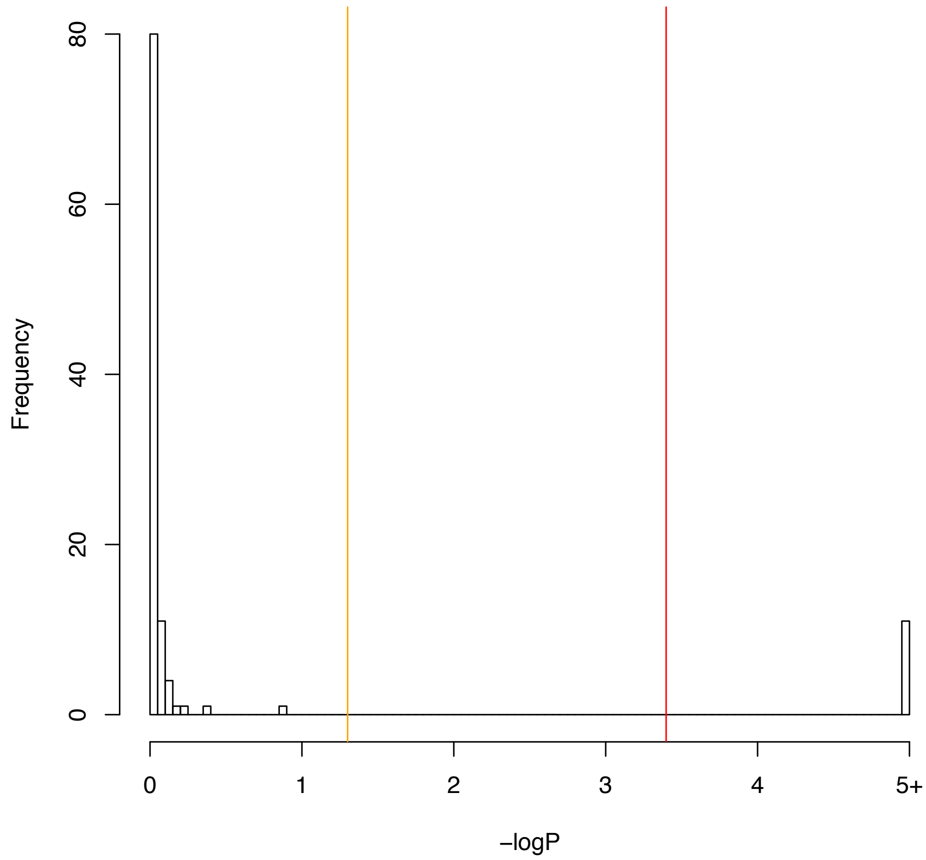


Figure 4.11: This is a histogram of p-values from the module overlap permutation test comparing modules generated from the both-sexes-together and the male-only hippocampus gene expression data. The yellow vertical line demarcates a p value of .05, while the red vertical line demarcates p = .0004, the Bonferroni-corrected significance threshold for 110 module comparisons (ten both-sexes-together modules multiplied by eleven male-only modules). There was a median p-value of .9966 across these 110 tests, an unsurprising statistic given the peak at the left of the histogram. The significant tests are well clear of the Bonferroni corrected threshold and represented by the peak on the far right.

Module for **both-sexes-together** hippocampus probes (# of probes in module)	Module for **female-only** hippocampus probes (# of probes in module)									
	turquoise (2330)	blue (1749)	brown (529)	yellow (294)	green (220)	red (162)	black (131)	pink (104)	magenta (72)	purple (64)
turquoise (2248)		1690/1749 (97%) $p < .00001$								
blue (1863)	1724/1863 (93%) $p < .00001$									
brown (687)			352/529 (67%) $p < .00001$							
yellow (243)				205/243 (84%) $p < .00001$						
green (203)					182/203 (90%) $p < .00001$					
red (180)						110/162 (68%) $p < .00001$				
black (105)								68/104 (65%) $p < .00001$		
pink (94)										50/64 (78%) $p < .00001$
magenta (87)							82/87 (94%) $p < .00001$			
purple (79)				67/79 (85%) $p < .00001$						
greenyellow (65)									46/65 (71%) $p < .00001$	

Figure 4.12: Overlap of both-sexes-together and female-only gene co-expression modules as assessed by a permutation test (overlaps below Bonferroni-corrected p-value threshold of .0004 shown; median p-value of .9910)

Module for **male-only** hippocampus probes (# of probes in module)	Module for **female-only** hippocampus probes (# of probes in module)									
	blue (2330)	turquoise (1749)	brown (529)	yellow (294)	green (220)	red (162)	magenta (131)	black (104)	purple (72)	pink (64)
turquoise (2453)		1652/1749 (94%) $p < .00001$								
blue (1877)	1668/1877 (89%) $p < .00001$									
brown (563)			302/529 (57%) $p < .00001$							
yellow (359)				261/294 (89%) $p < .00001$						
green (194)					164/194 (85%) $p < .00001$					
red (189)						103/162 (64%) $p < .00001$				
black (144)								79/104 (76%) $p < .00001$		
pink (76)										47/64 (73%) $p < .00001$
magenta (75)							70/75 (93%) $p < .00001$			
purple (68)									42/68 (62%) $p < .00001$	

Figure 4.13: Overlap of male-only and female-only gene co-expression modules as assessed by a permutation test (overlaps below Bonferroni-corrected p-value threshold of .0005 shown; median p-value of .9918)

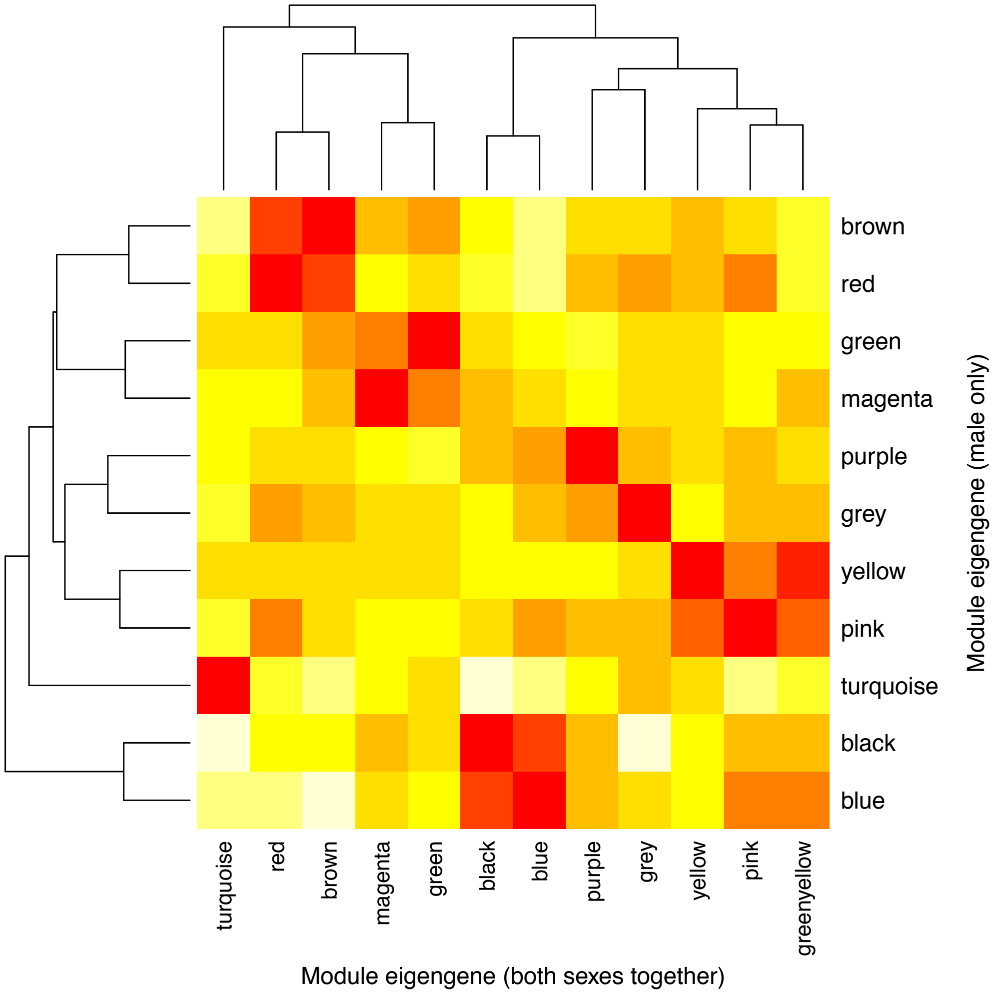


Figure 4.14: Heat map of the correlation hippocampus gene expression modules from the both-sexes-together and male-only data. Cluster dendrograms group the most correlated from each data set together. More highly correlated phenotypes and eigengenes are represented by warmer colours on the heat map. A table of all significant correlations is provided in Figure 4.10.

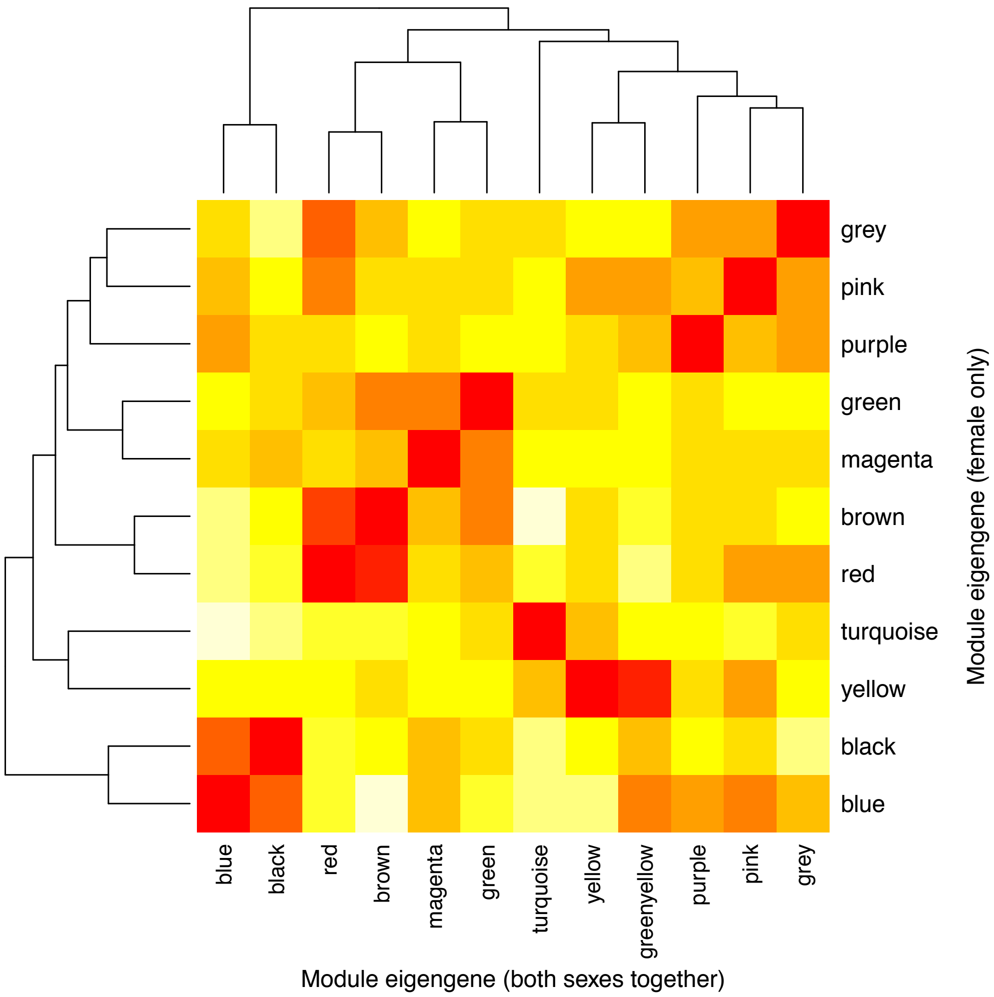


Figure 4.15: Similar to the correlation heatmap in Figure 4.14, except using female-only modules instead of those from males. A table of significant correlations is provided in Figure 4.12.

Module	GOID	Ontology	Term	p-value
brown	0044455	cellular component	mitochondrial membrane part	7.01E-07*
magenta	0043209	cellular component	myelin sheath	1.03E-06*
magenta	0043218	cellular component	compact myelin	8.59E-06
magenta	0019911	molecular function	structural constituent of myelin sheath	8.59E-06
magenta	0007272	biological process	ensheathment of neurons	1.17E-05
magenta	0008366	biological process	axon ensheathment	1.17E-05
pink	0033179	cellular component	proton-transporting V-type ATPase, V0 domain	1.73E-05
magenta	0019228	biological process	regulation of action potential in neuron	2.06E-05
magenta	0044304	cellular component	main axon	3.86E-05
pink	0044456	cellular component	synapse part	4.02E-05
yellow	0003676	molecular function	nucleic acid binding	4.47E-05
magenta	0005886	cellular component	plasma membrane	5.39E-05
purple	0032501	biological process	multicellular organismal process	6.81E-05
magenta	0001508	biological process	regulation of action potential	8.35E-05
greenyellow	0034109	biological process	homotypic cell-cell adhesion	8.83E-05
magenta	0071944	cellular component	cell periphery	0.000101
magenta	0042552	biological process	myelination	0.000109
pink	0044463	cellular component	cell projection part	0.000116
pink	0008021	cellular component	synaptic vesicle	0.000117
magenta	0042805	molecular function	actinin binding	0.000117
magenta	0051393	molecular function	alpha-actinin binding	0.000117
pink	0043005	cellular component	neuron projection	0.000120
greenyellow	0009653	biological process	anatomical structure morphogenesis	0.000129
pink	0000166	molecular function	nucleotide binding	0.000144
magenta	0016020	cellular component	membrane	0.000148
pink	0033176	cellular component	proton-transporting V-type ATPase complex	0.000155
pink	0033177	cellular component	proton-transporting two-sector ATPase complex...	0.000155
pink	0045202	cellular component	synapse	0.000192
red	0030017	cellular component	sarcomere	0.000197
brown	0005739	cellular component	mitochondrion	0.000200

Figure 4.16: This is a table of the top thirty Gene Ontology term enrichments across the 11 gene co-expression modules obtained using WGCNA, ranked according to p-values I calculated with Fisher's exact test. Only the top two terms pass the 1.6×10^{-6} p-value threshold ascertained by Bonferroni-correcting for 31408 hypothesis tests. Any GO terms that passed a more liberal threshold of $p < .001$ are provided in Appendix F, where they are sorted by module name for convenience.

In each directed acyclic graph, yellow nodes (boxes) indicate GO terms that are significantly enriched in a given module at a p-value threshold of .001. The darker the yellow, the lower the p-value. White nodes contain insignificant GO terms that link the significant ones to the highest-ranked GO terms in a given graph, which is always either "cellular component", "biological process" or "molecular function". Edges (arrows) are directed toward hierarchically lower GO terms. Red edges connect significant nodes, hatched black edges connect insignificant nodes, and solid black edges connect significant nodes to insignificant ones.

Within each node, there are several statistics. All nodes display the GO term and its reference number. Significant nodes also display details of Fisher's exact test for a given GO term and module. For example, Figure 4.22 illustrates one significant node, the only molecular function GO term for the yellow module with $p < .001$. The "nucleic acid binding" term (reference GO:0003676) was associated with 61 of the 243 probes in the yellow module and with 983 of the 6527 probes in the whole data set. Fisher's exact test indicates that, given this rate of occurrence of "nucleic acid binding" in the whole data set, the GO term is significantly enriched in the yellow module, $p = 4.47 \times 10^{-5}$. These figures are displayed in each significant node in the following format: "61/243 | 983/6527 (4.47e-5)".

The p-value threshold for displaying results was .001. One hundred and one GO term-module pairs surpassed this threshold. With a total of 31408 GO enrichment tests carried out across the eleven modules, a .05 significance threshold is Bonferroni-corrected to a very low 1.6×10^{-6}. Only two terms surpass this strict threshold: "mitochondrial membrane part" for the brown module ($p = 7 \times 10^{-7}$) and "myelin sheath" ($p = 1 \times 10^{-6}$) for the magneta module.

4.3.3 Module QTL mapping

I used Bagphenotype to map QTL for the eleven hippocampus gene co-expression network modules. I set Bagphenotype to carry out 100 resampled scans (each using data from 80% of the animals) per module. The number of resampled scans that a given QTL is included in is referred to as an RMIP. According to simulations (Valdar et al., 2006b), using an RMIP threshold of .25 (i.e., the QTL was included in at least 25 of 100 resamples) we should expect one false positive QTL for every four phenotypes mapped. Two QTL (for blue, with RMIP = .57; yellow with RMIP = .32) were above this threshold and one was a close call (black with RMIP = .24). The significant QTL are shown above the RMIP = .25 threshold in the histogram at Figure 4.27, whilst all QTL with .01 < RMIP < .24 are shown below it. Specifics of the significant QTL (and the close call), including genomic location, are provided in the table at Figure 4.28.

4.3.4 Network module relationship to phenotypes

Figure 4.29 uses a heat map to illustrate the correlations between hippocampus gene expression modules and the hippocampus-relevant HS mouse phenotypes. As summarised in the table in Figure 4.30, ten of these correlations had a p-value below .05. Adjusting for 160 comparisons by Bonferroni correction to a threshold of .0003, none of these correlations is significant.

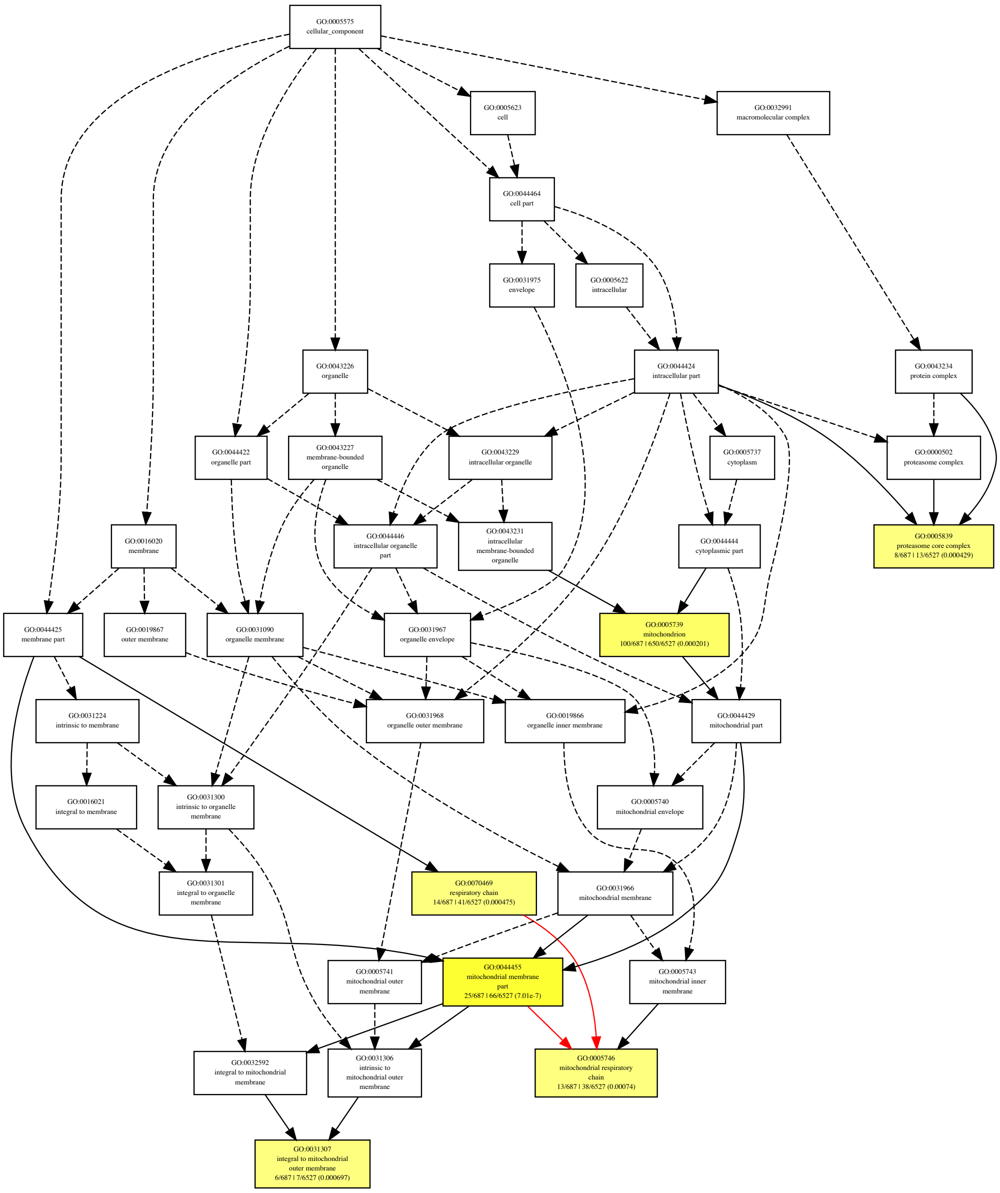


Figure 4.17: Cellular component GO terms associated with the brown module. Yellow nodes indicate GO terms that are significantly enriched in a given module at a p-value threshold of .001. The darker the yellow, the lower the p-value.

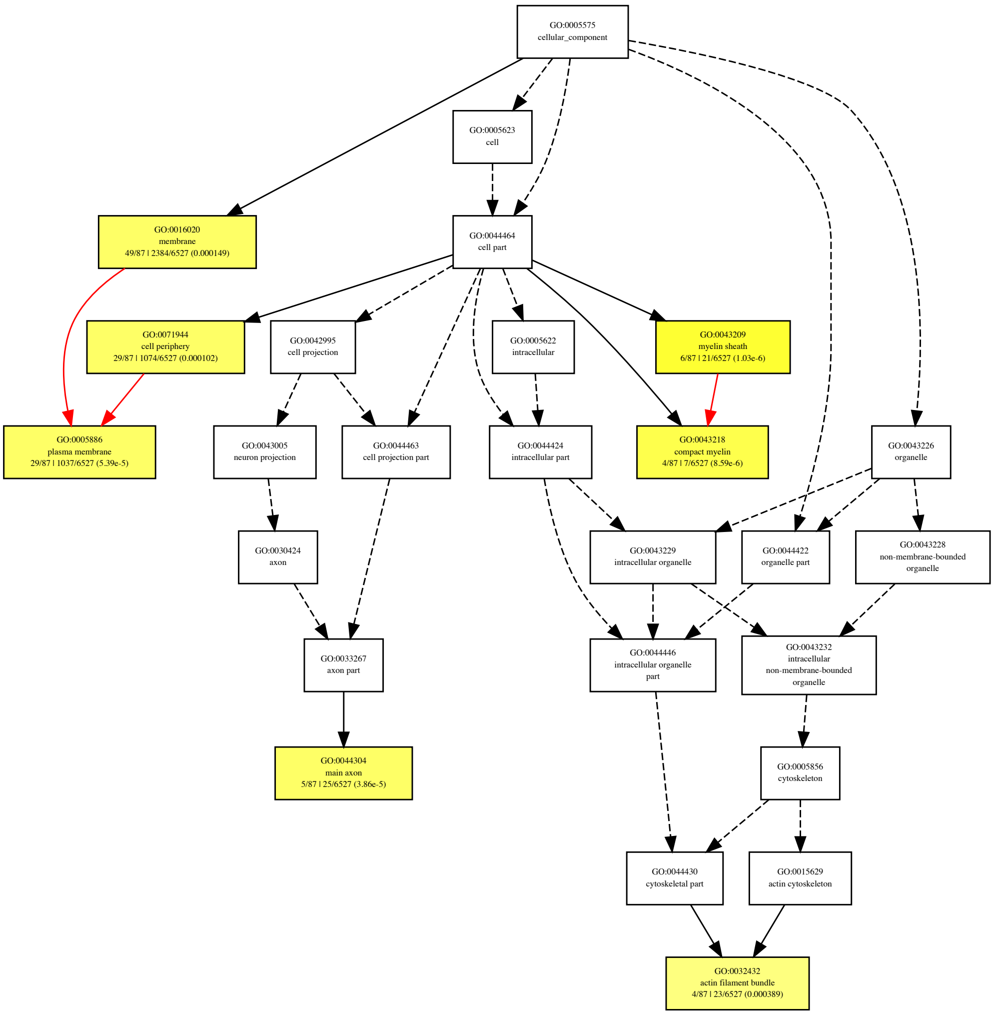


Figure 4.18: Cellular component GO terms associated with the magenta module

4.3.5 Markers for nervous system cells in network modules

I looked for enrichment of particular cell types — astrocytes, oligodendrocytes and neurons — within the hippocampus modules by cross-referencing the genetic markers for these cells provided by Oldham and colleagues (2008) with the genes mapped to by probes within the modules. Figure 4.31 is a table of the marker genes listed by Oldham and coworkers, with any probes that map uniquely to those genes, and the module that the probe was assigned to. The magenta module is enriched for oligodendrocyte-associated probes, $p = 1.0 \times 10^{-13}$ according to Fisher's exact test. None of the other cell types were enriched in any of the modules. The next strongest

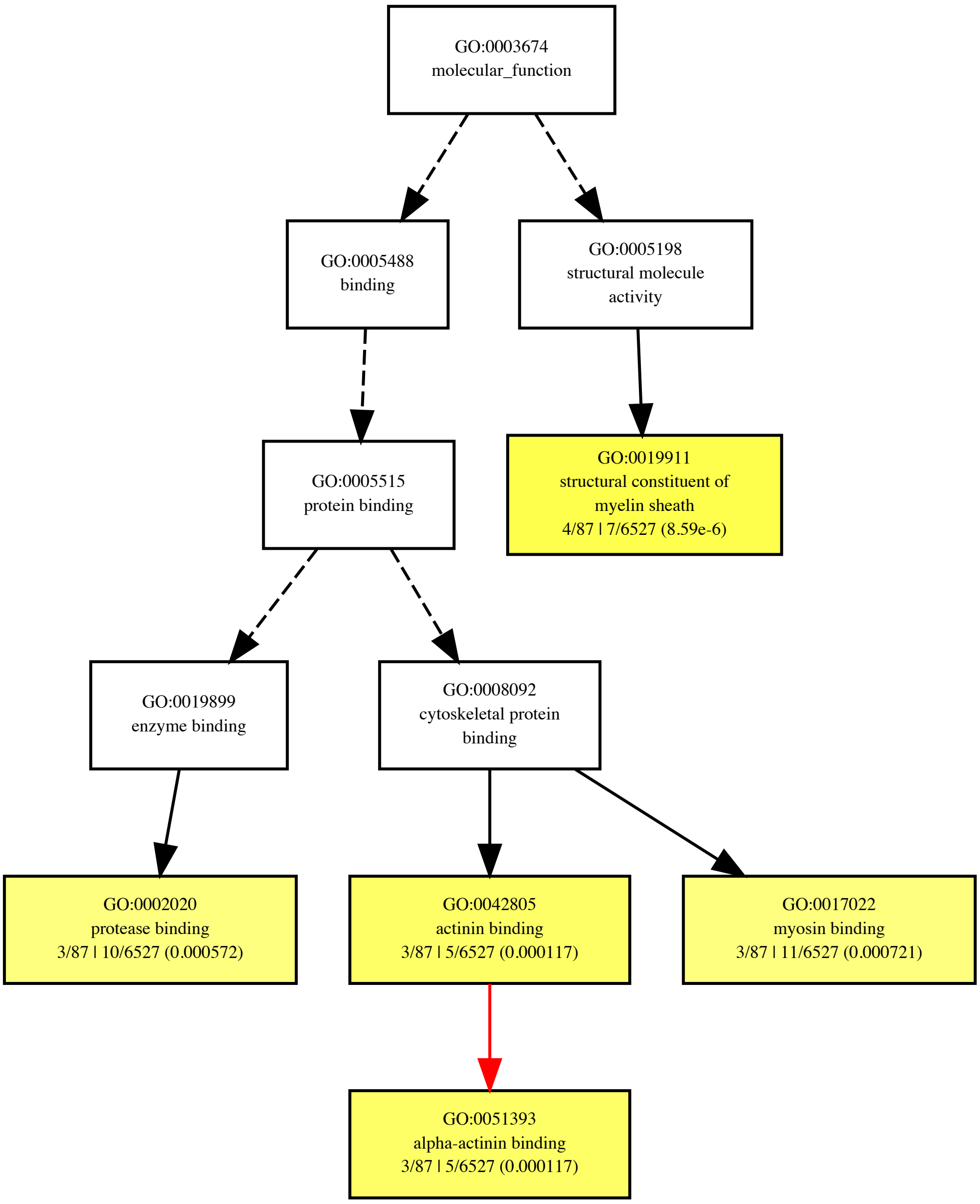


Figure 4.19: Molecular function GO terms associated with the magenta module

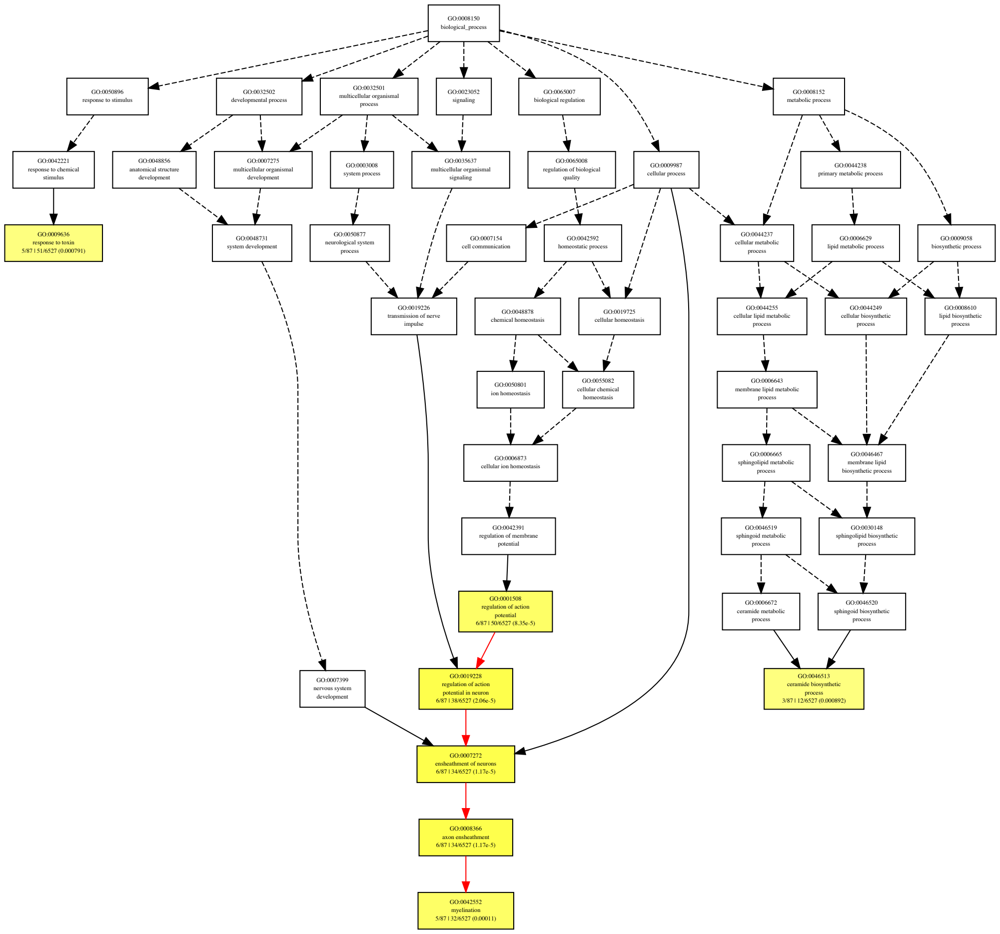


Figure 4.20: Biological process GO terms associated with the magenta module

pairing was the turquoise module with neuron-associated probes with $p = .35$.

4.4 Discussion

Using gene expression data from the hippocampus, I sought to identify modules of co-expressed genes and to characterise these with respect to fear-related behaviours. Unlike in the previous section (§3.5), sex surprisingly appears to have little relevance to the hippocampus data. Sex was not related to the top principal components of the hippocampus data as it was for liver (§2.6.8), gene co-expression module membership was nearly the same whether data from both sexes or just one were fit into networks (Figures 4.10 to 4.13), and single-sex modules were highly cor-

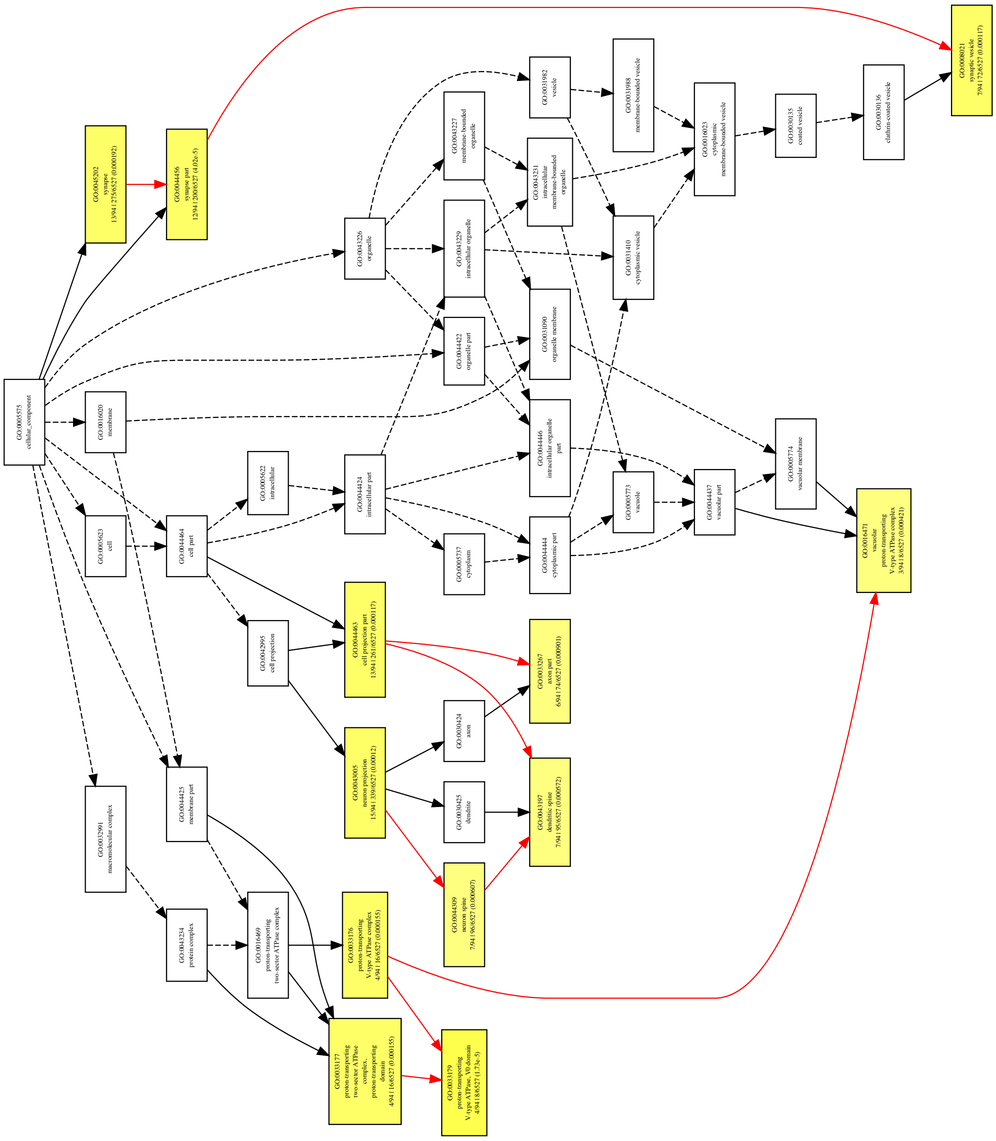


Figure 4.21: Cellular component GO terms associated with the pink module

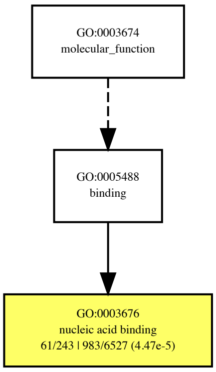


Figure 4.22: Molecular function GO terms associated with the yellow module

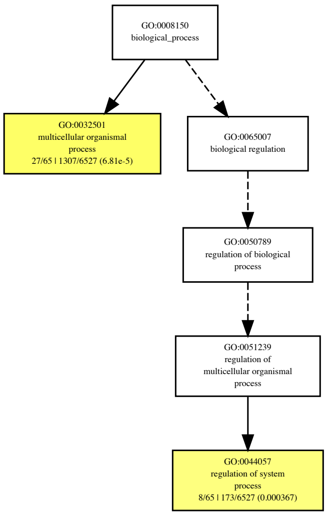


Figure 4.23: Biological process GO terms associated with the purple module

related with their both-sexes-together equivalents (Figures 4.14 and 4.15). As such, the present section of this thesis focuses only on data comprising both sexes simultaneously.

Two of the eleven modules of co-expressed hippocampus genes (Figure 4.7) were enriched in particularly interesting ways — the magenta module and the pink module. The magenta module was very significantly enriched for genes whose expression are markers of oligodendrocytes (§4.3.5), which are cells of the central nervous system that facilitate rapid signal transmission through the axons of neurons by providing them with myelin sheathes. Abnormalities in oligodendrocyte-

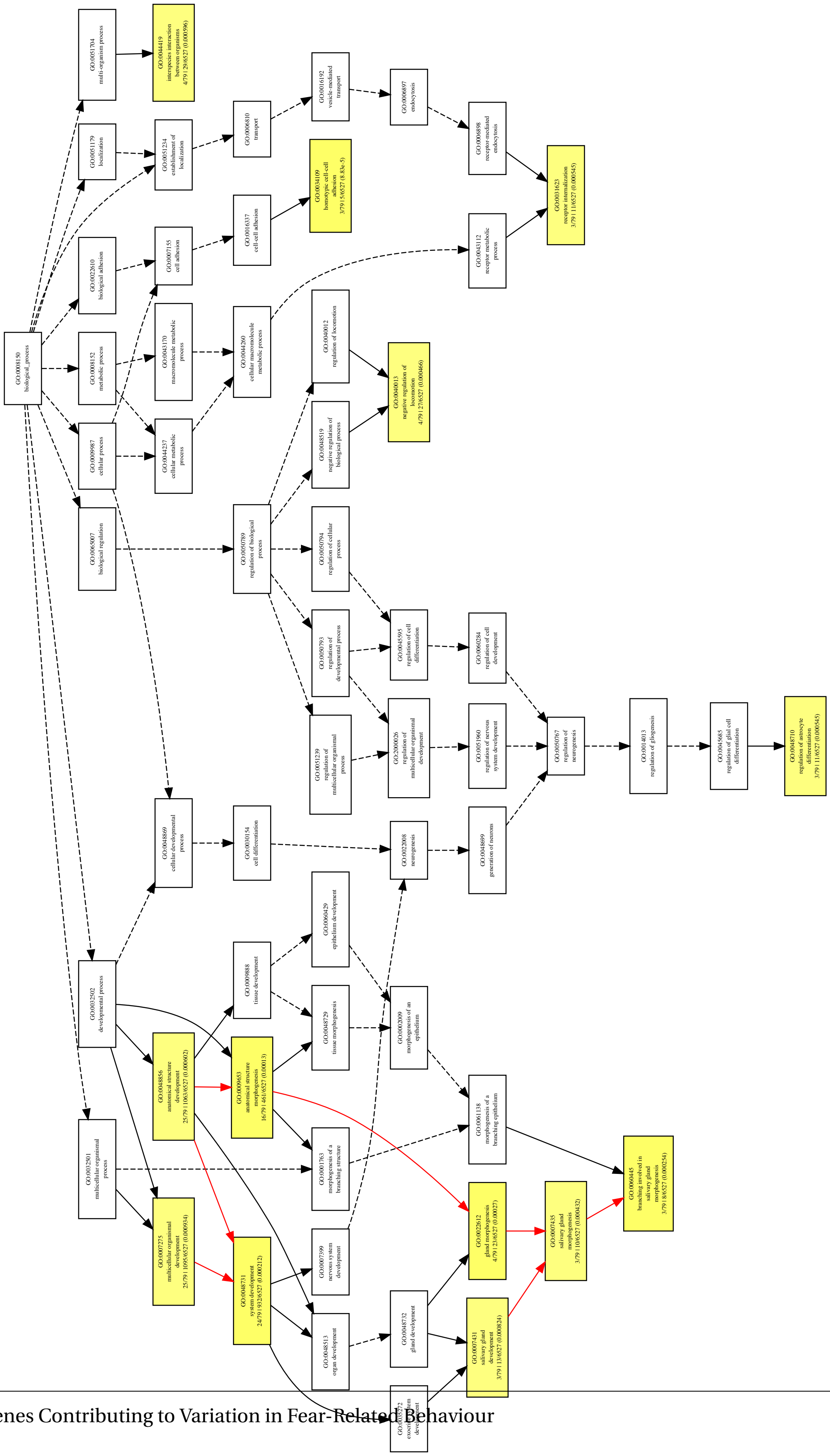


Figure 4.24: Biological process GO terms associated with the greenyellow module

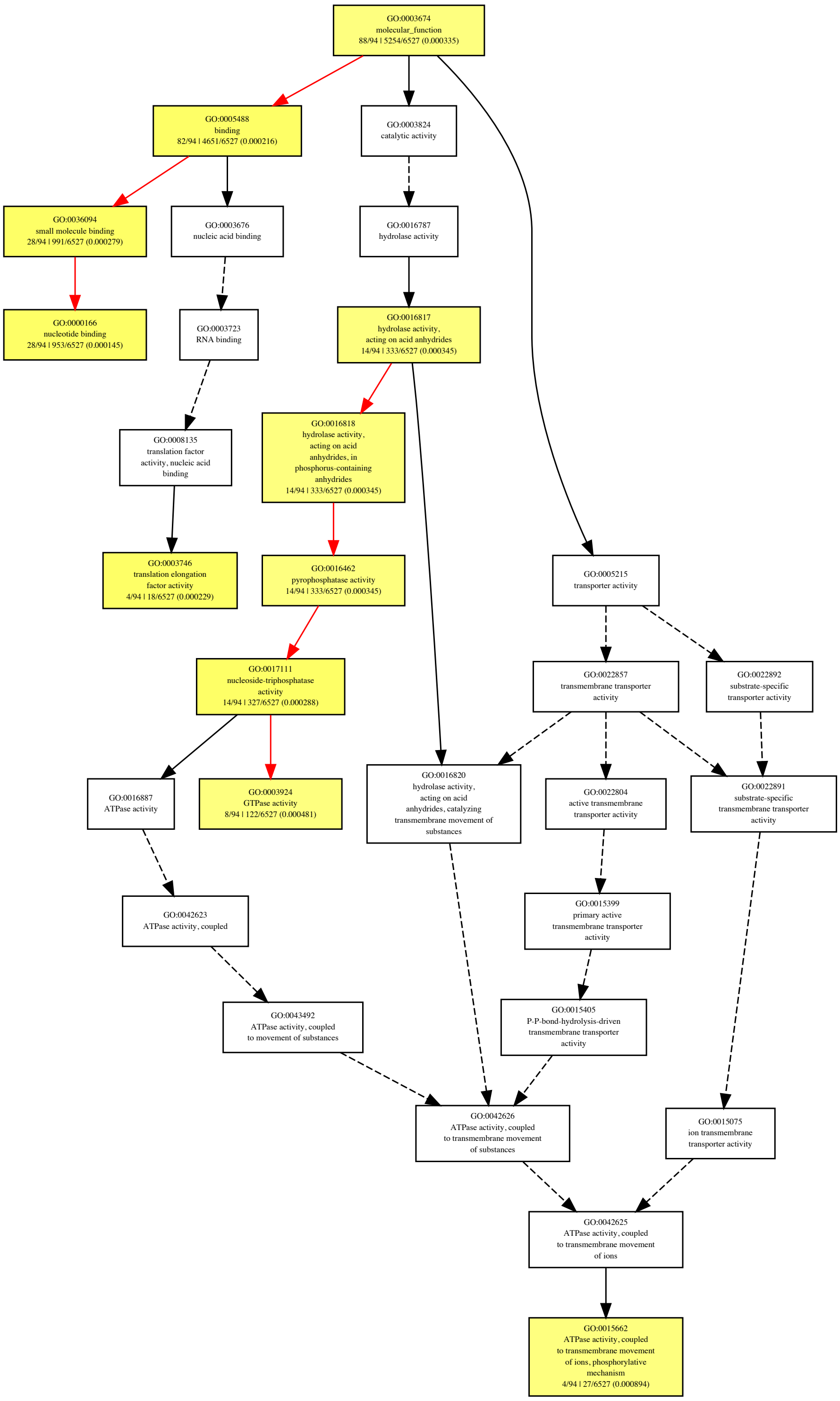


Figure 4.25: Molecular function GO terms associated with the pink module

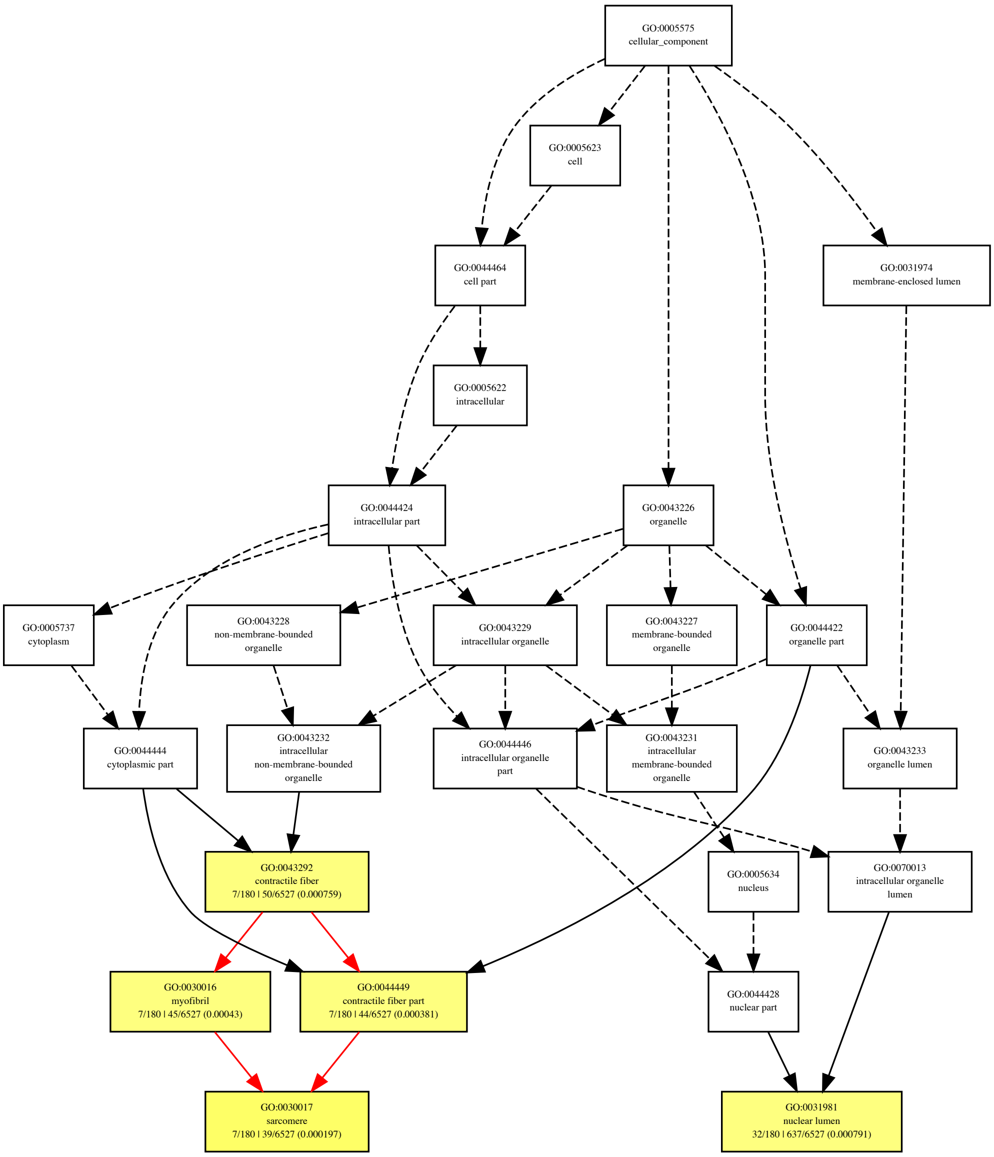


Figure 4.26: Cellular component GO terms associated with the red module

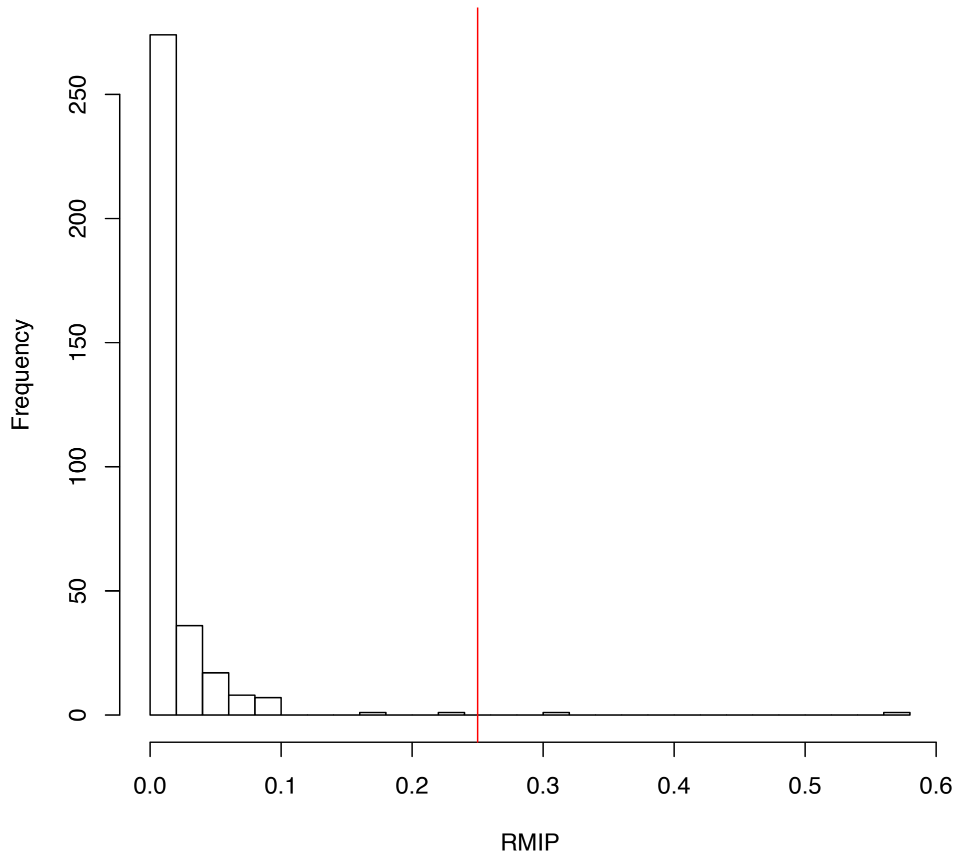


Figure 4.27: Histogram of the RMIP summary statistics resulting from QTL analysis with Bagphenotype. Any RMIP > 0, across all eleven hippocampus gene co-expression modules, is included. The red line indicates my significance threshold of RMIP = .25. Details of the two QTL above this threshold as well as the close call (RMIP = .24) are provided in Figure 4.28.

phenotype	SNP	chr	location (Mbp)	RMIP	% phenotypic variance explained
blue	rs3719767	5	115.6	0.57	7.1
yellow	rs13475735	1	15.0	0.32	6.5
black	rs13484040	X	138.5	0.24	5.9

Figure 4.28: Across the eleven hippocampus gene co-expression modules, only two QTL were identified above the .25 threshold and one, at RMIP = .24, was nearly significant.

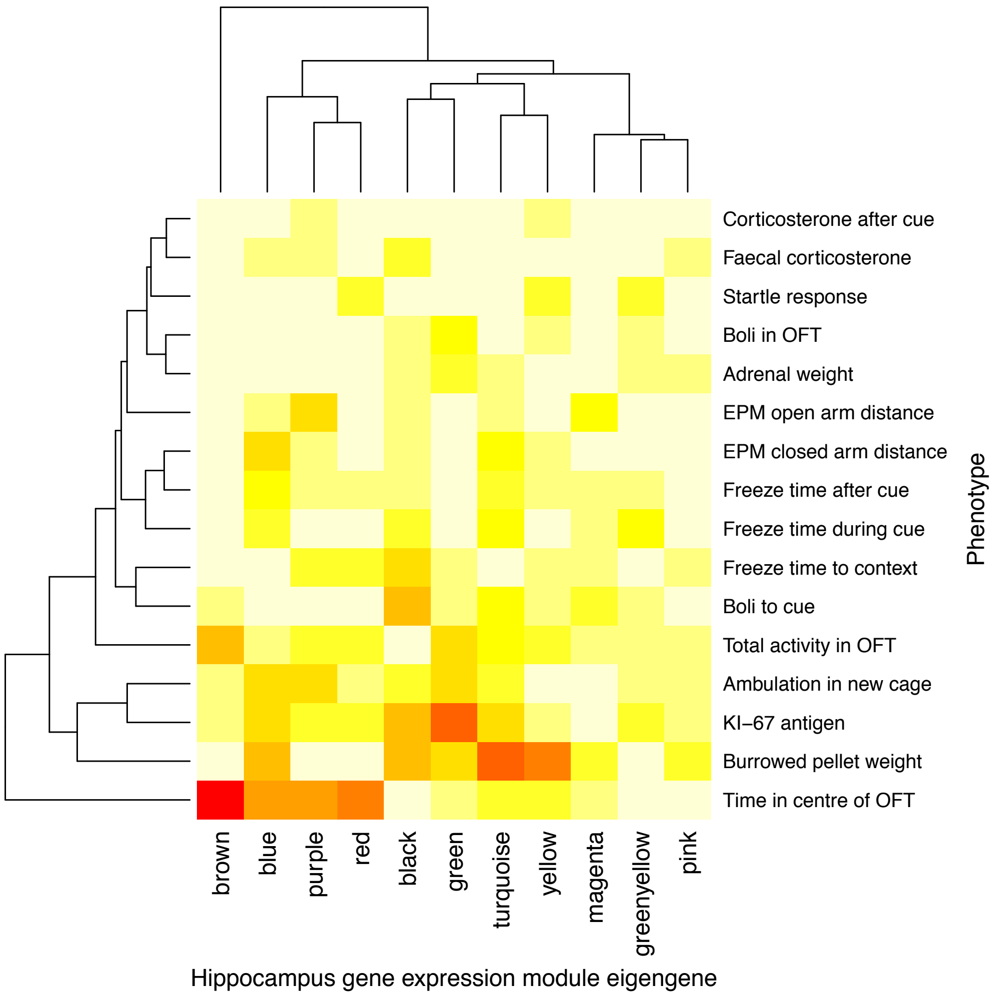


Figure 4.29: Heat map of the correlation between behavioural phenotypes and hippocampus gene expression modules. Cluster dendrograms respectively group the most correlated phenotypes and module eigengenes together. More highly correlated phenotypes and eigengenes are represented by warmer colours on the heat map, with the strongest correlation between the brown eigengene and time in the centre of the open field test, $p = .0003$. A table of all significant correlations is provided in Figure 4.30.

phenotype	module	r	t	df	p
Time in centre of OFT	brown	-0.15	-3.18	455	0.002
Burrowed pellet weight	turquoise	-0.12	-2.51	455	0.01
KI-67 antigen	green	0.12	2.49	449	0.01
Burrowed pellet weight	yellow	-0.11	-2.43	455	0.02
Time in centre of OFT	red	-0.11	-2.41	455	0.02
Time in centre of OFT	blue	0.10	2.2	455	0.03
Time in centre of OFT	purple	0.10	2.19	455	0.03
KI-67 antigen	black	-0.10	-2.05	449	0.04
Total activity in OFT	brown	-0.10	-2.04	453	0.04
Burrowed pellet weight	blue	0.10	2.04	455	0.04

Figure 4.30: This table provides details of the $p < .05$ correlations between behavioural phenotypes and module eigengenes provided in the heatmap in Figure 4.29. None of these correlations is significant after adjusting for multiple comparisons to a p-value threshold of .0003

Cell type	Gene	Probe	Module
astrocyte	Slc1a2	NA	
	Gfap	NA	
	Gjb6	scl45492.3_565-S	blue
	Fgfr3	scl014184.21_7-S	turquoise
	Aqp4	scl0011829.2_75-S	yellow
oligodendrocyte	Gjc2	scl40171.3.1_197-S	magenta
	Sox10	NA	
	Mag	scl31507.12.1_286-S	magenta
	Mog	scl0001753.1_34-S	magenta
	Mog	scl017441.3_16-S	magenta
	Mbp	scl51725.12_3-S	magenta
	Mbp	scl0002236.1_9-S	magenta
	Mbp	scl0002268.1_45-S	magenta
neuron	Nefm	NA	
	Gabra1	scl40325.12_575-S	turquoise
	Syt1	scl0020979.2_107-S	turquoise
	Syt1	scl37517.13_240-S	blue
	Slc12a5	scl19916.25_60-S	turquoise

Figure 4.31: This table details the brain cell genetic markers identified by Oldham and colleagues (2008), any hippocampus gene expression probes that map to those genes, and the modules that the probes were assigned to. "NA" in the probe name column indicates that no probes for that gene were included for analysis with WGCNA.

allocated myelin sheathes have been found in a range of psychiatric disorders including schizophrenia, bipolar disorder (Roy et al., 2007), and — critical to fear-related behaviours — anxiety and depression (Hamidi et al., 2004). Rather relevant here is that the second most significant GO term enrichment across all modules was the "myelin sheath" term in the magenta module ($p = 1 \times 10^{-6}$; Figure 4.16), one of only two terms still significant after correcting for multiple comparisons. A number of other axon- and myelin-affiliated GO terms populate the list of top GO terms, including the third through sixth, and the eighth and ninth (none with $p > 4 \times 10^{-5}$).

The pink module, meanwhile, was found to be enriched for a number of neurotransmission-related GO terms itself (Figure 4.21), including "dendritic spine" ($p = .0006$), "axon part" ($p = .0009$), and "synaptic vesicle" ($p = .0001$). Synaptic vesicles store neurotransmitters and then release them from the axon into the synapses between neurons to transmit a signal between brain cells. Dendritic spines are projections on the other side of the synapse, i.e., on the neuron receiving the signal being transmitted. Dendritic spines have been shown to vary in quantity and appearance in response to environmental changes. This plasticity may represent the molecular bases of memory formation and learning, including fear conditioning to cues and contexts that associated with an unpleasant stimulus like footshock. A number of genes within the pink module are implicated in the molecular pathways that facilitate dendritic spine plasticity, including *Ctnnd2*, *Neto1*, *Map1b*, *Dlg4*, *Ppp1ca*, *Gabbr1* and *Snap91* (Tolias et al., 2011).

Unfortunately, despite their enrichments, neither the pink nor magenta module was correlated with any fear-related phenotypes. Indeed, as shown in the heat map in Figure 4.29, the pink and magenta modules display some of the poorest correlations with phenotypes. Only ten module-phenotype pairs were correlated with $p < .05$. None of the correlations had a p below the Bonferroni-corrected value of .0003, with the lowest — the correlation between the brown module and time spent in the centre of the open field test — having a p of .002. These are not impressive results as with the 160 tests I carried out, nearly nine p-values below .05 would be expected by chance: $.05 \times 160 = 8.8$. Park and colleagues' (2011) finding of correlations between two hippocampus module eigengenes and conditioned fear to a context, introduced in §4.1, would however not have been significant either (at $p = .005$ and $.002$) had they adjusted for multiple comparisons: Having carried out sixty correlations, their Bonferroni-corrected threshold would have been .0008.

Time spent in the centre of the open field test was correlated with a disproportionate number of the ten module-phenotype pairs with $p < .05$: four of them (Figure 4.29). Its correlation with the brown module is noteworthy because the GO term with the lowest p-value was "mitochondrial membrane part" with the brown module, though the implications of this association are not obvious. The "burrowed pellet weight" phenotype accounted for a further four of the ten module-phenotype pairs with $p < .05$. These modules — black, green, turquoise, and yellow — are noteworthy for their lack of enrichment: None of these four modules was enriched for a cell type and only one, yellow, had a single GO term enrichment, for "nucleic acid binding" (Figure 4.22).

The yellow module was also able to be mapped to the genome with QTL on the first chromosome at 15 Mbp. Unfortunately, just as they did not correlate with any phenotypes so too were no QTL mapped for the magenta or pink modules. Although only three QTL were identified across eleven modules (Figure 4.28), an impressive percentage of phenotypic variance was explained by those QTL: six to seven percent. This high proportion of variance explained is particularly surprising given that we would expect nearly three false QTL (2.75 to be specific) across 11 genome wide scans at the RMIP threshold I selected. I did not include these results in this thesis, but these hippocampus module QTL mapping results look especially poor adjacent to results from other tissues: I found, for example, 17 QTL across 15 lung gene co-expression modules.

Part of the problem in identifying both QTL and correlations with phenotypes is that the first eigengene might not be the best representative of a given module. I could have gone beyond the first eigengene of each module and sought correlations with behavioural phenotypes and mapped QTL with slightly-lower ranked eigengenes too.

There are also many other resources out there for me to have used to attempt to identify cell type enrichments in modules, such as the brain cell type-specific transcriptome databases prepared by Okaty and colleagues (2011) and by Cahoy and coworkers (2008). Finally, it would be interesting to map eQTL using my preprocessing of the hippocampus gene expression data and compare these with the published eQTL (Huang et al., 2009) that used a preprocessing methodology that appears to have removed a substantial amount of biological signal relative to mine (see §2.6).

CHAPTER 5

Causal Pathways

Due to linkage disequilibrium, it is difficult to obtain high enough mapping resolution to identify the individual gene within a quantitative trait locus that is responsible for phenotypic variation. One solution to this is to model the causal direction of elements within the biological system, which in some instances can provide evidence that a particular gene is causal for a trait. In this chapter, I introduce a novel statistical technique for causal modelling and apply it to HS mouse data, including hippocampus gene expression levels, in an effort to identify individual genes responsible for fear-related behaviours.

5.1 Introduction

Here, I discuss why causal pathway modelling can be a useful tool for identifying the genes responsible for complex traits. I introduce the most popular method for causal modelling in genetic systems and detail its key shortcomings. Following that, I describe a novel causal modelling technique that accounts for some of these shortcomings, and I validate the method by applying it to data that include genes that are known to be causal.

5.1.1 The inference of causal pathways underlying complex traits

Linkage disequilibrium (LD), the tendency for genes next to each other to be passed along to progeny without meiotic recombination occurring between them, means that in the Oxford HS mice, resolution is insufficient to identify single genes responsible for phenotypic variation. Eric Schadt and his colleagues (Schadt et al., 2005; Chen et al., 2008) provided experimental evidence suggesting that the inclusion of gene expression data in a genetic mapping experiment can be used to solve this problem and identify the causal gene (or, much less likely, genes) within a QTL. Although Schadt and coworkers' technique, "likelihood-based causality model selection" (LCMS), appeared at first glance to be a revolutionary tool for genome research by facilitating data-driven discovery of candidate causal genes for complex traits, it has several critical flaws: (1) not modelling jointly the relationship of genetic markers nor gene expression levels with the complex trait, leading to wildly arbitrary results (exemplified by Figure 5.1); (2) not allowing for unobserved confounding variables; and (3) only allowing for three relationships between genes, transcripts and the complex trait (detailed in Figure 5.2), when many more such relationships are possible, as illustrated later in Figure 5.3.

Schadt and colleagues "validated" LCMS by publishing findings that their complex trait of interest, an obesity-related phenotype, was significantly impacted by genetic modification of three LCMS-identified candidate causal genes for the phenotype. However, the authors provide no explanation for why these particular three genes, from a field of 90 candidates, were selected for validation. Indeed, only one of the three was in the top ten candidates when they are sorted by the percentage of phenotypic variance that is "causally explained" by LCMS, so it is appears possible that these three results may have been focused upon after looking for and not finding a significant impact of genetic modification across more than three of the 90 genes. In this chapter, I introduce a novel machine learning-based computational technique called SParse Instrumental Variable analysis (SPIV) that accounts for the shortcomings of LCMS while seeking reliable identification of candidate genes for complex traits via the exploitation of genetic variant and gene expression data. I will describe how I validated the method by applying it to two known causal gene networks, and subsequently apply the method to the study of anxiety-related traits in HS mice (§2.1).

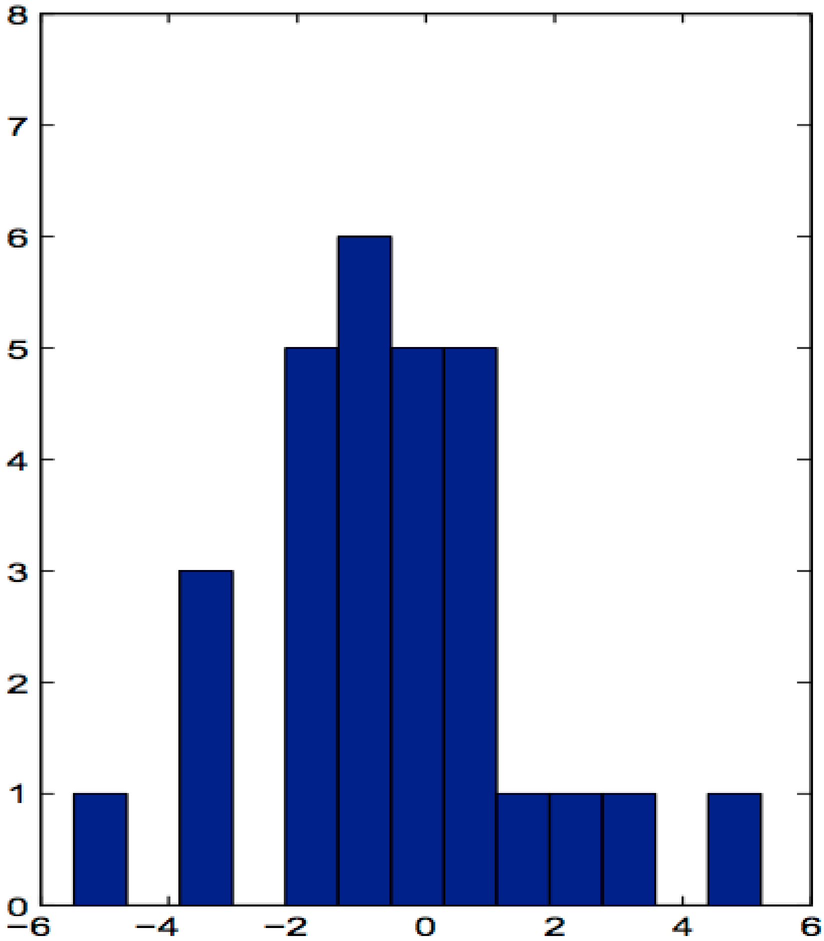


Figure 5.1: This figure, as published in a paper I contributed to (Agakov et al., 2011), illustrates the occasional arbitrariness of causal inference using LCMS (Schadt et al., 2005). While holding the choice of RNA transcript (x) and phenotype (y) constant, but varying the SNP used as the "instrumental variable" (g) to infer causality between x and y, estimates of whether x induces change in y (the "causal model", see Figure 5.2) or vice versa (the "reverse model") can swing considerably. The histogram shows the distribution of ((AIC score for the causal model) - (AIC score for the reverse model)). Though frequently ambiguous (difference ~0), in some instances the causal (difference is negative) or reverse (difference is positive) model are preferred depending on the choice of g_i. In this particular example, x is expression of the gene *Cyp27b1* in the livers of heterogeneous stock mice ($n = 273$) and y is serum high-density lipoprotein levels. g was restricted to SNPs that significantly predict y.

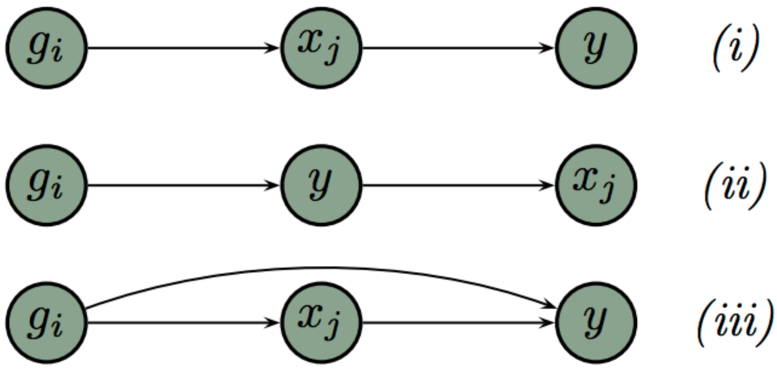


Figure 5.2: The three causal models considered by LCMS (Schadt et al., 2005). (i) is the "causal" model, (ii) is the "reverse" model, and (iii) is the "independent" model. g_i is a SNP being used as an instrumental variable (Angrist et al., 1996; Gelman and Hill, 2007), x_j is the expression level of a gene, and y is a phenotype of interest.

5.1.2 Nineteen causal relationships

While LCMS only considers three relationships between genetic markers (g), gene expression levels (x), and phenotypes (y; see Figure 5.2), SPIV considers nineteen. These models are listed in Figure 5.3 and broadly use the same nomenclature as LCMS: "causal" models involve gene expression influencing a phenotype ($x \to y$), and "reverse" models involve phenotypic variance influencing the expression of a gene ($y \to x$). To understand what is being modelled in each of the 19 models, one can refer to the "Conditional relationships" column of Figure 5.3. For example, in the first model, the "full causal", the probability (p) of x is conditional upon both g and z, while the probability of y is conditional upon x, z and g. In other words, the "full causal" model involves genetic markers (g) and latent confounders (z) causing variation in gene expression (x), while simultaneously involving genetic markers (g), latent confounders (z) and gene expression (x) causing phenotypic (y) variation.

I am most interested in identifying circumstances where the data best fit a "causal" model because it is in these situations that I am most likely to find a specific gene that causes variation in a phenotype. The identification of such quantitative trait genes (QTGs) is the purpose of many genetic studies, but observational studies like GWAS rarely have sufficient resolution to pinpoint a single gene, while experimental studies like gene knock-out are laborious, expensive and examine just one

	Model name	Conditional relationships
1	Full causal model	$p(x\|g,z)p(y\|x,z,g)$
2	Full reverse model	$p(y\|g,z)p(x\|y,z,g)$
3	Causal model with no pleiotropy *g->y*	$p(x\|g,z)p(y\|x,z)$
4	Reverse model with no pleiotropy *g->x*	$p(y\|g,z)p(x\|y,z)$
5	Causal model with no instruments *g->x*	$p(x\|z)p(y\|x,z,g)$
6	Reverse model with no instruments *g->y*	$p(y\|z)p(x\|y,z,g)$
7	Model with no causal link *x->y*	$p(x\|g,z)p(y\|g,z)$
8	Model with no causal link *x->y* and no pleiotropy *g->y*	$p(x\|g,z)p(y\|z)$
9	Model with no causal link *x->y* and no instruments *g->x*	$p(y\|g,z)p(x\|z)$
10	Decoupled model	$p(y\|g)p(x)$
11	Causal model with no *z*	$p(x\|g)p(y\|x,g)$
12	Reverse model with no *z*	$p(y\|g)p(x\|y,g)$
13	Causal model with no pleiotropy *g->y* and no *z*	$p(x\|g)p(y\|x)$
14	Reverse model with no pleiotropy *g->x* and no *z*	$p(y\|g)p(x\|y)$
15	Causal model with no instruments *g->x* and no *z*	$p(x)p(y\|x,g)$
16	Reverse model with no instruments *g->y* and no *z*	$p(y)p(x\|y,g)$
17	Model with no causal link *x->y* and no *z*	$p(x\|g)p(y\|g)$
18	Model with no causal link *x->y*, no pleiotropy *g->y*, and no *z*	$p(x\|g)p(y)$
19	Model with no causal link *g->x*, no instruments *g->x*, and no *z*	$p(y\|g)p(x)$

Figure 5.3: This is a list of the 19 models of causal relationships considered by SPIV. g denotes genetic markers, x the expression of a gene, y a phenotype, and z latent confounders. §5.1.2 provides a description of the nomenclature and conditional probabilities.

gene at a time.

5.1.3 Applying SPIV to known causal systems

To validate SPIV, I aimed to analyse genes that are strongly supported as causal for particular phenotypes. The two genes I focused on were *Apoa2* and *H2-Ea*, for which there is strong evidence that they are causal for high-density lipoprotein cholesterol levels and an immune system phenotype called CD4:CD8 ratio, respectively.

5.1.3.1 *Apoa2* and HDL cholesterol

The mouse gene *Apoa2*, is located on chromosome one at 173.16 Mbp and codes for the apolipoprotein A-II protein, the second most common protein in the high-density lipoprotein (HDL) particles that enable the transport of cholesterol and other lipids through blood. Low levels of HDL cholesterol are associated with heart disease (Toth, 2005) and variation in these levels have been shown in countless genetic studies to be in part determined by *Apoa2* in mice (e.g., Doolittle et al., 1990; Hedrick et al., 1993; Weng and Breslow, 1996; Dansky et al., 2002) and by the orthologous gene *APOA2* in humans (e.g., Scott et al., 1985; Bu et al., 1994; Brousseau et al., 2002). In the HS mice, *Apoa2* is included within a main effect QTL for HDL cholesterol on chromosome one that stretches from 171 to 174 Mbp with the highest-possible summary statistic (RMIP = 1.0, as in §3.3.1) when carrying out whole-genome mapping with the Bagphenotype multiple QTL modelling technique (Valdar et al., 2006b).

Since the liver synthesises cholesterol, which is then packaged into lipoproteins like HDL for transport throughout the body, I looked at whether expression of *Apoa2* in the liver would be identified by SPIV to appear to cause variation in blood plasma HDL cholesterol levels. With the Illumina platform that was used to analyse gene expression of the HS mice, I had two probes for *Apoa2* expression to work with. One of these, scl011807.2_4-S, was not correlated with HDL cholesterol nor with HDL cholesterol QTL, so I performed SPIV causal analysis with the alternative, scl000890.1_7-S, only. Looking at mutual information (MI), a probability theory-based measure of the relatedness of two random variables, this latter probe was the sixth-best predictor of HDL cholesterol in the Oxford HS mice while the former was the 16,885th.

As will be elaborated upon in §5.2.4, I carry out SPIV causal modelling six times for each probe-phenotype relationship I examine. This allows me to vary the prior for the latent confounder variables, i.e., my prior belief on how important the latent confounders are in a given model. Since the latent confounders are unknown, it's difficult to make a judgement on how strong their priors should be assumed to be. To circumvent this problem, I use a broad range of priors for the latent confounders from strong (1) through a variety of intermediates (.5, .1, .05, .01) to weak (.0001), and then see how well the models fit across all six circumstances.

To summarise the results from each of these runs, I use the statistic max(ML_{causal})-max(ML_{other}), which will also be elaborated upon in §5.2.4. The more positive the statistic is, the more support there is for the probe in the model causing variation in the phenotype. As summarised in Figure 5.4, a "causal" model, with *Apoa2* expression appearing to influence variance in HDL cholesterol levels, is supported across all confounder priors except where the confounders are strongest (i.e., = 1). Indeed, across three confounder priors (.5, .1, .05), the "causal" model is particularly well-supported with max(ML_{causal})-max(ML_{other}) > 8 in all three. Based on the extensive experimental evidence suggesting *Apoa2* is a causal gene for

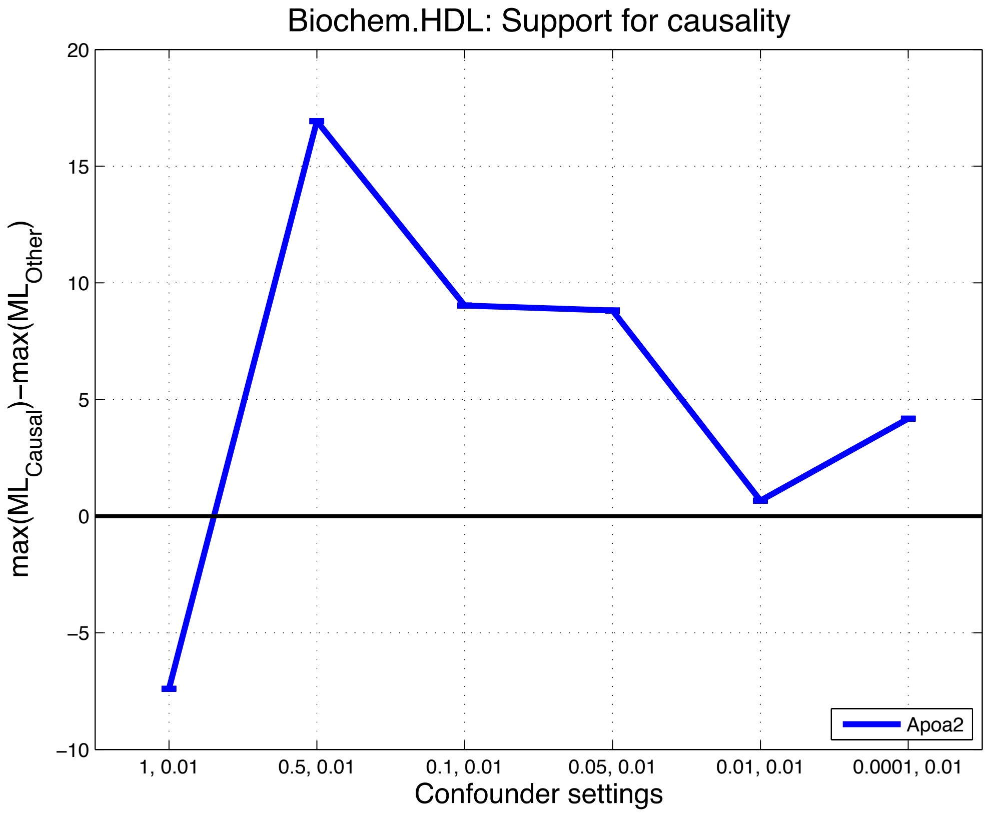


Figure 5.4: The "causal" model, where *Apoa2* expression appears to influence HDL cholesterol levels, is better supported than alternatives, as demonstrated by max(ML_{causal})-max(ML_{other}) > 0 across five of the six priors for latent confounding variables. See §5.2.4 for explanations of the max(ML_{causal})-max(ML_{other}) summary statistic and the use of a range of latent confounder priors.

HDL cholesterol levels, these causality modelling results are largely reassuring.

For this *Apoa2* exemplar as well as the *H2-Ea* one described next, I followed the same methodological protocol for causality analysis as I detail later regarding anxiety-related phenotypes in §5.2.4. Figure 5.5 provides an example of the summary statistics that can be provided by using SPIV to model several tiers of biological network information.

5.1.3.2 *H2-Ea* and CD4:CD8 ratio

T-lymphocytes are a prominent class of white blood cells. Within this class, cells can be categorised by the "cluster of differentiation" (CD) co-receptors they have on

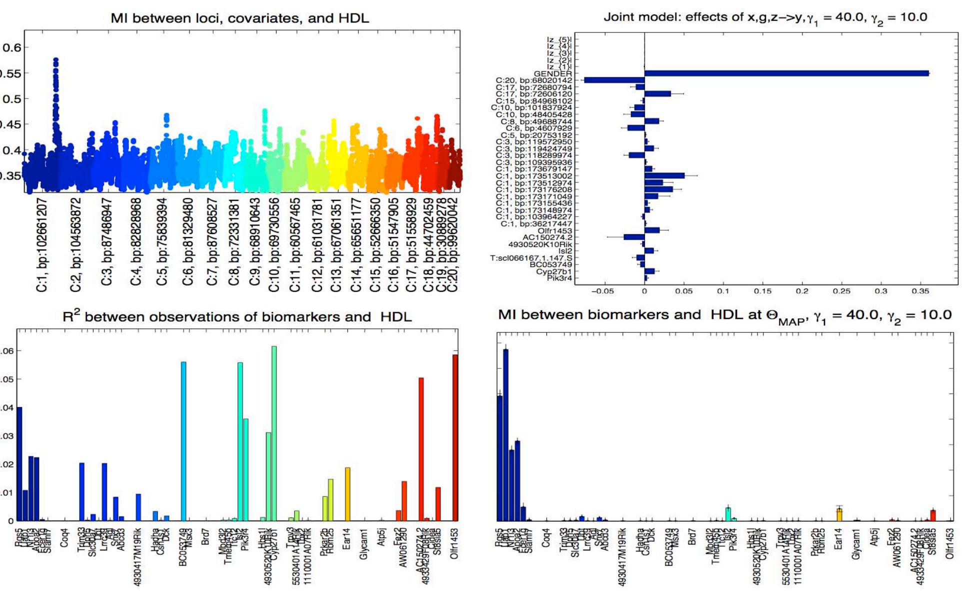


Figure 5.5: The *top-left* plot illustrates a genome-wide scan, carried out using SPIV, for Mutual Information (MI) between genetic markers and blood borne levels of high density lipoprotein (HDL) cholesterol. There is a particularly strong association on the first chromosome around 173 Mb. This peak, along with the others in the scan, corresponds with QTLs previously identified using the same data (Valdar et al., 2006b) and is known to include at least one gene, *Apoa2*, whose protein product affects HDL levels (Zhong et al., 1994).
The *top-right* plot illustrates the relative strength and direction of the relationship (Θ_{MAP}) between HDL levels and a number of variables, including (from the top of the y-axis): latent variables, gender, the genetic markers (sorted by physical location) with the strongest association with HDL, and the RNA transcripts (sorted by the physical location they were transcribed from) with the strongest association with HDL. Other than gender, the variables best associated with HDL levels (calculated by dividing each variable's mean Θ_{MAP} by its standard error) include a genetic marker on the sex chromosome, several markers near 173 Mb on chromosome one, and a transcript that maps to the gene *Cyp27b1*.
The *bottom* plots compare the relative strengths of association between transcript abundance and HDL levels using Pearson correlation (*bottom-left*) and SPIV (*bottom-right*). While the former take into account only the relationship between transcript levels and HDL, SPIV (as illustrated in Figure 5.3) also considers associations with latent variables, associations between genetic markers and HDL (i.e., pleiotropy), and dependencies between genetic markers. When all of these additional associations are taken into account, the relative importance of the left-hand, dark blue transcripts — all of which map to genes near 173 Mb on chromosome one, and including one transcribed from *Apoa2* — becomes clear. In both plots, the transcripts are sorted by the physical location they map to on the genome.

their surface, and these categorisations can have functional relevance. For example, T-lymphocytes that express both CD3 and CD4 co-receptors are by-and-large mature "T helper cells" that encourage immune function, while those with both CD3 and CD8 are a type of "regulatory T cell" that suppress immune function. A common test of immune system function is to examine the proportion of T helper cells relative to regulatory T cells. Because of the CD co-receptors that are mutually exclusive to these CD3-expressing T-lymphocytes, this proportion is usually referred to as CD4:CD8 ratio. CD4:CD8 ratio is a general indicator of immune system activation, but substantial divergence from normal can be indicative of immune disorders such as HIV infection.

The *H2-Ea* gene is found at 34.48 Mbp on chromosome 17 of the mouse genome and is contained within the very strong (RMIP = 1.0, as in §3.3.1) QTL for CD4:CD8 ratio that extends from 34.42 to 34.52 Mbp (Valdar et al., 2006b). *H2-Ea* codes for one of two protein complexes that regulate CD4-positive cell selection (i.e., release from the thymus, where these cells mature) and subsequent survival. Recently, Yalcin et al. (2010) employed commercially available outbred mice to determine that a 650 bp deletion within the *H2-Ea* promoter region significantly attenuates CD4:CD8 ratio. They went on to show that normal CD4:CD8 ratios are recovered in mice possessing the deletion when a relevant transgene ($E\alpha16$) is introduced. Thus, it appears that *H2-Ea* variation is causal for CD4:CD8 ratio.

Of the three tissues I had Oxford HS mouse gene expression data from (i.e., liver, lung, hippocampus), lung was the most appropriate to analyse with respect to CD4:CD8 ratio because of the abundance of T-cells found there. Only one Illumina probe for *H2-Ea* expression was available: scl50025.7.1_85-S.

As expected, and as with the *Apoa2*/HDL exemplar, SPIV causality modelling suggests that the "causal" model is the best fit, i.e., that across the range of six latent confounder priors, *H2-Ea* expression appears to influence CD4:CD8 ratio. Figure 5.6 illustrates how the "causal" model is favoured most when the impact of the latent confounders on the system is assumed to be small (i.e., the prior = .0001).

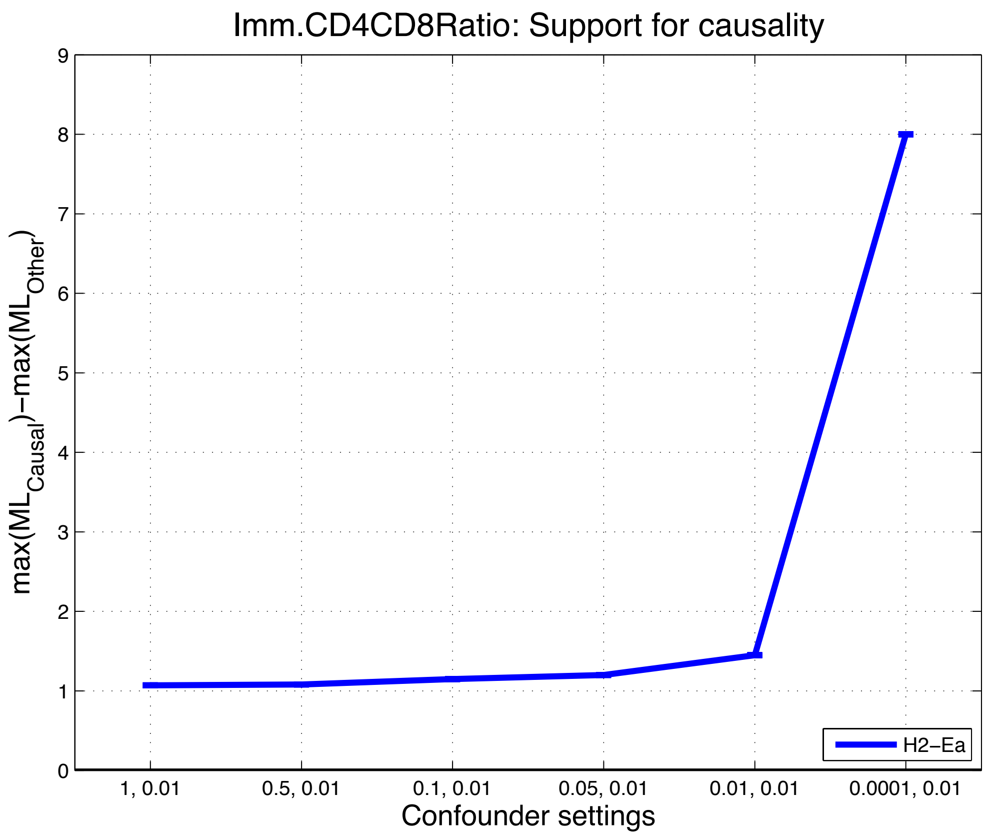


Figure 5.6: The "causal" model, where *H2-Ea* expression appears to influence CD4:CD8 ratio, is better supported than alternatives, as demonstrated by max(ML_{causal})-max(ML_{other}) > 0 across all prior settings for latent confounding variables. The "causal" model is particularly well-supported when we assume that the effect of latent confounding variables on the system is very small (i.e., prior = .0001). See §5.2.4 for explanations of the max(ML_{causal})-max(ML_{other}) summary statistic and the use of a range of latent confounder priors.

5.2 METHOD

SParse Instrumental Variable analysis (SPIV), as introduced in §5.1.1, is a novel computational tool coded in MATLAB (2010) that is useful for greatly reducing the dimensionality of massive data sets consisting of genetic variants, biomarkers (e.g., gene expression levels) and phenotypes, and subsequently calculating the strongest associations between the elements that make up the streamlined data — in some cases even allowing for the identification of the probable causal direction of the relationship between a biomarker and a phenotype. The first step, reduction of the data set, could be considered distinct from SPIV and called the "feature selection" phase (§5.2.1). The second step, in which associations are formally identified by Bayesian linear modelling, is SPIV proper (§5.2.2). I will briefly describe these two phases here, but a comprehensive methodology has been published in two articles, on both of which I was a co-author (Agakov et al., 2010, 2011).

Felix Agakov was the lead on coding SPIV and developing the machine learning theory behind it; he was assisted in those respects by Marco Colombo and we received much guidance from Paul McKeigue and Amos Storkey. All four of these collaborators were based at the University of Edinburgh. I worked extensively with them in Scotland to tailor SPIV to HS mouse-derived genetic, gene expression, and phenotypic data — the first major application of SPIV. I employed SPIV myself to perform the data analysis presented in this chapter.

5.2.1 Feature selection

The 12113 hippocampus transcript probes (as preprocessed in §2.6) and 13k genetic markers per animal ($\mu_n = 386.5 \pm 95.9$, range = 113 to 457, as detailed in Figure 2.1) I sought to analyse for relationships between each other and any given anxiety-related phenotype produced a massive data set that would have been several orders of magnitude beyond computational tractability for SPIV proper. Thus, a combination of seven feature selection methods (several filters described in §2.6.4; stepwise regression; approximation of mutual information with the phenotype; "lasso" shrinkage; "elastic net" shrinkage) was applied to drastically reduce the data set's dimensionality from >10^5 features to approximately fifty transcript probes and sixty sets of eight-dimensional genetic markers. As with the Bagphenotype-based analyses in §3.3.1, HAPPY (Mott et al., 2000) was employed to derive eight founder probabilities across inter-SNP intervals. Key environmental covariates, such as season, experimenter and apparatus, were also included as predictors where relevant; see Appendix A. Together, these key environmental covariates, ~60 genetic markers, and ~50 hippocampus gene expression probes constituted the set of features that could be considered as biological and environmental factors related to a given phenotype. Essentially, the purpose of the feature selection phase was to include in the predictive modelling as many relevant factors as possible. Per phenotype, there was a mean of 46.1 (±4.6) gene expression probes and 59.3 (±0.9) genetic markers retained from the feature selection phase for further analysis with SPIV (detailed in Figure 5.8).

As illustrated by Figure 5.7, I configured to SPIV to model a complex web of dependencies between genotypes, biomarkers and phenotypes while leaving opportunities for the influence of unobserved confounding variables and measurement error. For relative simplicity, some assumptions were made about the dependencies, e.g., that the impact of genetic variance upon biomarkers was not confounded. The model was penalised by marginal likelihood for including more parameters than necessary to explain the data. All of the parameters in the model were specified as random variables with priors, and further sparseness was encouraged by selecting priors (a product of zero-mean Laplace and zero-mean normal distributions; see Equation 2 in Agakov et al., 2011) that tend to shrink toward zero. The lengthy tails of the Laplacian distributions nevertheless allow for strong associations where they are merited by the data.

Using these priors, continuous optimisation with an expectation-maximisation algorithm (Chen et al., 2008) based on "automatic relevance determination" (MacKay, 1992) and "adaptive shrinkage" (Zou and Hastie, 2005), was iteratively able to reduce the number of links between data and fit Gaussian linear regression models where the phenotype was predicted by genetic variance, biomarker levels and latent variables (see Equation 1 of Agakov et al., 2011). The key posterior representing strength of associations that was output by this optimisation was the maximum a posteriori weight, Θ_{MAP} (Tibshirani, 1996). In the next section (§5.2.2), I expand a bit upon Θ_{MAP} estimation using expectation maximisation.

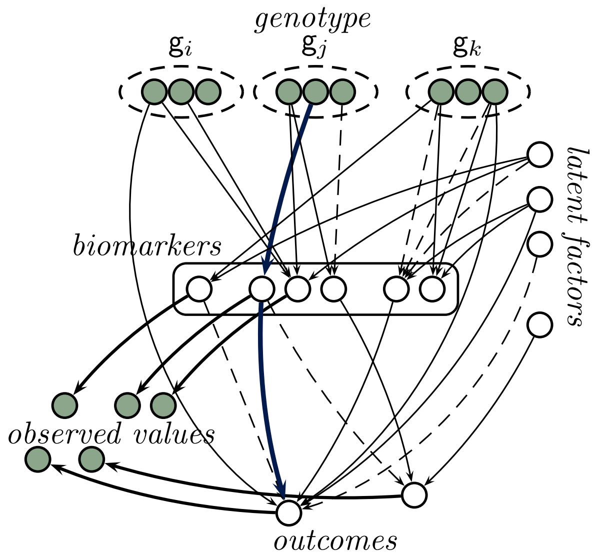


Figure 5.7: Schematic of dependencies between biological data as modelled by SPIV. This graphical representation of a contrived biological network, originally from a publication I co-authored (Agakov et al., 2010), shows possible relationships between genotypes, biomarkers (e.g., gene expression), and phenotypes while illustrating the influence of unobserved confounding variables and measurement noise. Genetic markers in LD are grouped together, an aspect of SPIV's modelling encouraged by the priors used. Dashed lines exemplify weak associations that would likely be pruned away by SPIV's sparseness-inducing priors. Observations are symbolised by green while the true state of nature is shown in white; SPIV models the error associated with measurement.

5.2.2 Joint modelling of retained features using EM

To examine the joint influence of the retained probes and genetic markers (Figure 5.8) on the phenotypes they are associated with, they were passed along into SPIV's Expectation-Maximisation (EM) algorithm. EM is a Bayesian statistical technique that iteratively progresses from initialisation with non-informative priors through to optimum model convergence. For each phenotype, the EM algorithm was run 50 times, with a different random starting point for several parameters at the initiation of each run, allowing model fits from a rich variety of perspectives (many starting points are required because otherwise the algorithm could repeatedly find the same local maxima in the model space and these local maxima may not represent the overall best model parameters). Each of the 50 runs consisted of 25 iterations. On each consecutive iteration within a run, the EM procedure adjusted model param-

Phenotype	# of RNA probes retained	# of genetic markers retained
Adrenal Gland Weight	38	60
Burrowed Pellet Weight	51	59
Freeze Time to Fear-Associated Context	45	60
Boli Produced after Fear-Associated Cue	50	60
Freeze Time to Fear-Associated Cue	48	60
Freeze Time after Fear-Associated Cue	40	59
Distance Travelled in EPM Closed Arm	47	58
Distance Travelled in EPM Open Arm	42	60
Faecal Corticosterone	48	60
Startle Response	42	58
KI-67 Antigen	47	59
Boli Produced in Open Field Test	41	60
Time Spent in Centre of Open Field Test	56	58
Total Activity in Open Field Test	46	60
Total Ambulation in New Home Cage	48	60
Corticosterone Levels after Fear-Associated Cue	48	58

Figure 5.8: For each of the 16 HS mouse behavioural phenotypes examined, these are the number of features — both RNA gene expression probes and genetic markers — that were retained following the SPIV feature selection phase. The features were subsequently fed into SPIV's Expectation-Maximisation algorithm to model their joint influence upon whichever phenotype they were associated with.

eters in an attempt to improve the model fit. One way to assess how well the model fits the data is to compute the log likelihood, with higher values indicating better model fit. Figure 5.9 illustrates the improvement in model fit over the 25 iterations of a typical run of EM.

The relationship of a given phenotype to these probes, as well as to genetic markers and unmeasured latent variables, were simultaneously modelled so the relationship of a single probe to a phenotype might be dramatically different than if that relationship were examined in isolation. I configured SPIV so that five latent variables were included in the initial model of each phenotype. Including more latent variables than this was unnecessary because the fifth was nearly always removed from the model by EM, i.e., its Θ_{MAP} was iteratively reduced to zero.

EM algorithms that estimate Θ_{MAP} are useful for modelling data, like those from the HS mice, which contain variables that are known to have measurement error (e.g., gene expression and phenotype measures) as well as unmeasured confounding variables (any of the myriad biological and environmental factors for which data were not collected but could nevertheless be highly relevant to the phenotype of interest). In particular, EM is useful for our purposes because it enables us to estimate approximate model fits: Due to the relatively complex, sparseness-inducing priors being fed into the model and the large number of model parameters, an exact solution would be computationally intractable. During each iteration of the EM, there are two steps: E (expectation) and M (maximisation). In the E step, the current (i) model parameters (Θ_{MAP}) are used to estimate the log likelihood function's expected value. In the M step, the Θ_{MAP} parameters of the next ($i+1$) iteration are determined based on the log likelihood estimate.

5.2.3 Global model parameters

SPIV has two global parameters that specify general attributes of the model across all factors included in the model. The first, γ_1, specifies the sparseness of the model, i.e., how many features we would like to include in the end model following each run of EM. More specifically, with γ_1, we are indicating how many features should have non-zero Θ_{MAP} posteriors. I set $\gamma_1 = 20$.

The second global parameter, γ_2, specifies whether features can be grouped together (i.e., $\gamma_2 > 0$) and, if they can, how many features can be included in one group (Zou and Hastie, 2005). Thus, the higher γ_2, the larger the groups of highly correlated features modelled by SPIV are permitted to be. These groupings are illustrated by the g_i, g_j, and g_k hatched ovals around genotype nodes in Figure 5.7. Prior to running the EM algorithm to identify Bayesian models that explain the phenotypes, γ_2, which was challenging to estimate *a priori*, needed to be optimised. Early trials of the EM algorithm suggested that varying γ_2 can substantially impact the quality of the EM model fitting and that the optimum γ_2 can vary phenotype-to-phenotype.

To estimate the optimum γ_2 value for each phenotype, I used a technique called k-fold cross-validation (the reader may recall that in §3.4.4, cross-validation was also employed to assess the proportion of variance accounted for by gene-by-sex interactions). For a given phenotype, the data were segmented at random into three equally-sized groups (i.e., $k = 3$), each containing a third of the mice and their associated measurements. Using two of these segments (comprising two-thirds of the data), 50 EM runs of 25 iterations each (just as in §5.2.2 immediately above) were carried out for each of four γ_2 values (these γ_2 values were selected to cover a broad

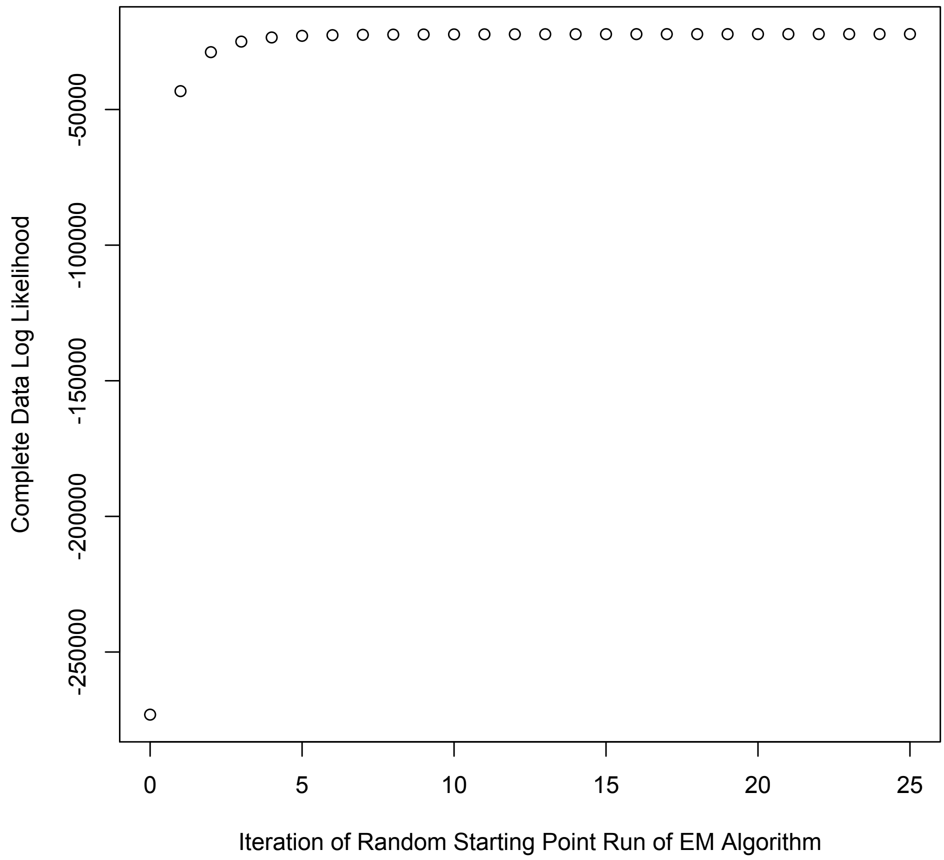


Figure 5.9: This is a plot of log likelihoods (which summarise how well a Bayesian model fits the data at hand) over 25 iterations of the EM algorithm for a typical run of EM. Similar convergence was observed for all of the runs, but these particular data come from a run using adrenal gland weight as the phenotype. Fifty EM runs were carried out for each of the 16 phenotypes examined. The initial log likelihood (i.e., at iteration 0) is relatively low because several model parameters had random starting points. Each iteration, as the EM algorithm attempts to improve the model fit by adjusting model parameters, the log likelihood converges upon a higher value (indicating the model more suitably fits the data) well before the final, 25th iteration.

range: 1, 5, 10 and 20). The Θ_{MAP} distributions estimated via this EM model fitting were then used to fit the final third of the data, and the quality of the model fit was tested by calculating its log likelihood. To treat all of the data equally, the entire k-fold cross-validation procedure was repeated three times such that each third of the data has an opportunity to be used as the test data.

Carrying out cross-validation was computationally expensive. For each phenotype, cross-validation required over 100 hours of time on a dedicated processing core of the Oxford Supercomputing Centre's newest cluster, "SAL", which has 2.53GHz Quad Core Nehalem processors, each with 3 GB of memory.

From the γ_2 values that were tested (1, 5, 10, 20), cross-validation indicated that for most of the 16 phenotypes (listed in Figure 5.8), the optimum γ_2 is 1. The four exceptions were freeze time to fear-associated cue, distance travelled in the closed arm of the elevated plus maze, boli produced in the open field test, and time spent in the centre of the open field test; for these four phenotypes, the optimum γ_2 was found to be 5.

From the dozens of hippocampus gene expression probes (Figure 5.8) jointly modelled for relationships with phenotypes, Figure 5.10 lists the probes with the strongest relationships (given as Θ_{MAP}) to their respective phenotype. Appendix G details all of the probes with $\Theta_{MAP} \geq .001$ (n = 210 probes) while Figure 5.11 is a histogram of the distribution of all these Θ_{MAP} weights ($\mu_\Theta = 12.7 \pm 2.2$). All sixteen phenotypes analysed with SPIV had probes associated with them with a Θ_{MAP} above .001, except "corticosterone levels after fear-associated cue". The highest-weighted probe for that phenotype had a Θ_{MAP} of just 6×10^{-5}.

5.2.4 Modelling causal relationships with SPIV

The probes with the strongest relationships with phenotypes in the joint model were used for the final stage of analysis with SPIV: modelling causal relationships. Using a probe Θ_{MAP} histogram (Figure 5.11), I decided that the strongest probes were those with a $\Theta_{MAP} \geq .01$. One hundred and nine probes (÷ 190 probes listed in Appendix G = 58%) were above this threshold. Except for "corticosterone levels after fear-associated cue", all phenotypes are represented by at least two probes above this threshold, with a mean of 7.3 (±3.2) probes per phenotype.

Although SPIV models 19 possible relationships between genetic markers, confounders, the expression of a gene, and a phenotype (see Figure 5.3), in the interest of finding genes whose expression *cause* phenotypic variation, I focused on five models listed in Figure 5.3: (1) full causal, (2) full reverse, (7) no causal link $x \to y$, (11) causal with no confounders, and (12) reverse with no confounders. To review briefly, the "causal" models involve the expression of a gene influencing phenotypic variance ($x \to y$), while the "reverse" models involve phenotype influencing gene expression levels ($y \to x$). In an effort to identify instances of the "causal" variety for a given pair of x and y, the "causal" model (i.e., (1) or (7)) with the highest marginal likelihood was compared with the non-"causal" model (i.e., (2), (11) or (12)) with the highest marginal likelihood. The higher the difference between these two marginal likelihoods (max(ML_{causal})-max(ML_{other})), the stronger the data support that the expression of a given gene x is causing variation in a given phenotype y. The convention max(ML_{causal})-max(ML_{other}) functions as a useful summary statistic throughout the reporting of SPIV results (§5.3) and the subsequent discussion (§5.4).

The remaining parameters that I specified for my runs of SPIV were: the noisiness of the measurements of features in the model, and the possible ranges of the starting points of the model parameters upon EM initialisation. Gene expression probes (x) and phenotypic measures (y) were assumed to have a fixed noisiness of 5%. Deriving more specific estimates of the deviation between the real, underlying value of these traits and the measured values of these traits proved challenging. By fixing them at the low 5% value across all expression probes and phenotypes, the influence of this noisiness parameter was minimal and uniform. Given the high accuracy of the Illumina genotyping (99.98% according to Shifman et al., 2006), noisiness for genetic markers (g) was set to zero. The random initialisations of the prior distributions (§5.2.1) of g and x were limited to a range around zero (-0.3 to 0.3) with a variance around one (0.8 to 1.2). Similarly, the range of the random initialisation of the prior distribution of the latent confounding variables (z) was 0.8 to 1.2.

5.3 Results

As explained in §5.1, SPIV is a novel machine learning technique for identifying associations between genetic markers, biomarkers (e.g., RNA transcripts), and phe-

Phenotype	Gene name	Probe name	Weight
Adrenal Gland Weight	Slc25a37	scl000296.1_62-S	0.056
	Lclat1	GI_38083242-S	0.039
	Mtmr11	scl0001985.1_48-S	0.039
	Phf20	scl20034.12.12_31-S	0.016
Burrowed Pellet Weight	AK018435	GI_38080828-S	0.044
	Sf3b5	scl0066125.2_261-S	0.036
	Dgki	scl29141.35.1_23-S	0.032
	Lfng	scl0016848.2_246-S	0.024
Freeze Time to Fear-Associated Context	5930434B04Rik	scl0003131.1_3-S	0.025
	Glt8d1	scl46500.10.1_48-S	0.011
	Psmd8	scl0057296.1_256-S	0.009
	Fras1	scl27563.74.239_16-S	0.004
Boli Produced after Fear-Associated Cue	AK033222	scl077994.4_29-S	0.092
	Gchfr	scl0003189.1_25-S	0.055
	Slc35b3	scl0003682.1_25-S	0.040
	Slc35b3	scl44068.10_181-S	0.038
Freeze Time to Fear-Associated Cue	CLCN3	scl000703.1_52-S	0.066
	Mrgprx1	GI_46430535-S	0.061
	Znhit6	scl069746.7_1-S	0.049
	Fzd3	scl45417.7.1_19-S	0.047
Freeze Time after Fear-Associated Cue	Spag4	scl20038.8.1_45-S	0.020
	Uts2	scl0002834.1_11-S	0.018
	Calu	scl0001174.1_68-S	0.013
	AK052547	scl19270.1.616_146-S	0.012
Distance Travelled in EPM Closed Arm	Renbp	scl54150.7.1_69-S	0.076
	Ube2t	scl17444.7.1_197-S	0.051
	Sult2b1	scl000224.1_0-S	0.042
	Fos	scl42959.4_58-S	0.031
Distance Travelled in EPM Open Arm	Tnrc6c	scl40682.19_710-S	0.054
	Tlk2	scl0001496.1_12-S	0.038
	Slc27a2	scl20335.12.1_10-S	0.033
	Abcc4	scl45160.32_9-S	0.032
Faecal Corticosterone	Gpx7	scl24011.4.1_9-S	0.051
	2610018G03Rik	scl54935.14.15_299-S	0.050
	AK012573	scl0067192.1_182-S	0.019
	Osbpl6	scl0099031.1_295-S	0.013
Startle Response	Itch	scl016396.2_0-S	0.045
	Rprm	scl19271.1.36_133-S	0.013
	Ube4a	scl35939.21_232-S	0.013
	AK032347	GI_38086173-S	0.011
KI-67 Antigen	AK006049	GI_20891894-S	0.047
	Zbtb2	GI_38088886-S	0.044
	Cdrt4	scl41438.2.1_10-S	0.026
	Ccdc137	scl0067291.1_12-S	0.026
Boli Produced in Open Field Test	Tbcc	scl50668.1.78_47-S	0.082
	Gatad2b	scl00229542.2_217-S	0.071
	Lxn	scl22088.5.1_88-S	0.070
	AK034614	scl0170624.1_278-S	0.067
Time Spent in Centre of Open Field Test	Pde4d	scl0238871.11_15-S	0.047
	Tatdn2	GI_38084987-S	0.043
	Kank4	scl0242553.1_69-S	0.032
	Ahi1	scl39099.27_528-S	0.031
Total Activity in Open Field Test	Rab5b	scl37351.6_4-S	0.060
	Trmt2a	scl0001815.1.4-S	0.051
	Olfr571	scl8889.1.1_230-S	0.049
	Elmo1	scl0003672.1_54-S	0.041
Total Ambulation in New Home Cage	AK018519	scl47627.1.1_171-S	0.046
	Wdr67	scl0002526.1_32-S	0.031
	Il17rb	scl45778.11.1_135-S	0.028
	Ttc21a	scl36345.29.1_111-S	0.022
Corticosterone Levels after Fear-Associated Cue	Adpgk	scl36877.7.1_29-S	0.00006
	Dclre1b	scl0140917.1_89-S	0.00004
	AK041356	scl00319906.1_32-S	0.00004
	Frmd6	scl43138.14.1_290-S	0.00003

Figure 5.10: This table lists the four hippocampus RNA expression probes with the strongest relationships (expressed as Θ_{MAP} weights) for each of the phenotypes analysed with SPIV. As described in §5.2.2, SPIV simultaneously models the relationship of dozens of probes and genetic markers on the phenotype so the strength of a given probe's relationship with the phenotype may be different than if studied in isolation. The "gene name" column is the name of the gene whose hippocampus expression is being assayed by a given probe.

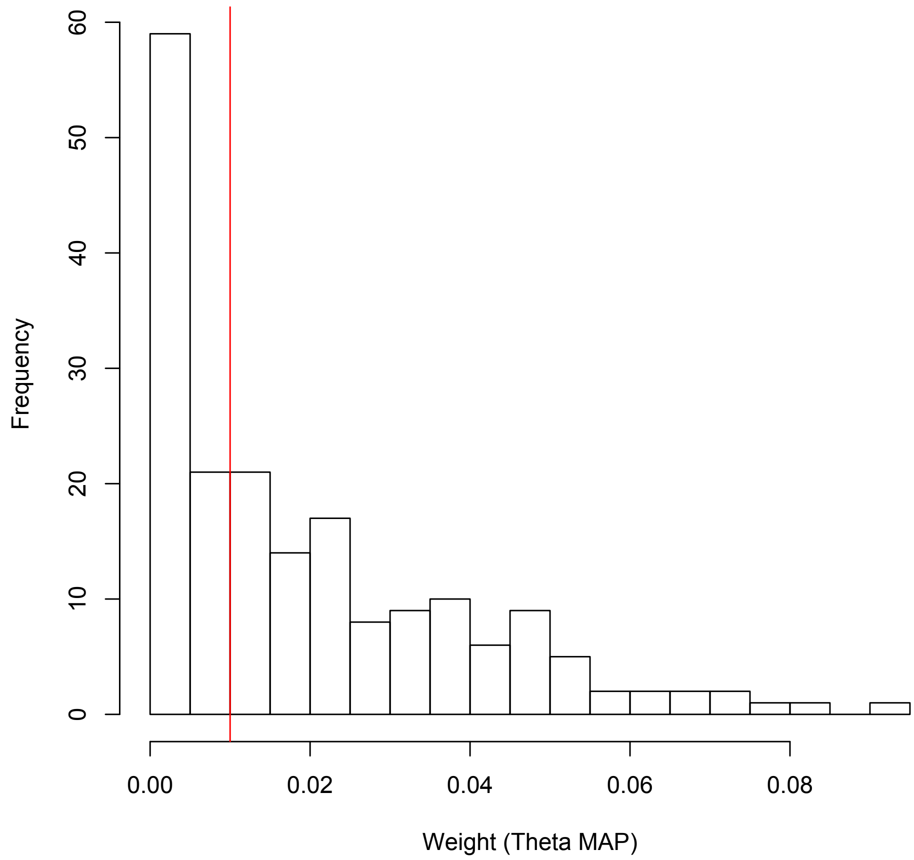


Figure 5.11: This is a histogram of the hippocampus gene expression probe Θ_{MAP} weights across all 16 phenotypes analysed by SPIV. Probes with $\Theta_{MAP} \geq .001$ were included ($n = 190$). I decided to retain the strongest of these ($\Theta_{MAP} \geq .01$; $n = 109$) for causal modelling (§5.2.4). A red vertical line represents this threshold.

notypes. Having established these links, SPIV is also capable of inferring the causal direction of the relationship between an associated biomarker-phenotype pair, i.e., whether the biomarker influences the phenotype ("causal" model $x \rightarrow y$) or vice versa ("reverse" model $y \rightarrow x$).

As a sanity check as to whether I broadly had SPIV operating sensibly, I ensured across all 16 phenotypes that I observed the *cis*-eQTL diagonal (as used in an earlier chapter to assess the quality of gene expression data preprocessing; §2.16) and that genetic markers with the highest Θ_{MAP} coincide with the strongest main effect QTL identified by Bagphenotype (Valdar et al., 2006b).

The full results of SPIV's causal modelling across the 109 top probes are provided in Appendix H. Following the method detailed in §5.2.4, the results are shown as the difference between "the marginal likelihood of the causal model with the highest marginal likelihood" and "the highest marginal likelihood of any other model". From here onward, this difference will be written as max(ML_{causal})-max(ML_{other}).

The mean (across all six confounder priors) of the max(ML_{causal})-max(ML_{other}) was not correlated with the Θ_{MAP} of a probe's relationship to its phenotype, ρ = .04, S = 206758, p = .66. I used non-parametric Spearman rank correlation because neither distribution was approximately Gaussian.

Probes were flagged as having some support for causality if at any one of the six confounder priors, max(ML_{causal})-max(ML_{other}) ≥ 5. The 27 such probes with support for causality (÷ 109 analysed probes = 25%) are listed in Figure 5.12 along with max(ML_{causal})-max(ML_{other}) statistics. The distribution of the maximum max(ML_{causal})-max(ML_{other}) values for these 27 probes is shown in Figure 5.13.

Seventeen of the 27 "causal"-flagged probes (63%) had positive max(ML_{causal})-max(ML_{other}) at all six latent confounder priors. Five of these (19%) had values ≥ 5 at all six priors: those ranked 2nd, 3rd, 5th, 6th and 15th in Figure 5.12 based on their highest max(ML_{causal})-max(ML_{other}). The probes ranked 1st and 4th narrowly missed inclusion in this list by each having a max(ML_{causal})-max(ML_{other}) of less than five but greater than four at a single prior. The two highest-ranked probes involve *Psg16* and *AK051928* expression appearing to cause a decrease in the number of boli produced in the open field test (Figure 5.14a & b). The third- and sixth-ranked involve *Ezr* and *Lfng* appearing to cause a decrease in burrowed pellet weight (Figure 5.14c & d). The fourth-ranked suggests *Renbp* causes an increase in

	Phenotype	Name of gene assayed by probe	max(ML_{causal})-max(ML_{other}) at six different settings of the confounder priors 1.0	0.5	0.1	0.05	0.01	0.0001	max
1	Boli Produced in Open Field Test	Psg16	5.01	4.47	6.97	8.13	4.87	35.57	35.57
2	Boli Produced in Open Field Test	AK051928	9.16	6.82	7.42	8.18	7.49	32.11	32.11
3	Burrowed Pellet Weight	Ezr	5.29	7.59	5.71	7.86	6.08	30.60	30.60
4	Distance Travelled in EPM Closed Arm	Renbp	4.11	7.48	7.38	8.15	8.74	30.46	30.46
5	Time Spent in Centre of Open Field Test	Pde4d	5.36	10.25	9.44	9.63	10.33	27.46	27.46
6	Burrowed Pellet Weight	Lfng	9.94	9.50	8.42	8.31	8.06	26.52	26.52
7	Boli Produced in Open Field Test	Il17rb	4.48	-0.30	1.83	4.90	2.85	21.64	21.64
8	Boli Produced in Open Field Test	AK045440	7.63	3.90	5.69	6.30	6.72	21.33	21.33
9	Boli Produced after Fear-Associated Cue	Slc25a37	5.31	-5.98	-0.75	-0.99	-0.16	15.66	15.66
10	Total Activity in Open Field Test	Olfr571	1.01	3.28	4.03	3.97	4.74	15.21	15.21
11	Distance Travelled in EPM Open Arm	Agfg2	5.40	3.35	0.36	0.99	1.43	14.81	14.81
12	Total Ambulation in New Home Cage	Ttc21a	-1.84	3.52	2.14	5.34	6.48	13.66	13.66
13	Total Activity in Open Field Test	Trmt2a	2.88	-0.47	3.64	1.83	2.21	12.50	12.50
14	Faecal Corticosterone	Osbpl6	11.87	8.24	8.75	9.57	10.74	-11.75	11.87
15	Freeze Time to Fear-Associated Cue	Fzd3	7.08	9.52	11.81	9.21	10.79	5.34	11.81
16	Adrenal Gland Weight	Gipc1	2.03	0.55	0.26	1.61	2.99	11.01	11.01
17	Freeze Time to Fear-Associated Cue	Znhit6	7.60	1.79	3.33	3.60	0.79	10.15	10.15
18	Burrowed Pellet Weight	Sf3b5	5.67	4.69	9.93	6.88	8.80	9.26	9.93
19	Boli Produced in Open Field Test	Atp6v0a1	4.21	1.26	2.25	0.92	5.73	9.76	9.76
20	Total Activity in Open Field Test	Ap3b1	1.78	4.22	2.13	0.20	1.41	8.96	8.96
21	Freeze Time to Fear-Associated Context	Glt8d1	-1.72	0.30	-0.60	0.28	-0.48	8.80	8.80
22	Time Spent in Centre of Open Field Test	Kank4	-5.41	-2.15	-1.52	-0.73	-1.47	8.22	8.22
23	Total Ambulation in New Home Cage	Elmo1	0.08	-0.07	-0.99	1.32	2.50	7.87	7.87
24	Total Activity in Open Field Test	Supt4h1	3.07	-0.30	1.44	-1.82	0.77	7.45	7.45
25	Total Ambulation in New Home Cage	AK018519	6.08	2.65	2.31	1.84	3.61	2.11	6.08
26	Boli Produced in Open Field Test	Gatad2b	5.95	-0.87	-0.10	2.01	-0.57	-3.74	5.95
27	Total Activity in Open Field Test	Olfr315	2.46	4.52	1.92	2.06	3.02	5.62	5.62

Figure 5.12: This is a table of the 27 hippocampus gene expression probes I flagged as candidates for causing changes in a phenotype because max(ML_{causal})-max(ML_{other}) was greater than five at at least one of the six confounder priors I considered (1, .5, .1, .05, .01 and .0001; see §5.3). The probes are listed alongside the phenotypes they appear to influence and are ranked by their maximum max(ML_{causal})-max(ML_{other}) across all six confounder priors. The distribution of the maximum max(ML_{causal})-max(ML_{other}) values for these 27 probes is shown in Figure 5.13.

the distance travelled in the closed arm of the elevated plus maze while the fifth has *Pde4d* causing an increase in the time spent in the centre of the open field test (Figure 5.14e & f). Simple Pearson correlation tests confirm that the expression of each of the six genes is significantly correlated with their respective phenotypes (in all six cases, $p < .01$).

Only three "causal"-flagged probes (÷ 27 = 11%) had a max(ML_{causal})-max(ML_{other}) ≤ -5 at any of the six latent confounder priors, and this only occurred at one of the priors in any of the three cases. Ninth-ranked *Slc25a37*, associated with boli produced after a fear-associated cue, had max(ML_{causal})-max(ML_{other}) =

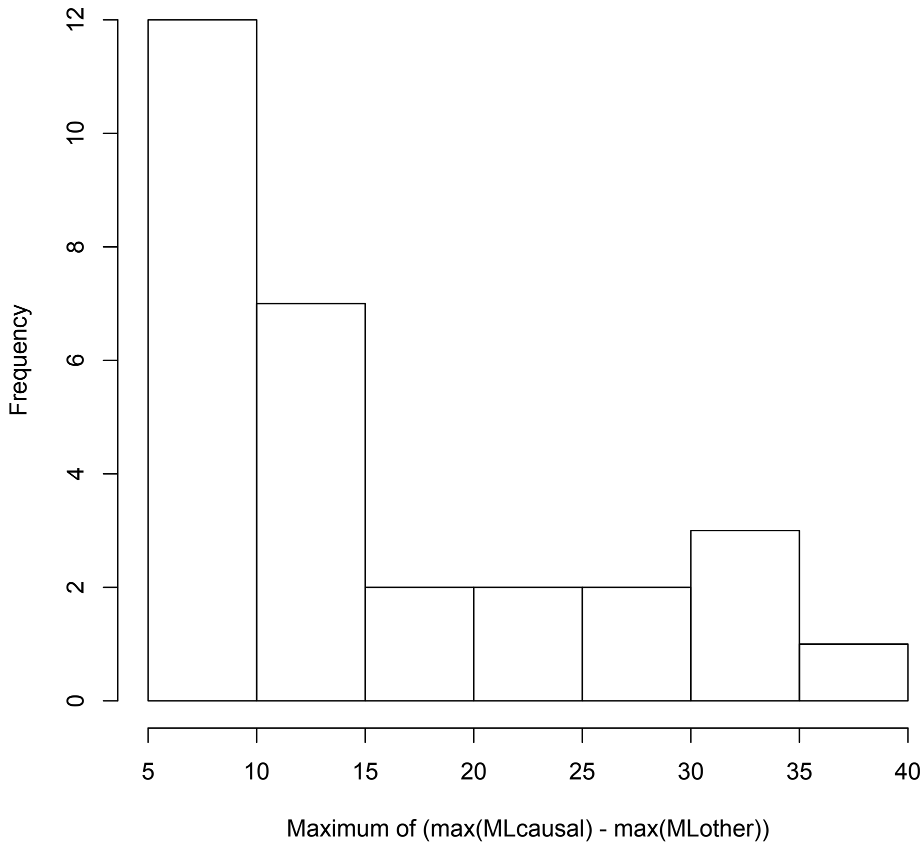


Figure 5.13: I considered any probes with a max(ML_{causal})-max(ML_{other})≥ 5 to be a strong candidate for causally influencing the phenotype they are associated with. There were 27 probes that met this criterion and they are listed in Figure 5.12. Shown here is a histogram of the maximum max(ML_{causal})-max(ML_{other}) across all six of the confounder priors I considered per probe (also see Figure 5.12 for details).

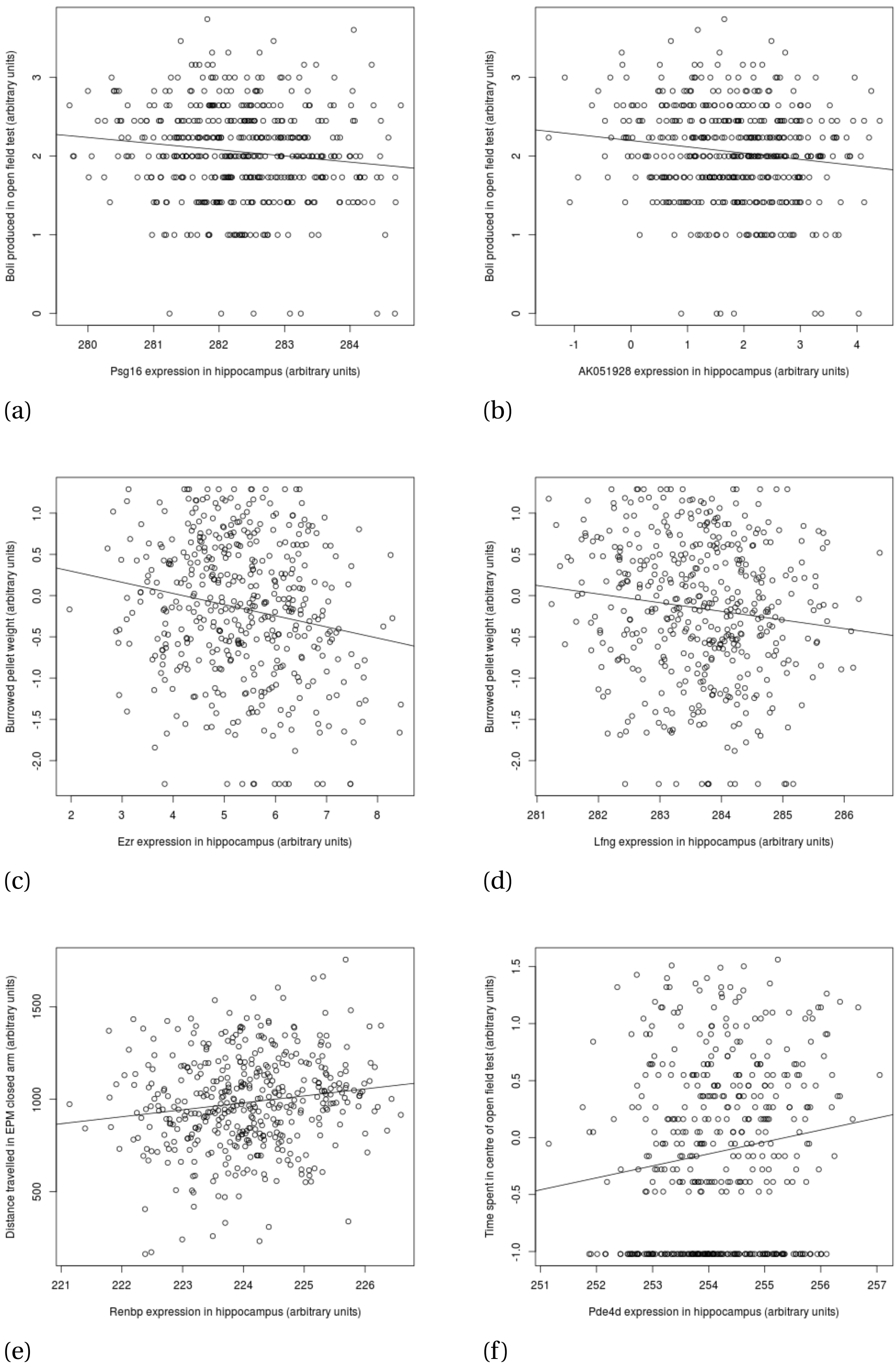


Figure 5.14: The top six “causal”-flagged genes versus their phenotypes

-6.0 at the latent confounder prior of .5; 14th-ranked *Osbpl6*, associated with faecal corticosterone, had max(ML_{causal})-max(ML_{other}) = -11.8 at the prior of .0001; and 22nd-ranked *Kank4*, associated with time spent in the centre of the open field test, had max(ML_{causal})-max(ML_{other}) = -5.4 at the prior of 1.0.

For 22 of 27 "causal"-flagged probes (81%), the maximum max(ML_{causal})-max(ML_{other}) corresponded to the the latent confounder prior being assumed to having a very small impact on the model, being set to .0001. Two maximum max(ML_{causal})-max(ML_{other}) corresponded to the fairly strong prior of .1 (÷ 27 = 7%), while the remaining three (÷ 27 = 11%) corresponded to the strongest prior I used, 1.0.

Of the 27 "causal"-flagged probes, nearly half (13 ÷ 27 = 48%) were contributed by the three phenotypes obtained from the open field test: Boli produced in the test accounted for six of the probes (including many of the highest-ranking ones: 1, 2, 7, 8, 19 and 26); total activity in the test five (10, 13, 20, 24 and 27); and time spent in the centre of the test a further two (5 and 22). None of the genes in these 13 cases were the same. Additionally, the open field test phenotypes are not especially correlated with each other (see Figure 4.29). Except for four phenotypes — freeze time after fear-associated cue, startle response, KI-67 antigen and corticosterone levels (the latter of which had no probes strong enough to merit causality analysis) — the remaining phenotypes contributed between one and three "causal"-flagged probes each.

5.4 Discussion

I used a novel Bayesian technique, SPIV, to identify genes whose expression in the hippocampus appear to cause variation in fear-related phenotypes. Because the relationship of dozens of probes and genetic markers (Figure 5.8) with each phenotype were modelled jointly, the weight of the relationship (Θ_{MAP}) between a given probe and phenotype might be dramatically different than if the relationship between that probe and phenotype were examined in isolation (e.g., by Pearson correlation). As an example, the top four probes for faecal corticosterone, according to their jointly-modelled Θ_{MAP} were for the genes *Zfp219*, *Tbc1d21*, *Ckap2* and *AK031852* (Figure 5.10). The Θ_{MAP} for these probes (± standard deviation over 50 independent runs of SPIV modelling), as well as the next highest-weighted probes (also indicated by gene names), the most highest-weighted genetic markers (indicated by "C:" chromosome number and "bp:" genomic location in Mbp), and confounding variables ("Conf") for faecal corticosterone are depicted in Figure 5.15. The importance of the four probes for explaining variation in faecal corticosterone is clear, particularly for *Zfp219*, which has a higher Θ_{MAP} associated with faecal corticosterone than any genetic marker or other probe. However, looking at Figure 5.16, a plot of the probes with the highest R^2 (as per Pearson correlations) with faecal corticosterone, *Zfp219* expression does not make the top 20. The inclusion of *Zfp219* in causal analyses despite its low R^2 could be important because it appears to be one of the strongest candidates for causing variation in a phenotype across all the probes and phenotypes I examined; it ranks fifth overall (Figure 5.12).

It is, nevertheless, common for probes with high Pearson correlations to also be some of the strongest probes when modelled jointly with SPIV. Continuing the faecal corticosterone example, the three highest-weighted probes as per Θ_{MAP} (*Tbc1d21*, *Ckap2* and *AK031852*) also have some of the highest R^2 values.

The "corticosterone levels after fear-associated cue" phenotype stands out as having a poor Θ_{MAP} relationship with any hippocampus gene expression probes relative to other fear-related phenotypes. This may be due to its small sample size ($n = 113$) relative to the other phenotypes ($\mu_n = 386.5 \pm 95.9$; from Figure 2.1). As detailed in Appendix G and summarised in Figure 5.10, the probe with the strongest relationship with the corticosterone phenotype had a Θ_{MAP} of 6×10^{-5} while all of the 15 other phenotypes had at least two probes (mean of 7.3 ± 3.2) associated with them with a Θ_{MAP} of at least .01. I might have been able to resolve this issue by retaining fewer predictors in the feature selection phase (§5.2.1) with this relatively low n phenotype.

Thirteen of 27 "causal" probes were associated with phenotypes from the OFT experiment, with the number of boli produced in the OFT alone associated with six, including some of the highest-ranking (i.e., 1, 2, 7 and 8 in Figure 5.12). Perhaps the molecular pathways underlying bolus production under stress are simple relative to other fear-related behaviours, many of which require complex motor tasks like ambulation. It is interesting to note that in addition to OFT phenotypes dominating the list of causal probes, half of the significant ($p < .05$) hippocampus gene co-expression network module eigengene versus phenotype correlations are con-

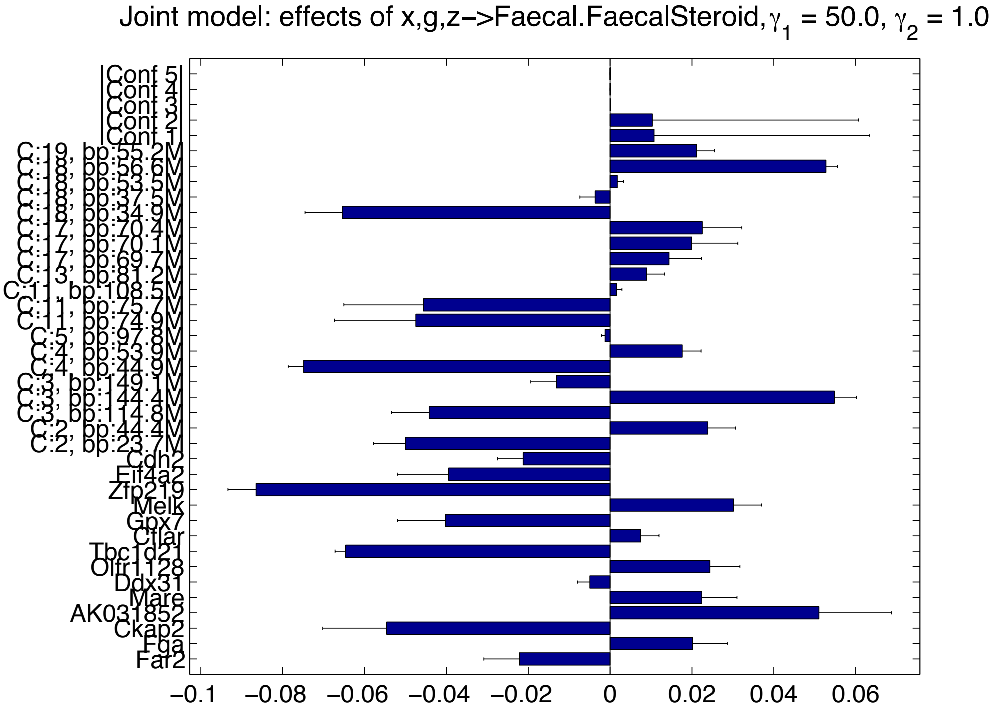


Figure 5.15: This is a graphical representation of Θ_{MAP} ($\pm$ standard deviation over 50 independent runs of SPIV modelling) for the highest-weighted joint predictors of faecal corticosterone levels. For the confounders (prefixed with "Conf"), whether Θ_{MAP} is positive or negative is meaningless since the effect modelled by a given confounder can vary with each run of SPIV. Thus the absolute value of Θ_{MAP} is shown for confounders. Direction is difficult to interpret for the genetic markers (denoted by "C:" and "bp:", representing the chromosome and genomic location in Mbp, respectively) since each marker consists of eight founder probabilities (see §...). For hippocampus gene expression probes (represented by the name of the gene they map to), a positive Θ_{MAP} suggests a positive relationship with faecal corticosterone levels, and of course the opposite for a negative Θ_{MAP}. This plot demonstrates one of the strengths of jointly modelling predictors with SPIV: *Zfp219* expression has the strongest Θ_{MAP} of any of the modelled predictors even though its relationship with faecal corticosterone is weak when looked at in isolation (see Figure 5.16).

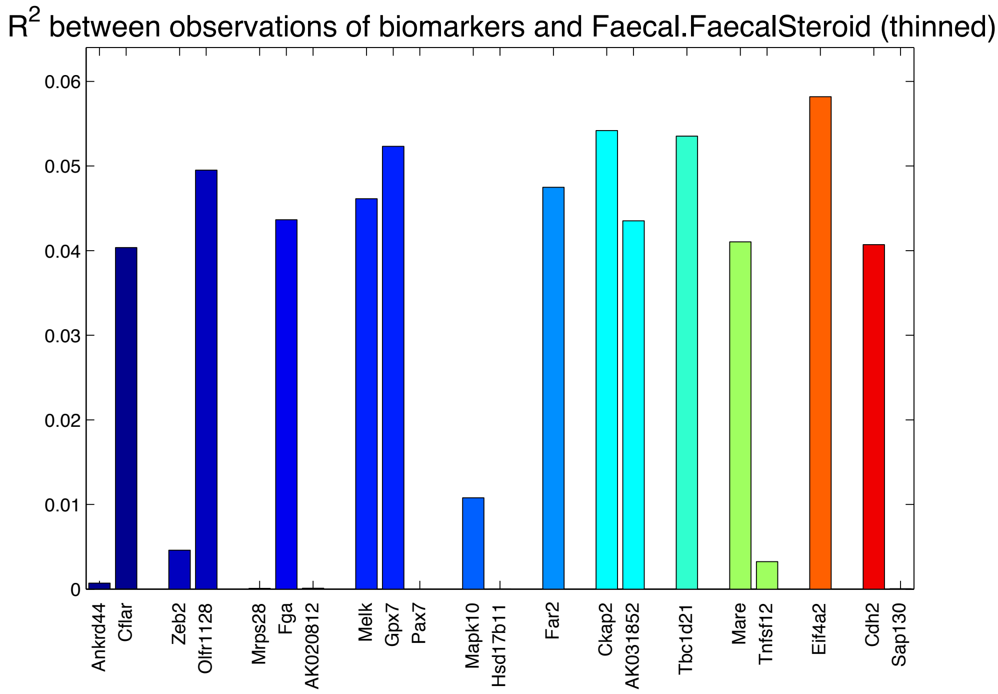


Figure 5.16: This is a plot of the 20 hippocampus gene expression probes with the highest R^2 with faecal corticosterone as per Pearson correlation tests. The probes are represented by the name of the gene they map to and are arranged by the genomic location of those genes (e.g., *Ankrd44* is on chromosome one while *Sap130* is on 18). Three of the four top-weighted probes for faecal corticosterone when modelled jointly with SPIV (*Tbc1d21*, *Ckap2* and *AK031852*; see Figure 5.16) also have some of the highest R^2 values. However, the top-weighted probe as per SPIV, *Zfp219* is not in the top 20 when examined in isolation with Pearson correlation, illustrating how modelling predictors jointly can impact the way one views the data.

tributed by OFT phenotypes (Figure 4.30).

5.4.1 Sensitivity analysis

Sensitivity analysis is the statistical practice of testing the posteriors that arise when using a variety of prior values for the hyperparameters (i.e., in this case, confounder noise). This reflects uncertainty in the choice of the hyperparameters and the impact that this choice might have upon the Bayesian modelling outcome. My results appear to be fairly consistent across the range of six priors I used. Of the 27 "causal"-flagged probes listed in Figure 5.12, that is, probes with a max(ML_{causal})-max(ML_{other}) above five at any one of the six priors, 66% of those probes had no max(ML_{causal})-max(ML_{other}) values dip below zero, and there were only three instances (out of six priors × 27 probes = 162 opportunities, ∴ 2% of all max(ML_{causal})-max(ML_{other}) values in Figure 5.12) where max(ML_{causal})-max(ML_{other}) is below -5. It is worth noting, however, that for 22 of 27 "causal" probes, the highest max(ML_{causal})-max(ML_{other}) was observed when confounding variables were assumed to have a little impact on the causal network by setting them to have a very small prior (0.0001).

5.4.2 Low levels of expression

Some gene names of the "causal"-flagged probes (Figure 5.12) may be unexpected because one might not anticipate them being expressed in the hippocampus. For example, the olfactory receptor genes *Olfr571* and *Olfr315* look particularly out of place. Nevertheless, these two genes were found to be significantly expressed in 5% and 12%, respectively (see Appendix I), of the 468 Oxford HS mice that had their hippocampal gene expression assayed. Indeed, *Olfr571* was recently identified as significantly overexpressed in the mouse brain relative to its mean expression in other mouse tissues (Bonilla et al., 2012).

Although many of the "causal"-flagged probes were expressed in the hippocampi of a sizeable portion of the Oxford HS mice — eight of the 27 were even expressed in over 98% of the mice — many were expressed much less. As depicted in Figure 5.17, eleven of the "causal"-flagged probes were expressed in fewer than 20% of the mice. As described in §2.6, I retained probes that were significantly expressed in at least 5% of the mice. Although this may sound excessively liberal, it meant that only 42% of probes that progressed to that stage of analysis were retained, and this threshold avoids the peak that approaches 0% in Figure 2.12. In any case, the reader can choose to ignore "causal"-flagged probes that are expressed in a small percentage of mice by consulting Appendix I. These low-expressed probes may still merit consideration because a gene's expression may be turned on by a somewhat rare allele that could nevertheless have a substantial impact upon phenotypic variation by exhibiting a large effect on a small number of animals.

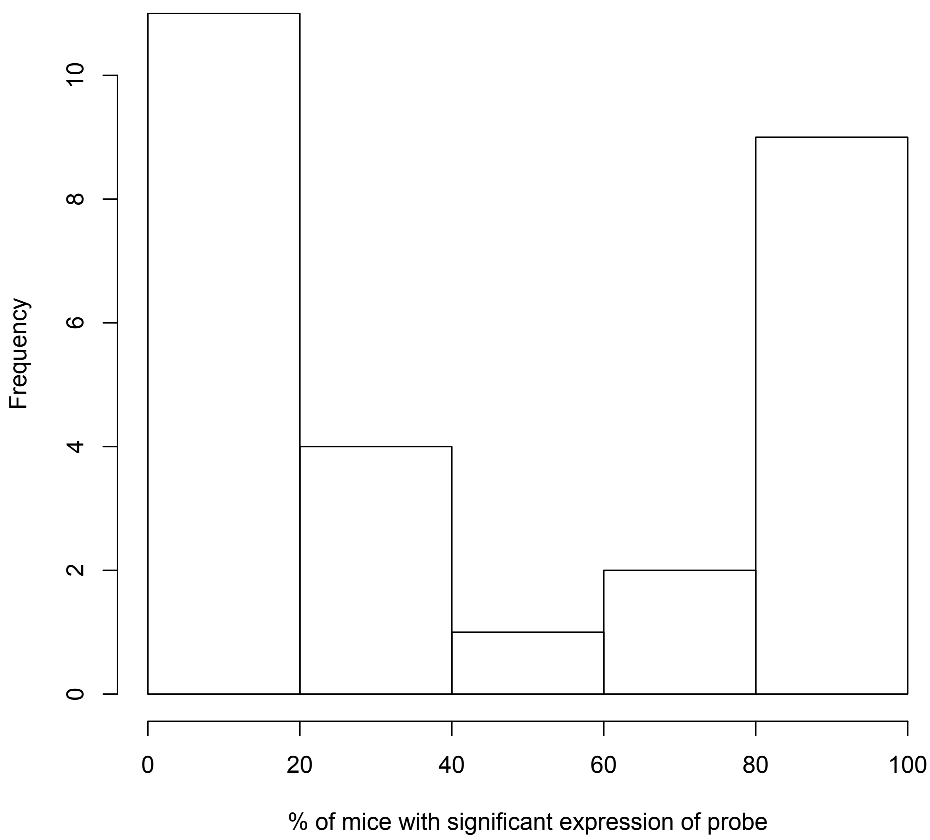


Figure 5.17: This is a histogram of the "pct_express" column in Appendix I, i.e., the percentage of mice significantly expressing in their hippocampi the "causal"-flagged probes listed in Figure 5.12.

5.4.3 SPIV cannot see the forest for the trees

Because of SPIV's sparse Bayesian framework, we would not expect two correlated probes to be included in the SPIV joint model for a given phenotype. So, even though the two top-ranked "causal"-flagged probes (expression of *Psg16* and *AK051928*; see Figure 5.12) are highly correlated with the number of boli produced in the open field test ($p < .01$ in both instances; see Figure 5.14a & b), the expression of these genes shouldn't themselves be correlated, and that is indeed the case: a Pearson correlation test shows no significant relationship between the expression of *Psg16* and *AK051928*, r = -.04, $t(455)$ = -.83, p = .41. Likewise, *Ezr* and *Lfng* (the third- and sixth-highest-ranked "causal"-flagged expression probes) are both highly correlated with burrowed pellet weight (both $p < .01$) but not with each other, r = .05, $t(455)$ = 1.0, p = .30.

A potential drawback of modelling predictors jointly in this sparse Bayesian way is that, while the strongest predictors of a given phenotype are retained in that phenotype's model, the myriad predictors that may be correlated with a given strong predictor will be ignored, despite these ignored predictors potentially being nearly as good predictors of the phenotype as the retained, slightly stronger, predictor. In other words, if gene x_1 is one of the strongest predictors of phenotype y and gene x_2 is nearly as strong a predictor of y as x_1, but x_1 and x_2 are themselves correlated, x_2 would likely be dropped from the SPIV joint model of y.

In a situation like the one just outlined, x_2 may still be an interesting, perhaps even causal, gene for y but, using my method in this chapter, it would not make it to the causality analysis stage. Therefore, it could be worthwhile looking to see if there is a gene co-expression network (Chapter 4) associated with x_1. If there is, then some or all of the genes in its network could be good candidates for causality analysis.

5.4.4 Further work

A broader range of γ_2 values could have been used for cross-validation of the parameters used in the EM model-fitting algorithm (§5.2.3), or perhaps a range closer the optimum values that were identified (near 1 to 5) may have yielded even better model fits. It might also be interesting to see if more causal probes can be identified with alternative causal system modelling software such as Network Edge Orienting (Park et al., 2011), although no alternatives exist that account for unobserved confounding variables like SPIV does.

I restricted my causal models to include only gene expression probes from the hippocampus as biomarkers (Figure 2.1), however it would be possible to expand this biomarker set to also include the gene expression data that is available from the liver and lung tissues. These extra data could simply be included in the feature selection phase (§5.2.1) and if any of the liver or lung probes happened to be strongly associated with either the phenotype or genetic markers, they would be included in causal modelling with SPIV proper. These additional probes could account for some of the variance attributed to latent confounders or they might even turn out to be causal probes. Metabolic processes regulated by gene expression in the liver for example could perhaps affect a mouse's activity level or bolus production in the tests of fear-related behaviour.

It might also be informative to apply SPIV to the analysis of multiple behavioural phenotypes simultaneously, a procedure that could be helpful for finding meaningful links given the relatively weak association between any one behavioural phenotype and an individual QTL. This multivariate strategy has previously proved successful in identifying QTL missed by univariate analyses (Amos et al., 1990; Schork et al., 1993; Hackett et al., 2001; Korol et al., 2001), including for murine anxiety-related behavioural phenotypes (Turri et al., 2004).

Finally, a far more rigorous validation of SPIV's causal modelling capability than the *Apoa2* and *H2-Ea* test cases I successfully executed in §5.1.3 would be to test mice that have had one of the top causal candidate genes from Figure 5.12 knocked out or had its expression otherwise modified. Although none of the top causal genes are available from the Knockout Mouse Project repository (Austin et al., 2004), vectors for several are — including *Psg16* (rank 1), *Renbp* (4) and *Lfmg* (6) — so knockouts could be engineered.

CHAPTER 6

CONCLUSION

In this chapter, I conclude my thesis by briefly summarising my key findings and discussing broad strengths and weaknesses of my work.

6.1 SUMMARY OF KEY FINDINGS

6.1.1 Genetic interactions with sex and environmental factors

Using a novel Bayesian technique, Sparse Partitioning, in Chapter 3 I identified 18 gene-by-sex QTL and seven gene-by-gene interactions from across 66 phenotypes in HS mice. It appears that the proportion of phenotypic variation accounted for by the GxS effects correlates with the proportion of phenotypic variation accounted for by sex as a main effect. However, except in the case of adrenal gland weight, GxS interactions accounted for less than 1% of phenotypic variance (Figure 3.13). Using a frequentist resample model averaging approach, I found a large set of interaction QTL in the HS mice, including 539 gene-by-environment QTL across 25 fear-related behaviour phenotypes.

6.1.2 Gene expression networks

In Chapter 4, I generated a network of co-expressed hippocampus gene expression probes consisting of eleven distinct modules. One of these modules was very significantly enriched for genetic markers of central nervous system support cells called oligodendrocytes, while another was enriched for several neurotransmission-related gene ontology terms. Disappointingly, neither of these modules was correlated with fear-related phenotypes, as this might have provided insight into the molecular mechanisms underlying these behaviours.

6.1.3 Causal pathways

Chapter 5 opened by describing SPIV, a Bayesian technique for modelling causal relationships with genetic data sets, and then validating the technique by successfully applying it to two understood causal systems within the HS mouse data. I applied SPIV to all fear-related behavioural phenotypes within those data, identifying a set of 27 circumstances where gene expression probes appear not just to be correlated with one of these phenotypes, but appear to *cause* the phenotypic variation.

6.2 Quantity and quality: Sample size and additional categories of data

Although I identified many interaction effects and candidate causal genes for fear-related behaviours, their contributions to phenotypic variance were not especially impressive. Perhaps much more data (e.g., gene expression data from the amygdala, copy number variation, epigenetic and proteomic data) need to be acquired and considered simultaneously to uncover the behaviours' "missing heritability" (Manolio et al., 2009).

On the other hand, some studies suggest that more data may not be particularly informative. For example, in the mouse liver, mRNA transcripts have been shown to be more highly correlated with relevant clinical phenotypes (e.g., adiposity) than the protein they code for (Ghazalpour et al., 2011). The addition of proteomic biomarkers highly correlated with transcript data we already have, might not add much additional information to a model — no matter whether it be a frequentist linear regression or a Bayesian network.

The most effective way forward might be much larger sample sizes and then mapping of thousands of common SNPs that each contribute a very small proportion to phenotypic variance. This approach has been effective for complex traits including height (Yang et al., 2010) and body mass index (Speliotes et al., 2010). It required nearly seven thousand human test subjects, half as controls, but this approach has been effective for two psychiatric disorders frequently comorbid with anxiety (Braga et al., 2005; Bauer et al., 2005): bipolar disorder and schizophrenia (Purcell et al., 2009).

6.3 ALTERNATIVE ANIMAL MODELS

The phenotypic variance of the fear-related behaviours I examined may have been limited. The HS mice were not bred for the particular purpose of being used as animal models of human psychiatric disorders, so relatively few individuals may have displayed levels of fear-related behaviour that would correspond to the debilitating human analogues of clinically-diagnosed anxiety or depression. Using alternative experimental methodologies, much larger phenotypic variance may have been obtained so we might have captured more extremely “anxious” animals. Such extreme phenotypic cases may have provided more power to my search for the molecular bases of fear-related behaviours. For example, relative to the HS mice I analysed, the Collaborative Cross founder strains have a much more diverse heritage, including three subspecies of wild mice (The Complex Trait Consortium: Churchill et al., 2004). Measurements of Collaborative Cross behavioural phenotypes should thus have wider tails in their distributions.

Another even more direct method for obtaining more phenotypic variance in the distributions of fear-related behaviours would be to selectively breed for diversity on this measure. That is, generation after generation, we could select the most “anxious” mice and breed them only with other very “anxious” mice, while simultaneously selectively breeding the least “anxious” mice in this manner as well. This strategy has been employed in rats to generate several inbred strains, including the Roman Low Avoidance strain (Bignami, 1965), the Flinders Sensitive Line (Overstreet et al., 2005), the High Anxiety-Related Behaviour strain (Hess et al., 1992), and FH/Wjd (Aulakh et al., 1998). The disadvantage with this approach is the relative paucity of mice that have been selectively bred for displaying anxiety-like behaviours. With the HS mice, we had the power and diversity of 2000 genetically-distinct subjects. Scale of this order of magnitude would be challenging and prohibitively expensive to obtain with animals selectively bred to be fearful.

6.4 Timing is everything

Perhaps the most daunting hurdle to obtaining meaningful and reproducible results with gene expression data is getting the timing right. Throughout neural development, there are transient cascades of signalling molecules (e.g., Nerve Growth Factor, Glial-Derived Neurotrophic Factor) that shape neural connectivity and thus the behaviour of an animal. Dynamic changes in gene expression both in response to and as a result of these signalling molecules continue over an organism's life span. Moreover, gene expression is impacted by external stimuli. For example, Nicole Powell and her colleagues (in press) recently demonstrated, in both mice and humans, that social stress affects white blood cell-related gene expression in bone marrow, resulting in up-regulation of the inflammatory response.

This complex interplay between gene expression, developmental processes and external stimuli unfolding over time means that highly specific experimental methodology would likely be required to have a chance at uncovering, and later reproducing the finding of, many behaviour-related molecular events. Thus, the HS mouse experimental methodology was not well-suited to identifying fear-related behaviour-associated gene expression networks and causal molecular pathways. I would expect the relevant gene expression pathways to be impacted by the gauntlet of anxiety-inducing behavioural measures the HS mice were put through (§2.2.1), just as humans with major depressive disorder have been shown to have reduced expression of the gene *GLO1* in their blood while depressed but not while in remission (*GLO1* and its rodent homolog *glo1* have been implicated in both human and mouse GWAS of anxiety; Sokolowska and Hovatta, 2013).

To have a good chance of characterising the fearful stimulus-cued gene expression pathways, we would ideally desire gene expression data obtained from animals immediately following presentation of those cues, but that was not the case with the HS mice. Instead, the HS mice underwent behavioural experimentation while aged 45 to 56 days, but tissue harvesting was not until much later, on day 71 (Figure 2.4). Obtaining stronger and more reliable results in behaviour-related gene expression experiments will require detailed experimental methodology tailored to highly specific temporal intervals.

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APPENDIX

A

COVARIATES

This is a table of the variables included as covariates for each phenotype in Bagphenotype scans. I included in C of the equation in Figure 3.1 all of the covariates that were available and that accounted for at least 1% of the variance in the phenotype y. These same covariates were also included as predictors in analyses using SPIV (Chapter 5), while they were regressed out of the phenotypes prior to analysis with Sparse Partitioning (§3.3.3). "EndNormalBW" is a measurement the animal's body weight at the end of all experiments.

Phenotype	Covariates
AdrenalMeanWeight	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Biochem.ALP	GENDER,EndNormalBW
Biochem.ALT	GENDER,EndNormalBW
Biochem.AST	GENDER,EndNormalBW
Biochem.Albumin	GENDER,EndNormalBW
Biochem.Calcium	GENDER,EndNormalBW
Biochem.Chloride	GENDER,EndNormalBW
Biochem.Creatinine	GENDER,EndNormalBW,Age
Biochem.Glucose	GENDER,EndNormalBW
Biochem.HDL	GENDER,EndNormalBW
Biochem.LDL	GENDER,EndNormalBW
Biochem.Phosphorous	GENDER,EndNormalBW
Biochem.Potassium	GENDER,EndNormalBW
Biochem.Sodium	GENDER,EndNormalBW
Biochem.Tot.Cholesterol	GENDER,EndNormalBW
Biochem.Tot.Protein	GENDER,EndNormalBW
Biochem.Triglycerides	GENDER,EndNormalBW
Biochem.Urea	GENDER,EndNormalBW
CD4Count	GENDER,EndNormalBW,Date.Season,Date.Month
CD8Count	GENDER,EndNormalBW,Date.Season,Date.Month
Context.Mean.Freeze	GENDER,EndNormalBW,Experimenter,CoatColour,Date.Month,FPS.TrainingChamber,Date.StudyDay
Cue.Activity.Base12.Increase	GENDER,EndNormalBW,Experimenter
Cue.Boli	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Cue.Mean.Freeze.Corrected.During	GENDER,EndNormalBW,CoatColour,FPS.TrainingChamber
Cue.Mean.Freeze.Post	GENDER,EndNormalBW,Date.Month,Date.StudyDay,FPS.TrainingChamber
Cue.Raw.Activity.Before.Tone1	GENDER,EndNormalBW,Date.Month,CoatColour,Date.StudyDay
EPM.ClosedArmDistance	GENDER,EndNormalBW,Date.StudyDay
EPM.ClosedArmEntries	GENDER,EndNormalBW,Experimenter,Date.Month,Date.StudyDay
EPM.ClosedArmTime	GENDER,EndNormalBW,Date.StudyDay
EPM.JunctionDistance	GENDER,EndNormalBW,Experimenter,CoatColour,Date.StudyDay
EPM.JunctionEntries	GENDER,EndNormalBW,Experimenter,Date.Month,CoatColour,Date.StudyDay
EPM.JunctionTime	GENDER,EndNormalBW,Date.StudyDay
EPM.OpenArmDistance	GENDER,EndNormalBW,Date.Month,CoatColour,Date.StudyDay
EPM.OpenArmEntries	GENDER,EndNormalBW,Date.Month,CoatColour,Date.StudyDay
EPM.OpenArmTime	GENDER,EndNormalBW,Date.Month,CoatColour,Date.StudyDay
EarHoleMeanArea	GENDER,EndNormalBW,Date.Season,Date.Month,Date.StudyDay
FPS.Bang.Increase	GENDER,EndNormalBW,CoatColour,Test.Date.StudyDay
FPS.Bang.Tone.Increase	GENDER,EndNormalBW,Test.Date.StudyDay
FPS.Pre.Bang.Mean	GENDER,EndNormalBW,Test.Chamber,Test.Date.Season,Test.Date.StudyDay
FPS.Pre.Bang.Tone.Mean	GENDER,EndNormalBW,Test.Date.StudyDay,Test.Chamber
FaecalSteroid	GENDER,EndNormalBW,Date.StudyDay
Glucose.Area	GENDER,EndNormalBW,Experimenter
Glucose.Area0	GENDER,EndNormalBW
Glucose.Slope	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Glucose_0	GENDER,EndNormalBW,InjectionTime.StudyDay,InjectionTime.StudyStartSeconds,Experimenter
Glucose_15	GENDER,EndNormalBW,InjectionTime.StudyDay,InjectionTime.StudyStartSeconds,Experimenter
Glucose_30	GENDER,EndNormalBW,Experimenter
Glucose_75	GENDER,EndNormalBW,Experimenter
Haem.BASabs	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Haem.HCT	GENDER,EndNormalBW,Date.StudyDay
Haem.HGB	GENDER,EndNormalBW,Date.StudyDay
Haem.LYMabs	GENDER,EndNormalBW,Date.Month,Date.StudyStartSeconds,Date.StudyDay
Haem.MCH	GENDER,EndNormalBW,Date.StudyDay
Haem.MCHC	GENDER,EndNormalBW,Age,Date.StudyDay
Haem.MCV	GENDER,Date.StudyDay
Haem.MONabs	GENDER,EndNormalBW,Date.Season,Date.Year,Date.Month,Date.StudyDay
Haem.MPV	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Haem.NEUabs	GENDER,EndNormalBW,CoatColour,Date.Season,Date.Year,Date.Month,Date.StudyDay
Haem.PCT	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Haem.PLT	GENDER,EndNormalBW,Date.StudyDay
Haem.RBC	GENDER,EndNormalBW,Date.StudyDay
Haem.RDW	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Haem.WBC	GENDER,EndNormalBW,Date.StudyDay
Imm.BCell.size	GENDER,EndNormalBW,Date.Month
Imm.CD4.size	GENDER,EndNormalBW,Date.Month
Imm.CD8.size	GENDER,EndNormalBW,Date.Month
Imm.CD4CD8Ratio	GENDER,EndNormalBW,Date.Season,Date.Month
Imm.CD4inCD3XGeoMean	GENDER,EndNormalBW,Date.Month,Date.StudyStartSeconds
Imm.CD8inCD3YGeoMean	GENDER,EndNormalBW,Date.Month,Date.StudyStartSeconds

Imm.PctB220	GENDER,EndNormalBW,Date.Month
Imm.PctCD3	GENDER,EndNormalBW,Date.Month
Imm.PctCD4	GENDER,EndNormalBW,Date.Month
Imm.PctCD4inCD3	GENDER,EndNormalBW,Date.Month
Imm.PctCD8	GENDER,EndNormalBW,Date.Month
Imm.PctCD8inCD3	GENDER,EndNormalBW,Date.Season,Date.Month
Imm.PctNKTAndOutliers	GENDER,EndNormalBW,Date.Month
AUC.IRI.AUC.G	GENDER,EndNormalBW,Date.Month,Date.StudyDay
DIRI.DG	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Glucose.AUC	GENDER,EndNormalBW,Date.Month,Experimenter,Date.StudyDay
Glucose.Delta	GENDER,EndNormalBW,Date.Month,Experimenter,Date.StudyDay
Glucose.Slope	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Insulin.0	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Insulin.15	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Insulin.30	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Insulin.75	GENDER,EndNormalBW,Experimenter,Date.Month,Date.StudyDay
Insulin.AUC	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Insulin.Delta	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Insulin.Slope	GENDER,EndNormalBW,Date.Month,Date.StudyDay
OFT.Boli	GENDER,EndNormalBW,Date.Hour,Date.Month,Date.StudyDay
OFT.CenterTime	GENDER,EndNormalBW
OFT.TotalActivity	GENDER,EndNormalBW,Experimenter,Date.StudyDay
PAS.Ambulatory1	GENDER,EndNormalBW,Experimenter,Date.StudyDay
PAS.Ambulatory6	GENDER,EndNormalBW,Date.Hour
PAS.TotalAmbulatory	GENDER,EndNormalBW,Experimenter,Date.StudyDay
PAS.TotalFine	GENDER,EndNormalBW,Date.StudyDay
Pleth.EnhancedDiff	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Pleth.base.BreathFrequency	GENDER,EndNormalBW,Date.Season,Date.Month,Date.StudyDay
Pleth.base.EnhancedPause	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Pleth.base.ExpiratoryTime	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Pleth.base.InspiratoryTime	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Pleth.base.MinuteVolume	GENDER,EndNormalBW,Date.StudyDay
Pleth.base.TidalVolume	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Pleth.meta.BreathFrequency	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Pleth.meta.EnhancedPause	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Pleth.meta.ExpiratoryTime	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Pleth.meta.InspiratoryTime	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Pleth.meta.MinuteVolume	GENDER,EndNormalBW,Date.Month,Date.StudyDay
Pleth.meta.TidalVolume	GENDER,EndNormalBW,Date.Month,Date.StudyDay

APPENDIX B

Bagphenotype Main Effect QTL

These are the 294 main effect QTL identified using Bagphenotype, as referenced in §3.4.1. The column headings are phenotype, chromosome, RMIP (QTL summary statistic, where 1 is the highest possible score), and QTL start and end locations (in bp).

phenotype	chr	RMIP	qtl.start	qtl.end
Adrenal.AdrenalMeanWeight	2	0.45	143786738	144359013
Adrenal.AdrenalMeanWeight	2	0.42	123481111	124239391
Adrenal.AdrenalMeanWeight	3	0.62	30845875	31266964
Adrenal.AdrenalMeanWeight	6	0.54	37481674	38079037
Adrenal.AdrenalMeanWeight	7	0.60	111851612	112321244
Adrenal.AdrenalMeanWeight	7	0.37	26528597	26701825
Adrenal.AdrenalMeanWeight	8	0.29	70720589	70880810
Adrenal.AdrenalMeanWeight	11	0.85	104889656	105127275
Adrenal.AdrenalMeanWeight	11	0.29	14519611	14903206
Adrenal.AdrenalMeanWeight	13	0.29	5977003	6575020
Adrenal.AdrenalMeanWeight	14	0.63	47278773	47610946
Biochem.ALP	X	0.32	101637548	103052874
Biochem.ALP	1	0.43	16837448	17297861
Biochem.ALP	4	0.28	22966056	23212380
Biochem.ALP	4	1.00	136594254	137031470
Biochem.ALP	5	0.35	26751200	26802237
Biochem.ALP	6	0.34	47596009	47907480
Biochem.ALP	8	0.27	15152117	15355016
Biochem.ALP	13	0.26	35408260	35965460
Biochem.ALP	15	0.64	13253265	13691188
Biochem.ALP	15	0.58	92076345	92458652
Biochem.ALP	17	0.82	39063900	39314765
Biochem.ALT	X	0.38	153522078	154738181
Biochem.ALT	X	0.59	49663745	50441355
Biochem.ALT	X	0.32	19748992	20920303
Biochem.ALT	3	0.27	68011701	68666753
Biochem.ALT	4	0.28	66144626	66474531
Biochem.ALT	6	0.34	30872398	31644114
Biochem.ALT	8	0.29	31809011	32371866
Biochem.ALT	8	0.29	45708217	46204214
Biochem.ALT	9	0.27	44199942	44429433
Biochem.ALT	10	0.91	98742734	99036087
Biochem.ALT	15	0.27	88047935	88522520
Biochem.Chloride	3	0.93	97507155	98035113
Biochem.Chloride	4	0.58	14958749	15072111
Biochem.Chloride	5	0.86	100641721	101275680
Biochem.Chloride	7	0.42	46946166	47173175
Biochem.Chloride	11	0.59	14612620	14997257
Biochem.Chloride	13	0.99	10064963	10826161
Biochem.Chloride	15	0.97	14525689	14812969
Biochem.Chloride	15	0.86	90596857	90759312
Biochem.HDL	1	0.31	137706366	138014096
Biochem.HDL	1	1.00	173512974	173631425
Biochem.HDL	1	0.69	103746211	104669880
Biochem.HDL	2	0.37	13792436	14231487
Biochem.HDL	2	0.30	169938514	170413806
Biochem.HDL	3	0.31	70005312	70392038
Biochem.HDL	4	0.95	109541448	109908196
Biochem.HDL	5	0.54	20753192	21119963
Biochem.HDL	6	0.25	79382020	79759628
Biochem.HDL	6	0.54	4107648	4607929
Biochem.HDL	7	0.26	73194773	73426073

Biochem.HDL	8	0.52	49778676	50078795
Biochem.HDL	18	0.60	45798061	46060011
Biochem.Phosphorous	1	0.40	173513002	173679147
Biochem.Phosphorous	2	0.31	21134873	21848398
Biochem.Phosphorous	11	0.25	30713660	30958801
Biochem.Phosphorous	11	0.49	72978371	73223858
Biochem.Phosphorous	18	0.33	83877615	84433246
Biochem.Triglycerides	2	0.30	17721904	17962047
Biochem.Triglycerides	2	0.68	57512164	57639277
Biochem.Triglycerides	3	0.33	74213736	74541941
Biochem.Triglycerides	3	0.27	59402835	59680532
Biochem.Triglycerides	3	0.26	98035113	98131534
Biochem.Triglycerides	4	0.28	125265532	126021388
Biochem.Triglycerides	4	0.58	17847456	18178916
Biochem.Triglycerides	10	0.31	25413801	25519225
Biochem.Triglycerides	10	0.54	9913339	10160516
Biochem.Triglycerides	12	0.28	67378932	68051553
Biochem.Triglycerides	13	0.27	83876493	84841025
Biochem.Triglycerides	19	0.39	26160762	26442205
Biochem.Urea	2	0.85	66188108	66339077
Biochem.Urea	7	0.26	69224043	69829234
Biochem.Urea	8	0.52	34176516	34498057
Biochem.Urea	13	0.39	11898065	12509475
CD4.CD4Count	8	0.52	23258929	23565005
CD4.CD4Count	8	0.44	14777201	15152117
CD4.CD4Count	9	0.72	61696857	62013883
CD4.CD4Count	13	0.46	54177934	54783261
CD4.CD8Count	2	0.30	13792436	14231487
CD4.CD8Count	8	0.59	15279270	15690967
CD4.CD8Count	8	0.28	71875421	72485969
CD4.CD8Count	10	0.45	79976439	80258009
CD4.CD8Count	15	0.33	76886562	77135358
CD4.CD8Count	16	0.42	93855411	94394983
CD4.CD8Count	18	0.66	18026648	18524137
Context.Mean.Freeze	2	0.27	44064311	44443738
Context.Mean.Freeze	4	0.26	66474531	66890386
Context.Mean.Freeze	8	0.28	68395771	68814125
Context.Mean.Freeze	13	0.29	47911259	48107521
Context.Mean.Freeze	16	0.59	88032927	88037391
Context.Mean.Freeze	17	0.84	12707370	13178634
Cue.Mean.Freeze.Corrected.During	15	1.00	91147389	91723248
EarPunch.EarHoleMeanArea	1	0.26	74335917	74488036
EarPunch.EarHoleMeanArea	1	0.47	172771717	173148974
EarPunch.EarHoleMeanArea	1	0.28	95279064	95905962
EarPunch.EarHoleMeanArea	1	0.38	161813131	162215119
EarPunch.EarHoleMeanArea	2	0.68	164778924	165221683
EarPunch.EarHoleMeanArea	3	0.30	141912370	142235599
EarPunch.EarHoleMeanArea	4	0.66	140166194	140528737
EarPunch.EarHoleMeanArea	4	0.32	51803136	52069787
EarPunch.EarHoleMeanArea	7	1.00	89219602	89628484
EarPunch.EarHoleMeanArea	11	0.28	6312108	6513859
EarPunch.EarHoleMeanArea	11	0.28	60881752	61574478
EarPunch.EarHoleMeanArea	18	0.99	15600228	16015601

End.Weight	X	0.54	156380260	156801190
End.Weight	3	0.41	80928334	81299007
End.Weight	3	0.54	98035113	98131534
End.Weight	4	0.41	150659678	151017396
End.Weight	4	0.49	37773315	38670260
End.Weight	5	0.26	21760276	22147944
End.Weight	6	0.31	27605607	28302421
End.Weight	7	0.44	65367018	65964613
End.Weight	10	0.97	38339766	38770767
End.Weight	11	0.27	53805218	53988266
End.Weight	12	0.32	39541226	40250023
End.Weight	12	0.35	113609980	113741390
End.Weight	12	0.68	53830588	53969744
End.Weight	15	0.72	92839368	93134753
End.Weight	17	0.41	76811277	77217163
End.Weight	18	0.26	15600228	16015601
End.Weight	18	0.28	48861550	49191214
End.Weight	19	0.43	3956242	4419602
FPS.Pre.Bang.Mean	4	0.98	87557243	88039370
FPS.Pre.Bang.Mean	6	0.49	108599580	108659081
FPS.Pre.Bang.Mean	9	0.39	59238150	59835072
FPS.Pre.Bang.Mean	11	0.27	108381128	108600081
FPS.Pre.Bang.Mean	11	0.96	116531783	116908402
FPS.Pre.Bang.Mean	15	0.49	81657003	81745113
FPS.Pre.Bang.Mean	15	1.00	91990394	92378459
FPS.Pre.Bang.Mean	17	0.49	78214131	78515909
Glucose.Glucose_75	3	0.38	128550917	128958345
Glucose.Glucose_75	4	0.92	84522419	84738519
Glucose.Glucose_75	6	0.37	94596852	95023409
Glucose.Glucose_75	15	0.32	72480554	73073329
Glucose.Glucose_75	19	0.50	16497086	16921354
Haem.BASabs	9	0.42	38263045	38635892
Haem.BASabs	18	0.35	30920314	30972624
Haem.HCT	1	0.69	191625780	191712842
Haem.HCT	2	0.26	159495462	159833677
Haem.HCT	3	0.28	74541941	74779333
Haem.HCT	3	0.28	33715275	33964549
Haem.HCT	9	0.29	58508797	58752187
Haem.HCT	17	0.30	80770639	81351500
Haem.HCT	18	0.37	56618586	56912584
Haem.MCH	1	0.31	133564393	133662206
Haem.MCH	2	0.44	78497194	78927614
Haem.MCH	6	0.82	84333438	84746715
Haem.MCH	6	0.60	92872959	93203361
Haem.MCH	7	0.99	111297435	111539097
Haem.MCH	8	0.47	123159343	123720769
Haem.MCH	8	0.28	92869685	93011781
Haem.MCH	8	0.67	84235111	84568855
Haem.MCH	8	0.44	66818506	67369013
Haem.MCH	9	1.00	108961792	109158429
Haem.MCH	10	0.25	82455510	82970768
Haem.MCH	11	0.84	5771004	6153573
Haem.MCH	11	0.63	101713427	102007903

Haem.MCH	14	1.00	70786590	70971693
Haem.MCH	15	0.51	86512676	87306911
Haem.MCH	15	0.36	72247666	72480554
Haem.MCV	1	1.00	132515586	132747429
Haem.MCV	5	0.44	21760276	22147944
Haem.MCV	6	0.33	118419659	118915770
Haem.MCV	8	0.63	67943127	68141649
Haem.MCV	9	0.92	109779388	110408954
Haem.MCV	11	0.50	16506613	16853289
Haem.MCV	13	0.70	38079327	38385387
Haem.MCV	14	1.00	70786590	70971693
Haem.MCV	14	0.83	85499213	85738128
Haem.MCV	17	0.34	85874356	86186332
Haem.MPV	X	0.33	155537023	155749245
Haem.MPV	1	1.00	172980758	173155436
Haem.MPV	2	0.28	116647258	116976418
Haem.MPV	15	0.38	98553359	98887460
Haem.MPV	19	0.53	60875841	61266404
Haem.WBC	3	0.45	35132840	35458514
Haem.WBC	4	0.47	33910931	34238266
Haem.WBC	4	0.67	136230463	136594254
Haem.WBC	7	0.42	88282967	88680004
Haem.WBC	8	0.53	15279270	15690967
Haem.WBC	11	0.49	68849550	69020023
Haem.WBC	16	0.90	39493346	39838640
Imm.CD4CD8Ratio	3	0.49	26231509	26538361
Imm.CD4CD8Ratio	3	0.29	126861851	127059593
Imm.CD4CD8Ratio	5	0.62	113588467	113832244
Imm.CD4CD8Ratio	6	0.98	71323583	71342106
Imm.CD4CD8Ratio	8	0.54	97509445	97879921
Imm.CD4CD8Ratio	9	0.43	38263045	38635892
Imm.CD4CD8Ratio	9	0.44	25697456	26263345
Imm.CD4CD8Ratio	12	0.97	30739596	30883364
Imm.CD4CD8Ratio	17	0.99	44641170	45704098
Imm.CD4CD8Ratio	17	1.00	34420136	34517928
Imm.CD4inCD3XGeoMean	1	0.29	49255589	49496117
Imm.CD4inCD3XGeoMean	1	0.32	173148974	173171049
Imm.CD4inCD3XGeoMean	2	0.34	3879916	4169609
Imm.CD4inCD3XGeoMean	2	0.25	117487158	117694452
Imm.CD4inCD3XGeoMean	3	0.42	98086868	98744531
Imm.CD4inCD3XGeoMean	4	0.74	129630675	129804877
Imm.CD4inCD3XGeoMean	5	0.61	106519195	106769381
Imm.CD4inCD3XGeoMean	6	0.60	125312051	125667401
Imm.CD4inCD3XGeoMean	7	0.50	13353999	13875817
Imm.CD4inCD3XGeoMean	9	0.40	81753346	82104520
Imm.CD4inCD3XGeoMean	10	0.45	47262385	47579405
Imm.CD4inCD3XGeoMean	13	0.35	107480591	107602250
Imm.CD4inCD3XGeoMean	16	0.59	31689506	32186535
Imm.CD4inCD3XGeoMean	17	0.31	50464072	50721050
Imm.CD8inCD3YGeoMean	2	0.40	143786738	144359013
Imm.CD8inCD3YGeoMean	4	0.33	122783070	123179153
Imm.CD8inCD3YGeoMean	10	0.44	57697414	57941566
Imm.CD8inCD3YGeoMean	15	0.89	19035197	19181632

Imm.CD8inCD3YGeoMean	15	0.72	8043432	8331330
Imm.CD8inCD3YGeoMean	16	0.73	54656264	54971641
Imm.PctB220	1	0.73	95933814	96419718
Imm.PctB220	1	0.38	130485541	130668783
Imm.PctB220	2	0.96	124821117	125127522
Imm.PctB220	2	0.30	52430672	53042542
Imm.PctB220	2	0.32	68921150	69180806
Imm.PctB220	3	0.40	109395936	109639266
Imm.PctB220	4	0.25	5251153	5606295
Imm.PctB220	5	0.64	85331648	85502488
Imm.PctB220	6	0.53	36435240	37022794
Imm.PctB220	6	0.71	136340184	136560667
Imm.PctB220	8	0.39	75503047	75702719
Imm.PctB220	8	0.77	130881543	131026984
Imm.PctB220	11	0.57	32663892	32951216
Imm.PctB220	12	0.68	25988592	26475992
Imm.PctB220	16	0.57	96264734	96723377
Imm.PctB220	16	0.67	23050231	23674997
Imm.PctCD3	1	0.84	173679147	174151791
Imm.PctCD3	1	0.60	95905962	96160263
Imm.PctCD3	2	0.99	125127522	125364587
Imm.PctCD3	3	0.41	94285935	94726527
Imm.PctCD3	3	0.41	18625290	19033618
Imm.PctCD3	6	1.00	135839502	135996423
Imm.PctCD3	7	0.59	121191677	121509474
Imm.PctCD3	11	0.27	52342239	52778134
Imm.PctCD3	12	0.34	89933366	90384450
Imm.PctCD3	12	0.64	41821284	42722559
Imm.PctCD3	13	0.43	53085859	53525724
Imm.PctCD3	17	0.50	68427741	68576493
Imm.PctCD4inCD3	3	0.35	115414977	115646074
Imm.PctCD4inCD3	3	0.32	26280500	26728308
Imm.PctCD4inCD3	5	0.29	150749356	151005494
Imm.PctCD4inCD3	5	0.76	113588467	113832244
Imm.PctCD4inCD3	6	0.95	71323583	71342106
Imm.PctCD4inCD3	8	0.32	45544937	45897278
Imm.PctCD4inCD3	8	0.36	97509445	97879921
Imm.PctCD4inCD3	9	0.34	25697456	26263345
Imm.PctCD4inCD3	9	0.40	38263045	38635892
Imm.PctCD4inCD3	11	0.49	111796613	112095415
Imm.PctCD4inCD3	12	0.99	30739596	30883364
Imm.PctCD4inCD3	17	1.00	34420136	34517928
Imm.PctCD8inCD3	3	0.38	126861851	127059593
Imm.PctCD8inCD3	3	0.55	26231509	26538361
Imm.PctCD8inCD3	5	0.30	66605887	67053013
Imm.PctCD8inCD3	5	0.55	113588467	113832244
Imm.PctCD8inCD3	6	0.94	71323583	71342106
Imm.PctCD8inCD3	8	0.50	97509445	97879921
Imm.PctCD8inCD3	9	0.46	38263045	38635892
Imm.PctCD8inCD3	12	0.94	30739596	30883364
Imm.PctCD8inCD3	17	1.00	34420136	34517928
Imm.PctCD8inCD3	17	1.00	44641170	45704098
Insulin.AUC	1	0.42	180859579	181073094

Insulin.AUC	2	0.53	166455786	166801701
Insulin.AUC	5	0.47	148792855	149012889
Insulin.AUC	6	0.47	92570387	92872959
Insulin.AUC	10	0.44	50586448	50990353
Insulin.AUC	11	0.28	8163496	8402096
Obesity.BMI	2	1.00	127973954	128300235
Obesity.BMI	6	0.43	91311931	91960999
Obesity.BMI	10	0.39	43876644	44091097
Obesity.BMI	11	0.53	99912042	100250921
OFT.Boli	3	0.43	18466041	18927810
OFT.Boli	4	0.32	94588437	95123600
OFT.Boli	6	0.30	49819443	50112764
OFT.Boli	7	0.47	149847465	150240950
OFT.Boli	10	0.33	104949312	105088384
OFT.Boli	11	0.31	4408632	4932000
OFT.Boli	15	0.33	42903032	43213422

APPENDIX

C

GxS QTL

This is an appendix of the GxS interaction, male-only main effect, and female-only main effect QTL identified by Bagphenotype, as referenced in §3.4.6.

Phenotype Category	Phenotype	Chr	Range1 (Mb)	Range2 (Mb)	RMIP	type
anatomy	AdrenalMeanWeight	2	121731696	124239391	0.31	female
anatomy	AdrenalMeanWeight	2	138033487	145107318	0.26	female
anatomy	AdrenalMeanWeight	4	122943300	125265532	0.45	female
anatomy	AdrenalMeanWeight	6	34603223	38495238	0.5	female
anatomy	AdrenalMeanWeight	7	24837074	27852765	0.32	female
anatomy	AdrenalMeanWeight	7	111381390	114746266	0.28	female
anatomy	AdrenalMeanWeight	X	129783295	133124932	0.79	female
anatomy	AdrenalMeanWeight	7	17157622	17517603	0.93	intxn
anatomy	AdrenalMeanWeight	14	118526480	118978067	0.35	intxn
anatomy	AdrenalMeanWeight	1	130485574	135256658	0.31	male
anatomy	AdrenalMeanWeight	3	29004632	39215658	0.3	male
anatomy	AdrenalMeanWeight	6	38804725	40081576	0.31	male
anatomy	AdrenalMeanWeight	7	3176074	6911682	0.28	male
anatomy	End.Weight	3	140551055	142720742	0.5	female
anatomy	End.Weight	5	20266652	22716575	0.42	female
anatomy	End.Weight	5	136305277	138095206	0.55	female
anatomy	End.Weight	13	88826415	93772727	0.32	female
anatomy	End.Weight	X	129783295	132263611	0.27	female
anatomy	End.Weight	5	59926204	60215583	0.77	intxn
anatomy	End.Weight	6	19885952	20413391	0.72	intxn
anatomy	End.Weight	19	39045504	39383344	0.77	intxn
anatomy	End.Weight	X	132120831	132473737	1	intxn
anatomy	End.Weight	5	57923864	65141892	0.4	male
anatomy	End.Weight	6	19885952	22074735	0.39	male
anatomy	End.Weight	10	36136190	36343122	0.44	male
anatomy	End.Weight	19	3185700	3717162	0.48	male
anatomy	End.Weight	X	148331809	150142966	0.26	male
anatomy	Obesity.BMI	12	87124120	88386384	0.52	female
anatomy	Obesity.BMI	1	84300299	90246244	0.32	male
anatomy	Obesity.BMI	2	115248529	120302445	0.29	male
anatomy	Obesity.BMI	2	126929073	128300235	0.5	male
anatomy	Obesity.BMI	4	3630716	5606295	0.37	male
anatomy	Obesity.BMI	6	90102227	91311931	0.34	male
anatomy	Obesity.BMI	11	98342741	101112093	0.57	male
anatomy	Obesity.BMI	14	21661895	24010972	0.31	male
anatomy	Obesity.BodyLength	1	84300299	92906418	0.52	male
anatomy	Start.Weight	1	32391447	33236435	0.4	female
anatomy	Start.Weight	3	71909206	72462519	0.29	female
anatomy	Start.Weight	3	90219126	90464434	0.42	female
anatomy	Start.Weight	4	43742456	46764494	0.57	female
anatomy	Start.Weight	X	8600783	9744195	0.25	female
anatomy	Start.Weight	2	149804648	150657049	0.94	intxn
anatomy	Start.Weight	1	15549818	18007464	0.38	male
anatomy	Start.Weight	1	32391447	33302519	0.25	male
anatomy	Start.Weight	3	113715126	116705235	0.54	male
anatomy	Start.Weight	5	63372768	65070390	0.27	male
anatomy	Start.Weight	6	92872959	95023409	0.32	male
anatomy	Start.Weight	7	64962636	65964613	0.4	male
anatomy	Start.Weight	8	13824360	18055828	0.53	male
anatomy	Start.Weight	9	74735777	80151180	0.54	male
anatomy	Start.Weight	12	3779593	7793844	0.35	male
anatomy	Start.Weight	14	56241427	58557220	0.48	male

anatomy	Start.Weight	17	74132903	78933888	0.31	male
anatomy	Start.Weight	19	19972679	21917591	0.27	male
anatomy	Start.Weight	X	152885686	158163919	0.45	male
anxiety	BurrowedPelletWeight	5	107349127	111700653	0.29	female
anxiety	BurrowedPelletWeight	7	105591657	109389714	0.38	female
anxiety	BurrowedPelletWeight	10	123922704	124772306	0.94	female
anxiety	BurrowedPelletWeight	8	73838970	75503047	0.28	male
anxiety	BurrowedPelletWeight	8	129937044	130354108	0.83	male
anxiety	Context.Mean.Freeze	6	135332855	136560667	0.27	female
anxiety	Context.Mean.Freeze	13	114908768	118393689	0.28	female
anxiety	Context.Mean.Freeze	14	47011225	48876075	0.39	female
anxiety	Context.Mean.Freeze	4	26576934	30348906	0.31	male
anxiety	Context.Mean.Freeze	13	43266279	48107521	0.78	male
anxiety	Context.Mean.Freeze	17	11997072	13825489	0.47	male
anxiety	Context.Mean.Freeze	17	46723440	50872569	0.31	male
anxiety	Context.Mean.Freeze	19	30621558	32123399	0.43	male
anxiety	Cue.Activity.Base12.Incre	14	8923889	10592743	0.47	male
anxiety	Cue.Boli	9	45405044	49784873	0.77	female
anxiety	Cue.Boli	1	34231233	35444172	0.37	male
anxiety	Cue.Boli	1	189435268	191354277	0.35	male
anxiety	Cue.Boli	6	49687282	50950045	0.33	male
anxiety	Cue.Boli	9	42649833	46368805	0.35	male
anxiety	Cue.Mean.Freeze.Correct	11	55207955	56514996	0.26	female
anxiety	Cue.Mean.Freeze.Correct	13	41224351	48013737	0.34	female
anxiety	Cue.Mean.Freeze.Correct	15	88996113	91723248	1	female
anxiety	Cue.Mean.Freeze.Correct	2	99057058	99324198	0.67	intxn
anxiety	Cue.Mean.Freeze.Correct	11	55885903	56224308	0.7	intxn
anxiety	Cue.Mean.Freeze.Correct	15	91723248	92992022	0.99	male
anxiety	Cue.Mean.Freeze.Post	3	113563124	116483896	0.35	female
anxiety	Cue.Mean.Freeze.Post	9	86761880	89333504	0.35	female
anxiety	Cue.Mean.Freeze.Post	14	77133085	78964297	0.61	female
anxiety	Cue.Mean.Freeze.Post	2	145712235	146524374	0.51	male
anxiety	Cue.Mean.Freeze.Post	4	3649723	7378587	0.26	male
anxiety	Cue.Mean.Freeze.Post	9	53636271	58318383	0.31	male
anxiety	Cue.Mean.Freeze.Post	9	106095334	107473108	0.32	male
anxiety	Cue.Mean.Freeze.Post	11	3234115	6774647	0.27	male
anxiety	Cue.Mean.Freeze.Post	12	40557473	41569343	0.25	male
anxiety	Cue.Raw.Activity.Before.T	5	121189068	123000743	0.33	female
anxiety	Cue.Raw.Activity.Before.T	10	86559122	89508168	0.36	female
anxiety	Cue.Raw.Activity.Before.T	11	20329667	22120472	0.28	female
anxiety	Cue.Raw.Activity.Before.T	13	84841025	90400197	0.33	female
anxiety	Cue.Raw.Activity.Before.T	5	4805294	7644118	0.28	male
anxiety	EPM.ClosedArmDistance	6	71326285	76742046	0.33	female
anxiety	EPM.ClosedArmDistance	11	37583470	39697632	0.6	female
anxiety	EPM.ClosedArmDistance	11	41281706	46029422	0.3	female
anxiety	EPM.ClosedArmDistance	14	71920012	74227679	0.25	female
anxiety	EPM.ClosedArmDistance	1	18595589	20623798	0.31	male
anxiety	EPM.ClosedArmDistance	9	41870531	44657615	0.33	male
anxiety	EPM.ClosedArmDistance	11	92322471	96137410	0.61	male
anxiety	EPM.ClosedArmEntries	7	47589446	49370127	0.52	female
anxiety	EPM.ClosedArmEntries	11	37583470	39912262	0.26	female
anxiety	EPM.ClosedArmEntries	10	98705083	98742734	0.91	intxn
anxiety	EPM.ClosedArmEntries	12	31568301	33843111	0.57	male

anxiety	EPM.ClosedArmTime	4	19991092	22163387	0.29	female
anxiety	EPM.ClosedArmTime	5	54717372	57923864	0.93	female
anxiety	EPM.ClosedArmTime	12	24809520	27578230	0.26	female
anxiety	EPM.ClosedArmTime	13	115746287	118129209	0.48	female
anxiety	EPM.ClosedArmTime	8	34176516	34498057	0.73	intxn
anxiety	EPM.OpenArmDistance	2	3242596	9751188	0.27	female
anxiety	EPM.OpenArmDistance	2	99342120	101424004	0.3	female
anxiety	EPM.OpenArmDistance	5	57923864	59926204	0.36	female
anxiety	EPM.OpenArmDistance	8	73838970	76584375	0.9	female
anxiety	EPM.OpenArmDistance	12	24809520	27578230	0.41	female
anxiety	EPM.OpenArmDistance	3	49558738	53064239	0.34	male
anxiety	EPM.OpenArmDistance	5	45049616	46967291	0.6	male
anxiety	EPM.OpenArmDistance	9	107385155	110408954	0.75	male
anxiety	EPM.OpenArmDistance	X	148556976	153742601	0.36	male
anxiety	EPM.OpenArmEntries	2	157291545	159087642	0.31	female
anxiety	EPM.OpenArmEntries	5	51835231	52155127	0.41	female
anxiety	EPM.OpenArmEntries	5	57771427	58345725	0.32	female
anxiety	EPM.OpenArmEntries	8	73988007	76584375	0.48	female
anxiety	EPM.OpenArmEntries	11	59042756	63825033	0.26	female
anxiety	EPM.OpenArmEntries	12	24809520	27128854	0.34	female
anxiety	EPM.OpenArmEntries	5	40028496	47339282	0.75	male
anxiety	EPM.OpenArmEntries	8	44107730	52845104	0.37	male
anxiety	EPM.OpenArmEntries	9	108700691	115055684	0.91	male
anxiety	EPM.OpenArmEntries	11	55885903	58057719	0.34	male
anxiety	EPM.OpenArmEntries	16	4086320	11503552	0.32	male
anxiety	EPM.OpenArmEntries	16	28564306	29736307	0.49	male
anxiety	EPM.OpenArmLatency	11	57337706	61265965	0.4	female
anxiety	EPM.OpenArmLatency	5	49045511	52211020	0.35	male
anxiety	EPM.OpenArmLatency	7	100461337	102506843	0.45	male
anxiety	EPM.OpenArmLatency	9	108100995	110265241	0.64	male
anxiety	EPM.OpenArmLatency	9	112348235	114377814	0.3	male
anxiety	EPM.OpenArmTime	2	99342120	100920628	0.25	female
anxiety	EPM.OpenArmTime	5	51835231	52211020	0.26	female
anxiety	EPM.OpenArmTime	5	57923864	60073894	0.28	female
anxiety	EPM.OpenArmTime	8	73838970	76584375	0.35	female
anxiety	EPM.OpenArmTime	11	104889656	105975540	0.38	female
anxiety	EPM.OpenArmTime	12	24809520	27258227	0.53	female
anxiety	EPM.OpenArmTime	9	107985586	111619685	0.84	male
anxiety	EPM.OpenArmTime	10	86050797	92719757	0.48	male
anxiety	FN.Latency	2	152016647	152404384	0.36	female
anxiety	FN.Latency	5	113197260	115597784	0.27	female
anxiety	FN.Latency	8	110196846	112023203	0.58	female
anxiety	FN.Latency	11	4131025	6312108	0.69	female
anxiety	FN.Latency	13	101266394	102063111	0.25	female
anxiety	FN.Latency	14	39677786	45448999	0.33	female
anxiety	FN.Latency	3	26280500	26728308	0.62	intxn
anxiety	FN.Latency	1	28472943	29807882	0.35	male
anxiety	FN.Latency	3	108821923	111397830	0.69	male
anxiety	FN.Latency	5	54048218	55615198	0.28	male
anxiety	FN.Latency	7	55758009	56783028	0.49	male
anxiety	FN.Latency	10	46577582	47579405	0.39	male
anxiety	FN.Latency	11	70926346	71293246	0.26	male
anxiety	FN.Latency	15	81061515	85601159	0.33	male

anxiety	FN.PctWtLoss	4	41427544	43912491	0.72	female
anxiety	FN.PctWtLoss	7	16621421	18591248	0.31	female
anxiety	FN.PctWtLoss	3	53884479	65830719	0.51	male
anxiety	FN.PctWtLoss	13	23956541	24397882	0.32	male
anxiety	FN.PctWtLoss	13	42402705	44979717	0.27	male
anxiety	FN.PctWtLoss	16	74160826	74869924	0.25	male
anxiety	FN.PctWtLoss	X	130309973	133124932	0.55	male
anxiety	FPS.Bang.Increase	15	90828181	92458652	0.59	female
anxiety	FPS.Bang.Increase	18	75971158	76464318	0.31	female
anxiety	FPS.Bang.Tone.Increase	3	29004632	30281954	0.38	female
anxiety	FPS.Bang.Tone.Increase	14	48938392	51129987	0.4	female
anxiety	FPS.Bang.Tone.Increase	17	68420921	69149097	0.51	female
anxiety	FPS.Bang.Tone.Increase	18	76110458	76451075	0.29	female
anxiety	FPS.Bang.Tone.Increase	4	35256917	38927814	0.26	male
anxiety	FPS.Bang.Tone.Increase	4	122629027	124745301	0.26	male
anxiety	FPS.Bang.Tone.Increase	10	123833587	124928036	0.52	male
anxiety	FPS.Pre.Bang.Mean	1	171780175	172980758	0.26	female
anxiety	FPS.Pre.Bang.Mean	11	107458150	108977608	0.76	female
anxiety	FPS.Pre.Bang.Mean	14	74925298	77890117	0.45	female
anxiety	FPS.Pre.Bang.Mean	15	90718436	92378459	1	female
anxiety	FPS.Pre.Bang.Mean	6	18107483	18272123	0.83	intxn
anxiety	FPS.Pre.Bang.Mean	2	170652373	172529097	0.31	male
anxiety	FPS.Pre.Bang.Mean	4	87106864	88541977	0.48	male
anxiety	FPS.Pre.Bang.Mean	4	90379743	98986670	0.62	male
anxiety	FPS.Pre.Bang.Mean	6	108599580	112015741	0.25	male
anxiety	FPS.Pre.Bang.Mean	7	36124756	37554905	0.27	male
anxiety	FPS.Pre.Bang.Mean	11	116531783	121529538	1	male
anxiety	FPS.Pre.Bang.Mean	15	90718436	92992022	0.99	male
anxiety	FPS.Pre.Bang.Mean	17	62731881	63149098	0.3	male
anxiety	FPS.Pre.Bang.Mean	X	61868716	65868119	0.38	male
anxiety	FPS.Pre.Bang.Tone.Mean	3	108995223	110356843	0.31	female
anxiety	FPS.Pre.Bang.Tone.Mean	14	75108998	77890117	0.47	female
anxiety	FPS.Pre.Bang.Tone.Mean	15	90828181	92378459	1	female
anxiety	FPS.Pre.Bang.Tone.Mean	6	18107483	18272123	0.81	intxn
anxiety	FPS.Pre.Bang.Tone.Mean	2	170413806	172529097	0.78	male
anxiety	FPS.Pre.Bang.Tone.Mean	4	86870741	88952212	0.48	male
anxiety	FPS.Pre.Bang.Tone.Mean	4	90787855	98986670	0.7	male
anxiety	FPS.Pre.Bang.Tone.Mean	7	35699798	37554905	0.3	male
anxiety	FPS.Pre.Bang.Tone.Mean	11	115383256	120581606	0.97	male
anxiety	FPS.Pre.Bang.Tone.Mean	15	88996113	92992022	1	male
anxiety	OFT.Boli	10	73132593	74981509	0.25	female
anxiety	OFT.Boli	11	3454099	7106175	0.6	female
anxiety	OFT.Boli	18	65605243	69905227	0.31	female
anxiety	OFT.Boli	3	97507155	98035113	0.85	intxn
anxiety	OFT.Boli	11	6774647	7285878	0.6	intxn
anxiety	OFT.Boli	12	87124120	87446547	0.58	intxn
anxiety	OFT.Boli	3	18466041	19163210	0.69	male
anxiety	OFT.CenterTime	2	20293263	21541388	0.25	female
anxiety	OFT.CenterTime	2	43299979	45522449	0.39	female
anxiety	OFT.CenterTime	2	130877423	132094012	0.28	female
anxiety	OFT.CenterTime	5	52325991	54048218	0.37	female
anxiety	OFT.CenterTime	11	4131025	5272253	0.37	female
anxiety	OFT.CenterTime	11	46580508	47930783	0.3	female

anxiety	OFT.CenterTime	12	7420720	9657085	0.25	female
anxiety	OFT.Latency	3	93051579	94926232	0.47	female
anxiety	OFT.Latency	9	74735777	77217184	0.47	female
anxiety	OFT.Latency	11	4408632	5429786	0.28	female
anxiety	OFT.Latency	11	27138460	29118438	0.39	female
anxiety	OFT.Latency	13	118393689	119173337	0.45	female
anxiety	OFT.Latency	15	84968102	86131284	0.49	female
anxiety	OFT.Latency	19	39045504	39383344	0.52	intxn
anxiety	OFT.Latency	11	81884699	83521835	0.84	male
anxiety	OFT.TotalActivity	2	139321967	141506351	0.65	female
anxiety	OFT.TotalActivity	5	23652158	23915252	0.38	female
anxiety	OFT.TotalActivity	7	69953899	71545069	0.28	female
anxiety	OFT.TotalActivity	9	46583551	48727355	0.32	female
anxiety	OFT.TotalActivity	10	124274319	128446742	0.73	female
anxiety	OFT.TotalActivity	11	26185985	29619848	0.58	female
anxiety	OFT.TotalActivity	11	45737555	46978283	0.41	female
anxiety	OFT.TotalActivity	13	115226491	115957149	0.27	female
anxiety	OFT.TotalActivity	6	49388381	50804267	0.29	male
anxiety	OFT.TotalActivity	7	71067331	73604499	0.47	male
anxiety	OFT.TotalActivity	7	100461337	103823476	0.25	male
anxiety	OFT.TotalActivity	10	123170614	124772306	0.29	male
anxiety	OFT.TotalActivity	11	92666343	98931599	0.46	male
anxiety	OFT.TotalActivity	11	105905627	107825609	0.28	male
anxiety	PAS.Ambulatory1	2	67347571	69773718	0.61	female
anxiety	PAS.Ambulatory1	11	22375936	25668891	0.28	female
anxiety	PAS.Ambulatory1	12	7420720	9954905	1	female
anxiety	PAS.Ambulatory1	16	27436301	27554840	0.65	intxn
anxiety	PAS.Ambulatory1	10	124928036	126249966	0.4	male
anxiety	PAS.Ambulatory1	11	20853203	24079054	0.35	male
anxiety	PAS.Ambulatory1	13	115226491	118645264	0.6	male
anxiety	PAS.TotalAmbulatory	1	3397373	6645944	0.55	female
anxiety	PAS.TotalAmbulatory	1	45566104	47260916	0.34	female
anxiety	PAS.TotalAmbulatory	2	7832634	10142362	0.67	female
anxiety	PAS.TotalAmbulatory	4	80950026	87055009	0.25	female
anxiety	PAS.TotalAmbulatory	11	21655867	22652379	0.27	female
anxiety	PAS.TotalAmbulatory	12	45826130	54936906	0.31	female
anxiety	PAS.TotalAmbulatory	14	38908201	39961649	0.39	female
anxiety	PAS.TotalAmbulatory	14	119355200	120110781	0.25	female
anxiety	PAS.TotalAmbulatory	7	4187447	4318365	0.52	intxn
anxiety	PAS.TotalAmbulatory	14	45448999	46175254	0.67	intxn
anxiety	PAS.TotalAmbulatory	7	47173175	47652751	0.39	male
anxiety	PAS.TotalAmbulatory	11	20218491	24572649	0.6	male
anxiety	PAS.TotalAmbulatory	15	30285053	34371808	0.54	male
anxiety	PAS.TotalFine	2	3046003	10142362	0.26	female
anxiety	PAS.TotalFine	4	116619969	118686859	0.47	female
anxiety	PAS.TotalFine	7	3667112	10749178	0.25	female
anxiety	PAS.TotalFine	11	99912042	104023311	0.55	female
anxiety	PAS.TotalFine	12	25413744	28507607	0.33	female
anxiety	PAS.TotalFine	13	94443333	98040091	0.4	female
anxiety	PAS.TotalFine	14	35141766	41430391	0.64	female
anxiety	PAS.TotalFine	7	3667112	4318332	0.7	intxn
anxiety	PAS.TotalFine	14	105941016	106668015	0.66	intxn
anxiety	PAS.TotalFine	18	72568975	72861816	0.61	intxn

anxiety	PAS.TotalFine	19	28130643	28172741	0.76	intxn
anxiety	PAS.TotalFine	4	104379829	105321384	0.94	male
anxiety	PAS.TotalFine	14	104560215	106935972	0.43	male
anxiety	PAS.TotalFine	15	29961592	32283162	0.55	male
anxiety	PAS.TotalFine	19	26442205	26805976	0.37	male
asthma	Pleth.base.BreathFreque	1	63624905	66461385	0.34	female
asthma	Pleth.base.BreathFreque	4	148493933	149135934	0.73	female
asthma	Pleth.base.BreathFreque	6	109902083	110763328	0.28	female
asthma	Pleth.base.BreathFreque	X	162637797	163789960	0.61	intxn
asthma	Pleth.base.BreathFreque	1	74335917	76887544	0.37	male
asthma	Pleth.base.BreathFreque	1	133649413	137179674	0.31	male
asthma	Pleth.base.BreathFreque	1	190268338	191159138	0.4	male
asthma	Pleth.base.BreathFreque	2	57512164	58748595	0.39	male
asthma	Pleth.base.BreathFreque	9	107473108	108700691	0.32	male
asthma	Pleth.base.BreathFreque	15	3927809	5426959	0.25	male
asthma	Pleth.base.EnhancedPau	17	91175280	92089638	0.51	female
asthma	Pleth.base.EnhancedPau	19	22531208	24536944	0.27	female
asthma	Pleth.base.EnhancedPau	2	42930156	48251240	0.39	male
asthma	Pleth.base.EnhancedPau	13	65287142	69092547	0.25	male
asthma	Pleth.base.EnhancedPau	13	98551075	101466172	0.58	male
asthma	Pleth.base.ExpiratoryTin	1	26311456	27171199	0.3	female
asthma	Pleth.base.ExpiratoryTin	1	62750655	66461385	0.55	female
asthma	Pleth.base.ExpiratoryTin	3	52308561	54853162	0.43	female
asthma	Pleth.base.ExpiratoryTin	4	147376306	149135934	0.78	female
asthma	Pleth.base.ExpiratoryTin	5	87894371	91079516	0.28	female
asthma	Pleth.base.ExpiratoryTin	6	109407139	113251562	0.38	female
asthma	Pleth.base.ExpiratoryTin	6	117050539	119067079	0.34	female
asthma	Pleth.base.ExpiratoryTin	7	4463972	5036704	0.41	female
asthma	Pleth.base.ExpiratoryTin	1	73645168	76557445	0.4	male
asthma	Pleth.base.ExpiratoryTin	1	133564393	135115263	0.37	male
asthma	Pleth.base.ExpiratoryTin	2	57563965	58748595	0.31	male
asthma	Pleth.base.ExpiratoryTin	9	113200134	113998284	0.48	male
asthma	Pleth.base.ExpiratoryTin	11	92666343	95910003	0.77	male
asthma	Pleth.base.ExpiratoryTin	14	86833310	87921720	0.27	male
asthma	Pleth.base.ExpiratoryTin	14	91470264	93389102	0.38	male
asthma	Pleth.base.InspiratoryTi	4	148054146	149135934	0.53	female
asthma	Pleth.base.InspiratoryTi	6	109902083	113251562	0.51	female
asthma	Pleth.base.InspiratoryTi	1	189435268	190735257	0.78	male
asthma	Pleth.base.InspiratoryTi	4	106111465	106748034	0.31	male
asthma	Pleth.base.InspiratoryTi	8	122856564	123361348	0.48	male
asthma	Pleth.base.InspiratoryTi	15	3927809	5426959	0.32	male
asthma	Pleth.base.InspiratoryTi	17	28575749	29373829	0.6	male
asthma	Pleth.base.MinuteVolum	2	5376317	6232263	0.34	female
asthma	Pleth.base.MinuteVolum	6	117050539	119361386	0.33	female
asthma	Pleth.base.MinuteVolum	5	147658707	149410472	0.36	male
asthma	Pleth.base.MinuteVolum	14	30433259	31698942	0.42	male
asthma	Pleth.base.MinuteVolum	16	24006175	24764645	0.25	male
asthma	Pleth.base.TidalVolume	11	92924770	96166802	0.66	female
asthma	Pleth.base.TidalVolume	12	34644286	37051142	0.25	female
asthma	Pleth.base.TidalVolume	8	95465648	97213397	0.63	male
asthma	Pleth.base.TidalVolume	15	89413198	89873413	0.37	male
asthma	Pleth.base.TidalVolume	16	32471847	35110554	0.35	male
asthma	Pleth.EnhancedDiff	4	144118797	147273762	0.34	female

asthma	Pleth.EnhancedDiff	5	70161473	71288882	0.25	male
asthma	Pleth.EnhancedDiff	7	140819613	142025996	0.38	male
asthma	Pleth.EnhancedDiff	11	64084780	72264312	0.25	male
asthma	Pleth.EnhancedDiff	11	100224573	105127275	0.56	male
asthma	Pleth.EnhancedDiff	12	56422669	61665885	0.78	male
asthma	Pleth.EnhancedDiff	17	30905773	35338547	0.25	male
asthma	Pleth.EnhancedDiff	17	49404168	54779006	0.81	male
asthma	Pleth.meta.BreathFreque	4	144118797	147273762	0.29	female
asthma	Pleth.meta.BreathFreque	8	110469016	113064325	0.94	female
asthma	Pleth.meta.BreathFreque	9	107733362	111126430	0.74	female
asthma	Pleth.meta.BreathFreque	X	39577766	40000413	0.54	female
asthma	Pleth.meta.BreathFreque	1	126908217	127170858	0.86	intxn
asthma	Pleth.meta.BreathFreque	1	42520890	45641714	0.33	male
asthma	Pleth.meta.BreathFreque	9	108417099	111126430	0.72	male
asthma	Pleth.meta.BreathFreque	12	106289356	110900130	0.3	male
asthma	Pleth.meta.BreathFreque	17	30905773	33699903	0.27	male
asthma	Pleth.meta.BreathFreque	17	52750785	55637822	0.83	male
asthma	Pleth.meta.BreathFreque	18	25646615	30597319	0.26	male
asthma	Pleth.meta.BreathFreque	19	14710093	16921354	0.28	male
asthma	Pleth.meta.EnhancedPau	4	144042787	144909460	0.3	female
asthma	Pleth.meta.EnhancedPau	13	72730481	72990649	0.73	intxn
asthma	Pleth.meta.EnhancedPau	1	124702258	130485541	0.26	male
asthma	Pleth.meta.EnhancedPau	5	70161473	71133199	0.26	male
asthma	Pleth.meta.EnhancedPau	7	141188524	142025996	0.31	male
asthma	Pleth.meta.EnhancedPau	11	100250921	105850994	0.39	male
asthma	Pleth.meta.EnhancedPau	12	56422669	58286624	0.37	male
asthma	Pleth.meta.EnhancedPau	17	50721050	54779006	0.49	male
asthma	Pleth.meta.ExpiratoryTir	4	141465582	142095083	0.31	female
asthma	Pleth.meta.ExpiratoryTir	6	118751926	119134752	0.33	female
asthma	Pleth.meta.ExpiratoryTir	6	131382302	135928182	0.4	female
asthma	Pleth.meta.ExpiratoryTir	9	109590865	110701061	0.43	female
asthma	Pleth.meta.ExpiratoryTir	1	126908217	127170858	0.82	intxn
asthma	Pleth.meta.ExpiratoryTir	6	132813297	133640518	0.74	intxn
asthma	Pleth.meta.ExpiratoryTir	1	23170215	27952444	0.46	male
asthma	Pleth.meta.ExpiratoryTir	1	76153308	78164064	0.86	male
asthma	Pleth.meta.ExpiratoryTir	18	27595271	30138131	0.47	male
asthma	Pleth.meta.InspiratoryTi	1	74335917	77223961	0.36	female
asthma	Pleth.meta.InspiratoryTi	4	147376306	149683429	0.48	female
asthma	Pleth.meta.InspiratoryTi	11	19879576	24656630	0.26	female
asthma	Pleth.meta.InspiratoryTi	11	31265392	32394877	0.36	female
asthma	Pleth.meta.InspiratoryTi	17	49562269	54965922	0.41	female
asthma	Pleth.meta.InspiratoryTi	4	147376306	147659124	0.62	intxn
asthma	Pleth.meta.InspiratoryTi	1	190342085	190994061	0.33	male
asthma	Pleth.meta.InspiratoryTi	5	68173658	71288882	0.52	male
asthma	Pleth.meta.InspiratoryTi	9	97259653	98080805	0.39	male
asthma	Pleth.meta.InspiratoryTi	11	98624873	101318682	0.25	male
asthma	Pleth.meta.InspiratoryTi	17	52300225	54779006	0.87	male
asthma	Pleth.meta.InspiratoryTi	18	28259743	30138131	0.3	male
asthma	Pleth.meta.InspiratoryTi	18	88720555	89867333	0.36	male
asthma	Pleth.meta.MinuteVolum	1	67618256	69916453	0.32	female
asthma	Pleth.meta.MinuteVolum	7	46946166	47861053	0.32	female
asthma	Pleth.meta.MinuteVolum	8	25962994	27552504	0.86	female
asthma	Pleth.meta.MinuteVolum	12	10357457	10607023	0.39	female

asthma	Pleth.meta.MinuteVolum	17	52300225	54128328	0.29	female
asthma	Pleth.meta.MinuteVolum	1	35090385	35935717	0.58	male
asthma	Pleth.meta.MinuteVolum	9	110701061	111255564	0.35	male
asthma	Pleth.meta.MinuteVolum	11	30780122	32860837	0.34	male
asthma	Pleth.meta.MinuteVolum	18	29519995	30771579	0.28	male
asthma	Pleth.meta.MinuteVolum	18	85150840	86749571	0.49	male
asthma	Pleth.meta.TidalVolume	7	46946166	47589446	0.25	female
asthma	Pleth.meta.TidalVolume	8	25612706	27552504	0.46	female
asthma	Pleth.meta.TidalVolume	14	37340626	38455338	0.38	female
asthma	Pleth.meta.TidalVolume	17	30905773	34993182	0.58	female
asthma	Pleth.meta.TidalVolume	1	171780175	175295409	0.59	male
asthma	Pleth.meta.TidalVolume	2	172563606	174553973	0.25	male
asthma	Pleth.meta.TidalVolume	5	70535407	73915574	0.34	male
asthma	Pleth.meta.TidalVolume	9	85678209	87870135	0.54	male
asthma	Pleth.meta.TidalVolume	17	34333839	37015293	0.63	male
asthma	Pleth.meta.TidalVolume	17	49404168	54433192	0.29	male
asthma	Pleth.meta.TidalVolume	18	87800560	89867333	0.31	male
asthma	Pleth.meta.TidalVolume	19	51021889	56744415	0.3	male
biochemistry	Biochem.Albumin	1	73785852	75283346	0.35	female
biochemistry	Biochem.Albumin	6	111302621	114213243	0.38	female
biochemistry	Biochem.Albumin	11	32646121	34127561	0.95	female
biochemistry	Biochem.Albumin	19	10248920	16955850	0.54	female
biochemistry	Biochem.Albumin	15	37299247	37710359	0.85	intxn
biochemistry	Biochem.Albumin	4	25691755	27943470	0.25	male
biochemistry	Biochem.Albumin	18	68674028	70283257	0.78	male
biochemistry	Biochem.ALP	1	130668783	133564393	0.6	female
biochemistry	Biochem.ALP	4	134974246	139804324	1	female
biochemistry	Biochem.ALP	5	65434363	67053013	0.36	female
biochemistry	Biochem.ALP	9	103527697	107607630	0.37	female
biochemistry	Biochem.ALP	12	107058673	109140900	0.25	female
biochemistry	Biochem.ALP	15	28975560	30896669	0.26	female
biochemistry	Biochem.ALP	17	33517617	43780952	0.31	female
biochemistry	Biochem.ALP	4	135525051	141170941	1	male
biochemistry	Biochem.ALP	5	89422254	93062967	0.37	male
biochemistry	Biochem.ALP	6	43905925	47731981	0.52	male
biochemistry	Biochem.ALP	19	22628546	24783638	0.26	male
biochemistry	Biochem.ALP	X	106221447	115361139	0.77	male
biochemistry	Biochem.ALT	1	186627043	187552612	0.29	female
biochemistry	Biochem.ALT	2	161278733	165221683	0.88	female
biochemistry	Biochem.ALT	X	98027281	101301320	0.33	female
biochemistry	Biochem.ALT	2	161278733	161565938	0.98	intxn
biochemistry	Biochem.ALT	5	55615198	56469165	0.58	intxn
biochemistry	Biochem.ALT	X	99934965	101301320	0.87	intxn
biochemistry	Biochem.ALT	2	150449200	153029515	0.37	male
biochemistry	Biochem.ALT	3	97507155	101413815	0.43	male
biochemistry	Biochem.ALT	4	127685633	130281463	0.31	male
biochemistry	Biochem.ALT	X	49663745	51078517	0.35	male
biochemistry	Biochem.AST	3	28979184	30845875	0.39	female
biochemistry	Biochem.AST	8	105860113	106368411	0.25	female
biochemistry	Biochem.AST	11	57574025	57644675	0.4	female
biochemistry	Biochem.AST	12	55550090	55988845	0.71	female
biochemistry	Biochem.AST	1	37372166	38555850	0.28	male
biochemistry	Biochem.AST	9	103604005	104015736	0.69	male

biochemistry	Biochem.AST	11	67705817	69031637	0.3	male
biochemistry	Biochem.Calcium	2	138305655	141777975	0.67	female
biochemistry	Biochem.Calcium	3	11119213	19033618	0.27	female
biochemistry	Biochem.Calcium	5	148799645	152187052	0.47	female
biochemistry	Biochem.Calcium	19	15843635	20275251	0.33	female
biochemistry	Biochem.Calcium	1	73785852	74415713	0.9	intxn
biochemistry	Biochem.Calcium	3	116605948	116623304	0.8	intxn
biochemistry	Biochem.Calcium	4	147768302	147982503	0.8	intxn
biochemistry	Biochem.Calcium	5	113588467	113832244	0.85	intxn
biochemistry	Biochem.Calcium	17	73285454	73689769	0.75	intxn
biochemistry	Biochem.Calcium	X	124092229	126177730	0.95	intxn
biochemistry	Biochem.Calcium	3	97507155	98035113	0.73	male
biochemistry	Biochem.Calcium	5	5431978	8916439	0.66	male
biochemistry	Biochem.Calcium	8	101142950	105277540	0.33	male
biochemistry	Biochem.Calcium	15	58447977	64422310	0.57	male
biochemistry	Biochem.Calcium	16	8838458	10700907	0.38	male
biochemistry	Biochem.Chloride	1	73464630	75283346	0.3	female
biochemistry	Biochem.Chloride	2	52430672	53042542	0.34	female
biochemistry	Biochem.Chloride	3	80665579	81299007	0.28	female
biochemistry	Biochem.Chloride	5	10670977	13998275	0.26	female
biochemistry	Biochem.Chloride	5	148792855	150849955	0.41	female
biochemistry	Biochem.Chloride	8	47724730	49778676	0.4	female
biochemistry	Biochem.Chloride	15	10505166	15646749	0.33	female
biochemistry	Biochem.Chloride	15	18084710	20105239	0.27	female
biochemistry	Biochem.Chloride	18	34792252	39107143	0.33	female
biochemistry	Biochem.Chloride	19	18712951	22263388	0.61	female
biochemistry	Biochem.Chloride	1	74635389	74948665	0.8	intxn
biochemistry	Biochem.Chloride	2	52430672	53042542	0.78	intxn
biochemistry	Biochem.Chloride	4	147982503	148054146	0.95	intxn
biochemistry	Biochem.Chloride	6	114357138	114760348	0.86	intxn
biochemistry	Biochem.Chloride	8	16233475	16536522	0.82	intxn
biochemistry	Biochem.Chloride	10	69222854	69508434	0.75	intxn
biochemistry	Biochem.Chloride	14	61521914	61810249	0.66	intxn
biochemistry	Biochem.Chloride	18	26291450	26717265	0.82	intxn
biochemistry	Biochem.Chloride	X	124092229	126177730	0.98	intxn
biochemistry	Biochem.Chloride	2	144810472	145857974	0.3	male
biochemistry	Biochem.Chloride	3	97507155	98763055	0.67	male
biochemistry	Biochem.Chloride	5	5431978	8916439	0.29	male
biochemistry	Biochem.Chloride	5	45254182	49876647	0.33	male
biochemistry	Biochem.Chloride	8	90852652	93011781	0.46	male
biochemistry	Biochem.Chloride	11	67962799	72150322	0.57	male
biochemistry	Biochem.Chloride	13	4597936	11898065	0.38	male
biochemistry	Biochem.Chloride	15	66752114	68411183	0.25	male
biochemistry	Biochem.Creatinine	2	145107318	145712235	0.25	female
biochemistry	Biochem.Creatinine	5	23915252	24391217	0.27	female
biochemistry	Biochem.Creatinine	8	31698271	33937411	0.28	female
biochemistry	Biochem.Creatinine	9	80013484	80065966	0.74	intxn
biochemistry	Biochem.Creatinine	9	92122215	92554542	0.91	male
biochemistry	Biochem.Creatinine	10	15130657	17233143	0.33	male
biochemistry	Biochem.Creatinine	11	98624873	101318682	0.43	male
biochemistry	Biochem.Creatinine	18	68820867	72137571	0.26	male
biochemistry	Biochem.Glucose	2	17721904	19676382	0.27	female
biochemistry	Biochem.Glucose	7	127271445	129257291	0.83	female

biochemistry	Biochem.Glucose	8	52039468	52720464	0.57	female
biochemistry	Biochem.Glucose	3	18927810	22640318	0.93	male
biochemistry	Biochem.Glucose	15	81061515	85631824	0.28	male
biochemistry	Biochem.HDL	1	173512974	175295409	1	female
biochemistry	Biochem.HDL	3	80665579	81299007	0.63	female
biochemistry	Biochem.HDL	4	108770805	111199155	0.62	female
biochemistry	Biochem.HDL	4	114037242	117083314	0.35	female
biochemistry	Biochem.HDL	7	31205452	31244528	0.43	female
biochemistry	Biochem.HDL	7	73843465	76700446	0.34	female
biochemistry	Biochem.HDL	8	48616114	53645706	0.34	female
biochemistry	Biochem.HDL	10	43355687	44882191	0.27	female
biochemistry	Biochem.HDL	10	68029824	70917635	0.44	female
biochemistry	Biochem.HDL	18	44316600	49028056	0.29	female
biochemistry	Biochem.HDL	X	153742601	156801190	0.57	female
biochemistry	Biochem.HDL	1	133401871	133564393	0.79	intxn
biochemistry	Biochem.HDL	3	60744554	61072070	0.88	intxn
biochemistry	Biochem.HDL	5	113588467	113832244	0.41	intxn
biochemistry	Biochem.HDL	7	132205716	132496708	0.68	intxn
biochemistry	Biochem.HDL	9	28739110	29112775	0.86	intxn
biochemistry	Biochem.HDL	12	92498332	92775317	0.88	intxn
biochemistry	Biochem.HDL	16	32232369	32471847	0.69	intxn
biochemistry	Biochem.HDL	17	73285454	73689769	0.69	intxn
biochemistry	Biochem.HDL	X	39577766	40000413	1	intxn
biochemistry	Biochem.HDL	1	171235205	173631425	1	male
biochemistry	Biochem.HDL	4	103313211	110238889	0.68	male
biochemistry	Biochem.HDL	5	128047790	135611538	0.44	male
biochemistry	Biochem.HDL	6	45986359	51845790	0.27	male
biochemistry	Biochem.HDL	10	101837924	102461576	0.37	male
biochemistry	Biochem.HDL	15	62952529	63489848	0.32	male
biochemistry	Biochem.HDL	15	81657003	85458326	0.34	male
biochemistry	Biochem.LDL	1	184271870	185401055	0.46	female
biochemistry	Biochem.LDL	4	89292013	91009109	0.29	female
biochemistry	Biochem.LDL	4	128200051	133435313	0.26	female
biochemistry	Biochem.LDL	5	24760691	31562855	0.27	female
biochemistry	Biochem.LDL	15	77135358	81657003	0.46	female
biochemistry	Biochem.LDL	16	83406529	85165653	0.35	female
biochemistry	Biochem.LDL	19	23295631	26429667	0.5	female
biochemistry	Biochem.LDL	19	23295631	23661236	0.72	intxn
biochemistry	Biochem.LDL	1	185385632	186627043	0.38	male
biochemistry	Biochem.LDL	2	156698689	158683823	0.46	male
biochemistry	Biochem.LDL	4	98811889	109541448	0.52	male
biochemistry	Biochem.LDL	11	32327598	37271257	0.41	male
biochemistry	Biochem.Phosphorous	3	40783983	41907956	0.33	female
biochemistry	Biochem.Phosphorous	4	38269852	40396917	0.33	female
biochemistry	Biochem.Phosphorous	16	93538251	96039450	0.38	female
biochemistry	Biochem.Phosphorous	18	80279943	87142544	0.48	female
biochemistry	Biochem.Phosphorous	16	89362055	89533020	0.62	intxn
biochemistry	Biochem.Phosphorous	19	48448264	48972782	0.66	intxn
biochemistry	Biochem.Phosphorous	2	36091355	38382286	0.56	male
biochemistry	Biochem.Phosphorous	3	86709915	87781832	0.31	male
biochemistry	Biochem.Phosphorous	4	130913579	131555056	0.29	male
biochemistry	Biochem.Phosphorous	5	6240949	7869718	0.27	male
biochemistry	Biochem.Phosphorous	6	147672016	149016561	0.26	male

biochemistry	Biochem.Phosphorous	8	13824360	15993277	0.6	male
biochemistry	Biochem.Phosphorous	9	112348235	115055684	0.32	male
biochemistry	Biochem.Phosphorous	11	36127399	39837716	0.39	male
biochemistry	Biochem.Phosphorous	15	82049630	89873413	0.44	male
biochemistry	Biochem.Sodium	1	74415713	74948665	0.55	female
biochemistry	Biochem.Sodium	5	100055311	101656677	0.25	female
biochemistry	Biochem.Sodium	5	145979296	150210576	0.36	female
biochemistry	Biochem.Sodium	8	47724730	51298931	0.29	female
biochemistry	Biochem.Sodium	18	30610787	36662957	0.31	female
biochemistry	Biochem.Sodium	X	127442520	130309973	0.26	female
biochemistry	Biochem.Sodium	1	74635389	74948665	0.86	intxn
biochemistry	Biochem.Sodium	2	135137887	135469618	0.76	intxn
biochemistry	Biochem.Sodium	3	116605948	116623304	0.54	intxn
biochemistry	Biochem.Sodium	4	147982503	148054146	0.97	intxn
biochemistry	Biochem.Sodium	5	113588467	113832244	0.94	intxn
biochemistry	Biochem.Sodium	6	114357138	114760348	0.81	intxn
biochemistry	Biochem.Sodium	17	73285454	73689769	0.66	intxn
biochemistry	Biochem.Sodium	X	124092229	126177730	0.96	intxn
biochemistry	Biochem.Sodium	2	133748072	135758294	0.35	male
biochemistry	Biochem.Sodium	3	97507155	98131534	0.39	male
biochemistry	Biochem.Sodium	5	3968674	8916439	0.45	male
biochemistry	Biochem.Sodium	10	89143688	92120795	0.33	male
biochemistry	Biochem.Sodium	18	11226896	11370513	0.3	male
biochemistry	Biochem.Tot.Cholesterol	1	87559483	93218794	0.32	female
biochemistry	Biochem.Tot.Cholesterol	1	172980758	173631425	1	female
biochemistry	Biochem.Tot.Cholesterol	11	83732214	86549892	0.88	female
biochemistry	Biochem.Tot.Cholesterol	15	8331330	12971988	0.5	female
biochemistry	Biochem.Tot.Cholesterol	4	124579015	125265532	0.64	intxn
biochemistry	Biochem.Tot.Cholesterol	1	61597351	63947477	0.35	male
biochemistry	Biochem.Tot.Cholesterol	1	173171049	173631425	1	male
biochemistry	Biochem.Tot.Cholesterol	4	103116893	104379829	0.56	male
biochemistry	Biochem.Tot.Cholesterol	7	39052660	47861053	0.26	male
biochemistry	Biochem.Tot.Cholesterol	8	13604916	16233475	0.25	male
biochemistry	Biochem.Tot.Cholesterol	12	90148649	90789877	0.54	male
biochemistry	Biochem.Tot.Protein	8	117662831	120068815	0.32	female
biochemistry	Biochem.Tot.Protein	4	98811889	99169792	0.9	intxn
biochemistry	Biochem.Tot.Protein	15	36869955	37230672	0.68	intxn
biochemistry	Biochem.Tot.Protein	3	68376449	69819671	0.27	male
biochemistry	Biochem.Tot.Protein	6	23915122	24365592	0.29	male
biochemistry	Biochem.Tot.Protein	15	32283162	34447594	0.27	male
biochemistry	Biochem.Tot.Protein	16	27868813	29670024	0.67	male
biochemistry	Biochem.Triglycerides	3	78863357	81299007	0.52	female
biochemistry	Biochem.Triglycerides	7	31220697	38888026	0.48	female
biochemistry	Biochem.Triglycerides	7	76635293	77309744	0.34	female
biochemistry	Biochem.Triglycerides	7	132726486	134927348	0.28	female
biochemistry	Biochem.Triglycerides	10	111836341	113842314	0.41	female
biochemistry	Biochem.Triglycerides	3	58293740	61269680	0.57	male
biochemistry	Biochem.Triglycerides	4	155234947	155495757	0.27	male
biochemistry	Biochem.Triglycerides	11	66810493	69633779	0.66	male
biochemistry	Biochem.Triglycerides	13	54124947	55212325	0.7	male
biochemistry	Biochem.Triglycerides	16	11750190	12887956	0.66	male
biochemistry	Biochem.Triglycerides	X	90183557	95472354	0.35	male
biochemistry	Biochem.Urea	1	117626679	120636961	0.34	female

biochemistry	Biochem.Urea	16	82393634	82599332	0.56	intxn
biochemistry	Biochem.Urea	X	131483657	132263611	0.7	intxn
biochemistry	Biochem.Urea	2	66543092	67059205	0.36	male
biochemistry	FaecalSteroid	1	133662206	137706366	0.584	female
biochemistry	FaecalSteroid	6	50804267	53701581	0.28	female
biochemistry	FaecalSteroid	7	20631993	28524660	0.352	female
biochemistry	FaecalSteroid	1	190852896	191159138	0.88	intxn
biochemistry	FaecalSteroid	2	167879623	168349019	0.83	intxn
biochemistry	FaecalSteroid	3	27874393	28537266	0.69	intxn
biochemistry	FaecalSteroid	4	48899643	49601364	0.72	intxn
biochemistry	FaecalSteroid	5	70759715	71133199	0.94	intxn
biochemistry	FaecalSteroid	6	53066091	53485558	0.77	intxn
biochemistry	FaecalSteroid	7	25722834	26076172	0.81	intxn
biochemistry	FaecalSteroid	18	80763536	81386979	0.79	intxn
biochemistry	FaecalSteroid	X	130529794	130913280	0.79	intxn
biochemistry	FaecalSteroid	17	79559924	79734252	0.57	male
diabetes	AUC.IRI.AUC.G	4	105321384	105559686	0.68	intxn
diabetes	AUC.IRI.AUC.G	4	119467629	119754487	0.62	intxn
diabetes	AUC.IRI.AUC.G	5	67288919	67739161	0.61	intxn
diabetes	AUC.IRI.AUC.G	10	59795986	60567967	0.43	male
diabetes	AUC.IRI.AUC.G	19	57970867	58525051	0.25	male
diabetes	DIRI.DG	1	15498164	15801632	0.66	intxn
diabetes	DIRI.DG	4	105321384	105559686	0.83	intxn
diabetes	DIRI.DG	5	67288919	67739161	0.68	intxn
diabetes	DIRI.DG	4	102255071	108647759	0.37	male
diabetes	DIRI.DG	10	59795986	60567967	0.33	male
diabetes	DIRI.DG	11	7852779	8402142	0.26	male
diabetes	DIRI.DG	13	118580076	120179440	0.25	male
diabetes	Glucose_0	2	160636812	161566006	0.5	female
diabetes	Glucose_0	3	25789217	30655403	0.84	female
diabetes	Glucose_0	7	53518649	56717200	0.4	female
diabetes	Glucose_0	11	22652379	24119207	0.54	female
diabetes	Glucose_0	3	128785590	129089561	0.84	intxn
diabetes	Glucose_0	7	54371892	55758009	0.68	intxn
diabetes	Glucose_0	9	111761160	112051764	0.67	intxn
diabetes	Glucose_0	11	102217793	102322554	0.72	intxn
diabetes	Glucose_0	3	19163210	21265573	0.46	male
diabetes	Glucose_0	6	62802636	63772977	0.27	male
diabetes	Glucose_0	11	5429786	5855027	0.35	male
diabetes	Glucose_0	14	47816920	49506830	0.33	male
diabetes	Glucose_15	11	104434921	106174095	0.28	female
diabetes	Glucose_15	13	32875693	33590127	0.26	female
diabetes	Glucose_15	7	57903543	61598711	0.39	male
diabetes	Glucose_15	17	76481364	87389606	0.87	male
diabetes	Glucose_30	1	127760938	128523738	0.39	female
diabetes	Glucose_30	3	29004632	32476036	0.64	female
diabetes	Glucose_30	4	127074444	129250674	0.43	female
diabetes	Glucose_30	16	19883071	21338976	0.33	female
diabetes	Glucose_30	2	99342120	100829374	0.25	male
diabetes	Glucose_30	7	57604413	58988207	0.91	male
diabetes	Glucose_30	17	83470807	87389606	0.42	male
diabetes	Glucose_75	4	127433785	129249377	0.69	female
diabetes	Glucose_75	X	103283648	104607924	0.46	female

diabetes	Glucose.AUC	4	127074444	129607739	0.86	female
diabetes	Glucose.AUC	5	13823258	18071808	0.39	female
diabetes	Glucose.AUC	8	126492366	127638433	0.4	female
diabetes	Glucose.AUC	2	166455786	166801701	0.72	intxn
diabetes	Glucose.AUC	4	129249377	129285361	0.84	intxn
diabetes	Glucose.AUC	7	3626116	3667112	0.65	intxn
diabetes	Glucose.AUC	7	62522641	65367018	0.82	male
diabetes	Glucose.AUC	12	14719531	17739797	0.87	male
diabetes	Glucose.DeadFromAnest	1	34593191	35090385	0.45	female
diabetes	Glucose.DeadFromAnest	4	66144626	66474531	0.83	male
diabetes	Glucose.DeadFromAnest	6	125312051	130435791	0.84	male
diabetes	Glucose.Delta	3	27500105	30281954	0.25	female
diabetes	Glucose.Delta	4	126021388	130636710	0.79	female
diabetes	Glucose.Delta	5	13823258	18734641	0.35	female
diabetes	Glucose.Delta	8	126492366	127638433	0.4	female
diabetes	Glucose.Delta	2	166455786	166801701	0.76	intxn
diabetes	Glucose.Delta	4	129249377	129285361	0.65	intxn
diabetes	Glucose.Delta	7	3626116	3667112	0.62	intxn
diabetes	Glucose.Delta	7	62432859	65367018	0.92	male
diabetes	Glucose.Delta	12	14719531	17739797	0.88	male
diabetes	Glucose.Slope	2	30043246	35252542	0.41	male
diabetes	Glucose.Slope	16	69809557	70194903	0.43	male
diabetes	Glucose.Slope	17	12243418	14731777	0.46	male
diabetes	Glucose.Slope	17	21057841	23916928	0.26	male
diabetes	Insulin.0	7	18686059	20031913	0.57	female
diabetes	Insulin.0	9	118436245	123488018	0.95	female
diabetes	Insulin.0	18	54213999	59570930	0.6	female
diabetes	Insulin.0	2	63950799	64579934	0.81	intxn
diabetes	Insulin.0	4	33372577	33910931	0.96	intxn
diabetes	Insulin.0	5	118108777	118651588	0.94	intxn
diabetes	Insulin.0	6	81908118	82353886	0.84	intxn
diabetes	Insulin.0	9	118883462	119337339	0.89	intxn
diabetes	Insulin.0	X	161064795	161702633	0.62	intxn
diabetes	Insulin.0	6	120528725	122902059	0.67	male
diabetes	Insulin.0	14	20198538	23011973	0.38	male
diabetes	Insulin.0	18	33281475	36173613	0.26	male
diabetes	Insulin.0	X	157365793	158163919	0.78	male
diabetes	Insulin.15	13	92011514	94443333	0.56	female
diabetes	Insulin.15	4	33372577	33910931	0.69	intxn
diabetes	Insulin.15	3	133413512	138557721	0.28	male
diabetes	Insulin.15	4	30911190	35509600	0.45	male
diabetes	Insulin.15	8	16536522	18512682	0.43	male
diabetes	Insulin.15	11	6167305	8585238	0.31	male
diabetes	Insulin.15	11	60256730	60812438	0.33	male
diabetes	Insulin.30	10	104621794	106921083	0.34	female
diabetes	Insulin.30	12	112505105	115578692	0.29	female
diabetes	Insulin.30	4	120416799	120708725	0.69	intxn
diabetes	Insulin.30	10	106267042	106640985	0.63	intxn
diabetes	Insulin.30	12	78704835	79273031	0.61	intxn
diabetes	Insulin.30	3	145932188	148608536	0.67	male
diabetes	Insulin.30	11	6513859	8402142	0.69	male
diabetes	Insulin.30	14	70786590	75319087	0.27	male
diabetes	Insulin.75	6	86363506	87703689	0.79	female

diabetes	Insulin.75	10	22828132	23647416	0.45	female
diabetes	Insulin.75	12	109744558	112919282	0.67	female
diabetes	Insulin.75	X	130138355	132751097	0.25	female
diabetes	Insulin.75	1	22158385	22671798	0.71	intxn
diabetes	Insulin.75	5	140892941	141093822	0.71	intxn
diabetes	Insulin.75	6	86363506	86831692	0.68	intxn
diabetes	Insulin.75	13	107538924	107783029	0.59	intxn
diabetes	Insulin.75	16	66732817	66934385	0.86	intxn
diabetes	Insulin.75	2	161329328	164215797	0.58	male
diabetes	Insulin.75	6	93599787	94633816	0.32	male
diabetes	Insulin.AUC	12	113741390	115578692	0.37	female
diabetes	Insulin.AUC	4	119467629	119754487	0.78	intxn
diabetes	Insulin.AUC	16	62797457	63048550	0.72	intxn
diabetes	Insulin.AUC	X	143156917	143984017	0.85	intxn
diabetes	Insulin.AUC	2	161565938	162677301	0.37	male
diabetes	Insulin.AUC	4	104187278	108752970	0.41	male
diabetes	Insulin.AUC	10	59795986	60567967	0.33	male
diabetes	Insulin.AUC	13	118295239	120179440	0.42	male
diabetes	Insulin.Delta	2	115114816	115487784	0.42	female
diabetes	Insulin.Delta	12	113741390	114730591	0.4	female
diabetes	Insulin.Delta	4	105321384	105559686	0.71	intxn
diabetes	Insulin.Delta	16	62797457	63048550	0.7	intxn
diabetes	Insulin.Delta	X	143156917	143984017	0.91	intxn
diabetes	Insulin.Delta	4	108383360	108647759	0.36	male
diabetes	Insulin.Delta	10	59795986	60567967	0.34	male
diabetes	Insulin.Delta	13	118393689	120179440	0.41	male
diabetes	Insulin.Slope	13	89479905	92011514	0.44	female
diabetes	Insulin.Slope	5	148799645	149316468	0.67	intxn
immunology	CD4Count	5	46065650	49959139	0.26	female
immunology	CD4Count	7	111297435	114746266	0.5	female
immunology	CD4Count	9	13010473	15693572	0.37	female
immunology	CD4Count	10	20971210	21502038	0.25	female
immunology	CD4Count	18	74895730	75971158	0.47	female
immunology	CD4Count	2	134344946	134712780	0.89	intxn
immunology	CD4Count	4	127433785	127707242	0.64	intxn
immunology	CD4Count	5	28035962	28333984	1	intxn
immunology	CD4Count	7	35541626	35854858	0.93	intxn
immunology	CD4Count	9	115055684	115141806	0.64	intxn
immunology	CD4Count	10	20971210	21502038	0.83	intxn
immunology	CD4Count	11	114532522	114757274	0.77	intxn
immunology	CD4Count	12	7021088	7420720	0.69	intxn
immunology	CD4Count	13	51355279	51948312	0.9	intxn
immunology	CD4Count	16	49855424	50013941	0.63	intxn
immunology	CD4Count	18	30090763	30522137	0.78	intxn
immunology	CD4Count	19	16153309	16761520	0.57	intxn
immunology	CD4Count	5	13253142	14804960	0.29	male
immunology	CD4Count	5	28165863	29413722	0.27	male
immunology	CD4Count	5	109059308	111537717	0.34	male
immunology	CD4Count	8	14696094	15152117	0.44	male
immunology	CD4Count	8	23258929	24559322	0.45	male
immunology	CD4Count	9	59934477	65397435	0.46	male
immunology	CD4Count	13	52660661	54980347	0.26	male
immunology	CD4Count	15	68909584	75435371	0.27	male

immunology	CD8Count	16	54656264	56982171	0.67	female
immunology	CD8Count	18	16225937	18676154	0.68	female
immunology	CD8Count	5	16220992	16515714	0.38	male
immunology	CD8Count	8	14758999	15993277	0.52	male
immunology	CD8Count	14	63105448	64881411	0.33	male
immunology	CD8Count	16	88158178	94690274	0.51	male
immunology	EarHoleMeanArea	1	159872834	163488843	0.36	female
immunology	EarHoleMeanArea	1	186268950	187710901	0.29	female
immunology	EarHoleMeanArea	2	123478649	125123408	0.32	female
immunology	EarHoleMeanArea	4	101882585	106748034	0.34	female
immunology	EarHoleMeanArea	4	139583632	140528737	0.27	female
immunology	EarHoleMeanArea	7	88739954	91417412	1	female
immunology	EarHoleMeanArea	11	6153573	8402096	0.54	female
immunology	EarHoleMeanArea	15	49175417	54944833	0.3	female
immunology	EarHoleMeanArea	18	15166567	16097068	0.54	female
immunology	EarHoleMeanArea	5	76154729	76305568	0.94	intxn
immunology	EarHoleMeanArea	15	43702338	44053606	0.61	intxn
immunology	EarHoleMeanArea	17	69618402	69968920	0.79	intxn
immunology	EarHoleMeanArea	1	92906418	95933814	0.27	male
immunology	EarHoleMeanArea	1	160302534	160621550	0.33	male
immunology	EarHoleMeanArea	1	172771717	173155436	0.43	male
immunology	EarHoleMeanArea	2	164200011	165221683	0.43	male
immunology	EarHoleMeanArea	3	141912370	144143601	0.46	male
immunology	EarHoleMeanArea	4	50880971	56035903	0.43	male
immunology	EarHoleMeanArea	7	89127286	90186386	1	male
immunology	EarHoleMeanArea	18	15408156	22319899	0.66	male
immunology	Haem.BASabs	10	39952114	40253282	0.81	intxn
immunology	Haem.BASabs	19	41357732	41840966	0.88	intxn
immunology	Haem.BASabs	17	3484561	7341224	0.25	male
immunology	Haem.BASabs	19	41357732	46090064	0.72	male
immunology	Haem.HCT	1	163955713	169192742	0.45	female
immunology	Haem.HCT	9	63514332	65312870	0.35	female
immunology	Haem.HCT	11	89105622	89761781	0.4	female
immunology	Haem.HCT	2	166801701	168792085	0.26	male
immunology	Haem.HCT	3	73675097	78034163	0.25	male
immunology	Haem.HCT	13	34306545	41426435	0.31	male
immunology	Haem.HGB	1	165540465	166007751	0.28	female
immunology	Haem.HGB	1	167838459	169192742	0.45	female
immunology	Haem.HGB	5	139536184	141093822	0.27	female
immunology	Haem.HGB	11	88977887	89938811	0.49	female
immunology	Haem.HGB	1	168410156	168762829	0.66	intxn
immunology	Haem.HGB	17	80478769	81351500	0.51	male
immunology	Haem.HGB	18	56618586	58717432	0.4	male
immunology	Haem.LYMabs	2	135137887	135592454	0.46	female
immunology	Haem.LYMabs	18	28318348	29763500	0.3	female
immunology	Haem.LYMabs	X	9430856	10276927	0.34	female
immunology	Haem.LYMabs	3	30655403	33964549	0.28	male
immunology	Haem.LYMabs	5	107112442	115597784	0.26	male
immunology	Haem.LYMabs	14	9425077	11494028	0.64	male
immunology	Haem.LYMabs	15	64914027	65833577	0.25	male
immunology	Haem.LYMabs	15	74802356	75435371	0.37	male
immunology	Haem.LYMabs	16	39493346	43610777	0.86	male
immunology	Haem.MCH	1	128625610	141417567	0.81	female

immunology	Haem.MCH	5	99880059	102108827	0.44	female
immunology	Haem.MCH	6	83505914	84840195	0.38	female
immunology	Haem.MCH	8	75173575	80766342	0.48	female
immunology	Haem.MCH	8	83200393	84568855	0.59	female
immunology	Haem.MCH	9	107917976	111255564	0.97	female
immunology	Haem.MCH	10	82455510	83110573	0.32	female
immunology	Haem.MCH	14	69379696	72653712	0.64	female
immunology	Haem.MCH	15	78989686	87306911	0.52	female
immunology	Haem.MCH	4	6800199	7127334	0.85	intxn
immunology	Haem.MCH	19	10248920	10670607	0.82	intxn
immunology	Haem.MCH	X	137910289	138602978	0.79	intxn
immunology	Haem.MCH	6	83292891	84746715	0.51	male
immunology	Haem.MCH	7	113660134	117906779	0.85	male
immunology	Haem.MCH	8	125471492	128414758	0.5	male
immunology	Haem.MCH	11	5535137	6167305	0.63	male
immunology	Haem.MCH	11	99302132	104023311	0.45	male
immunology	Haem.MCH	14	70786590	71177943	0.95	male
immunology	Haem.MCHC	1	3187380	7241664	0.3	female
immunology	Haem.MCHC	3	51370220	56168362	0.26	female
immunology	Haem.MCHC	4	139323656	141900317	0.25	female
immunology	Haem.MCHC	9	32203892	35912769	0.66	female
immunology	Haem.MCHC	9	42066624	44334296	0.38	female
immunology	Haem.MCHC	9	107607630	110930280	0.7	female
immunology	Haem.MCHC	11	24826085	29129769	0.29	female
immunology	Haem.MCHC	9	26263345	26632973	0.56	intxn
immunology	Haem.MCHC	11	99370053	99591254	0.85	intxn
immunology	Haem.MCHC	X	134541457	135324681	0.61	intxn
immunology	Haem.MCHC	4	140528737	141900317	0.53	male
immunology	Haem.MCHC	6	47596009	48992700	0.52	male
immunology	Haem.MCHC	6	99053757	101442149	0.47	male
immunology	Haem.MCHC	7	112321244	114512448	0.63	male
immunology	Haem.MCHC	10	109691426	110380515	0.26	male
immunology	Haem.MCHC	11	96942297	102007903	1	male
immunology	Haem.MCHC	X	49412403	51078517	0.35	male
immunology	Haem.MCHC	X	151385933	152885686	0.73	male
immunology	Haem.MCV	1	128523738	135115263	0.99	female
immunology	Haem.MCV	3	128047779	128958345	0.3	female
immunology	Haem.MCV	8	83200393	84644018	0.38	female
immunology	Haem.MCV	9	108991958	113824027	1	female
immunology	Haem.MCV	11	5535137	6153573	0.34	female
immunology	Haem.MCV	14	69379696	72989668	0.89	female
immunology	Haem.MCV	3	126861851	127059593	0.86	intxn
immunology	Haem.MCV	10	12728906	12912587	0.6	intxn
immunology	Haem.MCV	17	79559924	79734252	0.59	intxn
immunology	Haem.MCV	1	128464682	134993149	0.97	male
immunology	Haem.MCV	2	72933792	75021839	0.4	male
immunology	Haem.MCV	11	17204963	18566602	0.37	male
immunology	Haem.MCV	13	94170898	96470882	0.41	male
immunology	Haem.MCV	14	51202517	51637210	0.79	male
immunology	Haem.MCV	14	68750445	71177273	0.26	male
immunology	Haem.MCV	14	86187292	87234247	0.94	male
immunology	Haem.MCV	19	9972150	12068136	0.7	male
immunology	Haem.MONabs	1	146800236	147391248	0.87	intxn

immunology	Haem.MONabs	4	93092582	93167493	0.67	intxn
immunology	Haem.MONabs	7	35441313	35541626	0.92	intxn
immunology	Haem.MONabs	10	28885217	29449239	0.66	intxn
immunology	Haem.MONabs	11	20329667	20753709	0.95	intxn
immunology	Haem.MONabs	X	81021482	81485364	0.98	intxn
immunology	Haem.MPV	1	172771717	176723784	1	female
immunology	Haem.MPV	3	13643132	14887794	0.47	female
immunology	Haem.MPV	4	63558958	66377177	0.57	female
immunology	Haem.MPV	5	16300800	17827135	0.41	female
immunology	Haem.MPV	9	107473108	110701061	0.39	female
immunology	Haem.MPV	14	45858301	47467088	0.69	female
immunology	Haem.MPV	X	138602978	139242562	0.29	female
immunology	Haem.MPV	X	141449633	143400677	0.67	intxn
immunology	Haem.MPV	1	140096429	142430268	0.43	male
immunology	Haem.MPV	1	172771717	173155436	0.98	male
immunology	Haem.MPV	2	10478353	11989969	0.62	male
immunology	Haem.MPV	2	115832014	120302483	0.26	male
immunology	Haem.MPV	3	149089096	152287221	0.42	male
immunology	Haem.MPV	4	134294713	138420378	0.34	male
immunology	Haem.MPV	16	12237574	12887956	0.26	male
immunology	Haem.NEUabs	1	186146131	188452609	0.37	female
immunology	Haem.NEUabs	4	135488839	136775221	0.26	female
immunology	Haem.NEUabs	18	29519995	34074222	0.54	female
immunology	Haem.NEUabs	1	146800236	147391248	0.88	intxn
immunology	Haem.NEUabs	5	113832244	114439571	0.67	intxn
immunology	Haem.NEUabs	10	21653610	22640984	0.92	intxn
immunology	Haem.NEUabs	12	89805465	90148649	0.72	intxn
immunology	Haem.NEUabs	16	49855424	50013941	0.94	intxn
immunology	Haem.NEUabs	19	39045504	39383344	0.52	intxn
immunology	Haem.NEUabs	1	80719179	83524951	0.55	male
immunology	Haem.NEUabs	1	130357492	132515586	0.25	male
immunology	Haem.PCT	3	50235065	55060180	0.29	female
immunology	Haem.PCT	9	34266328	34646073	0.33	female
immunology	Haem.PCT	12	112426248	114385312	0.41	female
immunology	Haem.PCT	13	93113198	96283561	0.25	female
immunology	Haem.PCT	7	47652751	51559741	0.32	male
immunology	Haem.PCT	11	103369194	104434921	0.72	male
immunology	Haem.PCT	19	55093306	58525051	0.48	male
immunology	Haem.PLT	1	173176208	174420652	0.59	female
immunology	Haem.PLT	9	26263345	29112775	0.3	female
immunology	Haem.PLT	18	56763024	57397815	0.46	female
immunology	Haem.PLT	18	62145797	64232516	0.25	female
immunology	Haem.PLT	4	81082042	87302984	0.36	male
immunology	Haem.PLT	10	11485905	14123091	0.48	male
immunology	Haem.PLT	11	96942297	100250921	0.69	male
immunology	Haem.PLT	15	3927809	6270679	0.31	male
immunology	Haem.RBC	1	165927223	169192742	0.77	female
immunology	Haem.RBC	1	167838459	168323042	0.91	intxn
immunology	Haem.RBC	8	104866194	105113154	0.94	intxn
immunology	Haem.RBC	11	105670563	105850994	0.75	intxn
immunology	Haem.RBC	13	37338886	37610827	0.84	intxn
immunology	Haem.RBC	11	81061772	83225930	0.3	male
immunology	Haem.RBC	15	86437448	88522520	0.36	male

immunology	Haem.RBC	17	80770639	81351500	0.76	male
immunology	Haem.RDW	2	179860860	181454544	0.29	female
immunology	Haem.RDW	7	16856985	18591248	0.37	female
immunology	Haem.RDW	9	108961792	111126430	0.69	female
immunology	Haem.RDW	12	71335154	71948570	0.52	female
immunology	Haem.RDW	13	93113198	96748004	0.41	female
immunology	Haem.RDW	14	82910057	83805102	0.59	female
immunology	Haem.RDW	14	85738128	86833310	0.45	female
immunology	Haem.RDW	7	6661576	6911682	0.73	intxn
immunology	Haem.RDW	10	119503300	119844777	0.94	intxn
immunology	Haem.RDW	X	137910289	138602978	0.56	intxn
immunology	Haem.RDW	2	100290462	101669203	0.56	male
immunology	Haem.RDW	5	107623293	108405952	0.98	male
immunology	Haem.RDW	7	12778869	15242018	0.25	male
immunology	Haem.RDW	7	111381390	114746266	0.99	male
immunology	Haem.RDW	8	55169906	58020064	0.7	male
immunology	Haem.RDW	11	57600339	59142616	0.75	male
immunology	Haem.RDW	17	66129224	67111429	0.29	male
immunology	Haem.WBC	2	135137887	135592454	0.26	female
immunology	Haem.WBC	4	135849702	136594254	0.26	female
immunology	Haem.WBC	11	68849550	70371199	0.53	female
immunology	Haem.WBC	11	91481888	95706399	0.27	female
immunology	Haem.WBC	13	83876493	88799450	0.49	female
immunology	Haem.WBC	19	40657408	46961471	0.27	female
immunology	Haem.WBC	1	144498343	148052886	0.29	male
immunology	Haem.WBC	7	87470824	93725019	0.36	male
immunology	Haem.WBC	8	14480079	16233475	0.64	male
immunology	Haem.WBC	14	8923855	11494028	0.51	male
immunology	Haem.WBC	15	74988859	75435371	0.29	male
immunology	Haem.WBC	16	38069109	43943528	0.68	male
immunology	Imm.BCell.size	2	68682089	69180806	0.37	female
immunology	Imm.BCell.size	2	92217321	93119534	0.81	female
immunology	Imm.BCell.size	9	101004569	101520902	0.27	female
immunology	Imm.BCell.size	13	80877010	82234779	0.25	female
immunology	Imm.BCell.size	2	6153037	11989969	0.56	male
immunology	Imm.BCell.size	2	19676382	21541388	0.38	male
immunology	Imm.BCell.size	5	54717372	55122580	0.4	male
immunology	Imm.BCell.size	6	3416769	4607929	0.51	male
immunology	Imm.BCell.size	9	59238150	61358195	0.47	male
immunology	Imm.BCell.size	17	3000564	9032863	0.26	male
immunology	Imm.BCell.size	X	38296202	39805923	0.3	male
immunology	Imm.CD4.size	2	68682089	71279297	0.35	female
immunology	Imm.CD4.size	2	92217321	95550386	0.71	female
immunology	Imm.CD4.size	2	6981075	10677213	0.57	male
immunology	Imm.CD4.size	2	19938834	21134873	0.3	male
immunology	Imm.CD4.size	4	103634567	107061597	0.25	male
immunology	Imm.CD4.size	6	3416769	8012600	0.45	male
immunology	Imm.CD4.size	9	59835072	60984728	0.32	male
immunology	Imm.CD4.size	X	38296202	39805923	0.37	male
immunology	Imm.CD4CD8Ratio	1	53399835	55043651	0.38	female
immunology	Imm.CD4CD8Ratio	1	57243479	59435875	0.27	female
immunology	Imm.CD4CD8Ratio	5	13998275	16842022	0.29	female
immunology	Imm.CD4CD8Ratio	5	112765005	115597784	0.48	female

immunology	Imm.CD4CD8Ratio	6	68817518	74677758	0.5	female
immunology	Imm.CD4CD8Ratio	12	89933366	95234080	0.54	female
immunology	Imm.CD4CD8Ratio	17	34167248	40707958	1	female
immunology	Imm.CD4CD8Ratio	17	41425377	41918576	0.48	female
immunology	Imm.CD4CD8Ratio	17	45461862	48002496	0.36	female
immunology	Imm.CD4CD8Ratio	2	10899964	11092377	0.58	intxn
immunology	Imm.CD4CD8Ratio	6	103550252	103956785	0.97	intxn
immunology	Imm.CD4CD8Ratio	11	15349456	15652327	0.63	intxn
immunology	Imm.CD4CD8Ratio	12	114496741	114569903	0.63	intxn
immunology	Imm.CD4CD8Ratio	14	59695506	59823859	0.74	intxn
immunology	Imm.CD4CD8Ratio	3	115356189	119424749	0.25	male
immunology	Imm.CD4CD8Ratio	6	71323583	73776008	0.3	male
immunology	Imm.CD4CD8Ratio	6	103069280	107015161	0.26	male
immunology	Imm.CD4CD8Ratio	9	37007330	47075366	0.49	male
immunology	Imm.CD4CD8Ratio	11	5855027	6774647	0.36	male
immunology	Imm.CD4CD8Ratio	12	26818120	27258227	0.3	male
immunology	Imm.CD4CD8Ratio	17	33077989	37570713	1	male
immunology	Imm.CD4inCD3XGeoMea	3	112653405	115646074	0.36	female
immunology	Imm.CD4inCD3XGeoMea	4	129249377	134644420	0.53	female
immunology	Imm.CD4inCD3XGeoMea	6	77510828	82693471	0.59	female
immunology	Imm.CD4inCD3XGeoMea	10	47262385	48405428	0.42	female
immunology	Imm.CD4inCD3XGeoMea	12	10538257	10663632	0.59	female
immunology	Imm.CD4inCD3XGeoMea	14	38075998	40378447	0.78	female
immunology	Imm.CD4inCD3XGeoMea	14	23011973	23434979	0.65	intxn
immunology	Imm.CD4inCD3XGeoMea	1	172771717	176081703	0.75	male
immunology	Imm.CD4inCD3XGeoMea	5	104357881	108813581	0.32	male
immunology	Imm.CD4inCD3XGeoMea	6	125312051	125667401	0.4	male
immunology	Imm.CD4inCD3XGeoMea	9	29542937	31419441	0.31	male
immunology	Imm.CD4inCD3XGeoMea	11	98624873	100625636	0.79	male
immunology	Imm.CD4inCD3XGeoMea	16	31242726	32194765	0.42	male
immunology	Imm.CD4inCD3XGeoMea	16	91372479	91679059	0.26	male
immunology	Imm.CD8.size	2	34869056	36540065	0.28	female
immunology	Imm.CD8.size	2	68682089	69180806	0.36	female
immunology	Imm.CD8.size	2	92217321	95550386	0.66	female
immunology	Imm.CD8.size	2	6981075	10478353	0.57	male
immunology	Imm.CD8.size	4	89292013	92644997	0.27	male
immunology	Imm.CD8.size	6	3416769	5519360	0.38	male
immunology	Imm.CD8.size	6	29910948	37172431	0.6	male
immunology	Imm.CD8.size	9	59511009	61004239	0.26	male
immunology	Imm.CD8.size	15	89413198	92378459	0.48	male
immunology	Imm.CD8.size	18	60209551	60965973	0.38	male
immunology	Imm.CD8.size	X	38296202	40000413	0.3	male
immunology	Imm.CD8inCD3YGeoMea	9	29147731	31723273	0.29	female
immunology	Imm.CD8inCD3YGeoMea	17	41761386	43560014	0.32	female
immunology	Imm.CD8inCD3YGeoMea	17	69398741	69740044	0.32	female
immunology	Imm.CD8inCD3YGeoMea	5	50381344	50966137	0.67	intxn
immunology	Imm.CD8inCD3YGeoMea	7	36124756	36370162	0.6	intxn
immunology	Imm.CD8inCD3YGeoMea	9	30964110	31522909	0.72	intxn
immunology	Imm.CD8inCD3YGeoMea	15	88996113	89413198	1	intxn
immunology	Imm.CD8inCD3YGeoMea	17	93790718	93990892	0.67	intxn
immunology	Imm.CD8inCD3YGeoMea	3	90414133	91607832	0.26	male
immunology	Imm.CD8inCD3YGeoMea	4	53915257	56035903	0.46	male
immunology	Imm.CD8inCD3YGeoMea	8	111470906	112837135	0.3	male

immunology	Imm.CD8inCD3YGeoMea	12	43449827	46245477	0.72	male
immunology	Imm.PctB220	1	45566104	48200927	0.34	female
immunology	Imm.PctB220	1	120379270	122503972	0.31	female
immunology	Imm.PctB220	1	130357492	130928323	0.47	female
immunology	Imm.PctB220	2	50372238	53042542	0.26	female
immunology	Imm.PctB220	6	134571704	136698174	0.43	female
immunology	Imm.PctB220	12	25988592	28665483	0.91	female
immunology	Imm.PctB220	12	71468454	74144220	0.37	female
immunology	Imm.PctB220	6	43776711	44145673	0.69	intxn
immunology	Imm.PctB220	18	65141864	65605243	0.73	intxn
immunology	Imm.PctB220	1	93932364	97723675	0.88	male
immunology	Imm.PctB220	2	68682089	69180806	0.33	male
immunology	Imm.PctB220	2	118137997	128959365	0.89	male
immunology	Imm.PctB220	4	64960920	70061092	0.41	male
immunology	Imm.PctB220	5	84265009	85890122	0.38	male
immunology	Imm.PctB220	9	39934634	42066624	0.39	male
immunology	Imm.PctB220	11	32646121	33063196	0.4	male
immunology	Imm.PctB220	16	94664355	96723377	0.76	male
immunology	Imm.PctB220	18	64820731	68284961	0.25	male
immunology	Imm.PctB220	19	60875841	61266404	0.74	male
immunology	Imm.PctCD3	1	44668125	48361345	0.41	female
immunology	Imm.PctCD3	2	149749907	152530292	0.39	female
immunology	Imm.PctCD3	3	113786274	121501316	0.55	female
immunology	Imm.PctCD3	4	130004333	131083434	0.31	female
immunology	Imm.PctCD3	6	134571704	137411248	0.85	female
immunology	Imm.PctCD3	9	54508169	55292556	0.32	female
immunology	Imm.PctCD3	12	25779635	28665483	0.54	female
immunology	Imm.PctCD3	12	103766611	104892589	0.31	female
immunology	Imm.PctCD3	8	77081290	77417077	0.71	intxn
immunology	Imm.PctCD3	10	75692319	76175490	0.86	intxn
immunology	Imm.PctCD3	11	47593199	48065698	0.87	intxn
immunology	Imm.PctCD3	1	95905962	100503409	0.26	male
immunology	Imm.PctCD3	2	122449872	128959389	0.68	male
immunology	Imm.PctCD3	7	118398316	127927413	0.52	male
immunology	Imm.PctCD3	9	32645815	38061700	0.36	male
immunology	Imm.PctCD4	1	123887380	125550610	0.3	female
immunology	Imm.PctCD4	3	68871235	69819671	0.29	female
immunology	Imm.PctCD4	3	87619539	93138626	0.26	female
immunology	Imm.PctCD4	12	25779635	28665483	0.26	female
immunology	Imm.PctCD4	15	87533260	87908042	0.58	female
immunology	Imm.PctCD4	6	43776711	44145673	0.96	intxn
immunology	Imm.PctCD4	8	73988007	74148367	0.99	intxn
immunology	Imm.PctCD4	9	34769248	35323596	0.56	intxn
immunology	Imm.PctCD4	2	99507457	101541181	0.31	male
immunology	Imm.PctCD4	6	116847401	119361386	0.35	male
immunology	Imm.PctCD4	8	73838970	75068826	0.54	male
immunology	Imm.PctCD4	9	37007330	37748928	0.99	male
immunology	Imm.PctCD4	11	32860837	37583470	0.29	male
immunology	Imm.PctCD4	19	52034977	52276420	0.29	male
immunology	Imm.PctCD4inCD3	3	75061591	77716516	0.38	female
immunology	Imm.PctCD4inCD3	5	112765005	114910345	0.58	female
immunology	Imm.PctCD4inCD3	6	68817518	74638679	0.29	female
immunology	Imm.PctCD4inCD3	12	89933366	95234080	0.33	female

immunology	Imm.PctCD4inCD3	17	33155241	41918576	1	female
immunology	Imm.PctCD4inCD3	17	45706483	48002496	0.43	female
immunology	Imm.PctCD4inCD3	6	103550252	103956785	0.99	intxn
immunology	Imm.PctCD4inCD3	12	115578692	117385434	0.67	intxn
immunology	Imm.PctCD4inCD3	14	59695506	59823859	0.69	intxn
immunology	Imm.PctCD4inCD3	1	169192742	175676780	0.43	male
immunology	Imm.PctCD4inCD3	3	25789217	30845875	0.33	male
immunology	Imm.PctCD4inCD3	6	4763401	9787412	0.32	male
immunology	Imm.PctCD4inCD3	6	71323583	73776008	0.25	male
immunology	Imm.PctCD4inCD3	9	37007330	47075366	0.7	male
immunology	Imm.PctCD4inCD3	11	5855027	6513859	0.53	male
immunology	Imm.PctCD4inCD3	17	33077989	37658709	1	male
immunology	Imm.PctCD8	1	130485574	130928323	0.25	female
immunology	Imm.PctCD8	1	177945546	178339586	0.44	female
immunology	Imm.PctCD8	6	68817518	75834607	0.54	female
immunology	Imm.PctCD8	6	134399785	135272017	0.7	female
immunology	Imm.PctCD8	8	29288832	31235115	0.91	female
immunology	Imm.PctCD8	12	25779635	29344130	0.43	female
immunology	Imm.PctCD8	12	91589224	94983892	0.34	female
immunology	Imm.PctCD8	17	32390322	34517928	1	female
immunology	Imm.PctCD8	17	40707958	42803695	1	female
immunology	Imm.PctCD8	5	119343787	119758126	0.86	intxn
immunology	Imm.PctCD8	6	103550252	103956785	0.99	intxn
immunology	Imm.PctCD8	7	71534241	71546913	0.65	intxn
immunology	Imm.PctCD8	8	54340484	54906618	0.83	intxn
immunology	Imm.PctCD8	10	14122527	14141986	0.77	intxn
immunology	Imm.PctCD8	11	47593199	48065698	0.92	intxn
immunology	Imm.PctCD8	12	74389432	74706180	0.77	intxn
immunology	Imm.PctCD8	15	62588231	62952529	0.93	intxn
immunology	Imm.PctCD8	16	88033254	88158178	0.73	intxn
immunology	Imm.PctCD8	X	89565919	90058693	0.94	intxn
immunology	Imm.PctCD8	1	169017790	169890101	0.48	male
immunology	Imm.PctCD8	1	172343863	175676780	0.44	male
immunology	Imm.PctCD8	6	103069280	104683826	0.4	male
immunology	Imm.PctCD8	11	4131025	7285878	0.89	male
immunology	Imm.PctCD8	11	95489315	96817154	0.38	male
immunology	Imm.PctCD8	17	34329744	40807075	1	male
immunology	Imm.PctCD8	17	43961485	47054970	0.51	male
immunology	Imm.PctCD8inCD3	1	53399835	55611951	0.44	female
immunology	Imm.PctCD8inCD3	1	57243479	59435875	0.36	female
immunology	Imm.PctCD8inCD3	5	14824301	16842022	0.3	female
immunology	Imm.PctCD8inCD3	5	112765005	116005573	0.38	female
immunology	Imm.PctCD8inCD3	6	68817518	75834607	0.53	female
immunology	Imm.PctCD8inCD3	12	89933366	95234080	0.52	female
immunology	Imm.PctCD8inCD3	17	33765847	38311620	1	female
immunology	Imm.PctCD8inCD3	17	41347509	42580589	0.59	female
immunology	Imm.PctCD8inCD3	17	45823630	48002496	0.27	female
immunology	Imm.PctCD8inCD3	2	10899964	11092377	0.6	intxn
immunology	Imm.PctCD8inCD3	6	103550252	103956785	0.98	intxn
immunology	Imm.PctCD8inCD3	11	15349456	15652327	0.62	intxn
immunology	Imm.PctCD8inCD3	14	59695506	59823859	0.74	intxn
immunology	Imm.PctCD8inCD3	6	103069280	105083552	0.46	male
immunology	Imm.PctCD8inCD3	11	5855027	6774647	0.6	male

immunology	Imm.PctCD8inCD3	12	109759370	113032555	0.31	male
immunology	Imm.PctCD8inCD3	17	33077989	37570713	1	male
immunology	Imm.PctNKTAndOutliers	3	119943577	120606758	0.4	female
immunology	Imm.PctNKTAndOutliers	4	150458854	153699184	0.7	female
immunology	Imm.PctNKTAndOutliers	5	139970587	142082080	0.55	female
immunology	Imm.PctNKTAndOutliers	7	123277679	126387272	0.34	female
immunology	Imm.PctNKTAndOutliers	12	61240757	62244134	0.42	male

Appendix D

GxE QTL

This is an appendix of the GxE QTL identified by Bagphenotype, as referenced in §3.4.7.

Phenotype	Interacting Covariate	Chr	Range1 (Mb)	Range2 (Mb)	RMIP
Context.Mean.Freeze	CoatColour	2	178047052	178451924	0.37
Context.Mean.Freeze	Date.Month	1	20257883	20623798	0.95
Context.Mean.Freeze	Date.Month	1	151676987	151748240	0.81
Context.Mean.Freeze	Date.Month	4	43561953	43742456	0.64
Context.Mean.Freeze	Date.Month	4	55589355	56035903	0.68
Context.Mean.Freeze	Date.Month	5	100055311	100477533	0.54
Context.Mean.Freeze	Date.Month	6	30039897	30515836	0.47
Context.Mean.Freeze	Date.Month	10	117560527	118063735	0.41
Context.Mean.Freeze	Date.Month	11	45707542	45737555	0.37
Context.Mean.Freeze	Date.Month	13	73431400	73846529	0.78
Context.Mean.Freeze	Date.Month	18	68820867	69067790	0.69
Context.Mean.Freeze	Date.Month	18	77875926	78482335	0.53
Context.Mean.Freeze	Date.Month	19	58202917	58785753	0.48
Context.Mean.Freeze	Date.Month	X	50688037	53468970	0.54
Context.Mean.Freeze	Date.Month	X	113547981	113965360	0.99
Context.Mean.Freeze	Date.Month	X	126830139	127179924	1
Context.Mean.Freeze	Date.Month	X	141449633	143400677	0.77
Context.Mean.Freeze	EndNormalBW	3	92941948	93061548	0.95
Context.Mean.Freeze	EndNormalBW	5	12819202	13091879	0.81
Context.Mean.Freeze	EndNormalBW	10	109577782	109905492	0.67
Context.Mean.Freeze	EndNormalBW	15	40584414	40742342	0.65
Context.Mean.Freeze	Experimenter	2	157456246	157711471	0.49
Cue.Boli	Date.Month	17	73037965	73262801	0.55
Cue.Boli	EndNormalBW	17	48739076	49108349	0.96
Cue.Mean.Freeze.Correct	CoatColour	15	89413198	89873413	0.76
Cue.Mean.Freeze.Correct	EndNormalBW	13	57354450	57659623	0.65
Cue.Mean.Freeze.Correct	FPS.TrainingChamber	15	89413198	89873413	0.77
Cue.Mean.Freeze.Post	Date.Month	1	15549818	16119367	0.57
Cue.Mean.Freeze.Post	Date.Month	6	50950045	51147754	0.61
Cue.Mean.Freeze.Post	Date.Month	9	86947323	87332004	0.53
Cue.Raw.Activity.Before.T	Date.StudyDay	1	158916022	159139592	0.89
Cue.Raw.Activity.Before.T	Date.StudyDay	2	129049109	129125435	0.69
Cue.Raw.Activity.Before.T	Date.StudyDay	4	62368191	63036729	0.66
Cue.Raw.Activity.Before.T	Date.StudyDay	8	96189776	96772693	0.81
Cue.Raw.Activity.Before.T	Date.StudyDay	9	77779177	78050617	0.96
Cue.Raw.Activity.Before.T	Date.StudyDay	9	111560213	111761160	0.75
Cue.Raw.Activity.Before.T	Date.StudyDay	11	108750591	109194140	0.66
Cue.Raw.Activity.Before.T	Date.StudyDay	17	52436869	52750785	0.82
EPM.ClosedArmDistance	Date.StudyDay	5	40330530	40810823	0.99
EPM.ClosedArmDistance	Date.StudyDay	7	30807821	31205452	0.86
EPM.ClosedArmDistance	EndNormalBW	6	94255381	94633816	0.65
EPM.ClosedArmDistance	Experimenter	1	194439329	194834128	0.43
EPM.ClosedArmDistance	Experimenter	5	10166057	12371056	0.95
EPM.ClosedArmDistance	Experimenter	5	108405952	108813581	0.86
EPM.ClosedArmDistance	Experimenter	6	98258473	98363418	0.51
EPM.ClosedArmDistance	Experimenter	11	93622508	93851434	0.37
EPM.ClosedArmDistance	Experimenter	17	33077989	33247064	0.7
EPM.ClosedArmDistance	Experimenter	17	43371875	43563829	0.58
EPM.ClosedArmDistance	Experimenter	17	67450921	67854480	0.44
EPM.ClosedArmDistance	Experimenter	18	34860451	35366059	0.54
EPM.ClosedArmEntries	Date.Month	3	107244456	107273951	0.75
EPM.ClosedArmEntries	Date.Month	17	39314765	40807075	0.66

EPM.ClosedArmEntries	Date.Month	X		60678165	61595205	0.58
EPM.ClosedArmEntries	Experimenter		1	163036833	163449776	0.73
EPM.ClosedArmEntries	Experimenter		2	145107318	145712235	0.47
EPM.ClosedArmEntries	Experimenter		2	162322214	162677301	0.59
EPM.ClosedArmEntries	Experimenter		5	6996830	7461239	0.85
EPM.ClosedArmEntries	Experimenter		5	99729724	100055311	0.79
EPM.ClosedArmTime	Date.StudyDay		4	46188127	46553270	0.98
EPM.ClosedArmTime	Date.StudyDay		4	151534512	152935060	0.62
EPM.ClosedArmTime	Date.StudyDay		8	111470906	111936122	0.93
EPM.ClosedArmTime	Date.StudyDay		10	116291431	116582656	0.73
EPM.ClosedArmTime	Date.StudyDay		15	3229029	3927809	0.63
EPM.JunctionDistance	CoatColour		1	65557718	65946827	0.66
EPM.JunctionDistance	CoatColour		2	150727086	151386894	0.99
EPM.JunctionDistance	CoatColour		4	13418403	13764891	0.43
EPM.JunctionDistance	CoatColour		4	31651626	32107160	0.78
EPM.JunctionDistance	CoatColour		4	121069648	121366705	0.99
EPM.JunctionDistance	CoatColour		4	148561788	149023654	0.6
EPM.JunctionDistance	CoatColour		5	74027060	74219648	0.67
EPM.JunctionDistance	CoatColour		5	98407243	98940713	1
EPM.JunctionDistance	CoatColour		5	109548503	110024235	0.89
EPM.JunctionDistance	CoatColour		6	63509729	63772977	0.97
EPM.JunctionDistance	CoatColour		6	74847614	75333132	0.98
EPM.JunctionDistance	CoatColour		7	26701825	27375575	0.88
EPM.JunctionDistance	CoatColour		7	52163503	52276844	0.64
EPM.JunctionDistance	CoatColour		7	61940399	62432859	0.91
EPM.JunctionDistance	CoatColour		7	104154190	104540249	0.62
EPM.JunctionDistance	CoatColour		7	150663701	151056040	0.5
EPM.JunctionDistance	CoatColour		9	72676565	72952258	0.62
EPM.JunctionDistance	CoatColour		9	101224909	101520902	0.89
EPM.JunctionDistance	CoatColour		9	111864845	112348235	0.72
EPM.JunctionDistance	CoatColour		11	47289519	47930783	0.8
EPM.JunctionDistance	CoatColour		11	58923879	59042756	0.57
EPM.JunctionDistance	CoatColour		11	76227525	76760951	0.98
EPM.JunctionDistance	CoatColour		11	88786143	89105622	0.91
EPM.JunctionDistance	CoatColour		11	100250921	100625636	0.6
EPM.JunctionDistance	CoatColour		12	4841863	5260618	0.66
EPM.JunctionDistance	CoatColour		12	28507607	28961336	0.65
EPM.JunctionDistance	CoatColour		12	45826130	46245477	0.51
EPM.JunctionDistance	CoatColour		13	96748004	97286433	0.75
EPM.JunctionDistance	CoatColour		15	85529200	85631824	0.9
EPM.JunctionDistance	CoatColour		16	49776677	49891864	0.38
EPM.JunctionDistance	CoatColour		17	56836461	57492775	0.69
EPM.JunctionDistance	CoatColour		17	69398741	69740044	0.75
EPM.JunctionDistance	CoatColour		18	62663830	62998268	0.56
EPM.JunctionDistance	CoatColour	X		136375148	137212870	0.63
EPM.JunctionDistance	CoatColour	X		147892731	148232590	0.61
EPM.JunctionDistance	Date.StudyDay		1	63947477	64247914	0.79
EPM.JunctionDistance	Date.StudyDay		1	173148974	173171049	1
EPM.JunctionDistance	Date.StudyDay		1	186729361	187552612	0.6
EPM.JunctionDistance	Date.StudyDay		2	129928432	130216665	0.86
EPM.JunctionDistance	Date.StudyDay		3	117673563	118289974	0.66
EPM.JunctionDistance	Date.StudyDay		3	149427920	149617944	0.74
EPM.JunctionDistance	Date.StudyDay		4	43057706	43561953	0.78

EPM.JunctionDistance	Date.StudyDay		4	149683429	149827215	0.57
EPM.JunctionDistance	Date.StudyDay		5	74052085	74594494	0.91
EPM.JunctionDistance	Date.StudyDay		6	51745690	52193083	0.84
EPM.JunctionDistance	Date.StudyDay		6	90102227	90723596	0.99
EPM.JunctionDistance	Date.StudyDay		7	69076026	69695263	0.9
EPM.JunctionDistance	Date.StudyDay		9	48017309	48414675	0.98
EPM.JunctionDistance	Date.StudyDay		11	73402051	73660116	0.69
EPM.JunctionDistance	Date.StudyDay		12	25779635	26165733	0.82
EPM.JunctionDistance	Date.StudyDay		13	11898065	12509475	0.67
EPM.JunctionDistance	Date.StudyDay		15	4251292	4530033	0.8
EPM.JunctionDistance	Date.StudyDay		15	22448859	22837654	1
EPM.JunctionDistance	Date.StudyDay		16	88185769	88933953	0.83
EPM.JunctionDistance	Date.StudyDay		19	15540244	15843635	0.67
EPM.JunctionDistance	Date.StudyDay	X		53755134	54787588	0.85
EPM.JunctionDistance	Experimenter		4	103321564	103838932	0.47
EPM.JunctionDistance	Experimenter		10	125239648	125574982	0.68
EPM.JunctionEntries	CoatColour		3	151082216	151227184	0.58
EPM.JunctionEntries	CoatColour		4	31651626	32107160	0.45
EPM.JunctionEntries	CoatColour		15	84532436	84968102	0.78
EPM.JunctionEntries	CoatColour		19	45852919	46310045	0.47
EPM.JunctionEntries	Date.StudyDay		18	81002948	81802986	0.7
EPM.JunctionEntries	Experimenter		1	162990315	163265710	0.86
EPM.JunctionEntries	Experimenter		3	19163073	19544453	0.49
EPM.JunctionEntries	Experimenter		15	84532436	84968102	0.8
EPM.OpenArmDistance	CoatColour		1	12083914	12711181	0.6
EPM.OpenArmDistance	CoatColour		1	50157142	50773311	0.61
EPM.OpenArmDistance	CoatColour		1	65111496	65744752	0.64
EPM.OpenArmDistance	CoatColour		2	135137887	135469618	0.6
EPM.OpenArmDistance	CoatColour		2	149749907	150449200	0.8
EPM.OpenArmDistance	CoatColour		3	19544453	19906427	0.88
EPM.OpenArmDistance	CoatColour		3	27874393	28537266	0.81
EPM.OpenArmDistance	CoatColour		3	87719694	87781832	0.97
EPM.OpenArmDistance	CoatColour		3	97214214	97788637	0.94
EPM.OpenArmDistance	CoatColour		4	43742456	44245572	0.56
EPM.OpenArmDistance	CoatColour		4	73674171	73879334	0.63
EPM.OpenArmDistance	CoatColour		5	21329698	21773079	0.82
EPM.OpenArmDistance	CoatColour		6	25547520	26156709	0.66
EPM.OpenArmDistance	CoatColour		7	62592751	62893471	0.79
EPM.OpenArmDistance	CoatColour		9	102625858	103073400	0.79
EPM.OpenArmDistance	CoatColour		10	118763382	119215527	0.54
EPM.OpenArmDistance	CoatColour		11	70938207	71293246	0.55
EPM.OpenArmDistance	CoatColour		12	45826130	46245477	0.49
EPM.OpenArmDistance	CoatColour		12	82075601	82689682	0.62
EPM.OpenArmDistance	CoatColour		12	111199548	111535744	0.85
EPM.OpenArmDistance	CoatColour		13	59281797	59546101	0.87
EPM.OpenArmDistance	CoatColour		13	109432907	109760514	0.51
EPM.OpenArmDistance	CoatColour		14	24425422	24871370	0.87
EPM.OpenArmDistance	CoatColour		15	52445964	52854020	0.6
EPM.OpenArmDistance	CoatColour		15	62471953	62728616	0.64
EPM.OpenArmDistance	CoatColour		17	69322198	69618402	0.78
EPM.OpenArmDistance	CoatColour		19	41193046	41716445	0.92
EPM.OpenArmDistance	Date.StudyDay		1	62750655	63303607	1
EPM.OpenArmDistance	Date.StudyDay		1	76153308	76371490	0.54

EPM.OpenArmDistance	Date.StudyDay		1	190724667	190852896	0.66
EPM.OpenArmDistance	Date.StudyDay		3	32480432	32749574	0.68
EPM.OpenArmDistance	Date.StudyDay		3	61585436	61615426	0.6
EPM.OpenArmDistance	Date.StudyDay		4	46487258	46655593	0.84
EPM.OpenArmDistance	Date.StudyDay		4	76484734	76696979	0.75
EPM.OpenArmDistance	Date.StudyDay		4	131555056	132409910	0.73
EPM.OpenArmDistance	Date.StudyDay		5	77316124	77566964	0.67
EPM.OpenArmDistance	Date.StudyDay		6	17673571	17922517	1
EPM.OpenArmDistance	Date.StudyDay		7	26701825	27375575	1
EPM.OpenArmDistance	Date.StudyDay		7	35541626	35854858	0.69
EPM.OpenArmDistance	Date.StudyDay		7	146744713	146866196	0.75
EPM.OpenArmDistance	Date.StudyDay		8	111292415	111611078	0.74
EPM.OpenArmDistance	Date.StudyDay		9	61696857	62013883	0.7
EPM.OpenArmDistance	Date.StudyDay		9	80151180	80231375	0.94
EPM.OpenArmDistance	Date.StudyDay		10	113993805	114310830	0.9
EPM.OpenArmDistance	Date.StudyDay		11	97487291	97697688	0.88
EPM.OpenArmDistance	Date.StudyDay		12	45826130	46245477	0.92
EPM.OpenArmDistance	Date.StudyDay		12	59980659	60070916	0.84
EPM.OpenArmDistance	Date.StudyDay		12	86024506	86986186	0.77
EPM.OpenArmDistance	Date.StudyDay		13	52660661	52939247	0.79
EPM.OpenArmDistance	Date.StudyDay		13	76902854	77245598	0.87
EPM.OpenArmDistance	Date.StudyDay		14	36698907	37037783	0.71
EPM.OpenArmDistance	Date.StudyDay		14	75108998	75621081	0.77
EPM.OpenArmDistance	Date.StudyDay		15	3229029	3927809	0.67
EPM.OpenArmDistance	Date.StudyDay		15	19034910	19093626	0.81
EPM.OpenArmDistance	Date.StudyDay		15	50906993	51159618	0.98
EPM.OpenArmDistance	Date.StudyDay		16	4326508	4850057	0.74
EPM.OpenArmDistance	Date.StudyDay		16	55537783	56024095	0.96
EPM.OpenArmDistance	Date.StudyDay		17	45704313	45823630	0.78
EPM.OpenArmDistance	Date.StudyDay		18	64106639	64424225	0.87
EPM.OpenArmDistance	Date.StudyDay		19	14870225	15440559	0.87
EPM.OpenArmDistance	Date.StudyDay		19	50367613	50612275	0.92
EPM.OpenArmDistance	Date.StudyDay	X		53755134	54787588	0.77
EPM.OpenArmDistance	EndNormalBW		3	135276529	135672914	0.88
EPM.OpenArmDistance	Experimenter		2	59747646	60020985	0.55
EPM.OpenArmDistance	Experimenter		3	123076946	123337581	0.54
EPM.OpenArmDistance	Experimenter		3	144425138	144857234	0.48
EPM.OpenArmDistance	Experimenter		4	32107160	32296618	0.81
EPM.OpenArmDistance	Experimenter		4	43663620	43912491	0.93
EPM.OpenArmDistance	Experimenter		5	77316124	77566964	0.92
EPM.OpenArmDistance	Experimenter		5	110024235	110534158	0.57
EPM.OpenArmDistance	Experimenter		6	17673571	17922517	0.89
EPM.OpenArmDistance	Experimenter		6	48992700	49078409	0.38
EPM.OpenArmDistance	Experimenter		6	144091793	144263646	1
EPM.OpenArmDistance	Experimenter		7	114016869	114369436	0.9
EPM.OpenArmDistance	Experimenter		9	68739715	69455800	0.82
EPM.OpenArmDistance	Experimenter		14	13585884	13739903	0.54
EPM.OpenArmDistance	Experimenter		14	37561918	38075998	0.69
EPM.OpenArmDistance	Experimenter		15	13426421	14320173	0.44
EPM.OpenArmDistance	Experimenter		15	27257204	27734679	0.61
EPM.OpenArmDistance	Experimenter		15	58011958	58603687	0.74
EPM.OpenArmDistance	Experimenter		16	21678372	22241740	0.66
EPM.OpenArmDistance	Experimenter		16	74159922	74196580	0.79

EPM.OpenArmDistance	Experimenter		17	62204088	62900675	0.46
EPM.OpenArmDistance	Experimenter		18	27839238	28259743	0.52
EPM.OpenArmDistance	Experimenter		19	17198467	17653325	0.89
EPM.OpenArmDistance	Experimenter		19	50551540	50683533	0.92
EPM.OpenArmDistance	Experimenter	X		159071793	160727179	0.9
EPM.OpenArmEntries	CoatColour		1	65092280	65557718	0.69
EPM.OpenArmEntries	CoatColour		1	74335917	74488036	0.53
EPM.OpenArmEntries	CoatColour		3	28626776	29004632	0.62
EPM.OpenArmEntries	CoatColour		3	67349038	67810412	0.78
EPM.OpenArmEntries	CoatColour		3	87719694	87781832	0.98
EPM.OpenArmEntries	CoatColour		3	97214214	97788637	0.95
EPM.OpenArmEntries	CoatColour		4	43742456	44245572	0.58
EPM.OpenArmEntries	CoatColour		5	28743620	29413722	0.65
EPM.OpenArmEntries	CoatColour		5	75274591	75857065	0.69
EPM.OpenArmEntries	CoatColour		6	24899450	25547520	0.66
EPM.OpenArmEntries	CoatColour		7	26995386	27852765	0.86
EPM.OpenArmEntries	CoatColour		7	36370162	36597436	0.6
EPM.OpenArmEntries	CoatColour		7	61940399	62432859	0.92
EPM.OpenArmEntries	CoatColour		7	114369436	114542246	0.64
EPM.OpenArmEntries	CoatColour		8	113843138	114217297	0.59
EPM.OpenArmEntries	CoatColour		9	102625858	103073400	0.88
EPM.OpenArmEntries	CoatColour		11	70938207	71293246	0.71
EPM.OpenArmEntries	CoatColour		12	45826130	46245477	0.55
EPM.OpenArmEntries	CoatColour		12	72233655	72803408	0.59
EPM.OpenArmEntries	CoatColour		12	82075601	82689682	0.55
EPM.OpenArmEntries	CoatColour		12	111199548	111535744	0.6
EPM.OpenArmEntries	CoatColour		13	58825796	59454145	0.75
EPM.OpenArmEntries	CoatColour		15	22401999	22665260	0.79
EPM.OpenArmEntries	CoatColour		15	52666350	53002023	0.58
EPM.OpenArmEntries	CoatColour		15	62471953	62728616	0.56
EPM.OpenArmEntries	CoatColour		17	68482469	68906331	0.84
EPM.OpenArmEntries	CoatColour		19	26002049	26160762	0.68
EPM.OpenArmEntries	Date.StudyDay		1	39578671	39913615	0.87
EPM.OpenArmEntries	Date.StudyDay		1	62750655	63303607	1
EPM.OpenArmEntries	Date.StudyDay		1	103746211	104669880	0.74
EPM.OpenArmEntries	Date.StudyDay		2	22421237	23199200	0.62
EPM.OpenArmEntries	Date.StudyDay		2	130877423	131240678	0.74
EPM.OpenArmEntries	Date.StudyDay		2	159117960	159406644	0.66
EPM.OpenArmEntries	Date.StudyDay		3	101016654	101413815	0.69
EPM.OpenArmEntries	Date.StudyDay		3	117669709	117874656	0.73
EPM.OpenArmEntries	Date.StudyDay		4	46487258	46655593	1
EPM.OpenArmEntries	Date.StudyDay		4	80742455	81082042	0.96
EPM.OpenArmEntries	Date.StudyDay		4	131555056	132409910	0.92
EPM.OpenArmEntries	Date.StudyDay		6	7666492	8012600	0.66
EPM.OpenArmEntries	Date.StudyDay		6	18426234	18518150	1
EPM.OpenArmEntries	Date.StudyDay		6	146582126	147147647	1
EPM.OpenArmEntries	Date.StudyDay		7	13662058	13909627	0.74
EPM.OpenArmEntries	Date.StudyDay		7	26995386	27852765	1
EPM.OpenArmEntries	Date.StudyDay		7	35541626	35854858	0.81
EPM.OpenArmEntries	Date.StudyDay		7	89127286	89430510	0.56
EPM.OpenArmEntries	Date.StudyDay		7	146866196	147107029	0.85
EPM.OpenArmEntries	Date.StudyDay		8	111292415	111611078	0.94
EPM.OpenArmEntries	Date.StudyDay		9	35019941	35793170	0.58

EPM.OpenArmEntries	Date.StudyDay		9	46583551	47075366	0.84
EPM.OpenArmEntries	Date.StudyDay		9	61358195	61809262	0.63
EPM.OpenArmEntries	Date.StudyDay		9	80151180	80231375	0.88
EPM.OpenArmEntries	Date.StudyDay		10	69508434	69730556	0.78
EPM.OpenArmEntries	Date.StudyDay		10	113993805	114310830	0.96
EPM.OpenArmEntries	Date.StudyDay		11	3454099	3931801	0.91
EPM.OpenArmEntries	Date.StudyDay		11	73402051	73660116	0.91
EPM.OpenArmEntries	Date.StudyDay		11	97487291	97697688	0.89
EPM.OpenArmEntries	Date.StudyDay		12	46008876	46426013	0.94
EPM.OpenArmEntries	Date.StudyDay		12	59980659	60070916	0.69
EPM.OpenArmEntries	Date.StudyDay		12	86024506	86986186	0.81
EPM.OpenArmEntries	Date.StudyDay		13	11898065	12509475	0.72
EPM.OpenArmEntries	Date.StudyDay		13	51021176	51770787	0.99
EPM.OpenArmEntries	Date.StudyDay		13	63973239	64072890	0.67
EPM.OpenArmEntries	Date.StudyDay		13	76902854	77245598	0.97
EPM.OpenArmEntries	Date.StudyDay		14	30433259	30611522	0.89
EPM.OpenArmEntries	Date.StudyDay		14	75108998	75621081	0.91
EPM.OpenArmEntries	Date.StudyDay		15	3229029	3927809	0.89
EPM.OpenArmEntries	Date.StudyDay		15	13253265	13691188	0.7
EPM.OpenArmEntries	Date.StudyDay		15	22211678	22401999	0.93
EPM.OpenArmEntries	Date.StudyDay		15	50906993	51159618	0.75
EPM.OpenArmEntries	Date.StudyDay		15	77037666	77361546	0.72
EPM.OpenArmEntries	Date.StudyDay		16	4627635	5029442	0.82
EPM.OpenArmEntries	Date.StudyDay		16	55537783	56024095	0.96
EPM.OpenArmEntries	Date.StudyDay		17	45704313	45823630	1
EPM.OpenArmEntries	Date.StudyDay		18	5395135	5772854	0.75
EPM.OpenArmEntries	Date.StudyDay		18	37850272	38634488	0.68
EPM.OpenArmEntries	Date.StudyDay		18	54979194	55342370	0.68
EPM.OpenArmEntries	Date.StudyDay		18	64106639	64424225	0.84
EPM.OpenArmEntries	Date.StudyDay		18	77559607	77875926	0.66
EPM.OpenArmEntries	Date.StudyDay		19	15540244	15843635	0.93
EPM.OpenArmEntries	Date.StudyDay		19	50367613	50612275	1
EPM.OpenArmEntries	Date.StudyDay	X		49412403	50304095	1
EPM.OpenArmEntries	EndNormalBW		6	23784405	24223615	0.67
EPM.OpenArmTime	CoatColour		1	12083914	12711181	0.5
EPM.OpenArmTime	CoatColour		3	19544453	19906427	0.49
EPM.OpenArmTime	CoatColour		3	28293034	28626776	0.67
EPM.OpenArmTime	CoatColour		3	87719694	87781832	0.74
EPM.OpenArmTime	CoatColour		12	111199548	111535744	0.49
EPM.OpenArmTime	CoatColour		14	24425422	24871370	0.48
EPM.OpenArmTime	CoatColour		19	41193046	41716445	0.7
EPM.OpenArmTime	Date.StudyDay		1	62750655	63303607	0.94
EPM.OpenArmTime	Date.StudyDay		6	17673571	17922517	1
EPM.OpenArmTime	Date.StudyDay		7	26678879	26995386	0.9
EPM.OpenArmTime	Date.StudyDay		9	80151180	80231375	0.77
EPM.OpenArmTime	Date.StudyDay		10	113993805	114310830	0.63
EPM.OpenArmTime	Date.StudyDay		11	97185103	97627300	0.82
EPM.OpenArmTime	Date.StudyDay		12	114569903	114730591	0.7
EPM.OpenArmTime	Date.StudyDay		13	73106272	73431400	0.69
EPM.OpenArmTime	Date.StudyDay		18	64106639	64424225	0.71
EPM.OpenArmTime	Date.StudyDay		19	50367613	50612275	0.63
EPM.OpenArmTime	EndNormalBW		3	135276529	135672914	0.94
EPM.OpenArmTime	Experimenter		2	59747646	60020985	0.55

EPM.OpenArmTime	Experimenter		3	123076946	123337581	0.66
EPM.OpenArmTime	Experimenter		3	144305823	144668067	0.59
EPM.OpenArmTime	Experimenter		4	43561953	43742456	0.81
EPM.OpenArmTime	Experimenter		5	75877502	76098998	0.87
EPM.OpenArmTime	Experimenter		5	98266274	98793621	0.69
EPM.OpenArmTime	Experimenter		5	110534158	111078035	0.59
EPM.OpenArmTime	Experimenter		6	17673571	17922517	0.7
EPM.OpenArmTime	Experimenter		6	48992700	49078409	0.62
EPM.OpenArmTime	Experimenter		6	144091793	144263646	0.93
EPM.OpenArmTime	Experimenter		7	36917052	37211622	0.63
EPM.OpenArmTime	Experimenter		7	114016869	114369436	0.58
EPM.OpenArmTime	Experimenter		9	68739715	69455800	0.91
EPM.OpenArmTime	Experimenter		10	69963874	70573392	0.67
EPM.OpenArmTime	Experimenter		11	24511115	24652977	0.49
EPM.OpenArmTime	Experimenter		13	69230831	69467927	0.49
EPM.OpenArmTime	Experimenter		14	14139933	14437715	0.67
EPM.OpenArmTime	Experimenter		15	13253265	13691188	0.81
EPM.OpenArmTime	Experimenter		15	27257204	27734679	0.81
EPM.OpenArmTime	Experimenter		15	58011958	58603687	0.53
EPM.OpenArmTime	Experimenter		16	74159922	74196580	0.53
EPM.OpenArmTime	Experimenter		17	62204088	62900675	0.45
EPM.OpenArmTime	Experimenter		18	27839238	28259743	0.55
EPM.OpenArmTime	Experimenter		19	17198467	17653325	0.65
EPM.OpenArmTime	Experimenter		19	48744493	49343449	0.76
EPM.OpenArmTime	Experimenter	X		159071793	160727179	0.83
FPS.Bang.Tone.Increase	EndNormalBW		7	67179879	68111844	0.72
FPS.Bang.Tone.Increase	EndNormalBW		11	68740337	68922467	0.74
FPS.Bang.Tone.Increase	EndNormalBW		12	5398958	5951181	0.81
FPS.Pre.Bang.Mean	Date.StudyDay		1	100689777	100957343	0.97
FPS.Pre.Bang.Mean	Date.StudyDay		2	75987728	76424042	0.55
FPS.Pre.Bang.Mean	Date.StudyDay		3	21430278	22234167	0.64
FPS.Pre.Bang.Mean	Date.StudyDay		4	4494114	5013475	0.94
FPS.Pre.Bang.Mean	Date.StudyDay		4	34592952	34929896	0.83
FPS.Pre.Bang.Mean	Date.StudyDay		6	33026735	33463335	0.73
FPS.Pre.Bang.Mean	Date.StudyDay		6	116206534	116360091	0.78
FPS.Pre.Bang.Mean	Date.StudyDay		7	102651318	103251119	0.95
FPS.Pre.Bang.Mean	Date.StudyDay		10	90522899	91382191	0.82
FPS.Pre.Bang.Mean	Date.StudyDay		13	98186111	99206071	0.76
FPS.Pre.Bang.Mean	Date.StudyDay		13	107925388	108070177	0.98
FPS.Pre.Bang.Mean	Date.StudyDay		14	59172881	59434030	0.62
FPS.Pre.Bang.Mean	Date.StudyDay		16	80830216	81314519	0.78
FPS.Pre.Bang.Mean	Date.StudyDay		18	27595271	28154936	0.68
FPS.Pre.Bang.Mean	Date.StudyDay		19	29225288	30313613	0.81
FPS.Pre.Bang.Mean	Date.StudyDay	X		65262607	65868119	0.64
FPS.Pre.Bang.Mean	EndNormalBW		1	182669036	182865396	0.63
FPS.Pre.Bang.Mean	EndNormalBW		5	6954447	7163391	0.64
FPS.Pre.Bang.Mean	EndNormalBW		6	32910157	33247421	0.77
FPS.Pre.Bang.Mean	EndNormalBW		12	8382766	8976635	0.85
FPS.Pre.Bang.Mean	EndNormalBW		16	64434619	64828875	0.87
FPS.Pre.Bang.Mean	EndNormalBW		19	46090064	46656899	0.71
FPS.Pre.Bang.Tone.Mean	Date.StudyDay		1	100503409	100806554	0.96
FPS.Pre.Bang.Tone.Mean	Date.StudyDay		2	75987728	76424042	0.63
FPS.Pre.Bang.Tone.Mean	Date.StudyDay		4	33910931	34238266	0.62

FPS.Pre.Bang.Tone.Mean	Date.StudyDay		6	99053757	99670395	0.71
FPS.Pre.Bang.Tone.Mean	Date.StudyDay		7	102651318	103251119	0.68
FPS.Pre.Bang.Tone.Mean	Date.StudyDay		14	119425407	120021366	0.92
FPS.Pre.Bang.Tone.Mean	Date.StudyDay		19	14870225	15440559	0.57
FPS.Pre.Bang.Tone.Mean	Date.StudyDay		19	29140657	30055566	0.7
FPS.Pre.Bang.Tone.Mean	EndNormalBW		11	20208524	20329667	0.58
FPS.Pre.Bang.Tone.Mean	EndNormalBW		16	64434619	64828875	0.7
OFT.CenterTime	Experimenter		1	169640335	169907733	0.45
OFT.CenterTime	Experimenter		6	21625774	22074735	0.72
OFT.CenterTime	Experimenter		7	31244528	31303556	0.81
OFT.CenterTime	Experimenter		8	63851255	63992012	0.87
OFT.CenterTime	Experimenter		9	27651941	28106270	0.74
OFT.CenterTime	Experimenter		9	73688873	73953958	0.4
OFT.CenterTime	Experimenter		10	56917208	57472167	0.56
OFT.CenterTime	Experimenter		12	75887624	76396342	0.7
OFT.CenterTime	Experimenter		12	106753055	107058673	0.41
OFT.CenterTime	Experimenter		14	74925298	75319087	0.58
OFT.CenterTime	Experimenter		17	84146762	84190502	0.56
OFT.CenterTime	Experimenter		19	49343449	49964579	0.97
OFT.Latency	Experimenter		1	169640335	169907733	0.71
OFT.Latency	Experimenter		1	194325776	194704248	0.38
OFT.Latency	Experimenter		2	116157294	116341746	0.57
OFT.Latency	Experimenter		2	148357322	148697580	0.4
OFT.Latency	Experimenter		4	147360389	147520307	0.75
OFT.Latency	Experimenter		6	29360852	30039897	0.43
OFT.Latency	Experimenter		6	47731981	48341201	0.45
OFT.Latency	Experimenter		9	68910643	69502676	0.74
OFT.Latency	Experimenter		9	77775293	78045916	0.97
OFT.Latency	Experimenter		11	3023832	3454099	0.6
OFT.Latency	Experimenter		11	42844027	43366314	0.95
OFT.Latency	Experimenter		12	73988083	74389432	0.62
OFT.Latency	Experimenter		12	106753055	107058673	0.41
OFT.Latency	Experimenter		15	53655538	54193374	0.41
OFT.Latency	Experimenter	X		103774880	104607924	0.44
OFT.TotalActivity	Date.Season		1	162990315	163265710	0.69
OFT.TotalActivity	Date.Season		8	45708217	46204214	0.85
OFT.TotalActivity	Date.Season		9	122834240	123121097	0.76
OFT.TotalActivity	Date.Season		10	124928036	125090029	0.81
OFT.TotalActivity	Date.Season		12	76396342	76993554	0.72
OFT.TotalActivity	Date.Season		13	41115192	41295650	0.83
OFT.TotalActivity	Date.Season		15	26360701	26705525	0.51
OFT.TotalActivity	EndNormalBW		12	8100883	8350372	0.65
OFT.TotalActivity	EndNormalBW		12	17581249	19245953	0.99
OFT.TotalActivity	EndNormalBW		17	3484561	3794454	0.61
OFT.TotalActivity	Experimenter		1	39053030	39469790	0.5
OFT.TotalActivity	Experimenter		1	60819631	61228362	0.99
OFT.TotalActivity	Experimenter		1	160776009	160995436	0.77
OFT.TotalActivity	Experimenter		1	169907733	170259338	0.92
OFT.TotalActivity	Experimenter		2	42741553	42930156	0.61
OFT.TotalActivity	Experimenter		2	77028144	77317222	0.77
OFT.TotalActivity	Experimenter		2	97325801	97598246	0.71
OFT.TotalActivity	Experimenter		2	129970450	130367014	0.92
OFT.TotalActivity	Experimenter		2	145712235	145995921	0.74

OFT.TotalActivity	Experimenter		3	108821923	109084536	0.62
OFT.TotalActivity	Experimenter		3	136305786	136689544	0.79
OFT.TotalActivity	Experimenter		4	6638037	6820602	0.74
OFT.TotalActivity	Experimenter		4	52404614	52735566	0.74
OFT.TotalActivity	Experimenter		4	109125748	109541448	0.61
OFT.TotalActivity	Experimenter		5	8957127	9448809	0.53
OFT.TotalActivity	Experimenter		5	21760276	22147944	0.65
OFT.TotalActivity	Experimenter		5	108850183	109059308	0.8
OFT.TotalActivity	Experimenter		6	115892953	116040240	0.66
OFT.TotalActivity	Experimenter		7	114746266	116038935	0.8
OFT.TotalActivity	Experimenter		9	111255564	111619685	0.9
OFT.TotalActivity	Experimenter		10	57697414	57941566	0.95
OFT.TotalActivity	Experimenter		10	68029824	68304970	0.88
OFT.TotalActivity	Experimenter		11	3454099	3931801	0.62
OFT.TotalActivity	Experimenter		11	19368827	19463009	0.59
OFT.TotalActivity	Experimenter		11	38978863	39697632	0.68
OFT.TotalActivity	Experimenter		12	71817698	72105904	0.51
OFT.TotalActivity	Experimenter		12	81218210	81763439	0.6
OFT.TotalActivity	Experimenter		12	113609980	113741390	0.62
OFT.TotalActivity	Experimenter		14	31832036	32297239	0.62
OFT.TotalActivity	Experimenter		14	64681847	64867370	0.49
OFT.TotalActivity	Experimenter		14	76050626	76816724	0.56
OFT.TotalActivity	Experimenter		15	9017077	9717658	0.69
OFT.TotalActivity	Experimenter		15	22211678	22401999	0.7
OFT.TotalActivity	Experimenter		15	46712383	46998105	0.91
OFT.TotalActivity	Experimenter		15	54944833	55306230	0.75
OFT.TotalActivity	Experimenter		17	37185755	37570713	1
OFT.TotalActivity	Experimenter		17	66364287	66710315	0.69
OFT.TotalActivity	Experimenter		19	11170516	11629225	1
OFT.TotalActivity	Experimenter		19	51911554	52068523	0.9
OFT.TotalActivity	Experimenter		19	60875841	61266404	0.52
PAS.Ambulatory1	Date.Season		4	14958749	15072111	0.53
PAS.Ambulatory1	Date.Season		9	58318383	58724741	0.45
PAS.Ambulatory1	Date.Season		10	104406006	104441715	0.82
PAS.Ambulatory1	Date.Season		14	22443179	22803620	0.84
PAS.Ambulatory1	EndNormalBW		12	17176851	17739797	0.73
PAS.Ambulatory1	Experimenter		1	19281740	19624804	0.77
PAS.Ambulatory1	Experimenter		5	120880636	121345629	0.8
PAS.Ambulatory1	Experimenter		6	130423424	130435791	0.56
PAS.Ambulatory1	Experimenter		7	77106259	77309744	0.48
PAS.Ambulatory1	Experimenter		13	69633413	69754381	0.73
PAS.Ambulatory1	Experimenter		15	100783294	100949643	0.7
PAS.Ambulatory1	Experimenter		16	62269431	62631253	0.9
PAS.Ambulatory1	Experimenter		17	57135591	57771509	0.95
PAS.Ambulatory1	Experimenter		18	89553342	89867333	0.98
PAS.Ambulatory6	Date.Hour		8	89627039	89857354	0.65
PAS.Ambulatory6	Experimenter		5	113197260	113383992	0.42
PAS.Ambulatory6	Experimenter	X		89920738	90183557	0.45
PAS.Ambulatory6	Experimenter	X		98027281	98847343	0.57
PAS.TotalAmbulatory	Date.Season		1	92306052	92719618	0.77
PAS.TotalAmbulatory	Date.Season		2	36657104	37285090	0.71
PAS.TotalAmbulatory	Date.Season		3	30981290	31379399	0.96
PAS.TotalAmbulatory	Date.Season		15	35975770	36365475	0.82

PAS.TotalAmbulatory	Date.Season	X		130685050	131060256	0.86
PAS.TotalAmbulatory	Experimenter		1	61228362	61443691	0.92
PAS.TotalAmbulatory	Experimenter		2	30043246	30296386	0.47
PAS.TotalAmbulatory	Experimenter		2	60939626	61594742	0.48
PAS.TotalAmbulatory	Experimenter		3	31379399	32085902	0.61
PAS.TotalAmbulatory	Experimenter		5	112502580	112765005	0.75
PAS.TotalAmbulatory	Experimenter		5	120880636	121345629	0.78
PAS.TotalAmbulatory	Experimenter		6	60818356	61157764	0.61
PAS.TotalAmbulatory	Experimenter		6	92615909	93099493	0.89
PAS.TotalAmbulatory	Experimenter		6	121249276	121914349	0.38
PAS.TotalAmbulatory	Experimenter		7	47556768	47652751	0.51
PAS.TotalAmbulatory	Experimenter		7	77400104	77717078	0.76
PAS.TotalAmbulatory	Experimenter		8	6461410	6808249	0.61
PAS.TotalAmbulatory	Experimenter		8	48456317	48712840	0.62
PAS.TotalAmbulatory	Experimenter		10	125735778	126068682	0.68
PAS.TotalAmbulatory	Experimenter		11	63033272	63190603	0.44
PAS.TotalAmbulatory	Experimenter		12	81218210	81763439	0.5
PAS.TotalAmbulatory	Experimenter		13	45454556	45996991	0.66
PAS.TotalAmbulatory	Experimenter		13	69633413	69754381	0.89
PAS.TotalAmbulatory	Experimenter		13	81063798	81583762	0.65
PAS.TotalAmbulatory	Experimenter		13	90216156	90560208	0.56
PAS.TotalAmbulatory	Experimenter		14	22571373	23011973	0.64
PAS.TotalAmbulatory	Experimenter		15	100783294	100949643	0.68
PAS.TotalAmbulatory	Experimenter		17	54965922	55409309	0.89
PAS.TotalAmbulatory	Experimenter		18	8042585	8528261	0.64
PAS.TotalAmbulatory	Experimenter		19	57681996	58202917	0.65
PAS.TotalAmbulatory	Experimenter	X		10022175	10276927	0.85
PAS.TotalAmbulatory	Experimenter	X		38296202	39805923	0.84
PAS.TotalAmbulatory	Experimenter	X		90058693	90523699	0.88
PAS.TotalAmbulatory	Experimenter	X		98027281	98847343	0.96
PAS.TotalAmbulatory	Experimenter	X		119887753	122993058	0.6
PAS.TotalAmbulatory	Experimenter	X		135324681	136375148	0.61
PAS.TotalFine	Date.StudyDay		2	131352312	131486925	0.83
PAS.TotalFine	Date.StudyDay		3	4362409	5086420	0.47
PAS.TotalFine	Date.StudyDay		3	14626475	15073158	0.92
PAS.TotalFine	Date.StudyDay		5	120880636	121345629	0.97
PAS.TotalFine	Date.StudyDay		11	94427666	94797729	0.93
PAS.TotalFine	Date.StudyDay		11	118007201	118205164	0.63
PAS.TotalFine	Experimenter		1	62311313	62750655	0.58
PAS.TotalFine	Experimenter		1	164073118	164410272	0.54
PAS.TotalFine	Experimenter		2	134712780	135137887	0.57
PAS.TotalFine	Experimenter		5	120880636	121345629	0.66
PAS.TotalFine	Experimenter		6	8587415	9131625	0.6
PAS.TotalFine	Experimenter		8	26642792	27248946	0.95
PAS.TotalFine	Experimenter		9	10369266	11637857	0.72
PAS.TotalFine	Experimenter		9	44334296	44444800	0.53
PAS.TotalFine	Experimenter		17	66897224	67450921	0.79
PAS.TotalFine	Experimenter	X		89920738	90183557	0.93
PAS.TotalFine	Experimenter	X		98027281	98847343	0.73

APPENDIX E

Hippocampus Gene Co-Expression Modules

These are the (rather lengthy, sorry) details of the both-sexes-together hippocampus gene co-expression modules identified in Chapter 4 using weighted gene co-expression network analysis. See Figure 4.7 for a summary of the network modules. The probes are sorted by Ensembl mouse gene IDs (Kinsella et al., 2011). There were roughly 200 probes for which no Ensembl ID was assigned, so I provided these at the end of this appendix, ordered alphabetically by gene names as per Barbosa and colleagues (2010). Probes identified as being in the "grey" module were in fact not assigned to a specific module.

Index	Ensembl_gene_id	gene_symbol	probe_name	module_colour
1	ENSMUSG00000000078	Klf6	scl023849.4_8-S	yellow
2	ENSMUSG00000000088	Cox5a	scl36904.3.10_19-S	grey
3	ENSMUSG00000000126	Wnt9a	scl41503.4_653-S	grey
4	ENSMUSG00000000131	Xpo6	scl30696.27.1_29-S	blue
5	ENSMUSG00000000134	Tcfe3	scl55073.12_278-S	blue
6	ENSMUSG00000000171	Sdhd	scl35879.4_19-S	turquoise
7	ENSMUSG00000000194	Gpr107	scl0277463.18_58-S	blue
8	ENSMUSG00000000197	Nalcn	scl0268777.1_108-S	red
9	ENSMUSG00000000223	Drp2	scl54634.28.1_195-S	blue
10	ENSMUSG00000000282	Mnt	scl41278.6_6-S	black
11	ENSMUSG00000000295	Hddc2	scl0003806.1_19-S	brown
12	ENSMUSG00000000295	Hddc2	scl39038.6.1_21-S	turquoise
13	ENSMUSG00000000296	Tpd52l1	scl0003909.1_5-S	brown
14	ENSMUSG00000000296	Tpd52l1	scl38077.4.1_28-S	blue
15	ENSMUSG00000000326	Comt1	scl0012846.1_253-S	greenyellow
16	ENSMUSG00000000326	Comt1	scl48681.7.1_1-S	turquoise
17	ENSMUSG00000000346	Dazap2	scl023994.4_204-S	turquoise
18	ENSMUSG00000000355	Mcts1	scl54976.5.1_9-S	brown
19	ENSMUSG00000000374	Trappc10	GI_38090558-I	turquoise
20	ENSMUSG00000000399	Ndufa9	scl066108.3_20-S	brown
21	ENSMUSG00000000420	Galnt1	scl014423.11_27-S	turquoise
22	ENSMUSG00000000439	Mkrn2	scl29606.9_357-S	brown
23	ENSMUSG00000000441	Raf1	scl28523.18.1_12-S	turquoise
24	ENSMUSG00000000531	Grasp	scl056149.9_314-S	blue
25	ENSMUSG00000000532	Acvr1b	scl0002445.1_75-S	pink
26	ENSMUSG00000000532	Acvr1b	scl47487.1.1186_63-S	blue
27	ENSMUSG00000000563	Atp5f1	scl21701.9.1_3-S	turquoise
28	ENSMUSG00000000567	Sox9	scl40760.4_18-S	grey
29	ENSMUSG00000000568	Hnrnpd	scl0004214.1_77-S	turquoise
30	ENSMUSG00000000594	Gm2a	scl41542.4_321-S	brown
31	ENSMUSG00000000600	Krit1	scl079264.1_0-S	turquoise
32	ENSMUSG00000000605	Clcn4-2	scl012727.1_314-S	turquoise
33	ENSMUSG00000000631	Myo18a	scl41225.47_412-S	blue
34	ENSMUSG00000000632	Sez6	scl41217.17_5-S	blue
35	ENSMUSG00000000738	Spg7	scl33214.20.1_19-S	blue
36	ENSMUSG00000000738	Spg7	scl000671.1_1-S	blue
37	ENSMUSG00000000743	Chmp1a	scl0234852.1_50-S	turquoise
38	ENSMUSG00000000751	Rpa1	scl39937.19_289-S	turquoise
39	ENSMUSG00000000753	Serpinf1	scl020317.1_68-S	black
40	ENSMUSG00000000787	Ddx3x	scl55039.15_103-S	turquoise
41	ENSMUSG00000000792	Slc5a5	scl34686.15_590-S	grey
42	ENSMUSG00000000794	Kcnn3	scl0002105.1_331-S	grey
43	ENSMUSG00000000804	Usp32	scl0237898.1_282-S	turquoise
44	ENSMUSG00000000805	Car4	scl41114.9.1_30-S	turquoise
45	ENSMUSG00000000823	Gm632	GI_38075785-S	turquoise
46	ENSMUSG00000000826	Dnajc5	scl0013002.2_72-S	turquoise
47	ENSMUSG00000000827	Tpd52l2	scl19764.11_583-S	turquoise
48	ENSMUSG00000000861	Bcl11a	scl0014025.1_244-S	blue
49	ENSMUSG00000000861	Bcl11a	scl0001352.1_150-S	yellow
50	ENSMUSG00000000881	Dlg3	scl54747.23_352-S	blue
51	ENSMUSG00000000902	Smarcb1	scl37807.8.1_23-S	blue
52	ENSMUSG00000000915	Hip1r	scl27228.32_300-S	blue
53	ENSMUSG00000000934	Top1mt	scl47063.13.1_72-S	turquoise
54	ENSMUSG00000000948	Snrpn	scl000252.1_5-S	pink
55	ENSMUSG00000000948	Snrpn	scl0020646.1_10-S	pink
56	ENSMUSG00000000948	Snrpn	scl000186.1_92-S	brown
57	ENSMUSG00000000959	Oxa1l	scl000292.1_12-S	turquoise
58	ENSMUSG00000001016	Ilf2	scl067781.14_22-S	brown
59	ENSMUSG00000001017	2500003M10Rik	scl0066511.2_56-S	turquoise
60	ENSMUSG00000001017	2500003M10Rik	scl0066511.2_242-S	grey
61	ENSMUSG00000001025	S100a6	scl22942.3.1_64-S	magenta
62	ENSMUSG00000001036	Epn2	scl000078.1_211-S	turquoise
63	ENSMUSG00000001036	Epn2	scl000088.1_36_REVCOMP-S	grey
64	ENSMUSG00000001036	Epn2	scl40126.18_106-S	blue
65	ENSMUSG00000001039	B9d1	scl41466.6.1_80-S	brown
66	ENSMUSG00000001054	Rmnd5b	scl40257.8.9_25-S	turquoise
67	ENSMUSG00000001056	Nhp2	scl052530.1_22-S	brown
68	ENSMUSG00000001082	Mfsd10	scl26700.8.1_2-S	turquoise
69	ENSMUSG00000001089	Luzp1	scl00269593.1_72-S	blue
70	ENSMUSG00000001098	Kctd10	scl26184.7_56-S	blue
71	ENSMUSG00000001100	Poldip2	scl41198.10_516-S	blue
72	ENSMUSG00000001105	Ift20	scl0001329.1_110-S	brown
73	ENSMUSG00000001105	Ift20	scl41197.5.1_16-S	turquoise
74	ENSMUSG00000001120	Pcbp3	scl37789.23.1_65-S	blue
75	ENSMUSG00000001128	Cfp	scl54357.9.1_59-S	grey
76	ENSMUSG00000001134	Uxt	scl022294.1_13-S	brown
77	ENSMUSG00000001143	Lman2l	scl0214895.1_30-S	blue
78	ENSMUSG00000001158	Snrnp27	scl28746.7_64-S	brown
79	ENSMUSG00000001173	Ocrl	scl54954.24_73-S	turquoise
80	ENSMUSG00000001211	Agpat3	scl37771.20_206-S	turquoise
81	ENSMUSG00000001227	Sema6b	scl49772.19.1740_17-S	blue
82	ENSMUSG00000001229	Dpp9	scl49771.23.1_24-S	blue
83	ENSMUSG00000001240	Ramp2	scl40890.2_6-S	blue
84	ENSMUSG00000001270	Ckb	scl0012709.2_191-S	blue
85	ENSMUSG00000001280	Sp1	scl10556.1.1_1-S	turquoise
86	ENSMUSG00000001285	Myg1	scl0002566.1_2-S	grey
87	ENSMUSG00000001289	Pfdn5	scl056612.4_0-S	brown
88	ENSMUSG00000001289	Pfdn5	scl0002537.1_7-S	blue
89	ENSMUSG00000001300	Efnb2	scl35124.5_47-S	turquoise
90	ENSMUSG00000001305	Rrp15	scl067223.1_25-S	turquoise
91	ENSMUSG00000001313	Rnd2	scl011858.3_21-S	grey
92	ENSMUSG00000001323	Srr	scl0027364.1_305-S	blue
93	ENSMUSG00000001334	Fndc5	scl0384061.7_167-S	turquoise
94	ENSMUSG00000001366	Fbxo9	scl35577.16.1_50-S	black
95	ENSMUSG00000001415	Smg5	scl23004.24_634-S	turquoise
96	ENSMUSG00000001416	Cct3	scl012462.9_0-S	red
97	ENSMUSG00000001418	0610031J06Rik	scl23003.7.28_144-S	turquoise
98	ENSMUSG00000001424	Snd1	scl30301.28.1_43-S	blue
99	ENSMUSG00000001435	Col18a1	scl37787.43_431-S	green
100	ENSMUSG00000001440	Kpnb1	scl39652.23.1463_24-S	turquoise
101	ENSMUSG00000001445	Mrpl10	scl40969.4.1_13-S	turquoise
102	ENSMUSG00000001467	Cyp51	scl013121.10_1-S	blue
103	ENSMUSG00000001472	Tcf25	scl33204.17_108-S	blue
104	ENSMUSG00000001507	Itga3	scl39694.29_139-S	blue
105	ENSMUSG00000001524	Gtf2h4	scl49981.15.1_56-S	grey
106	ENSMUSG00000001525	Tubb5	scl022154.1_53-S	black
107	ENSMUSG00000001525	Tubb5	scl49975.4.297_19-S	pink
108	ENSMUSG00000001665	Gstt3	scl37812.5_586-S	green
109	ENSMUSG00000001666	Ddt	scl37813.3.1_14-S	turquoise
110	ENSMUSG00000001687	Ubl3	scl25753.9_50-S	brown
111	ENSMUSG00000001707	Eef1e1	scl44070.4.1_3-S	turquoise
112	ENSMUSG00000001741	Il16	scl016170.1_67-S	turquoise
113	ENSMUSG00000001751	Naglu	scl027419.6_267-S	brown
114	ENSMUSG00000001755	Coasy	scl071743.9_29-S	turquoise
115	ENSMUSG00000001761	Smo	scl0319757.3_203-S	turquoise

116	ENSMUSG00000001763	Tspan33	scl30285.8.1_23-S	blue
117	ENSMUSG00000001768	Rin2	scl20180.20_84-S	turquoise
118	ENSMUSG00000001783	D10Wsu52e	scl37666.12.1_12-S	grey
119	ENSMUSG00000001827	Folr1	scl30959.7.1_15-S	green
120	ENSMUSG00000001833	Sep-07	scl0235072.13_139-S	turquoise
121	ENSMUSG00000001844	Zdhhc4	scl25806.10.1_16-S	turquoise
122	ENSMUSG00000001909	Trmt1	scl0212528.15_6-S	turquoise
123	ENSMUSG00000001911	Nfix	scl018032.3_14-S	blue
124	ENSMUSG00000001911	Nfix	scl000555.1_74-S	blue
125	ENSMUSG00000001911	Nfix	scl000614.1_52-S	blue
126	ENSMUSG00000001924	Uba1	scl55020.28_14-S	blue
127	ENSMUSG00000001930	Vwf	scl29492.60.1_120-S	blue
128	ENSMUSG00000001964	Emd	scl0002880.1_15-S	turquoise
129	ENSMUSG00000001964	Emd	scl54837.5.1_4-S	turquoise
130	ENSMUSG00000001986	Gria3	scl053623.15_103-S	turquoise
131	ENSMUSG00000001986	Gria3	scl54967.10.1218_2-S	yellow
132	ENSMUSG00000001986	Gria3	scl8260.1.1_298-S	turquoise
133	ENSMUSG00000001986	Gria3	scl0002989.1_42-S	yellow
134	ENSMUSG00000001995	Sipa1l2	scl0244668.1_1-S	blue
135	ENSMUSG00000001999	Blvra	scl20330.11.1_76-S	brown
136	ENSMUSG00000002007	Srpk3	scl056504.15_296-S	magenta
137	ENSMUSG00000002010	Idh3g	scl54154.5.1_20-S	red
138	ENSMUSG00000002012	Pnck	scl54159.12.1_16-S	turquoise
139	ENSMUSG00000002014	Ssr4	scl54843.2_132-S	blue
140	ENSMUSG00000002015	Bcap31	scl54158.7.21_44-S	turquoise
141	ENSMUSG00000002017	Fam98a	scl072722.1_216-S	brown
142	ENSMUSG00000002028	Mll1	GI_38089805-S	turquoise
143	ENSMUSG00000002028	Mll1	scl35942.36_189-S	brown
144	ENSMUSG00000002052	Supt6h	scl020926.1_330-S	blue
145	ENSMUSG00000002059	S72304	scl41212.9.1_219-S	turquoise
146	ENSMUSG00000002064	Sdf2	scl41210.3.123_9-S	brown
147	ENSMUSG00000002102	Psmc3	scl019182.11_5-S	turquoise
148	ENSMUSG00000002103	Acp2	scl0011432.2_96-S	brown
149	ENSMUSG00000002103	Acp2	scl20637.10_518-S	grey
150	ENSMUSG00000002107	Cugbp2	scl0014007.1_233-S	turquoise
151	ENSMUSG00000002107	Cugbp2	scl014007.1_13-S	turquoise
152	ENSMUSG00000002129	Sf3a1	scl0067465.2_67-S	brown
153	ENSMUSG00000002190	Clgn	scl33608.15_606-S	grey
154	ENSMUSG00000002250	Ppard	scl0001742.1_530-S	blue
155	ENSMUSG00000002265	Peg3	scl0018616.2_167-S	yellow
156	ENSMUSG00000002265	Peg3	scl018616.1_273-S	yellow
157	ENSMUSG00000002274	Metrn	scl070083.1_37-S	brown
158	ENSMUSG00000002279	Tmem112	scl50977.11.1_49-S	blue
159	ENSMUSG00000002307	Daxx	scl50842.7.1_4-S	black
160	ENSMUSG00000002319	Ipo4	scl0075751.2_140-S	black
161	ENSMUSG00000002319	Ipo4	scl45537.28.1_29-S	brown
162	ENSMUSG00000002329	1810034K20Rik	scl45535.5_307-S	green
163	ENSMUSG00000002332	Dhrs1	scl45528.8.1_39-S	turquoise
164	ENSMUSG00000002341	Ncan	scl021811.1_58-S	blue
165	ENSMUSG00000002345	AK009829	scl072368.4_40-S	turquoise
166	ENSMUSG00000002379	Ndufa11	scl069875.2_16-S	brown
167	ENSMUSG00000002395	2010315L10Rik	scl000645.1_1-S	brown
168	ENSMUSG00000002395	Use1l	scl33705.5.1_110-S	brown
169	ENSMUSG00000002396	Ocel1	scl33704.1.431_29-S	turquoise
170	ENSMUSG00000002428	Hltf	scl23356.25.1035_6-S	brown
171	ENSMUSG00000002455	Prpf6	scl19759.21.1_156-S	grey
172	ENSMUSG00000002458	Rgs19	scl18197.5_22-S	turquoise
173	ENSMUSG00000002475	Abhd3	scl51657.9.1_30-S	brown
174	ENSMUSG00000002489	Tiam1	scl48225.31_410-S	blue
175	ENSMUSG00000002496	Tsc2	scl50206.42.1_126-S	blue
176	ENSMUSG00000002504	Slc9a3r2	scl50205.8_548-S	blue
177	ENSMUSG00000002524	Puf60	scl067959.1_232-S	blue
178	ENSMUSG00000002546	Golga2	scl0003150.1_14-S	yellow
179	ENSMUSG00000002546	Golga2	scl21063.24_624-S	blue
180	ENSMUSG00000002550	Uck1	scl022245.1_319-S	turquoise
181	ENSMUSG00000002550	Uck1	scl022245.8_1-S	pink
182	ENSMUSG00000002580	1810046J19Rik	scl39620.4_46-S	turquoise
183	ENSMUSG00000002588	Pon1	scl29314.10.1_67-S	green
184	ENSMUSG00000002602	Axl	scl31620.20_1-S	turquoise
185	ENSMUSG00000002625	Akap8l	scl054194.1_276-S	turquoise
186	ENSMUSG00000002635	Pdcd2l	scl31487.7.1_48-S	turquoise
187	ENSMUSG00000002658	Gtf2f1	scl098053.3_1-S	turquoise
188	ENSMUSG00000002660	Clpp	scl50582.4.1_9-S	blue
189	ENSMUSG00000002661	Alkbh7	scl50581.4.1_28-S	turquoise
190	ENSMUSG00000002718	Cse1l	scl0003305.1_130-S	brown
191	ENSMUSG00000002732	Fkbp7	scl19106.4.1_16-S	turquoise
192	ENSMUSG00000002733	Plekha3	scl20734.8_508-S	turquoise
193	ENSMUSG00000002763	Pex6	scl00224824.1_308-S	blue
194	ENSMUSG00000002767	Mrpl2	scl50673.7.1_4-S	blue
195	ENSMUSG00000002768	Mea1	scl017256.3_8-S	turquoise
196	ENSMUSG00000002781	Tmem143	scl32660.11_337-S	blue
197	ENSMUSG00000002797	Ggct	scl0001144.1_51-S	brown
198	ENSMUSG00000002797	Ggct	scl0001179.1_28-S	turquoise
199	ENSMUSG00000002812	Flii	scl40144.28.1_2-S	blue
200	ENSMUSG00000002831	S3-12	scl057435.1_222-S	grey
201	ENSMUSG00000002833	Hdgfrp2	scl50602.12.1_148-S	blue
202	ENSMUSG00000002844	Adprh	scl011544.1_20-S	blue
203	ENSMUSG00000002845	Tmem39a	scl49146.12.1_4-S	turquoise
204	ENSMUSG00000002949	Timm44	scl000655.1_18-S	turquoise
205	ENSMUSG00000002949	Timm44	scl35139.12.1_19-S	turquoise
206	ENSMUSG00000002957	Ap2a2	scl31879.23_1-S	blue
207	ENSMUSG00000002963	Pnkp	scl0009.1_32-S	blue
208	ENSMUSG00000002963	Pnkp	scl32703.15.1_0-S	turquoise
209	ENSMUSG00000002968	Med25	scl0075613.2_301-S	blue
210	ENSMUSG00000002981	Clptm1	scl31670.15.1_26-S	blue
211	ENSMUSG00000002985	Apoe	scl011816.1_11-S	turquoise
212	ENSMUSG00000002997	Prkar2b	scl42552.12_397-S	blue
213	ENSMUSG00000003038	Hmgn2	GI_38089740-S	turquoise
214	ENSMUSG00000003068	Stk11	scl38694.11.1_0-S	blue
215	ENSMUSG00000003072	Atp5d	scl38692.8.1_47-S	blue
216	ENSMUSG00000003099	Ppp5c	scl31708.12.11_106-S	blue
217	ENSMUSG00000003153	Slc2a3	scl28438.14_163-S	turquoise
218	ENSMUSG00000003154	Foxj2	scl29537.12_355-S	black
219	ENSMUSG00000003161	Sri	scl0109552.5_10-S	brown
220	ENSMUSG00000003166	Dgcr2	scl013356.3_25-S	blue
221	ENSMUSG00000003184	Irf3	scl32698.6.1_30-S	turquoise
222	ENSMUSG00000003199	Mpnd	scl0001652.1_18-S	blue
223	ENSMUSG00000003199	Mpnd	scl50604.11.1_29-S	turquoise
224	ENSMUSG00000003200	Sh3gl1	scl49778.7_54-S	turquoise
225	ENSMUSG00000003226	Ranbp2	scl38900.29.1_38-S	turquoise
226	ENSMUSG00000003234	Abcf3	scl0027406.2_22-S	turquoise
227	ENSMUSG00000003235	Eif2b5	scl0001864.1_38-S	turquoise
228	ENSMUSG00000003235	Eif2b5	scl49343.16.24_43-S	turquoise
229	ENSMUSG00000003273	Car11	scl32669.8.1_3-S	turquoise
230	ENSMUSG00000003279	mKIAA4162	scl00224997.1_139-S	blue
231	ENSMUSG00000003299	Mrpl4	scl066163.7_0-S	blue

232	ENSMUSG00000003308	Keap1	scl0003521.1_94-S	turquoise
233	ENSMUSG00000003308	Keap1	scl0003591.1_99-S	turquoise
234	ENSMUSG00000003308	Keap1	scl36150.5_156-S	blue
235	ENSMUSG00000003316	Glg1	scl0020340.2_254-S	greenyellow
236	ENSMUSG00000003344	Btbd2	scl0208198.1_7-S	blue
237	ENSMUSG00000003345	Csnk1g2	scl0003907.1_2-S	turquoise
238	ENSMUSG00000003345	Csnk1g2	scl38677.11_311-S	blue
239	ENSMUSG00000003352	Cacnb3	scl012297.14_29-S	turquoise
240	ENSMUSG00000003363	Pld3	scl31600.13.1_22-S	black
241	ENSMUSG00000003378	Grik5	scl31642.18_0-S	blue
242	ENSMUSG00000003380	Rabac1	scl00015.1_21-S	brown
243	ENSMUSG00000003380	Rabac1	scl014470.4_28-S	brown
244	ENSMUSG00000003402	Prkcsh	scl37209.17.10_83-S	blue
245	ENSMUSG00000003410	Elavl3	scl015571.1_35-S	greenyellow
246	ENSMUSG00000003411	Rab3b	scl25136.5_423-S	grey
247	ENSMUSG00000003420	Fcgrt	scl31392.8.1_11-S	brown
248	ENSMUSG00000003421	Nosip	scl00064.1_2-S	turquoise
249	ENSMUSG00000003421	Nosip	scl32695.9.13_0-S	brown
250	ENSMUSG00000003423	Pih1d1	scl068845.7_1-S	turquoise
251	ENSMUSG00000003429	Rps11	scl027207.2_8-S	brown
252	ENSMUSG00000003435	Supt5h	scl020924.2_9-S	blue
253	ENSMUSG00000003437	Paf1	scl054624.14_263-S	turquoise
254	ENSMUSG00000003452	AK036219	scl29329.1_464-S	blue
255	ENSMUSG00000003469	Phyhip	scl46125.6_409-S	brown
256	ENSMUSG00000003500	Impdh1	scl29213.18.1_30-S	blue
257	ENSMUSG00000003518	AK077266	scl12928.1.1_277-S	grey
258	ENSMUSG00000003527	Dgcr14	scl0027886.2_220-S	blue
259	ENSMUSG00000003531	Dgcr6	scl49365.7.10_25-S	turquoise
260	ENSMUSG00000003541	Ier3	scl50762.2_0-S	turquoise
261	ENSMUSG00000003549	Ercc1	scl000131.1_24-S	turquoise
262	ENSMUSG00000003573	Homer3	scl33731.10_375-S	blue
263	ENSMUSG00000003585	Sec14l2	scl40588.14.79_66-S	brown
264	ENSMUSG00000003657	Calb2	scl012308.1_237-S	grey
265	ENSMUSG00000003657	Calb2	scl34334.7.3_10-S	grey
266	ENSMUSG00000003660	Snrnp200	scl20329.42.1_43-S	turquoise
267	ENSMUSG00000003721	Insig2	scl000923.1_16-S	red
268	ENSMUSG00000003746	Man1a	scl37953.14_53-S	turquoise
269	ENSMUSG00000003808	Farsa	scl066590.10_12-S	blue
270	ENSMUSG00000003810	Mast2	scl017776.1_270-S	blue
271	ENSMUSG00000003847	Nfat5	scl000738.1_3831-S	red
272	ENSMUSG00000003847	Nfat5	scl0054446.1_138-S	turquoise
273	ENSMUSG00000003848	Nob1	scl34362.7_18-S	turquoise
274	ENSMUSG00000003863	Ppfia3	scl31382.5.64_0-S	blue
275	ENSMUSG00000003868	Ruvbl2	scl020174.3_1-S	blue
276	ENSMUSG00000003872	Lin7b	scl000155.1_43-S	grey
277	ENSMUSG00000003872	Lin7b	scl000279.1_1-S	turquoise
278	ENSMUSG00000003872	Lin7b	scl31379.5.1_34-S	turquoise
279	ENSMUSG00000003934	Efnb3	scl40030.5_246-S	blue
280	ENSMUSG00000003948	Mmd	scl41047.11_267-S	grey
281	ENSMUSG00000003970	Rpl8	scl47780.3.9_1-S	grey
282	ENSMUSG00000003992	Ssbp2	scl0003713.1_190-S	brown
283	ENSMUSG00000004018	Fancl	scl000080.1_69_REVCOMP-S	blue
284	ENSMUSG00000004018	Fancl	scl41761.12.1_9-S	turquoise
285	ENSMUSG00000004031	mKIAA1747	scl16080.8.1_118-S	blue
286	ENSMUSG00000004032	Gstm5	scl22733.6.2_0-S	turquoise
287	ENSMUSG00000004035	Gstm7	scl21665.7.1_0-S	magenta
288	ENSMUSG00000004040	Stat3	scl0020848.1_188-S	grey
289	ENSMUSG00000004054	Map3k11	scl026403.1_197-S	blue
290	ENSMUSG00000004056	Akt2	scl0011652.2_199-S	turquoise
291	ENSMUSG00000004069	Dnaja3	scl083945.11_198-S	blue
292	ENSMUSG00000004070	Hmox2	scl49476.8.9_25-S	turquoise
293	ENSMUSG00000004099	Dnmt1	scl36157.39.1_18-S	turquoise
294	ENSMUSG00000004151	Etv1	scl0014009.1_10-S	pink
295	ENSMUSG00000004151	Etv1	scl014009.1_30-S	grey
296	ENSMUSG00000004187	Kifc2	scl016581.18_49-S	blue
297	ENSMUSG00000004207	Psap	scl38880.29_102-S	blue
298	ENSMUSG00000004263	Atn1	scl013498.1_138-S	blue
299	ENSMUSG00000004267	Eno2	scl013807.1_30-S	blue
300	ENSMUSG00000004268	Emg1	scl0001050.1_29-S	blue
301	ENSMUSG00000004268	Emg1	scl28426.4.1_40-S	turquoise
302	ENSMUSG00000004285	Atp6v1f	scl066144.2_329-S	brown
303	ENSMUSG00000004319	Clcn3	scl000567.1_25-S	turquoise
304	ENSMUSG00000004319	Clcn3	scl0012725.1_238-S	turquoise
305	ENSMUSG00000004319	Clcn3	scl012725.2_29-S	red
306	ENSMUSG00000004364	Cul3	scl0026554.2_150-S	grey
307	ENSMUSG00000004366	Sst	scl48628.2.9_30-S	brown
308	ENSMUSG00000004383	Large	scl34640.17_455-S	brown
309	ENSMUSG00000004394	Tmed4	scl00103694.2_35-S	red
310	ENSMUSG00000004394	Tmed4	scl40540.3_48-S	red
311	ENSMUSG00000004460	Dnajb11	scl49316.10.1_12-S	blue
312	ENSMUSG00000004530	Coro1c	scl26190.16_67-S	brown
313	ENSMUSG00000004535	Tax1bp1	scl30036.21_295-S	blue
314	ENSMUSG00000004561	Mett11d1	GI_38097319-S	turquoise
315	ENSMUSG00000004565	Pnpla6	scl34136.35.1_121-S	blue
316	ENSMUSG00000004567	Mcoln1	scl094178.12_1-S	blue
317	ENSMUSG00000004568	Arhgef18	scl34138.20.882_255-S	blue
318	ENSMUSG00000004610	Etfb	scl32752.7.1_23-S	turquoise
319	ENSMUSG00000004626	Stxbp2	scl34132.19.1_1-S	turquoise
320	ENSMUSG00000004642	Slbp	GI_38075548-S	turquoise
321	ENSMUSG00000004655	Aqp1	scl0001100.1_114-S	green
322	ENSMUSG00000004655	Aqp1	scl30008.5_1-S	green
323	ENSMUSG00000004667	Polr2e	scl0003795.1_0-S	turquoise
324	ENSMUSG00000004667	Polr2e	scl37743.3.1_54-S	turquoise
325	ENSMUSG00000004677	Myo9b	scl0017925.1_325-S	turquoise
326	ENSMUSG00000004677	Myo9b	scl33707.42_67-S	turquoise
327	ENSMUSG00000004748	1700020C11Rik	scl40589.5.1_6-S	blue
328	ENSMUSG00000004788	Eif2b2	scl42961.8.1_47-S	turquoise
329	ENSMUSG00000004789	Dlst	scl0078920.2_103-S	turquoise
330	ENSMUSG00000004815	Dgkq	scl00110524.2_181-S	blue
331	ENSMUSG00000004846	Plod3	scl27109.17.1_35-S	turquoise
332	ENSMUSG00000004849	Ap1s1	scl0003948.1_98-S	turquoise
333	ENSMUSG00000004849	Ap1s1	scl0004007.1_23-S	turquoise
334	ENSMUSG00000004849	Ap1s1	scl25892.5.96_2-S	grey
335	ENSMUSG00000004865	Srpk1	scl50113.16.1_150-S	grey
336	ENSMUSG00000004892	Bcan	scl0002034.1_15-S	turquoise
337	ENSMUSG00000004892	Bcan	scl21988.12.1_0-S	black
338	ENSMUSG00000004894	Hapln2	scl21987.6.1_11-S	magenta
339	ENSMUSG00000004895	Prcc	scl21990.8.1_193-S	blue
340	ENSMUSG00000004897	Hdgf	scl0015191.2_3-S	turquoise
341	ENSMUSG00000004897	Hdgf	scl015191.7_7-S	turquoise
342	ENSMUSG00000004929	Thop1	scl38666.13.1_31-S	blue
343	ENSMUSG00000004931	Apba3	scl057267.10_22-S	blue
344	ENSMUSG00000004933	Matk	scl38657.13.1_54-S	turquoise
345	ENSMUSG00000004936	Map2k1	scl35703.13_436-S	turquoise
346	ENSMUSG00000004945	5730437N04Rik	scl070544.3_53-S	brown
347	ENSMUSG00000004947	Dtx2	scl27123.13.129_18-S	turquoise

348	ENSMUSG00000004961	Syt5	scl31809.10.1_30-S	turquoise
349	ENSMUSG00000004980	Hnrnpa2b1	scl0001076.1_117-S	turquoise
350	ENSMUSG00000004980	Hnrnpa2b1	scl0053379.2_22-S	red
351	ENSMUSG00000004980	Hnrnpa2b1	scl0001252.1_55-S	turquoise
352	ENSMUSG00000004994	Ccdc130	scl34564.9_192-S	blue
353	ENSMUSG00000005034	Prkacb	scl21406.13_103-S	yellow
354	ENSMUSG00000005045	Chd5	scl24654.4.1_3-S	turquoise
355	ENSMUSG00000005045	Chd5	scl00269610.1_306-S	blue
356	ENSMUSG00000005045	Chd5	scl0269610.10_41-S	blue
357	ENSMUSG00000005054	Cstb	scl38726.3.1_35-S	brown
358	ENSMUSG00000005069	Pex5	scl0001235.1_220-S	blue
359	ENSMUSG00000005069	Pex5	scl28431.17_422-S	black
360	ENSMUSG00000005078	1200003C05Rik	scl0002329.1_2-S	brown
361	ENSMUSG00000005078	1200003C05Rik	scl0104771.9_30-S	turquoise
362	ENSMUSG00000005103	Wdr1	scl0004117.1_32-S	turquoise
363	ENSMUSG00000005125	Ndrg1	scl47123.18_98-S	turquoise
364	ENSMUSG00000005125	Ndrg1	scl017990.3_27-S	magenta
365	ENSMUSG00000005142	Man2b1	scl0017159.2_303-S	blue
366	ENSMUSG00000005148	Klf5	scl0012224.2_233-S	purple
367	ENSMUSG00000005150	1500041N16Rik	scl0067836.2_257-S	turquoise
368	ENSMUSG00000005204	Senp3	scl40024.13.1_29-S	turquoise
369	ENSMUSG00000005262	Ufd1l	scl49355.14_64-S	turquoise
370	ENSMUSG00000005268	Prlr	scl0019116.1_207-S	green
371	ENSMUSG00000005299	Letm1	scl056384.3_31-S	black
372	ENSMUSG00000005312	Ubqln1	scl0003758.1_1237-S	brown
373	ENSMUSG00000005338	Cadm3	scl15910.11_547-S	brown
374	ENSMUSG00000005360	Slc1a3	scl47406.11_619-S	turquoise
375	ENSMUSG00000005362	Crbn	scl0001170.1_113-S	turquoise
376	ENSMUSG00000005362	Crbn	scl28573.11_3-S	turquoise
377	ENSMUSG00000005371	Fbxo11	GI_38082938-S	turquoise
378	ENSMUSG00000005417	AA536749	scl0001506.1_275-S	blue
379	ENSMUSG00000005417	AA536749	scl0026936.2_165-S	turquoise
380	ENSMUSG00000005442	Cic	scl32936.22_387-S	brown
381	ENSMUSG00000005447	Pafah1b3	scl31635.5.1_15-S	turquoise
382	ENSMUSG00000005483	Dnajb1	scl33605.4_245-S	grey
383	ENSMUSG00000005506	Cugbp1	scl0013046.1_235-S	pink
384	ENSMUSG00000005506	Cugbp1	scl013046.9_64-S	yellow
385	ENSMUSG00000005510	Ndufs3	scl0068349.1_0-S	turquoise
386	ENSMUSG00000005510	Ndufs3	scl068349.3_1-S	grey
387	ENSMUSG00000005514	Por	scl018984.16_308-S	blue
388	ENSMUSG00000005533	Igf1r	scl32561.2_388-S	blue
389	ENSMUSG00000005566	Trim28	scl33072.15.1_0-S	blue
390	ENSMUSG00000005575	Ube2m	scl022192.1_21-S	blue
391	ENSMUSG00000005580	Adcy9	scl48812.11_88-S	brown
392	ENSMUSG00000005583	Mef2c	scl017260.8_51-S	yellow
393	ENSMUSG00000005610	Eif4g2	scl000210.1_44-S	blue
394	ENSMUSG00000005610	Eif4g2	scl013690.1_50-S	turquoise
395	ENSMUSG00000005625	Psmd4	scl21852.5_6-S	turquoise
396	ENSMUSG00000005629	Scnm1	scl0002107.1_66-S	grey
397	ENSMUSG00000005629	Scnm1	scl21849.6.80_71-S	grey
398	ENSMUSG00000005672	Kit	scl27701.21_88-S	blue
399	ENSMUSG00000005683	Cs	scl38284.14_73-S	blue
400	ENSMUSG00000005686	Ampd3	scl32192.19_397-S	grey
401	ENSMUSG00000005687	Bcas2	scl068183.7_27-S	turquoise
402	ENSMUSG00000005698	Ctcf	scl33408.13_324-S	blue
403	ENSMUSG00000005699	Pard6a	scl056513.3_232-S	blue
404	ENSMUSG00000005716	Pvalb	scl46996.5.2_2-S	brown
405	ENSMUSG00000005732	Ranbp1	scl019385.1_25-S	brown
406	ENSMUSG00000005779	Psmb4	scl21857.5.1_13-S	turquoise
407	ENSMUSG00000005802	Slc30a4	scl18742.7_10-S	turquoise
408	ENSMUSG00000005804	Pldn	scl20359.10_330-S	turquoise
409	ENSMUSG00000005823	Gpr108	scl078308.1_13-S	turquoise
410	ENSMUSG00000005846	Rsl1d1	scl48754.10.1_30-S	brown
411	ENSMUSG00000005871	Apc	scl0011789.2_94-S	turquoise
412	ENSMUSG00000005871	Apc	scl52128.21_609-S	red
413	ENSMUSG00000005873	Reep5	scl51549.11_11-S	turquoise
414	ENSMUSG00000005881	Ergic3	scl066366.11_67-S	turquoise
415	ENSMUSG00000005881	Ergic3	scl20039.1_29-S	turquoise
416	ENSMUSG00000005892	Trh	scl28676.3_567-S	grey
417	ENSMUSG00000005899	Smpd4	scl0001884.1_59-S	turquoise
418	ENSMUSG00000005899	Smpd4	scl0077626.2_232-S	turquoise
419	ENSMUSG00000005936	Kctd20	scl0066989.1_296-S	turquoise
420	ENSMUSG00000005936	Kctd20	scl066989.6_1-S	turquoise
421	ENSMUSG00000005968	Tuft1	scl21861.13_343-S	green
422	ENSMUSG00000005981	Trap1	scl48818.18.1_43-S	grey
423	ENSMUSG00000005986	Ankrd13d	scl53451.16.1_293-S	black
424	ENSMUSG00000006010	BC003331	scl16174.14.1_64-S	grey
425	ENSMUSG00000006024	Napa	scl000240.1_2-S	pink
426	ENSMUSG00000006058	Snf8	scl027681.7_4-S	turquoise
427	ENSMUSG00000006127	Inpp5k	scl41259.8_72-S	grey
428	ENSMUSG00000006191	Cdkal1	scl0068916.1_226-S	blue
429	ENSMUSG00000006205	Htra1	scl31984.10.1_28-S	blue
430	ENSMUSG00000006215	Zbtb17	scl022642.16_28-S	turquoise
431	ENSMUSG00000006273	Atp6v1b2	scl33753.14_134-S	turquoise
432	ENSMUSG00000006276	Eps15l1	scl34655.25.1_28-S	blue
433	ENSMUSG00000006289	Osgep	scl45612.9.1_2-S	grey
434	ENSMUSG00000006299	Aamp	scl0227290.1_240-S	blue
435	ENSMUSG00000006304	Arpc2	scl17803.10.1_30-S	turquoise
436	ENSMUSG00000006307	Wbp7	scl31519.31.1_2-S	blue
437	ENSMUSG00000006315	Tmem147	scl31512.7.1_16-S	turquoise
438	ENSMUSG00000006333	Rps9	GI_28476905-S	turquoise
439	ENSMUSG00000006333	Rps9	scl076846.5_166-S	turquoise
440	ENSMUSG00000006335	Tfpt	scl000124.1_0-S	turquoise
441	ENSMUSG00000006356	Crip2	scl068337.8_322-S	blue
442	ENSMUSG00000006373	Pgrmc1	scl54996.3_58-S	turquoise
443	ENSMUSG00000006378	Gcat	scl026912.9_26-S	blue
444	ENSMUSG00000006392	Med8	scl0002689.1_21-S	turquoise
445	ENSMUSG00000006392	Med8	scl0002723.1_35-S	turquoise
446	ENSMUSG00000006395	Hyi	scl068180.6_62-S	grey
447	ENSMUSG00000006412	Pfdn2	scl018637.3_29-S	turquoise
448	ENSMUSG00000006418	Rnf114	scl19885.7_41-S	turquoise
449	ENSMUSG00000006435	Neurl	scl0018011.1_315-S	blue
450	ENSMUSG00000006442	Srm	scl0002839.1_0-S	blue
451	ENSMUSG00000006456	Rbm14	scl056275.3_18-S	turquoise
452	ENSMUSG00000006476	Nelf	scl056876.17_315-S	turquoise
453	ENSMUSG00000006494	Pdk1	scl20796.12_159-S	red
454	ENSMUSG00000006498	Ptbp1	scl38706.14_33-S	green
455	ENSMUSG00000006575	Rundc3a	scl40861.10.1_1-S	blue
456	ENSMUSG00000006576	Slc4a3	scl0020536.1_119-S	blue
457	ENSMUSG00000006586	Runx1t1	scl25657.15_226-S	turquoise
458	ENSMUSG00000006587	Snai3	scl34228.3.1_289-S	turquoise
459	ENSMUSG00000006638	Abhd1	scl0004065.1_58-S	grey
460	ENSMUSG00000006638	Abhd1	scl27967.7.1_149-S	grey
461	ENSMUSG00000006641	Slc5a6	scl26744.20.688_4-S	green
462	ENSMUSG00000006651	Aplp1	scl31526.16.1_20-S	blue
463	ENSMUSG00000006673	Qrich1	scl0069232.1_0-S	grey

464	ENSMUSG00000006675	P4htm	scl35348.11.1_65-S	blue
465	ENSMUSG00000006676	Usp19	scl0071472.2_238-S	blue
466	ENSMUSG00000006699	Cdc42	scl0012540.1_20-S	brown
467	ENSMUSG00000006711	D130043K22Rik	scl0210108.20_141-S	greenyellow
468	ENSMUSG00000006717	Them2	scl44185.3.1_24-S	turquoise
469	ENSMUSG00000006731	B4galnt1	scl38328.12.1_41-S	blue
470	ENSMUSG00000006736	Tspan31	scl37402.3_73-S	turquoise
471	ENSMUSG00000006782	Cnp	scl012799.3_0-S	magenta
472	ENSMUSG00000006800	Sulf2	scl072043.2_38-S	brown
473	ENSMUSG00000006818	Sod2	scl51108.6.3_0-S	blue
474	ENSMUSG00000006906	Stambp	scl28793.10_326-S	black
475	ENSMUSG00000006930	Hap1	scl39565.12_79-S	blue
476	ENSMUSG00000006932	Ctnnb1	scl36332.17_16-S	turquoise
477	ENSMUSG00000006958	Chrd	scl49330.22.4_270-S	blue
478	ENSMUSG00000007021	Syngr3	scl50202.5_41-S	brown
479	ENSMUSG00000007029	Vars	scl50798.28.1_41-S	blue
480	ENSMUSG00000007038	Neu1	scl0018010.2_202-S	blue
481	ENSMUSG00000007038	Neu1	scl50806.5_190-S	blue
482	ENSMUSG00000007097	Atp1a2	scl15920.22.1_21-S	turquoise
483	ENSMUSG00000007207	Stx1a	scl27139.10_417-S	turquoise
484	ENSMUSG00000007411	Mark3	scl017169.9_120-S	turquoise
485	ENSMUSG00000007415	Gatad1	scl067210.1_15-S	red
486	ENSMUSG00000007458	M6pr	scl017113.8_48-S	turquoise
487	ENSMUSG00000007564	Ppp2r1a	scl051792.12_26-S	blue
488	ENSMUSG00000007570	Fance	scl50925.11.59_20-S	turquoise
489	ENSMUSG00000007594	Hapln4	scl33741.4_276-S	blue
490	ENSMUSG00000007603	Dus3l	scl50585.7.1_2-S	blue
491	ENSMUSG00000007610	Gtpbp3	scl33698.9.1_28-S	blue
492	ENSMUSG00000007613	Tgfbr1	scl0021812.1_48-S	blue
493	ENSMUSG00000007617	Homer1	scl0003674.1_941-S	red
494	ENSMUSG00000007617	Homer1	scl44526.12_201-S	red
495	ENSMUSG00000007653	Gabrb2	scl41684.10_411-S	yellow
496	ENSMUSG00000007655	Cav1	scl012389.5_102-S	turquoise
497	ENSMUSG00000007656	Arpp19	scl36702.4_49-S	blue
498	ENSMUSG00000007659	Bcl2l1	scl0012048.1_98-S	blue
499	ENSMUSG00000007739	Cct4	scl012464.14_38-S	brown
500	ENSMUSG00000007777	0610009B22Rik	scl40255.4.1_5-S	turquoise
501	ENSMUSG00000007783	Cpt1c	scl0078070.2_207-S	blue
502	ENSMUSG00000007812	Zfp655	scl26985.7_260-S	brown
503	ENSMUSG00000007817	Zmiz1	scl00328365.2_167-S	blue
504	ENSMUSG00000007850	Hnrnph1	scl0059013.2_121-S	red
505	ENSMUSG00000007850	Hnrnph1	scl059013.8_10-S	red
506	ENSMUSG00000007850	Hnrnph1	scl0001293.1_51-S	red
507	ENSMUSG00000007867	1700019E19Rik	scl42950.10.1_98-S	turquoise
508	ENSMUSG00000007872	Id3	scl015903.3_124-S	green
509	ENSMUSG00000007880	Arid1a	scl093760.1_28-S	blue
510	ENSMUSG00000007888	Crlf1	scl33727.4.1_6-S	blue
511	ENSMUSG00000007944	Ttc9b	scl073032.2_11-S	blue
512	ENSMUSG00000007950	Abhd8	scl34676.6_69-S	turquoise
513	ENSMUSG00000007987	Rabl5	scl27111.3.1_10-S	brown
514	ENSMUSG00000008035	Mid1ip1	scl55044.4_94-S	turquoise
515	ENSMUSG00000008036	Ap2s1	scl000287.1_1-S	turquoise
516	ENSMUSG00000008036	Ap2s1	scl0232910.6_0-S	turquoise
517	ENSMUSG00000008136	Fhl2	scl16816.7.1_32-S	grey
518	ENSMUSG00000008153	Clstn3	scl28430.21.1_3-S	black
519	ENSMUSG00000008301	Rnuxa	scl51927.6.1_20-S	turquoise
520	ENSMUSG00000008305	Tle1	scl021885.1_30-S	grey
521	ENSMUSG00000008305	Tle1	scl24224.20.446_0-S	grey
522	ENSMUSG00000008307	1700109H08Rik	scl26888.6.1_18-S	turquoise
523	ENSMUSG00000008348	Ubc	gi_21070949_ref_NM_019639.2__531-S	blue
524	ENSMUSG00000008348	Ubc	scl022190.1_154-S	blue
525	ENSMUSG00000008429	Herpud2	scl0003470.1_173-S	turquoise
526	ENSMUSG00000008429	Herpud2	scl0003516.1_8-S	pink
527	ENSMUSG00000008450	Nutf2	scl068051.5_64-S	turquoise
528	ENSMUSG00000008489	Elavl2	scl24114.14_484-S	blue
529	ENSMUSG00000008604	Ubqln4	scl22997.10_102-S	turquoise
530	ENSMUSG00000008658	A2bp1	scl0268859.12_21-S	greenyellow
531	ENSMUSG00000008690	Ncaph2	scl0052683.1_230-S	turquoise
532	ENSMUSG00000008730	Hipk1	scl21738.18_117-S	turquoise
533	ENSMUSG00000008855	Hdac5	scl39517.28_30-S	turquoise
534	ENSMUSG00000008892	Vdac3	scl022335.1_61-S	turquoise
535	ENSMUSG00000009013	Dynll1	scl056455.3_23-S	turquoise
536	ENSMUSG00000009035	Tmem184b	scl46964.12_425-S	blue
537	ENSMUSG00000009073	Nf2	scl40578.23_535-S	turquoise
538	ENSMUSG00000009075	Cabp7	scl40579.4.1_15-S	pink
539	ENSMUSG00000009076	Zmat5	scl41883.7.1_5-S	turquoise
540	ENSMUSG00000009207	Lnp	scl19124.16_196-S	turquoise
541	ENSMUSG00000009281	Rarres2	scl29045.3.1_38-S	turquoise
542	ENSMUSG00000009291	Pttg1ip	scl38735.7_162-S	turquoise
543	ENSMUSG00000009418	Nav1	scl00215690.2_326-S	blue
544	ENSMUSG00000009549	Srp14	scl020813.1_157-S	blue
545	ENSMUSG00000009555	Cdk9	scl19440.7.1_73-S	blue
546	ENSMUSG00000009630	Ppp2cb	scl33924.6.9_11-S	turquoise
547	ENSMUSG00000009640	Dmap1	scl23934.7.25_111-S	turquoise
548	ENSMUSG00000009681	Bcr	scl0110279.7_217-S	turquoise
549	ENSMUSG00000009687	Fxyd5	scl31502.9_323-S	purple
550	ENSMUSG00000009733	Tcfcp2	scl021422.1_63-S	turquoise
551	ENSMUSG00000009863	Sdhb	scl067680.5_8-S	brown
552	ENSMUSG00000009894	Snap47	scl40160.8.1_28-S	red
553	ENSMUSG00000009905	Kdsr	scl16414.9.494_144-S	blue
554	ENSMUSG00000009995	Taz	scl066826.11_0-S	turquoise
555	ENSMUSG00000010025	Aldh3a2	scl40135.12_123-S	turquoise
556	ENSMUSG00000010045	Tmem115	scl36497.2.1_0-S	blue
557	ENSMUSG00000010047	Hyal2	scl0015587.1_282-S	turquoise
558	ENSMUSG00000010057	Tusc4	scl36496.9.1_37-S	blue
559	ENSMUSG00000010066	Cacna2d2	scl0056808.2_258-S	blue
560	ENSMUSG00000010067	Rassf1	scl056289.4_79-S	turquoise
561	ENSMUSG00000010086	Rnf112	scl40131.12_470-S	brown
562	ENSMUSG00000010095	Slc3a2	scl52780.10_0-S	turquoise
563	ENSMUSG00000010097	Nxf1	scl053319.21_22-S	grey
564	ENSMUSG00000010110	Stx5a	scl53409.10.1_1-S	turquoise
565	ENSMUSG00000010136	1700027A23Rik	scl21700.7.1_0-S	green
566	ENSMUSG00000010154	Spire2	scl33206.16.1_107-S	blue
567	ENSMUSG00000010175	Prox1	scl019130.1_4-S	blue
568	ENSMUSG00000010290	AI597479	scl18013.4_456-S	blue
569	ENSMUSG00000010307	Tmem86a	scl32642.3_586-S	green
570	ENSMUSG00000010376	Nedd8	scl45531.6.1_0-S	brown
571	ENSMUSG00000010406	Mrpl52	scl46304.5.1_86-S	turquoise
572	ENSMUSG00000010453	4632411B12Rik	scl16874.21_552-S	brown
573	ENSMUSG00000010476	Ebf3	scl073115.1_164-S	grey
574	ENSMUSG00000010505	Myt1	GI_23346428-S	grey
575	ENSMUSG00000010517	Faf1	scl25126.19.1_29-S	grey
576	ENSMUSG00000010607	Pigyl	scl37205.3.1_21-S	brown
577	ENSMUSG00000010663	Fads1	scl53380.11_494-S	grey
578	ENSMUSG00000010803	Gabra1	scl40325.12_575-S	turquoise
579	ENSMUSG00000010911	Apip	scl0003163.1_0-S	turquoise

580	ENSMUSG00000010911	Apip	scl20555.7.24_72-S	turquoise
581	ENSMUSG00000011096	Akt1s1	scl067605.5_228-S	blue
582	ENSMUSG00000011114	Tbrg1	scl0003566.1_12-S	turquoise
583	ENSMUSG00000011148	Adssl1	scl42729.13.1_74-S	magenta
584	ENSMUSG00000011589	Fsd1	scl50605.12.1_93-S	turquoise
585	ENSMUSG00000011751	Spnb4	scl080297.2_3-S	blue
586	ENSMUSG00000011752	Pgam1	scl018648.4_76-S	turquoise
587	ENSMUSG00000011831	Evi5	scl26258.25_611-S	blue
588	ENSMUSG00000011832	Evi5l	scl00213027.2_250-S	blue
589	ENSMUSG00000011877	Git1	GI_38091495-S	blue
590	ENSMUSG00000011884	Gltp	scl26182.5_119-S	magenta
591	ENSMUSG00000012017	Scarf2	scl49370.9_720-S	turquoise
592	ENSMUSG00000012076	Brms1l	scl43194.12_66-S	blue
593	ENSMUSG00000012114	Med15	scl0001799.1_81-S	black
594	ENSMUSG00000012114	Med15	scl094112.1_23-S	black
595	ENSMUSG00000012117	Dhdds	scl23702.9_75-S	blue
596	ENSMUSG00000012296	Tjap1	scl49870.17_60-S	grey
597	ENSMUSG00000012429	2810021B07Rik	scl45038.2_639-S	blue
598	ENSMUSG00000012483	Rpa3	scl068240.2_29-S	blue
599	ENSMUSG00000012535	Tnpo3	scl29206.21.1_1-S	yellow
600	ENSMUSG00000012609	Ttll5	GI_38050378-S	blue
601	ENSMUSG00000012848	Rps5	scl33074.8.142_21-S	brown
602	ENSMUSG00000013076	Amotl1	scl36219.16_473-S	yellow
603	ENSMUSG00000013076	Amotl1	scl6709.1.1_145-S	grey
604	ENSMUSG00000013160	Atp6v0d1	scl000708.1_100-S	pink
605	ENSMUSG00000013160	Atp6v0d1	scl000737.1_18-S	pink
606	ENSMUSG00000013160	Atp6v0d1	scl011972.1_247-S	blue
607	ENSMUSG00000013236	Ptprs	scl49765.36_30-S	turquoise
608	ENSMUSG00000013465	Cobra1	scl19578.8.4_2-S	turquoise
609	ENSMUSG00000013523	Bcas1	scl0076960.2_269-S	magenta
610	ENSMUSG00000013539	D16H22S680E	scl027883.1_63-S	turquoise
611	ENSMUSG00000013593	Ndufs2	scl000941.1_0-S	turquoise
612	ENSMUSG00000013593	Ndufs2	scl15941.6.1_27-S	turquoise
613	ENSMUSG00000013622	0610007C21Rik	GI_38079630-S	turquoise
614	ENSMUSG00000013622	0610007C21Rik	scl00381629.1_255-S	brown
615	ENSMUSG00000013662	Atad1	scl52549.14_1-S	brown
616	ENSMUSG00000013698	Pea15a	scl15925.5_61-S	turquoise
617	ENSMUSG00000013736	Trnt1	scl29679.10.1_75-S	brown
618	ENSMUSG00000013787	Ehmt2	scl50803.29.1_3-S	blue
619	ENSMUSG00000013822	Elof1	scl36121.3_28-S	turquoise
620	ENSMUSG00000013833	Med16	scl37745.17_21-S	blue
621	ENSMUSG00000013858	ORF61	scl0003929.1_0-S	blue
622	ENSMUSG00000013858	ORF61	scl37744.8.1_11-S	blue
623	ENSMUSG00000013921	Clip3	scl32820.14.1_13-S	brown
624	ENSMUSG00000013973	Dedd	scl000063.1_0_REVCOMP-S	grey
625	ENSMUSG00000013997	Nit1	scl000063.1_0-S	turquoise
626	ENSMUSG00000014074	Rnf168	scl49241.6_310-S	turquoise
627	ENSMUSG00000014075	Tctex1d2	scl49236.4.1_1-S	blue
628	ENSMUSG00000014077	1500003O03Rik	scl0056398.1_113-S	pink
629	ENSMUSG00000014077	1500003O03Rik	scl056398.1_30-S	pink
630	ENSMUSG00000014077	1500003O03Rik	scl056398.7_324-S	turquoise
631	ENSMUSG00000014195	Dnajc7	scl39557.17.1_8-S	turquoise
632	ENSMUSG00000014232	Cluap1	scl076779.5_22-S	brown
633	ENSMUSG00000014243	2410012H22Rik	scl40109.5.1_10-S	turquoise
634	ENSMUSG00000014294	Ndufa2	scl017991.2_1-S	brown
635	ENSMUSG00000014313	Cox6c	scl012864.3_58-S	turquoise
636	ENSMUSG00000014329	Bicc1	scl37833.23.1_1-S	grey
637	ENSMUSG00000014349	Ube2z	scl0268470.1_0-S	turquoise
638	ENSMUSG00000014361	Mertk	scl0017289.2_279-S	grey
639	ENSMUSG00000014402	Tsg101	scl022088.2_10-S	blue
640	ENSMUSG00000014470	Rnf166	scl34222.7_318-S	blue
641	ENSMUSG00000014504	Srp19	scl0002225.1_0-S	turquoise
642	ENSMUSG00000014550	Zfyve20	scl28677.12_376-S	turquoise
643	ENSMUSG00000014551	Mrps25	scl0001042.1_14-S	turquoise
644	ENSMUSG00000014554	Dguok	scl28799.5.1_30-S	turquoise
645	ENSMUSG00000014592	Camta1	scl0002765.1_0-S	turquoise
646	ENSMUSG00000014592	Camta1	scl0100072.1_155-S	brown
647	ENSMUSG00000014601	Fam40a	scl21676.20_237-S	blue
648	ENSMUSG00000014606	Slc25a11	scl39988.9.1_13-S	turquoise
649	ENSMUSG00000014633	2310061C15Rik	scl34280.9.1_28-S	turquoise
650	ENSMUSG00000014748	Tex261	scl0021766.1_289-S	turquoise
651	ENSMUSG00000014748	Tex261	scl28784.6_160-S	turquoise
652	ENSMUSG00000014767	Tbp	scl51090.8.1_21-S	turquoise
653	ENSMUSG00000014771	Pdcd2	scl0001716.1_4-S	brown
654	ENSMUSG00000014846	Tppp3	scl34402.5.1_27-S	magenta
655	ENSMUSG00000014850	Msh3	scl43695.26.1_70-S	turquoise
656	ENSMUSG00000014856	Tmem208	scl33416.4.1_0-S	turquoise
657	ENSMUSG00000014867	Surf4	scl19517.6_242-S	brown
658	ENSMUSG00000014873	Surf2	scl020931.4_63-S	turquoise
659	ENSMUSG00000014905	Dnajb9	scl42510.5_14-S	turquoise
660	ENSMUSG00000014956	Ppp1cb	scl0004044.1_9-S	blue
661	ENSMUSG00000014959	Gorasp2	scl0003043.1_9-S	pink
662	ENSMUSG00000014959	Gorasp2	scl0070231.1_327-S	turquoise
663	ENSMUSG00000014959	Gorasp2	scl20812.9.574_16-S	blue
664	ENSMUSG00000014980	5730449L18Rik	scl066637.1_226-S	blue
665	ENSMUSG00000015002	Efr3a	scl076740.18_3-S	red
666	ENSMUSG00000015085	Npdc1	scl012496.9_212-S	turquoise
667	ENSMUSG00000015087	B230208H17Rik	scl0227624.3_83-S	greenyellow
668	ENSMUSG00000015090	Ptgds	scl19558.7.10_4-S	grey
669	ENSMUSG00000015092	Edf1	scl0003286.1_154-S	blue
670	ENSMUSG00000015094	Npdc1	scl018146.8_16-S	turquoise
671	ENSMUSG00000015126	0610007P22Rik	scl50988.5.36_204-S	turquoise
672	ENSMUSG00000015126	0610007P22Rik	scl000093.1_57_REVCOMP-S	brown
673	ENSMUSG00000015126	0610007P22Rik	scl000098.1_12-S	brown
674	ENSMUSG00000015149	Sirt2	scl32859.16_106-S	magenta
675	ENSMUSG00000015165	Hnrnpl	scl32855.14.1_3-S	black
676	ENSMUSG00000015214	Mtmr1	scl54871.18_531-S	turquoise
677	ENSMUSG00000015222	Mtap2	scl0017756.2_234-S	pink
678	ENSMUSG00000015224	Cyp2j9	scl074519.1_143-S	blue
679	ENSMUSG00000015247	Nipsnap3a	scl0002709.1_68-S	brown
680	ENSMUSG00000015247	Nipsnap3a	scl0002714.1_31-S	turquoise
681	ENSMUSG00000015289	Lage3	scl066192.2_27-S	turquoise
682	ENSMUSG00000015290	Ubl4	scl027643.2_36-S	turquoise
683	ENSMUSG00000015291	Gdi1	scl0014567.2_263-S	blue
684	ENSMUSG00000015291	Gdi1	scl0014567.2_90-S	red
685	ENSMUSG00000015291	Gdi1	scl014567.8_50-S	red
686	ENSMUSG00000015291	Gdi1	scl54834.6_26-S	red
687	ENSMUSG00000015305	Sash1	scl38222.21_67-S	turquoise
688	ENSMUSG00000015335	Zdhhc12	scl19480.4_1-S	blue
689	ENSMUSG00000015354	Pcolce2	scl0003537.1_10-S	green
690	ENSMUSG00000015354	Pcolce2	scl36607.9.1_1-S	turquoise
691	ENSMUSG00000015377	1700027J05Rik	scl0069440.1_122-S	turquoise
692	ENSMUSG00000015396	Cd83	scl44840.4_185-S	turquoise
693	ENSMUSG00000015461	Atf6b	scl50814.22.1_1-S	blue
694	ENSMUSG00000015468	Notch4	scl018132.31_78-S	turquoise
695	ENSMUSG00000015474	Ppt2	scl054397.1_307-S	blue

696	ENSMUSG00000015476	Prrt1	scl50812.4.1_9-S	blue
697	ENSMUSG00000015522	Arnt	scl22882.20_49-S	grey
698	ENSMUSG00000015536	Mocs2	scl44342.6.5_4-S	blue
699	ENSMUSG00000015568	Lpl	scl0016956.1_234-S	purple
700	ENSMUSG00000015575	Atp6v0e	scl50948.6.850_26-S	green
701	ENSMUSG00000015597	Zfp318	scl0057908.1_214-S	yellow
702	ENSMUSG00000015652	Steap1	scl28141.5.1_35-S	green
703	ENSMUSG00000015668	Pdzd11	scl0002903.1_3-S	brown
704	ENSMUSG00000015668	Pdzd11	scl54000.2.1_5-S	brown
705	ENSMUSG00000015671	Psma2	scl019166.8_87-S	brown
706	ENSMUSG00000015697	Setdb1	scl21835.21.1_1-S	turquoise
707	ENSMUSG00000015709	Arnt2	scl31075.26_30-S	turquoise
708	ENSMUSG00000015714	Lass2	scl076893.11_90-S	magenta
709	ENSMUSG00000015714	Lass2	scl22884.7.1_23-S	magenta
710	ENSMUSG00000015747	Vps45	scl21820.14.1_60-S	brown
711	ENSMUSG00000015748	Prpf3	scl070767.1_256-S	turquoise
712	ENSMUSG00000015755	Map3k7ip2	scl38232.7_17-S	yellow
713	ENSMUSG00000015776	Med22	scl19515.3_120-S	black
714	ENSMUSG00000015790	Surf1	scl19516.4.19_7-S	brown
715	ENSMUSG00000015804	Med28	scl0066999.2_129-S	turquoise
716	ENSMUSG00000015806	Qdpr	scl0110391.1_29-S	magenta
717	ENSMUSG00000015837	Sqstm1	scl018412.1_16-S	blue
718	ENSMUSG00000015869	Prpsap1	scl39304.10.1_23-S	turquoise
719	ENSMUSG00000015889	Lta4h	scl0003853.1_11-S	turquoise
720	ENSMUSG00000015937	H2afy	scl43914.11.4_21-S	turquoise
721	ENSMUSG00000015937	H2afy	scl0003759.1_6-S	turquoise
722	ENSMUSG00000015942	Gtf2ird2	scl27146.19.1788_56-S	blue
723	ENSMUSG00000015943	Bola1	scl21817.6.1_28-S	turquoise
724	ENSMUSG00000015971	Actr8	scl46515.12.62_5-S	turquoise
725	ENSMUSG00000015981	Stk32c	scl30532.13.1_156-S	grey
726	ENSMUSG00000015994	Fnta	scl34985.11_48-S	brown
727	ENSMUSG00000016024	Lbp	scl20002.16.7_10-S	green
728	ENSMUSG00000016181	AA408296	scl0215193.1_66-S	turquoise
729	ENSMUSG00000016194	Hsd11b1	scl000857.1_11-S	brown
730	ENSMUSG00000016239	Lonrf3	scl54997.2.1442_77-S	turquoise
731	ENSMUSG00000016253	Th1l	scl19818.14.1_56-S	turquoise
732	ENSMUSG00000016256	Ctsz	scl0064138.2_328-S	turquoise
733	ENSMUSG00000016257	Slmo2	scl066390.1_295-S	blue
734	ENSMUSG00000016262	Sertad4	scl15751.8_2-S	brown
735	ENSMUSG00000016319	Slc25a5	scl011740.4_112-S	brown
736	ENSMUSG00000016344	2700038C09Rik	scl066496.2_57-S	blue
737	ENSMUSG00000016346	Kcnq2	scl18216.17.1_43-S	blue
738	ENSMUSG00000016349	Eef1a2	scl013628.1_321-S	blue
739	ENSMUSG00000016349	Eef1a2	scl18213.3.5_8-S	pink
740	ENSMUSG00000016356	Col20a1	scl19775.24.1_150-S	grey
741	ENSMUSG00000016382	Pls3	scl0102866.1_231-S	turquoise
742	ENSMUSG00000016427	Ndufa1	scl54331.2.4_4-S	blue
743	ENSMUSG00000016477	E2f3	scl0013557.1_74-S	turquoise
744	ENSMUSG00000016494	Cd34	scl17027.7_391-S	turquoise
745	ENSMUSG00000016495	5033414D02Rik	scl52593.10.1_23-S	turquoise
746	ENSMUSG00000016526	Dyrk3	scl00226419.2_84-S	black
747	ENSMUSG00000016528	Mapkapk2	scl16317.12_198-S	blue
748	ENSMUSG00000016534	Lamp2	scl0002883.1_98-S	turquoise
749	ENSMUSG00000016554	Eif3d	scl46998.15.1_4-S	turquoise
750	ENSMUSG00000016559	H3f3b	scl0015081.1_185-S	turquoise
751	ENSMUSG00000016637	Rabl4	scl46995.11.1_59-S	turquoise
752	ENSMUSG00000016757	Ttll12	scl00223723.2_285-S	blue
753	ENSMUSG00000016831	Tox4	scl0268741.7_16-S	turquoise
754	ENSMUSG00000016833	Mrps18c	scl068735.6_63-S	turquoise
755	ENSMUSG00000016918	Sulf1	scl00240725.2_185-S	green
756	ENSMUSG00000016940	Kctd2	scl40726.5_15-S	turquoise
757	ENSMUSG00000016995	Matn4	scl18361.12.1_11-S	grey
758	ENSMUSG00000017119	Nbr1	scl0001332.1_19-S	red
759	ENSMUSG00000017119	Nbr1	scl40878.26_32-S	turquoise
760	ENSMUSG00000017176	Nt5c3l	scl0001342.1_29-S	brown
761	ENSMUSG00000017176	Nt5c3l	scl0001518.1_3-S	turquoise
762	ENSMUSG00000017188	Ccdc56	scl052469.1_143-S	turquoise
763	ENSMUSG00000017210	Med24	scl39617.28.1_49-S	blue
764	ENSMUSG00000017210	Med24	scl023989.1_26-S	blue
765	ENSMUSG00000017221	Psmd3	scl0022123.1_274-S	blue
766	ENSMUSG00000017264	Exosc10	scl0002780.1_2-S	turquoise
767	ENSMUSG00000017288	Vps53	scl0068299.1_136-S	blue
768	ENSMUSG00000017291	Taok1	scl39900.2_456-S	blue
769	ENSMUSG00000017299	Dnttip1	scl19927.15.1_16-S	black
770	ENSMUSG00000017344	Vtn	scl41201.7.1_21-S	turquoise
771	ENSMUSG00000017376	Nlk	scl0018099.2_232-S	turquoise
772	ENSMUSG00000017400	Stac2	scl39630.11_261-S	blue
773	ENSMUSG00000017412	Cacnb4	scl19280.18_352-S	blue
774	ENSMUSG00000017412	Cacnb4	scl19285.1.86_4-S	turquoise
775	ENSMUSG00000017417	Plxdc1	scl39634.14_208-S	purple
776	ENSMUSG00000017421	Zfp207	scl0022680.1_25-S	brown
777	ENSMUSG00000017428	Psmd11	scl069077.10_34-S	turquoise
778	ENSMUSG00000017478	Zc3h18	scl076014.3_8-S	brown
779	ENSMUSG00000017485	Top2b	scl0021974.1_259-S	turquoise
780	ENSMUSG00000017485	Top2b	scl0319393.1_18-S	turquoise
781	ENSMUSG00000017493	Igfbp4	scl016010.7_252-S	blue
782	ENSMUSG00000017493	Igfbp4	scl40921.6_29-S	blue
783	ENSMUSG00000017615	Tnfaip1	scl39881.7_182-S	grey
784	ENSMUSG00000017631	Abr	scl0109934.1_81-S	blue
785	ENSMUSG00000017639	DQ551402	scl41183.17_270-S	blue
786	ENSMUSG00000017664	Slc35c2	scl0228875.1_123-S	blue
787	ENSMUSG00000017664	Slc35c2	scl18335.8.2_14-S	turquoise
788	ENSMUSG00000017670	Elmo2	scl18334.24_243-S	blue
789	ENSMUSG00000017677	Wsb1	scl39869.11_25-S	brown
790	ENSMUSG00000017686	Rhot1	scl059040.12_45-S	brown
791	ENSMUSG00000017692	VRHO	scl41173.9_495-S	blue
792	ENSMUSG00000017715	Pgs1	scl0074451.1_282-S	blue
793	ENSMUSG00000017721	Pigt	scl19937.12_3-S	blue
794	ENSMUSG00000017723	Wfdc2	scl0003156.1_0-S	green
795	ENSMUSG00000017734	Dbndd2	scl052840.5_2-S	magenta
796	ENSMUSG00000017740	Slc12a5	scl19916.25_60-S	turquoise
797	ENSMUSG00000017754	Pltp	scl18344.17.1_25-S	green
798	ENSMUSG00000017764	Zswim1	scl19923.3_605-S	blue
799	ENSMUSG00000017943	Gdap1l1	scl19961.4.1_2-S	turquoise
800	ENSMUSG00000017978	Cadps2	scl0001035.1_47-S	turquoise
801	ENSMUSG00000017978	Cadps2	scl29242.30.1_27-S	turquoise
802	ENSMUSG00000017999	Ddx27	scl19891.17.1_25-S	turquoise
803	ENSMUSG00000018001	Pscd3	scl27010.17_214-S	turquoise
804	ENSMUSG00000018008	Cyth4	scl47766.12_451-S	turquoise
805	ENSMUSG00000018012	Rac3	scl40623.5.1_6-S	blue
806	ENSMUSG00000018042	Cyb5r3	scl46905.12_121-S	blue
807	ENSMUSG00000018102	Hist1h2bc	scl44991.2.1_21-S	turquoise
808	ENSMUSG00000018167	Stard3	scl40940.15.1_40-S	turquoise
809	ENSMUSG00000018171	Tmem49	scl0001304.1_8-S	red
810	ENSMUSG00000018171	Tmem49	scl075909.1_96-S	blue
811	ENSMUSG00000018171	Tmem49	scl0001344.1_14-S	red

812	ENSMUSG00000018189	Uchl5	scl000968.1_12-S	red
813	ENSMUSG00000018189	Uchl5	scl17388.13.1_60-S	turquoise
814	ENSMUSG00000018196	Glrx2	scl069367.4_58-S	turquoise
815	ENSMUSG00000018199	Trove2	scl16191.8_301-S	brown
816	ENSMUSG00000018217	Pmp22	scl018858.5_31-S	blue
817	ENSMUSG00000018287	Spag7	scl39991.5_43-S	turquoise
818	ENSMUSG00000018293	Pfn1	scl018643.4_21-S	blue
819	ENSMUSG00000018322	Tomm34	scl18374.7.1_30-S	turquoise
820	ENSMUSG00000018326	Ywhab	scl19951.7_95-S	turquoise
821	ENSMUSG00000018340	Anxa6	scl40209.28.1_48-S	blue
822	ENSMUSG00000018347	Zkscan6	scl0052712.1_238-S	turquoise
823	ENSMUSG00000018377	Vezf1	scl41070.6_518-S	turquoise
824	ENSMUSG00000018379	Sfrs1	scl0110809.8_13-S	turquoise
825	ENSMUSG00000018395	Kif3a	scl0016568.1_42-S	turquoise
826	ENSMUSG00000018395	Kif3a	scl016568.8_47-S	yellow
827	ENSMUSG00000018401	Mtmr4	scl41083.21_226-S	grey
828	ENSMUSG00000018411	Mapt	scl017762.10_59-S	turquoise
829	ENSMUSG00000018412	1700081L11Rik	scl076719.2_8-S	turquoise
830	ENSMUSG00000018428	Akap1	scl0011640.2_184-S	turquoise
831	ENSMUSG00000018433	Nol11	scl39416.15_560-S	brown
832	ENSMUSG00000018449	Rpain	scl41320.8.1_17-S	brown
833	ENSMUSG00000018451	6330403K07Rik	scl0103712.1_49-S	grey
834	ENSMUSG00000018481	Appbp2	scl0066884.2_148-S	yellow
835	ENSMUSG00000018501	Ncor1	scl0020185.1_69-S	green
836	ENSMUSG00000018509	Prr6	scl40101.5.1_17-S	turquoise
837	ENSMUSG00000018547	Pip4k2b	scl39642.11_373-S	blue
838	ENSMUSG00000018548	Trim37	scl41088.24_278-S	turquoise
839	ENSMUSG00000018565	Rai12	scl0001572.1_0-S	blue
840	ENSMUSG00000018565	Rai12	scl40005.7.1_7-S	blue
841	ENSMUSG00000018567	Gabarap	scl41351.4.1_17-S	blue
842	ENSMUSG00000018572	Phf23	scl41350.6.1_10-S	turquoise
843	ENSMUSG00000018589	Glra2	scl53601.9_324-S	blue
844	ENSMUSG00000018651	Tada2l	scl0001529.1_346-S	brown
845	ENSMUSG00000018651	Tada2l	scl39810.17.1_7-S	turquoise
846	ENSMUSG00000018659	Pnpo	scl0001589.1_43-S	pink
847	ENSMUSG00000018677	Slc25a39	scl068066.1_115-S	brown
848	ENSMUSG00000018697	Aatf	scl39808.15.1_10-S	turquoise
849	ENSMUSG00000018707	Dync1h1	scl013424.9_0-S	blue
850	ENSMUSG00000018736	Ndel1	scl40050.12_410-S	turquoise
851	ENSMUSG00000018750	Zbtb4	scl077757.1_20-S	turquoise
852	ENSMUSG00000018765	Fxr2	scl0023879.2_268-S	blue
853	ENSMUSG00000018770	Atp5g3	scl19131.5.1_9-S	black
854	ENSMUSG00000018774	Cd68	scl40022.6.1_151-S	turquoise
855	ENSMUSG00000018809	Smyd4	scl41266.11.1_55-S	turquoise
856	ENSMUSG00000018820	Zfyve27	scl53114.14_573-S	black
857	ENSMUSG00000018848	Rars	scl40361.13.1_2-S	brown
858	ENSMUSG00000018849	Wwc1	scl40358.24.1_14-S	blue
859	ENSMUSG00000018921	Pelp1	scl39996.17.1192_12-S	brown
860	ENSMUSG00000018965	Ywhah	scl022629.4_2-S	turquoise
861	ENSMUSG00000018974	Sart3	scl26193.18.1_14-S	turquoise
862	ENSMUSG00000018999	Slc35b4	scl29168.10_523-S	brown
863	ENSMUSG00000019027	Dnahc1	scl45762.22.1_73-S	grey
864	ENSMUSG00000019039	Dalrd3	scl36462.6_134-S	turquoise
865	ENSMUSG00000019054	Fis1	scl0004104.1_48-S	brown
866	ENSMUSG00000019054	Fis1	scl27115.7.1_28-S	brown
867	ENSMUSG00000019066	Rab3d	scl36130.5_341-S	black
868	ENSMUSG00000019082	Slc25a22	scl068267.1_94-S	brown
869	ENSMUSG00000019087	Atp6ap1	scl54833.10_21-S	turquoise
870	ENSMUSG00000019124	Scrn1	scl069938.2_27-S	turquoise
871	ENSMUSG00000019124	Scrn1	scl28979.1_118-S	turquoise
872	ENSMUSG00000019132	BC005537	scl079555.6_1-S	turquoise
873	ENSMUSG00000019146	Cacng2	GI_6680825-S	greenyellow
874	ENSMUSG00000019173	Rab5c	scl39554.8_358-S	turquoise
875	ENSMUSG00000019179	Mdh2	scl017448.9_233-S	turquoise
876	ENSMUSG00000019188	H13	scl0003065.1_14-S	turquoise
877	ENSMUSG00000019188	H13	scl0003277.1_55-S	turquoise
878	ENSMUSG00000019189	Rnf145	scl41667.16_331-S	blue
879	ENSMUSG00000019194	Scn1b	scl000120.1_12-S	blue
880	ENSMUSG00000019210	Atp6v1e1	scl0011973.2_248-S	brown
881	ENSMUSG00000019232	Agxt2l1	scl22618.12_175-S	grey
882	ENSMUSG00000019235	Rps6kl1	scl42232.14.1_2-S	blue
883	ENSMUSG00000019302	Atp6v0a1	scl0001265.1_61-S	blue
884	ENSMUSG00000019302	Atp6v0a1	scl0011975.2_216-S	blue
885	ENSMUSG00000019302	Atp6v0a1	scl011975.20_15-S	blue
886	ENSMUSG00000019312	Grb7	scl40936.14_9-S	purple
887	ENSMUSG00000019362	D8Ertd738e	GI_38089372-S	turquoise
888	ENSMUSG00000019373	Cops3	scl40153.15.1_46-S	brown
889	ENSMUSG00000019428	Fkbp8	scl33725.12_115-S	black
890	ENSMUSG00000019432	Bat1a	scl50778.12.1_32-S	blue
891	ENSMUSG00000019433	Gipc1	scl33604.8.1_16-S	blue
892	ENSMUSG00000019437	Tlcd1	scl068385.4_14-S	brown
893	ENSMUSG00000019467	D10Ertd610e	scl0003818.1_1-S	pink
894	ENSMUSG00000019467	D10Ertd610e	scl0003846.1_20-S	blue
895	ENSMUSG00000019467	D10Ertd610e	scl37396.13.1_16-S	blue
896	ENSMUSG00000019478	Rab4a	scl019341.8_60-S	blue
897	ENSMUSG00000019494	Cops6	scl026893.9_4-S	turquoise
898	ENSMUSG00000019558	Slc6a8	scl54847.11_478-S	blue
899	ENSMUSG00000019577	Pdk4	scl29310.11_209-S	magenta
900	ENSMUSG00000019578	Ubxn6	scl0001633.1_3-S	turquoise
901	ENSMUSG00000019578	Ubxn6	scl066530.2_0-S	turquoise
902	ENSMUSG00000019579	D17Wsu104e	scl028106.1_129-S	brown
903	ENSMUSG00000019590	Cyb561	scl39460.6_144-S	grey
904	ENSMUSG00000019659	Ccdc12	scl072654.6_7-S	grey
905	ENSMUSG00000019689	Fmc1	scl30187.2.1_182-S	brown
906	ENSMUSG00000019699	Akt3	scl15870.13_49-S	turquoise
907	ENSMUSG00000019710	Mrpl24	scl23015.4.5_22-S	brown
908	ENSMUSG00000019738	Polr2i	scl069920.4_5-S	turquoise
909	ENSMUSG00000019762	Iyd	scl070337.5_268-S	grey
910	ENSMUSG00000019769	Syne1	GI_38090353-S	red
911	ENSMUSG00000019774	Mtrf1l	scl38242.7.1_214-S	turquoise
912	ENSMUSG00000019775	Rgs17	scl38240.6_287-S	turquoise
913	ENSMUSG00000019777	Hdac2	scl39022.13.1_2-S	turquoise
914	ENSMUSG00000019790	Stxbp5	GI_38090930-S	blue
915	ENSMUSG00000019790	Stxbp5	scl38213.31_299-S	grey
916	ENSMUSG00000019795	Pcmt1	scl0003838.1_10-S	red
917	ENSMUSG00000019795	Pcmt1	scl0018537.2_170-S	turquoise
918	ENSMUSG00000019796	Lrp11	scl39172.7_550-S	brown
919	ENSMUSG00000019797	1700021F05Rik	scl38001.5.1_73-S	brown
920	ENSMUSG00000019802	Sec63	scl38973.22_10-S	turquoise
921	ENSMUSG00000019804	Snx3	scl38976.4.1_15-S	turquoise
922	ENSMUSG00000019809	Pex3	scl0056535.2_0-S	brown
923	ENSMUSG00000019818	Cd164	scl38985.8_420-S	blue
924	ENSMUSG00000019820	Utrn	scl0022288.2_234-S	grey
925	ENSMUSG00000019831	Wasf1	scl083767.9_235-S	blue
926	ENSMUSG00000019837	Gtf3c6	scl067371.1_2-S	turquoise
927	ENSMUSG00000019837	Gtf3c6	scl38030.6.1_17-S	turquoise

928	ENSMUSG00000019841	Rev3l	scl39007.33.260_3-S	turquoise
929	ENSMUSG00000019848	Popdc3	scl38952.4.1_0-S	grey
930	ENSMUSG00000019849	Prep	scl38953.16.1_28-S	blue
931	ENSMUSG00000019861	Gopc	scl0094221.1_20-S	turquoise
932	ENSMUSG00000019863	Qrsl1	scl38000.11.1_181-S	brown
933	ENSMUSG00000019872	Smpdl3a	scl38908.9.1_88-S	green
934	ENSMUSG00000019877	Serinc1	scl37947.10_418-S	turquoise
935	ENSMUSG00000019878	Hsf2	scl015500.15_97-S	turquoise
936	ENSMUSG00000019890	Nts	scl0003764.1_13-S	blue
937	ENSMUSG00000019894	Slc6a15	scl0003791.1_56-S	red
938	ENSMUSG00000019897	Ccdc59	scl052713.2_45-S	turquoise
939	ENSMUSG00000019907	Ppp1r12a	scl0003827.1_21-S	yellow
940	ENSMUSG00000019916	P4ha1	scl38890.17_310-S	grey
941	ENSMUSG00000019923	Zwint	scl38781.10_357-S	blue
942	ENSMUSG00000019929	Dcn	scl0013179.1_275-S	blue
943	ENSMUSG00000019929	Dcn	scl013179.1_84-S	blue
944	ENSMUSG00000019929	Dcn	scl38511.3.1_54-S	blue
945	ENSMUSG00000019943	Atp2b1	GI_38077438-S	yellow
946	ENSMUSG00000019948	Actr6	scl37625.11.1_3-S	turquoise
947	ENSMUSG00000019951	Uhrf1bp1l	scl0075089.2_74-S	grey
948	ENSMUSG00000019960	Dusp6	scl38496.5_152-S	turquoise
949	ENSMUSG00000019969	Psen1	scl019164.11_11-S	turquoise
950	ENSMUSG00000019970	Sgk	scl020393.12_71-S	magenta
951	ENSMUSG00000019970	Sgk	scl0003908.1_61-S	magenta
952	ENSMUSG00000019975	1200009F10Rik	scl069435.3_112-S	blue
953	ENSMUSG00000019977	Hbs1l	scl0056422.1_70-S	black
954	ENSMUSG00000019978	Epb4.1l2	scl0013822.2_330-S	red
955	ENSMUSG00000019979	Apaf1	scl076129.1_180-S	magenta
956	ENSMUSG00000019986	Ahi1	scl39099.27_528-S	grey
957	ENSMUSG00000019997	Ctgf	scl39079.4_283-S	purple
958	ENSMUSG00000019998	Stx7	scl39081.11_80-S	blue
959	ENSMUSG00000020023	Tmcc3	scl0319880.4_99-S	yellow
960	ENSMUSG00000020024	Ccdc41	scl38529.17.1_20-S	brown
961	ENSMUSG00000020027	Socs2	scl00216233.1_1004-S	grey
962	ENSMUSG00000020029	Nudt4	scl37580.8_154-S	grey
963	ENSMUSG00000020032	Nuak1	GI_38090592-S	blue
964	ENSMUSG00000020044	Timp3	scl0021859.1_62-S	green
965	ENSMUSG00000020048	Hsp90b1	scl37659.18.259_11-S	turquoise
966	ENSMUSG00000020056	Ccdc53	scl38585.9.1_9-S	grey
967	ENSMUSG00000020064	Herc4	scl067345.15_210-S	turquoise
968	ENSMUSG00000020070	Rufy2	scl070432.11_6-S	yellow
969	ENSMUSG00000020074	Ccar1	scl0067500.2_43-S	blue
970	ENSMUSG00000020076	Ddx50	scl37892.17.17_22-S	brown
971	ENSMUSG00000020078	Vps26a	scl37899.10_160-S	blue
972	ENSMUSG00000020089	Ppa1	scl38868.13.1_10-S	blue
973	ENSMUSG00000020091	Eif4ebp2	scl0013688.1_69-S	greenyellow
974	ENSMUSG00000020099	Unc5b	scl0327759.1_278-S	magenta
975	ENSMUSG00000020100	Slc29a3	scl37927.8.1_330-S	turquoise
976	ENSMUSG00000020107	D10Ertd641e	scl37933.6_401-S	brown
977	ENSMUSG00000020108	Ddit4	scl37934.3_287-S	turquoise
978	ENSMUSG00000020111	Cbara1	scl38886.15_179-S	turquoise
979	ENSMUSG00000020114	Cand1	GI_38090794-S	turquoise
980	ENSMUSG00000020115	Tbk1	scl056480.1_127-S	blue
981	ENSMUSG00000020116	Pno1	scl40498.6_62-S	blue
982	ENSMUSG00000020132	Rab21	scl00216344.2_121-S	blue
983	ENSMUSG00000020134	Peli1	scl0001385.1_401-S	brown
984	ENSMUSG00000020134	Peli1	scl067245.8_3-S	turquoise
985	ENSMUSG00000020142	Slc1a4	scl40472.8_474-S	turquoise
986	ENSMUSG00000020150	Gamt	scl37740.6.1_17-S	turquoise
987	ENSMUSG00000020151	Ptprr	scl0003926.1_85-S	blue
988	ENSMUSG00000020153	Ndufs7	scl38688.8.1_12-S	blue
989	ENSMUSG00000020154	Ptprb	scl38416.13.1_1-S	turquoise
990	ENSMUSG00000020156	Mum1	scl068114.7_83-S	turquoise
991	ENSMUSG00000020166	Cnot2	scl072068.1_53-S	turquoise
992	ENSMUSG00000020166	Cnot2	scl078337.1_63-S	blue
993	ENSMUSG00000020170	Frs2	GI_31560836-S	grey
994	ENSMUSG00000020171	Yeats4	scl37470.5.1_23-S	turquoise
995	ENSMUSG00000020173	Cobl	scl0012808.2_292-S	purple
996	ENSMUSG00000020176	Grb10	scl40508.22_194-S	purple
997	ENSMUSG00000020180	Snrpd3	scl067332.3_15-S	blue
998	ENSMUSG00000020182	Ddc	scl40512.21.1_20-S	turquoise
999	ENSMUSG00000020183	Cpm	scl070574.7_30-S	magenta
1000	ENSMUSG00000020184	Mdm2	scl37463.11_46-S	turquoise
1001	ENSMUSG00000020186	Csrp2	scl38453.7.1_27-S	green
1002	ENSMUSG00000020190	Mknk2	scl017347.2_7-S	blue
1003	ENSMUSG00000020198	Ap3d1	scl37723.28_305-S	brown
1004	ENSMUSG00000020225	Tmbim4	scl38374.10.1_58-S	brown
1005	ENSMUSG00000020230	Prmt2	scl37802.13.1_87-S	turquoise
1006	ENSMUSG00000020235	Fzr1	scl056371.1_4-S	blue
1007	ENSMUSG00000020235	Fzr1	scl37699.11.9_0-S	blue
1008	ENSMUSG00000020246	Hcfc2	scl0003762.1_28-S	turquoise
1009	ENSMUSG00000020248	Nfyb	scl0018045.2_49-S	turquoise
1010	ENSMUSG00000020250	Txnrd1	scl38628.18.8_108-S	turquoise
1011	ENSMUSG00000020261	Slc36a1	scl14122.1.1_85-S	turquoise
1012	ENSMUSG00000020263	Appl2	scl37679.21_483-S	blue
1013	ENSMUSG00000020265	Sumo3	scl0020610.2_127-S	turquoise
1014	ENSMUSG00000020265	Sumo3	scl020610.4_145-S	turquoise
1015	ENSMUSG00000020267	Hint1	scl41548.2.100_36-S	brown
1016	ENSMUSG00000020273	Papolg	scl40436.22.1_11-S	turquoise
1017	ENSMUSG00000020277	Pfkl	scl018641.1_29-S	blue
1018	ENSMUSG00000020282	Rhbdf1	scl40390.17.1_199-S	turquoise
1019	ENSMUSG00000020284	1810043G02Rik	scl0067884.2_11-S	turquoise
1020	ENSMUSG00000020297	Nsg2	scl41730.11_1-S	turquoise
1021	ENSMUSG00000020300	mKIAA1673	scl0067579.1_156-S	turquoise
1022	ENSMUSG00000020305	Asb3	scl0001326.1_0-S	blue
1023	ENSMUSG00000020305	Asb3	scl0065257.2_56-S	blue
1024	ENSMUSG00000020307	Cdc34	scl0216150.5_158-S	blue
1025	ENSMUSG00000020311	4933407N01Rik	scl0001501.1_75-S	grey
1026	ENSMUSG00000020315	Spnb2	scl0001316.1_166-S	red
1027	ENSMUSG00000020315	Spnb2	scl0001563.1_89-S	turquoise
1028	ENSMUSG00000020315	Spnb2	scl0020742.1_100-S	yellow
1029	ENSMUSG00000020321	Mdh1	scl0001320.1_85-S	turquoise
1030	ENSMUSG00000020326	Ccng1	scl0001479.1_77-S	blue
1031	ENSMUSG00000020326	Ccng1	scl0012450.2_17-S	blue
1032	ENSMUSG00000020326	Ccng1	scl40331.6_57-S	blue
1033	ENSMUSG00000020328	Nudcd2	scl41687.5_165-S	turquoise
1034	ENSMUSG00000020329	Polrmt	scl37753.17.1_5-S	blue
1035	ENSMUSG00000020331	Hcn2	scl38714.10.10_60-S	brown
1036	ENSMUSG00000020340	Cyfip2	scl0076884.2_52-S	turquoise
1037	ENSMUSG00000020340	Cyfip2	scl40305.32_46-S	turquoise
1038	ENSMUSG00000020349	Ppp2ca	scl41579.7_169-S	grey
1039	ENSMUSG00000020358	Hnrnpab	scl015384.1_1-S	brown
1040	ENSMUSG00000020361	Hspa4	scl0001502.1_0-S	turquoise
1041	ENSMUSG00000020362	Cnot6	GI_38091344-S	yellow
1042	ENSMUSG00000020362	Cnot6	scl00104625.2_13-S	blue
1043	ENSMUSG00000020366	Mapk9	scl41621.13_164-S	purple

1044	ENSMUSG00000020372	Gnb2l1	scl41635.8.225_0-S	turquoise
1045	ENSMUSG00000020374	Rasgef1c	GI_38091345-S	turquoise
1046	ENSMUSG00000020375	Rufy1	scl40272.18.1_23-S	turquoise
1047	ENSMUSG00000020376	Rnf130	scl41618.6.1_22-S	magenta
1048	ENSMUSG00000020377	Ltc4s	scl40277.4.24_53-S	green
1049	ENSMUSG00000020381	3010026O09Rik	scl068067.7_227-S	brown
1050	ENSMUSG00000020385	Clk4	scl41598.17.1_21-S	blue
1051	ENSMUSG00000020385	Clk4	scl0001372.1_16-S	blue
1052	ENSMUSG00000020386	Sar1b	scl41582.8.1_74-S	brown
1053	ENSMUSG00000020388	Pdlim4	scl40219.8.1_51-S	green
1054	ENSMUSG00000020392	Cdkn2aipnl	scl41586.4_460-S	grey
1055	ENSMUSG00000020397	Med7	scl41644.4_98-S	blue
1056	ENSMUSG00000020400	Tnip1	scl057783.1_1-S	blue
1057	ENSMUSG00000020402	Vdac1	scl022333.10_87-S	turquoise
1058	ENSMUSG00000020409	Slu7	scl41677.17_612-S	blue
1059	ENSMUSG00000020413	Hus1	scl0015574.1_224-S	blue
1060	ENSMUSG00000020427	Igfbp3	scl40526.6_232-S	grey
1061	ENSMUSG00000020430	Pes1	scl0064934.1_269-S	turquoise
1062	ENSMUSG00000020432	Tcn2	scl40593.13.11_2-S	green
1063	ENSMUSG00000020435	Osbp2	scl074309.1_115-S	brown
1064	ENSMUSG00000020436	Gabrg2	scl0001414.1_316-S	brown
1065	ENSMUSG00000020436	Gabrg2	scl014406.1_194-S	brown
1066	ENSMUSG00000020440	Arf5	scl011844.1_12-S	blue
1067	ENSMUSG00000020441	2310033P09Rik	scl0001288.1_3-S	greenyellow
1068	ENSMUSG00000020448	Rnf185	scl00193670.1_279-S	turquoise
1069	ENSMUSG00000020457	Drg1	scl0001267.1_72-S	turquoise
1070	ENSMUSG00000020457	Drg1	scl40603.7.49_6-S	black
1071	ENSMUSG00000020458	Rtn4	scl0001428.1_12-S	grey
1072	ENSMUSG00000020458	Rtn4	scl0001537.1_132-S	turquoise
1073	ENSMUSG00000020458	Rtn4	scl0068585.2_67-S	grey
1074	ENSMUSG00000020463	Smek2	scl00104570.2_297-S	yellow
1075	ENSMUSG00000020471	Pold2	scl40552.11.1_156-S	turquoise
1076	ENSMUSG00000020473	Aebp1	scl41866.19_12-S	blue
1077	ENSMUSG00000020475	Pgam2	scl40555.3.1_120-S	turquoise
1078	ENSMUSG00000020477	Mrps24	scl064660.1_30-S	grey
1079	ENSMUSG00000020482	Ccdc117	scl00104479.1_248-S	turquoise
1080	ENSMUSG00000020483	Dynll2	GI_31542030-S	brown
1081	ENSMUSG00000020484	Xbp1	scl022433.7_46-S	grey
1082	ENSMUSG00000020496	Rnf187	scl40177.4_172-S	brown
1083	ENSMUSG00000020514	Mrpl22	scl0216767.5_8-S	blue
1084	ENSMUSG00000020519	Sap30l	scl41530.4.1_0-S	turquoise
1085	ENSMUSG00000020522	Mfap3	scl0216760.3_93-S	grey
1086	ENSMUSG00000020523	1810073G14Rik	scl40200.14_192-S	grey
1087	ENSMUSG00000020524	Gria1	GI_34328127-S	turquoise
1088	ENSMUSG00000020524	Gria1	scl0014799.1_68-S	turquoise
1089	ENSMUSG00000020524	Gria1	scl014799.15_1-S	greenyellow
1090	ENSMUSG00000020524	Gria1	scl41536.20_63-S	greenyellow
1091	ENSMUSG00000020525	Ppm1d	scl41108.8_163-S	grey
1092	ENSMUSG00000020528	Prpsap2	scl0212627.1_235-S	turquoise
1093	ENSMUSG00000020530	Ggnbp2	scl0217039.1_54-S	brown
1094	ENSMUSG00000020530	Ggnbp2	scl0109150.1_258-S	turquoise
1095	ENSMUSG00000020537	Drg2	scl013495.13_174-S	turquoise
1096	ENSMUSG00000020544	Cox11	scl41046.4.1_69-S	turquoise
1097	ENSMUSG00000020547	Bzw2	scl42528.12.1_19-S	yellow
1098	ENSMUSG00000020570	Sypl	scl0002356.1_173-S	turquoise
1099	ENSMUSG00000020570	Sypl	scl0019027.2_109-S	blue
1100	ENSMUSG00000020572	Nampt	scl43302.13_107-S	brown
1101	ENSMUSG00000020576	4933425L03Rik	scl43377.58.1_149-S	turquoise
1102	ENSMUSG00000020577	Tspan13	scl42532.6_0-S	turquoise
1103	ENSMUSG00000020585	Laptm4a	scl43398.10.1_4-S	turquoise
1104	ENSMUSG00000020594	Pum2	scl0080913.2_173-S	red
1105	ENSMUSG00000020598	C130076O07Rik	scl00319504.2_83-S	brown
1106	ENSMUSG00000020599	Rgs9	scl39397.22.1_286-S	grey
1107	ENSMUSG00000020601	Trib2	scl42611.4_130-S	turquoise
1108	ENSMUSG00000020604	Arsg	scl074008.10_42-S	green
1109	ENSMUSG00000020607	Fam84a	scl42613.3_51-S	turquoise
1110	ENSMUSG00000020612	Prkar1a	scl40772.15_67-S	grey
1111	ENSMUSG00000020612	Prkar1a	scl0001419.1_32-S	pink
1112	ENSMUSG00000020621	Rdh14	scl43391.2_27-S	red
1113	ENSMUSG00000020628	Ttc15	scl42571.13_277-S	blue
1114	ENSMUSG00000020629	Adi1	scl0104923.5_14-S	turquoise
1115	ENSMUSG00000020630	Rnh1	scl43334.10.1_0-S	turquoise
1116	ENSMUSG00000020635	Fkbp1b	scl42655.4.46_11-S	blue
1117	ENSMUSG00000020638	Cmpk2	scl43337.5_334-S	turquoise
1118	ENSMUSG00000020644	Id2	scl42591.3.1_5-S	turquoise
1119	ENSMUSG00000020646	Mboat2	scl43347.15_53-S	grey
1120	ENSMUSG00000020647	Ncoa1	scl0017977.2_208-S	blue
1121	ENSMUSG00000020648	Dus4l	scl071916.1_187-S	grey
1122	ENSMUSG00000020650	Bcap29	scl42558.9_151-S	brown
1123	ENSMUSG00000020651	Slc26a4	scl42559.23.1_85-S	grey
1124	ENSMUSG00000020656	Grhl1	scl43351.17_346-S	grey
1125	ENSMUSG00000020657	Dnajc27	scl0217378.12_30-S	turquoise
1126	ENSMUSG00000020659	Cbll1	scl42560.6_64-S	turquoise
1127	ENSMUSG00000020664	Dld	scl42561.14.1_88-S	turquoise
1128	ENSMUSG00000020664	Dld	scl0002332.1_7-S	brown
1129	ENSMUSG00000020668	Kif3c	scl0016570.1_92-S	blue
1130	ENSMUSG00000020668	Kif3c	scl016570.2_240-S	blue
1131	ENSMUSG00000020669	Sh3yl1	scl43315.9.1_17-S	grey
1132	ENSMUSG00000020674	mKIAA0230	scl43319.25_22-S	turquoise
1133	ENSMUSG00000020677	Ddx52	scl41127.15.1_23-S	blue
1134	ENSMUSG00000020681	Ace	scl40807.26_6-S	green
1135	ENSMUSG00000020687	Cdc27	scl00217232.1_33-S	turquoise
1136	ENSMUSG00000020694	Tlk2	scl40824.25_304-S	turquoise
1137	ENSMUSG00000020700	Map3k3	scl40799.17_134-S	turquoise
1138	ENSMUSG00000020701	Tmem132e	scl0270893.10_267-S	blue
1139	ENSMUSG00000020706	Ftsj3	scl39451.19.1_30-S	turquoise
1140	ENSMUSG00000020708	Psmc5	scl0001433.1_54-S	turquoise
1141	ENSMUSG00000020708	Psmc5	scl40797.10.1_7-S	grey
1142	ENSMUSG00000020713	Gh	scl39450.5.4_10-S	grey
1143	ENSMUSG00000020720	Psmd12	scl40787.10.7_5-S	turquoise
1144	ENSMUSG00000020721	AK014258	scl13902.1.1_129-S	blue
1145	ENSMUSG00000020721	AK079163	scl0109278.1_112-S	blue
1146	ENSMUSG00000020721	Helz	scl40784.34_153-S	red
1147	ENSMUSG00000020734	Grin2c	scl39346.15.1_80-S	turquoise
1148	ENSMUSG00000020736	Nt5c	scl39338.3_4-S	turquoise
1149	ENSMUSG00000020737	Hn1	scl015374.1_66-S	turquoise
1150	ENSMUSG00000020740	Gga3	scl00260302.2_98-S	blue
1151	ENSMUSG00000020740	Gga3	scl0260302.1_205-S	blue
1152	ENSMUSG00000020741	1300001I01Rik	scl41281.26_86-S	blue
1153	ENSMUSG00000020744	Slc25a19	scl067283.1_285-S	blue
1154	ENSMUSG00000020745	Pafah1b1	scl018472.2_44-S	grey
1155	ENSMUSG00000020758	Itgb4	scl0192897.13_3-S	magenta
1156	ENSMUSG00000020766	Galk1	scl39322.7.11_5-S	turquoise
1157	ENSMUSG00000020775	Mrpl38	scl39316.7.1_30-S	turquoise
1158	ENSMUSG00000020776	Fbf1	scl39315.29_470-S	blue
1159	ENSMUSG00000020785	Camkk1	scl41298.15_342-S	blue

1160	ENSMUSG00000020792	Exoc7	scl0053413.2_143-S	grey
1161	ENSMUSG00000020792	Exoc7	scl39310.22.1_30-S	turquoise
1162	ENSMUSG00000020794	Ube2g1	scl0001439.1_101-S	red
1163	ENSMUSG00000020794	Ube2g1	scl0067128.1_219-S	grey
1164	ENSMUSG00000020794	Ube2g1	scl067128.8_166-S	grey
1165	ENSMUSG00000020799	Tekt1	scl0001423.1_94-S	green
1166	ENSMUSG00000020799	Tekt1	scl39970.10.1_46-S	green
1167	ENSMUSG00000020801	Med31	scl39972.2.1_24-S	brown
1168	ENSMUSG00000020802	Ube2o	scl0217342.1_24-S	blue
1169	ENSMUSG00000020811	Wscd1	scl41318.13.1_30-S	blue
1170	ENSMUSG00000020817	Rabep1	scl054189.18_28-S	blue
1171	ENSMUSG00000020823	Sec14l1	scl40690.19.366_4-S	blue
1172	ENSMUSG00000020827	Mink1	scl41333.33.1_21-S	blue
1173	ENSMUSG00000020841	Cpd	scl0012874.1_259-S	turquoise
1174	ENSMUSG00000020844	Nxn	scl0018230.2_224-S	green
1175	ENSMUSG00000020848	Doc2b	scl013447.1_264-S	brown
1176	ENSMUSG00000020848	Doc2b	scl39929.9.1_88-S	blue
1177	ENSMUSG00000020850	Prpf8	scl41264.42.1_0-S	blue
1178	ENSMUSG00000020859	Spag9	scl0070834.1_254-S	turquoise
1179	ENSMUSG00000020859	Spag9	scl070834.2_16-S	blue
1180	ENSMUSG00000020863	3300001P08Rik	scl0067684.1_211-S	blue
1181	ENSMUSG00000020863	3300001P08Rik	scl067684.2_37-S	yellow
1182	ENSMUSG00000020864	Ankrd40	scl071452.5_105-S	turquoise
1183	ENSMUSG00000020866	Cacna1g	scl0001312.1_33-S	turquoise
1184	ENSMUSG00000020866	Cacna1g	scl39711.41_251-S	grey
1185	ENSMUSG00000020869	Lrrc59	scl000075.1_18_REVCOMP-S	brown
1186	ENSMUSG00000020869	Lrrc59	scl000086.1_135-S	turquoise
1187	ENSMUSG00000020869	Lrrc59	scl41025.7_232-S	blue
1188	ENSMUSG00000020873	Slc35b1	scl41012.9.1_84-S	blue
1189	ENSMUSG00000020886	Dlg4	scl0013385.2_175-S	pink
1190	ENSMUSG00000020886	Dlg4	scl41346.23_152-S	blue
1191	ENSMUSG00000020889	Nr1d1	scl39616.9.169_52-S	blue
1192	ENSMUSG00000020892	Aloxe3	scl41379.14.1_107-S	turquoise
1193	ENSMUSG00000020893	Per1	scl41377.24.1_22-S	blue
1194	ENSMUSG00000020894	Vamp2	scl41376.4_29-S	brown
1195	ENSMUSG00000020898	1500010J02Rik	scl41382.23.1_64-S	blue
1196	ENSMUSG00000020899	RP23-153N12.1	scl0237823.1_321-S	grey
1197	ENSMUSG00000020900	Myh10	scl0077579.2_42-S	blue
1198	ENSMUSG00000020900	Myh10	scl41389.43_646-S	blue
1199	ENSMUSG00000020903	Stx8	scl0001383.1_41-S	brown
1200	ENSMUSG00000020903	Stx8	scl0055943.1_284-S	brown
1201	ENSMUSG00000020903	Stx8	scl055943.5_30-S	brown
1202	ENSMUSG00000020917	Acly	scl0104112.1_197-S	blue
1203	ENSMUSG00000020918	Kat2a	scl0014534.2_181-S	blue
1204	ENSMUSG00000020918	Kat2a	scl39553.16.1_62-S	blue
1205	ENSMUSG00000020922	Lsm12	scl00268490.1_147-S	turquoise
1206	ENSMUSG00000020922	Lsm12	scl0268490.8_24-S	yellow
1207	ENSMUSG00000020922	Lsm12	scl39516.6_65-S	turquoise
1208	ENSMUSG00000020923	Ubtf	scl021429.1_33-S	turquoise
1209	ENSMUSG00000020925	Ccdc43	scl052715.1_0-S	grey
1210	ENSMUSG00000020926	Adam11	scl40853.26_29-S	brown
1211	ENSMUSG00000020929	Eftud2	scl0001292.1_30-S	blue
1212	ENSMUSG00000020929	Eftud2	scl39496.28.1_108-S	blue
1213	ENSMUSG00000020932	M25937	scl39495.10_537-S	magenta
1214	ENSMUSG00000020946	Gosr2	scl39475.6_48-S	red
1215	ENSMUSG00000020946	Gosr2	scl0001446.1_126-S	red
1216	ENSMUSG00000020950	Foxg1	scl0015228.1_213-S	turquoise
1217	ENSMUSG00000020952	Scfd1	scl43225.27.1_94-S	turquoise
1218	ENSMUSG00000020954	Strn3	scl42484.15.73_1-S	turquoise
1219	ENSMUSG00000020955	Ap4s1	scl43223.12.1_25-S	blue
1220	ENSMUSG00000020964	Sel1l	scl020338.1_17-S	blue
1221	ENSMUSG00000020978	Klhdc2	scl43155.10.40_7-S	turquoise
1222	ENSMUSG00000020982	Sdccag1	scl42392.19.1_13-S	yellow
1223	ENSMUSG00000020986	Sec23a	scl0020334.2_256-S	red
1224	ENSMUSG00000020986	Sec23a	scl42425.21_390-S	turquoise
1225	ENSMUSG00000020993	Trappc6b	scl0002291.1_1-S	turquoise
1226	ENSMUSG00000021000	Ctage5	scl43180.27.1_0-S	grey
1227	ENSMUSG00000021007	Spata7	scl0104871.12_180-S	turquoise
1228	ENSMUSG00000021013	Ttc8	scl0002347.1_9-S	turquoise
1229	ENSMUSG00000021013	Ttc8	scl42881.15.1_25-S	turquoise
1230	ENSMUSG00000021018	Polr2h	scl0245841.4_4-S	brown
1231	ENSMUSG00000021025	Nfkbia	scl42451.6.1_16-S	turquoise
1232	ENSMUSG00000021027	Garnl1	scl42444.40_226-S	turquoise
1233	ENSMUSG00000021028	Mbip	scl42441.8.1_72-S	turquoise
1234	ENSMUSG00000021033	Gstz1	scl42938.12_138-S	turquoise
1235	ENSMUSG00000021039	Snw1	scl42200.14_120-S	turquoise
1236	ENSMUSG00000021040	1810035L17Rik	scl0380773.4_2-S	turquoise
1237	ENSMUSG00000021044	Adck1	scl42934.12.1_88-S	turquoise
1238	ENSMUSG00000021051	Ppp2r5e	scl0002382.1_8-S	turquoise
1239	ENSMUSG00000021051	Ppp2r5e	scl0026932.2_213-S	brown
1240	ENSMUSG00000021054	Sgpp1	scl42333.3_174-S	turquoise
1241	ENSMUSG00000021061	Spnb1	scl00008.1_398-S	brown
1242	ENSMUSG00000021062	Rab15	scl42322.9_395-S	blue
1243	ENSMUSG00000021065	Fut8	scl43059.15.1_19-S	turquoise
1244	ENSMUSG00000021068	Nin	scl0002340.1_98-S	turquoise
1245	ENSMUSG00000021071	Trim9	scl094090.1_3-S	pink
1246	ENSMUSG00000021071	Trim9	scl0002358.1_1625-S	blue
1247	ENSMUSG00000021076	Actr10	scl0002273.1_3-S	turquoise
1248	ENSMUSG00000021076	Actr10	scl056444.13_2-S	blue
1249	ENSMUSG00000021087	Rtn1	scl0002336.1_289-S	pink
1250	ENSMUSG00000021087	Rtn1	scl0002317.1_123-S	blue
1251	ENSMUSG00000021091	Serpina3k	scl020716.5_261-S	grey
1252	ENSMUSG00000021094	Dhrs7	scl0002381.1_12-S	blue
1253	ENSMUSG00000021094	Dhrs7	scl066375.2_40-S	magenta
1254	ENSMUSG00000021096	Ppm1a	scl019042.1_95-S	red
1255	ENSMUSG00000021102	Glrx5	scl0073046.2_136-S	brown
1256	ENSMUSG00000021103	Mnat1	scl0002412.1_56-S	brown
1257	ENSMUSG00000021111	Papola	scl0018789.1_2-S	pink
1258	ENSMUSG00000021113	Snapc1	scl43097.11.1_34-S	turquoise
1259	ENSMUSG00000021124	Vti1b	scl42309.7.1_14-S	turquoise
1260	ENSMUSG00000021127	Zfp36l1	scl0012192.2_207-S	turquoise
1261	ENSMUSG00000021130	Galntl1	scl0108760.4_329-S	brown
1262	ENSMUSG00000021131	Erh	scl019068.1_323-S	blue
1263	ENSMUSG00000021133	4933426M11Rik	scl43022.7_1-S	blue
1264	ENSMUSG00000021134	Sfrs5	scl0002293.1_7-S	red
1265	ENSMUSG00000021136	Smoc1	scl43019.15_590-S	grey
1266	ENSMUSG00000021139	1810020G14Rik	scl066272.3_26-S	brown
1267	ENSMUSG00000021139	Synj2bp	scl0002324.1_12-S	brown
1268	ENSMUSG00000021143	Pacs2	scl0217893.6_312-S	magenta
1269	ENSMUSG00000021147	Wdr37	scl00207615.1_0-S	turquoise
1270	ENSMUSG00000021156	Zmynd11	scl0003731.1_439-S	red
1271	ENSMUSG00000021179	BC002230	scl0217827.2_0-S	turquoise
1272	ENSMUSG00000021190	Lgmn	scl42127.12.1_16-S	turquoise
1273	ENSMUSG00000021192	Golga5	scl42857.13.1_22-S	turquoise
1274	ENSMUSG00000021194	Chga	scl0002400.1_38-S	blue
1275	ENSMUSG00000021194	Chga	scl42855.7.114_47-S	blue

1276	ENSMUSG00000021196	Pfkp	scl0003623.1_49-S	turquoise
1277	ENSMUSG00000021196	Pfkp	scl0003729.1_9-S	pink
1278	ENSMUSG00000021198	9030205A07Rik	scl42844.21.1_76-S	greenyellow
1279	ENSMUSG00000021203	Otub2	scl0068149.1_319-S	grey
1280	ENSMUSG00000021209	8430415E04Rik	scl0002309.1_167-S	grey
1281	ENSMUSG00000021209	8430415E04Rik	scl42841.28.1_167-S	turquoise
1282	ENSMUSG00000021217	Tshz3	scl32778.3_549-S	purple
1283	ENSMUSG00000021218	Gdi2	scl0003746.1_25-S	turquoise
1284	ENSMUSG00000021224	Numb	scl42256.15_169-S	grey
1285	ENSMUSG00000021235	Coq6	scl42976.13.1_6-S	turquoise
1286	ENSMUSG00000021242	Npc2	scl42239.4_289-S	turquoise
1287	ENSMUSG00000021244	Ylpm1	scl42964.22.1_29-S	turquoise
1288	ENSMUSG00000021250	Fos	scl42959.4_58-S	grey
1289	ENSMUSG00000021252	0610007P14Rik	scl058520.1_161-S	brown
1290	ENSMUSG00000021252	0610007P14Rik	scl42219.1_29-S	red
1291	ENSMUSG00000021262	Evl	scl42795.16.1_26-S	turquoise
1292	ENSMUSG00000021266	Wars	scl42057.12_19-S	blue
1293	ENSMUSG00000021275	Tecpr2	scl42761.20_481-S	blue
1294	ENSMUSG00000021277	Traf3	scl42756.16.1_0-S	blue
1295	ENSMUSG00000021278	Amn	scl42754.12.1_99-S	purple
1296	ENSMUSG00000021279	Cdc42bpb	scl42037.39_16-S	blue
1297	ENSMUSG00000021282	Eif5	scl0002315.1_12-S	yellow
1298	ENSMUSG00000021282	Eif5	scl00217869.1_91-S	red
1299	ENSMUSG00000021286	Zfyve21	scl068520.7_219-S	grey
1300	ENSMUSG00000021288	Klc1	scl42739.19.1_0-S	black
1301	ENSMUSG00000021290	2010107E04Rik	scl070257.1_12-S	blue
1302	ENSMUSG00000021303	Gng4	scl45060.6_526-S	purple
1303	ENSMUSG00000021313	Ryr2	scl44295.19.197_54-S	turquoise
1304	ENSMUSG00000021314	Amph	scl45034.23_392-S	blue
1305	ENSMUSG00000021326	Trim27	scl0003726.1_69-S	blue
1306	ENSMUSG00000021326	Trim27	scl019720.8_242-S	blue
1307	ENSMUSG00000021327	Zkscan3	scl44239.8_168-S	turquoise
1308	ENSMUSG00000021342	Prl	scl44971.5.8_29-S	grey
1309	ENSMUSG00000021360	Gcnt2	scl44868.8_25-S	grey
1310	ENSMUSG00000021361	Tmem14c	scl066154.6_169-S	turquoise
1311	ENSMUSG00000021361	Tmem14c	scl0003742.1_4-S	turquoise
1312	ENSMUSG00000021365	Nedd9	scl44054.10_313-S	turquoise
1313	ENSMUSG00000021368	Tbc1d7	scl0003678.1_3-S	turquoise
1314	ENSMUSG00000021368	Tbc1d7	scl0003709.1_47-S	turquoise
1315	ENSMUSG00000021368	Tbc1d7	scl44051.9.1_139-S	blue
1316	ENSMUSG00000021377	Dek	scl0110052.3_51-S	turquoise
1317	ENSMUSG00000021379	Id4	scl44805.3_51-S	turquoise
1318	ENSMUSG00000021385	Ippk	scl075678.13_86-S	purple
1319	ENSMUSG00000021395	Spin1	scl0003745.1_1178-S	pink
1320	ENSMUSG00000021395	Spin1	scl020729.4_276-S	turquoise
1321	ENSMUSG00000021400	Wrnip1	scl0003612.1_5-S	turquoise
1322	ENSMUSG00000021423	Ly86	scl44899.5.1_87-S	blue
1323	ENSMUSG00000021432	Slc35b3	scl44068.10_181-S	brown
1324	ENSMUSG00000021453	Gadd45g	scl44772.3.1_6-S	turquoise
1325	ENSMUSG00000021468	Sptlc1	scl0003647.1_892-S	turquoise
1326	ENSMUSG00000021474	Sfxn1	scl014057.6_27-S	turquoise
1327	ENSMUSG00000021478	Drd1a	scl0013488.2_233-S	grey
1328	ENSMUSG00000021486	Prelid1	scl0066494.2_134-S	turquoise
1329	ENSMUSG00000021493	Pdlim7	scl43921.12.1_95-S	grey
1330	ENSMUSG00000021494	Ddx41	scl43919.15.1_45-S	turquoise
1331	ENSMUSG00000021495	BC021381	scl43917.11.1_43-S	turquoise
1332	ENSMUSG00000021496	Pcbd2	scl44721.4.1_21-S	grey
1333	ENSMUSG00000021497	Txndc15	scl44722.4.8_25-S	turquoise
1334	ENSMUSG00000021501	Caml	scl44726.4.1_4-S	turquoise
1335	ENSMUSG00000021508	Cxcl14	scl43911.4.1_38-S	turquoise
1336	ENSMUSG00000021508	Cxcl14	scl0057266.1_102-S	blue
1337	ENSMUSG00000021519	Mterfd1	scl0003722.1_92-S	blue
1338	ENSMUSG00000021534	1700001L19Rik	scl44657.3.1_70-S	grey
1339	ENSMUSG00000021536	Adcy2	scl43784.25.1_156-S	grey
1340	ENSMUSG00000021537	Cetn3	scl44578.8.1_13-S	blue
1341	ENSMUSG00000021540	Smad5	scl44709.8_227-S	blue
1342	ENSMUSG00000021541	Trpc7	scl43906.11.1_163-S	grey
1343	ENSMUSG00000021546	Hnrnpk	scl015387.16_11-S	pink
1344	ENSMUSG00000021548	Ccnh	scl0066671.2_25-S	turquoise
1345	ENSMUSG00000021552	Gkap1	scl056278.9_3-S	yellow
1346	ENSMUSG00000021555	Mak10	scl44694.18.1_26-S	turquoise
1347	ENSMUSG00000021556	Golm1	scl00105348.2_131-S	purple
1348	ENSMUSG00000021559	Dapk1	scl0069635.2_263-S	blue
1349	ENSMUSG00000021567	Nkd2	scl0072293.2_258-S	blue
1350	ENSMUSG00000021567	Nkd2	scl43764.10_550-S	turquoise
1351	ENSMUSG00000021573	Tppp	scl44625.4_223-S	red
1352	ENSMUSG00000021589	Rhobtb3	scl0073296.1_60-S	brown
1353	ENSMUSG00000021596	Mctp1	scl44605.22_625-S	turquoise
1354	ENSMUSG00000021606	Ndufs6	GI_38075370-S	brown
1355	ENSMUSG00000021607	Mrpl36	scl44635.2.1_29-S	turquoise
1356	ENSMUSG00000021610	Clptm1l	scl44632.16.1_30-S	blue
1357	ENSMUSG00000021615	Xrcc4	scl00108138.1_7-S	blue
1358	ENSMUSG00000021619	Atg10	scl43706.9.1_17-S	brown
1359	ENSMUSG00000021629	Slc30a5	scl0003645.1_147-S	brown
1360	ENSMUSG00000021629	Slc30a5	scl43584.17.1_2-S	brown
1361	ENSMUSG00000021635	Rad17	scl43593.17_243-S	turquoise
1362	ENSMUSG00000021639	Gtf2h2	scl0023894.2_0-S	blue
1363	ENSMUSG00000021643	Serf1	scl0020365.1_201-S	turquoise
1364	ENSMUSG00000021645	Smn1	scl44463.11.22_177-S	blue
1365	ENSMUSG00000021647	Cartpt	scl43607.3.1_1-S	grey
1366	ENSMUSG00000021650	Ptcd2	scl0003640.1_4-S	red
1367	ENSMUSG00000021660	Btf3	scl0218490.3_0-S	brown
1368	ENSMUSG00000021665	BC146503	scl43644.9.1_5-S	turquoise
1369	ENSMUSG00000021666	Gfm2	scl00320806.1_195-S	turquoise
1370	ENSMUSG00000021670	Hmgcr	scl015357.2_29-S	grey
1371	ENSMUSG00000021680	Crhbp	scl012919.2_18-S	yellow
1372	ENSMUSG00000021684	Pde8b	scl00218461.1_104-S	turquoise
1373	ENSMUSG00000021687	Scamp1	scl0003651.1_17-S	red
1374	ENSMUSG00000021687	Scamp1	scl43672.16_14-S	turquoise
1375	ENSMUSG00000021701	Plk2	scl44387.13_320-S	turquoise
1376	ENSMUSG00000021703	Serinc5	scl00218442.1_227-S	turquoise
1377	ENSMUSG00000021706	Zfyve16	scl43692.18.1_6-S	blue
1378	ENSMUSG00000021709	Erbb2ip	scl059079.1_41-S	turquoise
1379	ENSMUSG00000021712	Trim23	scl0003687.1_76-S	blue
1380	ENSMUSG00000021712	Trim23	scl0081003.2_293-S	turquoise
1381	ENSMUSG00000021719	Rgs7bp	scl0052882.2_137-S	yellow
1382	ENSMUSG00000021719	Rgs7bp	scl43542.9_234-S	turquoise
1383	ENSMUSG00000021721	Htr1a	scl44430.1.474_5-S	blue
1384	ENSMUSG00000021731	Mrps30	scl43457.5.1_29-S	grey
1385	ENSMUSG00000021732	Fgf10	scl0014165.1_114-S	blue
1386	ENSMUSG00000021733	Slc4a7	scl0218756.18_6-S	yellow
1387	ENSMUSG00000021737	Psmd6	scl000397.1_19-S	turquoise
1388	ENSMUSG00000021737	Psmd6	scl45887.9.1_15-S	turquoise
1389	ENSMUSG00000021743	Fezf2	scl45900.6.1_19-S	blue
1390	ENSMUSG00000021750	Fam107a	scl45912.6_183-S	grey
1391	ENSMUSG00000021752	Kctd6	scl46638.4_82-S	blue

1392	ENSMUSG00000021754	Map3k1	scl43508.21.1_5-S	grey
1393	ENSMUSG00000021759	Ppap2a	scl44367.7.1_13-S	green
1394	ENSMUSG00000021760	Gpx8	scl43495.3.1_6-S	green
1395	ENSMUSG00000021764	Ndufs4	scl0003628.1_0-S	brown
1396	ENSMUSG00000021764	Ndufs4	scl0017993.1_168-S	turquoise
1397	ENSMUSG00000021764	Ndufs4	scl017993.1_123-S	turquoise
1398	ENSMUSG00000021767	Myst4	scl0054169.1_231-S	greenyellow
1399	ENSMUSG00000021770	Samd8	scl46571.1.746_173-S	turquoise
1400	ENSMUSG00000021771	Vdac2	scl46570.12.1_20-S	turquoise
1401	ENSMUSG00000021774	Ube2e1	scl022194.1_318-S	turquoise
1402	ENSMUSG00000021782	Dlg5	scl071228.1_292-S	blue
1403	ENSMUSG00000021791	Dydc2	scl45682.5.1_217-S	green
1404	ENSMUSG00000021792	5730469M10Rik	scl45683.9_474-S	blue
1405	ENSMUSG00000021796	Bmpr1a	scl0012166.1_24-S	turquoise
1406	ENSMUSG00000021806	Nid2	scl46602.21_8-S	green
1407	ENSMUSG00000021807	2700060E02Rik	scl068045.1_243-S	blue
1408	ENSMUSG00000021810	Ecd	scl45859.16.1_70-S	turquoise
1409	ENSMUSG00000021816	Ppp3cb	scl0019056.2_142-S	blue
1410	ENSMUSG00000021819	2310021P13Rik	scl46589.23.1_15-S	blue
1411	ENSMUSG00000021820	Camk2g	scl45839.23_390-S	blue
1412	ENSMUSG00000021822	Plau	scl46587.11.1_61-S	black
1413	ENSMUSG00000021823	Vcl	scl46585.22_265-S	turquoise
1414	ENSMUSG00000021832	Psmc6	scl0067089.2_186-S	turquoise
1415	ENSMUSG00000021843	Ktn1	scl46398.42.1_4-S	turquoise
1416	ENSMUSG00000021848	Otx2	scl018424.1_30-S	green
1417	ENSMUSG00000021870	Slmap	scl0083997.1_6-S	turquoise
1418	ENSMUSG00000021871	Pnp1	scl018950.7_181-S	brown
1419	ENSMUSG00000021876	Rnase4	scl058809.2_14-S	turquoise
1420	ENSMUSG00000021877	Arf4	scl46538.6_28-S	turquoise
1421	ENSMUSG00000021891	Mettl6	scl45756.6.1_149-S	blue
1422	ENSMUSG00000021893	Capn7	scl46489.21.1_17-S	brown
1423	ENSMUSG00000021901	Bap1	scl46492.14_472-S	blue
1424	ENSMUSG00000021905	Dph3	scl45748.3_30-S	turquoise
1425	ENSMUSG00000021905	Dph3	scl000359.1_0-S	brown
1426	ENSMUSG00000021910	Nisch	scl45764.20_72-S	blue
1427	ENSMUSG00000021911	Parg	scl0026430.2_0-S	black
1428	ENSMUSG00000021913	Ogdhl	GI_38075901-S	grey
1429	ENSMUSG00000021916	Glt8d1	scl46500.10.1_48-S	blue
1430	ENSMUSG00000021917	Spcs1	scl45769.2.281_2-S	brown
1431	ENSMUSG00000021928	Ebpl	scl000389.1_0-S	turquoise
1432	ENSMUSG00000021928	Ebpl	scl068177.1_35-S	blue
1433	ENSMUSG00000021929	AK049373	scl45459.17_81-S	turquoise
1434	ENSMUSG00000021932	Rnaseh2b	scl067153.8_8-S	blue
1435	ENSMUSG00000021936	AK039254	scl45735.13_394-S	blue
1436	ENSMUSG00000021939	Ctsb	scl013030.16_220-S	turquoise
1437	ENSMUSG00000021947	Cryl1	scl45491.13.1_29-S	brown
1438	ENSMUSG00000021948	Prkcd	scl45774.17.1_29-S	magenta
1439	ENSMUSG00000021951	N6amt2	scl45489.6.1_24-S	turquoise
1440	ENSMUSG00000021957	Tkt	scl021881.14_30-S	blue
1441	ENSMUSG00000021973	Efha1	scl45482.13_126-S	turquoise
1442	ENSMUSG00000021982	Cdadc1	scl000298.1_86-S	turquoise
1443	ENSMUSG00000021990	Spata13	scl0219140.10_154-S	grey
1444	ENSMUSG00000021991	Cacna2d3	scl012294.1_10-S	blue
1445	ENSMUSG00000021996	Esd	scl013885.9_29-S	brown
1446	ENSMUSG00000022000	Zc3h13	scl067302.8_2-S	yellow
1447	ENSMUSG00000022000	Zc3h13	scl070302.4_170-S	yellow
1448	ENSMUSG00000022010	Tsc22d1	scl000295.1_2787-S	blue
1449	ENSMUSG00000022010	Tsc22d1	scl000333.1_26-S	grey
1450	ENSMUSG00000022010	Tsc22d1	scl46082.11_140-S	turquoise
1451	ENSMUSG00000022012	Enox1	scl46071.24.1_0-S	blue
1452	ENSMUSG00000022019	Tdrd3	scl46038.17.1_26-S	turquoise
1453	ENSMUSG00000022020	Narg1l	scl000289.1_27-S	black
1454	ENSMUSG00000022023	Wbp4	scl45265.10.1_1-S	red
1455	ENSMUSG00000022024	Sugt1	scl46052.12.1_12-S	turquoise
1456	ENSMUSG00000022031	Elp3	scl45413.15_171-S	turquoise
1457	ENSMUSG00000022035	Ccdc25	scl46161.10_342-S	turquoise
1458	ENSMUSG00000022037	Clu	scl46160.15.1_21-S	turquoise
1459	ENSMUSG00000022040	Ephx2	scl45408.20.1_29-S	grey
1460	ENSMUSG00000022043	Trim35	scl0066854.2_74-S	turquoise
1461	ENSMUSG00000022044	Stmn4	scl46156.8.1_4-S	turquoise
1462	ENSMUSG00000022048	Dpysl2	scl0012934.1_152-S	blue
1463	ENSMUSG00000022051	Bnip3l	scl45393.10_71-S	blue
1464	ENSMUSG00000022066	Entpd4	scl0067464.2_263-S	blue
1465	ENSMUSG00000022075	Rhobtb2	scl0246710.1_114-S	blue
1466	ENSMUSG00000022075	Rhobtb2	scl45362.9.1_18-S	blue
1467	ENSMUSG00000022090	Pdlim2	scl000330.1_8-S	magenta
1468	ENSMUSG00000022090	Pdlim2	scl000337.1_47-S	magenta
1469	ENSMUSG00000022090	Pdlim2	scl45359.10.52_9-S	magenta
1470	ENSMUSG00000022095	Rai16	scl45347.17_343-S	blue
1471	ENSMUSG00000022098	Bmp1	scl000373.1_361-S	blue
1472	ENSMUSG00000022098	Bmp1	scl012153.1_23-S	turquoise
1473	ENSMUSG00000022100	Xpo7	scl0065246.1_38-S	turquoise
1474	ENSMUSG00000022105	Rb1	scl45319.27_70-S	turquoise
1475	ENSMUSG00000022108	Itm2b	scl016432.2_9-S	turquoise
1476	ENSMUSG00000022109	Med4	scl46105.6.1_21-S	turquoise
1477	ENSMUSG00000022132	Cldn10	scl0058187.1_36-S	grey
1478	ENSMUSG00000022132	Cldn10	scl000308.1_148-S	brown
1479	ENSMUSG00000022132	Cldn10	scl000293.1_16-S	blue
1480	ENSMUSG00000022141	Nipbl	scl071175.1_21-S	yellow
1481	ENSMUSG00000022141	Nipbl	scl0002489.1_318-S	grey
1482	ENSMUSG00000022150	Dab2	scl013132.15_5-S	green
1483	ENSMUSG00000022151	Ttc33	scl0002463.1_48-S	red
1484	ENSMUSG00000022151	Ttc33	scl48128.6_4-S	turquoise
1485	ENSMUSG00000022174	Dad1	scl0013135.2_58-S	turquoise
1486	ENSMUSG00000022175	Lrp10	scl46303.7_279-S	blue
1487	ENSMUSG00000022176	Rem2	scl46302.5.151_110-S	blue
1488	ENSMUSG00000022180	Slc7a8	scl45563.11.1_75-S	blue
1489	ENSMUSG00000022184	Fbxo4	scl0002499.1_186-S	turquoise
1490	ENSMUSG00000022185	Acin1	scl45561.26_336-S	blue
1491	ENSMUSG00000022186	Oxct1	scl48137.14.1_1-S	turquoise
1492	ENSMUSG00000022194	Bcl2l2	scl0012050.1_82-S	turquoise
1493	ENSMUSG00000022195	6030458C11Rik	scl0077877.1_184-S	turquoise
1494	ENSMUSG00000022198	Pabpn1	scl054196.5_3-S	turquoise
1495	ENSMUSG00000022199	MBOCT	scl45555.8.1_9-S	blue
1496	ENSMUSG00000022199	MBOCT	scl000354.1_6-S	pink
1497	ENSMUSG00000022203	Efs	scl45556.6_151-S	green
1498	ENSMUSG00000022206	Npr3	scl47389.1.29_71-S	turquoise
1499	ENSMUSG00000022208	Jph4	scl45544.6_53-S	blue
1500	ENSMUSG00000022211	Lrrc16b	GI_38076307-S	blue
1501	ENSMUSG00000022212	Cpne6	scl46281.16.1_127-S	blue
1502	ENSMUSG00000022214	Wdr23	scl46280.17_461-S	turquoise
1503	ENSMUSG00000022216	Psme1	scl0019186.1_187-S	turquoise
1504	ENSMUSG00000022216	Psme1	scl019186.11_4-S	turquoise
1505	ENSMUSG00000022217	Fam158a	scl45540.5.1_3-S	blue
1506	ENSMUSG00000022223	Sdr39u1	scl000416.1_19-S	blue
1507	ENSMUSG00000022234	Cct5	scl47326.13.2_27-S	turquoise

1508	ENSMUSG00000022235	Cmbl	scl48020.10.1_127-S	turquoise
1509	ENSMUSG00000022240	Ctnnd2	scl018163.25_164-S	turquoise
1510	ENSMUSG00000022240	Ctnnd2	scl48025.23_23-S	pink
1511	ENSMUSG00000022241	Tars	scl0110960.1_77-S	turquoise
1512	ENSMUSG00000022246	Rai14	scl47392.22_290-S	purple
1513	ENSMUSG00000022247	Bxdc2	scl47395.9.8_1-S	brown
1514	ENSMUSG00000022255	Mtdh	scl0002503.1_18-S	yellow
1515	ENSMUSG00000022257	Laptm4b	scl0114128.8_210-S	turquoise
1516	ENSMUSG00000022261	Sdc2	scl015529.6_196-S	blue
1517	ENSMUSG00000022265	Ank	scl48036.13_340-S	black
1518	ENSMUSG00000022270	Fam134b	scl066270.6_30-S	yellow
1519	ENSMUSG00000022280	Rnf19a	scl47300.10_333-S	grey
1520	ENSMUSG00000022283	Pabpc1	GI_31560655-S	blue
1521	ENSMUSG00000022283	Pabpc1	scl018458.3_17-S	turquoise
1522	ENSMUSG00000022285	Ywhaz	scl022631.1_10-S	turquoise
1523	ENSMUSG00000022295	Atp6v1c1	scl066335.13_14-S	greenyellow
1524	ENSMUSG00000022295	Atp6v1c1	scl47965.12.3_6-S	blue
1525	ENSMUSG00000022300	Wdsof1	scl0223499.9_30-S	turquoise
1526	ENSMUSG00000022306	Zfpm2	scl47940.8_382-S	grey
1527	ENSMUSG00000022307	Oxr1	scl0002541.1_6-S	blue
1528	ENSMUSG00000022307	Oxr1	scl0170719.14_114-S	turquoise
1529	ENSMUSG00000022311	Csmd3	scl0239420.1_119-S	blue
1530	ENSMUSG00000022311	Csmd3	GI_38077501-S	blue
1531	ENSMUSG00000022312	Eif3h	scl068135.3_22-S	turquoise
1532	ENSMUSG00000022323	Hrsp12	scl015473.5_18-S	brown
1533	ENSMUSG00000022332	Khdrbs3	scl47844.7.1_12-S	turquoise
1534	ENSMUSG00000022336	Eif3e	scl0016341.1_91-S	turquoise
1535	ENSMUSG00000022340	5730410E15Rik	scl0319613.1_56-S	blue
1536	ENSMUSG00000022350	E430025E21Rik	scl47166.29.1_41-S	turquoise
1537	ENSMUSG00000022351	Sqle	scl0002494.1_23-S	turquoise
1538	ENSMUSG00000022351	Sqle	scl47884.11.17_1-S	blue
1539	ENSMUSG00000022354	Ndufb9	scl066218.3_27-S	turquoise
1540	ENSMUSG00000022361	Zhx1	scl0022770.2_174-S	blue
1541	ENSMUSG00000022361	Zhx1	scl022770.1_29-S	red
1542	ENSMUSG00000022362	9130401M01Rik	scl075758.2_4-S	turquoise
1543	ENSMUSG00000022370	Mrpl13	scl47189.8.1_128-S	turquoise
1544	ENSMUSG00000022376	Adcy8	scl47132.18.1_100-S	purple
1545	ENSMUSG00000022377	Asap1	scl47133.29_179-S	blue
1546	ENSMUSG00000022378	0910001A06Rik	scl0002560.1_12-S	red
1547	ENSMUSG00000022378	0910001A06Rik	scl47140.13_286-S	grey
1548	ENSMUSG00000022387	Brd1	scl46866.15_163-S	brown
1549	ENSMUSG00000022389	Tef	scl47703.8_132-S	turquoise
1550	ENSMUSG00000022391	Rangap1	scl46932.19_335-S	blue
1551	ENSMUSG00000022394	L3mbtl2	scl47705.17_95-S	blue
1552	ENSMUSG00000022400	Rbx1	scl0056438.1_154-S	brown
1553	ENSMUSG00000022400	Rbx1	scl056438.5_27-S	turquoise
1554	ENSMUSG00000022401	Xpnpep3	scl00321003.2_45-S	yellow
1555	ENSMUSG00000022403	St13	scl070356.1_235-S	turquoise
1556	ENSMUSG00000022404	Slc25a17	scl46938.9_3-S	turquoise
1557	ENSMUSG00000022414	Map3k7ip1	scl47734.11_199-S	blue
1558	ENSMUSG00000022421	Nptxr	scl46953.1.327_25-S	blue
1559	ENSMUSG00000022425	Enpp2	scl018606.1_11-S	green
1560	ENSMUSG00000022426	Josd1	scl46956.4_124-S	blue
1561	ENSMUSG00000022433	Csnk1e	scl0027373.2_39-S	brown
1562	ENSMUSG00000022433	Csnk1e	scl027373.3_30-S	blue
1563	ENSMUSG00000022443	Myh9	scl0002511.1_1272-S	brown
1564	ENSMUSG00000022450	Ndufa6	scl067130.2_3-S	turquoise
1565	ENSMUSG00000022451	Twf1	scl0019230.1_1679-S	grey
1566	ENSMUSG00000022452	1500032L24Rik	scl069029.1_30-S	turquoise
1567	ENSMUSG00000022454	Nell2	scl0054003.1_330-S	blue
1568	ENSMUSG00000022454	Nell2	scl054003.2_7-S	blue
1569	ENSMUSG00000022456	Sep-03	scl0024050.1_59-S	yellow
1570	ENSMUSG00000022456	Sep-03	scl024050.9_20-S	turquoise
1571	ENSMUSG00000022462	Slc38a2	scl0002482.1_22-S	blue
1572	ENSMUSG00000022463	Srebf2	scl0020788.1_174-S	blue
1573	ENSMUSG00000022466	Rpap3	scl071919.4_35-S	turquoise
1574	ENSMUSG00000022469	Rapgef3	scl46781.31.1_55-S	turquoise
1575	ENSMUSG00000022473	Slc48a1	scl47561.6_103-S	green
1576	ENSMUSG00000022474	Pmm1	scl46927.7.227_16-S	turquoise
1577	ENSMUSG00000022477	Aco2	scl011429.19_155-S	turquoise
1578	ENSMUSG00000022477	Aco2	GI_18079338-S	turquoise
1579	ENSMUSG00000022489	Pde1b	scl018574.14_254-S	blue
1580	ENSMUSG00000022490	Ppp1r1a	scl46654.8.1_7-S	brown
1581	ENSMUSG00000022500	Litaf	scl0056722.2_11-S	magenta
1582	ENSMUSG00000022505	Emp2	scl48775.5_265-S	turquoise
1583	ENSMUSG00000022508	Bcl6	scl48625.8_280-S	blue
1584	ENSMUSG00000022512	Cldn1	scl48613.5_237-S	green
1585	ENSMUSG00000022514	Il1rap	scl0001857.1_53-S	grey
1586	ENSMUSG00000022515	Anks3	scl48796.17_240-S	turquoise
1587	ENSMUSG00000022516	Nudt16l1	scl49474.3_50-S	turquoise
1588	ENSMUSG00000022517	Mgrn1	scl49475.21_477-S	blue
1589	ENSMUSG00000022521	Crebbp	scl48815.9.1_11-S	grey
1590	ENSMUSG00000022523	Fgf12	scl48597.11_551-S	blue
1591	ENSMUSG00000022528	Hes1	scl49266.7.1_79-S	blue
1592	ENSMUSG00000022529	Zfp263	scl49488.8_241-S	turquoise
1593	ENSMUSG00000022540	Rogdi	scl066049.1_83-S	blue
1594	ENSMUSG00000022545	Ercc4	scl050505.11_70-S	turquoise
1595	ENSMUSG00000022546	Gpt	scl47787.2_58-S	turquoise
1596	ENSMUSG00000022548	Apod	scl48566.2.188_10-S	brown
1597	ENSMUSG00000022551	Cyc1	scl066445.5_23-S	blue
1598	ENSMUSG00000022552	Sharpin	scl47044.6.24_75-S	turquoise
1599	ENSMUSG00000022553	Maf1	scl068877.8_322-S	blue
1600	ENSMUSG00000022556	Hsf1	scl0015499.2_255-S	blue
1601	ENSMUSG00000022564	Grina	scl47805.7_5-S	blue
1602	ENSMUSG00000022565	Plec1	scl0018810.1_283-S	blue
1603	ENSMUSG00000022570	Tsta3	scl47056.10.1_17-S	turquoise
1604	ENSMUSG00000022571	Pycrl	scl066194.1_36-S	turquoise
1605	ENSMUSG00000022574	Naprt1	scl47060.10.1_13-S	turquoise
1606	ENSMUSG00000022577	Ly6h	scl0023934.1_223-S	blue
1607	ENSMUSG00000022577	Ly6h	scl023934.2_19-S	blue
1608	ENSMUSG00000022577	Ly6h	scl47068.5.1_9-S	blue
1609	ENSMUSG00000022587	Ly6e	scl017069.4_4-S	blue
1610	ENSMUSG00000022602	Arc	scl47086.3_589-S	grey
1611	ENSMUSG00000022607	Ptk2	scl47095.40_145-S	turquoise
1612	ENSMUSG00000022617	Chkb	scl0012651.2_322-S	turquoise
1613	ENSMUSG00000022617	Chkb	scl0002548.1_130-S	grey
1614	ENSMUSG00000022620	Arsa	scl0011883.2_180-S	brown
1615	ENSMUSG00000022621	Rabl2a	scl068708.1_138-S	turquoise
1616	ENSMUSG00000022623	Shank3	scl47614.23.1_38-S	blue
1617	ENSMUSG00000022629	Kif21a	scl46838.37_242-S	brown
1618	ENSMUSG00000022634	YAF2	scl46822.5_2-S	blue
1619	ENSMUSG00000022635	Zcrb1	scl46821.2.2_6-S	yellow
1620	ENSMUSG00000022636	Alcam	scl0011658.2_92-S	turquoise
1621	ENSMUSG00000022637	Cblb	scl00208650.1_97-S	turquoise
1622	ENSMUSG00000022641	Bbx	scl48409.23_594-S	yellow
1623	ENSMUSG00000022658	Tagln3	scl48442.3.1_5-S	turquoise

1624	ENSMUSG00000022663	Atg3	scl49065.9.1_50-S	turquoise
1625	ENSMUSG00000022664	Slc35a5	scl0074102.2_20-S	brown
1626	ENSMUSG00000022665	Ccdc80	scl0067896.2_111-S	grey
1627	ENSMUSG00000022678	Nde1	scl0067203.2_205-S	turquoise
1628	ENSMUSG00000022678	Nde1	scl49399.9_518-S	grey
1629	ENSMUSG00000022679	Mpv17l	scl0001782.1_1-S	red
1630	ENSMUSG00000022681	Ntan1	scl49405.9.1_2-S	brown
1631	ENSMUSG00000022682	Rrn3	scl0106298.14_12-S	turquoise
1632	ENSMUSG00000022684	Bfar	scl067118.7_5-S	turquoise
1633	ENSMUSG00000022696	Sidt1	scl48454.28.1_30-S	greenyellow
1634	ENSMUSG00000022706	Mrpl40	scl48676.4_117-S	turquoise
1635	ENSMUSG00000022708	Zbtb20	scl0056490.1_199-S	yellow
1636	ENSMUSG00000022710	Usp7	GI_38080162-S	turquoise
1637	ENSMUSG00000022715	Tmem114	scl48785.4.1_310-S	blue
1638	ENSMUSG00000022744	Cldnd1	scl49010.6_349-S	turquoise
1639	ENSMUSG00000022747	St3gal6	scl0054613.2_126-S	blue
1640	ENSMUSG00000022749	Tbc1d23	scl067581.1_259-S	blue
1641	ENSMUSG00000022750	Klhl22	scl00224023.1_141-S	turquoise
1642	ENSMUSG00000022750	Klhl22	scl49371.8_144-S	turquoise
1643	ENSMUSG00000022752	Tomm70a	scl0028185.2_148-S	turquoise
1644	ENSMUSG00000022756	Slc7a4	scl00224022.2_173-S	blue
1645	ENSMUSG00000022757	Tfg	scl48382.9_267-S	blue
1646	ENSMUSG00000022760	Thap7	scl48706.4_308-S	blue
1647	ENSMUSG00000022761	Lztr1	scl49375.21_69-S	turquoise
1648	ENSMUSG00000022769	Sdf2l1	scl48713.2.9_29-S	black
1649	ENSMUSG00000022770	Dlg1	scl49249.30_34-S	turquoise
1650	ENSMUSG00000022771	Ppil2	scl48711.21.1_26-S	turquoise
1651	ENSMUSG00000022774	Ncbp2	scl068092.4_14-S	red
1652	ENSMUSG00000022779	Top3b	scl49387.17.1_22-S	turquoise
1653	ENSMUSG00000022789	Dnm1l	scl0074006.2_261-S	red
1654	ENSMUSG00000022789	Dnm1l	scl0001869.1_367-S	blue
1655	ENSMUSG00000022789	Dnm1l	scl48723.22_456-S	turquoise
1656	ENSMUSG00000022793	B4galt4	scl49145.9_59-S	turquoise
1657	ENSMUSG00000022807	Osbpl11	scl49219.13_574-S	turquoise
1658	ENSMUSG00000022811	Zfp148	scl0022661.2_277-S	yellow
1659	ENSMUSG00000022812	Gsk3b	scl49158.12.6_21-S	turquoise
1660	ENSMUSG00000022816	Fstl1	scl49164.12_81-S	brown
1661	ENSMUSG00000022817	Itgb5	scl0016419.2_269-S	turquoise
1662	ENSMUSG00000022817	Itgb5	scl49205.14.5_75-S	turquoise
1663	ENSMUSG00000022820	Ndufb4	scl0068194.2_330-S	turquoise
1664	ENSMUSG00000022828	Gtf2e1	scl48494.5_274-S	blue
1665	ENSMUSG00000022836	Mylk	scl49197.1.55_65-S	grey
1666	ENSMUSG00000022837	Iqcb1	scl49175.14_151-S	blue
1667	ENSMUSG00000022840	Adcy5	scl0224129.19_263-S	blue
1668	ENSMUSG00000022843	Clcn2	scl48660.21.1_63-S	blue
1669	ENSMUSG00000022855	Smt3ip2	scl0075826.2_162-S	blue
1670	ENSMUSG00000022856	Tmem41a	scl48649.5.1_0-S	blue
1671	ENSMUSG00000022861	Dgkg	scl00110197.2_147-S	blue
1672	ENSMUSG00000022864	D16Ertd472e	scl0067102.2_268-S	blue
1673	ENSMUSG00000022883	Robo1	scl019876.3_41-S	blue
1674	ENSMUSG00000022884	Eif4a2	scl0001816.1_0-S	red
1675	ENSMUSG00000022884	Eif4a2	scl49311.6_124-S	turquoise
1676	ENSMUSG00000022884	Eif4a2	scl0001779.1_17-S	red
1677	ENSMUSG00000022885	St6gal1	scl49300.12_501-S	black
1678	ENSMUSG00000022889	Mrpl39	scl48279.10.1_23-S	turquoise
1679	ENSMUSG00000022890	Atp5j	scl0000102.1_16-S	turquoise
1680	ENSMUSG00000022892	App	scl0011820.2_119-S	blue
1681	ENSMUSG00000022895	Ets2	scl023872.11_215-S	brown
1682	ENSMUSG00000022897	Dyrk1a	scl48842.13_674-S	turquoise
1683	ENSMUSG00000022899	Slc15a2	scl48500.22_173-S	brown
1684	ENSMUSG00000022905	Kpna1	scl49185.16_349-S	brown
1685	ENSMUSG00000022913	Psmg1	scl056088.2_28-S	blue
1686	ENSMUSG00000022914	Brwd1	scl0001797.1_1160-S	brown
1687	ENSMUSG00000022940	Pigp	scl0001801.1_3-S	blue
1688	ENSMUSG00000022947	Cbr3	scl48854.3.1_11-S	grey
1689	ENSMUSG00000022949	Clic6	scl0209195.6_234-S	green
1690	ENSMUSG00000022951	Rcan1	scl48193.7_228-S	turquoise
1691	ENSMUSG00000022962	Gart	scl48206.19.77_2-S	turquoise
1692	ENSMUSG00000022964	Tmem50b	scl0077975.2_18-S	turquoise
1693	ENSMUSG00000022965	Ifngr2	scl015980.8_163-S	grey
1694	ENSMUSG00000022965	Ifngr2	scl48876.7.1_7-S	grey
1695	ENSMUSG00000022982	Sod1	scl020655.4_35-S	brown
1696	ENSMUSG00000022987	Zfp641	scl00239652.2_53-S	turquoise
1697	ENSMUSG00000022994	Adcy6	scl011512.2_0-S	turquoise
1698	ENSMUSG00000022995	Enah	scl013800.1_217-S	blue
1699	ENSMUSG00000023004	Tuba1b	GI_34740334-S	turquoise
1700	ENSMUSG00000023010	Tmbim6	scl47531.14_82-S	blue
1701	ENSMUSG00000023017	Accn2	scl47526.10_548-S	blue
1702	ENSMUSG00000023018	Smarcd1	scl47522.9_109-S	blue
1703	ENSMUSG00000023019	Gpd1	scl47523.9_497-S	blue
1704	ENSMUSG00000023020	2310016M24Rik	scl47524.3.1_1-S	brown
1705	ENSMUSG00000023021	Lass5	scl0071949.2_8-S	turquoise
1706	ENSMUSG00000023025	Larp4	scl00207214.1_11-S	turquoise
1707	ENSMUSG00000023026	Dip2b	scl47510.32_484-S	blue
1708	ENSMUSG00000023032	Slc4a8	scl47498.1.1_244-S	blue
1709	ENSMUSG00000023033	Scn8a	scl0020273.2_171-S	blue
1710	ENSMUSG00000023033	Scn8a	scl47493.30_393-S	blue
1711	ENSMUSG00000023036	Pcdhga2	scl0093699.1_40-S	blue
1712	ENSMUSG00000023043	Krt18	scl016668.7_96-S	green
1713	ENSMUSG00000023044	Csad	scl0246277.1_158-S	turquoise
1714	ENSMUSG00000023046	Igfbp6	scl016012.5_14-S	grey
1715	ENSMUSG00000023050	Map3k12	scl026404.1_65-S	blue
1716	ENSMUSG00000023051	Tarbp2	scl021357.9_262-S	turquoise
1717	ENSMUSG00000023064	Sncg	scl45723.1.148_13-S	brown
1718	ENSMUSG00000023067	Cdkn1a	scl012575.1_2-S	grey
1719	ENSMUSG00000023074	Mospd1	scl070380.1_33-S	turquoise
1720	ENSMUSG00000023075	Akirin1	scl068050.2_0-S	turquoise
1721	ENSMUSG00000023087	Ccrn4l	scl012457.3_248-S	turquoise
1722	ENSMUSG00000023089	Ndufa5	scl0001121.1_1-S	turquoise
1723	ENSMUSG00000023092	Fhl1	scl54919.12_462-S	turquoise
1724	ENSMUSG00000023094	Msrb2	scl21241.7.1_29-S	turquoise
1725	ENSMUSG00000023104	Rfc2	scl0004059.1_11-S	turquoise
1726	ENSMUSG00000023110	Prmt5	scl45569.16_259-S	turquoise
1727	ENSMUSG00000023122	Sult1c2	scl49794.7.1_23-S	green
1728	ENSMUSG00000023150	Ivns1abp	scl000898.1_12-S	red
1729	ENSMUSG00000023150	Ivns1abp	scl17376.15_492-S	blue
1730	ENSMUSG00000023236	Scg5	scl18858.8.1_25-S	blue
1731	ENSMUSG00000023266	Frs3	scl50645.13_521-S	blue
1732	ENSMUSG00000023272	Creld2	scl47631.9.1_4-S	blue
1733	ENSMUSG00000023307	Mar-05	scl0069104.1_104-S	turquoise
1734	ENSMUSG00000023328	Ache	scl27107.5.1_169-S	blue
1735	ENSMUSG00000023353	Agap3	scl28037.21.1_21-S	turquoise
1736	ENSMUSG00000023391	Dlx2	GI_6753645-S	blue
1737	ENSMUSG00000023456	Tpi1	scl0021991.1_26-S	red
1738	ENSMUSG00000023456	Tpi1	scl021991.1_200-S	grey
1739	ENSMUSG00000023460	Rab12	scl0019328.2_52-S	pink

1740	ENSMUSG00000023467	Tulp2	scl32679.14.1_2-S	black
1741	ENSMUSG00000023473	Celsr3	scl0107934.22_249-S	blue
1742	ENSMUSG00000023495	Pcbp4	scl059092.13_316-S	grey
1743	ENSMUSG00000023571	Fam132a	scl24602.8.5_0-S	green
1744	ENSMUSG00000023572	Ccndbp1	scl0003372.1_2-S	turquoise
1745	ENSMUSG00000023723	Mrps23	scl064656.5_1-S	blue
1746	ENSMUSG00000023791	Pigx	scl48556.8.1_18-S	blue
1747	ENSMUSG00000023809	Rps6ka2	scl020112.1_15-S	turquoise
1748	ENSMUSG00000023830	Igf2r	scl50305.48_81-S	blue
1749	ENSMUSG00000023832	Acat2	scl0110460.1_24-S	turquoise
1750	ENSMUSG00000023883	Phf10	scl000091.1_88-S	turquoise
1751	ENSMUSG00000023883	Phf10	scl50289.12.1_79-S	turquoise
1752	ENSMUSG00000023886	Smoc2	scl51099.14_176-S	blue
1753	ENSMUSG00000023911	Flywch2	scl50230.5.1_81-S	grey
1754	ENSMUSG00000023912	Slc25a27	scl0074011.2_171-S	black
1755	ENSMUSG00000023913	Pla2g7	scl50703.12.1_8-S	turquoise
1756	ENSMUSG00000023915	Tnfrsf21	scl0094185.2_20-S	blue
1757	ENSMUSG00000023923	Tbc1d5	scl49807.23_539-S	black
1758	ENSMUSG00000023927	Satb1	scl0020230.2_317-S	purple
1759	ENSMUSG00000023939	Mrpl14	scl50686.4.1_41-S	grey
1760	ENSMUSG00000023944	Hsp90ab1	scl0015516.2_121-S	blue
1761	ENSMUSG00000023944	Hsp90ab1	scl0015516.2_144-S	blue
1762	ENSMUSG00000023944	Hsp90ab1	scl015516.6_124-S	blue
1763	ENSMUSG00000023951	Vegfa	scl49877.10_136-S	turquoise
1764	ENSMUSG00000023952	Gtpbp2	scl50683.12_301-S	blue
1765	ENSMUSG00000023961	Enpp4	scl00224794.1_18-S	yellow
1766	ENSMUSG00000023965	Fbxl17	scl49708.14_0-S	blue
1767	ENSMUSG00000023966	Rsph9	scl49876.5.1_70-S	green
1768	ENSMUSG00000023967	Mrps18a	scl50684.6.1_99-S	blue
1769	ENSMUSG00000023973	Tnrc5	scl49852.7_79-S	blue
1770	ENSMUSG00000024002	Brd4	scl0057261.1_145-S	blue
1771	ENSMUSG00000024002	Brd4	scl057261.4_30-S	greenyellow
1772	ENSMUSG00000024012	Mtch1	scl0001700.1_14-S	pink
1773	ENSMUSG00000024012	Mtch1	scl50103.16_203-S	blue
1774	ENSMUSG00000024013	Fgd2	scl50897.17.1_8-S	grey
1775	ENSMUSG00000024018	1110021J02Rik	scl068597.1_6-S	blue
1776	ENSMUSG00000024019	1300018I05Rik	scl074157.24_303-S	turquoise
1777	ENSMUSG00000024026	Glo1	scl50087.9.265_72-S	grey
1778	ENSMUSG00000024030	Abcg1	scl0011307.2_72-S	blue
1779	ENSMUSG00000024033	Rsph1	scl50081.7.1_21-S	green
1780	ENSMUSG00000024038	Ndufv3	scl50873.6.1_76-S	turquoise
1781	ENSMUSG00000024044	Epb4.1l3	scl013823.22_328-S	grey
1782	ENSMUSG00000024045	Akap8	scl056399.1_113-S	turquoise
1783	ENSMUSG00000024050	Wiz	scl50064.18_425-S	blue
1784	ENSMUSG00000024054	Smchd1	scl0074355.2_0-S	turquoise
1785	ENSMUSG00000024067	2810410M20Rik	scl066310.2_4-S	brown
1786	ENSMUSG00000024067	2810410M20Rik	scl0001607.1_37-S	brown
1787	ENSMUSG00000024068	Spast	scl050850.17_73-S	turquoise
1788	ENSMUSG00000024069	Slc30a6	scl0210148.13_0-S	turquoise
1789	ENSMUSG00000024082	2410091C18Rik	scl0001759.1_49-S	turquoise
1790	ENSMUSG00000024083	Pja2	scl00224938.2_37-S	yellow
1791	ENSMUSG00000024087	Cyp1b1	scl0013078.2_259-S	turquoise
1792	ENSMUSG00000024091	Vapa	scl49695.8_112-S	turquoise
1793	ENSMUSG00000024095	Hnrpll	scl49589.13.8_8-S	red
1794	ENSMUSG00000024096	Ralbp1	scl019765.2_155-S	brown
1795	ENSMUSG00000024098	AK190433	scl0065960.1_26-S	green
1796	ENSMUSG00000024099	Ndufv2	scl49682.13.1_21-S	turquoise
1797	ENSMUSG00000024101	ORF19	scl068767.10_282-S	turquoise
1798	ENSMUSG00000024109	Nrxn1	scl0001703.1_19-S	yellow
1799	ENSMUSG00000024109	Nrxn1	scl0001711.1_8-S	yellow
1800	ENSMUSG00000024109	Nrxn1	scl49490.24.1_9-S	yellow
1801	ENSMUSG00000024112	Cacna1h	scl50181.36_559-S	blue
1802	ENSMUSG00000024120	Lrpprc	scl49545.10.1_27-S	yellow
1803	ENSMUSG00000024121	Atp6v0c	scl50216.3_15-S	pink
1804	ENSMUSG00000024121	Atp6v0c	scl011984.1_128-S	turquoise
1805	ENSMUSG00000024122	Pdpk1	scl50221.17.1_145-S	yellow
1806	ENSMUSG00000024127	Prepl	scl49542.15_45-S	turquoise
1807	ENSMUSG00000024130	Abca3	scl51018.32_4-S	blue
1808	ENSMUSG00000024132	Dci	scl51015.5.49_29-S	green
1809	ENSMUSG00000024142	Gbl	scl50208.9_12-S	turquoise
1810	ENSMUSG00000024145	Pigf	scl49529.6.1_149-S	blue
1811	ENSMUSG00000024146	Cript	scl056724.5_33-S	turquoise
1812	ENSMUSG00000024158	Hagh	scl014651.8_3-S	turquoise
1813	ENSMUSG00000024163	Mapk8ip3	scl030957.1_28-S	blue
1814	ENSMUSG00000024175	Tekt4	scl50981.6.1_113-S	grey
1815	ENSMUSG00000024176	Sox8	scl50179.2_171-S	magenta
1816	ENSMUSG00000024181	Mrpl28	scl50963.5.1_38-S	grey
1817	ENSMUSG00000024182	Axin1	scl50961.11_474-S	blue
1818	ENSMUSG00000024186	Rgs11	scl50958.11.1_13-S	turquoise
1819	ENSMUSG00000024190	Dusp1	scl50147.4_283-S	grey
1820	ENSMUSG00000024191	Bnip1	scl50947.7.155_43-S	blue
1821	ENSMUSG00000024194	Cuta	scl50143.3.1_18-S	turquoise
1822	ENSMUSG00000024201	Kdm4b	scl50598.25_178-S	blue
1823	ENSMUSG00000024208	2900010M23Rik	scl067267.4_0-S	brown
1824	ENSMUSG00000024211	Grm8	scl0014823.2_170-S	purple
1825	ENSMUSG00000024213	Nudt3	scl50134.9_8-S	turquoise
1826	ENSMUSG00000024218	Taf11	scl068776.1_229-S	blue
1827	ENSMUSG00000024220	Zfp523	scl50928.15.1_1-S	turquoise
1828	ENSMUSG00000024222	Fkbp5	scl50117.17_16-S	blue
1829	ENSMUSG00000024234	Mtpap	scl0067440.1_72-S	turquoise
1830	ENSMUSG00000024234	Mtpap	scl067440.9_18-S	turquoise
1831	ENSMUSG00000024238	Zeb1	scl0021417.2_96-S	brown
1832	ENSMUSG00000024240	Epc1	scl013831.1_46-S	red
1833	ENSMUSG00000024240	Epc1	scl0002264.1_586-S	grey
1834	ENSMUSG00000024256	Adcyap1	scl0011516.2_115-S	brown
1835	ENSMUSG00000024258	Polr2d	scl0002238.1_5-S	brown
1836	ENSMUSG00000024258	Polr2d	scl0002272.1_96-S	turquoise
1837	ENSMUSG00000024258	Polr2d	scl52151.4.1_36-S	brown
1838	ENSMUSG00000024260	Sap130	scl00269003.2_105-S	brown
1839	ENSMUSG00000024261	Syt4	scl0020983.2_127-S	blue
1840	ENSMUSG00000024268	Brunol4	scl0002232.1_0-S	pink
1841	ENSMUSG00000024270	Slc39a6	scl51584.10_193-S	brown
1842	ENSMUSG00000024271	Elp2	scl058523.22_90-S	brown
1843	ENSMUSG00000024271	Elp2	scl0002239.1_15-S	red
1844	ENSMUSG00000024276	Zfp397	scl52189.2_366-S	blue
1845	ENSMUSG00000024277	Mapre2	scl00212307.2_257-S	brown
1846	ENSMUSG00000024277	Mapre2	scl0212307.7_1-S	turquoise
1847	ENSMUSG00000024286	Ccny	scl0067974.2_124-S	turquoise
1848	ENSMUSG00000024302	Dtna	scl0013527.1_266-S	blue
1849	ENSMUSG00000024302	Dtna	scl013527.8_0-S	turquoise
1850	ENSMUSG00000024304	Cdh2	scl0012558.1_44-S	grey
1851	ENSMUSG00000024304	Cdh2	scl012558.4_4-S	turquoise
1852	ENSMUSG00000024327	Slc39a7	scl50031.6.1_11-S	blue
1853	ENSMUSG00000024335	Brd2	scl0014312.2_62-S	blue
1854	ENSMUSG00000024335	Brd2	scl014312.1_1-S	yellow
1855	ENSMUSG00000024347	Psd2	scl52097.15_214-S	green

1856	ENSMUSG00000024352	5133400G04Rik	scl51530.6.1_65-S	brown
1857	ENSMUSG00000024359	Hspa9	scl015526.3_30-S	brown
1858	ENSMUSG00000024369	Rdbp	scl0027632.2_240-S	blue
1859	ENSMUSG00000024369	Rdbp	scl50808.8.1_29-S	turquoise
1860	ENSMUSG00000024378	Stard4	scl00170459.2_123-S	grey
1861	ENSMUSG00000024381	Bin1	scl0002240.1_22-S	pink
1862	ENSMUSG00000024381	Bin1	scl0030948.2_12-S	grey
1863	ENSMUSG00000024382	Ercc3	scl52142.13_3-S	turquoise
1864	ENSMUSG00000024392	Bat3	scl00224727.2_315-S	blue
1865	ENSMUSG00000024392	Bat3	scl50788.25.1_56-S	blue
1866	ENSMUSG00000024393	Bat2	scl49993.30.1_12-S	blue
1867	ENSMUSG00000024395	Lims2	scl0225341.10_229-S	magenta
1868	ENSMUSG00000024397	Aif1	scl0001712.1_14-S	brown
1869	ENSMUSG00000024403	Atp6v1g2	scl0001655.1_23-S	blue
1870	ENSMUSG00000024403	Atp6v1g2	scl50777.5_28-S	blue
1871	ENSMUSG00000024404	Riok3	scl066878.10_113-S	red
1872	ENSMUSG00000024410	3110002H16Rik	scl00001.1_0-S	turquoise
1873	ENSMUSG00000024410	3110002H16Rik	scl076482.18_130-S	turquoise
1874	ENSMUSG00000024411	Aqp4	scl0011829.2_75-S	yellow
1875	ENSMUSG00000024413	Npc1	scl00001.1_0_REVCOMP-S	turquoise
1876	ENSMUSG00000024420	Zfp521	scl00225207.2_53-S	magenta
1877	ENSMUSG00000024423	Impact	scl0319442.1_23-S	yellow
1878	ENSMUSG00000024426	2610110G12Rik	scl0073242.2_145-S	blue
1879	ENSMUSG00000024436	Mrps18b	scl0066973.1_60-S	turquoise
1880	ENSMUSG00000024446	Rpp21	scl49959.3.1_23-S	blue
1881	ENSMUSG00000024454	Hdac3	scl0015183.2_163-S	black
1882	ENSMUSG00000024457	Trim26	scl50746.12_453-S	grey
1883	ENSMUSG00000024462	Gabbr1	scl0001636.1_6-S	pink
1884	ENSMUSG00000024474	Ik	scl52081.14_14-S	brown
1885	ENSMUSG00000024480	Ap3s1	scl011777.6_49-S	turquoise
1886	ENSMUSG00000024483	Ankhd1	scl0002180.1_25-S	turquoise
1887	ENSMUSG00000024493	Lars	scl51469.24.1_0-S	blue
1888	ENSMUSG00000024500	Ppp2r2b	scl072930.1_117-S	turquoise
1889	ENSMUSG00000024515	Smad4	scl0017128.2_236-S	brown
1890	ENSMUSG00000024516	Sec11c	scl51843.7.3_62-S	turquoise
1891	ENSMUSG00000024517	Grp	scl51842.4.1_165-S	turquoise
1892	ENSMUSG00000024526	Cidea	scl51827.6.1_1-S	turquoise
1893	ENSMUSG00000024535	Snx24	scl51946.9_43-S	yellow
1894	ENSMUSG00000024558	Mapk4	scl51269.7_133-S	blue
1895	ENSMUSG00000024560	Cxxc1	scl51774.11.3_64-S	black
1896	ENSMUSG00000024571	Txnl4a	scl028062.4_5-S	turquoise
1897	ENSMUSG00000024579	Pcyox1l	scl51357.6.1_32-S	blue
1898	ENSMUSG00000024581	Napg	GI_38084003-S	yellow
1899	ENSMUSG00000024581	Napg	scl0108123.14_161-S	turquoise
1900	ENSMUSG00000024583	Txnl1	scl0053382.2_104-S	blue
1901	ENSMUSG00000024587	Nars	scl51338.13_19-S	grey
1902	ENSMUSG00000024588	Fech	scl0002175.1_5-S	grey
1903	ENSMUSG00000024589	Nedd4l	scl0083814.1_187-S	blue
1904	ENSMUSG00000024593	Megf10	scl15160.1.1_303-S	turquoise
1905	ENSMUSG00000024597	Slc12a2	scl51913.28_530-S	green
1906	ENSMUSG00000024603	Dctn4	scl0067665.1_200-S	brown
1907	ENSMUSG00000024603	Dctn4	scl067665.1_0-S	turquoise
1908	ENSMUSG00000024608	Rps14	scl020044.5_19-S	brown
1909	ENSMUSG00000024613	Tcof1	scl0021453.2_208-S	greenyellow
1910	ENSMUSG00000024617	Camk2a	scl0002197.1_1632-S	greenyellow
1911	ENSMUSG00000024617	Camk2a	scl51891.20_359-S	blue
1912	ENSMUSG00000024621	Csf1r	scl012978.19_21-S	turquoise
1913	ENSMUSG00000024639	Gnaq	scl0014682.1_7-S	turquoise
1914	ENSMUSG00000024640	Psat1	scl52691.13_82-S	blue
1915	ENSMUSG00000024642	Tle4	scl52693.20_358-S	turquoise
1916	ENSMUSG00000024645	1700034H14Rik	scl067105.1_68-S	brown
1917	ENSMUSG00000024661	Fth1	scl014319.1_33-S	turquoise
1918	ENSMUSG00000024665	Fads2	scl0056473.2_148-S	turquoise
1919	ENSMUSG00000024665	Fads2	scl52762.14_136-S	turquoise
1920	ENSMUSG00000024667	Tmem216	scl068642.1_282-S	turquoise
1921	ENSMUSG00000024683	Mrpl16	scl53353.3_239-S	turquoise
1922	ENSMUSG00000024725	Ostf1	scl52675.8.401_6-S	turquoise
1923	ENSMUSG00000024732	Ccdc86	scl00108673.2_110-S	blue
1924	ENSMUSG00000024735	Prpf19	scl000522.1_26-S	turquoise
1925	ENSMUSG00000024736	Tmem132a	scl000043.1_1-S	brown
1926	ENSMUSG00000024736	Tmem132a	scl52742.10_14-S	brown
1927	ENSMUSG00000024740	Ddb1	scl53371.28_117-S	blue
1928	ENSMUSG00000024758	Rtn3	scl020168.1_23-S	greenyellow
1929	ENSMUSG00000024767	Otub1	scl52894.8_133-S	blue
1930	ENSMUSG00000024776	Stambpl1	scl076630.10_6-S	blue
1931	ENSMUSG00000024780	Cdc37l1	scl000422.1_41-S	turquoise
1932	ENSMUSG00000024780	Cdc37l1	scl0067072.1_237-S	blue
1933	ENSMUSG00000024780	Cdc37l1	scl067072.6_68-S	brown
1934	ENSMUSG00000024781	Lipa	scl52537.9_557-S	yellow
1935	ENSMUSG00000024782	Ak3	scl0056248.2_157-S	turquoise
1936	ENSMUSG00000024782	Ak3	scl056248.1_79-S	turquoise
1937	ENSMUSG00000024785	Rcl1	scl53234.12_152-S	turquoise
1938	ENSMUSG00000024793	Tnfrsf25	scl24658.9.1_90-S	grey
1939	ENSMUSG00000024797	1110014N23Rik	scl068505.1_329-S	blue
1940	ENSMUSG00000024800	Rpp30	scl53186.10.89_4-S	brown
1941	ENSMUSG00000024807	Syvn1	scl52860.17_315-S	blue
1942	ENSMUSG00000024810	Il33	scl53221.10_351-S	blue
1943	ENSMUSG00000024812	Tjp2	scl52642.29_318-S	magenta
1944	ENSMUSG00000024817	Uhrf2	scl000501.1_12-S	grey
1945	ENSMUSG00000024817	Uhrf2	scl00109113.1_250-S	grey
1946	ENSMUSG00000024817	Uhrf2	scl53217.16.138_16-S	red
1947	ENSMUSG00000024841	Eif1ad	scl069860.1_67-S	grey
1948	ENSMUSG00000024844	Banf1	scl000538.1_65-S	turquoise
1949	ENSMUSG00000024844	Banf1	scl0023825.1_1-S	turquoise
1950	ENSMUSG00000024847	Aip	scl53441.6.1_144-S	grey
1951	ENSMUSG00000024851	Pitpnm1	scl52806.22.1_43-S	blue
1952	ENSMUSG00000024853	Sf3b2	scl53487.20.1_122-S	blue
1953	ENSMUSG00000024855	Pacs1	scl53489.23_479-S	brown
1954	ENSMUSG00000024856	Cdk2ap2	scl52801.4.1_26-S	turquoise
1955	ENSMUSG00000024862	Klc2	scl53486.15_226-S	blue
1956	ENSMUSG00000024870	Rab1b	scl000472.1_13-S	pink
1957	ENSMUSG00000024875	Yif1a	scl000533.1_30-S	turquoise
1958	ENSMUSG00000024883	Rin1	GI_21703973-S	blue
1959	ENSMUSG00000024883	Rin1	scl0225870.1_275-S	blue
1960	ENSMUSG00000024896	Minpp1	scl017330.5_48-S	turquoise
1961	ENSMUSG00000024908	Saps3	scl0073197.1_297-S	turquoise
1962	ENSMUSG00000024908	Saps3	scl53421.25_339-S	grey
1963	ENSMUSG00000024909	Efemp2	scl52843.9.1_76-S	green
1964	ENSMUSG00000024911	Fibp	scl0058249.2_204-S	turquoise
1965	ENSMUSG00000024911	Fibp	scl52842.4.1_43-S	turquoise
1966	ENSMUSG00000024924	Vldlr	scl0022359.2_126-S	yellow
1967	ENSMUSG00000024927	Rela	scl52850.12_273-S	turquoise
1968	ENSMUSG00000024935	Slc1a1	scl0020510.2_224-S	blue
1969	ENSMUSG00000024935	Slc1a1	scl020510.12_56-S	grey
1970	ENSMUSG00000024939	Mtvr2	scl0056390.1_292-S	blue
1971	ENSMUSG00000024939	Mtvr2	scl017826.2_113-S	blue

1972	ENSMUSG00000024941	Scyl1	scl53512.15.1_29-S	blue
1973	ENSMUSG00000024944	Arl2	scl53528.4.1_29-S	turquoise
1974	ENSMUSG00000024947	Men1	scl017283.2_24-S	blue
1975	ENSMUSG00000024948	Map4k2	scl0026412.2_155-S	blue
1976	ENSMUSG00000024948	Map4k2	scl52873.29_9-S	turquoise
1977	ENSMUSG00000024949	Sf1	scl0022668.2_279-S	blue
1978	ENSMUSG00000024949	Sf1	scl000441.1_274-S	blue
1979	ENSMUSG00000024949	Sf1	scl52875.14_150-S	blue
1980	ENSMUSG00000024952	Rps6ka4	scl52914.17.1_108-S	blue
1981	ENSMUSG00000024953	Prdx5	scl000502.1_59-S	blue
1982	ENSMUSG00000024953	Prdx5	scl0054683.2_242-S	turquoise
1983	ENSMUSG00000024953	Prdx5	scl054683.1_165-S	brown
1984	ENSMUSG00000024955	Esrra	scl52911.9_189-S	black
1985	ENSMUSG00000024958	Gpr137	scl0107173.1_330-S	turquoise
1986	ENSMUSG00000024959	Bad	scl53554.5.129_30-S	green
1987	ENSMUSG00000024962	Vegfb	scl52906.7.1_110-S	black
1988	ENSMUSG00000024966	Stip1	scl52902.14.1_38-S	blue
1989	ENSMUSG00000024968	Rcor2	scl53547.13_444-S	black
1990	ENSMUSG00000024969	Mark2	scl013728.1_329-S	blue
1991	ENSMUSG00000024974	Smc3	scl013006.10_13-S	turquoise
1992	ENSMUSG00000024974	Smc3	scl013006.15_44-S	turquoise
1993	ENSMUSG00000024975	Pdcd4	scl0018569.1_4-S	turquoise
1994	ENSMUSG00000024975	Pdcd4	scl52979.12_115-S	grey
1995	ENSMUSG00000024983	Vti1a	scl0053611.1_163-S	blue
1996	ENSMUSG00000024985	Tcf4	scl0021416.1_5-S	grey
1997	ENSMUSG00000024991	Eif3a	scl0013669.1_3-S	blue
1998	ENSMUSG00000024993	1810055E12Rik	scl000543.1_10-S	blue
1999	ENSMUSG00000024993	1810055E12Rik	scl067894.9_40-S	blue
2000	ENSMUSG00000024997	Prdx3	scl52314.6.1_5-S	brown
2001	ENSMUSG00000025006	Sorbs1	scl0020411.1_138-S	turquoise
2002	ENSMUSG00000025006	Sorbs1	scl6031.1.1_4-S	turquoise
2003	ENSMUSG00000025008	Tctn3	scl0067590.2_244-S	turquoise
2004	ENSMUSG00000025025	Mxi1	scl0017859.1_306-S	turquoise
2005	ENSMUSG00000025026	Add3	scl52961.19_173-S	turquoise
2006	ENSMUSG00000025027	Xpnpep1	scl0170750.1_173-S	turquoise
2007	ENSMUSG00000025034	Trim8	scl53028.7_552-S	blue
2008	ENSMUSG00000025040	Fundc1	scl54373.7_168-S	brown
2009	ENSMUSG00000025050	Pcgf6	scl52395.11_299-S	brown
2010	ENSMUSG00000025066	6330577E15Rik	scl067788.3_30-S	turquoise
2011	ENSMUSG00000025068	Gsto1	scl53077.5.8_20-S	turquoise
2012	ENSMUSG00000025078	Nhlrc2	scl53039.13_3-S	grey
2013	ENSMUSG00000025086	Trub1	scl000536.1_550-S	grey
2014	ENSMUSG00000025086	Trub1	scl0072133.2_35-S	grey
2015	ENSMUSG00000025089	Gfra1	scl014585.2_30-S	turquoise
2016	ENSMUSG00000025092	Hspa12a	scl52332.22_483-S	blue
2017	ENSMUSG00000025104	Hdgfrp3	scl31098.6_436-S	blue
2018	ENSMUSG00000025128	Bhlhe22	scl23364.1.268_58-S	turquoise
2019	ENSMUSG00000025130	P4hb	scl39233.12_145-S	turquoise
2020	ENSMUSG00000025133	Ints4	scl32350.23.1_118-S	brown
2021	ENSMUSG00000025134	Thoc4	scl0021681.1_61-S	turquoise
2022	ENSMUSG00000025137	Pcyt2	scl0001280.1_1-S	turquoise
2023	ENSMUSG00000025137	Pcyt2	scl39229.10.14_5-S	blue
2024	ENSMUSG00000025138	Sirt7	scl0209011.1_312-S	grey
2025	ENSMUSG00000025142	Aspscr1	scl068938.13_42-S	blue
2026	ENSMUSG00000025153	Fasn	scl014104.1_1-S	turquoise
2027	ENSMUSG00000025155	Dus1l	scl0068730.1_249-S	blue
2028	ENSMUSG00000025155	Dus1l	scl068730.1_55-S	brown
2029	ENSMUSG00000025156	Gps1	scl0209318.14_24-S	turquoise
2030	ENSMUSG00000025157	Zdhhc16	scl53123.9.6_1-S	turquoise
2031	ENSMUSG00000025158	Rfng	scl0019719.2_122-S	blue
2032	ENSMUSG00000025158	Rfng	scl39221.6_560-S	blue
2033	ENSMUSG00000025162	Csnk1d	scl00104318.1_298-S	black
2034	ENSMUSG00000025162	Csnk1d	scl0104318.1_214-S	blue
2035	ENSMUSG00000025173	Wdr45l	scl066840.3_20-S	yellow
2036	ENSMUSG00000025175	Fn3k	scl40613.6.1_112-S	turquoise
2037	ENSMUSG00000025178	Pi4k2a	scl53116.10_62-S	blue
2038	ENSMUSG00000025190	Got1	scl52460.11.1_30-S	black
2039	ENSMUSG00000025192	Entpd7	scl53103.12_0-S	brown
2040	ENSMUSG00000025199	Chuk	scl52451.21_19-S	brown
2041	ENSMUSG00000025203	Scd2	scl020250.10_235-S	blue
2042	ENSMUSG00000025208	Mrpl43	scl000468.1_25-S	blue
2043	ENSMUSG00000025208	Mrpl43	scl52435.3.1_22-S	blue
2044	ENSMUSG00000025212	Sfxn3	scl094280.14_180-S	blue
2045	ENSMUSG00000025220	E330018D03Rik	scl0320319.1_19-S	yellow
2046	ENSMUSG00000025220	Mgea5	scl000506.1_4-S	yellow
2047	ENSMUSG00000025221	Kcnip2	scl52418.9.1_3-S	turquoise
2048	ENSMUSG00000025223	Ldb1	scl52415.12_0-S	blue
2049	ENSMUSG00000025226	Fbxl15	scl53022.3.1_132-S	blue
2050	ENSMUSG00000025227	Tmem180	scl53023.9_185-S	blue
2051	ENSMUSG00000025228	Actr1a	scl52406.11.1_60-S	turquoise
2052	ENSMUSG00000025235	Bbs4	scl35765.18_440-S	blue
2053	ENSMUSG00000025237	Parp6	scl0003398.1_59-S	pink
2054	ENSMUSG00000025237	Parp6	scl0003605.1_0-S	turquoise
2055	ENSMUSG00000025237	Parp6	scl36871.20.1_240-S	turquoise
2056	ENSMUSG00000025241	Fyco1	scl35165.21_648-S	turquoise
2057	ENSMUSG00000025255	Zfhx4	scl23407.11_189-S	turquoise
2058	ENSMUSG00000025260	Hsd17b10	scl54548.7.1_64-S	blue
2059	ENSMUSG00000025261	Huwe1	scl54549.37_1-S	turquoise
2060	ENSMUSG00000025264	Tsr2	scl0002919.1_16-S	turquoise
2061	ENSMUSG00000025264	Tsr2	scl53730.6_161-S	red
2062	ENSMUSG00000025266	Gnl3l	scl0237107.1_138-S	turquoise
2063	ENSMUSG00000025266	Gnl3l	scl53731.16_655-S	pink
2064	ENSMUSG00000025268	Maged2	scl53733.14.273_30-S	turquoise
2065	ENSMUSG00000025270	Alas2	scl54562.12.1_64-S	black
2066	ENSMUSG00000025272	Tro	scl53734.13.1_1-S	blue
2067	ENSMUSG00000025272	Tro	scl0056191.2_129-S	turquoise
2068	ENSMUSG00000025278	Flnb	GI_38075550-S	red
2069	ENSMUSG00000025283	Sat1	scl020229.1_41-S	brown
2070	ENSMUSG00000025289	Prdx4	scl53686.6.11_16-S	blue
2071	ENSMUSG00000025318	Jph3	scl33235.4_45-S	blue
2072	ENSMUSG00000025323	Sp4	scl3322.1.1_157-S	turquoise
2073	ENSMUSG00000025337	Sbds	scl25991.5.1_3-S	brown
2074	ENSMUSG00000025340	Rabgef1	scl27165.9_379-S	grey
2075	ENSMUSG00000025349	Bloc1s1	scl37341.3.1_8-S	brown
2076	ENSMUSG00000025350	Rdh5	scl37342.5.7_184-S	green
2077	ENSMUSG00000025369	Smarcc2	scl068094.2_112-S	blue
2078	ENSMUSG00000025372	Baiap2	scl00108100.2_211-S	blue
2079	ENSMUSG00000025372	Baiap2	scl0001533.1_63-S	blue
2080	ENSMUSG00000025374	Obfc2b	scl37365.9.1_0-S	blue
2081	ENSMUSG00000025381	Cnpy2	scl38287.7.1_16-S	blue
2082	ENSMUSG00000025384	2310003H01Rik	scl39241.9.1_75-S	blue
2083	ENSMUSG00000025393	Atp5b	scl38298.13.28_46-S	turquoise
2084	ENSMUSG00000025404	R3hdm2	scl071750.18_235-S	turquoise
2085	ENSMUSG00000025408	Ddit3	scl38324.4.1_0-S	turquoise
2086	ENSMUSG00000025417	Pip4k2c	scl37393.11_210-S	blue
2087	ENSMUSG00000025421	Hdhd2	scl0002235.1_6-S	red

2088	ENSMUSG00000025421	Hdhd2	scl51747.9.1_30-S	brown
2089	ENSMUSG00000025423	Pias2	scl0002153.1_23-S	turquoise
2090	ENSMUSG00000025423	Pias2	scl0002216.1_1-S	turquoise
2091	ENSMUSG00000025425	St8sia5	scl51743.8.1_178-S	brown
2092	ENSMUSG00000025428	Atp5a1	scl51737.13.1_28-S	turquoise
2093	ENSMUSG00000025439	Clns1a	scl0012729.2_6-S	turquoise
2094	ENSMUSG00000025451	Paip1	scl44323.5.1_4-S	grey
2095	ENSMUSG00000025465	Echs1	scl30519.4.1_41-S	turquoise
2096	ENSMUSG00000025474	Tubgcp2	scl30523.17.39_21-S	turquoise
2097	ENSMUSG00000025477	Inpp5a	scl0212111.7_156-S	turquoise
2098	ENSMUSG00000025481	1190003J15Rik	scl31909.4.1_14-S	grey
2099	ENSMUSG00000025484	Bet1l	scl30510.5_349-S	turquoise
2100	ENSMUSG00000025486	Sirt3	scl30509.9.1_6-S	turquoise
2101	ENSMUSG00000025487	Psmd13	scl31901.9_22-S	turquoise
2102	ENSMUSG00000025487	Psmd13	scl00071.1_7-S	red
2103	ENSMUSG00000025488	Cox8b	scl30508.2.1_18-S	green
2104	ENSMUSG00000025491	Ifitm1	scl068713.2_9-S	green
2105	ENSMUSG00000025491	Ifitm1	GI_40254488-S	grey
2106	ENSMUSG00000025492	Ifitm3	scl30506.2_36-S	green
2107	ENSMUSG00000025495	Ptdss2	scl027388.9_53-S	turquoise
2108	ENSMUSG00000025499	Hras1	scl0015461.2_188-S	blue
2109	ENSMUSG00000025499	Hras1	scl30498.4_24-S	brown
2110	ENSMUSG00000025503	Taldo1	GI_38090462-S	turquoise
2111	ENSMUSG00000025503	Taldo1	scl021351.9_19-S	turquoise
2112	ENSMUSG00000025505	Tmem80	scl31888.5_427-S	grey
2113	ENSMUSG00000025509	Pnpla2	scl0066853.2_236-S	turquoise
2114	ENSMUSG00000025510	Cd151	scl012476.8_4-S	green
2115	ENSMUSG00000025532	Crcp	scl012909.6_94-S	turquoise
2116	ENSMUSG00000025544	Tm9sf2	scl000394.1_10-S	turquoise
2117	ENSMUSG00000025544	Tm9sf2	scl45932.17_232-S	turquoise
2118	ENSMUSG00000025555	Farp1	scl00223254.1_50-S	turquoise
2119	ENSMUSG00000025555	Farp1	scl0223254.9_31-S	turquoise
2120	ENSMUSG00000025558	Dock9	scl0105445.1_143-S	grey
2121	ENSMUSG00000025571	Tnrc6c	scl40682.19_710-S	brown
2122	ENSMUSG00000025576	D11Bwg0517e	scl0001493.1_2-S	greenyellow
2123	ENSMUSG00000025576	D11Bwg0517e	scl052897.1_9-S	greenyellow
2124	ENSMUSG00000025579	Gaa	scl40663.20.6_89-S	blue
2125	ENSMUSG00000025580	Eif4a3	scl0192170.3_20-S	blue
2126	ENSMUSG00000025582	Nptx1	scl39254.5_649-S	blue
2127	ENSMUSG00000025583	4932417H02Rik	scl40651.35_428-S	blue
2128	ENSMUSG00000025584	Pde8a	scl32464.22.1_107-S	turquoise
2129	ENSMUSG00000025586	Cpeb1	scl012877.1_54-S	turquoise
2130	ENSMUSG00000025607	Copg2	scl29196.23.1_29-S	blue
2131	ENSMUSG00000025608	Podxl	scl29187.8_67-S	blue
2132	ENSMUSG00000025609	Mkln1	scl027418.18_28-S	blue
2133	ENSMUSG00000025613	Cct8	scl48261.13.240_30-S	blue
2134	ENSMUSG00000025626	Phf6	scl0002988.1_2158-S	brown
2135	ENSMUSG00000025630	Hprt1	gi_7305154_ref_NM_013556.1__205-S	brown
2136	ENSMUSG00000025630	Hprt1	scl0002995.1_2-S	turquoise
2137	ENSMUSG00000025630	Hprt1	scl54930.9.1_1-S	turquoise
2138	ENSMUSG00000025646	6620401K05Rik	scl0235610.2_72-S	turquoise
2139	ENSMUSG00000025647	Shisa5	scl36445.9_185-S	turquoise
2140	ENSMUSG00000025648	Pfkfb4	scl0270198.14_257-S	turquoise
2141	ENSMUSG00000025651	Uqcrc1	scl022273.17_12-S	blue
2142	ENSMUSG00000025656	Arhgef9	scl0236915.2_52-S	turquoise
2143	ENSMUSG00000025658	Cnksr2	scl53666.23.1_1-S	turquoise
2144	ENSMUSG00000025666	Tmem47	scl00192216.1_279-S	blue
2145	ENSMUSG00000025722	Wdr73	scl31119.7_170-S	turquoise
2146	ENSMUSG00000025724	Sec11a	scl056529.1_95-S	blue
2147	ENSMUSG00000025728	Pigq	GI_31981379-S	turquoise
2148	ENSMUSG00000025730	Rab40c	scl50165.9_604-S	turquoise
2149	ENSMUSG00000025731	0610011F06Rik	scl0001647.1_23-S	turquoise
2150	ENSMUSG00000025731	0610011F06Rik	scl50967.4_2-S	turquoise
2151	ENSMUSG00000025732	9530058B02Rik	scl50172.5.1_49-S	turquoise
2152	ENSMUSG00000025733	Rhot2	scl0214952.1_17-S	blue
2153	ENSMUSG00000025735	Rhbdl1	scl50168.8.1_112-S	blue
2154	ENSMUSG00000025736	Jmjd8	scl072106.9_198-S	blue
2155	ENSMUSG00000025738	Fbxl16	scl0214931.6_73-S	black
2156	ENSMUSG00000025739	Gng13	scl50974.4.1_30-S	brown
2157	ENSMUSG00000025742	Prps2	scl53577.7_510-S	turquoise
2158	ENSMUSG00000025743	Sdc3	scl24887.7_12-S	blue
2159	ENSMUSG00000025757	Hspa4l	scl0018415.2_190-S	turquoise
2160	ENSMUSG00000025777	Gdap1	scl0014545.2_19-S	brown
2161	ENSMUSG00000025781	Atp5c1	scl011949.3_3-S	brown
2162	ENSMUSG00000025782		scl19686.9_81-S	turquoise
2163	ENSMUSG00000025785	Exosc7	scl36296.9.19_70-S	brown
2164	ENSMUSG00000025788	Chd2	scl0244059.4_14-S	yellow
2165	ENSMUSG00000025790	Slco3a1	scl00108116.1_242-S	turquoise
2166	ENSMUSG00000025790	Slco3a1	scl0108116.1_30-S	turquoise
2167	ENSMUSG00000025810	Nrp1	scl0018186.1_241-S	blue
2168	ENSMUSG00000025810	Nrp1	scl018186.2_129-S	greenyellow
2169	ENSMUSG00000025813	Homer2	scl026557.1_7-S	yellow
2170	ENSMUSG00000025816	Sec61a2	scl0003193.1_7-S	red
2171	ENSMUSG00000025816	Sec61a2	scl19722.13_136-S	brown
2172	ENSMUSG00000025817	Nudt5	scl21320.10.1_37-S	brown
2173	ENSMUSG00000025821	Zfp282	scl0101095.9_35-S	blue
2174	ENSMUSG00000025823	Pdia4	scl29051.11.1_27-S	brown
2175	ENSMUSG00000025825	Iscu	scl066383.5_131-S	turquoise
2176	ENSMUSG00000025855	Prkar1b	scl25851.18_321-S	blue
2177	ENSMUSG00000025856	Pdgfa	scl0018590.2_128-S	turquoise
2178	ENSMUSG00000025858	1110007L15Rik	scl067604.1_6-S	blue
2179	ENSMUSG00000025858	1110007L15Rik	scl27066.10_346-S	blue
2180	ENSMUSG00000025862	Stag2	scl0020843.2_126-S	turquoise
2181	ENSMUSG00000025862	Stag2	scl54964.36_266-S	turquoise
2182	ENSMUSG00000025867	Cplx2	scl012890.1_4-S	yellow
2183	ENSMUSG00000025868	Higd2a	scl44752.2.1_30-S	blue
2184	ENSMUSG00000025871	4833439L19Rik	scl097820.1_227-S	brown
2185	ENSMUSG00000025885	Myo5b	scl51769.42.1_6-S	turquoise
2186	ENSMUSG00000025888	Casp1	scl37317.9.1_34-S	blue
2187	ENSMUSG00000025899	Alkbh8	scl067667.2_1-S	turquoise
2188	ENSMUSG00000025907	Rb1cc1	GI_20819699-S	yellow
2189	ENSMUSG00000025915	Sgk3	scl0170755.15_107-S	brown
2190	ENSMUSG00000025920	Stau2	scl0029819.2_92-S	turquoise
2191	ENSMUSG00000025920	Stau2	scl16973.17.1_29-S	grey
2192	ENSMUSG00000025935	Tram1	scl072265.1_70-S	turquoise
2193	ENSMUSG00000025950	Idh1	scl0015926.2_189-S	red
2194	ENSMUSG00000025959	AK150559	scl16685.5_486-S	greenyellow
2195	ENSMUSG00000025959	Klf7	scl0093691.2_69-S	greenyellow
2196	ENSMUSG00000025964	Adam23	scl023792.26_1-S	brown
2197	ENSMUSG00000025964	Adam23	scl0329173.1_142-S	grey
2198	ENSMUSG00000025967	Eef1b2	scl055949.3_17-S	turquoise
2199	ENSMUSG00000025969	Nrp2	scl068752.1_26-S	brown
2200	ENSMUSG00000025978	Rftn2	GI_38049502-S	turquoise
2201	ENSMUSG00000025978	Rftn2	scl16744.12_327-S	blue
2202	ENSMUSG00000025979	Mobkl3	scl0001004.1_0-S	red
2203	ENSMUSG00000025980	Hspd1	scl000928.1_86-S	red

2204	ENSMUSG00000025986	Slc39a10	scl0227059.2_31-S	turquoise
2205	ENSMUSG00000025993	Slc40a1	scl16803.9_203-S	grey
2206	ENSMUSG00000025995	Wdr75	GI_38074274-S	blue
2207	ENSMUSG00000026000	Lancl1	scl000779.1_49-S	turquoise
2208	ENSMUSG00000026000	Lancl1	scl16664.9_588-S	turquoise
2209	ENSMUSG00000026018	Ica1l	scl16712.12_256-S	turquoise
2210	ENSMUSG00000026020	Nop58	scl0055989.2_71-S	yellow
2211	ENSMUSG00000026021	Sumo1	scl0022218.1_0-S	blue
2212	ENSMUSG00000026021	Sumo1	scl022218.1_29-S	brown
2213	ENSMUSG00000026024	Als2	scl0074018.2_230-S	grey
2214	ENSMUSG00000026024	Als2	scl074018.1_26-S	turquoise
2215	ENSMUSG00000026027	Stradb	scl00227154.2_32-S	turquoise
2216	ENSMUSG00000026028	Trak2	scl070827.2_21-S	grey
2217	ENSMUSG00000026032	Ndufb3	scl066495.2_23-S	brown
2218	ENSMUSG00000026034	Clk1	scl16734.10.1_6-S	turquoise
2219	ENSMUSG00000026034	Clk1	scl000989.1_15-S	red
2220	ENSMUSG00000026035	Ppil3	scl16732.7.1_6-S	blue
2221	ENSMUSG00000026051	1500015O10Rik	scl18005.4.1_0-S	green
2222	ENSMUSG00000026062	Slc9a2	scl00226999.1_58-S	grey
2223	ENSMUSG00000026083	Eif5b	scl0226980.4_11-S	yellow
2224	ENSMUSG00000026087	Mrpl30	scl0107734.5_7-S	brown
2225	ENSMUSG00000026090	2010300C02Rik	scl16857.4.1_20-S	blue
2226	ENSMUSG00000026102	Inpp1	scl16776.7.1_45-S	turquoise
2227	ENSMUSG00000026116	Tmem131	scl16864.41.1_0-S	turquoise
2228	ENSMUSG00000026123	Plekhb2	scl0226971.13_54-S	turquoise
2229	ENSMUSG00000026131	Dst	scl000756.1_295-S	turquoise
2230	ENSMUSG00000026150	Mff	scl000768.1_18-S	red
2231	ENSMUSG00000026154	1110058L19Rik	scl16929.3.1_7-S	brown
2232	ENSMUSG00000026155	Smap1	scl0098366.1_13-S	turquoise
2233	ENSMUSG00000026155	Smap1	scl098366.1_53-S	turquoise
2234	ENSMUSG00000026159	Agfg1	scl17740.13_298-S	brown
2235	ENSMUSG00000026163	4930544G21Rik	scl000954.1_16-S	red
2236	ENSMUSG00000026163	Sphkap	scl16544.13_20-S	blue
2237	ENSMUSG00000026172	Bcs1l	scl17795.8.1_1-S	turquoise
2238	ENSMUSG00000026181	Ppm1f	scl49386.9_715-S	turquoise
2239	ENSMUSG00000026185	Igfbp5	scl016011.3_113-S	greenyellow
2240	ENSMUSG00000026189	Pecr	scl16633.10.1_180-S	turquoise
2241	ENSMUSG00000026193	Fn1	scl000949.1_9-S	turquoise
2242	ENSMUSG00000026197	Zfand2b	scl000926.1_1-S	turquoise
2243	ENSMUSG00000026197	Zfand2b	scl17782.7.1_158-S	turquoise
2244	ENSMUSG00000026198	Abcb6	scl074104.1_75-S	brown
2245	ENSMUSG00000026199	Ankzf1	scl0052231.1_82-S	turquoise
2246	ENSMUSG00000026199	Ankzf1	scl17781.7.1_157-S	green
2247	ENSMUSG00000026203	Dnajb10	scl056812.9_277-S	turquoise
2248	ENSMUSG00000026204	Ptprn	scl16598.23.1_93-S	blue
2249	ENSMUSG00000026219	Trip12	scl0014897.1_159-S	turquoise
2250	ENSMUSG00000026219	Trip12	scl014897.1_29-S	turquoise
2251	ENSMUSG00000026219	Trip12	scl014897.1_33-S	turquoise
2252	ENSMUSG00000026219	Trip12	scl073751.1_0-S	brown
2253	ENSMUSG00000026223	Itm2c	scl17725.6_585-S	blue
2254	ENSMUSG00000026229	Psmd1	scl000819.1_3-S	yellow
2255	ENSMUSG00000026229	Psmd1	scl070247.20_34-S	yellow
2256	ENSMUSG00000026235	Epha4	scl0013838.1_175-S	turquoise
2257	ENSMUSG00000026239	Pde6d	scl000766.1_20-S	turquoise
2258	ENSMUSG00000026239	Pde6d	scl16516.6.1_29-S	turquoise
2259	ENSMUSG00000026240	Cops7b	scl0026895.1_34-S	turquoise
2260	ENSMUSG00000026245	Farsb	scl16583.17.10_2-S	brown
2261	ENSMUSG00000026248	Mrpl44	scl17758.3.1_30-S	turquoise
2262	ENSMUSG00000026249	Serpine2	scl16572.10_105-S	blue
2263	ENSMUSG00000026255	Efhd1	scl0098363.2_64-S	magenta
2264	ENSMUSG00000026259	Ngef	scl16508.16.1_213-S	purple
2265	ENSMUSG00000026260	Ndufa10	scl0067273.2_276-S	turquoise
2266	ENSMUSG00000026269	Rnpepl1	scl0108657.5_28-S	blue
2267	ENSMUSG00000026273	Mterfd2	scl0069821.2_297-S	brown
2268	ENSMUSG00000026277	Stk25	scl000828.1_34-S	grey
2269	ENSMUSG00000026277	Stk25	scl16459.13.6_3-S	turquoise
2270	ENSMUSG00000026278	Bok	scl051800.6_308-S	turquoise
2271	ENSMUSG00000026281	Dtymk	scl0021915.2_168-S	turquoise
2272	ENSMUSG00000026281	Dtymk	scl16457.5.1_7-S	brown
2273	ENSMUSG00000026305	Lrrfip1	scl17660.30_146-S	turquoise
2274	ENSMUSG00000026309	Ilkap	scl0067444.2_48-S	turquoise
2275	ENSMUSG00000026311	Asb1	scl17645.6_17-S	grey
2276	ENSMUSG00000026313	Hdac4	scl16472.29.1_1-S	turquoise
2277	ENSMUSG00000026319	2310035C23Rik	scl000817.1_13-S	red
2278	ENSMUSG00000026343	Gpr39	scl17541.2.1_103-S	grey
2279	ENSMUSG00000026344	Lypd1	scl16356.5_24-S	grey
2280	ENSMUSG00000026354	Lct	GI_38073302-S	blue
2281	ENSMUSG00000026355	Mcm6	scl000980.1_16-S	grey
2282	ENSMUSG00000026356	Dars	scl16334.7.1_2-S	brown
2283	ENSMUSG00000026374	Tsn	scl000794.1_5-S	turquoise
2284	ENSMUSG00000026377	Mki67ip	scl0067949.2_13-S	blue
2285	ENSMUSG00000026385	Dbi	scl16375.7_22-S	brown
2286	ENSMUSG00000026388	3110009E18Rik	scl17557.9.1_60-S	grey
2287	ENSMUSG00000026409	Pfkfb2	scl0018640.2_76-S	brown
2288	ENSMUSG00000026411	Tmem9	scl17430.7_3-S	turquoise
2289	ENSMUSG00000026424	Gpr37l1	scl16261.2_128-S	red
2290	ENSMUSG00000026426	Arl8a	scl17443.8_550-S	turquoise
2291	ENSMUSG00000026443	Lrrn2	scl17473.2_640-S	turquoise
2292	ENSMUSG00000026456	Cyb5r1	scl17454.7_371-S	brown
2293	ENSMUSG00000026457	Adipor1	scl17453.8_267-S	blue
2294	ENSMUSG00000026470	Stx6	scl058244.8_59-S	turquoise
2295	ENSMUSG00000026473	Glul	scl17355.9_0-S	turquoise
2296	ENSMUSG00000026475	Rgs16	scl17359.5_60-S	turquoise
2297	ENSMUSG00000026491	Ahctf1	scl00226747.2_221-S	blue
2298	ENSMUSG00000026496	Parp1	scl011545.25_15-S	blue
2299	ENSMUSG00000026496	Parp1	scl17140.18.1_11-S	turquoise
2300	ENSMUSG00000026499	Acbd3	scl17135.9_190-S	turquoise
2301	ENSMUSG00000026500	2310005N03Rik	scl066359.2_17-S	turquoise
2302	ENSMUSG00000026509	Capn2	scl0012334.2_163-S	blue
2303	ENSMUSG00000026509	Capn2	scl012334.3_9-S	grey
2304	ENSMUSG00000026509	Capn2	scl15816.17.1_28-S	grey
2305	ENSMUSG00000026514	Cnih3	scl17124.6.1_14-S	turquoise
2306	ENSMUSG00000026526	Fh1	scl15890.11.1_28-S	turquoise
2307	ENSMUSG00000026527	Rgs7	scl15892.18.1_65-S	turquoise
2308	ENSMUSG00000026546	Ccdc19	scl17200.12.1_115-S	green
2309	ENSMUSG00000026553	Copa	scl012847.15_153-S	turquoise
2310	ENSMUSG00000026554	Wdr42a	scl098193.14_109-S	turquoise
2311	ENSMUSG00000026563	Tada1l	scl17258.8_12-S	brown
2312	ENSMUSG00000026568	Brp44	scl0070456.1_86-S	turquoise
2313	ENSMUSG00000026568	Brp44	scl070456.4_0-S	turquoise
2314	ENSMUSG00000026571	Iqwd1	scl16006.18.3_31-S	grey
2315	ENSMUSG00000026576	Atp1b1	scl0011931.2_36-S	blue
2316	ENSMUSG00000026578	4930455F23Rik	scl17282.7.92_117-S	brown
2317	ENSMUSG00000026584	Scyl3	scl17290.14_518-S	turquoise
2318	ENSMUSG00000026585	Kifap3	scl016579.20_85-S	turquoise
2319	ENSMUSG00000026585	Kifap3	scl17291.19.1_9-S	turquoise

2320	ENSMUSG00000026600	Soat1	scl16099.14_15-S	turquoise
2321	ENSMUSG00000026603	Smyd2	scl15773.8_26-S	turquoise
2322	ENSMUSG00000026608	Kctd3	scl15779.17_93-S	turquoise
2323	ENSMUSG00000026617	Bpnt1	scl17096.10_189-S	turquoise
2324	ENSMUSG00000026620	Mark1	scl00226778.2_143-S	turquoise
2325	ENSMUSG00000026623	Lpgat1	scl17047.9.4_6-S	turquoise
2326	ENSMUSG00000026623	Lpgat1	scl17048.2_461-S	purple
2327	ENSMUSG00000026634	Angel2	scl0052477.2_74-S	turquoise
2328	ENSMUSG00000026634	Angel2	scl17063.15_85-S	turquoise
2329	ENSMUSG00000026640	Plxna2	scl0018845.2_170-S	blue
2330	ENSMUSG00000026649	1700009P17Rik	scl17236.9.1_1-S	green
2331	ENSMUSG00000026650	Meig1	scl19749.5.1_9-S	turquoise
2332	ENSMUSG00000026657	Frmd4a	scl00209630.2_217-S	grey
2333	ENSMUSG00000026668	Ucma	scl21323.5.1_279-S	turquoise
2334	ENSMUSG00000026688	Mgst3	scl066447.2_3-S	blue
2335	ENSMUSG00000026696	Vamp4	scl17296.11_403-S	grey
2336	ENSMUSG00000026696	Vamp4	scl000897.1_256-S	blue
2337	ENSMUSG00000026701	Prdx6	scl011758.1_35-S	turquoise
2338	ENSMUSG00000026709	Dars2	scl00226539.2_30-S	grey
2339	ENSMUSG00000026718	Stam	scl21273.14_161-S	turquoise
2340	ENSMUSG00000026721	Rabgap1l	scl0029809.2_171-S	turquoise
2341	ENSMUSG00000026727	Rsu1	scl19667.9.1_67-S	turquoise
2342	ENSMUSG00000026739	Bmi1	scl21247.13_325-S	blue
2343	ENSMUSG00000026739	Bmi1	scl0012151.1_305-S	red
2344	ENSMUSG00000026750	Psmb7	GI_6755205-S	brown
2345	ENSMUSG00000026750	Psmb7	scl19361.2.11_20-S	brown
2346	ENSMUSG00000026750	Psmb7	scl0003171.1_33-S	brown
2347	ENSMUSG00000026753	Ppp6c	scl0067857.2_151-S	blue
2348	ENSMUSG00000026754	Golga1	scl19346.22_0-S	brown
2349	ENSMUSG00000026755	Arpc5l	scl20983.4_177-S	turquoise
2350	ENSMUSG00000026761	Orc4l	scl0026428.1_235-S	turquoise
2351	ENSMUSG00000026764	Kif5c	scl20943.27_672-S	grey
2352	ENSMUSG00000026766	Mmadhc	scl19300.3.1_12-S	turquoise
2353	ENSMUSG00000026767	2310047O13Rik	scl0003100.1_18-S	turquoise
2354	ENSMUSG00000026773	Pfkfb3	scl0003111.1_1260-S	black
2355	ENSMUSG00000026773	Pfkfb3	scl0170768.1_23-S	blue
2356	ENSMUSG00000026775	Yme1l1	scl21209.20_282-S	turquoise
2357	ENSMUSG00000026787	Gad2	scl21216.1.1627_35-S	grey
2358	ENSMUSG00000026790	Odf2	scl0003358.1_23-S	turquoise
2359	ENSMUSG00000026790	Odf2	scl21107.24.1_32-S	turquoise
2360	ENSMUSG00000026796	Fam129b	scl21049.17_300-S	green
2361	ENSMUSG00000026797	Stxbp1	scl0003201.1_62-S	blue
2362	ENSMUSG00000026797	Stxbp1	scl020910.1_1-S	blue
2363	ENSMUSG00000026799	Med27	scl21115.10.785_126-S	turquoise
2364	ENSMUSG00000026807	1190002A17Rik	scl21125.15.1_85-S	green
2365	ENSMUSG00000026810	Dpm2	scl013481.4_295-S	turquoise
2366	ENSMUSG00000026812	Tsc1	scl21124.22_5-S	turquoise
2367	ENSMUSG00000026817	Ak1	scl0011636.2_17-S	blue
2368	ENSMUSG00000026819	Slc25a25	scl0227731.1_83-S	grey
2369	ENSMUSG00000026825	Dnm1	scl013429.1_38-S	blue
2370	ENSMUSG00000026825	mKIAA4093	scl0003104.1_69-S	blue
2371	ENSMUSG00000026826	Nr4a2	scl0018227.2_224-S	turquoise
2372	ENSMUSG00000026826	S53744	scl018227.1_24-S	turquoise
2373	ENSMUSG00000026827	AK152097	scl0014571.1_161-S	yellow
2374	ENSMUSG00000026827	AK152097	scl014571.1_22-S	turquoise
2375	ENSMUSG00000026833	Olfm1	scl0003319.1_0-S	turquoise
2376	ENSMUSG00000026833	Olfm1	scl0003387.1_1121-S	blue
2377	ENSMUSG00000026836	Acvr1	scl0011477.2_228-S	brown
2378	ENSMUSG00000026837	Col5a1	scl0012831.1_231-S	purple
2379	ENSMUSG00000026841	Fibcd1	scl098970.1_324-S	blue
2380	ENSMUSG00000026843	Fubp3	scl0320267.1_220-S	blue
2381	ENSMUSG00000026849	Tor1a	scl0003308.1_58-S	turquoise
2382	ENSMUSG00000026849	Tor1a	scl030931.1_245-S	turquoise
2383	ENSMUSG00000026853	Crat	scl0012908.2_4-S	turquoise
2384	ENSMUSG00000026854	Usp20	scl074270.26_30-S	blue
2385	ENSMUSG00000026858	Fam73b	scl21090.15_384-S	blue
2386	ENSMUSG00000026860	Sh3glb2	scl19472.10_43-S	blue
2387	ENSMUSG00000026864	Hspa5	scl014828.8_22-S	turquoise
2388	ENSMUSG00000026867	Gapvd1	scl0066691.1_167-S	turquoise
2389	ENSMUSG00000026872	Zeb2	scl024136.1_28-S	yellow
2390	ENSMUSG00000026878	Rab14	scl068365.1_71-S	blue
2391	ENSMUSG00000026888	Grb14	scl0003079.1_4-S	turquoise
2392	ENSMUSG00000026889	Rbm18	scl19388.5_90-S	brown
2393	ENSMUSG00000026895	Ndufa8	scl19390.3.3_3-S	turquoise
2394	ENSMUSG00000026914	Psmd14	scl20874.15.4_12-S	turquoise
2395	ENSMUSG00000026918	Brd3	scl0067382.2_271-S	blue
2396	ENSMUSG00000026923	Notch1	scl19523.39_64-S	turquoise
2397	ENSMUSG00000026924	Sec16a	scl0227648.1_142-S	blue
2398	ENSMUSG00000026926	Pmpca	scl0066865.1_100-S	turquoise
2399	ENSMUSG00000026927	Sdccag3	scl0003146.1_50-S	yellow
2400	ENSMUSG00000026927	Sdccag3	scl19527.7_3-S	turquoise
2401	ENSMUSG00000026930	Gpsm1	scl21156.17_438-S	blue
2402	ENSMUSG00000026933	Camsap1	scl0227634.1_319-S	turquoise
2403	ENSMUSG00000026939	Tmem141	scl19549.5.1_109-S	brown
2404	ENSMUSG00000026944	Abca2	scl21177.47.1_118-S	blue
2405	ENSMUSG00000026956	Uap1l1	scl0227620.1_20-S	grey
2406	ENSMUSG00000026958	Dpp7	scl19566.6.1_18-S	turquoise
2407	ENSMUSG00000026965	Anapc2	scl21185.13.1_16-S	brown
2408	ENSMUSG00000026991	Pkp4	scl20894.20.1_21-S	yellow
2409	ENSMUSG00000026991	Pkp4	scl0003078.1_29-S	turquoise
2410	ENSMUSG00000026999	Nup35	scl0003092.1_40-S	blue
2411	ENSMUSG00000027001	Dusp19	scl068082.4_12-S	turquoise
2412	ENSMUSG00000027007	Ssfa2	scl20716.18_43-S	green
2413	ENSMUSG00000027011	Ube2e3	scl0022193.2_31-S	red
2414	ENSMUSG00000027012	Dync1i2	scl20807.21.1_18-S	turquoise
2415	ENSMUSG00000027018	Hat1	scl20804.11.1_101-S	blue
2416	ENSMUSG00000027030	Stk39	scl19176.21_114-S	green
2417	ENSMUSG00000027067	Ssrp1	scl20682.16.1_20-S	turquoise
2418	ENSMUSG00000027076	Timm10	scl20689.4.1_4-S	blue
2419	ENSMUSG00000027088	Phospho2	scl073373.8_41-S	blue
2420	ENSMUSG00000027091	Zc3h15	scl069082.11_146-S	turquoise
2421	ENSMUSG00000027131	Tmem85	scl18868.1.64_1-S	turquoise
2422	ENSMUSG00000027133	Nop10	scl20479.1.60_10-S	blue
2423	ENSMUSG00000027164	Traf6	scl0022034.1_201-S	turquoise
2424	ENSMUSG00000027168	AK047243	scl0003318.1_26-S	grey
2425	ENSMUSG00000027176	Cstf3	scl00228410.1_260-S	turquoise
2426	ENSMUSG00000027176	Cstf3	scl0228410.3_8-S	brown
2427	ENSMUSG00000027180	Fbxo3	GI_46877053-I	turquoise
2428	ENSMUSG00000027180	Fbxo3	scl0003006.1_310-S	red
2429	ENSMUSG00000027184	Caprin1	scl0003202.1_259-S	red
2430	ENSMUSG00000027184	Caprin1	scl0053872.2_123-S	turquoise
2431	ENSMUSG00000027188	Pamr1	scl20561.14_317-S	purple
2432	ENSMUSG00000027189	Trim44	scl18950.6_2-S	grey
2433	ENSMUSG00000027195	Hsd17b12	scl056348.1_132-S	turquoise
2434	ENSMUSG00000027200	Sema6d	scl0003180.1_1442-S	turquoise
2435	ENSMUSG00000027201	Myef2	scl0017876.1_262-S	blue

2436	ENSMUSG00000027210	Mrg1	scl0003294.1_25-S	grey
2437	ENSMUSG00000027210	Mrg1	scl18838.17_213-S	turquoise
2438	ENSMUSG00000027215	Cd82	scl012521.1_26-S	green
2439	ENSMUSG00000027220	Syt13	scl20599.6_229-S	brown
2440	ENSMUSG00000027221	Chst1	scl076969.2_187-S	brown
2441	ENSMUSG00000027223	Mapk8ip1	scl18987.13.1_0-S	grey
2442	ENSMUSG00000027227	Sord	scl20365.10_131-S	grey
2443	ENSMUSG00000027236	Eif3j	scl0078655.1_180-S	turquoise
2444	ENSMUSG00000027244	D2Ertd391e	scl0051897.1_90-S	blue
2445	ENSMUSG00000027245	2310003F16Rik	scl20381.3.1_57-S	blue
2446	ENSMUSG00000027248	Pdia3	scl20384.11.8_5-S	blue
2447	ENSMUSG00000027253	AK142445	scl20633.35.1_246-S	grey
2448	ENSMUSG00000027254	Mtap1a	scl0017754.1_4-S	black
2449	ENSMUSG00000027255	Arfgap2	scl077038.16_27-S	turquoise
2450	ENSMUSG00000027257	Pacsin3	scl0080708.1_141-S	grey
2451	ENSMUSG00000027259	Adal	scl20389.12_2-S	blue
2452	ENSMUSG00000027270	6330527O06Rik	scl20236.5.1_61-S	grey
2453	ENSMUSG00000027273	Snap25	scl20231.9_372-S	grey
2454	ENSMUSG00000027274	Mkks	scl0003351.1_17-S	brown
2455	ENSMUSG00000027284	Ttbk2	scl18775.2.48_53-S	turquoise
2456	ENSMUSG00000027286	Lrrc57	scl18778.5_150-S	turquoise
2457	ENSMUSG00000027287	Snap23	scl0003245.1_6-S	blue
2458	ENSMUSG00000027288	Zfp106	scl0022647.1_28-S	brown
2459	ENSMUSG00000027296	Itpka	scl20413.8.1_90-S	black
2460	ENSMUSG00000027297	Ltk	scl18799.18.1_164-S	grey
2461	ENSMUSG00000027298	Tyro3	scl0022174.2_41-S	turquoise
2462	ENSMUSG00000027298	Tyro3	scl20412.23_326-S	blue
2463	ENSMUSG00000027305	Ndufaf1	scl18802.5.1_208-S	turquoise
2464	ENSMUSG00000027309	4930402H24Rik	scl00228602.2_5-S	grey
2465	ENSMUSG00000027312	Atrn	scl20271.27_70-S	turquoise
2466	ENSMUSG00000027313	Chac1	scl20421.3_574-S	blue
2467	ENSMUSG00000027316	Gfra4	scl014588.3_20-S	blue
2468	ENSMUSG00000027327	1700037H04Rik	scl0067326.2_320-S	purple
2469	ENSMUSG00000027329	Spef1	scl18646.8.1_26-S	grey
2470	ENSMUSG00000027332	Ivd	scl0056357.2_122-S	turquoise
2471	ENSMUSG00000027333	Smox	scl0228608.7_126-S	turquoise
2472	ENSMUSG00000027339	Rassf2	scl18632.11_218-S	turquoise
2473	ENSMUSG00000027340	Slc23a2	scl18631.16_116-S	turquoise
2474	ENSMUSG00000027341	BC080755	scl070612.1_126-S	turquoise
2475	ENSMUSG00000027342	Pcna	scl018538.1_192-S	turquoise
2476	ENSMUSG00000027346	Prei4	scl0003095.1_34-S	pink
2477	ENSMUSG00000027346	Prei4	scl0074182.2_93-S	brown
2478	ENSMUSG00000027346	Prei4	scl0003168.1_6-S	pink
2479	ENSMUSG00000027346	Prei4	scl18620.21_88-S	blue
2480	ENSMUSG00000027347	Rasgrp1	scl0019419.1_154-S	grey
2481	ENSMUSG00000027347	Rasgrp1	scl019419.1_0-S	red
2482	ENSMUSG00000027350	Chgb	scl20253.5_8-S	blue
2483	ENSMUSG00000027357	Crls1	scl0003132.1_48-S	turquoise
2484	ENSMUSG00000027357	Crls1	scl0066586.2_90-S	turquoise
2485	ENSMUSG00000027357	Crls1	scl20251.8_441-S	blue
2486	ENSMUSG00000027359	Slc27a2	scl20335.12.1_10-S	grey
2487	ENSMUSG00000027363	Usp8	scl20333.19.1_3-S	brown
2488	ENSMUSG00000027366	2010106G01Rik	scl0066552.1_146-S	blue
2489	ENSMUSG00000027371	Fahd2a	scl0003028.1_68-S	turquoise
2490	ENSMUSG00000027371	Fahd2a	scl18705.7.9_1-S	turquoise
2491	ENSMUSG00000027374	Mrps5	scl0077721.2_286-S	brown
2492	ENSMUSG00000027375	Mal	scl18702.4_379-S	turquoise
2493	ENSMUSG00000027378	Nphp1	scl0003144.1_0-S	turquoise
2494	ENSMUSG00000027384	2310003L22Rik	scl0003363.1_1-S	brown
2495	ENSMUSG00000027397	Slc20a1	scl20301.11_1-S	turquoise
2496	ENSMUSG00000027400	Pdyn	scl18671.5_48-S	grey
2497	ENSMUSG00000027404	Snrpb	scl0003098.1_1-S	blue
2498	ENSMUSG00000027404	Snrpb	scl020638.2_15-S	blue
2499	ENSMUSG00000027405	Nop56	scl067134.7_2-S	red
2500	ENSMUSG00000027411	Vps16	scl0003209.1_38-S	turquoise
2501	ENSMUSG00000027411	Vps16	scl20282.17.126_1-S	turquoise
2502	ENSMUSG00000027419	Pcsk2	scl018549.12_191-S	turquoise
2503	ENSMUSG00000027419	Pcsk2	scl20208.12.1_29-S	turquoise
2504	ENSMUSG00000027422	Rrbp1	scl18579.23.1_24-S	black
2505	ENSMUSG00000027423	Snx5	scl069178.1_5-S	turquoise
2506	ENSMUSG00000027425	Csrp2bp	scl0228714.3_276-S	blue
2507	ENSMUSG00000027439	Gzf1	scl20159.6_23-S	brown
2508	ENSMUSG00000027447	Cst3	scl013010.2_9-S	blue
2509	ENSMUSG00000027452	Acss1	scl068738.1_270-S	green
2510	ENSMUSG00000027455	Nsfl1c	scl0386649.7_4-S	blue
2511	ENSMUSG00000027457	Snph	scl18511.7_584-S	blue
2512	ENSMUSG00000027465	AK204443	scl20126.8_30-S	turquoise
2513	ENSMUSG00000027465	Tbc1d20	scl0067231.2_265-S	turquoise
2514	ENSMUSG00000027466	Rbck1	scl18502.11.410_28-S	turquoise
2515	ENSMUSG00000027487	Cdk5rap1	scl0003190.1_15-S	grey
2516	ENSMUSG00000027487	Cdk5rap1	scl0003256.1_3-S	black
2517	ENSMUSG00000027487	Cdk5rap1	scl18476.16.14_21-S	grey
2518	ENSMUSG00000027498	Cstf1	scl067337.2_19-S	grey
2519	ENSMUSG00000027499	Pkia	scl23405.6_408-S	blue
2520	ENSMUSG00000027500	Stmn2	scl23400.7_310-S	red
2521	ENSMUSG00000027520	Zdbf2	scl17872.1_157-S	grey
2522	ENSMUSG00000027523	Gnas	scl0003116.1_14-S	blue
2523	ENSMUSG00000027523	Gnas	scl014683.1_3-S	blue
2524	ENSMUSG00000027531	Impa1	scl055980.1_58-S	turquoise
2525	ENSMUSG00000027540	Ptpn1	scl0019246.2_230-S	turquoise
2526	ENSMUSG00000027546	Atp9a	scl011981.2_30-S	black
2527	ENSMUSG00000027546	Atp9a	scl18294.24.1_12-S	blue
2528	ENSMUSG00000027562	Car2	scl0001995.1_3-S	magenta
2529	ENSMUSG00000027566	Psma7	scl18232.3.7_30-S	brown
2530	ENSMUSG00000027568	Ntsr1	scl19787.4.1_256-S	purple
2531	ENSMUSG00000027573	2310003C23Rik	scl19783.6_7-S	turquoise
2532	ENSMUSG00000027575	Arfgap1	scl19777.13_152-S	brown
2533	ENSMUSG00000027577	Chrna4	scl0011438.1_248-S	grey
2534	ENSMUSG00000027581	Stmn3	scl020262.2_8-S	turquoise
2535	ENSMUSG00000027582	Lime1	scl072699.4_22-S	grey
2536	ENSMUSG00000027589	Pcmtd2	scl0245867.4_1-S	turquoise
2537	ENSMUSG00000027593	Raly	scl019383.10_130-S	turquoise
2538	ENSMUSG00000027598	Itch	scl0016396.1_119-S	turquoise
2539	ENSMUSG00000027602	Map1lc3a	scl0003102.1_1-S	blue
2540	ENSMUSG00000027602	Map1lc3a	scl20056.4.1_63-S	blue
2541	ENSMUSG00000027603	Ggt7	scl18460.16.1_0-S	blue
2542	ENSMUSG00000027605	Acss2	scl060525.18_152-S	grey
2543	ENSMUSG00000027612	Mmp24	scl20046.9_689-S	blue
2544	ENSMUSG00000027613	Eif6	scl016418.1_114-S	black
2545	ENSMUSG00000027615	Hps3	scl22353.18_6-S	brown
2546	ENSMUSG00000027620	Rbm39	scl0170791.2_95-S	yellow
2547	ENSMUSG00000027624	Epb4.1l1	scl0003233.1_11-S	grey
2548	ENSMUSG00000027624	Epb4.1l1	scl20027.27_426-S	blue
2549	ENSMUSG00000027637	1110008F13Rik	scl20017.4.1_0-S	turquoise
2550	ENSMUSG00000027646	Src	scl20012.17_28-S	turquoise
2551	ENSMUSG00000027649	Ctnnbl1	scl20009.15.26_12-S	blue

2552	ENSMUSG00000027660	Skil	scl23302.1.414_13-S	turquoise
2553	ENSMUSG00000027663	Zmat3	scl022401.2_30-S	brown
2554	ENSMUSG00000027667	Zfp639	scl23294.9_553-S	brown
2555	ENSMUSG00000027668	Mfn1	scl067414.12_0-S	turquoise
2556	ENSMUSG00000027669	Gnb4	scl014696.1_75-S	blue
2557	ENSMUSG00000027671	Actl6a	scl056456.15_85-S	turquoise
2558	ENSMUSG00000027673	Ndufb5	scl066046.6_22-S	turquoise
2559	ENSMUSG00000027674	Pex2	scl22265.18.1_20-S	turquoise
2560	ENSMUSG00000027677	Ttc14	scl0067120.1_59-S	grey
2561	ENSMUSG00000027680	Fxr1	scl0001994.1_3-S	turquoise
2562	ENSMUSG00000027692	BC050868	GI_38077769-S	black
2563	ENSMUSG00000027708	Dcun1d1	scl0114893.1_279-S	turquoise
2564	ENSMUSG00000027709	Mccc1	scl22246.19.1_4-S	turquoise
2565	ENSMUSG00000027710	Acad9	scl0229211.16_4-S	grey
2566	ENSMUSG00000027712	Anxa5	scl011747.1_83-S	brown
2567	ENSMUSG00000027739	Rab33b	GI_8394132-S	blue
2568	ENSMUSG00000027739	Rab33b	scl23219.3_221-S	turquoise
2569	ENSMUSG00000027742	Cog6	scl22167.22_124-S	brown
2570	ENSMUSG00000027752	Exosc8	scl22158.8.1_12-S	turquoise
2571	ENSMUSG00000027763	Mbnl1	scl23145.17_313-S	blue
2572	ENSMUSG00000027770	Dhx36	scl22110.22.1_30-S	blue
2573	ENSMUSG00000027777	Schip1	scl23105.14.1_23-S	blue
2574	ENSMUSG00000027784	AK031097	scl23093.1.1_122-S	blue
2575	ENSMUSG00000027784	Ppm1l	scl00242083.1_302-S	yellow
2576	ENSMUSG00000027784	Ppm1l	scl0242083.4_30-S	greenyellow
2577	ENSMUSG00000027787	Nmd3	scl0097112.2_117-S	turquoise
2578	ENSMUSG00000027797	Dclk1	scl0002012.1_0-S	grey
2579	ENSMUSG00000027799	Nbea	GI_38076499-S	blue
2580	ENSMUSG00000027799	Nbea	scl026422.1_17-S	turquoise
2581	ENSMUSG00000027803	Wwtr1	scl22141.1.362_235-S	turquoise
2582	ENSMUSG00000027804	Ppid	scl067738.10_4-S	blue
2583	ENSMUSG00000027805	Pfn2	scl0001986.1_111-S	turquoise
2584	ENSMUSG00000027805	Pfn2	scl22134.5_174-S	turquoise
2585	ENSMUSG00000027806	Tsc22d2	scl23169.3_170-S	grey
2586	ENSMUSG00000027806	Tsc22d2	scl12701.1.1_249-S	blue
2587	ENSMUSG00000027809	Etfdh	scl22042.11.1_29-S	blue
2588	ENSMUSG00000027810	Eif2a	scl0002016.1_29-S	brown
2589	ENSMUSG00000027810	Eif2a	scl23164.14.1_82-S	blue
2590	ENSMUSG00000027827	Kcnab1	scl0001952.1_548-S	pink
2591	ENSMUSG00000027827	Kcnab1	scl23131.18_205-S	grey
2592	ENSMUSG00000027828	Ssr3	scl067437.2_28-S	turquoise
2593	ENSMUSG00000027829	Ccnl1	scl22093.9.1_2-S	turquoise
2594	ENSMUSG00000027848	Olfml3	scl21737.4_335-S	blue
2595	ENSMUSG00000027858	Tspan2	scl0070747.2_23-S	blue
2596	ENSMUSG00000027858	Tspan2	scl22799.9_397-S	magenta
2597	ENSMUSG00000027889	Ampd2	scl21659.17_152-S	blue
2598	ENSMUSG00000027893	Ahcyl1	scl00229709.2_323-S	red
2599	ENSMUSG00000027894	Slc6a17	scl21678.15_29-S	blue
2600	ENSMUSG00000027895	Kcnc4	scl0002079.1_8-S	turquoise
2601	ENSMUSG00000027895	Kcnc4	scl21680.4_681-S	purple
2602	ENSMUSG00000027900	Tmem77	scl0067171.2_285-S	turquoise
2603	ENSMUSG00000027905	Ddx20	scl21707.11_464-S	blue
2604	ENSMUSG00000027932	Slc27a3	scl21918.10.1_222-S	blue
2605	ENSMUSG00000027933	Ints3	scl0229543.1_170-S	blue
2606	ENSMUSG00000027940	Tpm3	scl0002124.1_39-S	pink
2607	ENSMUSG00000027942	4933434E20Rik	scl0001999.1_48-S	blue
2608	ENSMUSG00000027942	4933434E20Rik	scl0099650.1_60-S	turquoise
2609	ENSMUSG00000027942	4933434E20Rik	scl099650.7_29-S	blue
2610	ENSMUSG00000027950	Chrnb2	scl0011444.1_149-S	brown
2611	ENSMUSG00000027951	Adar	scl22966.17.916_66-S	brown
2612	ENSMUSG00000027953	Rag1ap1	scl21948.4.1_81-S	turquoise
2613	ENSMUSG00000027962	Vcam1	scl0022329.2_144-S	green
2614	ENSMUSG00000027963	Extl2	scl22694.6_358-S	brown
2615	ENSMUSG00000027963	Extl2	GI_38076997-S	pink
2616	ENSMUSG00000027965	Olfm3	scl22700.8.1_2-S	turquoise
2617	ENSMUSG00000027978	Prss12	scl22657.12.1_29-S	blue
2618	ENSMUSG00000028005	Gucy1b3	scl22027.14_14-S	blue
2619	ENSMUSG00000028007	Snx7	scl21598.9.1_53-S	turquoise
2620	ENSMUSG00000028020	Glrb	scl0002020.1_150-S	red
2621	ENSMUSG00000028020	Glrb	scl22031.10.1_29-S	turquoise
2622	ENSMUSG00000028029	Scye1	scl013722.3_29-S	brown
2623	ENSMUSG00000028035	Dnajb4	scl0002109.1_724-S	turquoise
2624	ENSMUSG00000028041	Adam15	scl21941.24.1_72-S	blue
2625	ENSMUSG00000028048	Gba	scl22981.10.34_21-S	turquoise
2626	ENSMUSG00000028053	Ash1l	GI_20872872-S	pink
2627	ENSMUSG00000028053	Ash1l	scl00192195.1_183-S	turquoise
2628	ENSMUSG00000028057	Rit1	scl0019769.2_219-S	grey
2629	ENSMUSG00000028059	Arhgef2	scl016800.23_0-S	turquoise
2630	ENSMUSG00000028062	Robld3	scl21970.4.1_6-S	turquoise
2631	ENSMUSG00000028063	Lmna	scl0001934.1_38-S	blue
2632	ENSMUSG00000028063	Lmna	scl016905.3_15-S	blue
2633	ENSMUSG00000028063	Lmna	scl21973.8_21-S	blue
2634	ENSMUSG00000028064	Sema4a	scl21972.20_222-S	turquoise
2635	ENSMUSG00000028069	Gpatch4	scl23010.9_157-S	blue
2636	ENSMUSG00000028070	Apoa1bp	scl21986.3.1_30-S	turquoise
2637	ENSMUSG00000028078	Dclk2	scl21998.21_151-S	blue
2638	ENSMUSG00000028080	Lrba	scl23030.63_179-S	turquoise
2639	ENSMUSG00000028082	Sh3d19	scl0027059.2_196-S	green
2640	ENSMUSG00000028086	Fbxw7	scl050754.10_4-S	blue
2641	ENSMUSG00000028089	Chd1l	scl068058.2_29-S	grey
2642	ENSMUSG00000028101	Pias3	scl0002099.1_352-S	black
2643	ENSMUSG00000028101	Pias3	scl22851.14_43-S	turquoise
2644	ENSMUSG00000028124	Gclm	scl014630.7_323-S	black
2645	ENSMUSG00000028126	Pip5k1a	scl0002013.1_8-S	turquoise
2646	ENSMUSG00000028126	Pip5k1a	scl0018720.2_261-S	greenyellow
2647	ENSMUSG00000028126	Pip5k1a	scl21850.17_155-S	turquoise
2648	ENSMUSG00000028127	Abcd3	scl21582.24_10-S	turquoise
2649	ENSMUSG00000028128	F3	scl22672.6.1_17-S	turquoise
2650	ENSMUSG00000028132	Tmem56	scl21590.13_517-S	blue
2651	ENSMUSG00000028136	Snx27	scl21863.12_12-S	turquoise
2652	ENSMUSG00000028139	Ncrna00166	scl21867.7.1_21-S	brown
2653	ENSMUSG00000028140	Mrpl9	GI_29789252-S	turquoise
2654	ENSMUSG00000028140	Mrpl9	scl22902.7.1_30-S	turquoise
2655	ENSMUSG00000028149	Rap1gds1	scl0229877.2_148-S	brown
2656	ENSMUSG00000028161	Ppp3ca	scl0002039.1_121-S	turquoise
2657	ENSMUSG00000028161	Ppp3ca	scl0019055.2_130-S	brown
2658	ENSMUSG00000028173	Gpr177	scl0068151.2_330-S	green
2659	ENSMUSG00000028176	Lrrc7	scl21349.34_3-S	grey
2660	ENSMUSG00000028180	Zranb2	scl22424.8_80-S	blue
2661	ENSMUSG00000028187	Bxdc5	scl0002028.1_25-S	brown
2662	ENSMUSG00000028194	Ddah1	scl0069219.2_49-S	yellow
2663	ENSMUSG00000028207	Asph	scl065973.2_37-S	red
2664	ENSMUSG00000028211	Trp53inp1	scl25678.6_114-S	blue
2665	ENSMUSG00000028218	Fam92a	scl24545.4.1_12-S	brown
2666	ENSMUSG00000028222	Calb1	scl25651.11_145-S	blue
2667	ENSMUSG00000028226	Mmp16	scl0002621.1_925-S	grey

2668	ENSMUSG00000028233	Tgs1	scl00116940.1_172-S	yellow
2669	ENSMUSG00000028234	Rps20	scl0067427.2_328-S	blue
2670	ENSMUSG00000028234	Rps20	GI_37693517-S	blue
2671	ENSMUSG00000028245	Nsmaf	scl24576.29.1_36-S	turquoise
2672	ENSMUSG00000028248	BC060111	scl0002695.1_712-S	brown
2673	ENSMUSG00000028249	Sdcbp	scl0053378.2_54-S	red
2674	ENSMUSG00000028252	Ccnc	scl25632.14_24-S	brown
2675	ENSMUSG00000028266	Lmo4	scl21429.6_290-S	blue
2676	ENSMUSG00000028274	Rngtt	scl024018.16_30-S	brown
2677	ENSMUSG00000028289	Epha7	scl013841.6_30-S	red
2678	ENSMUSG00000028291	Akirin2	scl25565.5.123_2-S	turquoise
2679	ENSMUSG00000028292	Rars2	scl25562.17.18_7-S	blue
2680	ENSMUSG00000028293	Slc35a1	scl24467.10_119-S	blue
2681	ENSMUSG00000028295	1810030N24Rik	scl0066291.2_269-S	blue
2682	ENSMUSG00000028300	3110043O21Rik	scl0002644.1_1164-S	red
2683	ENSMUSG00000028307	Aldob	scl0230163.1_72-S	turquoise
2684	ENSMUSG00000028312	Smc2	scl25441.25_49-S	brown
2685	ENSMUSG00000028329	Xpa	scl0022590.2_38-S	brown
2686	ENSMUSG00000028343	Erp44	scl24344.15.1_2-S	turquoise
2687	ENSMUSG00000028344	Invs	scl25451.20.1_292-S	grey
2688	ENSMUSG00000028347	Tmeff1	scl25447.12_116-S	turquoise
2689	ENSMUSG00000028351	Dbc1	scl0056710.2_12-S	blue
2690	ENSMUSG00000028351	Dbc1	scl24235.8_240-S	brown
2691	ENSMUSG00000028354	Fmn2	scl17185.20.1_57-S	grey
2692	ENSMUSG00000028385	Snx30	scl00209131.1_196-S	greenyellow
2693	ENSMUSG00000028393	Alad	scl24261.12.1_29-S	blue
2694	ENSMUSG00000028394	AK007693	scl24260.3_379-S	turquoise
2695	ENSMUSG00000028397	Kdm4c	scl25338.24.1_67-S	turquoise
2696	ENSMUSG00000028398	3110001D03Rik	scl24219.2.1_21-S	grey
2697	ENSMUSG00000028399	Ptprd	scl070222.2_44-S	blue
2698	ENSMUSG00000028407	AK008077	scl25549.2.1_20-S	turquoise
2699	ENSMUSG00000028409	Smu1	scl074255.2_27-S	turquoise
2700	ENSMUSG00000028409	Smu1	scl24435.7.6_19-S	red
2701	ENSMUSG00000028411	Aptx	scl0002752.1_25-S	brown
2702	ENSMUSG00000028411	Aptx	scl0066408.1_304-S	turquoise
2703	ENSMUSG00000028412	Slc44a1	scl0100434.7_162-S	magenta
2704	ENSMUSG00000028412	Slc44a1	scl25429.7.1_20-S	magenta
2705	ENSMUSG00000028416	Bag1	scl24433.7.1_53-S	turquoise
2706	ENSMUSG00000028419	Chmp5	scl076959.8_48-S	turquoise
2707	ENSMUSG00000028430	Nol6	scl0002699.1_4-S	brown
2708	ENSMUSG00000028433	Ubap2	scl24427.29_125-S	turquoise
2709	ENSMUSG00000028441	1110017D15Rik	scl24421.8.1_15-S	green
2710	ENSMUSG00000028444	Cntfr	scl0002829.1_12-S	grey
2711	ENSMUSG00000028445	2310040A07Rik	scl068919.2_149-S	grey
2712	ENSMUSG00000028445	2310040A07Rik	scl24418.2_44-S	turquoise
2713	ENSMUSG00000028447	Dctn3	scl24417.1.36_21-S	turquoise
2714	ENSMUSG00000028456	Unc13b	scl022249.50_191-S	brown
2715	ENSMUSG00000028466	Creb3	scl25513.7.1_27-S	brown
2716	ENSMUSG00000028467	Gba2	scl24399.13_176-S	turquoise
2717	ENSMUSG00000028469	Npr2	scl25510.19.1_73-S	turquoise
2718	ENSMUSG00000028470	Hint2	scl24398.4.1_27-S	green
2719	ENSMUSG00000028478	Clta	scl012757.9_180-S	turquoise
2720	ENSMUSG00000028479	Gne	scl24386.16_188-S	brown
2721	ENSMUSG00000028483	Snapc3	scl0002753.1_55-S	red
2722	ENSMUSG00000028484	Psip1	scl00101739.1_35-S	brown
2723	ENSMUSG00000028484	Psip1	scl0101739.9_21-S	turquoise
2724	ENSMUSG00000028488	Sh3gl2	scl020404.8_19-S	pink
2725	ENSMUSG00000028496	Mllt3	scl2369.1.1_21-S	turquoise
2726	ENSMUSG00000028517	Ppap2b	scl0067916.1_299-S	greenyellow
2727	ENSMUSG00000028517	Ppap2b	scl25185.2.323_16-S	greenyellow
2728	ENSMUSG00000028519	Dab1	scl013131.2_19-S	turquoise
2729	ENSMUSG00000028519	Dab1	scl0320776.3_58-S	turquoise
2730	ENSMUSG00000028521	Slc35d1	scl24051.10_612-S	grey
2731	ENSMUSG00000028524	Sgip1	scl0073094.1_52-S	blue
2732	ENSMUSG00000028527	Ak3l1	scl011639.5_169-S	grey
2733	ENSMUSG00000028528	Dnajc6	scl0072685.1_143-S	grey
2734	ENSMUSG00000028530	Jak1	scl24063.27.1_21-S	turquoise
2735	ENSMUSG00000028532	Cachd1	scl00320508.1_241-S	blue
2736	ENSMUSG00000028540	Dph2	scl23928.4.1_17-S	blue
2737	ENSMUSG00000028542	Slc6a9	scl0014664.2_299-S	blue
2738	ENSMUSG00000028546	Elavl4	scl015572.1_241-S	turquoise
2739	ENSMUSG00000028552	Eps15	scl0013858.2_190-S	blue
2740	ENSMUSG00000028552	Eps15	scl25131.24_224-S	blue
2741	ENSMUSG00000028557	Rnf11	scl0002818.1_24-S	grey
2742	ENSMUSG00000028557	Rnf11	scl029864.1_22-S	turquoise
2743	ENSMUSG00000028559	Osbpl9	scl00100273.2_58-S	brown
2744	ENSMUSG00000028560	Usp1	scl0230484.9_241-S	turquoise
2745	ENSMUSG00000028565	Nfia	scl25259.1.303_25-S	turquoise
2746	ENSMUSG00000028567	Txndc12	scl066073.8_269-S	turquoise
2747	ENSMUSG00000028572	Hook1	scl0077963.1_19-S	red
2748	ENSMUSG00000028573	Fggy	scl25272.22.1_44-S	grey
2749	ENSMUSG00000028577	Plaa	scl018786.2_1-S	turquoise
2750	ENSMUSG00000028580	Pum1	scl24889.23_167-S	blue
2751	ENSMUSG00000028582	Cc2d1b	scl25143.20.1_12-S	turquoise
2752	ENSMUSG00000028583	Pdpn	scl23564.6_587-S	green
2753	ENSMUSG00000028603	Scp2	scl0020280.2_23-S	turquoise
2754	ENSMUSG00000028603	Scp2	scl020280.7_0-S	brown
2755	ENSMUSG00000028603	Scp2	scl0002716.1_33-S	brown
2756	ENSMUSG00000028607	Cpt2	scl000022.1_12-S	turquoise
2757	ENSMUSG00000028607	Cpt2	scl24019.5_109-S	green
2758	ENSMUSG00000028608	0610037L13Rik	scl0002708.1_0-S	brown
2759	ENSMUSG00000028609	Magoh	scl0002678.1_34-S	brown
2760	ENSMUSG00000028609	Magoh	scl25152.5.1_78-S	turquoise
2761	ENSMUSG00000028618	Tmem59	scl25163.8.1_30-S	green
2762	ENSMUSG00000028619	2210012G02Rik	scl066526.1_1-S	black
2763	ENSMUSG00000028622	Mrpl37	scl0002671.1_55-S	blue
2764	ENSMUSG00000028622	Mrpl37	scl24033.7.1_11-S	blue
2765	ENSMUSG00000028633	Ctps	scl23887.17.1_103-S	turquoise
2766	ENSMUSG00000028633	Ctps	scl0002828.1_23-S	turquoise
2767	ENSMUSG00000028643	Ccdc23	scl25031.4.1_22-S	turquoise
2768	ENSMUSG00000028645	Slc2a1	scl25032.12_179-S	blue
2769	ENSMUSG00000028646	Rragc	scl054170.29_181-S	blue
2770	ENSMUSG00000028654	Mycl1	scl24999.4_423-S	blue
2771	ENSMUSG00000028655	Mfsd2	scl23864.14.1_204-S	grey
2772	ENSMUSG00000028656	Cap1	scl012331.2_166-S	blue
2773	ENSMUSG00000028657	Ppt1	scl019063.8_2-S	red
2774	ENSMUSG00000028661	Epha8	scl23654.17.1_41-S	purple
2775	ENSMUSG00000028664	Ephb2	scl0013844.2_257-S	blue
2776	ENSMUSG00000028668	Tceb3	scl23664.11_168-S	turquoise
2777	ENSMUSG00000028669	1110049F12Rik	scl0002658.1_37-S	blue
2778	ENSMUSG00000028670	Lypla2	scl23666.9_53-S	brown
2779	ENSMUSG00000028672	Hmgcl	scl0002854.1_22-S	turquoise
2780	ENSMUSG00000028672	Hmgcl	scl24827.11.452_11-S	turquoise
2781	ENSMUSG00000028677	Rnf220	scl23937.12.5_13-S	turquoise
2782	ENSMUSG00000028680	Plk3	scl23942.14.1_32-S	blue
2783	ENSMUSG00000028683	Eif2b3	scl25057.15.1_6-S	brown

2784	ENSMUSG00000028684	Urod	scl23946.8.1_41-S	brown
2785	ENSMUSG00000028688	Toe1	scl068276.1_0-S	blue
2786	ENSMUSG00000028690	Mmachc	scl0067096.2_233-S	turquoise
2787	ENSMUSG00000028691	Prdx1	scl018477.6_2-S	blue
2788	ENSMUSG00000028692	Akr1a4	scl058810.1_30-S	turquoise
2789	ENSMUSG00000028698	Pik3r3	scl0018710.2_219-S	blue
2790	ENSMUSG00000028698	Pik3r3	scl25076.10_59-S	turquoise
2791	ENSMUSG00000028703	Lrrc41	scl25081.14.1_17-S	black
2792	ENSMUSG00000028729	Ebna1bp2	scl069072.8_1-S	brown
2793	ENSMUSG00000028743	Akr7a5	scl24777.7.1_203-S	blue
2794	ENSMUSG00000028745	Capzb	scl0002845.1_3-S	blue
2795	ENSMUSG00000028756	Pink1	scl23635.5.2_0-S	turquoise
2796	ENSMUSG00000028756	Pink1	scl068943.2_5-S	turquoise
2797	ENSMUSG00000028757	Ddost	scl24791.10_1-S	blue
2798	ENSMUSG00000028759	Hp1bp3	scl015441.12_277-S	grey
2799	ENSMUSG00000028760	Eif4g3	scl0230861.11_53-S	brown
2800	ENSMUSG00000028771	Ptpn12	scl26859.18.1_18-S	turquoise
2801	ENSMUSG00000028772	Zcchc17	scl0002795.1_13-S	yellow
2802	ENSMUSG00000028772	Zcchc17	scl23752.10_407-S	blue
2803	ENSMUSG00000028773	Fabp3	scl014077.4_160-S	brown
2804	ENSMUSG00000028782	Bai2	scl24900.29.1_9-S	blue
2805	ENSMUSG00000028785	Hpca	scl015444.1_100-S	blue
2806	ENSMUSG00000028788	Ptp4a2	scl0002832.1_59-S	red
2807	ENSMUSG00000028788	Ptp4a2	scl0019244.1_47-S	red
2808	ENSMUSG00000028788	Ptp4a2	scl019244.5_2-S	yellow
2809	ENSMUSG00000028788	Ptp4a2	scl0002761.1_5-S	turquoise
2810	ENSMUSG00000028790	Khdrbs1	scl0020218.1_3-S	turquoise
2811	ENSMUSG00000028793	Ibrdc3	scl075267.1_5-S	blue
2812	ENSMUSG00000028795	Ccdc28b	scl0002652.1_12-S	turquoise
2813	ENSMUSG00000028795	Ccdc28b	scl066264.3_24-S	turquoise
2814	ENSMUSG00000028796	Phc2	scl24928.17_534-S	blue
2815	ENSMUSG00000028797	2510006D16Rik	scl076799.5_108-S	grey
2816	ENSMUSG00000028798	Eif3i	scl0002631.1_50-S	brown
2817	ENSMUSG00000028798	Eif3i	scl23771.9.1_58-S	brown
2818	ENSMUSG00000028804	Csmd2	scl24932.1.1_293-S	blue
2819	ENSMUSG00000028809	Srrm1	scl23675.18_254-S	blue
2820	ENSMUSG00000028820	Sfpq	scl071514.8_14-S	yellow
2821	ENSMUSG00000028822	Tmem50a	scl23678.5.1_21-S	brown
2822	ENSMUSG00000028826	Tmem57	scl23680.13_149-S	purple
2823	ENSMUSG00000028830	AU040320	scl00100317.1_138-S	blue
2824	ENSMUSG00000028833	Ncdn	scl23812.7_84-S	blue
2825	ENSMUSG00000028837	Psmb2	scl0002609.1_52-S	turquoise
2826	ENSMUSG00000028837	Psmb2	scl24957.6.1_12-S	turquoise
2827	ENSMUSG00000028843	Sh3bgrl3	scl23697.3.1_58-S	blue
2828	ENSMUSG00000028847	Trappc3	scl0002767.1_35-S	turquoise
2829	ENSMUSG00000028847	Trappc3	scl0027096.1_27-S	blue
2830	ENSMUSG00000028847	Trappc3	scl027096.1_199-S	brown
2831	ENSMUSG00000028851	Nudc	scl018221.7_88-S	turquoise
2832	ENSMUSG00000028854	Slc9a1	scl24865.12_18-S	blue
2833	ENSMUSG00000028857	Tmem222	scl23717.7_545-S	turquoise
2834	ENSMUSG00000028861	Mrps15	scl066407.8_34-S	turquoise
2835	ENSMUSG00000028861	Mrps15	scl0002737.1_15-S	turquoise
2836	ENSMUSG00000028863	2310005N01Rik	scl24976.4.1_46-S	turquoise
2837	ENSMUSG00000028868	Wasf2	scl24869.10_287-S	turquoise
2838	ENSMUSG00000028878	BC008163	scl0230789.1_243-S	turquoise
2839	ENSMUSG00000028882	Ppp1r8	scl23724.7_67-S	turquoise
2840	ENSMUSG00000028883	Sema3a	scl28110.22_407-S	blue
2841	ENSMUSG00000028884	Rpa2	scl0002615.1_14-S	turquoise
2842	ENSMUSG00000028884	Rpa2	scl24872.9.1_70-S	turquoise
2843	ENSMUSG00000028894	Inpp5b	scl24987.27.1_4-S	turquoise
2844	ENSMUSG00000028898	Trnau1ap	scl23736.8.1_149-S	turquoise
2845	ENSMUSG00000028899	Taf12	scl0002627.1_6-S	turquoise
2846	ENSMUSG00000028902	Sf3a3	scl24988.17.1_42-S	brown
2847	ENSMUSG00000028906	Epb4.1	scl23744.24_29-S	grey
2848	ENSMUSG00000028907	Utp11l	scl23840.4_11-S	brown
2849	ENSMUSG00000028911	Sfrs4	scl24880.7_98-S	brown
2850	ENSMUSG00000028917	Plekhm2	scl23588.20_436-S	blue
2851	ENSMUSG00000028927	Padi2	GI_6679264-S	magenta
2852	ENSMUSG00000028927	Padi2	scl0018600.1_295-S	magenta
2853	ENSMUSG00000028931	Kcnab2	scl23461.27_162-S	blue
2854	ENSMUSG00000028932	Psmc2	scl28063.9.402_1-S	turquoise
2855	ENSMUSG00000028937	Acot7	scl0002605.1_2-S	pink
2856	ENSMUSG00000028937	Acot7	scl0002866.1_3-S	blue
2857	ENSMUSG00000028937	Acot7	scl24656.12.1_25-S	blue
2858	ENSMUSG00000028949	Smarcd3	scl066993.2_1-S	black
2859	ENSMUSG00000028953	Abcf2	scl0027407.2_100-S	turquoise
2860	ENSMUSG00000028953	Abcf2	scl027407.6_4-S	red
2861	ENSMUSG00000028953	Abcf2	scl0027407.2_308-S	turquoise
2862	ENSMUSG00000028954	Nub1	scl28031.14_314-S	turquoise
2863	ENSMUSG00000028955	Vamp3	scl23476.5_13-S	brown
2864	ENSMUSG00000028959	Fastk	scl0004207.1_37-S	turquoise
2865	ENSMUSG00000028959	Fastk	scl26802.3_29-S	turquoise
2866	ENSMUSG00000028960	Ube4b	scl23509.31_82-S	blue
2867	ENSMUSG00000028961	Pgd	scl0110208.1_282-S	blue
2868	ENSMUSG00000028962	Slc4a2	scl020535.23_4-S	green
2869	ENSMUSG00000028964	Park7	scl23478.14.23_30-S	turquoise
2870	ENSMUSG00000028967	Errfi1	scl074155.4_43-S	grey
2871	ENSMUSG00000028969	Cdk5	scl26804.8_290-S	turquoise
2872	ENSMUSG00000028971	Cort	scl23500.2.1_152-S	grey
2873	ENSMUSG00000028974	Dffa	scl24696.6_92-S	turquoise
2874	ENSMUSG00000028975	Pex14	scl23497.11_62-S	brown
2875	ENSMUSG00000028979	Masp2	scl0002868.1_92-S	grey
2876	ENSMUSG00000028982	Slc25a33	scl23492.6.209_2-S	turquoise
2877	ENSMUSG00000028986	Klhl7	scl28043.12_286-S	turquoise
2878	ENSMUSG00000028988	Ctnnbip1	scl24691.6_256-S	blue
2879	ENSMUSG00000028991	Frap1	scl24706.58_26-S	blue
2880	ENSMUSG00000028998	Tomm7	scl066169.3_11-S	brown
2881	ENSMUSG00000029001	Fbxo44	scl23522.8_437-S	turquoise
2882	ENSMUSG00000029003	Mad2l2	scl24707.8.1_1-S	grey
2883	ENSMUSG00000029012	Orc5l	scl0004120.1_356-S	brown
2884	ENSMUSG00000029012	Orc5l	scl026429.1_36-S	brown
2885	ENSMUSG00000029014	Dnajc2	scl0022792.2_35-S	turquoise
2886	ENSMUSG00000029014	Dnajc2	scl022791.10_3-S	turquoise
2887	ENSMUSG00000029017	Pmpcb	scl28064.14.1_8-S	turquoise
2888	ENSMUSG00000029020	Mfn2	scl23528.23_0-S	blue
2889	ENSMUSG00000029028	Lrrc47	scl24643.7_53-S	blue
2890	ENSMUSG00000029030	Tprgl	scl23453.4_99-S	blue
2891	ENSMUSG00000029030	Tprgl	scl0002841.1_13-S	turquoise
2892	ENSMUSG00000029033	Acap3	scl24609.23_97-S	blue
2893	ENSMUSG00000029036	AK154077	scl0108888.1_320-S	blue
2894	ENSMUSG00000029038	Ssu72	scl24615.5.1_59-S	blue
2895	ENSMUSG00000029048	Rer1	scl0002748.1_8-S	brown
2896	ENSMUSG00000029050	Ski	scl23441.8_64-S	blue
2897	ENSMUSG00000029053	Prkcz	scl0018762.1_190-S	turquoise
2898	ENSMUSG00000029053	Prkcz	scl23440.19_602-S	blue
2899	ENSMUSG00000029054	Gabrd	scl23437.8.1_39-S	turquoise

2900	ENSMUSG00000029055	Plch2	scl23443.27.1_150-S	blue
2901	ENSMUSG00000029056	Pank4	scl24632.19.1_94-S	blue
2902	ENSMUSG00000029059	2810405K02Rik	scl066469.2_10-S	brown
2903	ENSMUSG00000029060	Mib2	scl23433.18.1_222-S	blue
2904	ENSMUSG00000029062	Cdc2l1	scl24617.16.29_1-S	blue
2905	ENSMUSG00000029063	Nadk	scl24620.16_177-S	turquoise
2906	ENSMUSG00000029064	Gnb1	scl24621.11.93_24-S	turquoise
2907	ENSMUSG00000029066	Mrpl20	scl066448.4_32-S	turquoise
2908	ENSMUSG00000029071	Dvl1	scl24607.15_131-S	blue
2909	ENSMUSG00000029086	Prom1	scl0019126.2_253-S	grey
2910	ENSMUSG00000029088	Kcnip4	scl0004178.1_33-S	red
2911	ENSMUSG00000029088	Kcnip4	scl26603.11_362-S	turquoise
2912	ENSMUSG00000029094	Afap1	scl27894.1.960_198-S	turquoise
2913	ENSMUSG00000029095	Ablim2	scl27898.30.1_23-S	turquoise
2914	ENSMUSG00000029101	Rgs12	scl0004049.1_686-S	turquoise
2915	ENSMUSG00000029103	Lrpap1	scl0016976.2_258-S	brown
2916	ENSMUSG00000029106	Add1	scl27909.18_34-S	blue
2917	ENSMUSG00000029110	Rnf4	scl019822.7_223-S	red
2918	ENSMUSG00000029111	Whsc2	scl0024116.2_231-S	blue
2919	ENSMUSG00000029120	Ppp2r2c	scl27887.10_414-S	turquoise
2920	ENSMUSG00000029121	Crmp1	scl27884.17.1_26-S	blue
2921	ENSMUSG00000029125	Stx18	scl27879.8.321_13-S	turquoise
2922	ENSMUSG00000029126	Nsg1	scl26668.5_235-S	turquoise
2923	ENSMUSG00000029142	Mrpl33	scl0004113.1_27-S	brown
2924	ENSMUSG00000029142	Mrpl33	scl066845.4_127-S	brown
2925	ENSMUSG00000029144	Gtf3c2	scl0071752.2_61-S	grey
2926	ENSMUSG00000029144	Gtf3c2	scl26741.21_29-S	grey
2927	ENSMUSG00000029144	Mpv17	GI_6678925-S	blue
2928	ENSMUSG00000029144	Mpv17	scl0004014.1_22-S	turquoise
2929	ENSMUSG00000029144	Mpv17	scl0004061.1_14-S	blue
2930	ENSMUSG00000029144	Mpv17	scl017527.1_149-S	yellow
2931	ENSMUSG00000029145	Eif2b4	scl26742.12.1_68-S	blue
2932	ENSMUSG00000029146	Snx17	scl0004002.1_3-S	pink
2933	ENSMUSG00000029146	Snx17	scl27959.12_30-S	blue
2934	ENSMUSG00000029151	Slc30a3	scl022784.1_270-S	turquoise
2935	ENSMUSG00000029152	Ociad1	scl0004139.1_41-S	turquoise
2936	ENSMUSG00000029153	Ociad2	scl0004073.1_36-S	blue
2937	ENSMUSG00000029156	Sgcb	scl024051.1_222-S	grey
2938	ENSMUSG00000029166	Mapre3	scl0100732.7_1-S	turquoise
2939	ENSMUSG00000029167	PGC-1v	scl26595.14.1_90-S	yellow
2940	ENSMUSG00000029169	Dhx15	scl013204.1_302-S	turquoise
2941	ENSMUSG00000029176	Anapc4	scl27818.30.1_7-S	brown
2942	ENSMUSG00000029177	Cenpa	scl012615.5_26-S	grey
2943	ENSMUSG00000029178	Klf3	scl0016599.2_295-S	greenyellow
2944	ENSMUSG00000029189	2310045A20Rik	scl26582.30.1_36-S	blue
2945	ENSMUSG00000029190	D5Ertd579e	scl26679.9_306-S	grey
2946	ENSMUSG00000029192	Tbc1d14	scl26681.23_128-S	blue
2947	ENSMUSG00000029199	Lias	scl0004148.1_17-S	turquoise
2948	ENSMUSG00000029199	Lias	scl079464.11_51-S	blue
2949	ENSMUSG00000029203	Ube2k	scl0003990.1_13-S	blue
2950	ENSMUSG00000029203	Ube2k	scl0004155.1_21-S	turquoise
2951	ENSMUSG00000029209	Gnpda2	scl0067980.2_203-S	blue
2952	ENSMUSG00000029212	Gabrb1	scl27736.9.1_26-S	turquoise
2953	ENSMUSG00000029223	Uchl1	scl27752.9.1_0-S	blue
2954	ENSMUSG00000029231	Pdgfra	scl27703.26_20-S	blue
2955	ENSMUSG00000029233	Srd5a3	scl27696.10_114-S	blue
2956	ENSMUSG00000029238	Clock	scl0012753.1_131-S	brown
2957	ENSMUSG00000029246	Ppat	scl00231327.1_147-S	turquoise
2958	ENSMUSG00000029247	Paics	scl27687.10.1_4-S	turquoise
2959	ENSMUSG00000029267	Mtf2	scl27470.22_46-S	blue
2960	ENSMUSG00000029283	Cdc7	scl27483.11_488-S	blue
2961	ENSMUSG00000029287	Tgfbr3	scl021814.1_6-S	green
2962	ENSMUSG00000029291	Rufy3	scl0052822.2_239-S	brown
2963	ENSMUSG00000029304	Spp1	scl0020750.1_112-S	turquoise
2964	ENSMUSG00000029309	Sparcl1	scl26291.11.1_15-S	turquoise
2965	ENSMUSG00000029311	Hsd17b11	scl0004146.1_45-S	grey
2966	ENSMUSG00000029311	Hsd17b11	scl0114664.1_62-S	grey
2967	ENSMUSG00000029313	Aff1	scl27520.2_50-S	turquoise
2968	ENSMUSG00000029326	Enoph1	scl27541.6_227-S	turquoise
2969	ENSMUSG00000029330	Cds1	scl27531.14_563-S	blue
2970	ENSMUSG00000029344	Tpst2	scl27412.8.1_4-S	blue
2971	ENSMUSG00000029345	Tfip11	scl27411.14_7-S	blue
2972	ENSMUSG00000029359	Tesc	scl27313.11.1_0-S	blue
2973	ENSMUSG00000029386	Tctn2	scl27216.15.1_27-S	turquoise
2974	ENSMUSG00000029388	Eif2b1	scl0003953.1_5-S	brown
2975	ENSMUSG00000029388	Eif2b1	scl26028.9.1_5-S	turquoise
2976	ENSMUSG00000029389	Ddx55	scl0067848.2_220-S	grey
2977	ENSMUSG00000029390	Tmed2	scl0056334.1_201-S	turquoise
2978	ENSMUSG00000029397	Rchy1	scl068098.1_43-S	turquoise
2979	ENSMUSG00000029403	Cdkl2	scl26378.15_277-S	red
2980	ENSMUSG00000029404	Arl6ip4	scl0004030.1_2-S	turquoise
2981	ENSMUSG00000029404	Arl6ip4	scl27224.3.7_29-S	turquoise
2982	ENSMUSG00000029405	G3bp2	scl0004136.1_20-S	yellow
2983	ENSMUSG00000029405	G3bp2	scl0023881.1_86-S	yellow
2984	ENSMUSG00000029406	Pitpnm2	scl26041.27.1_85-S	brown
2985	ENSMUSG00000029407	Uso1	scl27584.25_22-S	turquoise
2986	ENSMUSG00000029408	Abcb9	scl0056325.2_260-S	blue
2987	ENSMUSG00000029422	Rsrc2	scl0208606.2_109-S	red
2988	ENSMUSG00000029422	Rsrc2	scl0004168.1_6-S	yellow
2989	ENSMUSG00000029426	Scarb2	scl26367.12.1_1-S	blue
2990	ENSMUSG00000029432	Gbas	scl27180.9.1_11-S	turquoise
2991	ENSMUSG00000029433	Diablo	scl26052.6_321-S	turquoise
2992	ENSMUSG00000029436	Mmp17	scl023948.13_25-S	brown
2993	ENSMUSG00000029438	Bcl7a	scl0077045.2_69-S	brown
2994	ENSMUSG00000029455	Aldh2	scl26088.14.1_16-S	black
2995	ENSMUSG00000029458	Brap	scl27274.14_233-S	blue
2996	ENSMUSG00000029461	Fam168a	scl00319604.2_16-S	greenyellow
2997	ENSMUSG00000029461	Fam168a	scl32307.11_346-S	turquoise
2998	ENSMUSG00000029462	Vps29	scl0004181.1_42-S	brown
2999	ENSMUSG00000029462	Vps29	scl056433.4_275-S	turquoise
3000	ENSMUSG00000029465	Arpc3	scl056378.6_20-S	yellow
3001	ENSMUSG00000029467	Atp2a2	scl0003984.1_492-S	blue
3002	ENSMUSG00000029467	Atp2a2	scl0011938.1_293-S	turquoise
3003	ENSMUSG00000029467	Atp2a2	scl0004020.1_31-S	pink
3004	ENSMUSG00000029469	Ift81	scl26073.20.7_5-S	blue
3005	ENSMUSG00000029471	Camkk2	scl0207565.1_29-S	turquoise
3006	ENSMUSG00000029472	Anapc5	scl059008.1_54-S	turquoise
3007	ENSMUSG00000029472	Anapc5	scl0004124.1_11-S	red
3008	ENSMUSG00000029474	Rnf34	scl0004174.1_30-S	red
3009	ENSMUSG00000029474	Rnf34	scl080751.6_5-S	brown
3010	ENSMUSG00000029474	Rnf34	scl27252.3_4-S	red
3011	ENSMUSG00000029475	Kdm2b	scl030841.1_204-S	blue
3012	ENSMUSG00000029478	Ncor2	scl020602.1_1-S	blue
3013	ENSMUSG00000029482	Aacs	scl27205.18_385-S	blue
3014	ENSMUSG00000029484	Anxa3	scl27561.16.206_36-S	grey
3015	ENSMUSG00000029486	Mrpl1	scl094061.9_0-S	turquoise

3016	ENSMUSG00000029502	Golga3	scl00269682.2_253-S	turquoise
3017	ENSMUSG00000029505	Ep400	scl26220.57_399-S	blue
3018	ENSMUSG00000029512	Ulk1	scl26219.29_122-S	blue
3019	ENSMUSG00000029513	Prkab1	scl26152.7_34-S	turquoise
3020	ENSMUSG00000029516	BB358012	scl27347.1.1_178-S	purple
3021	ENSMUSG00000029518	Rab35	scl077407.4_257-S	blue
3022	ENSMUSG00000029524	Sirt4	scl26157.7.1_148-S	grey
3023	ENSMUSG00000029534	St7	scl0001099.1_185-S	turquoise
3024	ENSMUSG00000029535	Triap1	scl27363.2_20-S	brown
3025	ENSMUSG00000029538	Sfrs9	scl27364.5.1_30-S	blue
3026	ENSMUSG00000029544	Cabp1	scl26163.5.1_11-S	blue
3027	ENSMUSG00000029547	Ints1	scl25842.35.1_138-S	blue
3028	ENSMUSG00000029550	Sppl3	scl27370.13_382-S	blue
3029	ENSMUSG00000029559	2210016L21Rik	scl27377.5.1_10-S	pink
3030	ENSMUSG00000029560	Snx8	scl25834.12_533-S	turquoise
3031	ENSMUSG00000029577	Ube3b	scl0004050.1_49-S	pink
3032	ENSMUSG00000029577	Ube3b	scl27388.28_359-S	blue
3033	ENSMUSG00000029580	Actb	scl011461.1_64-S	greenyellow
3034	ENSMUSG00000029581	Fscn1	scl27024.7_349-S	blue
3035	ENSMUSG00000029587	Zfp12	scl27021.5_396-S	grey
3036	ENSMUSG00000029599	Ddx54	scl0071990.2_197-S	blue
3037	ENSMUSG00000029602	Rasal1	scl27289.22.1_2-S	blue
3038	ENSMUSG00000029603	Dtx1	scl26112.11_493-S	brown
3039	ENSMUSG00000029608	Rph3a	scl10192.1.1_117-S	blue
3040	ENSMUSG00000029610	Jtv1	scl25798.3_114-S	turquoise
3041	ENSMUSG00000029613	Eif2ak1	scl0015467.2_272-S	turquoise
3042	ENSMUSG00000029616	Erp29	scl067397.1_307-S	turquoise
3043	ENSMUSG00000029621	Arpc1a	scl0004033.1_10-S	turquoise
3044	ENSMUSG00000029621	Arpc1a	scl0004056.1_143-S	blue
3045	ENSMUSG00000029621	Arpc1a	scl26990.11.129_69-S	blue
3046	ENSMUSG00000029622	Arpc1b	scl0004022.1_70-S	turquoise
3047	ENSMUSG00000029623	Pdap1	scl25784.5.1_54-S	yellow
3048	ENSMUSG00000029629	Phf14	scl0001105.1_0-S	yellow
3049	ENSMUSG00000029632	Ndufa4	scl017992.3_16-S	brown
3050	ENSMUSG00000029634	Rnf6	scl074132.1_5-S	yellow
3051	ENSMUSG00000029635	Cdk8	scl00264064.2_74-S	grey
3052	ENSMUSG00000029638	Glcci1	scl000073.1_22-S	turquoise
3053	ENSMUSG00000029641	Rasl11a	scl26974.4.1_24-S	turquoise
3054	ENSMUSG00000029647	Pan3	scl072587.6_94-S	turquoise
3055	ENSMUSG00000029648	Flt1	scl25760.31.1_106-S	blue
3056	ENSMUSG00000029649	Pomp	scl26959.5.1_79-S	brown
3057	ENSMUSG00000029650	Slc46a3	scl25758.6.1_14-S	turquoise
3058	ENSMUSG00000029655	N4bp2l2	scl078325.1_150-S	blue
3059	ENSMUSG00000029657	Hsph1	scl25735.19_37-S	turquoise
3060	ENSMUSG00000029659	6330406I15Rik	scl26948.15.1061_6-S	grey
3061	ENSMUSG00000029669	Tspan12	scl29249.10_180-S	blue
3062	ENSMUSG00000029673	Auts2	GI_38081035-S	greenyellow
3063	ENSMUSG00000029674	Limk1	scl25939.18_265-S	blue
3064	ENSMUSG00000029684	Wasl	scl29233.13_53-S	black
3065	ENSMUSG00000029686	Cul1	scl30098.24.1_15-S	turquoise
3066	ENSMUSG00000029695	Aass	scl29246.24.1_18-S	green
3067	ENSMUSG00000029712	Actl6b	scl0003952.1_26-S	blue
3068	ENSMUSG00000029713	Gnb2	scl014693.1_109-S	blue
3069	ENSMUSG00000029715	Pop7	scl25877.2.1_20-S	turquoise
3070	ENSMUSG00000029718	Pcolce	scl018542.3_8-S	green
3071	ENSMUSG00000029722	Agfg2	scl25869.12_138-S	turquoise
3072	ENSMUSG00000029723	Tsc22d4	scl27096.8.1_1-S	turquoise
3073	ENSMUSG00000029726	Mepce	scl25868.6.1_19-S	turquoise
3074	ENSMUSG00000029729	Zkscan1	scl27085.6_362-S	turquoise
3075	ENSMUSG00000029752	Asns	scl0001016.1_199-S	turquoise
3076	ENSMUSG00000029752	Asns	scl29294.14.1_194-S	turquoise
3077	ENSMUSG00000029757	Dync1i1	scl30414.18.1_38-S	turquoise
3078	ENSMUSG00000029763	Exoc4	scl30230.21.1_91-S	yellow
3079	ENSMUSG00000029767	Calu	scl0012321.1_21-S	brown
3080	ENSMUSG00000029767	Calu	scl0001217.1_1480-S	brown
3081	ENSMUSG00000029769	Ccdc136	scl30294.21.694_19-S	purple
3082	ENSMUSG00000029772	4631427C17Rik	scl30281.25_19-S	turquoise
3083	ENSMUSG00000029775	Klhdc10	scl30268.11_576-S	grey
3084	ENSMUSG00000029776	Hibadh	scl28993.8_275-S	grey
3085	ENSMUSG00000029777	Gars	scl30011.18.1_29-S	turquoise
3086	ENSMUSG00000029778	Adcyap1r1	scl1664.1.1_301-S	turquoise
3087	ENSMUSG00000029787	Kiaa0241	scl29998.16_610-S	blue
3088	ENSMUSG00000029804	Herc3	scl073998.24_21-S	turquoise
3089	ENSMUSG00000029804	Herc3	scl29980.2.1_4-S	pink
3090	ENSMUSG00000029810	Tmem176b	scl29041.8.1_24-S	turquoise
3091	ENSMUSG00000029815	AK153503	GI_38084253-S	blue
3092	ENSMUSG00000029816	Gpnmb	scl093695.11_9-S	grey
3093	ENSMUSG00000029819	Npy	scl30062.4.1_1-S	grey
3094	ENSMUSG00000029822	Osbpl3	scl0071720.1_33-S	grey
3095	ENSMUSG00000029838	Ptn	scl0019242.2_183-S	brown
3096	ENSMUSG00000029860	Zyx	scl022793.9_329-S	blue
3097	ENSMUSG00000029863	Casp2	scl012366.11_305-S	blue
3098	ENSMUSG00000029864	Gstk1	scl076263.8_129-S	blue
3099	ENSMUSG00000029869	Ephb6	scl30134.18.1_125-S	blue
3100	ENSMUSG00000029875	AI836003	scl47556.1.3_35-S	blue
3101	ENSMUSG00000029878	Dbpht2	scl0386753.1_250-S	yellow
3102	ENSMUSG00000029911	Ssbp1	scl0381760.7_51-S	turquoise
3103	ENSMUSG00000029918	Mrps33	scl014548.2_14-S	brown
3104	ENSMUSG00000029922	Mkrn1	scl29109.11_491-S	brown
3105	ENSMUSG00000029993	Nfu1	scl056748.8_105-S	turquoise
3106	ENSMUSG00000030002	Dusp11	scl28755.11.1_30-S	turquoise
3107	ENSMUSG00000030016	Zfml	scl018139.26_3-S	blue
3108	ENSMUSG00000030020	Prickle2	scl28675.1.1_200-S	grey
3109	ENSMUSG00000030029	Lrig1	scl016206.3_54-S	grey
3110	ENSMUSG00000030030	1700003E16Rik	scl29844.3_633-S	blue
3111	ENSMUSG00000030036	Mogs	scl29846.4_459-S	blue
3112	ENSMUSG00000030037	Mrpl53	scl29852.1_47-S	brown
3113	ENSMUSG00000030048	1190003M12Rik	scl28735.6.1_187-S	grey
3114	ENSMUSG00000030055	Rab43	scl28730.1.337_21-S	turquoise
3115	ENSMUSG00000030058	Copg	scl29780.26_164-S	blue
3116	ENSMUSG00000030067	Foxp1	scl00108655.1_10-S	turquoise
3117	ENSMUSG00000030068	Eif4e3	scl0066892.1_63-S	blue
3118	ENSMUSG00000030077	Chl1	scl0001198.1_53-S	blue
3119	ENSMUSG00000030079	Ruvbl1	scl0056505.2_24-S	turquoise
3120	ENSMUSG00000030083	Abtb1	scl28709.9_141-S	turquoise
3121	ENSMUSG00000030086	Chchd6	scl28701.8.1_115-S	turquoise
3122	ENSMUSG00000030087	Klf15	scl29751.3_94-S	turquoise
3123	ENSMUSG00000030088	Aldh1l1	scl29749.21.1_4-S	turquoise
3124	ENSMUSG00000030092	Cntn6	scl29684.24.1_24-S	grey
3125	ENSMUSG00000030095	Tmem43	scl29744.12_13-S	blue
3126	ENSMUSG00000030096	Slc6a6	scl29741.15_76-S	blue
3127	ENSMUSG00000030102	Itpr1	scl29671.63_470-S	black
3128	ENSMUSG00000030109	Slc6a12	scl29552.17.1_293-S	grey
3129	ENSMUSG00000030120	Mlf2	scl29514.8.22_6-S	blue
3130	ENSMUSG00000030123	Plxnd1	GI_38084997-S	turquoise
3131	ENSMUSG00000030125	Lrrc23	scl28421.8.141_12-S	green

3132	ENSMUSG00000030126	Tmcc1	scl0330401.1_15-S	turquoise
3133	ENSMUSG00000030127	Cops7a	scl026894.1_5-S	turquoise
3134	ENSMUSG00000030127	Cops7a	scl28412.11.2_3-S	turquoise
3135	ENSMUSG00000030134	Rasgef1a	GI_38085112-S	turquoise
3136	ENSMUSG00000030134	Rasgef1a	scl070727.12_249-S	turquoise
3137	ENSMUSG00000030137	Tuba8	scl0053857.2_245-S	grey
3138	ENSMUSG00000030157	Clec2d	scl29467.5.1_148-S	black
3139	ENSMUSG00000030161	Gabarapl1	scl29462.4_169-S	turquoise
3140	ENSMUSG00000030166	Rad52	scl29572.9.1_67-S	turquoise
3141	ENSMUSG00000030168	Adipor2	scl28480.7_231-S	magenta
3142	ENSMUSG00000030189	Csda	scl28312.12.1_12-S	turquoise
3143	ENSMUSG00000030204	Ddx47	scl0001184.1_52-S	turquoise
3144	ENSMUSG00000030204	Ddx47	scl067755.12_300-S	turquoise
3145	ENSMUSG00000030207	8430419L09Rik	scl0074525.2_276-S	blue
3146	ENSMUSG00000030216	Wbp11	scl28277.12_197-S	blue
3147	ENSMUSG00000030218	Mgp	scl017313.2_5-S	green
3148	ENSMUSG00000030222	Rerg	scl28269.8_450-S	purple
3149	ENSMUSG00000030245	Golt1b	scl1412.1.1_281-S	blue
3150	ENSMUSG00000030268	Bcat1	scl0001086.1_0-S	pink
3151	ENSMUSG00000030268	Bcat1	scl28214.16_48-S	turquoise
3152	ENSMUSG00000030269	Mtmr14	scl29636.20.1_18-S	turquoise
3153	ENSMUSG00000030270	Cpne9	scl00211232.2_312-S	grey
3154	ENSMUSG00000030272	Camk1	scl0001229.1_5-S	turquoise
3155	ENSMUSG00000030282	Cmas	scl29381.10.1_63-S	turquoise
3156	ENSMUSG00000030284	Creld1	scl29631.10_10-S	blue
3157	ENSMUSG00000030286	Tmem111	scl0001142.1_10-S	turquoise
3158	ENSMUSG00000030286	Tmem111	scl28539.8_61-S	turquoise
3159	ENSMUSG00000030291	Med21	scl29355.4.1_15-S	blue
3160	ENSMUSG00000030298	Sec13	scl28535.9.1_27-S	blue
3161	ENSMUSG00000030301	Ccdc91	scl29342.18_151-S	blue
3162	ENSMUSG00000030304	Ergic2	scl0001180.1_25-S	turquoise
3163	ENSMUSG00000030307	Slc6a11	scl29619.14.1344_171-S	turquoise
3164	ENSMUSG00000030316	1500001M20Rik	scl28528.10.882_17-S	turquoise
3165	ENSMUSG00000030317	Timp4	scl28526.3_1-S	red
3166	ENSMUSG00000030327	Necap1	scl29535.9_66-S	turquoise
3167	ENSMUSG00000030330	Ing4	GI_19111151-I	turquoise
3168	ENSMUSG00000030330	Ing4	scl0001148.1_50-S	turquoise
3169	ENSMUSG00000030335	Mrpl51	scl066493.3_45-S	blue
3170	ENSMUSG00000030342	Cd9	scl28399.6.24_1-S	green
3171	ENSMUSG00000030347	D6Wsu163e	scl29486.14.1_29-S	brown
3172	ENSMUSG00000030350	Prmt8	scl0381813.1_195-S	turquoise
3173	ENSMUSG00000030357	Fkbp4	scl0014228.2_173-S	turquoise
3174	ENSMUSG00000030376	Slc8a2	scl33056.10_21-S	blue
3175	ENSMUSG00000030401	Rtn2	scl020167.10_162-S	blue
3176	ENSMUSG00000030403	Vasp	scl31690.17_96-S	blue
3177	ENSMUSG00000030409	S60315	scl33011.16_16-S	grey
3178	ENSMUSG00000030410	Dmwd	scl33012.5.1_34-S	blue
3179	ENSMUSG00000030417	Pdcd5	scl0056330.1_0-S	brown
3180	ENSMUSG00000030421	C80913	scl019777.1_32-S	turquoise
3181	ENSMUSG00000030428	Ttyh1	scl0057776.1_221-S	grey
3182	ENSMUSG00000030431	2210411K11Rik	scl31800.2.1_30-S	turquoise
3183	ENSMUSG00000030435	U2af2	scl0022185.2_118-S	brown
3184	ENSMUSG00000030447	Cyfip1	scl020430.29_22-S	turquoise
3185	ENSMUSG00000030450	Oca2	scl32603.25.9_1-S	green
3186	ENSMUSG00000030451	Herc2	scl015204.23_217-S	blue
3187	ENSMUSG00000030452	Nipa2	scl31304.6_75-S	turquoise
3188	ENSMUSG00000030465	Psd3	scl34743.1.1_137-S	turquoise
3189	ENSMUSG00000030471	Zdhhc13	scl32640.18.1_14-S	brown
3190	ENSMUSG00000030500	Slc17a6	scl32619.12_480-S	blue
3191	ENSMUSG00000030512	Snrpa1	scl000146.1_5-S	grey
3192	ENSMUSG00000030515	Tarsl2	scl0272396.21_80-S	turquoise
3193	ENSMUSG00000030516	Tjp1	scl31237.29_375-S	turquoise
3194	ENSMUSG00000030533	Unc45a	scl000151.1_308-S	turquoise
3195	ENSMUSG00000030533	Unc45a	scl31127.23.1_1-S	blue
3196	ENSMUSG00000030534	Vps33b	scl32478.21.1_1-S	turquoise
3197	ENSMUSG00000030536	Iqgap1	scl0029875.2_286-S	green
3198	ENSMUSG00000030538	Cib1	scl31132.7.1_7-S	green
3199	ENSMUSG00000030539	Sema4b	scl32481.15_623-S	blue
3200	ENSMUSG00000030541	Idh2	scl31133.10.1_10-S	turquoise
3201	ENSMUSG00000030545	Pex11a	scl0018631.2_259-S	greenyellow
3202	ENSMUSG00000030556	Lrrc28	scl31224.16_382-S	grey
3203	ENSMUSG00000030557	AK136368	scl00040.1_6-S	turquoise
3204	ENSMUSG00000030557	AK136368	scl31226.15_497-S	pink
3205	ENSMUSG00000030560	Ctsc	scl000253.1_401-S	green
3206	ENSMUSG00000030579	Tyrobp	scl32817.6.1_8-S	turquoise
3207	ENSMUSG00000030583	Sipa1l3	scl31550.23.1_53-S	brown
3208	ENSMUSG00000030588	Yif1b	scl00029.1_14-S	blue
3209	ENSMUSG00000030588	Yif1b	scl32844.9.1_17-S	blue
3210	ENSMUSG00000030590	1110006G06Rik	scl31560.6.38_45-S	blue
3211	ENSMUSG00000030591	Psmd8	scl0057296.1_256-S	brown
3212	ENSMUSG00000030592	Ryr1	scl020190.3_9-S	grey
3213	ENSMUSG00000030592	Ryr1	scl31563.14.1_34-S	grey
3214	ENSMUSG00000030603	Psmc4	scl31589.11.1_58-S	grey
3215	ENSMUSG00000030605	Mfge8	scl31155.10_11-S	blue
3216	ENSMUSG00000030611	Mrps11	scl00036.1_15-S	turquoise
3217	ENSMUSG00000030612	Mrpl46	scl31161.4.1_8-S	brown
3218	ENSMUSG00000030613	2310015N07Rik	scl0066365.1_89-S	blue
3219	ENSMUSG00000030615	Tmem126a	scl31053.2.1_38-S	turquoise
3220	ENSMUSG00000030619	Eed	scl31056.12.1_57-S	turquoise
3221	ENSMUSG00000030630	Fah	scl31074.15.1_32-S	grey
3222	ENSMUSG00000030638	Sh3gl3	scl32452.10.1_47-S	blue
3223	ENSMUSG00000030652	Coq7	scl30756.4.28_1-S	blue
3224	ENSMUSG00000030653	Pde2a	scl0207728.16_127-S	blue
3225	ENSMUSG00000030654	Arl6ip1	scl30761.7_77-S	brown
3226	ENSMUSG00000030662	Ipo5	scl45943.26_212-S	brown
3227	ENSMUSG00000030680	2900092E17Rik	scl067278.1_10-S	blue
3228	ENSMUSG00000030683	Sez6l2	scl0233878.18_252-S	blue
3229	ENSMUSG00000030689	Ino80e	scl00233875.2_247-S	blue
3230	ENSMUSG00000030691	Fchsd2	scl32303.22_382-S	brown
3231	ENSMUSG00000030695	Aldoa	scl011674.2_46-S	blue
3232	ENSMUSG00000030697	Ppp4c	scl30672.9.1_29-S	blue
3233	ENSMUSG00000030701	Plekhb1	scl30978.11_3-S	blue
3234	ENSMUSG00000030703	Gdpd3	scl32054.9.1_17-S	grey
3235	ENSMUSG00000030704	Rab6	scl00072.1_32-S	pink
3236	ENSMUSG00000030706	Mrpl48	scl000251.1_1-S	brown
3237	ENSMUSG00000030706	Mrpl48	scl00038.1_12-S	grey
3238	ENSMUSG00000030707	Coro1a	scl000111.1_99-S	blue
3239	ENSMUSG00000030707	Coro1a	scl000112.1_18-S	turquoise
3240	ENSMUSG00000030707	Coro1a	scl30675.13.1_1-S	blue
3241	ENSMUSG00000030711	Sult1a1	scl000152.1_1-S	blue
3242	ENSMUSG00000030711	Sult1a1	scl30678.8_112-S	grey
3243	ENSMUSG00000030718	Ppme1	scl30988.16_625-S	turquoise
3244	ENSMUSG00000030726	Pold3	scl30991.12_298-S	grey
3245	ENSMUSG00000030729	Pgm2l1	scl32319.17.234_75-S	yellow
3246	ENSMUSG00000030733	Sh2b1	scl30686.13_297-S	brown
3247	ENSMUSG00000030737	Slco2b1	scl31001.17.1_88-S	brown

3248	ENSMUSG00000030738	Eif3c	scl056347.10_39-S	blue
3249	ENSMUSG00000030741	Spns1	scl30691.10.4_70-S	brown
3250	ENSMUSG00000030750	Nsmce1	scl30702.10.1_59-S	brown
3251	ENSMUSG00000030760	Acer3	scl066190.1_22-S	turquoise
3252	ENSMUSG00000030761	Myo7a	scl017921.2_30-S	green
3253	ENSMUSG00000030763	Lcmt1	scl32083.13.1_101-S	brown
3254	ENSMUSG00000030766	Arhgap17	scl30707.21_229-S	grey
3255	ENSMUSG00000030770	Parva	scl32180.18_394-S	turquoise
3256	ENSMUSG00000030772	Dkk3	scl30798.9_425-S	brown
3257	ENSMUSG00000030779	Rbbp6	scl0019647.2_60-S	turquoise
3258	ENSMUSG00000030779	Rbbp6	scl32090.6_89-S	turquoise
3259	ENSMUSG00000030801	Myst1	scl32009.10.1_38-S	turquoise
3260	ENSMUSG00000030802	Bckdk	scl000148.1_9-S	turquoise
3261	ENSMUSG00000030802	Bckdk	scl32013.13.1_60-S	blue
3262	ENSMUSG00000030804	Vkorc1	scl000237.1_40-S	turquoise
3263	ENSMUSG00000030804	Vkorc1	scl30629.5.1_26-S	brown
3264	ENSMUSG00000030814	Bcl7c	scl0012055.2_161-S	blue
3265	ENSMUSG00000030815	Phkg2	scl32026.9.1_5-S	turquoise
3266	ENSMUSG00000030816	Rnf40	scl00233900.2_139-S	blue
3267	ENSMUSG00000030822	Prr14	scl32033.10.26_108-S	blue
3268	ENSMUSG00000030824	Nucb1	scl0018220.1_39-S	blue
3269	ENSMUSG00000030824	Nucb1	scl018220.1_69-S	blue
3270	ENSMUSG00000030835	Nomo1	scl32657.31.1_97-S	blue
3271	ENSMUSG00000030842	2400001E08Rik	scl066508.5_236-S	grey
3272	ENSMUSG00000030844	Rgs10	scl067865.1_323-S	turquoise
3273	ENSMUSG00000030846	Tial1	scl0021843.2_5-S	turquoise
3274	ENSMUSG00000030846	Tial1	scl30615.10_353-S	turquoise
3275	ENSMUSG00000030849	Fgfr2	scl30605.20_54-S	magenta
3276	ENSMUSG00000030850	Ate1	scl30601.15_186-S	brown
3277	ENSMUSG00000030852	Tacc2	scl31989.25.1_124-S	brown
3278	ENSMUSG00000030854	Ptpn5	scl31333.17.1_37-S	blue
3279	ENSMUSG00000030868	Plk1	scl32098.5_114-S	turquoise
3280	ENSMUSG00000030872	Gga2	scl074105.1_2-S	blue
3281	ENSMUSG00000030872	Gga2	scl30720.15_54-S	blue
3282	ENSMUSG00000030876	Mettl9	scl32110.5.1_11-S	grey
3283	ENSMUSG00000030878	Cdr2	scl30730.6_511-S	green
3284	ENSMUSG00000030879	Mrpl17	scl027397.1_17-S	turquoise
3285	ENSMUSG00000030880	Polr3e	scl32113.20.1_9-S	grey
3286	ENSMUSG00000030881	Arfip2	scl30883.9.1_56-S	turquoise
3287	ENSMUSG00000030882	Fxc1	scl00089.1_20-S	turquoise
3288	ENSMUSG00000030884	Uqcrc2	scl32119.15.11_22-S	brown
3289	ENSMUSG00000030894	Tpp1	scl30879.11_205-S	green
3290	ENSMUSG00000030898	Cckbr	scl012426.5_191-S	purple
3291	ENSMUSG00000030905	Crym	scl30734.8.1_4-S	grey
3292	ENSMUSG00000030930	4631426J05Rik	scl0077590.2_319-S	blue
3293	ENSMUSG00000030942	Thumpd1	scl30741.3_137-S	grey
3294	ENSMUSG00000030965	Fam175b	scl31965.9_618-S	blue
3295	ENSMUSG00000030967	Zranb1	scl00360216.2_44-S	red
3296	ENSMUSG00000030980	2310008H09Rik	scl066356.1_13-S	turquoise
3297	ENSMUSG00000030983	Bccip	scl000028.1_0-S	turquoise
3298	ENSMUSG00000030983	Bccip	scl31959.7.1_44-S	brown
3299	ENSMUSG00000030983	Bccip	scl000154.1_82-S	turquoise
3300	ENSMUSG00000030986	Dhx32	scl30561.16.1_47-S	grey
3301	ENSMUSG00000030987	Stim1	scl32278.15_211-S	blue
3302	ENSMUSG00000031007	Atp6ap2	scl0002902.1_39-S	red
3303	ENSMUSG00000031007	Atp6ap2	scl0002998.1_67-S	red
3304	ENSMUSG00000031007	Atp6ap2	scl0002891.1_24-S	red
3305	ENSMUSG00000031021	Tmem9b	scl000137.1_6-S	red
3306	ENSMUSG00000031021	Tmem9b	scl30830.6_4-S	blue
3307	ENSMUSG00000031024	St5	scl30833.27_114-S	blue
3308	ENSMUSG00000031029	Eif3f	scl32211.7.1_6-S	blue
3309	ENSMUSG00000031065	Pctk1	scl55019.13_214-S	blue
3310	ENSMUSG00000031066	Usp11	scl55018.15.23_30-S	blue
3311	ENSMUSG00000031066	Usp11	scl0236733.21_43-S	turquoise
3312	ENSMUSG00000031078	Cttn	scl013043.1_15-S	turquoise
3313	ENSMUSG00000031095	Cul4b	scl072584.1_264-S	green
3314	ENSMUSG00000031099	Smarca1	scl54295.26.1_21-S	blue
3315	ENSMUSG00000031105	Slc25a14	scl54944.9.1_0-S	turquoise
3316	ENSMUSG00000031111	Igsf1	scl0002884.1_251-S	grey
3317	ENSMUSG00000031133	Arhgef6	scl073341.1_128-S	turquoise
3318	ENSMUSG00000031134	Rbmx	scl0019655.2_139-S	brown
3319	ENSMUSG00000031137	Fgf13	scl0014168.2_0-S	blue
3320	ENSMUSG00000031137	Fgf13	scl014168.2_27-S	blue
3321	ENSMUSG00000031143	Ccdc22	scl54450.17.1_6-S	grey
3322	ENSMUSG00000031144	Syp	scl020977.7_194-S	blue
3323	ENSMUSG00000031149	Praf2	scl0002955.1_15-S	turquoise
3324	ENSMUSG00000031149	Praf2	scl054637.2_3-S	turquoise
3325	ENSMUSG00000031153	Gripap1	scl0002910.1_314-S	turquoise
3326	ENSMUSG00000031153	Gripap1	scl0054645.1_120-S	turquoise
3327	ENSMUSG00000031154	Otud5	scl054644.12_28-S	brown
3328	ENSMUSG00000031155	Pim2	scl018715.6_137-S	blue
3329	ENSMUSG00000031157	Pqbp1	scl54442.9.1_77-S	turquoise
3330	ENSMUSG00000031161	Hdac6	scl54440.26.1_53-S	turquoise
3331	ENSMUSG00000031169	Porcn	scl54429.14.1_20-S	blue
3332	ENSMUSG00000031170	Slc38a5	scl55061.19.1_283-S	grey
3333	ENSMUSG00000031176	Dynlt3	scl54409.6_0-S	turquoise
3334	ENSMUSG00000031197	Vbp1	scl022327.6_246-S	turquoise
3335	ENSMUSG00000031201	Brcc3	scl0210766.8_41-S	turquoise
3336	ENSMUSG00000031207	Msn	scl54770.14_288-S	green
3337	ENSMUSG00000031209	Heph	scl0002952.1_136-S	brown
3338	ENSMUSG00000031221	Igbp1	scl54754.6.1_12-S	brown
3339	ENSMUSG00000031226	2610029G23Rik	scl0002929.1_32-S	brown
3340	ENSMUSG00000031227	Magee1	scl54702.1.23_260-S	brown
3341	ENSMUSG00000031229	Atrx	scl067403.1_251-S	blue
3342	ENSMUSG00000031231	Cox7b	scl0066142.1_255-S	turquoise
3343	ENSMUSG00000031239	Itm2a	scl0002945.1_58-S	brown
3344	ENSMUSG00000031242	2610002M06Rik	scl6958.1.1_328-S	turquoise
3345	ENSMUSG00000031246	Sh3bgrl	scl54681.4_59-S	turquoise
3346	ENSMUSG00000031256	Cstf2	scl54639.14_151-S	turquoise
3347	ENSMUSG00000031278	Acsl4	scl0050790.1_147-S	turquoise
3348	ENSMUSG00000031278	Acsl4	scl53773.1.1793_9-S	turquoise
3349	ENSMUSG00000031284	Pak3	scl018481.14_0-S	blue
3350	ENSMUSG00000031285	Dcx	scl0013193.1_96-S	blue
3351	ENSMUSG00000031292	Cdkl5	scl53651.15.1_42-S	yellow
3352	ENSMUSG00000031295	Phka2	scl0110094.31_17-S	turquoise
3353	ENSMUSG00000031297	Slc7a3	scl53996.13.1_171-S	brown
3354	ENSMUSG00000031299	Pdha1	scl53656.13_28-S	brown
3355	ENSMUSG00000031302	Nlgn3	scl0245537.6_116-S	blue
3356	ENSMUSG00000031302	Nlgn3	scl072991.1_200-S	blue
3357	ENSMUSG00000031310	Zmym3	scl53989.25_581-S	blue
3358	ENSMUSG00000031311	Nono	scl053610.12_290-S	turquoise
3359	ENSMUSG00000031314	Taf1	GI_38086463-S	turquoise
3360	ENSMUSG00000031328	Flna	scl54141.46.3_34-S	turquoise
3361	ENSMUSG00000031342	Gpm6b	scl014758.7_197-S	turquoise
3362	ENSMUSG00000031343	Gabra3	scl54171.15.268_23-S	brown
3363	ENSMUSG00000031347	Cetn2	scl54170.6.1_1-S	turquoise

3364	ENSMUSG00000031353	Rbbp7	scl0245688.1_74-S	red
3365	ENSMUSG00000031353	Rbbp7	scl0245688.12_1-S	turquoise
3366	ENSMUSG00000031357	Syap1	scl53624.9_65-S	turquoise
3367	ENSMUSG00000031367	Ap1s2	scl54492.8.1_0-S	red
3368	ENSMUSG00000031380	Figf	scl54487.7.1_9-S	grey
3369	ENSMUSG00000031381	Piga	scl54485.6_175-S	grey
3370	ENSMUSG00000031386	Hcfc1	scl54148.25_5-S	turquoise
3371	ENSMUSG00000031388	Ard1a	scl0056292.1_41-S	turquoise
3372	ENSMUSG00000031388	Ard1a	scl0002876.1_12-S	turquoise
3373	ENSMUSG00000031388	Ard1a	scl056292.1_247-S	turquoise
3374	ENSMUSG00000031393	Mecp2	scl0017257.1_80-S	grey
3375	ENSMUSG00000031399	Fam3a	scl54135.8_95-S	blue
3376	ENSMUSG00000031422	Morf4l2	scl056397.1_158-S	blue
3377	ENSMUSG00000031425	Plp1	scl54609.9_173-S	turquoise
3378	ENSMUSG00000031428	Zcchc18	scl54605.3_321-S	turquoise
3379	ENSMUSG00000031429	Psmd10	scl0002924.1_11-S	blue
3380	ENSMUSG00000031429	Psmd10	scl53786.5.1_4-S	blue
3381	ENSMUSG00000031431	Tsc22d3	scl0002932.1_144-S	grey
3382	ENSMUSG00000031432	Prps1	scl54584.7_603-S	turquoise
3383	ENSMUSG00000031442	Mcf2l	scl34062.34_199-S	grey
3384	ENSMUSG00000031451	Gas6	scl35076.15.1_19-S	blue
3385	ENSMUSG00000031453	Rasa3	scl0019414.2_254-S	blue
3386	ENSMUSG00000031458	2410022L05Rik	scl35070.6.62_8-S	turquoise
3387	ENSMUSG00000031479	Vps36	scl34002.14.1_30-S	blue
3388	ENSMUSG00000031483	Erlin2	scl33949.16_183-S	turquoise
3389	ENSMUSG00000031486	Gpr124	scl000050.1_4-S	turquoise
3390	ENSMUSG00000031487	Brf2	scl066653.1_40-S	blue
3391	ENSMUSG00000031502	Col4a1	scl35102.50_84-S	turquoise
3392	ENSMUSG00000031503	Col4a2	scl34083.48_466-S	turquoise
3393	ENSMUSG00000031505	Carkd	scl34081.10.510_67-S	turquoise
3394	ENSMUSG00000031508	Ankrd10	scl35096.10_154-S	turquoise
3395	ENSMUSG00000031513	Leprotl1	scl34938.5_401-S	blue
3396	ENSMUSG00000031516	Dctn6	scl34935.10.1_29-S	turquoise
3397	ENSMUSG00000031517	Gpm6a	scl000623.1_241-S	pink
3398	ENSMUSG00000031517	Gpm6a	scl0234267.8_19-S	turquoise
3399	ENSMUSG00000031532	Tmem66	scl000679.1_109-S	red
3400	ENSMUSG00000031532	Tmem66	scl33916.7_57-S	grey
3401	ENSMUSG00000031533	Mrps31	scl000735.1_34-S	brown
3402	ENSMUSG00000031536	Polb	scl018970.2_6-S	turquoise
3403	ENSMUSG00000031538	Plat	scl33993.13_72-S	turquoise
3404	ENSMUSG00000031543	Ank1	scl0011733.2_121-S	blue
3405	ENSMUSG00000031545	Agpat6	scl0102247.1_13-S	turquoise
3406	ENSMUSG00000031555	Adam9	scl35003.22_120-S	turquoise
3407	ENSMUSG00000031557	Plekha2	scl35001.15_103-S	grey
3408	ENSMUSG00000031558	Slit2	scl0020563.2_90-S	grey
3409	ENSMUSG00000031561	Odz3	scl023965.2_37-S	blue
3410	ENSMUSG00000031562	Dctd	scl33833.8_84-S	turquoise
3411	ENSMUSG00000031563	Wwc2	scl0052357.1_307-S	blue
3412	ENSMUSG00000031575	Ash2l	scl0023808.2_287-S	turquoise
3413	ENSMUSG00000031578	Mak16	scl34969.6.1_9-S	turquoise
3414	ENSMUSG00000031591	Asah1	scl000624.1_18-S	red
3415	ENSMUSG00000031591	Asah1	scl011886.1_45-S	brown
3416	ENSMUSG00000031600	Vps37a	scl33880.11_117-S	turquoise
3417	ENSMUSG00000031601	Cnot7	scl000572.1_890-S	turquoise
3418	ENSMUSG00000031605	Klhl2	scl077113.1_28-S	turquoise
3419	ENSMUSG00000031609	Sap30	scl34795.4.1_9-S	blue
3420	ENSMUSG00000031610	Scrg1	scl33805.3.1_18-S	brown
3421	ENSMUSG00000031617	Tmem184c	scl34623.10.1_30-S	turquoise
3422	ENSMUSG00000031627	Irf2	scl33841.11_453-S	brown
3423	ENSMUSG00000031631	4933411K20Rik	scl33848.6_136-S	blue
3424	ENSMUSG00000031633	Slc25a4	scl34858.4_85-S	turquoise
3425	ENSMUSG00000031634	Ufsp2	scl000603.1_82-S	red
3426	ENSMUSG00000031634	Ufsp2	scl33851.12.1_1-S	turquoise
3427	ENSMUSG00000031642	Sh3rf1	scl000575.1_1731-S	blue
3428	ENSMUSG00000031644	BC042777	scl33792.34_294-S	brown
3429	ENSMUSG00000031652	BC004022	scl34521.8.1_20-S	greenyellow
3430	ENSMUSG00000031654	Cbln1	scl34520.5_191-S	purple
3431	ENSMUSG00000031666	Rbl2	scl33521.22_145-S	grey
3432	ENSMUSG00000031668	Eif2ak3	scl29907.19_469-S	turquoise
3433	ENSMUSG00000031672	Got2	scl0014719.1_330-S	blue
3434	ENSMUSG00000031681	Smad1	scl34607.9_25-S	turquoise
3435	ENSMUSG00000031697	Orc6	scl33558.9.1_16-S	brown
3436	ENSMUSG00000031700	Gpt2	scl33556.12_71-S	blue
3437	ENSMUSG00000031708	Gpsn2	scl34581.9.1_48-S	grey
3438	ENSMUSG00000031708	Gpsn2	scl000669.1_31-S	turquoise
3439	ENSMUSG00000031709	Tbc1d9	scl33613.21_157-S	blue
3440	ENSMUSG00000031714	Gab1	scl34595.13_308-S	magenta
3441	ENSMUSG00000031715	Smarca5	scl0093762.1_285-S	turquoise
3442	ENSMUSG00000031723	Txnl4b	scl33340.4_635-S	brown
3443	ENSMUSG00000031728	Zfp821	scl33337.10_7-S	grey
3444	ENSMUSG00000031729	2400003C14Rik	scl071955.1_257-S	turquoise
3445	ENSMUSG00000031730	Dhodh	scl0056749.2_187-S	blue
3446	ENSMUSG00000031740	Mmp2	scl33502.12_190-S	green
3447	ENSMUSG00000031748	Gnao1	scl0014681.2_87-S	blue
3448	ENSMUSG00000031748	Gnao1	scl000618.1_71-S	blue
3449	ENSMUSG00000031748	Gnao1	scl33497.11_25-S	brown
3450	ENSMUSG00000031749	St3gal2	scl000601.1_1063-S	brown
3451	ENSMUSG00000031751	Amfr	scl0023802.2_62-S	blue
3452	ENSMUSG00000031755	Bbs2	scl34474.17.1_135-S	turquoise
3453	ENSMUSG00000031760	Mt3	scl017751.1_8-S	grey
3454	ENSMUSG00000031762	Mt2	scl33493.3.1_90-S	turquoise
3455	ENSMUSG00000031765	Mt1	scl017748.3_145-S	turquoise
3456	ENSMUSG00000031772	Cntnap4	scl000654.1_209-S	turquoise
3457	ENSMUSG00000031774	2310065K24Rik	scl0102122.1_65-S	turquoise
3458	ENSMUSG00000031776	Arl2bp	scl000628.1_299-S	grey
3459	ENSMUSG00000031778	Cx3cl1	scl020312.5_187-S	blue
3460	ENSMUSG00000031780	Ccl17	scl33474.3.1_12-S	grey
3461	ENSMUSG00000031781	Ciapin1	scl00109006.2_49-S	turquoise
3462	ENSMUSG00000031787	Katnb1	GI_38089556-S	blue
3463	ENSMUSG00000031796	Gtl3	scl014894.1_227-S	turquoise
3464	ENSMUSG00000031799	Tpm4	scl0326618.9_77-S	blue
3465	ENSMUSG00000031808	Slc27a1	scl33695.16.1_25-S	blue
3466	ENSMUSG00000031811	Fbxo31	scl076454.1_17-S	blue
3467	ENSMUSG00000031811	Fbxo31	scl34239.10.1_18-S	blue
3468	ENSMUSG00000031812	Map1lc3b	scl0067443.1_283-S	turquoise
3469	ENSMUSG00000031813	Fam125a	scl33697.10.1_67-S	blue
3470	ENSMUSG00000031818	Cox4i1	scl33243.5.1_27-S	turquoise
3471	ENSMUSG00000031819	Cox4nb	scl000586.1_12-S	turquoise
3472	ENSMUSG00000031823	Zdhhc7	scl34254.8_613-S	blue
3473	ENSMUSG00000031824	6430548M08Rik	scl00234797.2_307-S	yellow
3474	ENSMUSG00000031824	6430548M08Rik	scl33247.15_555-S	blue
3475	ENSMUSG00000031826	Usp10	scl022224.14_3-S	turquoise
3476	ENSMUSG00000031827	Cotl1	scl072042.2_8-S	blue
3477	ENSMUSG00000031832	Taf1c	scl021341.1_249-S	blue
3478	ENSMUSG00000031834	Pik3r2	scl34692.17.1_21-S	blue
3479	ENSMUSG00000031835	Mbtps1	scl000597.1_31-S	turquoise

3480	ENSMUSG00000031835	Mbtps1	scl34268.27.955_23-S	turquoise
3481	ENSMUSG00000031837	Necab2	scl33260.8.1_8-S	blue
3482	ENSMUSG00000031840	Rab3a	scl019339.5_272-S	brown
3483	ENSMUSG00000031843	Mphosph6	scl068533.1_32-S	brown
3484	ENSMUSG00000031848	Lsm4	scl33713.6.1_0-S	blue
3485	ENSMUSG00000031851	2310079N02Rik	scl33169.8.1_16-S	blue
3486	ENSMUSG00000031858	9130404D08Rik	scl074549.2_261-S	turquoise
3487	ENSMUSG00000031862	Atp13a1	scl33747.13.1_5-S	blue
3488	ENSMUSG00000031864	Ints10	scl0070885.2_95-S	turquoise
3489	ENSMUSG00000031864	Ints10	scl000650.1_5-S	grey
3490	ENSMUSG00000031875	Cmtm3	scl33440.8_211-S	turquoise
3491	ENSMUSG00000031878	Nae1	scl000701.1_5-S	blue
3492	ENSMUSG00000031878	Nae1	scl0234664.3_26-S	brown
3493	ENSMUSG00000031879	Fam96b	scl068523.5_22-S	turquoise
3494	ENSMUSG00000031885	Cbfb	scl33423.6_118-S	brown
3495	ENSMUSG00000031889	D230025D16Rik	scl33425.15_229-S	turquoise
3496	ENSMUSG00000031897	Psmb10	scl0019171.2_204-S	turquoise
3497	ENSMUSG00000031897	Psmb10	scl34384.4.1_27-S	brown
3498	ENSMUSG00000031903	Pla2g15	scl33390.7_348-S	blue
3499	ENSMUSG00000031906	Smpd3	scl34375.12_133-S	blue
3500	ENSMUSG00000031907	Zfp90	scl022751.4_4-S	turquoise
3501	ENSMUSG00000031913	Vps4a	scl33375.10_5-S	blue
3502	ENSMUSG00000031916	Cog8	scl097484.1_16-S	blue
3503	ENSMUSG00000031917	Nip7	scl066164.1_0-S	red
3504	ENSMUSG00000031917	Nip7	scl000639.1_71-S	brown
3505	ENSMUSG00000031921	Terf2	scl34369.10.1_11-S	brown
3506	ENSMUSG00000031924	Cyb5b	scl33370.7_212-S	grey
3507	ENSMUSG00000031925	Maml2	scl0244690.3_117-S	turquoise
3508	ENSMUSG00000031931	Ankrd49	scl36214.3_394-S	brown
3509	ENSMUSG00000031932	Gpr83	scl0014608.2_63-S	grey
3510	ENSMUSG00000031938	4931406C07Rik	scl36203.11_30-S	turquoise
3511	ENSMUSG00000031950	Gabarapl2	scl093739.4_24-S	turquoise
3512	ENSMUSG00000031954	Cfdp1	scl023837.2_17-S	brown
3513	ENSMUSG00000031955	Bcar1	scl34310.8_274-S	blue
3514	ENSMUSG00000031960	Aars	scl0234734.18_28-S	blue
3515	ENSMUSG00000031971	1700054N08Rik	scl34189.5_72-S	blue
3516	ENSMUSG00000031972	Acta1	scl34188.7.1_72-S	blue
3517	ENSMUSG00000031977	Galnt2	scl33186.17_230-S	blue
3518	ENSMUSG00000031979	Cog2	scl33184.17.37_9-S	turquoise
3519	ENSMUSG00000031983	2310022B05Rik	scl34177.5_600-S	grey
3520	ENSMUSG00000031987	Egln1	scl00112405.2_28-S	turquoise
3521	ENSMUSG00000031988	AK040818	scl36089.6_17-S	turquoise
3522	ENSMUSG00000031990	Jam3	scl0083964.2_193-S	turquoise
3523	ENSMUSG00000031993	Snx19	scl00102607.2_257-S	brown
3524	ENSMUSG00000031996	Aplp2	scl36067.18_4-S	blue
3525	ENSMUSG00000032002	Dcun1d5	scl37311.9.1_1-S	turquoise
3526	ENSMUSG00000032010	Usp2	scl37045.17.1_33-S	blue
3527	ENSMUSG00000032011	Thy1	scl37046.4_393-S	blue
3528	ENSMUSG00000032012	Pvrl1	scl0058235.1_49-S	brown
3529	ENSMUSG00000032024	9030425E11Rik	scl0071566.2_189-S	brown
3530	ENSMUSG00000032030	Cul5	scl35846.21_29-S	brown
3531	ENSMUSG00000032040	Dcps	scl36050.5.8_18-S	turquoise
3532	ENSMUSG00000032046	Abhd12	scl18519.15.1_30-S	blue
3533	ENSMUSG00000032058	Ppp2r1b	scl073699.19_34-S	turquoise
3534	ENSMUSG00000032060	Cryab	scl36966.5.1_28-S	magenta
3535	ENSMUSG00000032064	Dixdc1	scl0330938.1_96-S	turquoise
3536	ENSMUSG00000032076	Cadm1	scl0054725.2_225-S	turquoise
3537	ENSMUSG00000032076	Cadm1	scl36991.12_218-S	blue
3538	ENSMUSG00000032078	Zfp259	scl0022687.2_83-S	turquoise
3539	ENSMUSG00000032086	Bace	scl0023821.2_49-S	brown
3540	ENSMUSG00000032097	Ddx6	scl0003527.1_242-S	yellow
3541	ENSMUSG00000032101	Ddx25	scl36044.11.1_77-S	blue
3542	ENSMUSG00000032112	Trappc4	scl35956.2.1_28-S	red
3543	ENSMUSG00000032114	Slc37a4	scl014385.8_306-S	turquoise
3544	ENSMUSG00000032115	Hyou1	scl37037.27_257-S	blue
3545	ENSMUSG00000032118	Fez1	scl0003544.1_55-S	grey
3546	ENSMUSG00000032118	Fez1	scl37121.13.1_3-S	grey
3547	ENSMUSG00000032120	C2cd2l	scl35960.12_340-S	brown
3548	ENSMUSG00000032131	Abcg4	scl35962.15.2_53-S	blue
3549	ENSMUSG00000032174	Icam5	scl37234.11.1_133-S	blue
3550	ENSMUSG00000032177	Pde4a	scl0003524.1_16-S	greenyellow
3551	ENSMUSG00000032177	Pde4a	scl37231.19.1_55-S	blue
3552	ENSMUSG00000032178	Ilf3	scl016201.19_34-S	black
3553	ENSMUSG00000032178	Ilf3	scl0003466.1_62-S	turquoise
3554	ENSMUSG00000032182	Yipf2	scl36137.8_30-S	turquoise
3555	ENSMUSG00000032187	Smarca4	scl37216.34.1_23-S	blue
3556	ENSMUSG00000032192	Gnb5	scl014697.10_11-S	turquoise
3557	ENSMUSG00000032192	Gnb5	scl0003602.1_637-S	turquoise
3558	ENSMUSG00000032193	Ldlr	scl37215.15_243-S	blue
3559	ENSMUSG00000032194	Kank2	scl36131.12_27-S	turquoise
3560	ENSMUSG00000032198	Dock6	scl067539.1_109-S	turquoise
3561	ENSMUSG00000032202	Rab27a	scl36717.10_331-S	turquoise
3562	ENSMUSG00000032212	Sltm	scl0066660.1_237-S	turquoise
3563	ENSMUSG00000032212	Sltm	scl066660.3_29-S	yellow
3564	ENSMUSG00000032221	Mns1	scl36733.11.1_17-S	green
3565	ENSMUSG00000032224	Fam81a	scl35652.15_474-S	grey
3566	ENSMUSG00000032231	Anxa2	scl36760.13.1_118-S	green
3567	ENSMUSG00000032232	Cgnl1	scl068178.1_250-S	green
3568	ENSMUSG00000032238	Rora	scl0019883.1_304-S	blue
3569	ENSMUSG00000032239	rp9	scl36111.9.1_0-S	yellow
3570	ENSMUSG00000032244	Fem1b	scl35722.2_7-S	turquoise
3571	ENSMUSG00000032249	Anp32a	scl011737.7_8-S	turquoise
3572	ENSMUSG00000032281	Acsbg1	scl35836.16.1_27-S	turquoise
3573	ENSMUSG00000032285	Dnaja4	scl36939.8_109-S	grey
3574	ENSMUSG00000032288	AK030236	GI_38079581-S	blue
3575	ENSMUSG00000032288	Imp3	scl0102462.1_25-S	brown
3576	ENSMUSG00000032288	Imp3	GI_19527195-S	grey
3577	ENSMUSG00000032289	Thsd4	scl35747.13.1_171-S	grey
3578	ENSMUSG00000032295	Man2c1	scl36909.24.1_99-S	blue
3579	ENSMUSG00000032299	Commd4	scl35797.7.1_123-S	turquoise
3580	ENSMUSG00000032301	Psma4	scl026441.8_13-S	brown
3581	ENSMUSG00000032306	Mpi	scl35790.9.1_0-S	turquoise
3582	ENSMUSG00000032307	Ube2q2	scl36930.15.1_0-S	turquoise
3583	ENSMUSG00000032308	Ulk3	scl36897.12_497-S	turquoise
3584	ENSMUSG00000032312	Csk	scl012988.1_164-S	blue
3585	ENSMUSG00000032314	Etfa	scl0110842.2_3-S	turquoise
3586	ENSMUSG00000032314	Etfa	scl0003604.1_30-S	green
3587	ENSMUSG00000032324	Tspan3	scl0003580.1_5-S	pink
3588	ENSMUSG00000032329	Hmg20a	scl36919.9_243-S	turquoise
3589	ENSMUSG00000032334	Loxl1	scl0016949.2_233-S	blue
3590	ENSMUSG00000032340	Neo1	scl0018007.1_62-S	blue
3591	ENSMUSG00000032342	Mto1	scl36676.10.87_5-S	turquoise
3592	ENSMUSG00000032346	Ooep	scl35573.3.1_114-S	green
3593	ENSMUSG00000032348	Gsta4	scl36679.7.1_96-S	brown
3594	ENSMUSG00000032349	Elovl5	scl36684.10_99-S	blue
3595	ENSMUSG00000032355	2310046A06Rik	scl0069642.1_9-S	turquoise

3596	ENSMUSG00000032356	Rasgrf1	scl36632.28.1_170-S	blue
3597	ENSMUSG00000032366	Tpm1	scl35670.14_0-S	blue
3598	ENSMUSG00000032368	Zic1	scl35507.4.1_71-S	grey
3599	ENSMUSG00000032370	Lactb	scl35671.6_128-S	turquoise
3600	ENSMUSG00000032373	Car12	scl36787.11_464-S	green
3601	ENSMUSG00000032382	Snx1	scl35682.17.1_6-S	turquoise
3602	ENSMUSG00000032383	Ppib	scl36793.6.1_16-S	blue
3603	ENSMUSG00000032384	Csnk1g1	scl36794.1.1108_240-S	turquoise
3604	ENSMUSG00000032388	Spg21	scl36804.10.1_24-S	turquoise
3605	ENSMUSG00000032393	Dpp8	scl36817.19_229-S	brown
3606	ENSMUSG00000032396	Dis3l	scl35702.23.1_49-S	grey
3607	ENSMUSG00000032402	Smad3	scl35708.10_49-S	blue
3608	ENSMUSG00000032403	AK009046	scl35713.2.1_23-S	turquoise
3609	ENSMUSG00000032407	2610101N10Rik	scl0067958.1_275-S	blue
3610	ENSMUSG00000032409	Atr	scl36601.18.1_52-S	turquoise
3611	ENSMUSG00000032412	Atp1b3	scl35489.7_147-S	blue
3612	ENSMUSG00000032413	Rasa2	scl00114713.2_158-S	red
3613	ENSMUSG00000032417	Rwdd2a	scl36646.3.1_24-S	brown
3614	ENSMUSG00000032422	Snx14	scl35520.27.10_5-S	turquoise
3615	ENSMUSG00000032423	Syncrip	scl35519.13_74-S	blue
3616	ENSMUSG00000032434	Cmtm6	scl36385.5_13-S	grey
3617	ENSMUSG00000032435	AK180240	scl068820.2_140-S	blue
3618	ENSMUSG00000032435	Dync1li1	scl0235661.13_50-S	blue
3619	ENSMUSG00000032440	Tgfbr2	scl0003424.1_2300-S	green
3620	ENSMUSG00000032458	Copb2	scl36580.22.1_188-S	brown
3621	ENSMUSG00000032462	Pik3cb	scl35462.25_609-S	grey
3622	ENSMUSG00000032463	Faim	scl36575.5.1_23-S	grey
3623	ENSMUSG00000032468	Armc8	scl0003496.1_3-S	red
3624	ENSMUSG00000032468	Armc8	scl0003593.1_5-S	turquoise
3625	ENSMUSG00000032468	Armc8	scl074125.2_27-S	red
3626	ENSMUSG00000032469	Dbr1	scl36570.9.1_64-S	grey
3627	ENSMUSG00000032480	Dhx30	scl35324.20.1_127-S	blue
3628	ENSMUSG00000032481	Smarcc1	scl020588.27_42-S	grey
3629	ENSMUSG00000032482	Cspg5	scl36437.4.1700_28-S	black
3630	ENSMUSG00000032485	Scap	scl36431.25.1_92-S	brown
3631	ENSMUSG00000032498	Mlh1	scl35303.18.1_6-S	grey
3632	ENSMUSG00000032500	Dclk3	scl36405.5.1_303-S	blue
3633	ENSMUSG00000032503	Arpp21	scl0003493.1_408-S	purple
3634	ENSMUSG00000032519	Slc25a38	scl36342.8.1_2-S	turquoise
3635	ENSMUSG00000032523	Hhatl	scl35195.14.1_5-S	grey
3636	ENSMUSG00000032526	Deb1	scl026901.3_41-S	blue
3637	ENSMUSG00000032527	Pccb	scl35445.15.1_13-S	turquoise
3638	ENSMUSG00000032532	Cck	scl35202.5.1_0-S	grey
3639	ENSMUSG00000032536	Trak1	scl067095.2_231-S	turquoise
3640	ENSMUSG00000032537	Ephb1	scl35435.17_108-S	blue
3641	ENSMUSG00000032547	Ryk	scl36548.17_86-S	grey
3642	ENSMUSG00000032549	Rab6b	scl0270192.9_201-S	blue
3643	ENSMUSG00000032553	Srprb	scl020818.5_51-S	blue
3644	ENSMUSG00000032554	Trf	scl022041.3_13-S	magenta
3645	ENSMUSG00000032557	Uba5	scl35421.10.1_30-S	brown
3646	ENSMUSG00000032560	Dnajc13	scl00235567.1_50-S	turquoise
3647	ENSMUSG00000032562	Gnai2	scl35368.9_193-S	blue
3648	ENSMUSG00000032565	Nudt16	scl35414.1_2-S	blue
3649	ENSMUSG00000032570	PMR1	scl0235574.1_14-S	pink
3650	ENSMUSG00000032579	Hemk1	scl35377.11.1_104-S	green
3651	ENSMUSG00000032580	Rbm5	scl0003447.1_0-S	yellow
3652	ENSMUSG00000032583	Mon1a	scl36488.7.1_49-S	blue
3653	ENSMUSG00000032590	Apeh	scl35358.15.1_146-S	grey
3654	ENSMUSG00000032594	Ip6k1	scl027399.1_171-S	blue
3655	ENSMUSG00000032598	Nckipsd	scl36455.12.1_30-S	blue
3656	ENSMUSG00000032599	Ihpk2	scl36454.7.1_119-S	grey
3657	ENSMUSG00000032601	Prkar2a	scl0019087.2_280-S	turquoise
3658	ENSMUSG00000032612	Usp4	scl36473.24.9_6-S	turquoise
3659	ENSMUSG00000032615	Nt5m	scl0103850.4_86-S	blue
3660	ENSMUSG00000032624	Eml4	scl0078798.2_83-S	red
3661	ENSMUSG00000032633	Flcn	scl40154.14_234-S	grey
3662	ENSMUSG00000032640	Chsy1	GI_38086849-S	brown
3663	ENSMUSG00000032641	Gpr19	scl28296.6_592-S	grey
3664	ENSMUSG00000032666	1700025G04Rik	scl16161.8_304-S	turquoise
3665	ENSMUSG00000032667	Pon2	scl0330260.1_61-S	green
3666	ENSMUSG00000032698	Lmo2	scl016909.6_211-S	grey
3667	ENSMUSG00000032705	Exd2	scl43030.13_217-S	grey
3668	ENSMUSG00000032712	2810474O19Rik	scl067246.4_216-S	turquoise
3669	ENSMUSG00000032727	Mier3	scl44383.15_255-S	red
3670	ENSMUSG00000032741	Tpcn1	scl00252972.1_246-S	brown
3671	ENSMUSG00000032743	D430042O09Rik	scl32066.25_84-S	grey
3672	ENSMUSG00000032745	Gpbp1	scl073274.2_7-S	brown
3673	ENSMUSG00000032763	Ilvbl	scl38724.13_60-S	turquoise
3674	ENSMUSG00000032786	Alas1	scl35398.12.2_77-S	blue
3675	ENSMUSG00000032802	Srxn1	scl0076650.1_42-S	turquoise
3676	ENSMUSG00000032802	Srxn1	scl076650.2_28-S	pink
3677	ENSMUSG00000032802	Srxn1	scl076650.2_4-S	turquoise
3678	ENSMUSG00000032807	Alox12b	scl41375.14.1_15-S	blue
3679	ENSMUSG00000032816	Igdcc4	scl36816.23_421-S	grey
3680	ENSMUSG00000032826	Ank2	scl00109676.2_66-S	blue
3681	ENSMUSG00000032826	Ank2	scl21538.56_207-S	turquoise
3682	ENSMUSG00000032827	Ppp1r9a	scl30419.24_421-S	brown
3683	ENSMUSG00000032834	Pwp2	scl37772.15_266-S	turquoise
3684	ENSMUSG00000032850	Rnft2	scl26132.13_30-S	blue
3685	ENSMUSG00000032854	Ugt8a	scl21552.7_36-S	blue
3686	ENSMUSG00000032855	Pkd1	scl51011.43_30-S	turquoise
3687	ENSMUSG00000032869	Psmf1	scl00228769.2_248-S	blue
3688	ENSMUSG00000032870	Smap2	scl23878.10_23-S	blue
3689	ENSMUSG00000032892	Rangrf	scl057785.2_9-S	turquoise
3690	ENSMUSG00000032898	Fbxo21	scl27314.13_303-S	black
3691	ENSMUSG00000032925	Itgbl1	scl00223272.2_246-S	magenta
3692	ENSMUSG00000032936	Camkv	scl36485.10_349-S	blue
3693	ENSMUSG00000032939	Nup93	scl0071805.2_3-S	turquoise
3694	ENSMUSG00000032940	Rbm11	scl00224344.2_231-S	grey
3695	ENSMUSG00000032966	Fkbp1a	scl0003181.1_45-S	blue
3696	ENSMUSG00000032977	1810008A18Rik	scl37784.7_145-S	blue
3697	ENSMUSG00000032988	Slc16a8	scl46970.5_134-S	green
3698	ENSMUSG00000032997	Chpf	scl16594.5_443-S	brown
3699	ENSMUSG00000032998	Foxj3	scl0230700.13_329-S	turquoise
3700	ENSMUSG00000033009	Ogfod1	scl33496.14_17-S	blue
3701	ENSMUSG00000033014	Trim33	scl22787.1.77_17-S	blue
3702	ENSMUSG00000033014	Trim33	scl0094093.2_245-S	turquoise
3703	ENSMUSG00000033020	Polr2f	scl47751.3.4_1-S	turquoise
3704	ENSMUSG00000033021	Gmppa	scl0069080.2_160-S	blue
3705	ENSMUSG00000033029	1700088E04Rik	scl027660.1_217-S	brown
3706	ENSMUSG00000033039	Micall1	scl0027008.1_147-S	turquoise
3707	ENSMUSG00000033047	Eif3l	scl0002578.1_9-S	blue
3708	ENSMUSG00000033047	Eif3l	scl47754.11.388_4-S	turquoise
3709	ENSMUSG00000033060	Lmo7	GI_38076620-S	turquoise
3710	ENSMUSG00000033061	Resp18	scl16596.6.1_82-S	grey
3711	ENSMUSG00000033065	Pfkm	scl0018642.1_78-S	blue

3712	ENSMUSG00000033068	Entpd6	scl20142.14.1_120-S	blue
3713	ENSMUSG00000033088	Triobp	scl0002552.1_594-S	magenta
3714	ENSMUSG00000033088	Triobp	scl0110253.14_323-S	magenta
3715	ENSMUSG00000033096	2310001A20Rik	scl18523.10_225-S	brown
3716	ENSMUSG00000033102	Cdc14b	scl00218294.2_195-S	turquoise
3717	ENSMUSG00000033124	Atg9a	scl0245860.3_111-S	blue
3718	ENSMUSG00000033128	Gga1	scl00106039.1_65-S	blue
3719	ENSMUSG00000033161	Atp1a1	scl21752.24.8_3-S	blue
3720	ENSMUSG00000033174	Mgll	scl0001197.1_14-S	turquoise
3721	ENSMUSG00000033174	Mgll	scl29767.12_42-S	brown
3722	ENSMUSG00000033184	AK029576	GI_38083572-S	red
3723	ENSMUSG00000033208	S100b	scl020203.1_66-S	turquoise
3724	ENSMUSG00000033214	Slitrk5	scl45992.1.277_250-S	greenyellow
3725	ENSMUSG00000033228	Sfrs2ip	scl072193.1_10-S	turquoise
3726	ENSMUSG00000033237	Arid2	scl077044.6_17-S	turquoise
3727	ENSMUSG00000033272	Slc35a4	scl067843.3_172-S	blue
3728	ENSMUSG00000033287	Kctd17	GI_38077842-S	blue
3729	ENSMUSG00000033287	Kctd17	scl072844.1_278-S	blue
3730	ENSMUSG00000033294	Noc4l	scl26224.14.1_3-S	blue
3731	ENSMUSG00000033342	4833424O15Rik	scl22688.6_553-S	turquoise
3732	ENSMUSG00000033350	Chst2	scl0054371.1_300-S	blue
3733	ENSMUSG00000033352	Map2k4	scl40072.13_201-S	blue
3734	ENSMUSG00000033365	Ipo13	scl23927.19.1_34-S	blue
3735	ENSMUSG00000033377	Palmd	scl21601.6.1_41-S	grey
3736	ENSMUSG00000033382	D030074E01Rik	scl075964.2_56-S	blue
3737	ENSMUSG00000033389	AU040829	scl40078.22.435_203-S	blue
3738	ENSMUSG00000033419	mKIAA0656	scl35528.21.6_0-S	pink
3739	ENSMUSG00000033419	Snap91	scl020616.1_75-S	turquoise
3740	ENSMUSG00000033420	Antxr1	scl28741.20.2224_6-S	green
3741	ENSMUSG00000033423	Prnpip1	scl0002598.1_1-S	pink
3742	ENSMUSG00000033423	Prnpip1	scl25049.13.1_0-S	blue
3743	ENSMUSG00000033430	Terf2ip	scl057321.4_17-S	turquoise
3744	ENSMUSG00000033436	Armcx2	scl067416.1_190-S	blue
3745	ENSMUSG00000033444	mKIAA0376	scl38765.21_246-S	turquoise
3746	ENSMUSG00000033460	Armcx1	scl54629.5_192-S	turquoise
3747	ENSMUSG00000033487	Fndc3a	scl00319448.2_96-S	red
3748	ENSMUSG00000033510	Otud7a	scl32590.14.1_290-S	blue
3749	ENSMUSG00000033526	Hisppd2a	scl18763.35.1_291-S	blue
3750	ENSMUSG00000033530	Ttc7b	scl42149.21_128-S	blue
3751	ENSMUSG00000033545	Znrf1	scl0170737.5_30-S	yellow
3752	ENSMUSG00000033557	Fam20b	scl0215015.1_6-S	greenyellow
3753	ENSMUSG00000033565	Rbm9	scl093686.1_1-S	yellow
3754	ENSMUSG00000033569	Bai3	scl00210933.2_330-S	turquoise
3755	ENSMUSG00000033569	Bai3	scl16911.32.1_67-S	grey
3756	ENSMUSG00000033577	Myo6	scl36669.38.1_11-S	blue
3757	ENSMUSG00000033578	Tmem35	scl54637.2_201-S	grey
3758	ENSMUSG00000033579	Fa2h	scl0338521.2_75-S	magenta
3759	ENSMUSG00000033585	Ndn	scl32592.2.658_11-S	blue
3760	ENSMUSG00000033594	Spata2L	scl078779.1_155-S	blue
3761	ENSMUSG00000033595	Lgi3	scl46124.8.1_10-S	blue
3762	ENSMUSG00000033597	Caskin1	scl0268932.5_13-S	blue
3763	ENSMUSG00000033615	Cplx1	scl26249.4_662-S	blue
3764	ENSMUSG00000033628	Pik3c3	scl52158.26.1_1-S	turquoise
3765	ENSMUSG00000033629	Ptplad1	scl0057874.1_260-S	blue
3766	ENSMUSG00000033653	Vps8	scl0209018.32_127-S	turquoise
3767	ENSMUSG00000033653	Vps8	scl49324.37.1_0-S	pink
3768	ENSMUSG00000033676	Gabrb3	scl0014402.2_185-S	pink
3769	ENSMUSG00000033676	Gabrb3	scl32600.10_229-S	grey
3770	ENSMUSG00000033684	Qsox1	scl16114.13_1-S	blue
3771	ENSMUSG00000033685	Ucp2	scl00035.1_45-S	grey
3772	ENSMUSG00000033697	D15Wsu169e	scl47029.15_63-S	blue
3773	ENSMUSG00000033701	Acbd6	scl17348.11.20_75-S	blue
3774	ENSMUSG00000033703	Fuk	scl34329.24.1_1-S	black
3775	ENSMUSG00000033707	Lrrc24	scl0378937.1_229-S	blue
3776	ENSMUSG00000033717	Adra2a	scl52981.3.767_203-S	blue
3777	ENSMUSG00000033720	Sfxn5	scl28768.18.1930_9-S	yellow
3778	ENSMUSG00000033722	BC034090	scl16121.8.1_163-S	magenta
3779	ENSMUSG00000033732	Sf3b3	scl34330.23.1_25-S	turquoise
3780	ENSMUSG00000033735	Spr	scl28771.4_14-S	turquoise
3781	ENSMUSG00000033768	Nrxn2	scl018190.1_20-S	blue
3782	ENSMUSG00000033769	mKIAA0919	scl0075914.1_304-S	grey
3783	ENSMUSG00000033773	Rpap2	scl0231571.13_44-S	brown
3784	ENSMUSG00000033773	Rpap2	GI_21450300-S	blue
3785	ENSMUSG00000033792	Atp7a	scl0011977.1_52-S	green
3786	ENSMUSG00000033805	Ephx4	GI_38080441-S	purple
3787	ENSMUSG00000033819	Ppp1r16a	scl47788.9.1_15-S	turquoise
3788	ENSMUSG00000033821	AK045595	scl0328644.3_317-S	purple
3789	ENSMUSG00000033862	AK188812	scl000705.1_51-S	turquoise
3790	ENSMUSG00000033862	Cdk10	scl00234854.1_10-S	pink
3791	ENSMUSG00000033862	Cdk10	scl000606.1_3-S	turquoise
3792	ENSMUSG00000033862	Cdk10	scl0234854.13_245-S	blue
3793	ENSMUSG00000033863	Klf9	scl53274.2_128-S	yellow
3794	ENSMUSG00000033871	Ppargc1b	scl0170826.1_122-S	greenyellow
3795	ENSMUSG00000033880	Lgals3bp	scl39273.6_263-S	green
3796	ENSMUSG00000033900	Mtap9	scl075994.1_160-S	grey
3797	ENSMUSG00000033902	Mapkbp1	scl20407.30.36_15-S	turquoise
3798	ENSMUSG00000033904	6330503K22Rik	scl0101565.9_22-S	blue
3799	ENSMUSG00000033909	Usp36	scl0072344.1_165-S	black
3800	ENSMUSG00000033910	Gucy1a3	scl0060596.1_205-S	purple
3801	ENSMUSG00000033916	Chmp2a	scl000160.1_38-S	brown
3802	ENSMUSG00000033916	Chmp2a	scl31746.2.26_98-S	turquoise
3803	ENSMUSG00000033917	Gde1	scl30753.7.1_3-S	turquoise
3804	ENSMUSG00000033933	Vhl	scl29623.5_373-S	turquoise
3805	ENSMUSG00000033938	Ndufb7	scl066916.1_19-S	brown
3806	ENSMUSG00000033940	6720456B07Rik	scl29626.4_8-S	turquoise
3807	ENSMUSG00000033960	9430020K01Rik	scl068804.1_158-S	turquoise
3808	ENSMUSG00000033965	Slc16a2	scl53954.7_10-S	turquoise
3809	ENSMUSG00000033981	Gria2	scl0014800.2_192-S	blue
3810	ENSMUSG00000033983	Coil	scl41054.7_53-S	turquoise
3811	ENSMUSG00000034006	Pqlc1	scl066943.7_225-S	yellow
3812	ENSMUSG00000034021	Pds5b	scl00100710.2_193-S	red
3813	ENSMUSG00000034021	Pds5b	scl0004176.1_1597-S	blue
3814	ENSMUSG00000034022	Cpsf1	scl47038.26.1_10-S	blue
3815	ENSMUSG00000034024	Cct2	scl37474.12.36_46-S	turquoise
3816	ENSMUSG00000034040	Wbscr17	scl25990.12.1_131-S	blue
3817	ENSMUSG00000034055	Phka1	scl0002905.1_92-S	turquoise
3818	ENSMUSG00000034059	Ypel4	GI_20840808-S	turquoise
3819	ENSMUSG00000034064	Ktelc1	scl00224143.2_195-S	blue
3820	ENSMUSG00000034083	C130022K22Rik	scl29739.10.1_239-S	brown
3821	ENSMUSG00000034098	Fstl5	scl0213262.16_329-S	turquoise
3822	ENSMUSG00000034108	Ccs	scl53474.8.1_75-S	grey
3823	ENSMUSG00000034111	Tmed8	scl3444.1.1_120-S	turquoise
3824	ENSMUSG00000034118	Tpst1	scl022021.6_75-S	blue
3825	ENSMUSG00000034120	Sfrs2	scl020382.2_66-S	turquoise
3826	ENSMUSG00000034135	BC033915	scl070661.5_4-S	blue
3827	ENSMUSG00000034152	Exoc3	scl0211446.1_21-S	grey

3828	ENSMUSG00000034156	Bzrap1	scl0207777.9_233-S	blue
3829	ENSMUSG00000034157	2310044G17Rik	scl00217732.2_273-S	turquoise
3830	ENSMUSG00000034157	2310044G17Rik	scl42940.8_203-S	grey
3831	ENSMUSG00000034160	Ogt	scl00108155.2_325-S	blue
3832	ENSMUSG00000034160	Ogt	scl54735.22_173-S	turquoise
3833	ENSMUSG00000034163	Zfc3h1	scl0216345.21_201-S	brown
3834	ENSMUSG00000034187	Nsf	scl39472.24_150-S	blue
3835	ENSMUSG00000034189	Hsdl1	scl34266.7_421-S	turquoise
3836	ENSMUSG00000034190	Chmp7	scl45363.6_489-S	blue
3837	ENSMUSG00000034192	Lsm3	scl067678.4_130-S	brown
3838	ENSMUSG00000034194	R3hcc1	scl45364.8.1_112-S	blue
3839	ENSMUSG00000034201	Gas2l1	scl0078926.2_61-S	blue
3840	ENSMUSG00000034203	Chchd4	scl28683.3_131-S	grey
3841	ENSMUSG00000034209	Rasl10a	scl41877.4.1_1-S	blue
3842	ENSMUSG00000034210	4732418C07Rik	scl00230648.1_86-S	grey
3843	ENSMUSG00000034220	Gpc1	scl0014733.2_286-S	blue
3844	ENSMUSG00000034235	Usp54	scl45854.5_74-S	turquoise
3845	ENSMUSG00000034243	Golgb1	scl49173.10.1_50-S	turquoise
3846	ENSMUSG00000034245	Hdac11	scl29747.11_233-S	turquoise
3847	ENSMUSG00000034247	Plekhm1	scl39478.12_629-S	brown
3848	ENSMUSG00000034248	Slc25a37	scl45372.3_35-S	grey
3849	ENSMUSG00000034263	2010321M09Rik	scl36820.13_122-S	turquoise
3850	ENSMUSG00000034265	Zdhhc14	scl00224454.2_102-S	blue
3851	ENSMUSG00000034269	Setd5	scl29642.23_305-S	turquoise
3852	ENSMUSG00000034271	Jdp2	scl42956.7_401-S	brown
3853	ENSMUSG00000034274	Thoc5	scl0107829.17_13-S	turquoise
3854	ENSMUSG00000034295	Fhod3	scl0225288.15_175-S	turquoise
3855	ENSMUSG00000034300	Fam53c	scl066306.4_122-S	turquoise
3856	ENSMUSG00000034317	Trim59	scl22076.2_386-S	turquoise
3857	ENSMUSG00000034333	Zbed4	scl0223773.9_321-S	turquoise
3858	ENSMUSG00000034341	Wbp2	scl39318.8_348-S	blue
3859	ENSMUSG00000034353	Ramp1	scl17654.5.1_10-S	turquoise
3860	ENSMUSG00000034361	Cpne2	scl33481.17.1_142-S	blue
3861	ENSMUSG00000034377	Tulp4	scl068842.1_129-S	grey
3862	ENSMUSG00000034390	mKIAA1694	scl074440.16_72-S	greenyellow
3863	ENSMUSG00000034403	Pja1	scl018744.1_4-S	turquoise
3864	ENSMUSG00000034403	Pja1	scl0002962.1_181-S	pink
3865	ENSMUSG00000034453	Polr3b	scl070428.20_289-S	turquoise
3866	ENSMUSG00000034462	Pkd2	scl27505.17_595-S	brown
3867	ENSMUSG00000034463	Scara3	scl45410.6_648-S	grey
3868	ENSMUSG00000034467	Dynlrb2	scl33281.4.1_129-S	green
3869	ENSMUSG00000034484	Snx2	scl0002189.1_18-S	turquoise
3870	ENSMUSG00000034484	Snx2	scl067804.15_75-S	blue
3871	ENSMUSG00000034486	Gbx2	scl16491.2.1_166-S	grey
3872	ENSMUSG00000034525	mKIAA0947	scl0218333.1_228-S	turquoise
3873	ENSMUSG00000034525	mKIAA0947	scl43777.6.1_2-S	red
3874	ENSMUSG00000034543	Morc2a	scl074522.7_319-S	blue
3875	ENSMUSG00000034544	Rsrc1	scl23114.14_378-S	brown
3876	ENSMUSG00000034557	Zfyve9	scl0002744.1_1-S	brown
3877	ENSMUSG00000034560	A230046K03Rik	scl38623.34_689-S	brown
3878	ENSMUSG00000034570	Inpp5j	scl40598.13.96_215-S	blue
3879	ENSMUSG00000034574	Daam1	scl43124.28_0-S	turquoise
3880	ENSMUSG00000034575	Pols	scl0210106.1_119-S	blue
3881	ENSMUSG00000034586	C630004H02Rik	scl39341.19.1_29-S	blue
3882	ENSMUSG00000034593	Myo5a	scl36701.41_34-S	grey
3883	ENSMUSG00000034593	Myo5a	scl36699.4_279-S	grey
3884	ENSMUSG00000034602	Mon2	scl0067074.2_293-S	blue
3885	ENSMUSG00000034614	Pik3ip1	scl41909.3_17-S	turquoise
3886	ENSMUSG00000034616	Ssh3	scl0245857.15_50-S	blue
3887	ENSMUSG00000034620	Tmem5	scl00216395.2_163-S	turquoise
3888	ENSMUSG00000034621	BC035255	scl0237943.1_29-S	blue
3889	ENSMUSG00000034648	Lrrn1	scl29678.2_366-S	blue
3890	ENSMUSG00000034653	BC037178	scl52003.17_261-S	turquoise
3891	ENSMUSG00000034659	Tmem109	scl52741.7_234-S	turquoise
3892	ENSMUSG00000034667	Xpot	scl076284.1_94-S	grey
3893	ENSMUSG00000034673	Pbx2	scl50819.9_414-S	blue
3894	ENSMUSG00000034674	Tdg	scl021665.1_179-S	turquoise
3895	ENSMUSG00000034675	Dbn1	scl43923.16.1_30-S	blue
3896	ENSMUSG00000034681	Rnps1	scl51016.8.1_19-S	blue
3897	ENSMUSG00000034701	Neurod1	scl19085.2_285-S	turquoise
3898	ENSMUSG00000034707	Gns	scl38366.14_414-S	blue
3899	ENSMUSG00000034708	Grn	scl40859.13.1_14-S	blue
3900	ENSMUSG00000034723	Tmx4	scl18613.8_123-S	blue
3901	ENSMUSG00000034731	Dgkh	scl000401.1_34-S	grey
3902	ENSMUSG00000034744	Nagk	scl0001171.1_13-S	turquoise
3903	ENSMUSG00000034744	Nagk	scl29832.6.7_1-S	turquoise
3904	ENSMUSG00000034771	Tle2	scl0003859.1_7-S	turquoise
3905	ENSMUSG00000034771	Tle2	scl38645.19.1_1-S	turquoise
3906	ENSMUSG00000034780	AK018190	scl20847.1.1_254-S	turquoise
3907	ENSMUSG00000034781	Gna11	scl0003767.1_12-S	blue
3908	ENSMUSG00000034781	Gna11	scl0003816.1_114-S	blue
3909	ENSMUSG00000034781	Gna11	scl37690.5.564_26-S	blue
3910	ENSMUSG00000034781	Gna11	scl0003933.1_1635-S	blue
3911	ENSMUSG00000034789	Rab24	scl067793.9_15-S	turquoise
3912	ENSMUSG00000034793	G6pc3	scl0001294.1_4-S	blue
3913	ENSMUSG00000034793	G6pc3	scl40865.6.1_13-S	blue
3914	ENSMUSG00000034796	Cpne7	scl33212.10.1_24-S	blue
3915	ENSMUSG00000034807	Glt25d1	scl33692.10_16-S	grey
3916	ENSMUSG00000034813	Grip1	scl0074053.2_257-S	greenyellow
3917	ENSMUSG00000034813	Grip1	scl38386.32_176-S	grey
3918	ENSMUSG00000034820	5730453I16Rik	scl00269061.2_126-S	red
3919	ENSMUSG00000034825	Nrip3	scl30829.8_606-S	grey
3920	ENSMUSG00000034839	Larp6	scl067557.3_10-S	brown
3921	ENSMUSG00000034845	Plvap	scl34674.6.1_40-S	blue
3922	ENSMUSG00000034858	BC031353	scl0235493.12_117-S	brown
3923	ENSMUSG00000034868	Myl12b	scl067938.1_193-S	grey
3924	ENSMUSG00000034868	Myl12b	scl0001718.1_14-S	red
3925	ENSMUSG00000034875	Nudt19	scl31469.3.28_7-S	grey
3926	ENSMUSG00000034889	2510012J08Rik	GI_38090577-S	blue
3927	ENSMUSG00000034889	2510012J08Rik	scl070312.7_310-S	blue
3928	ENSMUSG00000034891	Sncb	scl43935.7_206-S	brown
3929	ENSMUSG00000034893	Cog3	scl45300.23_484-S	brown
3930	ENSMUSG00000034908	Sidt2	scl000039.1_11-S	turquoise
3931	ENSMUSG00000034908	Sidt2	scl35917.28_89-S	blue
3932	ENSMUSG00000034912	Mdga2	scl00320772.1_270-S	yellow
3933	ENSMUSG00000034926	Dhcr24	scl25176.1.2_129-S	blue
3934	ENSMUSG00000034928	Rnf44	scl0105239.1_62-S	blue
3935	ENSMUSG00000034932	Mrpl54	scl37704.3.1_30-S	green
3936	ENSMUSG00000034936	Arl4d	scl40873.2_406-S	magenta
3937	ENSMUSG00000034940	Ap1gbp1	GI_34996506-S	blue
3938	ENSMUSG00000034940	Ap1gbp1	scl41124.9_150-S	blue
3939	ENSMUSG00000034951	Cog7	scl0233824.2_3-S	blue
3940	ENSMUSG00000034957	Cebpa	scl012606.3_81-S	blue
3941	ENSMUSG00000034981	9130213B05Rik	scl00231440.1_287-S	blue
3942	ENSMUSG00000034981	9130213B05Rik	scl27589.4_81-S	blue
3943	ENSMUSG00000034994	Eef2	scl0013629.1_11-S	pink

3944	ENSMUSG00000034994	Eef2	scl013629.6_24-S	pink
3945	ENSMUSG00000034994	Eef2	scl013629.14_1-S	blue
3946	ENSMUSG00000035007	Rundc1	scl40882.5_302-S	blue
3947	ENSMUSG00000035011	Zbtb7a	scl0016969.1_242-S	greenyellow
3948	ENSMUSG00000035027	Map2k2	scl38665.9.1_23-S	blue
3949	ENSMUSG00000035049	Rrp12	scl0107094.1_210-S	brown
3950	ENSMUSG00000035051	Dhx57	scl49586.23.1_29-S	turquoise
3951	ENSMUSG00000035062	Zc4h2	GI_38087200-S	brown
3952	ENSMUSG00000035069	Oma1	scl25200.12.1_24-S	turquoise
3953	ENSMUSG00000035086	Becn1	scl0056208.2_9-S	turquoise
3954	ENSMUSG00000035104	Fam176a	scl29861.5_188-S	blue
3955	ENSMUSG00000035139	Secisbp2	scl44775.16.1_15-S	turquoise
3956	ENSMUSG00000035150	Eif2s3x	scl54038.12_59-S	brown
3957	ENSMUSG00000035168	Tanc1	scl066860.1_6-S	turquoise
3958	ENSMUSG00000035189	Ano4	GI_20865051-S	turquoise
3959	ENSMUSG00000035198	Tubg1	scl40893.11.1_49-S	blue
3960	ENSMUSG00000035199	Arl6ip5	scl0001044.1_79-S	red
3961	ENSMUSG00000035199	Arl6ip5	scl29713.3_34-S	turquoise
3962	ENSMUSG00000035206	3110056O03Rik	scl38670.16_420-S	blue
3963	ENSMUSG00000035228	Ccdc106	scl0232821.5_303-S	blue
3964	ENSMUSG00000035236	A930041I02Rik	scl0329395.1_255-S	turquoise
3965	ENSMUSG00000035246	Pcyt1b	scl54788.9_612-S	turquoise
3966	ENSMUSG00000035247	Hectd1	scl0002306.1_28-S	turquoise
3967	ENSMUSG00000035248	Zcchc6	scl00214290.1_251-S	grey
3968	ENSMUSG00000035248	Zcchc6	scl0214290.2_34-S	turquoise
3969	ENSMUSG00000035274	Tpbg	scl0021983.2_246-S	grey
3970	ENSMUSG00000035275	Raver2	scl25228.16_571-S	turquoise
3971	ENSMUSG00000035285	Nat14	scl0269854.3_319-S	turquoise
3972	ENSMUSG00000035297	Cops4	scl026891.10_198-S	blue
3973	ENSMUSG00000035297	Cops4	scl27538.6.1001_4-S	blue
3974	ENSMUSG00000035314	Gdpd5	scl0233552.18_262-S	purple
3975	ENSMUSG00000035342	Lzts2	scl0226154.4_125-S	turquoise
3976	ENSMUSG00000035354	Uvrag	scl31012.23.455_0-S	blue
3977	ENSMUSG00000035370	Scamp4	scl38678.9_100-S	brown
3978	ENSMUSG00000035372	1810055G02Rik	scl52790.5_512-S	blue
3979	ENSMUSG00000035376	Ptplb	scl47100.1.18_67-S	turquoise
3980	ENSMUSG00000035382	Pcsk7	scl018554.17_162-S	turquoise
3981	ENSMUSG00000035392	Dennd1a	scl19362.25_47-S	blue
3982	ENSMUSG00000035401	2210018M11Rik	scl00233545.1_305-S	yellow
3983	ENSMUSG00000035413	Tmem98	scl41166.7_90-S	green
3984	ENSMUSG00000035431	Sstr1	scl43185.2_219-S	grey
3985	ENSMUSG00000035437	Rabgap1	scl0227800.12_249-S	brown
3986	ENSMUSG00000035441	Myo1d	scl39850.23_57-S	magenta
3987	ENSMUSG00000035443	Thyn1	scl37183.6.1_31-S	turquoise
3988	ENSMUSG00000035459	Stab2	scl37657.36.1_139-S	grey
3989	ENSMUSG00000035478	Mbd3	scl37735.5.1_7-S	blue
3990	ENSMUSG00000035486	Plk5	scl38681.14.1_267-S	blue
3991	ENSMUSG00000035495	BC057893	scl0272027.1_270-S	turquoise
3992	ENSMUSG00000035504	Reep6	scl38682.6_297-S	blue
3993	ENSMUSG00000035505	Cox18	scl26399.6.849_28-S	blue
3994	ENSMUSG00000035529	Prdm4	scl37667.13_1-S	turquoise
3995	ENSMUSG00000035547	Capn5	scl31022.12_350-S	blue
3996	ENSMUSG00000035559	Mpv17l2	scl34694.5.9_23-S	blue
3997	ENSMUSG00000035566	Pcdh17	GI_38076487-S	greenyellow
3998	ENSMUSG00000035569	Ankrd11	scl34205.11.307_7-S	yellow
3999	ENSMUSG00000035569	Ankrd11	scl34210.5.1_30-S	blue
4000	ENSMUSG00000035569	Ankrd11	GI_38089455-S	brown
4001	ENSMUSG00000035575	Utp6	scl00216987.2_51-S	grey
4002	ENSMUSG00000035596	Mboat7	scl31831.6_332-S	blue
4003	ENSMUSG00000035597	Prpf39	scl43172.15_129-S	turquoise
4004	ENSMUSG00000035615	Frmpd1	scl25475.13_629-S	turquoise
4005	ENSMUSG00000035620	Ric8b	scl0237422.9_211-S	blue
4006	ENSMUSG00000035621	Midn	scl38691.9.1510_67-S	blue
4007	ENSMUSG00000035623	AK021117	scl9432.1.1_2-S	blue
4008	ENSMUSG00000035629	1700021K19Rik	scl48541.22_313-S	blue
4009	ENSMUSG00000035637	Grhpr	scl25480.9.1_148-S	blue
4010	ENSMUSG00000035640	Dos	GI_38090565-S	blue
4011	ENSMUSG00000035640	Dos	scl0216164.1_206-S	blue
4012	ENSMUSG00000035642	1810020D17Rik	scl31031.8.1_28-S	brown
4013	ENSMUSG00000035649	Zcchc7	scl25485.5.1_26-S	brown
4014	ENSMUSG00000035649	Zcchc7	scl25487.7_691-S	blue
4015	ENSMUSG00000035653	Lrfn5	scl43177.7.1267_38-S	turquoise
4016	ENSMUSG00000035674	Ndufa3	scl33146.4.49_0-S	brown
4017	ENSMUSG00000035696	Rnf38	scl24381.3.573_10-S	turquoise
4018	ENSMUSG00000035711	Dok3	scl43920.5.585_30-S	grey
4019	ENSMUSG00000035722	Abca7	scl38697.44.1_55-S	blue
4020	ENSMUSG00000035757	1300018J18Rik	scl47626.7.1_0-S	turquoise
4021	ENSMUSG00000035764	Fbxo45	scl48554.2.791_84-S	turquoise
4022	ENSMUSG00000035765	Dym	scl51764.24.1_222-S	blue
4023	ENSMUSG00000035776	Cd99l2	scl0002942.1_1346-S	red
4024	ENSMUSG00000035776	Cd99l2	scl54178.10_163-S	brown
4025	ENSMUSG00000035781	C030046I01Rik	scl00109284.2_77-S	turquoise
4026	ENSMUSG00000035781	C030046I01Rik	scl37746.9_45-S	blue
4027	ENSMUSG00000035783	Acta2	scl0068377.2_268-S	grey
4028	ENSMUSG00000035798	Zdhhc17	GI_27369783-S	turquoise
4029	ENSMUSG00000035824	Tk2	scl34424.10_15-S	blue
4030	ENSMUSG00000035828	Pim3	scl47630.6_103-S	blue
4031	ENSMUSG00000035847	Ids	scl54186.10_25-S	turquoise
4032	ENSMUSG00000035849	Krt222	scl39606.6_138-S	turquoise
4033	ENSMUSG00000035851	Ythdc1	scl0231386.4_56-S	grey
4034	ENSMUSG00000035851	Ythdc1	GI_38083203-S	yellow
4035	ENSMUSG00000035863	Palm	scl38708.12_196-S	blue
4036	ENSMUSG00000035864	Syt1	scl0020979.2_107-S	turquoise
4037	ENSMUSG00000035864	Syt1	scl37517.13_240-S	blue
4038	ENSMUSG00000035885	Cox8a	scl012868.2_102-S	grey
4039	ENSMUSG00000035901	Dennd5a	scl30825.22_142-S	blue
4040	ENSMUSG00000035919	Bbs9	scl37199.27.1_42-S	turquoise
4041	ENSMUSG00000035941	Ibtk	scl35535.28_151-S	grey
4042	ENSMUSG00000035953	Tmem55b	scl45611.6.1_108-S	turquoise
4043	ENSMUSG00000035954	Dock4	scl00238130.1_200-S	grey
4044	ENSMUSG00000035964	Tmem59l	scl34700.7.1_46-S	blue
4045	ENSMUSG00000035967	Ddx26b	scl00236790.1_87-S	blue
4046	ENSMUSG00000035984	Nme5	scl0075533.2_243-S	green
4047	ENSMUSG00000035984	Nme5	scl51546.7.1_73-S	green
4048	ENSMUSG00000035992	Fnip1	GI_38091276-S	blue
4049	ENSMUSG00000035992	Fnip1	scl41556.19_541-S	blue
4050	ENSMUSG00000036002	B230312A22Rik	scl0230088.1_170-S	turquoise
4051	ENSMUSG00000036006	Fam65b	scl00193385.1_22-S	grey
4052	ENSMUSG00000036006	Fam65b	scl0105121.5_1-S	grey
4053	ENSMUSG00000036023	Parp2	scl46372.17.1_65-S	grey
4054	ENSMUSG00000036026	Tmem63b	scl0224807.4_25-S	blue
4055	ENSMUSG00000036052	Dnajb5	scl25525.4_618-S	blue
4056	ENSMUSG00000036053	Fmnl2	scl20917.35_21-S	turquoise
4057	ENSMUSG00000036054	Sfrs14	scl0234373.9_64-S	blue
4058	ENSMUSG00000036057	Ptpn23	scl0104831.1_70-S	blue
4059	ENSMUSG00000036067	Slc2a6	scl19511.8_175-S	brown

4060	ENSMUSG00000036078	Sigmar1	scl0002696.1_5-S	turquoise
4061	ENSMUSG00000036078	Sigmar1	scl018391.1_236-S	blue
4062	ENSMUSG00000036095	Dgkb	scl0002343.1_498-S	pink
4063	ENSMUSG00000036097	Fam178a	scl000513.1_2582-S	grey
4064	ENSMUSG00000036104	Rab3gap1	scl17530.23_508-S	blue
4065	ENSMUSG00000036138	Acaa1a	scl00113868.1_328-S	grey
4066	ENSMUSG00000036158	Prickle1	GI_38077129-S	blue
4067	ENSMUSG00000036158	Prickle1	scl0106042.1_246-S	brown
4068	ENSMUSG00000036186	Fam69b	scl21150.5.1_23-S	turquoise
4069	ENSMUSG00000036188	Ankmy2	scl43280.11_443-S	brown
4070	ENSMUSG00000036225	Kctd1	scl0106931.1_1-S	brown
4071	ENSMUSG00000036242	3632451O06Rik	scl0067419.2_138-S	turquoise
4072	ENSMUSG00000036256	Igfbp7	scl26445.6.1_1-S	green
4073	ENSMUSG00000036257	Pnpla8	scl0002371.1_10-S	red
4074	ENSMUSG00000036257	Pnpla8	scl0067452.2_1-S	blue
4075	ENSMUSG00000036270	Edc4	scl33400.27.1_21-S	blue
4076	ENSMUSG00000036273	Lrrk2	scl066725.8_229-S	turquoise
4077	ENSMUSG00000036275	9530068E07Rik	scl0213673.3_37-S	blue
4078	ENSMUSG00000036281	Snapc4	scl0227644.2_60-S	blue
4079	ENSMUSG00000036282	Nat12	scl46378.5_118-S	grey
4080	ENSMUSG00000036285	2610024G14Rik	scl26446.8.1_29-S	blue
4081	ENSMUSG00000036295	Lrrn3	scl42517.2_446-S	blue
4082	ENSMUSG00000036298	Slc2a13	scl46834.6.2176_154-S	blue
4083	ENSMUSG00000036309	Skp1a	scl41578.9_407-S	turquoise
4084	ENSMUSG00000036315	Znrd1	scl49941.4.1_39-S	brown
4085	ENSMUSG00000036323	Srp72	scl27683.19_361-S	turquoise
4086	ENSMUSG00000036333	Kidins220	scl0077480.1_264-S	black
4087	ENSMUSG00000036352	Ubac1	scl0003373.1_54-S	turquoise
4088	ENSMUSG00000036352	Ubac1	scl098766.1_292-S	turquoise
4089	ENSMUSG00000036362	P2ry13	scl22119.2_559-S	brown
4090	ENSMUSG00000036371	Serbp1	scl066870.7_39-S	brown
4091	ENSMUSG00000036377	C530008M17Rik	scl0320827.6_21-S	turquoise
4092	ENSMUSG00000036398	Ppp1r11	scl0076497.2_72-S	brown
4093	ENSMUSG00000036402	Gng12	scl29940.6_220-S	blue
4094	ENSMUSG00000036430	Tbcc	scl50668.1.78_47-S	blue
4095	ENSMUSG00000036437	Npy1r	scl018166.3_27-S	turquoise
4096	ENSMUSG00000036438	Calm2	scl012314.1_140-S	turquoise
4097	ENSMUSG00000036442	Thap11	scl33402.1_220-S	turquoise
4098	ENSMUSG00000036450	Hif1an	scl53094.2_453-S	turquoise
4099	ENSMUSG00000036459	Wtip	scl0101543.1_246-S	grey
4100	ENSMUSG00000036466	Megf11	scl36827.30.403_46-S	grey
4101	ENSMUSG00000036478	Btg1	scl0012226.2_9-S	pink
4102	ENSMUSG00000036478	Btg1	scl012226.1_1-S	turquoise
4103	ENSMUSG00000036499	Eea1	scl38521.7_336-S	turquoise
4104	ENSMUSG00000036501	Fam13b	scl00002.1_228_REVCOMP-S	red
4105	ENSMUSG00000036501	Fam13b	scl00225358.2_258-S	red
4106	ENSMUSG00000036502	Fam70a	scl0245386.1_3-S	turquoise
4107	ENSMUSG00000036503	Rnf13	scl069825.1_31-S	blue
4108	ENSMUSG00000036504	Phpt1	scl19556.3.1_14-S	turquoise
4109	ENSMUSG00000036533	Cdc42ep3	scl00260409.2_193-S	turquoise
4110	ENSMUSG00000036550	Cnot1	scl00234594.1_78-S	blue
4111	ENSMUSG00000036555	Iqce	scl0074239.2_292-S	turquoise
4112	ENSMUSG00000036564	Ndrg4	scl0234593.14_96-S	turquoise
4113	ENSMUSG00000036565	Ttyh3	scl25830.14_357-S	blue
4114	ENSMUSG00000036578	Fxyd7	scl31501.6.1_29-S	blue
4115	ENSMUSG00000036580	Spg20	scl23190.10_91-S	grey
4116	ENSMUSG00000036585	Fgf1	scl51485.9_146-S	red
4117	ENSMUSG00000036591	Arhgap21	scl071435.1_313-S	grey
4118	ENSMUSG00000036598	Ccdc113	scl33459.9.1_80-S	green
4119	ENSMUSG00000036606	Plxnb2	scl0140570.1_51-S	blue
4120	ENSMUSG00000036613	Tssc1	scl0002281.1_5-S	pink
4121	ENSMUSG00000036613	Tssc1	scl00380752.1_280-S	turquoise
4122	ENSMUSG00000036617	Etl4	scl21235.24_380-S	purple
4123	ENSMUSG00000036620	Mgat4b	scl0103534.9_24-S	blue
4124	ENSMUSG00000036622	Atp13a2	scl24758.27.1_59-S	blue
4125	ENSMUSG00000036632	Alg5	scl0002044.1_26-S	brown
4126	ENSMUSG00000036632	Alg5	scl0002086.1_57-S	brown
4127	ENSMUSG00000036632	Alg5	scl23193.10.1_8-S	brown
4128	ENSMUSG00000036634	Mag	scl31507.12.1_286-S	magenta
4129	ENSMUSG00000036646	Man1b1	scl21181.13_417-S	brown
4130	ENSMUSG00000036649	Slc45a4	GI_38077788-S	blue
4131	ENSMUSG00000036667	3321401G04Rik	scl077574.1_0-S	turquoise
4132	ENSMUSG00000036672	Cenpt	scl34390.13.1_40-S	blue
4133	ENSMUSG00000036686	Cc2d1a	scl34568.25_184-S	blue
4134	ENSMUSG00000036693	Nop14	scl26699.18.1_4-S	turquoise
4135	ENSMUSG00000036698	Eif2c2	scl0239528.1_91-S	yellow
4136	ENSMUSG00000036699	Zcchc12	scl54999.4_50-S	brown
4137	ENSMUSG00000036712	Cyld	scl33529.1.1073_300-S	grey
4138	ENSMUSG00000036712	mKIAA0849	GI_27734059-S	blue
4139	ENSMUSG00000036712	mKIAA0849	scl33531.19_441-S	blue
4140	ENSMUSG00000036733	3100004P22Rik	scl0071909.1_310-S	brown
4141	ENSMUSG00000036733	3100004P22Rik	scl068035.2_9-S	blue
4142	ENSMUSG00000036745	Ttll7s	scl22473.6.1_75-S	blue
4143	ENSMUSG00000036748	Cuedc2	scl067116.1_6-S	turquoise
4144	ENSMUSG00000036751	Cox6b1	scl0110323.3_24-S	brown
4145	ENSMUSG00000036752	Tubb2c	scl0227613.1_83-S	brown
4146	ENSMUSG00000036766	Dner	scl16535.14_269-S	grey
4147	ENSMUSG00000036769	Wdr44	scl0072404.1_24-S	turquoise
4148	ENSMUSG00000036775	Decr2	scl50155.9_2-S	turquoise
4149	ENSMUSG00000036777	Anln	scl0068743.1_43-S	blue
4150	ENSMUSG00000036781	Rps27l	scl067941.3_4-S	green
4151	ENSMUSG00000036782	Klhl13	scl067455.1_261-S	turquoise
4152	ENSMUSG00000036810	Tmem188	scl000719.1_1-S	red
4153	ENSMUSG00000036815	Dpp10	scl16360.27_149-S	blue
4154	ENSMUSG00000036817	Unc84a	scl27067.26_61-S	turquoise
4155	ENSMUSG00000036822	Topors	scl24439.3_48-S	turquoise
4156	ENSMUSG00000036840	Siah1a	scl34524.3_290-S	grey
4157	ENSMUSG00000036845	Lin37	scl31521.10_99-S	grey
4158	ENSMUSG00000036873	2410004B18Rik	scl0066421.2_54-S	turquoise
4159	ENSMUSG00000036880	Acaa2	scl51768.11.1_9-S	green
4160	ENSMUSG00000036885	4631416L12Rik	scl23140.3.1397_82-S	turquoise
4161	ENSMUSG00000036890	Gtdc1	scl19314.17_32-S	blue
4162	ENSMUSG00000036893	Ehmt1	scl0077683.1_104-S	turquoise
4163	ENSMUSG00000036896	C1qc	scl23656.3.1_6-S	brown
4164	ENSMUSG00000036902	Neto2	scl34530.10_50-S	blue
4165	ENSMUSG00000036907	C1ql2	scl0226359.3_308-S	blue
4166	ENSMUSG00000036916	Zfp280c	scl54284.20_250-S	turquoise
4167	ENSMUSG00000036940	Kdm1	scl099982.1_115-S	blue
4168	ENSMUSG00000036943	Rab8B	scl00235442.1_185-S	blue
4169	ENSMUSG00000036943	Rab8B	scl0235442.1_8-S	grey
4170	ENSMUSG00000036943	Rab8B	scl35677.8_443-S	blue
4171	ENSMUSG00000036948	BC037034	scl0231807.1_240-S	blue
4172	ENSMUSG00000036949	Slc39a12	GI_38074448-S	brown
4173	ENSMUSG00000036955	2510003E04Rik	scl37896.8_186-S	turquoise
4174	ENSMUSG00000036966	Spryd3	scl46688.11_26-S	blue
4175	ENSMUSG00000036980	Taf6	scl0000117.1_15-S	turquoise

4176	ENSMUSG00000036985	Zdhhc9		scl54291.11_376-S	blue
4177	ENSMUSG00000037001	Zfp39		scl40178.5_602-S	grey
4178	ENSMUSG00000037012	Hk1		scl37903.28_124-S	blue
4179	ENSMUSG00000037015	Tmem185b		scl00226351.2_117-S	grey
4180	ENSMUSG00000037032	Apbb1		scl30886.20_47-S	blue
4181	ENSMUSG00000037049	Smpd1		scl0003.1_30-S	grey
4182	ENSMUSG00000037049	Smpd1		scl32240.5.1_5-S	turquoise
4183	ENSMUSG00000037058	Paip2		scl067869.4_264-S	turquoise
4184	ENSMUSG00000037071	Scd1		scl52445.7_23-S	blue
4185	ENSMUSG00000037072		Sep-15	scl0002080.1_55-S	brown
4186	ENSMUSG00000037072		Sep-15	scl22501.2_29-S	brown
4187	ENSMUSG00000037086	BC094615		scl54956.2.1_13-S	green
4188	ENSMUSG00000037089	Slc35b2		scl50689.6_424-S	turquoise
4189	ENSMUSG00000037098	Rab11fip3		scl50156.18_539-S	brown
4190	ENSMUSG00000037103	BC057552		scl34569.13_162-S	turquoise
4191	ENSMUSG00000037104	Socs5		scl50402.5_409-S	turquoise
4192	ENSMUSG00000037111	Setd7		scl22186.1.956_113-S	turquoise
4193	ENSMUSG00000037119	D15Ertd621e		scl47892.24_470-S	turquoise
4194	ENSMUSG00000037149	Ddx1		scl42615.25.8_1-S	brown
4195	ENSMUSG00000037166	Ppp1r14a		scl00061.1_10-S	turquoise
4196	ENSMUSG00000037196	Pacrg		scl50311.6.1_173-S	grey
4197	ENSMUSG00000037204	9430023L20Rik		scl068118.3_287-S	brown
4198	ENSMUSG00000037217	Syn1		scl0020964.1_0-S	blue
4199	ENSMUSG00000037217	Syn1		scl54358.13_95-S	blue
4200	ENSMUSG00000037236	Matr3		scl0002269.1_18-S	black
4201	ENSMUSG00000037243	Zfp692		scl41520.9.1_11-S	turquoise
4202	ENSMUSG00000037254	Itih2		scl19685.22.1_10-S	grey
4203	ENSMUSG00000037257	2310007F21Rik		scl066939.11_66-S	turquoise
4204	ENSMUSG00000037259	6330439K17Rik		scl4087.1.1_256-S	turquoise
4205	ENSMUSG00000037260	Hgsnat		scl052120.1_108-S	grey
4206	ENSMUSG00000037286	Stag1		scl0020842.1_84-S	turquoise
4207	ENSMUSG00000037287	Tbcel		scl35981.11_448-S	green
4208	ENSMUSG00000037291	mKIAA1371		scl23260.28.28_99-S	blue
4209	ENSMUSG00000037296	Lsm1		GI_38089162-S	turquoise
4210	ENSMUSG00000037300	Ttc13		scl0234875.1_259-S	grey
4211	ENSMUSG00000037306	Man1c1		scl00230815.2_83-S	blue
4212	ENSMUSG00000037316	Bag4		scl0067384.1_276-S	pink
4213	ENSMUSG00000037339	Fam53a		scl26717.6.1_165-S	blue
4214	ENSMUSG00000037343	Taf2		GI_38077458-S	red
4215	ENSMUSG00000037353	Letmd1		scl47504.5_20-S	turquoise
4216	ENSMUSG00000037364	Srrt		scl0004167.1_44-S	blue
4217	ENSMUSG00000037364	Srrt		scl0083701.2_327-S	blue
4218	ENSMUSG00000037364	Srrt		scl25881.20.1_16-S	blue
4219	ENSMUSG00000037369	Kdm6a		scl0002899.1_69-S	blue
4220	ENSMUSG00000037369	Kdm6a		scl022289.28_11-S	blue
4221	ENSMUSG00000037376	Trmt6		scl18618.8_0-S	turquoise
4222	ENSMUSG00000037386	Rims2		scl00116838.2_261-S	turquoise
4223	ENSMUSG00000037400	Atp11b		scl076295.3_96-S	turquoise
4224	ENSMUSG00000037415	Ranbp10		scl34388.19_15-S	blue
4225	ENSMUSG00000037416	Dmxl1		GI_38083570-S	brown
4226	ENSMUSG00000037419	Endod1		scl36223.4.1187_49-S	magenta
4227	ENSMUSG00000037434	Slc30a1		scl14261.1.1_139-S	turquoise
4228	ENSMUSG00000037455	1110021L09Rik		scl076306.2_241-S	turquoise
4229	ENSMUSG00000037463	Fbxo27		scl0233040.6_239-S	blue
4230	ENSMUSG00000037492	Zmat4		scl33981.9.1_17-S	brown
4231	ENSMUSG00000037493	Cib2		scl0003513.1_13-S	turquoise
4232	ENSMUSG00000037493	Cib2		scl35837.6.1_14-S	turquoise
4233	ENSMUSG00000037503	Fam168b		scl16881.8_26-S	blue
4234	ENSMUSG00000037509	Arhgef4		scl18085.12.1_243-S	blue
4235	ENSMUSG00000037513	Samd4b		scl0233033.1_330-S	blue
4236	ENSMUSG00000037514	Pank2		scl20265.12.1_14-S	blue
4237	ENSMUSG00000037519	BC038349		scl0233977.1_279-S	grey
4238	ENSMUSG00000037533	Rapgef6		scl00327930.1_3-S	turquoise
4239	ENSMUSG00000037570	Mcrs1		scl0051812.2_78-S	turquoise
4240	ENSMUSG00000037578	Pkd2l1		scl52448.14.1_260-S	grey
4241	ENSMUSG00000037579	Kcnh3		scl016512.15_22-S	blue
4242	ENSMUSG00000037617	Phka1		scl47982.21.1_30-S	grey
4243	ENSMUSG00000037624	Kcnk2		scl016526.1_311-S	turquoise
4244	ENSMUSG00000037625	Cldn11		scl23301.3_380-S	magenta
4245	ENSMUSG00000037656	Slc20a2		scl33996.15_314-S	green
4246	ENSMUSG00000037664	Cdkn1c		scl30455.5_27-S	green
4247	ENSMUSG00000037669	1110057K04Rik		scl43410.8_467-S	turquoise
4248	ENSMUSG00000037674	Rfx7		scl36729.1.556_102-S	turquoise
4249	ENSMUSG00000037679	2610204M08Rik		scl42730.18.154_13-S	blue
4250	ENSMUSG00000037685	Atp8a1		scl26522.39_597-S	yellow
4251	ENSMUSG00000037692	Ahdc1		scl24870.7.1_13-S	blue
4252	ENSMUSG00000037703	RP23-100C5.8		scl0241638.1_112-S	blue
4253	ENSMUSG00000037706	Cd81		scl012520.7_274-S	grey
4254	ENSMUSG00000037709	Fam13a		scl0058909.2_289-S	turquoise
4255	ENSMUSG00000037712	Fermt2		scl45667.15_40-S	turquoise
4256	ENSMUSG00000037720	Tmem33		scl0004156.1_115-S	brown
4257	ENSMUSG00000037720	Tmem33		scl0067878.2_53-S	blue
4258	ENSMUSG00000037736	Limch1		scl077569.20_137-S	yellow
4259	ENSMUSG00000037738	Nek5		scl35028.22.1_110-S	green
4260	ENSMUSG00000037747	Phyhipl		scl070911.1_5-S	turquoise
4261	ENSMUSG00000037750	BC017647		scl00216971.1_119-S	blue
4262	ENSMUSG00000037754	Ppp1r16b		scl19990.13_167-S	grey
4263	ENSMUSG00000037773	Fam113a		scl0319513.1_116-S	blue
4264	ENSMUSG00000037788	AW146242		scl28959.7_65-S	turquoise
4265	ENSMUSG00000037791	Phf12		scl00268448.1_163-S	turquoise
4266	ENSMUSG00000037795	AK088388		scl27764.24_495-S	blue
4267	ENSMUSG00000037808	Fam76b		scl072826.1_101-S	blue
4268	ENSMUSG00000037815	Ctnna1		scl012385.18_225-S	green
4269	ENSMUSG00000037816	Fbxw17		scl44784.10.1_138-S	turquoise
4270	ENSMUSG00000037818	3110057O12Rik		scl23237.22_584-S	turquoise
4271	ENSMUSG00000037822	1110003E01Rik		scl068552.1_11-S	turquoise
4272	ENSMUSG00000037824	Tspan14		scl45684.12_151-S	grey
4273	ENSMUSG00000037826	Ppm1k		scl28962.1.687_175-S	turquoise
4274	ENSMUSG00000037843	Vstm2l		scl0277432.5_328-S	blue
4275	ENSMUSG00000037855	Zfp365		scl37856.7_341-S	turquoise
4276	ENSMUSG00000037868	Egr2		scl013654.4_67-S	grey
4277	ENSMUSG00000037872	Darc		scl15911.2_36-S	blue
4278	ENSMUSG00000037887	Dusp8		scl018218.1_142-S	blue
4279	ENSMUSG00000037896	Rcor1		scl00217864.2_195-S	yellow
4280	ENSMUSG00000037902	Sirpa		scl0003333.1_170-S	pink
4281	ENSMUSG00000037916	Ndufv1		scl53438.9.1_79-S	turquoise
4282	ENSMUSG00000037933	Bicd2		scl44795.7_219-S	turquoise
4283	ENSMUSG00000037935	Smarce1		scl39607.11_182-S	brown
4284	ENSMUSG00000037936	Scarb1		scl020778.1_265-S	blue
4285	ENSMUSG00000037972	Snn		scl020621.3_134-S	turquoise
4286	ENSMUSG00000037979	Ccdc92		scl00215707.2_239-S	blue
4287	ENSMUSG00000037979	Ccdc92		scl26026.5_460-S	blue
4288	ENSMUSG00000037989	Wnk2		scl43996.22.1_91-S	turquoise
4289	ENSMUSG00000037990	Sh3rf3		scl00237353.1_95-S	blue
4290	ENSMUSG00000037996	Slc24a2		scl2370.1.1_197-S	grey
4291	ENSMUSG00000037999	mKIAA0580		scl26570.35_194-S	blue

4292	ENSMUSG00000037999	mKIAA0580	GI_20887520-S	yellow
4293	ENSMUSG00000038002	Cramp1l	scl057354.1_85-S	grey
4294	ENSMUSG00000038007	Acer2	scl0230379.5_233-S	grey
4295	ENSMUSG00000038013	Wipf2	scl40925.4.3563_8-S	greenyellow
4296	ENSMUSG00000038014	Fam120a	scl0218236.1_149-S	turquoise
4297	ENSMUSG00000038025	Phf2	scl43999.22_97-S	blue
4298	ENSMUSG00000038028	9630033F20Rik	scl729.1.1_233-S	blue
4299	ENSMUSG00000038042	Ptpdc1	scl44003.12_452-S	black
4300	ENSMUSG00000038055	Dexi	scl0058239.1_184-S	blue
4301	ENSMUSG00000038055	Dexi	scl058239.1_71-S	brown
4302	ENSMUSG00000038056	Mll3	scl26782.45_53-S	yellow
4303	ENSMUSG00000038072	Galnt11	scl28023.13.1_30-S	grey
4304	ENSMUSG00000038074	Fkbp14	scl0231997.1_5-S	brown
4305	ENSMUSG00000038077	Kcna6	scl0016494.1_229-S	blue
4306	ENSMUSG00000038077	Kcna6	scl28393.5.1_16-S	turquoise
4307	ENSMUSG00000038094	Atp13a4	scl0224079.1_3-S	turquoise
4308	ENSMUSG00000038095	Sbno1	scl26033.1.1904_52-S	turquoise
4309	ENSMUSG00000038102	D030016E14Rik	scl000681.1_2-S	turquoise
4310	ENSMUSG00000038115	Tmem16b	scl0243634.25_189-S	grey
4311	ENSMUSG00000038116	Phf20	scl00228829.1_121-S	yellow
4312	ENSMUSG00000038116	Phf20	scl20034.12.12_31-S	yellow
4313	ENSMUSG00000038116	Phf20	scl00228829.1_258-S	turquoise
4314	ENSMUSG00000038126	Mphosph9	scl10180.1.1_89-S	brown
4315	ENSMUSG00000038143	Stox2	scl34845.7_126-S	turquoise
4316	ENSMUSG00000038150	Ormdl3	scl066612.1_144-S	blue
4317	ENSMUSG00000038152	5033430I15Rik	scl44824.2.224_179-S	blue
4318	ENSMUSG00000038156	Spon1	scl0233744.9_15-S	turquoise
4319	ENSMUSG00000038170	Pde4dip	scl00229622.1_168-S	turquoise
4320	ENSMUSG00000038173	Enpp6	scl00320981.2_269-S	blue
4321	ENSMUSG00000038174	Fam126b	scl16729.16_418-S	brown
4322	ENSMUSG00000038187	Btbd10	scl30792.12_207-S	turquoise
4323	ENSMUSG00000038195	Rilp	GI_38091482-S	green
4324	ENSMUSG00000038248	Sobp	scl00109205.1_28-S	greenyellow
4325	ENSMUSG00000038248	Sobp	scl5468.1.1_137-S	blue
4326	ENSMUSG00000038252	Ncapd2	scl28408.31.1_3-S	grey
4327	ENSMUSG00000038255	Neurod2	scl39623.2_265-S	blue
4328	ENSMUSG00000038256	Bcl9	scl21793.3_27-S	blue
4329	ENSMUSG00000038267	Slc22a23	scl073102.1_21-S	blue
4330	ENSMUSG00000038268	Dph1	scl0246257.1_125-S	grey
4331	ENSMUSG00000038280	Ostm1	scl38974.6_243-S	brown
4332	ENSMUSG00000038291	Snx25	GI_38089243-S	turquoise
4333	ENSMUSG00000038296	Galntl4	scl0233733.1_115-S	blue
4334	ENSMUSG00000038299	Wdr36	scl52139.21.14_8-S	blue
4335	ENSMUSG00000038301	Snx10	scl30048.11_144-S	turquoise
4336	ENSMUSG00000038312	Edem2	scl00108687.2_201-S	blue
4337	ENSMUSG00000038324	Trpc4ap	scl056407.1_179-S	blue
4338	ENSMUSG00000038324	Trpc4ap	scl18457.19.17_30-S	blue
4339	ENSMUSG00000038332	Sesn1	scl38979.10_298-S	brown
4340	ENSMUSG00000038351	Sgsm2	scl39943.24_68-S	blue
4341	ENSMUSG00000038365	Fbxo25	scl34044.10_124-S	turquoise
4342	ENSMUSG00000038366	Lasp1	scl0016796.1_242-S	blue
4343	ENSMUSG00000038368	BC057079	scl25295.54.1_177-S	turquoise
4344	ENSMUSG00000038369	Ncoa6	scl0003270.1_2823-S	turquoise
4345	ENSMUSG00000038369	Ncoa6	scl18462.14.1_6-S	turquoise
4346	ENSMUSG00000038370	Pcp4l1	scl066425.1_159-S	green
4347	ENSMUSG00000038372	Gmds	scl44126.11.1_57-S	turquoise
4348	ENSMUSG00000038375	Trp53inp2	scl068728.7_0-S	turquoise
4349	ENSMUSG00000038384	mKIAA1076	scl27246.12.1_228-S	brown
4350	ENSMUSG00000038388	Mpp6	scl30059.16.1_6-S	turquoise
4351	ENSMUSG00000038390	Gpr162	scl0001152.1_862-S	blue
4352	ENSMUSG00000038393	Txnip	scl22856.7_28-S	turquoise
4353	ENSMUSG00000038406	Scaf1	scl0233208.1_10-S	blue
4354	ENSMUSG00000038416	Cdc16	scl34048.16.227_13-S	turquoise
4355	ENSMUSG00000038417	Fig4	scl38024.23.1_253-S	turquoise
4356	ENSMUSG00000038418	Egr1	scl52114.2_187-S	brown
4357	ENSMUSG00000038422	Hdhd3	scl24262.3_152-S	turquoise
4358	ENSMUSG00000038429	Usp5	scl28422.20.1_17-S	blue
4359	ENSMUSG00000038446	Cdc40	scl0071713.1_60-S	blue
4360	ENSMUSG00000038456	Dennd2a	scl29107.21_498-S	turquoise
4361	ENSMUSG00000038459	Fam108c	scl31078.5_227-S	turquoise
4362	ENSMUSG00000038463	Olfml2b	scl0320078.9_68-S	blue
4363	ENSMUSG00000038467	Chmp4b	scl20067.4.141_17-S	black
4364	ENSMUSG00000038473	Nos1ap	GI_38074094-S	blue
4365	ENSMUSG00000038481	Cdc2l6	scl0078334.1_222-S	brown
4366	ENSMUSG00000038481	Cdc2l6	scl38994.14_327-S	brown
4367	ENSMUSG00000038482	Tfdp1	scl021781.11_3-S	red
4368	ENSMUSG00000038486	Sv2a	scl064051.13_189-S	blue
4369	ENSMUSG00000038486	Sv2a	scl22868.13.1_55-S	pink
4370	ENSMUSG00000038489	AK011021	scl0066491.1_300-S	brown
4371	ENSMUSG00000038495	Otud7b	scl12575.1.1_286-S	turquoise
4372	ENSMUSG00000038497	Tmco3	scl000600.1_5-S	turquoise
4373	ENSMUSG00000038502	Ptov1	scl084113.2_12-S	blue
4374	ENSMUSG00000038510	Bxdc1	scl38032.11.1_165-S	turquoise
4375	ENSMUSG00000038520	Il4i1	scl00233204.2_75-S	blue
4376	ENSMUSG00000038526	Car14	scl21825.13.80_16-S	green
4377	ENSMUSG00000038530	Rgs4	scl019736.1_86-S	brown
4378	ENSMUSG00000038545	Cul7	scl50672.19.1_126-S	blue
4379	ENSMUSG00000038546	Ranbp9	scl44046.14.7_2-S	turquoise
4380	ENSMUSG00000038564	Ift172	scl26735.47.1_66-S	blue
4381	ENSMUSG00000038576	Susd4	scl0096935.2_73-S	turquoise
4382	ENSMUSG00000038582	Pptc7	scl27262.6_658-S	grey
4383	ENSMUSG00000038587	Akap12	scl30597.2_2-S	purple
4384	ENSMUSG00000038602	Slc35f1	scl38927.8_352-S	turquoise
4385	ENSMUSG00000038604	Fam65a	scl33409.21.1_6-S	blue
4386	ENSMUSG00000038607	Gng10	scl25392.4_268-S	blue
4387	ENSMUSG00000038608	mKIAA0694	scl0210293.1_0-S	turquoise
4388	ENSMUSG00000038611	Phrf1	scl31890.12.1_22-S	blue
4389	ENSMUSG00000038612	Mcl1	scl22876.3_595-S	turquoise
4390	ENSMUSG00000038615	Nfe2l1	scl018023.1_196-S	blue
4391	ENSMUSG00000038622	Med30	scl069790.3_16-S	brown
4392	ENSMUSG00000038633	Degs1	scl013244.1_23-S	blue
4393	ENSMUSG00000038642	Ctss	scl22880.8.1_176-S	turquoise
4394	ENSMUSG00000038650	Rnh1	scl30499.14.1_7-S	green
4395	ENSMUSG00000038664	AK019286	scl078507.1_19-S	yellow
4396	ENSMUSG00000038668	Lpar1	scl014745.1_6-S	turquoise
4397	ENSMUSG00000038671	Arfrp1	scl0003291.1_0-S	turquoise
4398	ENSMUSG00000038679	Trps1	scl0083925.1_57-S	turquoise
4399	ENSMUSG00000038685	Rtel1	scl0269400.28_245-S	turquoise
4400	ENSMUSG00000038690	Atp5j2	scl057423.2_11-S	brown
4401	ENSMUSG00000038695	Josd2	scl32713.7.1_59-S	grey
4402	ENSMUSG00000038702	Dsel	scl16401.2_136-S	turquoise
4403	ENSMUSG00000038712	Fam63a	scl075007.4_290-S	turquoise
4404	ENSMUSG00000038722	Bud31	scl26989.6.1_126-S	brown
4405	ENSMUSG00000038729	Akap2	scl0002855.1_1056-S	turquoise
4406	ENSMUSG00000038740	Fam125b	scl19423.12_9-S	blue
4407	ENSMUSG00000038759	mKIAA0225	scl30210.43.1_46-S	blue

4408	ENSMUSG00000038760	Trhr	scl47932.5.1_206-S	blue
4409	ENSMUSG00000038762	Abcf1	scl49970.18.121_17-S	blue
4410	ENSMUSG00000038774	Ascc3	scl38942.8.1_3-S	brown
4411	ENSMUSG00000038775	Vill	scl36353.20.1_79-S	purple
4412	ENSMUSG00000038784	Cnot4	scl0001062.1_67-S	yellow
4413	ENSMUSG00000038816	Ctnnal1	scl24307.19_191-S	green
4414	ENSMUSG00000038822	Hace1	scl38949.25.1_91-S	turquoise
4415	ENSMUSG00000038827	BC026590	scl00230234.1_296-S	turquoise
4416	ENSMUSG00000038828	Tmem214	scl0068796.2_313-S	turquoise
4417	ENSMUSG00000038831	AK140547	scl19429.19_321-S	grey
4418	ENSMUSG00000038848	Ythdf1	scl18219.6_128-S	black
4419	ENSMUSG00000038859	Baiap2l1	scl25791.15_62-S	grey
4420	ENSMUSG00000038860	Garnl3	scl19431.33.1_37-S	purple
4421	ENSMUSG00000038861	Pi4kb	scl22895.12.1_51-S	blue
4422	ENSMUSG00000038879	Nipal2	scl00223473.2_241-S	green
4423	ENSMUSG00000038880	Mrps34	scl50998.1_28-S	blue
4424	ENSMUSG00000038884	A230050P20Rik	scl37239.6.39_1-S	blue
4425	ENSMUSG00000038895	Zfp653	scl0319601.1_34-S	turquoise
4426	ENSMUSG00000038910	Plcl2	scl00224860.2_197-S	blue
4427	ENSMUSG00000038914	Dido1	scl0023856.1_90-S	grey
4428	ENSMUSG00000038914	Dido1	scl0269399.1_1-S	turquoise
4429	ENSMUSG00000038916	6330407J23Rik	scl067412.7_37-S	turquoise
4430	ENSMUSG00000038936	Sccpdh	scl17151.10_21-S	blue
4431	ENSMUSG00000038949	9630058J23Rik	scl17152.12_234-S	turquoise
4432	ENSMUSG00000038954	Supt3h	scl50694.13.20_68-S	turquoise
4433	ENSMUSG00000038965	Ube2l3	scl0022195.1_278-S	turquoise
4434	ENSMUSG00000038965	Ube2l3	scl48709.7_108-S	blue
4435	ENSMUSG00000038970	Lmtk2	scl0231876.5_65-S	blue
4436	ENSMUSG00000038975	Rabggtb	scl21371.8.1_29-S	brown
4437	ENSMUSG00000038976	Ppp1r9b	scl41017.13_82-S	brown
4438	ENSMUSG00000038982	Muted	scl0003751.1_1235-S	grey
4439	ENSMUSG00000038990	Cables2	scl0252966.1_19-S	blue
4440	ENSMUSG00000038991	Txndc5	scl0105245.1_201-S	turquoise
4441	ENSMUSG00000039000	Ube3c	scl27993.23_276-S	grey
4442	ENSMUSG00000039001	Rps21	scl066481.4_0-S	brown
4443	ENSMUSG00000039007	Pgcp	scl054381.6_56-S	green
4444	ENSMUSG00000039016	Timm8b	scl030057.2_1-S	brown
4445	ENSMUSG00000039018	Mtg1	scl0212508.11_34-S	brown
4446	ENSMUSG00000039037	St6galnac5	scl21386.6_225-S	greenyellow
4447	ENSMUSG00000039041	Adrm1	scl056436.9_4-S	blue
4448	ENSMUSG00000039048	Foxred1	scl0235169.2_28-S	turquoise
4449	ENSMUSG00000039048	Foxred1	scl36048.5_11-S	turquoise
4450	ENSMUSG00000039050	Osbpl2	scl0228983.14_82-S	brown
4451	ENSMUSG00000039058	Ak5	scl00229949.2_260-S	blue
4452	ENSMUSG00000039058	Ak5	scl21387.15_249-S	blue
4453	ENSMUSG00000039059	Hrh3	scl18231.3.1_11-S	blue
4454	ENSMUSG00000039067	Psmd7	scl000612.1_15-S	red
4455	ENSMUSG00000039067	Psmd7	scl34359.7_33-S	grey
4456	ENSMUSG00000039086	Ss18l1	scl19794.11_451-S	turquoise
4457	ENSMUSG00000039087	Rreb1	GI_38074406-S	grey
4458	ENSMUSG00000039087	Rreb1	scl068750.4_57-S	purple
4459	ENSMUSG00000039100	Mar-06	scl00223455.2_26-S	red
4460	ENSMUSG00000039100	Mar-06	scl47328.26_25-S	grey
4461	ENSMUSG00000039114	Nrn1	scl44090.4_104-S	grey
4462	ENSMUSG00000039128	Cdc123	scl19726.14.1_76-S	turquoise
4463	ENSMUSG00000039130	Zc3hc1	scl0001040.1_164-S	turquoise
4464	ENSMUSG00000039130	Zc3hc1	scl29201.11.474_200-S	turquoise
4465	ENSMUSG00000039137	Whrn	scl073750.1_299-S	grey
4466	ENSMUSG00000039145	Camk1d	scl00227541.2_221-S	greenyellow
4467	ENSMUSG00000039145	Camk1d	scl19727.12_379-S	brown
4468	ENSMUSG00000039148	Sart1	scl53492.15.1_3-S	blue
4469	ENSMUSG00000039154	Shd	scl50606.7.1_142-S	turquoise
4470	ENSMUSG00000039156	Stim2	GI_41529819-S	blue
4471	ENSMUSG00000039156	Stim2	scl27810.1_0-S	grey
4472	ENSMUSG00000039159	Ube2h	scl0022214.2_142-S	turquoise
4473	ENSMUSG00000039163	Cmc1	scl0067899.2_259-S	blue
4474	ENSMUSG00000039183	Nubp2	scl0001628.1_55-S	turquoise
4475	ENSMUSG00000039195	1110008P14Rik	scl073737.1_220-S	grey
4476	ENSMUSG00000039197	Adk	scl000377.1_101-S	red
4477	ENSMUSG00000039197	Adk	scl000408.1_6-S	brown
4478	ENSMUSG00000039201	Tbc1d25	scl54432.6_461-S	black
4479	ENSMUSG00000039205	Ciz1	scl0068379.1_280-S	brown
4480	ENSMUSG00000039206	Daglb	scl0231871.16_33-S	black
4481	ENSMUSG00000039218	Srrm2	scl075956.6_20-S	blue
4482	ENSMUSG00000039219	Arid4b	scl45056.23_630-S	brown
4483	ENSMUSG00000039220	Ppp1r10	scl0052040.1_253-S	brown
4484	ENSMUSG00000039221	Rpl22l1	scl068028.3_20-S	turquoise
4485	ENSMUSG00000039230	Tbcd	scl40612.43.1_21-S	turquoise
4486	ENSMUSG00000039239	Tgfb2	scl0021808.2_65-S	turquoise
4487	ENSMUSG00000039246	Lyplal1	scl15797.5_597-S	turquoise
4488	ENSMUSG00000039252	Lgi2	scl00246316.2_198-S	purple
4489	ENSMUSG00000039257	Vstm2b	scl32765.8.1_43-S	brown
4490	ENSMUSG00000039262	mKIAA0515	scl21064.31_2-S	brown
4491	ENSMUSG00000039270	Megf9	scl00230316.2_241-S	yellow
4492	ENSMUSG00000039270	Megf9	scl24229.6_463-S	grey
4493	ENSMUSG00000039275	Foxk2	scl068837.8_1-S	blue
4494	ENSMUSG00000039278	Pcsk1n	scl0030052.2_159-S	blue
4495	ENSMUSG00000039285	Azi2	scl0003596.1_1065-S	brown
4496	ENSMUSG00000039318	Rab3gap2	scl0098732.2_94-S	turquoise
4497	ENSMUSG00000039323	Igfbp2	scl17826.1.31_58-S	green
4498	ENSMUSG00000039345	BC024814	scl0239706.7_17-S	turquoise
4499	ENSMUSG00000039347	Atp6v0e2	scl0001036.1_14-S	pink
4500	ENSMUSG00000039347	Atp6v0e2	scl30088.4_382-S	blue
4501	ENSMUSG00000039367	Sec24c	scl46590.24_108-S	blue
4502	ENSMUSG00000039372	Mar-04	GI_38049568-S	blue
4503	ENSMUSG00000039375	Wdr17	scl000570.1_106-S	turquoise
4504	ENSMUSG00000039382	Wdr45	scl054636.13_168-S	grey
4505	ENSMUSG00000039410	Prdm16	scl0330006.1_306-S	grey
4506	ENSMUSG00000039419	Cntnap2	scl066797.3_51-S	turquoise
4507	ENSMUSG00000039419	Cntnap2	scl0066797.1_308-S	turquoise
4508	ENSMUSG00000039458	Mtmr12	scl0268783.16_21-S	turquoise
4509	ENSMUSG00000039461	Tcta	scl00102791.2_289-S	turquoise
4510	ENSMUSG00000039470	Zdhhc2	scl33881.13_257-S	brown
4511	ENSMUSG00000039474	Wfs1	scl26674.8_0-S	blue
4512	ENSMUSG00000039478	2900075B16Rik	scl078506.1_26-S	turquoise
4513	ENSMUSG00000039501	Znfx1	scl098999.1_128-S	blue
4514	ENSMUSG00000039509	Nup133	scl000643.1_49-S	turquoise
4515	ENSMUSG00000039515	Ppp2r4	scl21088.14_336-S	blue
4516	ENSMUSG00000039519	Cyp7b1	scl22366.7.1_2-S	purple
4517	ENSMUSG00000039531	2700019D07Rik	scl38062.12.1_8-S	turquoise
4518	ENSMUSG00000039533	Mmd2	scl25824.7_328-S	grey
4519	ENSMUSG00000039536	Stau1	scl020853.1_177-S	blue
4520	ENSMUSG00000039542	Ncam1	scl0003519.1_175-S	greenyellow
4521	ENSMUSG00000039542	Ncam1	scl0017967.2_96-S	blue
4522	ENSMUSG00000039542	Ncam1	scl35883.23_148-S	blue
4523	ENSMUSG00000039546	Ajap1	GI_38079063-S	blue

4524	ENSMUSG00000039552	Rshl3	scl39033.6.5_159-S	green
4525	ENSMUSG00000039556	Ppp1r3f	scl54449.5_574-S	blue
4526	ENSMUSG00000039577	Nphp4	scl24649.35.1_68-S	blue
4527	ENSMUSG00000039579	Grin3a	scl24334.3_574-S	purple
4528	ENSMUSG00000039585	Myo9a	scl0270163.13_79-S	red
4529	ENSMUSG00000039601	Rcan2	scl50699.8.1_77-S	grey
4530	ENSMUSG00000039615	Stub1	scl50166.4.1_1-S	blue
4531	ENSMUSG00000039621	Prex1	scl00277360.1_60-S	black
4532	ENSMUSG00000039623	C330006K01Rik	scl0231855.15_16-S	blue
4533	ENSMUSG00000039634	Zfp189	scl25444.3_226-S	blue
4534	ENSMUSG00000039640	Mrpl12	scl056282.5_222-S	brown
4535	ENSMUSG00000039646	Dnaja3	scl0246154.2_131-S	blue
4536	ENSMUSG00000039652	Cpeb3	scl52524.16_678-S	greenyellow
4537	ENSMUSG00000039656	Rxrb	scl020182.9_313-S	blue
4538	ENSMUSG00000039671	Prkcbp1	scl0003203.1_308-S	turquoise
4539	ENSMUSG00000039671	Prkcbp1	scl18325.32_1-S	blue
4540	ENSMUSG00000039676	Capsl	scl48089.5.1_29-S	green
4541	ENSMUSG00000039678	Tbc1d13	scl21096.14_260-S	blue
4542	ENSMUSG00000039680	Slc5a3	scl0121022.3_149-S	green
4543	ENSMUSG00000039686	Zer1	scl00227693.1_292-S	blue
4544	ENSMUSG00000039703	Nploc4	scl0217365.1_17-S	black
4545	ENSMUSG00000039706	Ldb2	scl26624.7.1_4-S	turquoise
4546	ENSMUSG00000039713	Plekhg5	GI_38079055-S	blue
4547	ENSMUSG00000039713	Plekhg5	scl0269608.7_81-S	blue
4548	ENSMUSG00000039735	Fnbp1l	scl21577.11_122-S	blue
4549	ENSMUSG00000039737	Prkrip1	scl066801.6_14-S	turquoise
4550	ENSMUSG00000039738	Btbd12	scl48821.4_3-S	blue
4551	ENSMUSG00000039740	Alg2	scl24346.2_118-S	blue
4552	ENSMUSG00000039745	Htatip2	scl32632.7.1_23-S	turquoise
4553	ENSMUSG00000039753	Fbxl5	scl0242960.1_52-S	turquoise
4554	ENSMUSG00000039765	Cc2d2a	scl27858.40.1_129-S	turquoise
4555	ENSMUSG00000039770	Ypel5	scl0383295.3_18-S	blue
4556	ENSMUSG00000039771	Polr2j	scl27119.4.1_2-S	brown
4557	ENSMUSG00000039781	Azi1	scl39247.26.1_37-S	blue
4558	ENSMUSG00000039804	Ncoa5	scl18338.8_547-S	blue
4559	ENSMUSG00000039810	Zc3h10	scl00103284.2_177-S	blue
4560	ENSMUSG00000039831	Arhgap29	scl00214137.2_222-S	blue
4561	ENSMUSG00000039835	Nhsl1	scl39121.4_36-S	turquoise
4562	ENSMUSG00000039840	5430411K18Rik	scl51735.42.647_134-S	turquoise
4563	ENSMUSG00000039844	Rapgef1	scl21113.26_436-S	blue
4564	ENSMUSG00000039887	Alg14	scl0066789.2_51-S	brown
4565	ENSMUSG00000039911	Spsb1	scl23489.7_25-S	grey
4566	ENSMUSG00000039914	Coq10a	GI_28503279-S	turquoise
4567	ENSMUSG00000039917	Rhbdd2	scl0215160.4_168-S	blue
4568	ENSMUSG00000039952	Dag1	scl013138.1_18-S	greenyellow
4569	ENSMUSG00000039952	Dag1	scl35355.5_339-S	greenyellow
4570	ENSMUSG00000039953	Clstn1	scl0065945.2_70-S	blue
4571	ENSMUSG00000039953	Clstn1	scl24688.19_192-S	blue
4572	ENSMUSG00000039959	Hip1	scl25924.32_40-S	grey
4573	ENSMUSG00000039960	Rhou	scl33196.2.1635_134-S	turquoise
4574	ENSMUSG00000039967	Zfp292	scl0030046.1_16-S	yellow
4575	ENSMUSG00000039967	Zfp292	scl030046.1_110-S	yellow
4576	ENSMUSG00000039982	Dtx4	scl52707.12_170-S	turquoise
4577	ENSMUSG00000039987	Phtf2	scl26866.19_111-S	turquoise
4578	ENSMUSG00000040006	BC013529	scl00215751.1_299-S	blue
4579	ENSMUSG00000040018	Cox15	scl00226139.2_5-S	turquoise
4580	ENSMUSG00000040034	Nup43	scl39170.8.1_34-S	turquoise
4581	ENSMUSG00000040037	Negr1	scl0320840.6_19-S	brown
4582	ENSMUSG00000040055	Gjb6	scl45492.3_565-S	blue
4583	ENSMUSG00000040097	Flywch1	scl00224613.2_5-S	greenyellow
4584	ENSMUSG00000040105	Ppapdc2	scl53241.1.45_0-S	brown
4585	ENSMUSG00000040111	Gramd1b	scl36003.13.1_201-S	blue
4586	ENSMUSG00000040112	Mrps35	scl29346.9.1_7-S	grey
4587	ENSMUSG00000040118	Cacna2d1	scl012293.44_74-S	yellow
4588	ENSMUSG00000040123	Zmym5	scl0219105.1_166-S	blue
4589	ENSMUSG00000040124	Gorab	scl16025.6_102-S	turquoise
4590	ENSMUSG00000040133	Gpr176	scl0381413.1_190-S	grey
4591	ENSMUSG00000040138	Ndp	scl54376.3.1_245-S	blue
4592	ENSMUSG00000040147	Maob	scl54377.16.1_8-S	green
4593	ENSMUSG00000040174	Alkbh3	scl18972.12.1_41-S	brown
4594	ENSMUSG00000040188	Scamp2	scl36902.11_284-S	turquoise
4595	ENSMUSG00000040229	Gpr34	scl55037.4_229-S	blue
4596	ENSMUSG00000040249	Lrp1	scl016971.1_277-S	turquoise
4597	ENSMUSG00000040250	4933424B01Rik	scl28198.16.9_0-S	turquoise
4598	ENSMUSG00000040268	Plekha1	scl00101476.1_284-S	blue
4599	ENSMUSG00000040269	Mrps28	scl22402.6.1_12-S	brown
4600	ENSMUSG00000040276	Pacsin1	scl0023969.1_255-S	blue
4601	ENSMUSG00000040276	Pacsin1	scl023969.4_26-S	blue
4602	ENSMUSG00000040276	Pacsin1	scl50934.9.2_2-S	blue
4603	ENSMUSG00000040289	Hey1	scl22405.4_235-S	grey
4604	ENSMUSG00000040297	AI848100	GI_33859790-S	red
4605	ENSMUSG00000040327	Cul9	scl49866.19.1_90-S	turquoise
4606	ENSMUSG00000040339	Fam102b	scl21638.11_586-S	yellow
4607	ENSMUSG00000040354	Mars	GI_38090996-S	turquoise
4608	ENSMUSG00000040356	Skiv2l	scl0001683.1_11-S	brown
4609	ENSMUSG00000040356	Skiv2l	scl50011.20.1_22-S	blue
4610	ENSMUSG00000040359	1810074P20Rik	scl24492.20.1_105-S	brown
4611	ENSMUSG00000040365	Trim41	scl40289.5_205-S	blue
4612	ENSMUSG00000040385	Ppp1ca	scl000041.1_12-S	black
4613	ENSMUSG00000040385	Ppp1ca	scl000045.1_44_REVCOMP-S	blue
4614	ENSMUSG00000040385	Ppp1ca	scl000534.1_21-S	pink
4615	ENSMUSG00000040385	Ppp1ca	scl019045.1_99-S	blue
4616	ENSMUSG00000040387	Klhl32	GI_38078097-S	yellow
4617	ENSMUSG00000040389	Wdr47	scl22717.15.1_30-S	red
4618	ENSMUSG00000040396	Abhd13	scl0068904.1_325-S	turquoise
4619	ENSMUSG00000040407	Akap9	scl00100986.1_185-S	brown
4620	ENSMUSG00000040407	Akap9	scl0100986.1_13-S	yellow
4621	ENSMUSG00000040414	Slc25a28	scl52458.4_47-S	turquoise
4622	ENSMUSG00000040415	Dtx3	scl37395.7.349_6-S	blue
4623	ENSMUSG00000040429	Mterf	scl0208595.2_271-S	blue
4624	ENSMUSG00000040430	Pitpnc1	scl0071795.2_10-S	blue
4625	ENSMUSG00000040430	Pitpnc1	scl39417.12_309-S	turquoise
4626	ENSMUSG00000040446	Rprd1a	scl0016991.1_78-S	brown
4627	ENSMUSG00000040451	Sgms1	scl52550.23_145-S	turquoise
4628	ENSMUSG00000040452	Cdh12	GI_38076979-S	turquoise
4629	ENSMUSG00000040459	Arglu1	scl00234023.2_117-S	turquoise
4630	ENSMUSG00000040462	Os9	scl37399.12_263-S	blue
4631	ENSMUSG00000040472	Rabggta	scl45529.12.1_2-S	turquoise
4632	ENSMUSG00000040479	Dgkz	scl18990.34.1_21-S	blue
4633	ENSMUSG00000040481	Bptf	scl00207165.1_237-S	turquoise
4634	ENSMUSG00000040482	Dom3z	scl50807.7.1_59-S	blue
4635	ENSMUSG00000040488	Ltbp4	scl31603.36.1_19-S	blue
4636	ENSMUSG00000040490	Lrfn2	scl50629.3.1_224-S	blue
4637	ENSMUSG00000040502	Mar-09	scl37400.4_232-S	blue
4638	ENSMUSG00000040506	Ambra1	scl20622.20_179-S	blue
4639	ENSMUSG00000040521	Tsfm	scl37403.6.1_51-S	blue

4640	ENSMUSG00000040536	Efcbp1	scl24533.15_115-S	blue
4641	ENSMUSG00000040548	Tex2	scl39441.15.1_92-S	turquoise
4642	ENSMUSG00000040548	Tex2	scl39445.1.46_133-S	turquoise
4643	ENSMUSG00000040549	Ckap5	scl0075786.1_87-S	blue
4644	ENSMUSG00000040550	Otud6b	scl072201.1_290-S	turquoise
4645	ENSMUSG00000040560	Wdr7	scl51863.38_476-S	blue
4646	ENSMUSG00000040562	Gstm2	scl014863.1_325-S	green
4647	ENSMUSG00000040563	BC018242	scl37211.10_96-S	blue
4648	ENSMUSG00000040564	Apoc1	scl00021.1_10-S	green
4649	ENSMUSG00000040564	Apoc1	scl31674.3.1_6-S	green
4650	ENSMUSG00000040565	Btaf1	scl53173.13_456-S	blue
4651	ENSMUSG00000040570	Rundc3b	scl0242819.10_30-S	turquoise
4652	ENSMUSG00000040612	Ildr2	scl14355.1.1_113-S	turquoise
4653	ENSMUSG00000040616	Tmem51	scl0214359.1_299-S	turquoise
4654	ENSMUSG00000040620	Dhx33	scl39981.11_196-S	grey
4655	ENSMUSG00000040631	Dok4	scl34464.12_3-S	turquoise
4656	ENSMUSG00000040640	Erc2	scl46522.28_243-S	red
4657	ENSMUSG00000040648	Hisppd1	scl00227399.2_17-S	turquoise
4658	ENSMUSG00000040652	Oaz2	scl018247.9_19-S	blue
4659	ENSMUSG00000040653	Ppp1r14c	scl0003840.1_14-S	grey
4660	ENSMUSG00000040663	Clcf1	scl056708.1_17-S	grey
4661	ENSMUSG00000040667	Nup88	scl39983.12.1_110-S	turquoise
4662	ENSMUSG00000040669	Phc1	scl28444.18.1_1-S	blue
4663	ENSMUSG00000040675	Mthfd1l	scl0270685.28_30-S	blue
4664	ENSMUSG00000040687	Madd	scl0003327.1_30-S	pink
4665	ENSMUSG00000040690	Col16a1	scl24899.72.1_88-S	turquoise
4666	ENSMUSG00000040697	Dnajc16	scl00214063.1_272-S	blue
4667	ENSMUSG00000040697	Dnajc16	scl0214063.1_118-S	turquoise
4668	ENSMUSG00000040710	St8sia4	scl0020452.1_241-S	turquoise
4669	ENSMUSG00000040720	1110037F02Rik	scl25676.27_663-S	turquoise
4670	ENSMUSG00000040721	Zfhx2	GI_38076301-S	blue
4671	ENSMUSG00000040722	Scamp5	scl35792.9_485-S	blue
4672	ENSMUSG00000040724	Kcna2	scl22742.3.1_275-S	turquoise
4673	ENSMUSG00000040731	Eif4h	scl25941.7_8-S	blue
4674	ENSMUSG00000040738	Ints8	scl072656.1_14-S	turquoise
4675	ENSMUSG00000040746	Rnf167	scl0001587.1_50-S	blue
4676	ENSMUSG00000040746	Rnf167	scl070510.9_205-S	blue
4677	ENSMUSG00000040747	Cd53	scl0012508.2_215-S	turquoise
4678	ENSMUSG00000040759	Cmtm5	scl46294.4.1_0-S	magenta
4679	ENSMUSG00000040760	Appl1	scl0072993.2_232-S	brown
4680	ENSMUSG00000040760	Appl1	scl078142.2_31-S	turquoise
4681	ENSMUSG00000040774	Cept1	scl099712.1_51-S	turquoise
4682	ENSMUSG00000040785	Ttc3	scl0001856.1_23-S	blue
4683	ENSMUSG00000040785	Ttc3	scl0022129.1_200-S	blue
4684	ENSMUSG00000040785	Ttc3	scl022129.32_83-S	turquoise
4685	ENSMUSG00000040794	C1qtnf4	scl20653.2_227-S	blue
4686	ENSMUSG00000040797	Iqsec3	scl28446.23_488-S	blue
4687	ENSMUSG00000040818	A630054L15Rik	scl46540.20_142-S	blue
4688	ENSMUSG00000040824	Snrpd2	scl0107686.2_24-S	brown
4689	ENSMUSG00000040848	Sft2d2	scl00108735.2_193-S	grey
4690	ENSMUSG00000040850	Psme4	scl0103554.4_30-S	red
4691	ENSMUSG00000040856	Dlk1	scl42790.6_48-S	grey
4692	ENSMUSG00000040859	Bsdc1	scl24913.11_38-S	blue
4693	ENSMUSG00000040883	Tmem205	scl0003600.1_3-S	brown
4694	ENSMUSG00000040883	Tmem205	scl0235043.1_144-S	brown
4695	ENSMUSG00000040888	Gfer	scl50203.3_209-S	turquoise
4696	ENSMUSG00000040904	Rnasek	scl052898.2_0-S	brown
4697	ENSMUSG00000040928	S100pbp	scl23790.8_478-S	grey
4698	ENSMUSG00000040940	mFLJ00369	scl32944.30.1_12-S	blue
4699	ENSMUSG00000040957	Cables1	scl063955.10_154-S	purple
4700	ENSMUSG00000040964	Arhgef10l	scl23613.33_174-S	turquoise
4701	ENSMUSG00000040972	Igsf21	scl0230868.3_5-S	blue
4702	ENSMUSG00000040997	Abhd4	scl46309.9_175-S	turquoise
4703	ENSMUSG00000041014	Nrg3	scl0018183.2_196-S	turquoise
4704	ENSMUSG00000041020	Mtap7d2	scl54513.18.1_54-S	blue
4705	ENSMUSG00000041020	Mtap7d2	GI_38086938-S	yellow
4706	ENSMUSG00000041035	5330431N19Rik	scl000481.1_29-S	brown
4707	ENSMUSG00000041037	Irgq	scl00210146.1_172-S	brown
4708	ENSMUSG00000041040	Fam117b	GI_38049525-S	grey
4709	ENSMUSG00000041040	Fam117b	scl17911.8_508-S	turquoise
4710	ENSMUSG00000041084	Ostc	scl21513.4.14_14-S	brown
4711	ENSMUSG00000041112	Elmo1	scl0003760.1_927-S	purple
4712	ENSMUSG00000041115	Iqsec2	GI_38086808-S	brown
4713	ENSMUSG00000041124	8430410K20Rik	scl37319.3_438-S	brown
4714	ENSMUSG00000041126	H2afz	scl0001353.1_10-S	turquoise
4715	ENSMUSG00000041132	N4bp2l1	scl0100637.1_115-S	turquoise
4716	ENSMUSG00000041133	Smc1a	scl54546.18_0-S	red
4717	ENSMUSG00000041168	Lonp1	scl49760.15.1_0-S	blue
4718	ENSMUSG00000041203	2310036O22Rik	scl068544.3_98-S	turquoise
4719	ENSMUSG00000041215	Yeats2	scl49344.11_561-S	turquoise
4720	ENSMUSG00000041220	Elovl6	scl00170439.1_29-S	grey
4721	ENSMUSG00000041235	Chd7	scl25693.5.1_159-S	yellow
4722	ENSMUSG00000041236	Vps41	scl0003721.1_3-S	grey
4723	ENSMUSG00000041236	Vps41	scl45036.29.1_11-S	turquoise
4724	ENSMUSG00000041258	AK156842	scl0329002.1_2-S	turquoise
4725	ENSMUSG00000041263	Rusc1	scl21953.10.1_6-S	blue
4726	ENSMUSG00000041264	Uspl1	scl26951.9_50-S	brown
4727	ENSMUSG00000041272	Tox	scl24570.12.1_113-S	purple
4728	ENSMUSG00000041278	Ttc1	scl0066827.2_11-S	brown
4729	ENSMUSG00000041298	Katnal1	scl25750.10.1_14-S	yellow
4730	ENSMUSG00000041309	Nkx6-2	scl0014912.1_327-S	magenta
4731	ENSMUSG00000041329	Atp1b2	scl40029.6_18-S	blue
4732	ENSMUSG00000041341	Atg2b	scl076559.1_202-S	black
4733	ENSMUSG00000041341	Atg2b	scl42084.1.372_28-S	blue
4734	ENSMUSG00000041351	Rap1gap	scl0110351.13_329-S	brown
4735	ENSMUSG00000041355	Ssr2	scl22994.6_49-S	brown
4736	ENSMUSG00000041360	D19Bwg1357e	scl52614.18.1_13-S	blue
4737	ENSMUSG00000041375	Ccdc9	scl0243846.1_330-S	blue
4738	ENSMUSG00000041378	Cldn5	scl49357.1.362_28-S	blue
4739	ENSMUSG00000041390	Mdfic	scl30362.8.2_277-S	green
4740	ENSMUSG00000041408	Wapal	scl46449.20.1_0-S	turquoise
4741	ENSMUSG00000041415	Dicer1	scl42097.1_384-S	turquoise
4742	ENSMUSG00000041417	Pik3r1	scl0018708.1_307-S	yellow
4743	ENSMUSG00000041423	Paqr6	scl068957.3_51-S	turquoise
4744	ENSMUSG00000041438	Cirh1a	scl33380.18.1_13-S	turquoise
4745	ENSMUSG00000041444	Grit	scl37157.14.1121_194-S	greenyellow
4746	ENSMUSG00000041459	Tardbp	scl00230908.1_169-S	brown
4747	ENSMUSG00000041468	Gpr12	scl25771.3_570-S	grey
4748	ENSMUSG00000041481	Serpina3g	scl020715.6_281-S	magenta
4749	ENSMUSG00000041483	AK034110	scl17419.2_111-S	blue
4750	ENSMUSG00000041483	Zfp281	scl00226442.2_7-S	grey
4751	ENSMUSG00000041491	Cep78	scl0208518.1_281-S	grey
4752	ENSMUSG00000041528	Rnf123	scl35359.38.17_4-S	turquoise
4753	ENSMUSG00000041540	Sox5	scl0020678.1_3-S	yellow
4754	ENSMUSG00000041540	Sox5	scl28224.2_30-S	grey
4755	ENSMUSG00000041548	Hspb8	scl26144.4_263-S	green

4756	ENSMUSG00000041556	Fbxo2	scl24708.6.1_98-S	turquoise
4757	ENSMUSG00000041560	Gltscr2	scl068077.3_0-S	turquoise
4758	ENSMUSG00000041570	Camsap1l1	scl16234.18_249-S	grey
4759	ENSMUSG00000041571	Sepw1	scl31730.8.4_24-S	blue
4760	ENSMUSG00000041577	Prelp	scl16279.4_434-S	green
4761	ENSMUSG00000041594	Tmtc4	scl45122.22_116-S	turquoise
4762	ENSMUSG00000041607	Mbp	scl51725.12_3-S	magenta
4763	ENSMUSG00000041607	Mbp	scl0002236.1_9-S	magenta
4764	ENSMUSG00000041607	Mbp	scl0002268.1_45-S	magenta
4765	ENSMUSG00000041608	Entpd3	scl36335.20.967_4-S	grey
4766	ENSMUSG00000041609	Ccdc64	scl26154.16_189-S	turquoise
4767	ENSMUSG00000041617	2310015A05Rik	GI_38079711-S	turquoise
4768	ENSMUSG00000041623	D11Wsu47e	scl40755.5.1_55-S	grey
4769	ENSMUSG00000041625	A2ld1	scl45125.3_164-S	turquoise
4770	ENSMUSG00000041642	Rpl18	scl016565.3_322-S	turquoise
4771	ENSMUSG00000041645	AK018862	scl0002318.1_312-S	yellow
4772	ENSMUSG00000041645	Ddx24	scl42112.9.1_0-S	blue
4773	ENSMUSG00000041650	Pcca	scl45926.20.1_29-S	blue
4774	ENSMUSG00000041658	Rragb	GI_38086895-S	blue
4775	ENSMUSG00000041670	Rims1	scl0226928.1_84-S	turquoise
4776	ENSMUSG00000041685	Fcho2	scl43625.26_196-S	blue
4777	ENSMUSG00000041697	Cox6a1	scl0012861.1_173-S	turquoise
4778	ENSMUSG00000041697	Cox6a1	scl012861.2_54-S	turquoise
4779	ENSMUSG00000041708	Mpped1	scl47676.12_182-S	blue
4780	ENSMUSG00000041712	Ubr7	scl42852.11_140-S	blue
4781	ENSMUSG00000041720	Pi4ka	scl48707.57.4_151-S	blue
4782	ENSMUSG00000041733	Coq5	scl27366.3_38-S	turquoise
4783	ENSMUSG00000041736	Tspo	scl47677.6.2_17-S	green
4784	ENSMUSG00000041740	Rnf10	scl26162.14.72_6-S	turquoise
4785	ENSMUSG00000041747	Utp15	scl43635.12_640-S	turquoise
4786	ENSMUSG00000041763	Tpp2	scl18004.30_24-S	turquoise
4787	ENSMUSG00000041765	Ubac2	scl45935.10_60-S	blue
4788	ENSMUSG00000041769	Ppp2r2d	scl31935.10_97-S	brown
4789	ENSMUSG00000041773	Enc1	scl44485.3_91-S	blue
4790	ENSMUSG00000041774	Ydjc	scl069101.5_23-S	turquoise
4791	ENSMUSG00000041794	Myrip	scl36339.23_192-S	blue
4792	ENSMUSG00000041815	Poldip3	scl0002542.1_41-S	pink
4793	ENSMUSG00000041815	Poldip3	scl46904.9_7-S	brown
4794	ENSMUSG00000041836	Ptpre	scl00018.1_3-S	blue
4795	ENSMUSG00000041837	Pdcd7	scl36808.5_96-S	black
4796	ENSMUSG00000041870	Ankrd13a	scl27382.16_83-S	magenta
4797	ENSMUSG00000041879	Ipo9	scl00226432.1_235-S	turquoise
4798	ENSMUSG00000041881	Ndufa7	scl066416.3_80-S	brown
4799	ENSMUSG00000041891	Lman1	scl070361.1_127-S	grey
4800	ENSMUSG00000041911	Dlx1	scl20799.4_384-S	blue
4801	ENSMUSG00000041912	Tdrkh	scl072634.6_30-S	brown
4802	ENSMUSG00000041915	Ammecr1l	scl00225339.2_67-S	turquoise
4803	ENSMUSG00000041920	Slc16a6	scl00104681.2_288-S	turquoise
4804	ENSMUSG00000041921	Metapl1	scl20801.11.1_31-S	grey
4805	ENSMUSG00000041923	Nol4	scl0319211.1_216-S	turquoise
4806	ENSMUSG00000041936	Agrn	scl0011603.2_274-S	blue
4807	ENSMUSG00000041957	Pkp2	scl067451.10_18-S	blue
4808	ENSMUSG00000041957	Pkp2	scl49390.9.3_12-S	grey
4809	ENSMUSG00000041958	Pigs	scl0276846.12_121-S	blue
4810	ENSMUSG00000041959	S100a10	scl22910.4.1_66-S	turquoise
4811	ENSMUSG00000041977	Arhgef11	scl0213498.14_294-S	blue
4812	ENSMUSG00000041986	Elmod1	scl0270162.2_29-S	turquoise
4813	ENSMUSG00000041997	mKIAA0137	scl19160.22_222-S	turquoise
4814	ENSMUSG00000042032	Mat2b	scl0001524.1_45-S	red
4815	ENSMUSG00000042043	Tbca	scl021371.3_17-S	brown
4816	ENSMUSG00000042066	Tmcc2	scl068875.1_8-S	blue
4817	ENSMUSG00000042078	Svop	scl26188.18_422-S	brown
4818	ENSMUSG00000042082	Arsb	scl071784.1_62-S	blue
4819	ENSMUSG00000042105	Inpp5f	scl31997.22_366-S	brown
4820	ENSMUSG00000042109	Csdc2	scl47700.4_662-S	turquoise
4821	ENSMUSG00000042148	Cox10	scl40083.7.1_85-S	blue
4822	ENSMUSG00000042156	Dzip1	scl066573.1_18-S	turquoise
4823	ENSMUSG00000042178	Armc5	scl0233912.6_269-S	brown
4824	ENSMUSG00000042182	Bend6	scl16889.8_555-S	brown
4825	ENSMUSG00000042197	Zfp451	scl0098403.1_256-S	turquoise
4826	ENSMUSG00000042198	Chchd7	scl25713.4.87_24-S	turquoise
4827	ENSMUSG00000042202	A530082C11Rik	scl00320541.1_138-S	turquoise
4828	ENSMUSG00000042208	0610010F05Rik	scl071675.1_1-S	red
4829	ENSMUSG00000042208	0610010F05Rik	scl0071675.1_286-S	turquoise
4830	ENSMUSG00000042211	Fbxo38	scl51350.23.1_4-S	turquoise
4831	ENSMUSG00000042229	Rabif	scl17449.2_22-S	turquoise
4832	ENSMUSG00000042271	Nxt2	scl0237082.4_163-S	blue
4833	ENSMUSG00000042272	AK161179	scl19093.1_10-S	turquoise
4834	ENSMUSG00000042275	Itga1	scl0105083.1_137-S	blue
4835	ENSMUSG00000042289	Hsd3b7	scl00101502.1_299-S	green
4836	ENSMUSG00000042292	Mkl1	scl46940.15_253-S	blue
4837	ENSMUSG00000042298	Ttc19	scl072795.9_17-S	grey
4838	ENSMUSG00000042303	Sgsm3	scl0105835.22_280-S	blue
4839	ENSMUSG00000042305	Tmem183a	scl16272.9_285-S	brown
4840	ENSMUSG00000042308	Setd1a	scl0233904.6_160-S	blue
4841	ENSMUSG00000042312	S100a13	scl22947.3.8_31-S	brown
4842	ENSMUSG00000042323	Pbrm1	scl0066923.1_207-S	grey
4843	ENSMUSG00000042323	Pbrm1	scl066923.1_197-S	turquoise
4844	ENSMUSG00000042323	Pbrm1	scl076748.10_21-S	turquoise
4845	ENSMUSG00000042328	Hps4	scl070270.2_38-S	yellow
4846	ENSMUSG00000042331	Cytsb	scl41458.1.1_236-S	blue
4847	ENSMUSG00000042348	Arl15	scl44350.7_318-S	black
4848	ENSMUSG00000042350	1110018G07Rik	scl42235.24_353-S	blue
4849	ENSMUSG00000042354	Gnl3	scl45770.11.1_1-S	brown
4850	ENSMUSG00000042359	Osbpl6	scl0099031.1_295-S	blue
4851	ENSMUSG00000042359	Osbpl6	scl0003377.1_167-S	yellow
4852	ENSMUSG00000042363	1110067D22Rik	scl00216551.2_0-S	turquoise
4853	ENSMUSG00000042369	Rbm45	scl0003137.1_53-S	turquoise
4854	ENSMUSG00000042380	BC003266	scl24944.2_480-S	blue
4855	ENSMUSG00000042388	Dlgap3	scl0242667.10_106-S	blue
4856	ENSMUSG00000042389	Tsen2	scl0381802.12_9-S	grey
4857	ENSMUSG00000042401	Crtac1	scl52473.16_34-S	blue
4858	ENSMUSG00000042406	Atf4	scl47732.2_4-S	turquoise
4859	ENSMUSG00000042410	Agps	scl20743.21_355-S	brown
4860	ENSMUSG00000042426	Dhx29	scl44365.26.1_123-S	grey
4861	ENSMUSG00000042429	Adora1	scl16275.2_366-S	blue
4862	ENSMUSG00000042439	Zfp532	scl0328977.8_50-S	turquoise
4863	ENSMUSG00000042444	B230380D07Rik	scl35647.8.7_6-S	turquoise
4864	ENSMUSG00000042447	Mios	scl30402.11.1_13-S	turquoise
4865	ENSMUSG00000042453	Reln	scl0019699.2_228-S	black
4866	ENSMUSG00000042492	Tbc1d10b	scl30654.9_73-S	blue
4867	ENSMUSG00000042505	Acn9	scl071238.2_50-S	turquoise
4868	ENSMUSG00000042506	Usp22	GI_38091649-S	pink
4869	ENSMUSG00000042506	Usp22	scl40136.13_129-S	blue
4870	ENSMUSG00000042508	Dmtf1	scl0004045.1_65-S	red
4871	ENSMUSG00000042508	Dmtf1	scl28154.19_171-S	blue

4872	ENSMUSG00000042520	Ubap2l	scl0074383.1_273-S	blue
4873	ENSMUSG00000042520	Ubap2l	scl074383.1_23-S	black
4874	ENSMUSG00000042535	Gtpbp1	scl47740.13_198-S	blue
4875	ENSMUSG00000042541	Shfm1	scl29303.3.1_9-S	blue
4876	ENSMUSG00000042548	Asxl1	scl0228790.3_3-S	turquoise
4877	ENSMUSG00000042557	Sin3a	scl0020466.2_206-S	turquoise
4878	ENSMUSG00000042570	Mier2	scl070427.1_310-S	blue
4879	ENSMUSG00000042572	Ube2q1	scl070093.11_3-S	turquoise
4880	ENSMUSG00000042572	Ube2q1	scl12614.1.1_13-S	blue
4881	ENSMUSG00000042579	BC106127	scl0074034.1_260-S	turquoise
4882	ENSMUSG00000042581	Thsd7b	scl00210417.1_254-S	turquoise
4883	ENSMUSG00000042590	Ipo11	scl43536.32_392-S	blue
4884	ENSMUSG00000042594	Sh2b3	scl0016923.1_194-S	blue
4885	ENSMUSG00000042599	Jhdm1d	scl29112.21_421-S	turquoise
4886	ENSMUSG00000042605	Atxn2	scl020239.25_113-S	blue
4887	ENSMUSG00000042606	Hirip3	scl32046.5.1_83-S	turquoise
4888	ENSMUSG00000042613	Pbxip1	scl00229534.2_23-S	grey
4889	ENSMUSG00000042616	1810007P19Rik	scl0002647.1_116-S	turquoise
4890	ENSMUSG00000042659	Arrdc4	scl066412.2_22-S	grey
4891	ENSMUSG00000042671	Rgs8	scl17360.1.193_85-S	blue
4892	ENSMUSG00000042682	Selk	scl080795.5_227-S	blue
4893	ENSMUSG00000042688	Mapk6	scl35598.8_175-S	purple
4894	ENSMUSG00000042700	Sipa1l1	scl00217692.2_267-S	greenyellow
4895	ENSMUSG00000042705	Commd10	scl51985.8_140-S	turquoise
4896	ENSMUSG00000042712	Wbp5	scl022381.3_136-S	brown
4897	ENSMUSG00000042726	Trafd1	scl0004042.1_234-S	turquoise
4898	ENSMUSG00000042737	Dpm3	scl22977.3.91_193-S	brown
4899	ENSMUSG00000042743	Sgtb	scl44443.11_211-S	blue
4900	ENSMUSG00000042744	mKIAA0614	scl0269700.12_110-S	blue
4901	ENSMUSG00000042747	Krtcap2	scl22978.7.1_18-S	brown
4902	ENSMUSG00000042750	Bex2	scl53819.3_141-S	blue
4903	ENSMUSG00000042757	Tmem108	scl35423.7.1_70-S	blue
4904	ENSMUSG00000042770	Hebp1	scl28293.6.1_86-S	grey
4905	ENSMUSG00000042787	Endogl1	scl36347.8_506-S	turquoise
4906	ENSMUSG00000042790	Rnf214	scl00235315.2_221-S	blue
4907	ENSMUSG00000042797	Aqp11	scl000268.1_28-S	grey
4908	ENSMUSG00000042810	Krba1	scl0077827.2_271-S	turquoise
4909	ENSMUSG00000042834	D0H4S114	scl51556.7_209-S	blue
4910	ENSMUSG00000042978	Sbk1	scl0104175.6_273-S	turquoise
4911	ENSMUSG00000042992	Loh12cr1	scl29443.6_26-S	blue
4912	ENSMUSG00000043004	Gng2	scl0014702.1_273-S	brown
4913	ENSMUSG00000043059	Zfp513	scl0101023.1_246-S	blue
4914	ENSMUSG00000043091	Tuba1c	scl022146.5_240-S	green
4915	ENSMUSG00000043153	4930579E17Rik	scl43275.14_277-S	blue
4916	ENSMUSG00000043154	3222402P14Rik	scl35441.16_458-S	blue
4917	ENSMUSG00000043155	Hpdl	scl23947.1.22_246-S	grey
4918	ENSMUSG00000043165	Lor	scl21907.2_5-S	blue
4919	ENSMUSG00000043190	Rfesd	scl00218341.2_26-S	brown
4920	ENSMUSG00000043207	Zmpste24	scl00230709.1_4-S	blue
4921	ENSMUSG00000043241	Upf2	scl0326622.12_322-S	blue
4922	ENSMUSG00000043259	1200015N20Rik	scl0071721.2_141-S	grey
4923	ENSMUSG00000043284	Tmem11	scl40141.3_333-S	black
4924	ENSMUSG00000043300	B3galnt1	scl22075.4_6-S	blue
4925	ENSMUSG00000043323	2410025L10Rik	GI_38080370-S	blue
4926	ENSMUSG00000043384	Gprasp1	scl54622.12_49-S	brown
4927	ENSMUSG00000043388	Tmem130	scl25790.8_644-S	blue
4928	ENSMUSG00000043391	2510009E07Rik	scl072190.1_208-S	grey
4929	ENSMUSG00000043411	Usp48	scl24797.1_325-S	turquoise
4930	ENSMUSG00000043411	Usp48	scl24801.31.1_2-S	turquoise
4931	ENSMUSG00000043419	A030009H04Rik	scl41371.2_575-S	turquoise
4932	ENSMUSG00000043432	Leng9	scl00243813.1_281-S	black
4933	ENSMUSG00000043445	Jag2	scl067078.2_14-S	greenyellow
4934	ENSMUSG00000043448	Gjc2	scl40171.3.1_197-S	magenta
4935	ENSMUSG00000043456	Zfp536	scl00243937.2_157-S	greenyellow
4936	ENSMUSG00000043460	Elfn2	scl46984.5_578-S	greenyellow
4937	ENSMUSG00000043463	Rab9b	scl53809.3_492-S	brown
4938	ENSMUSG00000043518	Rai2	scl024004.2_257-S	turquoise
4939	ENSMUSG00000043535	Setx	scl21117.18_194-S	turquoise
4940	ENSMUSG00000043542	Fam164a	scl067306.2_29-S	blue
4941	ENSMUSG00000043602	Zfp3	scl41325.2_569-S	turquoise
4942	ENSMUSG00000043636	mKIAA1239	scl27788.8.2924_41-S	turquoise
4943	ENSMUSG00000043644	AK005967	scl40636.2.1_9-S	turquoise
4944	ENSMUSG00000043668	Tox3	scl34505.6_160-S	turquoise
4945	ENSMUSG00000043670	Diras1	scl0208666.1_329-S	blue
4946	ENSMUSG00000043733	Ptpn11	scl0019247.1_12-S	turquoise
4947	ENSMUSG00000043843	Tmem145	scl32933.15.1_222-S	purple
4948	ENSMUSG00000043858	Nup62	scl018226.2_9-S	turquoise
4949	ENSMUSG00000043866	Taf10	scl024075.4_0-S	turquoise
4950	ENSMUSG00000043881	Kbtbd7	scl2648.1.1_126-S	turquoise
4951	ENSMUSG00000043909	Trp53bp1	scl0027223.1_124-S	black
4952	ENSMUSG00000043909	Trp53bp1	scl027223.2_10-S	grey
4953	ENSMUSG00000043964	Orai3	scl32018.3_67-S	blue
4954	ENSMUSG00000044005	Gls2	scl38293.19.1_26-S	grey
4955	ENSMUSG00000044024	Rell2	scl00225392.1_86-S	blue
4956	ENSMUSG00000044024	Rell2	scl52045.2_4-S	pink
4957	ENSMUSG00000044030	Irf2bp1	scl33017.2_469-S	blue
4958	ENSMUSG00000044067	Gpr22	scl42555.3_391-S	blue
4959	ENSMUSG00000044071	Fam19a2	scl00268354.2_83-S	red
4960	ENSMUSG00000044071	Fam19a2	scl38346.6_205-S	turquoise
4961	ENSMUSG00000044072	C230094A16Rik	scl00237711.2_170-S	grey
4962	ENSMUSG00000044117	2900011O08Rik	scl0001785.1_33-S	red
4963	ENSMUSG00000044117	2900011O08Rik	scl49400.6_138-S	turquoise
4964	ENSMUSG00000044134	Fam109a	scl00231717.2_326-S	turquoise
4965	ENSMUSG00000044134	Fam109a	scl27269.5_229-S	turquoise
4966	ENSMUSG00000044147	Arf6	scl43154.2_481-S	blue
4967	ENSMUSG00000044149	Nkrf	scl0077286.1_137-S	brown
4968	ENSMUSG00000044155	Lsm8	scl30348.4.1_28-S	turquoise
4969	ENSMUSG00000044164	Rnf182	scl44844.2.1_32-S	greenyellow
4970	ENSMUSG00000044176	Spink10	scl51875.11.1_29-S	grey
4971	ENSMUSG00000044221	Grsf1	scl26406.12_265-S	grey
4972	ENSMUSG00000044224	AK141303	scl078121.4_47-S	black
4973	ENSMUSG00000044349	Snhg11	scl20001.6.1_12-S	yellow
4974	ENSMUSG00000044352	Ankrd43	scl40236.1.295_31-S	turquoise
4975	ENSMUSG00000044365	Cxxc4	scl22588.2.3131_13-S	brown
4976	ENSMUSG00000044408	1110002B05Rik	scl42464.2_123-S	turquoise
4977	ENSMUSG00000044442	Hemk2	scl48912.5_69-S	yellow
4978	ENSMUSG00000044452	ZFP507	scl00243924.1_251-S	turquoise
4979	ENSMUSG00000044465	Fam160a2	scl0074349.2_256-S	blue
4980	ENSMUSG00000044475	Ascc1	scl38883.14.1_156-S	turquoise
4981	ENSMUSG00000044477	Zfand3	scl50887.7_31-S	turquoise
4982	ENSMUSG00000044502	2310022M17Rik	scl0069556.1_196-S	turquoise
4983	ENSMUSG00000044628	Rnf208	scl21188.2_9-S	blue
4984	ENSMUSG00000044629	Cnrip1	scl070255.1_21-S	turquoise
4985	ENSMUSG00000044629	Cnrip1	scl073228.3_238-S	grey
4986	ENSMUSG00000044636	Csrnp2	scl46722.5_604-S	blue
4987	ENSMUSG00000044700	Tmem201	scl00230917.2_257-S	blue

4988	ENSMUSG00000044791	Setd2	scl0235626.1_238-S	grey
4989	ENSMUSG00000044857	Lemd2	scl00224640.2_275-S	turquoise
4990	ENSMUSG00000044912	Syt16	scl43094.11.1_246-S	blue
4991	ENSMUSG00000044927	H1fx	scl0243529.4_9-S	blue
4992	ENSMUSG00000044948	D19Ertd652e	GI_38085186-S	green
4993	ENSMUSG00000044949	Ubtd2	scl41716.5.1_57-S	turquoise
4994	ENSMUSG00000044986	Tst	scl46993.2.1_42-S	grey
4995	ENSMUSG00000045007	Tubg2	scl40892.11.1_309-S	blue
4996	ENSMUSG00000045009	Prrt3	scl28540.6.1_0-S	blue
4997	ENSMUSG00000045039	mKIAA0817	scl0269878.14_318-S	blue
4998	ENSMUSG00000045087	S1pr5	scl36149.3_215-S	magenta
4999	ENSMUSG00000045095	Magi1	scl0014924.2_213-S	turquoise
5000	ENSMUSG00000045103	DYSTROPHIN	scl54811.82_56-S	brown
5001	ENSMUSG00000045107	1810063B07Rik	scl067509.1_36-S	grey
5002	ENSMUSG00000045128	Rpl18a	scl076808.4_30-S	turquoise
5003	ENSMUSG00000045136	Tubb2b	scl0073710.1_12-S	pink
5004	ENSMUSG00000045136	Tubb2b	GI_21746160-S	yellow
5005	ENSMUSG00000045160	Bola3	scl078653.2_11-S	brown
5006	ENSMUSG00000045174	Fam123c	scl18087.2_490-S	blue
5007	ENSMUSG00000045176	2310047M10Rik	scl41381.1.1515_7-S	blue
5008	ENSMUSG00000045180	Shroom2	GI_27369584-S	grey
5009	ENSMUSG00000045193	Cirbp	scl012696.5_98-S	blue
5010	ENSMUSG00000045211	Nudt18	scl00213484.2_217-S	brown
5011	ENSMUSG00000045216	Hs6st1	scl18078.2_144-S	blue
5012	ENSMUSG00000045237	1110012L19Rik	scl068618.1_97-S	brown
5013	ENSMUSG00000045252	Zfp574	scl32942.2_625-S	blue
5014	ENSMUSG00000045257	Morn2	scl0378462.4_10-S	turquoise
5015	ENSMUSG00000045259	Klhdc9	scl15936.4.1_73-S	grey
5016	ENSMUSG00000045287	Rtn4rl1	scl41270.2_525-S	blue
5017	ENSMUSG00000045302	Preb	scl0050907.2_191-S	blue
5018	ENSMUSG00000045312	Lhfpl2	scl44517.9_405-S	turquoise
5019	ENSMUSG00000045318	Adra2c	scl27902.1_282-S	blue
5020	ENSMUSG00000045337	Defb11	scl35030.3.1_41-S	green
5021	ENSMUSG00000045348	6430598A04Rik	scl0243300.1_92-S	blue
5022	ENSMUSG00000045404	Kcnk13	scl0217826.2_241-S	magenta
5023	ENSMUSG00000045409	Trim39	scl49960.7_412-S	turquoise
5024	ENSMUSG00000045411	2410002F23Rik	scl066976.9_299-S	turquoise
5025	ENSMUSG00000045438	Cox19	scl0068033.1_52-S	brown
5026	ENSMUSG00000045482	Trrap	scl26992.46_0-S	turquoise
5027	ENSMUSG00000045546	Rnf113a2	scl42978.1_15-S	turquoise
5028	ENSMUSG00000045567	Col22a1	scl069700.1_259-S	grey
5029	ENSMUSG00000045573	Penk	scl24582.2_41-S	grey
5030	ENSMUSG00000045576	St7l	scl0002097.1_75-S	turquoise
5031	ENSMUSG00000045594	Glb1	scl0012091.2_274-S	green
5032	ENSMUSG00000045625	Pigz	scl0239827.3_270-S	magenta
5033	ENSMUSG00000045664	Cdc42ep2	scl00104252.2_200-S	magenta
5034	ENSMUSG00000045665	Mfsd5	scl47467.2_297-S	blue
5035	ENSMUSG00000045679	Pqlc3	scl00217430.2_0-S	green
5036	ENSMUSG00000045691	Thtpa	scl0105663.2_267-S	turquoise
5037	ENSMUSG00000045694	Rps20	GI_38086917-S	turquoise
5038	ENSMUSG00000045733	Sprn	scl000140.1_18-S	turquoise
5039	ENSMUSG00000045733	Sprn	scl00212518.2_249-S	pink
5040	ENSMUSG00000045733	Sprn	scl30517.3.1_18-S	turquoise
5041	ENSMUSG00000045763	Basp1	scl47358.1_193-S	blue
5042	ENSMUSG00000045767	B230219D22Rik	scl44723.2_201-S	turquoise
5043	ENSMUSG00000045896	Paip2b	scl00232164.2_22-S	red
5044	ENSMUSG00000045903	Npas4	scl53482.9.1_175-S	grey
5045	ENSMUSG00000045912	4932409I22Rik	scl0237397.1_281-S	blue
5046	ENSMUSG00000045948	Mrps12	scl0024030.2_121-S	grey
5047	ENSMUSG00000045954	Sdpr	scl17984.2_572-S	green
5048	ENSMUSG00000045962	Wnk1	scl0001157.1_152-S	yellow
5049	ENSMUSG00000045962	Wnk1	scl00232341.1_311-S	grey
5050	ENSMUSG00000045967	Gpr158	scl21222.12_521-S	grey
5051	ENSMUSG00000045983	Eif4g1	scl49333.35.1_32-S	black
5052	ENSMUSG00000045991	Onecut2	scl51859.1.3752_6-S	grey
5053	ENSMUSG00000046058	Eid2	scl0386655.1_75-S	blue
5054	ENSMUSG00000046062	Ppp1r15b	scl17471.3_7-S	turquoise
5055	ENSMUSG00000046079	Lrrc8d	scl27491.7_248-S	blue
5056	ENSMUSG00000046093	Hpcal4	scl24997.7_361-S	turquoise
5057	ENSMUSG00000046139	AV312086	scl53350.20_138-S	blue
5058	ENSMUSG00000046159	Chrm3	scl44299.4.1_276-S	blue
5059	ENSMUSG00000046185	Zfp84	scl9636.1.1_309-S	turquoise
5060	ENSMUSG00000046201	Rbm16	scl0106583.1_2-S	turquoise
5061	ENSMUSG00000046229	Scand1	scl18441.3.11_50-S	blue
5062	ENSMUSG00000046287	Pnma3	scl54855.1.1_274-S	blue
5063	ENSMUSG00000046312	AI464131	scl24422.2_383-S	turquoise
5064	ENSMUSG00000046321	Hs3st2	scl00195646.1_300-S	blue
5065	ENSMUSG00000046324	Ermp1	scl52590.16_341-S	magenta
5066	ENSMUSG00000046351	Zfp322a	scl0218100.1_36-S	turquoise
5067	ENSMUSG00000046352	Gjb2	scl014619.1_28-S	turquoise
5068	ENSMUSG00000046378	Asphd1	scl30664.4.1_54-S	blue
5069	ENSMUSG00000046402	Rbp1	scl36582.7.1_25-S	green
5070	ENSMUSG00000046404	Yod1	scl17509.2_142-S	blue
5071	ENSMUSG00000046417	BC046404	scl0192976.1_323-S	purple
5072	ENSMUSG00000046432	Ngfrap1	scl54613.4.1_8-S	turquoise
5073	ENSMUSG00000046432	Ngfrap1	scl0014481.1_2-S	turquoise
5074	ENSMUSG00000046434	Hnrnpa1	scl015382.13_13-S	turquoise
5075	ENSMUSG00000046442	Ppm1e	scl39758.7_531-S	blue
5076	ENSMUSG00000046449	C77370	scl0245555.1_16-S	yellow
5077	ENSMUSG00000046519	Golph3l	scl22878.5_439-S	blue
5078	ENSMUSG00000046523	Kctd4	scl46086.2_122-S	yellow
5079	ENSMUSG00000046562	Unc119b	scl00106840.2_67-S	turquoise
5080	ENSMUSG00000046567	4930430F08Rik	scl37560.8_425-S	blue
5081	ENSMUSG00000046572	Zfp518b	scl26662.1_71-S	grey
5082	ENSMUSG00000046585	BC057135	GI_38085188-S	brown
5083	ENSMUSG00000046658	Zfp316	scl0054201.1_158-S	turquoise
5084	ENSMUSG00000046671	Fam54b	scl0076824.1_187-S	grey
5085	ENSMUSG00000046675	D230037D09Rik	scl42853.2.1_24-S	turquoise
5086	ENSMUSG00000046699	Slitrk4	scl54197.4_379-S	yellow
5087	ENSMUSG00000046707	Csnk2a2	scl0013000.1_146-S	brown
5088	ENSMUSG00000046707	Csnk2a2	scl013000.1_10-S	blue
5089	ENSMUSG00000046709	Mapk10	scl26307.1.3366_81-S	turquoise
5090	ENSMUSG00000046709	Mapk10	scl0004010.1_24-S	pink
5091	ENSMUSG00000046709	Mapk10	scl026414.2_6-S	red
5092	ENSMUSG00000046718	Bst2	scl34673.5.1_43-S	green
5093	ENSMUSG00000046727	0610010O12Rik	scl52091.9.1_29-S	turquoise
5094	ENSMUSG00000046756	Mrps7	scl40724.4.1_15-S	turquoise
5095	ENSMUSG00000046791	2410016O06Rik	scl42993.1.28_269-S	blue
5096	ENSMUSG00000046792	Zfp787	GI_38085699-S	turquoise
5097	ENSMUSG00000046798	Cldn12	scl28136.6_235-S	turquoise
5098	ENSMUSG00000046808	Atp10d	scl27730.23_48-S	green
5099	ENSMUSG00000046818	Ddit4l	scl22560.5_561-S	purple
5100	ENSMUSG00000046822	Slc39a3	scl0106947.1_49-S	black
5101	ENSMUSG00000046844	Vat1l	scl33299.10_656-S	green
5102	ENSMUSG00000046861	Hectd3	scl0076608.2_255-S	blue
5103	ENSMUSG00000046876	Atxn1	scl44029.9_118-S	yellow

5104	ENSMUSG00000046982	Tshz1	scl0110796.1_34-S	greenyellow
5105	ENSMUSG00000046985	Tapt1	scl0231225.1_255-S	blue
5106	ENSMUSG00000047013	Fbxo41	scl28764.4.5_90-S	yellow
5107	ENSMUSG00000047036	Zfp445	scl0235682.1_81-S	yellow
5108	ENSMUSG00000047037	Nipa1	scl00233280.1_7-S	magenta
5109	ENSMUSG00000047044	D030056L22Rik	scl0225995.2_210-S	grey
5110	ENSMUSG00000047085	Lrrc4b	scl32716.2_264-S	brown
5111	ENSMUSG00000047126	Cltc	scl0001345.1_85-S	turquoise
5112	ENSMUSG00000047181	Samd14	scl41018.11_650-S	turquoise
5113	ENSMUSG00000047187	Rab2a	scl25694.8.816_12-S	blue
5114	ENSMUSG00000047205	Dusp18	scl41898.2_350-S	turquoise
5115	ENSMUSG00000047213	Ythdf3	scl00229096.1_119-S	turquoise
5116	ENSMUSG00000047215	Rpl9	GI_14149646-S	blue
5117	ENSMUSG00000047221	AI847670	scl28067.9_404-S	grey
5118	ENSMUSG00000047230	Cldn2	scl0012738.2_49-S	green
5119	ENSMUSG00000047238	Mageh1	scl53701.1.378_12-S	red
5120	ENSMUSG00000047238	Mageh1	GI_38086909-S	turquoise
5121	ENSMUSG00000047242	Taf9b	GI_38086492-S	red
5122	ENSMUSG00000047250	Ptgs1	scl0019224.1_106-S	turquoise
5123	ENSMUSG00000047261	Gap43	scl014432.1_11-S	turquoise
5124	ENSMUSG00000047284	Neurl4	scl0001321.1_142-S	blue
5125	ENSMUSG00000047284	Neurl4	scl0216860.7_143-S	blue
5126	ENSMUSG00000047368	Fam108b	scl00226016.2_58-S	turquoise
5127	ENSMUSG00000047368	Fam108b	scl53290.5_226-S	yellow
5128	ENSMUSG00000047379	B3gnt1	scl52829.1_29-S	blue
5129	ENSMUSG00000047388	Atmin	scl33277.4_326-S	brown
5130	ENSMUSG00000047394	Odf3b	scl46852.4_352-S	green
5131	ENSMUSG00000047415	Gpr68	scl42144.4_219-S	blue
5132	ENSMUSG00000047423	AI837181	scl52839.2_29-S	blue
5133	ENSMUSG00000047428	Dlk2	scl50678.6_219-S	turquoise
5134	ENSMUSG00000047454	Gphn	scl00268566.1_142-S	black
5135	ENSMUSG00000047454	Gphn	scl43053.27.1_6-S	turquoise
5136	ENSMUSG00000047473	Zfp30	scl32836.5_532-S	grey
5137	ENSMUSG00000047495	Dlgap2	scl00244310.2_283-S	blue
5138	ENSMUSG00000047495	Dlgap2	scl0244310.9_27-S	grey
5139	ENSMUSG00000047496	Rnf152	scl16430.4.1_256-S	green
5140	ENSMUSG00000047502	AK134749	GI_38078627-S	turquoise
5141	ENSMUSG00000047507	Baiap3	scl000098.1_12_REVCOMP-S	turquoise
5142	ENSMUSG00000047507	Baiap3	scl000093.1_57-S	turquoise
5143	ENSMUSG00000047509	Lztfl1	GI_38085224-S	blue
5144	ENSMUSG00000047514	Tspyl1	scl39032.1_64-S	blue
5145	ENSMUSG00000047547	Cltb	scl43941.6_46-S	blue
5146	ENSMUSG00000047557	Lxn	scl22088.5.1_88-S	black
5147	ENSMUSG00000047613	A430005L14Rik	scl0097159.2_118-S	blue
5148	ENSMUSG00000047617	BC029214	scl00227622.2_208-S	turquoise
5149	ENSMUSG00000047649	Cd3eap	scl070333.1_111-S	greenyellow
5150	ENSMUSG00000047676	Rpsa	GI_38073578-S	turquoise
5151	ENSMUSG00000047714	Ppp1r2	scl0066849.1_145-S	turquoise
5152	ENSMUSG00000047721	Bola2	scl32057.1.564_6-S	brown
5153	ENSMUSG00000047731	D19Wsu162e	scl53030.7_286-S	blue
5154	ENSMUSG00000047767	Atg16l2	scl073683.2_12-S	turquoise
5155	ENSMUSG00000047786	Lix1	scl0066643.1_65-S	blue
5156	ENSMUSG00000047786	Lix1	scl51074.6_288-S	brown
5157	ENSMUSG00000047786	Lix1	scl0066643.1_330-S	turquoise
5158	ENSMUSG00000047793	Sned1	scl00208777.1_274-S	green
5159	ENSMUSG00000047810	Ccdc88b	scl52908.26.6_30-S	turquoise
5160	ENSMUSG00000047842	Diras2	scl43971.2.2_53-S	turquoise
5161	ENSMUSG00000047843	Bri3	scl21206.2.1_228-S	blue
5162	ENSMUSG00000047866	Lonp2	scl33549.18.1_0-S	turquoise
5163	ENSMUSG00000047879	Usp14	scl51664.18.1_87-S	turquoise
5164	ENSMUSG00000047904	Sstr2	scl40757.3.1_234-S	grey
5165	ENSMUSG00000047907	Tshz2	GI_38075271-S	purple
5166	ENSMUSG00000047945	Marcksl1	scl0017357.2_64-S	turquoise
5167	ENSMUSG00000048001	Hes5	scl24634.4_103-S	grey
5168	ENSMUSG00000048040	Spcs3	scl54618.1.2_1-S	blue
5169	ENSMUSG00000048078	Odz4	scl32363.39_490-S	blue
5170	ENSMUSG00000048100	Taf13	scl0099730.2_131-S	turquoise
5171	ENSMUSG00000048108	Tmem72	scl28507.5_55-S	green
5172	ENSMUSG00000048109	Rbm15	scl21684.2.5_0-S	turquoise
5173	ENSMUSG00000048126	Col6a3	scl0012835.1_152-S	grey
5174	ENSMUSG00000048142	Nat8l	scl27919.3_374-S	blue
5175	ENSMUSG00000048142	Nat8l	scl068762.2_131-S	blue
5176	ENSMUSG00000048163	Selplg	scl26191.2_17-S	grey
5177	ENSMUSG00000048216	Gpr85	scl0064450.1_199-S	blue
5178	ENSMUSG00000048218	Amigo2	scl00105827.2_285-S	blue
5179	ENSMUSG00000048218	Amigo2	scl46785.2.1_0-S	turquoise
5180	ENSMUSG00000048232	Fbxo10	GI_38078281-S	blue
5181	ENSMUSG00000048240	Gng7	scl37714.6_223-S	blue
5182	ENSMUSG00000048251	Bcl11b	scl0002349.1_957-S	turquoise
5183	ENSMUSG00000048251	Bcl11b	scl3387.1.1_34-S	brown
5184	ENSMUSG00000048251	Bcl11b	scl42068.4_0-S	turquoise
5185	ENSMUSG00000048264	Dip2c	scl00208440.1_1-S	turquoise
5186	ENSMUSG00000048307	Ankrd46	scl068839.1_117-S	turquoise
5187	ENSMUSG00000048332	Lhfp	scl0108927.4_201-S	turquoise
5188	ENSMUSG00000048376	F2r	scl43661.2_29-S	grey
5189	ENSMUSG00000048385	Scrt1	scl0170729.1_37-S	brown
5190	ENSMUSG00000048424	Ranbp3l	scl0223332.14_5-S	blue
5191	ENSMUSG00000048450	Msx1	scl26670.3.10_104-S	green
5192	ENSMUSG00000048486	BC090994	scl18384.2_543-S	blue
5193	ENSMUSG00000048490	Nrip1	scl0108849.1_230-S	turquoise
5194	ENSMUSG00000048497	Mmgt2	scl0216829.1_190-S	grey
5195	ENSMUSG00000048550	Thnsl1	GI_29243945-S	brown
5196	ENSMUSG00000048578	2410014A08Rik	scl26166.1_3-S	turquoise
5197	ENSMUSG00000048583	Igf2	scl30469.7_1-S	green
5198	ENSMUSG00000048644	Ctxn1	scl35140.2_153-S	blue
5199	ENSMUSG00000048668	5930416I19Rik	scl072440.1_180-S	turquoise
5200	ENSMUSG00000048706	D4Bwg0951e	scl25332.2_140-S	grey
5201	ENSMUSG00000048707	C430004E15Rik	scl21186.4.1_111-S	magenta
5202	ENSMUSG00000048747	E130114P18Rik	scl0319865.1_73-S	turquoise
5203	ENSMUSG00000048758	Rpl29	scl019944.1_21-S	grey
5204	ENSMUSG00000048799	Cep120	scl51413.22_393-S	turquoise
5205	ENSMUSG00000048814	Lonrf2	GI_38074255-S	turquoise
5206	ENSMUSG00000048833	Slc39a9	scl43025.1.128_22-S	turquoise
5207	ENSMUSG00000048834	Vstm2a	scl00211739.1_242-S	turquoise
5208	ENSMUSG00000048834	Vstm2a	scl0211739.4_64-S	red
5209	ENSMUSG00000048874	Phf3	GI_38074211-S	black
5210	ENSMUSG00000048874	Phf3	scl16903.16_97-S	grey
5211	ENSMUSG00000048878	Hexim1	scl40848.1_563-S	grey
5212	ENSMUSG00000048895	Cdk5r1	scl41169.1_6-S	brown
5213	ENSMUSG00000048899	Rimkla	scl0194237.1_178-S	grey
5214	ENSMUSG00000048910	2810453I06Rik	scl0067238.2_233-S	turquoise
5215	ENSMUSG00000048915	Efna5	scl0013640.1_290-S	purple
5216	ENSMUSG00000048930	Tada3l	scl0001054.1_42-S	black
5217	ENSMUSG00000048930	Tada3l	scl00101206.2_281-S	blue
5218	ENSMUSG00000048970	C1galt1c1	scl059048.1_115-S	turquoise
5219	ENSMUSG00000048988	Elfn1	scl27056.3_478-S	blue

5220	ENSMUSG00000049044	Rapgef4	scl056508.28_32-S	turquoise
5221	ENSMUSG00000049047	Armcx3	scl071703.5_40-S	brown
5222	ENSMUSG00000049086	Bmyc	scl21165.1.12_85-S	turquoise
5223	ENSMUSG00000049100	Pcdh10	scl018526.1_213-S	blue
5224	ENSMUSG00000049106	Wdr22	scl00320808.2_13-S	turquoise
5225	ENSMUSG00000049119	Fam110b	scl00242297.2_152-S	blue
5226	ENSMUSG00000049148	Plcxd3	scl48135.4.1_204-S	turquoise
5227	ENSMUSG00000049154	3100002J23Rik	scl40179.4.1_10-S	blue
5228	ENSMUSG00000049232	Tigd2	scl29979.4_457-S	blue
5229	ENSMUSG00000049252	Lrp1b	scl19322.82_322-S	turquoise
5230	ENSMUSG00000049281	Scn3b	scl0235281.6_73-S	pink
5231	ENSMUSG00000049295	Zfp219	scl069890.1_204-S	turquoise
5232	ENSMUSG00000049299	Trappc1	GI_38091426-S	brown
5233	ENSMUSG00000049303	Syt12	scl53461.8_48-S	blue
5234	ENSMUSG00000049313	Sorl1	scl0020660.2_10-S	blue
5235	ENSMUSG00000049327	Setd8	scl067956.13_1-S	brown
5236	ENSMUSG00000049327	Setd8	scl0067956.1_111-S	blue
5237	ENSMUSG00000049339	Fam134a	scl17783.10_25-S	turquoise
5238	ENSMUSG00000049401	Ogfr	scl19785.7_63-S	blue
5239	ENSMUSG00000049420	C030003D03Rik	scl38108.3_14-S	blue
5240	ENSMUSG00000049422	Chchd10	scl38757.5.1_81-S	brown
5241	ENSMUSG00000049482	2310061F22Rik	GI_38089453-S	turquoise
5242	ENSMUSG00000049504	2810046L04Rik	scl23200.12_402-S	black
5243	ENSMUSG00000049532	Sall2	scl45584.3_58-S	blue
5244	ENSMUSG00000049536	Tceal1	scl54611.2_16-S	brown
5245	ENSMUSG00000049550	Clip1	scl0056430.2_105-S	turquoise
5246	ENSMUSG00000049550	Clip1	scl26054.30_361-S	blue
5247	ENSMUSG00000049553	Polr1a	scl0020019.1_252-S	black
5248	ENSMUSG00000049577	Zfpm1	scl33230.10_515-S	blue
5249	ENSMUSG00000049583	Grm5	GI_38088766-S	yellow
5250	ENSMUSG00000049583	Grm5	scl0108071.1_257-S	yellow
5251	ENSMUSG00000049606	Zfp644	scl052397.1_25-S	blue
5252	ENSMUSG00000049612	Omg	scl0018377.2_15-S	brown
5253	ENSMUSG00000049630	C1ql3	scl19669.2.1_3-S	pink
5254	ENSMUSG00000049630	C1ql3	scl4596.1.1_107-S	turquoise
5255	ENSMUSG00000049643	2310022A10Rik	scl32892.12_87-S	blue
5256	ENSMUSG00000049647	AK009365	scl076437.1_89-S	turquoise
5257	ENSMUSG00000049647	Purb	scl0019291.1_135-S	yellow
5258	ENSMUSG00000049658	Bdp1	scl43605.23_398-S	turquoise
5259	ENSMUSG00000049659	Aftph	scl40468.10_17-S	blue
5260	ENSMUSG00000049670	Morn4	scl52479.6_328-S	turquoise
5261	ENSMUSG00000049672	Zfp161	scl022666.6_141-S	turquoise
5262	ENSMUSG00000049680	2010005J08Rik	scl072046.1_70-S	blue
5263	ENSMUSG00000049721	Gal3st1	scl41896.5_609-S	magenta
5264	ENSMUSG00000049744	Arhgap15	scl0076117.1_128-S	blue
5265	ENSMUSG00000049744	Arhgap15	scl076117.22_2-S	red
5266	ENSMUSG00000049755	Zfp672	scl0319475.1_238-S	grey
5267	ENSMUSG00000049760	2410015M20Rik	scl0224904.1_72-S	blue
5268	ENSMUSG00000049800	Sertad2	scl0058172.1_221-S	greenyellow
5269	ENSMUSG00000049804	Armcx4	GI_38087316-S	grey
5270	ENSMUSG00000049807	4933428G20Rik	scl0058996.1_51-S	blue
5271	ENSMUSG00000049878	Rlf	scl23875.1.1208_1-S	blue
5272	ENSMUSG00000049882	Gm71	GI_28521532-S	grey
5273	ENSMUSG00000049892	Rasd1	scl40151.2_453-S	brown
5274	ENSMUSG00000049907	Rasl11b	scl27712.5_609-S	grey
5275	ENSMUSG00000049922	Slc35c1	scl18985.4_291-S	blue
5276	ENSMUSG00000049929	Lpar4	scl078134.3_260-S	blue
5277	ENSMUSG00000049940	Pgrmc2	scl22215.3_32-S	turquoise
5278	ENSMUSG00000049960	Mrps16	scl066242.2_14-S	brown
5279	ENSMUSG00000050002	5133401N09Rik	scl0075731.2_157-S	turquoise
5280	ENSMUSG00000050017	Pitpnb	scl27424.11_172-S	blue
5281	ENSMUSG00000050029	Rap2c	scl54266.5_48-S	blue
5282	ENSMUSG00000050043	Txndc14	scl066958.2_91-S	turquoise
5283	ENSMUSG00000050052	2610019F03Rik	scl35069.4_181-S	blue
5284	ENSMUSG00000050088	1600012H06Rik	scl067912.2_23-S	turquoise
5285	ENSMUSG00000050103	Tmem195	scl43272.15.1_17-S	blue
5286	ENSMUSG00000050121	Opalin	scl0226115.1_174-S	magenta
5287	ENSMUSG00000050144	Slc25a44	scl0229517.1_78-S	blue
5288	ENSMUSG00000050188	Lsm10	scl0116748.2_296-S	blue
5289	ENSMUSG00000050211	Pla2g4e	scl18791.2_626-S	grey
5290	ENSMUSG00000050244	Heatr1	scl00217995.1_300-S	brown
5291	ENSMUSG00000050244	Heatr1	scl45065.22.7_66-S	grey
5292	ENSMUSG00000050271	D8Ertd82e	scl33900.6_43-S	blue
5293	ENSMUSG00000050272	Dscam	scl0013508.1_59-S	brown
5294	ENSMUSG00000050310	4921505C17Rik	scl0078757.1_96-S	blue
5295	ENSMUSG00000050321	Neto1	scl0002185.1_202-S	pink
5296	ENSMUSG00000050321	Neto1	scl00246317.2_110-S	turquoise
5297	ENSMUSG00000050335	Lgals3	scl46402.6.1_29-S	green
5298	ENSMUSG00000050357	Rltpr	scl000548.1_6-S	blue
5299	ENSMUSG00000050428	Fbxo46	scl33009.3_512-S	blue
5300	ENSMUSG00000050530	Fam171a1	scl21344.10_377-S	green
5301	ENSMUSG00000050552	0910001L09Rik	scl27078.4.1_81-S	brown
5302	ENSMUSG00000050567	Maml1	scl40273.5_591-S	grey
5303	ENSMUSG00000050604	AK014105	scl29574.1.666_27-S	grey
5304	ENSMUSG00000050623	1700019N12Rik	scl000514.1_121-S	blue
5305	ENSMUSG00000050668	2310002B06Rik	scl053951.10_10-S	brown
5306	ENSMUSG00000050711	Scg2	scl0020254.2_71-S	turquoise
5307	ENSMUSG00000050714	Zbtb26	scl19382.1_174-S	turquoise
5308	ENSMUSG00000050732	Vamp8	scl0001079.1_24-S	green
5309	ENSMUSG00000050786	Ccdc126	scl30066.5_708-S	blue
5310	ENSMUSG00000050812	AI314180	scl00230249.2_159-S	turquoise
5311	ENSMUSG00000050821	Fam131a	scl078408.1_245-S	turquoise
5312	ENSMUSG00000050822	Slc29a4	scl27026.11.1_112-S	green
5313	ENSMUSG00000050836	AK053689	scl077943.1_53-S	yellow
5314	ENSMUSG00000050856	Atp5k	scl011958.2_29-S	turquoise
5315	ENSMUSG00000050873	AK019339	scl34036.2.1_51-S	greenyellow
5316	ENSMUSG00000050890	Pdik1l	scl0230809.1_12-S	blue
5317	ENSMUSG00000050910	Cdr2l	scl40733.1.945_40-S	turquoise
5318	ENSMUSG00000050914	Ankrd37	scl34861.7.1_55-S	turquoise
5319	ENSMUSG00000050947	Amigo1	scl22729.4.1_31-S	turquoise
5320	ENSMUSG00000050953	Gja1	scl38917.7_7-S	blue
5321	ENSMUSG00000050967	Creg2	scl16828.4_391-S	yellow
5322	ENSMUSG00000050989	Sepn1	scl23684.11_537-S	blue
5323	ENSMUSG00000051007	Pddc1	scl30490.6.1_1-S	blue
5324	ENSMUSG00000051022	Hs3st1	scl26655.5_57-S	blue
5325	ENSMUSG00000051041	Olfml1	scl32224.3.1_237-S	green
5326	ENSMUSG00000051062	Fbll1	GI_38091594-S	blue
5327	ENSMUSG00000051116	EG666465	GI_38081989-S	turquoise
5328	ENSMUSG00000051149	Adnp	GI_6752989-S	red
5329	ENSMUSG00000051149	Adnp	scl011538.1_211-S	grey
5330	ENSMUSG00000051177	Plcb1	scl20242.34.1_74-S	turquoise
5331	ENSMUSG00000051223	Bzw1	scl0066882.1_105-S	turquoise
5332	ENSMUSG00000051232	Tmem199	scl39882.5_436-S	blue
5333	ENSMUSG00000051234	Rnf7	scl35488.3_0-S	turquoise
5334	ENSMUSG00000051256	Jagn1	scl29632.2_358-S	turquoise
5335	ENSMUSG00000051285	Pcmtd1	scl00319263.1_175-S	turquoise

5336	ENSMUSG00000051285	Pcmtd1	scl18180.9.1_47-S	blue
5337	ENSMUSG00000051285	Pcmtd1	scl00319263.2_23-S	turquoise
5338	ENSMUSG00000051306	Usp42	scl052364.1_161-S	grey
5339	ENSMUSG00000051319	BC048556	scl067885.2_20-S	brown
5340	ENSMUSG00000051323	Pcdh19	scl53845.5.4_30-S	blue
5341	ENSMUSG00000051331	L01776	scl0012288.1_89-S	blue
5342	ENSMUSG00000051343	Rab11fip5	scl28767.1.1090_117-S	blue
5343	ENSMUSG00000051344	Plekhm3	scl13668.1.1_133-S	blue
5344	ENSMUSG00000051351	Zfp46	scl24818.5.937_3-S	grey
5345	ENSMUSG00000051355	Commd1	scl0001436.1_98-S	turquoise
5346	ENSMUSG00000051355	Commd1	scl017846.2_20-S	brown
5347	ENSMUSG00000051359	Ncald	scl47279.22_242-S	turquoise
5348	ENSMUSG00000051379	Flrt3	scl071436.1_7-S	blue
5349	ENSMUSG00000051391	Ywhag	scl25917.6_37-S	blue
5350	ENSMUSG00000051495	BC048951	GI_38089495-S	brown
5351	ENSMUSG00000051497	Kcnj16	scl40763.6_142-S	brown
5352	ENSMUSG00000051510	Mafg	scl0017134.1_226-S	grey
5353	ENSMUSG00000051550	Zfp579	scl068490.3_256-S	blue
5354	ENSMUSG00000051586	Kiaa0819	scl0194404.1_81-S	blue
5355	ENSMUSG00000051615	Rap2a	scl45945.2_83-S	turquoise
5356	ENSMUSG00000051617	Krt9	scl0107656.2_28-S	turquoise
5357	ENSMUSG00000051671	1810063B05Rik	scl33163.3.1_18-S	blue
5358	ENSMUSG00000051674	Dcun1d4	scl27718.20_150-S	turquoise
5359	ENSMUSG00000051675	Trim32	scl25352.3_37-S	turquoise
5360	ENSMUSG00000051695	Pcbp1	scl28749.2.254_68-S	yellow
5361	ENSMUSG00000051736	1700025K23Rik	scl38049.5.1_21-S	blue
5362	ENSMUSG00000051790	Nlgn2	scl0216856.1_260-S	blue
5363	ENSMUSG00000051817	Sox12	scl069985.1_46-S	blue
5364	ENSMUSG00000051851	Cxx1c	scl072865.1_125-S	blue
5365	ENSMUSG00000051853	Arf3	scl46760.5_2-S	blue
5366	ENSMUSG00000051864	Tbc1d22a	scl47641.14_223-S	green
5367	ENSMUSG00000051890	Klhdc1	scl0271005.13_174-S	brown
5368	ENSMUSG00000051920	Rspo2	scl47248.5.1_265-S	turquoise
5369	ENSMUSG00000051965	Nanos2	scl0378430.1_272-S	grey
5370	ENSMUSG00000052026	Slc6a7	scl0240332.1_47-S	blue
5371	ENSMUSG00000052087	Rgs14	scl44735.15.1_114-S	turquoise
5372	ENSMUSG00000052105	1110012J17Rik	scl49680.14.1_14-S	blue
5373	ENSMUSG00000052139	Bre	scl00107976.2_176-S	turquoise
5374	ENSMUSG00000052139	Bre	scl27946.19.1_69-S	turquoise
5375	ENSMUSG00000052144	Ppp4r2	scl00232314.1_232-S	turquoise
5376	ENSMUSG00000052151	Ppap2c	scl37761.6_244-S	magenta
5377	ENSMUSG00000052155	Acvr2a	scl011480.11_306-S	turquoise
5378	ENSMUSG00000052296	Saps1	scl00243819.2_7-S	blue
5379	ENSMUSG00000052298	Cdc42se2	scl40213.8_306-S	turquoise
5380	ENSMUSG00000052310	Slc39a1	scl0030791.1_194-S	grey
5381	ENSMUSG00000052336	Cx3cr1	scl35213.3_207-S	yellow
5382	ENSMUSG00000052369	Tmem106c	scl0380967.6_277-S	grey
5383	ENSMUSG00000052372	AK018225	scl7041.1.1_265-S	turquoise
5384	ENSMUSG00000052373	Mpp3	scl00192882.1_253-S	blue
5385	ENSMUSG00000052374	Actn2	scl44289.22.3_135-S	blue
5386	ENSMUSG00000052384	Lrrc33	scl0224109.1_93-S	turquoise
5387	ENSMUSG00000052387	Trpm3	scl0226025.7_51-S	green
5388	ENSMUSG00000052397	Ezr	scl0022350.2_262-S	green
5389	ENSMUSG00000052423	B4galt3	scl17232.7_64-S	blue
5390	ENSMUSG00000052428	Tmco1	scl068944.7_1-S	blue
5391	ENSMUSG00000052429	Prmt1	scl015469.1_28-S	turquoise
5392	ENSMUSG00000052456	Asna1	scl34546.7.1_7-S	turquoise
5393	ENSMUSG00000052459	Atp6v1a	scl011964.1_274-S	turquoise
5394	ENSMUSG00000052488	Cherp	scl027967.3_2-S	blue
5395	ENSMUSG00000052539	Magi3	scl21721.22_329-S	grey
5396	ENSMUSG00000052560	Cpne8	scl46842.21.1_64-S	turquoise
5397	ENSMUSG00000052572	Dlg2	scl32400.30_67-S	grey
5398	ENSMUSG00000052584	2810032E02Rik	scl45288.5.3_74-S	turquoise
5399	ENSMUSG00000052605	Isoc2b	scl31797.6.1_289-S	grey
5400	ENSMUSG00000052609	Plekhg3	GI_38073446-S	magenta
5401	ENSMUSG00000052656	Rnf103	scl022644.5_265-S	turquoise
5402	ENSMUSG00000052676	Zmat1	scl00215693.1_84-S	yellow
5403	ENSMUSG00000052681	Rap1b	scl0215449.1_111-S	blue
5404	ENSMUSG00000052684	Jun	scl24094.1_31-S	blue
5405	ENSMUSG00000052698	Tln2	scl35668.26.1_1-S	turquoise
5406	ENSMUSG00000052707	Tnrc6a	scl000274.1_354-S	grey
5407	ENSMUSG00000052707	Tnrc6a	scl0233835.12_26-S	grey
5408	ENSMUSG00000052727	Mtap1b	scl0003675.1_16-S	yellow
5409	ENSMUSG00000052727	Mtap1b	scl0017755.1_176-S	pink
5410	ENSMUSG00000052727	Mtap1b	scl017755.1_80-S	yellow
5411	ENSMUSG00000052738	Suclg1	scl0001102.1_1-S	brown
5412	ENSMUSG00000052748	1200016B10Rik	scl0066875.1_121-S	grey
5413	ENSMUSG00000052833	Sae1	scl000147.1_6-S	turquoise
5414	ENSMUSG00000052833	Sae1	scl0056459.2_315-S	turquoise
5415	ENSMUSG00000052852	Reep1	scl29896.7_289-S	grey
5416	ENSMUSG00000052889	Prkcb	scl000183.1_192-S	turquoise
5417	ENSMUSG00000052889	Prkcb	scl018751.17_49-S	blue
5418	ENSMUSG00000052889	Prkcb	scl000121.1_106-S	turquoise
5419	ENSMUSG00000052911	Lamb2	scl016779.32_71-S	turquoise
5420	ENSMUSG00000052915	Msl1	scl0074026.1_154-S	blue
5421	ENSMUSG00000052915	Msl1	scl074026.3_179-S	turquoise
5422	ENSMUSG00000052917	Senp7	scl49028.27_379-S	brown
5423	ENSMUSG00000053024	Cntn2	scl0021367.1_277-S	greenyellow
5424	ENSMUSG00000053046	Brsk2	scl075770.2_292-S	blue
5425	ENSMUSG00000053062	Jam2	scl0067374.1_279-S	turquoise
5426	ENSMUSG00000053093	Myh7	scl00140781.1_330-S	grey
5427	ENSMUSG00000053110	Yap1	scl36257.10_16-S	turquoise
5428	ENSMUSG00000053128	Rnf26	scl0213211.1_202-S	blue
5429	ENSMUSG00000053137	Mapk11	scl0002534.1_775-S	turquoise
5430	ENSMUSG00000053137	Mapk11	scl019094.1_245-S	purple
5431	ENSMUSG00000053192	Mllt11	scl056772.1_0-S	turquoise
5432	ENSMUSG00000053199	Arhgap20	scl00244867.2_39-S	brown
5433	ENSMUSG00000053279	Aldh1a1	scl011668.12_94-S	turquoise
5434	ENSMUSG00000053291	Mia1	scl0019342.1_231-S	blue
5435	ENSMUSG00000053293	Pom121	scl25927.13_1-S	turquoise
5436	ENSMUSG00000053297	AI854703	scl30083.6.1_315-S	purple
5437	ENSMUSG00000053329	D10Jhu81e	scl37776.6_58-S	grey
5438	ENSMUSG00000053411	Cbx7	scl052609.1_148-S	blue
5439	ENSMUSG00000053436	Mapk14	scl50915.17_55-S	blue
5440	ENSMUSG00000053453	Thoc7	scl00320611.1_109-S	turquoise
5441	ENSMUSG00000053470	Jmjd1a	scl28879.24.1_17-S	blue
5442	ENSMUSG00000053477	Tcf4	scl0021413.1_300-S	yellow
5443	ENSMUSG00000053510	Nrd1	scl25133.32.1_60-S	turquoise
5444	ENSMUSG00000053550	D430041B17Rik	scl31798.5_248-S	blue
5445	ENSMUSG00000053565	Eif3k	scl31564.8.5_30-S	turquoise
5446	ENSMUSG00000053581	Zfand2a	scl25844.10_237-S	turquoise
5447	ENSMUSG00000053693	Mast1	scl056527.1_28-S	blue
5448	ENSMUSG00000053702	Nebl	scl0003046.1_12-S	yellow
5449	ENSMUSG00000053740	BC003885	scl00225215.1_56-S	red
5450	ENSMUSG00000053754	Chd8	scl067772.1_248-S	blue
5451	ENSMUSG00000053769	Lysmd1	scl0217779.3_307-S	blue

5452	ENSMUSG00000053819	Camk2d	scl00108058.2_28-S	red
5453	ENSMUSG00000053870	Fpgt	scl21362.5_78-S	brown
5454	ENSMUSG00000053898	Ech1	scl32856.10.1_9-S	blue
5455	ENSMUSG00000053907	Mat2a	scl00232087.1_95-S	yellow
5456	ENSMUSG00000053907	Mat2a	scl0232087.7_6-S	turquoise
5457	ENSMUSG00000053907	Mat2a	scl0232087.1_5-S	turquoise
5458	ENSMUSG00000053929	Cyhr1	scl0002484.1_551-S	brown
5459	ENSMUSG00000053929	Cyhr1	scl47034.7.297_44-S	turquoise
5460	ENSMUSG00000053935	AK011885	scl072488.1_25-S	grey
5461	ENSMUSG00000053963	6330403A02Rik	GI_38073638-S	turquoise
5462	ENSMUSG00000054000	Tusc1	scl24109.2_501-S	turquoise
5463	ENSMUSG00000054008	Ndst1	scl0015531.1_129-S	greenyellow
5464	ENSMUSG00000054013	Tmem179	scl42021.6.6_18-S	blue
5465	ENSMUSG00000054027	Nt5dc3	scl38595.2_598-S	blue
5466	ENSMUSG00000054034	Tceal5	scl53816.4_374-S	blue
5467	ENSMUSG00000054199	Gon4l	scl0076022.1_281-S	brown
5468	ENSMUSG00000054199	mKIAA1606	scl0069001.1_75-S	yellow
5469	ENSMUSG00000054226	Tprkb	scl0069786.1_6-S	turquoise
5470	ENSMUSG00000054237	5730455O13Rik	scl52515.14.1_211-S	turquoise
5471	ENSMUSG00000054252	Fgfr3	scl014184.21_7-S	turquoise
5472	ENSMUSG00000054302	Eapp	scl42463.7.1_1-S	turquoise
5473	ENSMUSG00000054312	Mrps21	scl066292.2_43-S	brown
5474	ENSMUSG00000054423	Cadps	scl027062.1_219-S	grey
5475	ENSMUSG00000054426	AK020812	scl068161.2_48-S	grey
5476	ENSMUSG00000054428	Atpif1	scl0011983.1_209-S	brown
5477	ENSMUSG00000054455	Vapb	scl0056491.1_59-S	blue
5478	ENSMUSG00000054455	Vapb	scl056491.5_30-S	turquoise
5479	ENSMUSG00000054459	Vsnl1	scl0026950.2_239-S	turquoise
5480	ENSMUSG00000054459	Vsnl1	scl42619.4_418-S	turquoise
5481	ENSMUSG00000054477	Kcnn2	scl0140492.8_64-S	grey
5482	ENSMUSG00000054484	Tmem62	scl20391.15_58-S	turquoise
5483	ENSMUSG00000054604	Cggbp1	scl49001.3_229-S	turquoise
5484	ENSMUSG00000054611	Kdm2a	scl0225876.10_109-S	greenyellow
5485	ENSMUSG00000054630	Ugt2b5	scl022238.1_263-S	turquoise
5486	ENSMUSG00000054640	Slc8a1	scl49565.1.1_305-S	blue
5487	ENSMUSG00000054648	1200003I07Rik	scl066869.1_197-S	turquoise
5488	ENSMUSG00000054679	RP23-12I24.6	scl25570.5.1_79-S	turquoise
5489	ENSMUSG00000054690	Emcn	scl0059308.2_162-S	green
5490	ENSMUSG00000054693	Adam10	scl36743.16_85-S	turquoise
5491	ENSMUSG00000054728	Phactr1	scl44848.19_46-S	blue
5492	ENSMUSG00000054808	Actn4	scl31568.26.194_22-S	blue
5493	ENSMUSG00000054814	AK004525	scl26474.1.1_266-S	grey
5494	ENSMUSG00000054823	Whsc1l1	scl33963.1.655_163-S	grey
5495	ENSMUSG00000054850	6330419J24Rik	scl00320237.2_303-S	turquoise
5496	ENSMUSG00000054863	Fam19a5	scl47637.6_660-S	brown
5497	ENSMUSG00000054889	Dsp	scl44881.2_33-S	blue
5498	ENSMUSG00000054920	Klhl5	scl0004175.1_57-S	turquoise
5499	ENSMUSG00000054934	Kcnmb4	scl058802.1_145-S	brown
5500	ENSMUSG00000054942	Fam73a	scl00215708.2_187-S	yellow
5501	ENSMUSG00000054942	Fam73a	scl21389.13_163-S	blue
5502	ENSMUSG00000055022	Cntn1	scl0012805.2_145-S	blue
5503	ENSMUSG00000055041	Commd5	scl0066398.2_63-S	turquoise
5504	ENSMUSG00000055065	Ddx17	scl46959.14_72-S	turquoise
5505	ENSMUSG00000055116	Arntl	scl32171.20.103_51-S	turquoise
5506	ENSMUSG00000055125	Fam148b	scl36783.2.1_280-S	blue
5507	ENSMUSG00000055204	Ankrd17	scl081702.1_30-S	turquoise
5508	ENSMUSG00000055235	Wdr86	scl0269633.1_325-S	green
5509	ENSMUSG00000055254	Ntrk2	GI_38074722-S	turquoise
5510	ENSMUSG00000055254	Ntrk2	scl12209.1.1_18-S	blue
5511	ENSMUSG00000055254	Ntrk2	scl44698.20.1_73-S	blue
5512	ENSMUSG00000055334	Snupn	scl066069.9_217-S	brown
5513	ENSMUSG00000055371	Stam2	scl0056324.2_184-S	turquoise
5514	ENSMUSG00000055397	Gats	scl27148.11_0-S	blue
5515	ENSMUSG00000055401	Fbxo6	scl23523.7.1_20-S	turquoise
5516	ENSMUSG00000055436	Sfrs11	scl21351.16_335-S	brown
5517	ENSMUSG00000055491	Pprc1	scl52940.15.185_1-S	blue
5518	ENSMUSG00000055538	Zcchc24	scl071918.2_294-S	grey
5519	ENSMUSG00000055540	Epha6	scl48347.19.1_168-S	turquoise
5520	ENSMUSG00000055567	BC042720	scl17851.8.1_103-S	yellow
5521	ENSMUSG00000055629	B4galnt4	GI_38088087-S	blue
5522	ENSMUSG00000055629	B4galnt4	scl31898.18.1_35-S	turquoise
5523	ENSMUSG00000055670	Zzef1	scl0195018.6_13-S	grey
5524	ENSMUSG00000055676	MGC68323	scl0277333.1_280-S	turquoise
5525	ENSMUSG00000055681	Cope	scl059042.1_5-S	turquoise
5526	ENSMUSG00000055681	Cope	scl059042.7_5-S	turquoise
5527	ENSMUSG00000055692	BC058760	scl0224019.10_293-S	blue
5528	ENSMUSG00000055694	Lass1	scl0014559.1_200-S	blue
5529	ENSMUSG00000055707	Klhl26	scl34704.4_282-S	blue
5530	ENSMUSG00000055717	Slain1	scl00105439.1_193-S	turquoise
5531	ENSMUSG00000055723	Rras2	scl066922.3_13-S	turquoise
5532	ENSMUSG00000055733	Nap1l3	scl54673.1_134-S	turquoise
5533	ENSMUSG00000055761	Fam77D	scl24512.7.1_43-S	greenyellow
5534	ENSMUSG00000055762	Eef1d	scl0002589.1_2-S	turquoise
5535	ENSMUSG00000055762	Eef1d	scl066656.2_23-S	turquoise
5536	ENSMUSG00000055817	Mta3	scl0116871.14_11-S	black
5537	ENSMUSG00000055835	Zfp1	scl33316.5_357-S	yellow
5538	ENSMUSG00000055850	Rnf181	scl0001255.1_2-S	turquoise
5539	ENSMUSG00000055850	Rnf181	scl066510.1_267-S	brown
5540	ENSMUSG00000055862	9030607L17Rik	scl0003925.1_2-S	turquoise
5541	ENSMUSG00000055862	9030607L17Rik	scl071564.46_320-S	turquoise
5542	ENSMUSG00000055866	Per2	scl16475.25_424-S	grey
5543	ENSMUSG00000055932	Fto	scl33513.12_427-S	blue
5544	ENSMUSG00000055943	2900064A13Rik	scl073024.7_20-S	turquoise
5545	ENSMUSG00000055945	Prr18	scl51149.4_213-S	magenta
5546	ENSMUSG00000055963	OTTMUSG00000004461	scl25663.5_353-S	brown
5547	ENSMUSG00000056076	Eif3b	scl27050.15.6_2-S	blue
5548	ENSMUSG00000056091	St3gal5	scl29888.9.1_8-S	grey
5549	ENSMUSG00000056121	Fez2	scl49610.9.216_11-S	grey
5550	ENSMUSG00000056124	B4galt6	scl0056386.2_68-S	blue
5551	ENSMUSG00000056158	Car10	scl41039.12.1_215-S	purple
5552	ENSMUSG00000056167	Cnot10	scl35272.19.217_33-S	turquoise
5553	ENSMUSG00000056185	Snx32	scl53500.11.1_1-S	turquoise
5554	ENSMUSG00000056211	R3hdm1	scl0001006.1_8-S	yellow
5555	ENSMUSG00000056211	R3hdm1	scl17524.28_118-S	grey
5556	ENSMUSG00000056222	Spock1	scl0020745.1_153-S	blue
5557	ENSMUSG00000056306	6030405A18Rik	scl22155.5.1_273-S	turquoise
5558	ENSMUSG00000056367	Actr3b	scl28020.17.1_9-S	turquoise
5559	ENSMUSG00000056413	Adap1	GI_38081359-S	green
5560	ENSMUSG00000056413	Adap1	scl0231821.1_108-S	blue
5561	ENSMUSG00000056413	Adap1	scl25850.9.11_3-S	turquoise
5562	ENSMUSG00000056429	Tgoln1	scl022135.1_141-S	blue
5563	ENSMUSG00000056493	Foxk1	scl27030.9_471-S	blue
5564	ENSMUSG00000056501	Cebpb	scl012608.3_48-S	blue
5565	ENSMUSG00000056515	Rab22B	scl49691.9_66-S	magenta
5566	ENSMUSG00000056598	Lrrc48	scl000085.1_5-S	turquoise
5567	ENSMUSG00000056598	Lrrc48	scl0074665.1_81-S	green

5568	ENSMUSG00000056602	Fry	scl0320365.12_9-S	blue
5569	ENSMUSG00000056608	mKIAA0308	scl33522.11_60-S	red
5570	ENSMUSG00000056612	Ppp1r14b	GI_6679402-S	turquoise
5571	ENSMUSG00000056629	Fkbp2	scl014227.3_23-S	brown
5572	ENSMUSG00000056673	Kdm5d	scl0020592.1_22-S	turquoise
5573	ENSMUSG00000056692	D17Wsu92e	GI_38082130-S	turquoise
5574	ENSMUSG00000056692	D17Wsu92e	scl50129.4_4-S	turquoise
5575	ENSMUSG00000056749	Nfil3	scl43966.3_250-S	blue
5576	ENSMUSG00000056752	Dnahc9	scl40071.17.1_51-S	grey
5577	ENSMUSG00000056752	Dnahc9	scl40069.11.1_238-S	blue
5578	ENSMUSG00000056755	Grm7	scl1516.1.1_172-S	turquoise
5579	ENSMUSG00000056763	Cspp1	scl0211660.12_302-S	turquoise
5580	ENSMUSG00000056812	St8sia3	scl51861.8.1_123-S	turquoise
5581	ENSMUSG00000056820	Tsnax	scl33177.8_75-S	grey
5582	ENSMUSG00000056851	Pcbp2	scl018521.14_30-S	blue
5583	ENSMUSG00000056938	Acbd4	scl40849.10_252-S	blue
5584	ENSMUSG00000056941	Commd7	scl0099311.1_306-S	turquoise
5585	ENSMUSG00000056962	Jmjd6	scl39292.4_16-S	turquoise
5586	ENSMUSG00000056999	Ide	scl0015925.2_2-S	yellow
5587	ENSMUSG00000056999	Ide	scl52522.27_217-S	turquoise
5588	ENSMUSG00000057060	Slc35f3	scl33165.11.1_4-S	greenyellow
5589	ENSMUSG00000057093	C030039L03Rik	scl9658.1.1_21-S	blue
5590	ENSMUSG00000057130	Txnl4a	scl027366.4_62-S	grey
5591	ENSMUSG00000057182	Scn3a	GI_38074782-S	grey
5592	ENSMUSG00000057193	Slc44a2	scl0068682.1_300-S	blue
5593	ENSMUSG00000057229	Atp5sl	scl32925.7_312-S	turquoise
5594	ENSMUSG00000057230	Aak1	scl00269774.1_129-S	blue
5595	ENSMUSG00000057254	BC066107	scl0240066.1_321-S	grey
5596	ENSMUSG00000057322	Rpl38	scl40751.1_9-S	blue
5597	ENSMUSG00000057335	Cep170	scl0071098.2_41-S	turquoise
5598	ENSMUSG00000057335	Cep170	scl15880.9_346-S	blue
5599	ENSMUSG00000057367	Birc2	scl0011797.2_322-S	turquoise
5600	ENSMUSG00000057375	Yipf1	scl25160.11.1_73-S	blue
5601	ENSMUSG00000057388	Mrpl18	scl067681.3_8-S	brown
5602	ENSMUSG00000057406	AK031931	scl27924.1_36-S	blue
5603	ENSMUSG00000057411	Fam173a	scl50160.5.1_23-S	turquoise
5604	ENSMUSG00000057421	Las1l	scl069154.1_165-S	turquoise
5605	ENSMUSG00000057455	Rit2	scl0019762.2_135-S	blue
5606	ENSMUSG00000057469	E2f6	scl0050496.2_252-S	grey
5607	ENSMUSG00000057469	E2f6	scl050496.7_1-S	turquoise
5608	ENSMUSG00000057522	Spop	scl0020747.2_286-S	turquoise
5609	ENSMUSG00000057522	Spop	scl41010.14_14-S	brown
5610	ENSMUSG00000057531	Dtnbp1	scl44037.11.1_29-S	turquoise
5611	ENSMUSG00000057541	Pus7	scl078697.1_5-S	turquoise
5612	ENSMUSG00000057551	Zfp317	scl00244713.2_109-S	turquoise
5613	ENSMUSG00000057554	Lgals8	scl44288.11_154-S	brown
5614	ENSMUSG00000057594	Arl16	scl39237.2_0-S	turquoise
5615	ENSMUSG00000057614	Gnai1	scl014677.2_17-S	yellow
5616	ENSMUSG00000057637	Prdm2	scl0002836.1_427-S	yellow
5617	ENSMUSG00000057637	Prdm2	scl00110593.1_306-S	yellow
5618	ENSMUSG00000057649	Brd9	GI_28526377-S	turquoise
5619	ENSMUSG00000057691	Znf746	scl069228.1_123-S	blue
5620	ENSMUSG00000057707	Rpl29	GI_38074152-S	blue
5621	ENSMUSG00000057738	Spna2	GI_38074606-I	pink
5622	ENSMUSG00000057738	Spna2	scl020740.12_248-S	turquoise
5623	ENSMUSG00000057836	Xlr3a	scl022445.1_223-S	grey
5624	ENSMUSG00000057863	Rpl36	scl054217.2_13-S	turquoise
5625	ENSMUSG00000057880	Abat	scl49449.1.769_0-S	turquoise
5626	ENSMUSG00000057897	Camk2b	scl40549.24_164-S	blue
5627	ENSMUSG00000057914	Cacnb2	scl0012296.1_165-S	turquoise
5628	ENSMUSG00000057969	Sema3b	scl0020347.2_287-S	green
5629	ENSMUSG00000058076	Sdhc	scl0066052.1_175-S	turquoise
5630	ENSMUSG00000058135	Gstm1	scl014862.2_242-S	grey
5631	ENSMUSG00000058153	Sez6l	scl26208.17_33-S	blue
5632	ENSMUSG00000058217	Mia1	scl012587.2_41-S	green
5633	ENSMUSG00000058230	Grlf1	scl31719.6_147-S	grey
5634	ENSMUSG00000058233	3110082D06Rik	scl073235.2_160-S	blue
5635	ENSMUSG00000058239	Usf2	scl022282.6_54-S	turquoise
5636	ENSMUSG00000058240	Cryzl1	scl0001778.1_28-S	brown
5637	ENSMUSG00000058240	Cryzl1	scl066609.1_124-S	turquoise
5638	ENSMUSG00000058248	Kcnh1	scl17041.12.1_241-S	greenyellow
5639	ENSMUSG00000058254	Tspan7	scl55045.9_124-S	blue
5640	ENSMUSG00000058297	Spock2	scl094214.11_38-S	blue
5641	ENSMUSG00000058317	Ube2e2	scl45867.12_561-S	brown
5642	ENSMUSG00000058351	AK008341	scl066487.1_1-S	brown
5643	ENSMUSG00000058392	Rrp1b	scl072462.6_25-S	yellow
5644	ENSMUSG00000058420	Syt17	scl30758.8.1_56-S	turquoise
5645	ENSMUSG00000058444	Map2k5	scl35716.24.1_20-S	blue
5646	ENSMUSG00000058488	Kl	scl26921.6_55-S	green
5647	ENSMUSG00000058503	5830415L20Rik	scl068152.6_9-S	turquoise
5648	ENSMUSG00000058558	Rpl5	scl019983.8_15-S	turquoise
5649	ENSMUSG00000058569	Tmed9	scl44728.4.1_7-S	turquoise
5650	ENSMUSG00000058589	Anks1b	scl0077531.1_129-S	yellow
5651	ENSMUSG00000058594	Fbxo18	scl19676.20.1_12-S	turquoise
5652	ENSMUSG00000058607	Rpl31	GI_38089159-S	blue
5653	ENSMUSG00000058624	Gda	scl52660.16_323-S	grey
5654	ENSMUSG00000058704	Memo1	scl0076890.1_96-S	turquoise
5655	ENSMUSG00000058709	Egln2	scl31612.8.1_58-S	blue
5656	ENSMUSG00000058740	Kcnt1	scl0227632.4_14-S	grey
5657	ENSMUSG00000058756	Thra	scl000082.1_54_REVCOMP-S	blue
5658	ENSMUSG00000058756	Thra	scl0001541.1_86-S	blue
5659	ENSMUSG00000058756	Thra	scl021833.8_22-S	blue
5660	ENSMUSG00000058761	2900057K09Rik	scl30996.1.1917_2-S	grey
5661	ENSMUSG00000058833	2810428I15Rik	scl34701.2.1_7-S	brown
5662	ENSMUSG00000058873	Ptp4a1	GI_38085321-S	red
5663	ENSMUSG00000058927	Cycs	scl013063.3_11-S	blue
5664	ENSMUSG00000058975	Kcnc1	scl0320399.1_192-S	blue
5665	ENSMUSG00000058979	Cecr5	scl0214932.1_204-S	grey
5666	ENSMUSG00000059119	Nap1l4	scl30452.18_578-S	turquoise
5667	ENSMUSG00000059144	2310061J03Rik	scl48388.1.45_188-S	blue
5668	ENSMUSG00000059146	Ntrk3	scl000230.1_44-S	turquoise
5669	ENSMUSG00000059146	Ntrk3	scl00047.1_77-S	greenyellow
5670	ENSMUSG00000059146	Ntrk3	scl018213.1_5-S	greenyellow
5671	ENSMUSG00000059149	Mfsd4	scl16305.11_82-S	blue
5672	ENSMUSG00000059173	Pde1a	scl0018573.1_106-S	yellow
5673	ENSMUSG00000059173	Pde1a	scl018573.1_0-S	blue
5674	ENSMUSG00000059187	Fam19a1	scl29715.6_625-S	turquoise
5675	ENSMUSG00000059208	Hnrnpm	scl076936.1_75-S	grey
5676	ENSMUSG00000059213	Ddn	scl013199.1_68-S	turquoise
5677	ENSMUSG00000059248	Sep-09	scl40689.20_176-S	blue
5678	ENSMUSG00000059263	Usp47	GI_38087125-S	turquoise
5679	ENSMUSG00000059263	Usp47	scl074996.5_121-S	blue
5680	ENSMUSG00000059273	Zc3h4	scl0330474.1_256-S	blue
5681	ENSMUSG00000059278	Lsmd1	scl41370.5.1_1-S	brown
5682	ENSMUSG00000059336	Slc14a1	scl14832.1.1_161-S	blue
5683	ENSMUSG00000059361	Nrsn2	GI_38075177-S	blue

5684	ENSMUSG00000059399	Rps6	GI_38090520-S	turquoise
5685	ENSMUSG00000059409	Ppp2r5d	scl021770.4_4-S	blue
5686	ENSMUSG00000059412	Fxyd2	scl37010.9.16_21-S	grey
5687	ENSMUSG00000059436	Max	scl42320.8_4-S	turquoise
5688	ENSMUSG00000059439	Bcas3	scl00192197.1_323-S	blue
5689	ENSMUSG00000059447	Hadhb	scl0231086.16_205-S	turquoise
5690	ENSMUSG00000059456	Ptk2b	scl45401.31_10-S	blue
5691	ENSMUSG00000059474	Mbtd1	scl00103537.2_139-S	turquoise
5692	ENSMUSG00000059486	Kbtbd2	scl28965.7_274-S	turquoise
5693	ENSMUSG00000059518	Znhit1	scl25890.5.9_30-S	turquoise
5694	ENSMUSG00000059534	1110020P15Rik	scl40580.5.1_111-S	brown
5695	ENSMUSG00000059554	Ccdc28a	scl0215814.3_35-S	turquoise
5696	ENSMUSG00000059658	LOC100040259	GI_38090249-S	turquoise
5697	ENSMUSG00000059689	Zfp637	scl29584.3_468-S	turquoise
5698	ENSMUSG00000059708	Sfrs17b	scl00338351.1_46-S	blue
5699	ENSMUSG00000059713	Rcan3	scl0053902.1_216-S	blue
5700	ENSMUSG00000059714	Flot1	scl0001745.1_1-S	blue
5701	ENSMUSG00000059734	Ndufs8	scl53435.8.1_0-S	brown
5702	ENSMUSG00000059742	Gca	scl19219.1.708_20-S	turquoise
5703	ENSMUSG00000059743	Fdps	scl0110196.3_64-S	turquoise
5704	ENSMUSG00000059811	Atl2	scl0056298.2_141-S	red
5705	ENSMUSG00000059811	Atl2	scl056298.1_121-S	turquoise
5706	ENSMUSG00000059824	Dbp	scl32668.4.1_181-S	blue
5707	ENSMUSG00000059857	Ntng1	scl0080883.1_122-S	purple
5708	ENSMUSG00000059890	Ube4a	scl35939.21_232-S	blue
5709	ENSMUSG00000059895	Ptp4a3	scl0002580.1_4-S	blue
5710	ENSMUSG00000059923	Grb2	scl39328.7_317-S	blue
5711	ENSMUSG00000059942	Olfr887	scl37106.1.1_52-S	grey
5712	ENSMUSG00000059970	Hspa2	scl43073.2_375-S	blue
5713	ENSMUSG00000059974	Ntm	scl0235106.2_40-S	yellow
5714	ENSMUSG00000059995	Atxn7l3	GI_38091833-S	blue
5715	ENSMUSG00000059995	Atxn7l3	scl39515.13_173-S	blue
5716	ENSMUSG00000060073	Psma3	scl019167.11_85-S	blue
5717	ENSMUSG00000060090	Rp2h	scl019889.2_174-S	turquoise
5718	ENSMUSG00000060098	Prmt7	scl00214572.1_279-S	turquoise
5719	ENSMUSG00000060147	Serpinb6a	scl020719.1_146-S	brown
5720	ENSMUSG00000060152	Pop5	scl0117109.5_26-S	turquoise
5721	ENSMUSG00000060152	Pop5	scl27367.4.1_8-S	grey
5722	ENSMUSG00000060166	Zdhhc8	scl027801.1_9-S	blue
5723	ENSMUSG00000060212	Pcnxl2	scl000696.1_123-S	blue
5724	ENSMUSG00000060212	Pcnxl2	scl0270109.1_6-S	blue
5725	ENSMUSG00000060216	Arrb2	scl41339.16.1_19-S	blue
5726	ENSMUSG00000060227	Casc4	scl0319996.20_16-S	turquoise
5727	ENSMUSG00000060240	Cend1	scl30489.3_121-S	blue
5728	ENSMUSG00000060260	Pwwp2b	GI_38087537-S	blue
5729	ENSMUSG00000060261	Gtf2i	scl25948.44_208-S	blue
5730	ENSMUSG00000060279	Ap2a1	scl011771.3_3-S	blue
5731	ENSMUSG00000060371	Caln1	scl00140904.2_248-S	blue
5732	ENSMUSG00000060373	Hnrnpc	scl015381.1_4-S	blue
5733	ENSMUSG00000060373	Hnrnpc	scl0015381.1_237-S	blue
5734	ENSMUSG00000060376	Bckdha	scl31626.10.1_112-S	black
5735	ENSMUSG00000060402	Chst8	scl068947.1_27-S	blue
5736	ENSMUSG00000060424	AK019154	scl16821.8.1_66-S	turquoise
5737	ENSMUSG00000060450	Rnf14	scl0002257.1_38-S	pink
5738	ENSMUSG00000060450	Rnf14	scl52040.12.1_6-S	red
5739	ENSMUSG00000060477	Irak2	scl29624.16_44-S	turquoise
5740	ENSMUSG00000060519	Tor3a	scl030935.1_107-S	turquoise
5741	ENSMUSG00000060538	Tmem219	scl30665.8.1_14-S	turquoise
5742	ENSMUSG00000060548	Tnfrsf19	scl45464.12_145-S	brown
5743	ENSMUSG00000060591	Ifitm2	scl080876.2_10-S	green
5744	ENSMUSG00000060657	4921513D23Rik	scl48736.7.1_328-S	grey
5745	ENSMUSG00000060679	Mrps9	scl18015.10.1_64-S	turquoise
5746	ENSMUSG00000060681	Slc9a6	scl00236794.2_11-S	turquoise
5747	ENSMUSG00000060681	Slc9a6	scl54920.17_335-S	blue
5748	ENSMUSG00000060716	Plekhh1	scl43045.31_238-S	magenta
5749	ENSMUSG00000060780	Lrrtm1	scl29871.3.1_119-S	blue
5750	ENSMUSG00000060803	Gstp1	scl0014870.1_15-S	turquoise
5751	ENSMUSG00000060803	Gstp1	scl014870.5_30-S	blue
5752	ENSMUSG00000060882	Kcnd2	scl0016508.2_152-S	greenyellow
5753	ENSMUSG00000060882	Kcnd2	scl30345.6_391-S	turquoise
5754	ENSMUSG00000060904	Arl1	scl0104303.6_291-S	turquoise
5755	ENSMUSG00000060961	Slc4a4	scl054403.19_44-S	yellow
5756	ENSMUSG00000060981	Hist1h4h	GI_23943921-S	grey
5757	ENSMUSG00000061028	Sfrs16	scl31678.22.1_32-S	grey
5758	ENSMUSG00000061032	Rrp1	scl37770.12.7_11-S	turquoise
5759	ENSMUSG00000061046	Haghl	scl0068977.2_330-S	blue
5760	ENSMUSG00000061080	Lsamp	scl0001826.1_137-S	turquoise
5761	ENSMUSG00000061080	Lsamp	scl49109.9_489-S	blue
5762	ENSMUSG00000061086	Myl4	scl40832.13.1_18-S	brown
5763	ENSMUSG00000061111	BC003940	scl39231.4_382-S	turquoise
5764	ENSMUSG00000061118	Dnajc30	scl066114.1_221-S	blue
5765	ENSMUSG00000061119	Prcp	scl32376.11_593-S	grey
5766	ENSMUSG00000061130	Ppm1b	scl0019043.2_303-S	grey
5767	ENSMUSG00000061130	Ppm1b	scl0001695.1_1621-S	grey
5768	ENSMUSG00000061132	Blnk	scl52495.17.1_252-S	grey
5769	ENSMUSG00000061273	Mmgt1	scl54227.4_188-S	turquoise
5770	ENSMUSG00000061288	AK013486	scl27332.1.1_317-S	turquoise
5771	ENSMUSG00000061313	Ddhd2	scl0072108.1_60-S	turquoise
5772	ENSMUSG00000061315	Naca	scl017938.7_45-S	turquoise
5773	ENSMUSG00000061322	Dnaic1	scl25530.21.1_149-S	green
5774	ENSMUSG00000061353	Cxcl12	scl0001241.1_2518-S	blue
5775	ENSMUSG00000061374	Fiz1	scl31790.5_79-S	blue
5776	ENSMUSG00000061393	Acvr2b	scl36349.9.1_1-S	blue
5777	ENSMUSG00000061410	Zcchc14	scl00142682.1_213-S	blue
5778	ENSMUSG00000061451	Tmem151a	GI_38084801-S	blue
5779	ENSMUSG00000061461	1810013D10Rik	scl27816.7.1_36-S	brown
5780	ENSMUSG00000061479	Snrpa	scl0053607.2_0-S	pink
5781	ENSMUSG00000061479	Snrpa	scl053607.7_2-S	pink
5782	ENSMUSG00000061479	Snrpa	scl0053607.2_231-S	blue
5783	ENSMUSG00000061488	Rpl27a	GI_38090513-S	blue
5784	ENSMUSG00000061517	Sox21	scl0223227.1_10-S	grey
5785	ENSMUSG00000061518	Cox5b	scl0012859.2_116-S	turquoise
5786	ENSMUSG00000061576	Dpp6	scl28017.28_503-S	blue
5787	ENSMUSG00000061601	Pclo	scl0026875.1_310-S	grey
5788	ENSMUSG00000061601	Pclo	scl026875.15_1-S	turquoise
5789	ENSMUSG00000061666	Gdpd1	scl39769.10_186-S	brown
5790	ENSMUSG00000061689	Dlgap4	scl0228836.7_6-S	blue
5791	ENSMUSG00000061689	Dlgap4	scl20023.12.1_20-S	blue
5792	ENSMUSG00000061702	Tmem91	scl00320208.2_271-S	brown
5793	ENSMUSG00000061718	Ppp1r1b	scl40938.8.1_26-S	green
5794	ENSMUSG00000061731	Ext1	scl47204.11.1_33-S	turquoise
5795	ENSMUSG00000061740	Cyp2d22	scl056448.1_20-S	turquoise
5796	ENSMUSG00000061751	Kalrn	GI_38079759-S	yellow
5797	ENSMUSG00000061751	Kalrn	scl00239835.2_111-S	yellow
5798	ENSMUSG00000061751	Kalrn	scl48534.5_445-S	blue
5799	ENSMUSG00000061758	2310005E10Rik	scl0067861.2_64-S	brown

5800	ENSMUSG00000061759	1700052N19Rik	GI_20851448-I	turquoise
5801	ENSMUSG00000061762	Tac1	scl30408.3.3_26-S	brown
5802	ENSMUSG00000061808	Ttr	scl52209.6.1_16-S	green
5803	ENSMUSG00000061878	Sphk1	scl0020698.1_299-S	purple
5804	ENSMUSG00000061887	Ssbp3	scl0002734.1_23-S	blue
5805	ENSMUSG00000061887	Ssbp3	scl0072475.2_71-S	black
5806	ENSMUSG00000061904	Slc25a3	scl37617.5_6-S	turquoise
5807	ENSMUSG00000061950	Ppp4r1	scl0070351.2_206-S	turquoise
5808	ENSMUSG00000061981	Flot2	scl014252.10_327-S	blue
5809	ENSMUSG00000062038	Cycs	GI_38079525-S	brown
5810	ENSMUSG00000062054	Iah1	scl067732.2_80-S	grey
5811	ENSMUSG00000062070	Pgk1	scl018655.12_25-S	turquoise
5812	ENSMUSG00000062075	Lmnb2	scl37715.13_93-S	turquoise
5813	ENSMUSG00000062078	Qk	scl0001708.1_442-S	blue
5814	ENSMUSG00000062098	Btbd3	scl0228662.5_115-S	pink
5815	ENSMUSG00000062169	Cnih4	scl078578.3_1-S	grey
5816	ENSMUSG00000062184	Hs6st2	scl0002956.1_592-S	turquoise
5817	ENSMUSG00000062184	Hs6st2	scl54262.7_282-S	turquoise
5818	ENSMUSG00000062190	Lancl2	scl0071835.2_207-S	turquoise
5819	ENSMUSG00000062198	2700097O09Rik	scl42454.7.1_176-S	blue
5820	ENSMUSG00000062202	Btbd9	scl50089.9.1_2-S	blue
5821	ENSMUSG00000062203	Gspt1	scl014852.1_8-S	grey
5822	ENSMUSG00000062232	Rapgef2	scl22054.17.1_4-S	blue
5823	ENSMUSG00000062234	Gak	GI_38080360-S	turquoise
5824	ENSMUSG00000062234	Gak	scl26247.31.1_10-S	blue
5825	ENSMUSG00000062257	Opcml	scl37169.1_27-S	turquoise
5826	ENSMUSG00000062309	Rpp25	scl36905.1.71_309-S	grey
5827	ENSMUSG00000062373	Tmem65	scl47170.8_74-S	turquoise
5828	ENSMUSG00000062381	Vps28	scl47036.7.1_29-S	brown
5829	ENSMUSG00000062421	Arf2	scl40837.7_339-S	brown
5830	ENSMUSG00000062444	Ap3b2	scl31109.12.1_24-S	blue
5831	ENSMUSG00000062542	Syt9	scl32225.7_148-S	grey
5832	ENSMUSG00000062591	Tubb4	scl49746.4_205-S	blue
5833	ENSMUSG00000062604	Srpk2	scl0020817.2_230-S	red
5834	ENSMUSG00000062619	2310039H08Rik	scl50670.2.184_270-S	green
5835	ENSMUSG00000062661	Freq	scl0014299.1_177-S	blue
5836	ENSMUSG00000062753	AI413582	GI_38082125-S	turquoise
5837	ENSMUSG00000062760	1810041L15Rik	scl072301.1_55-S	grey
5838	ENSMUSG00000062822	4833420G17Rik	scl44322.14.1_14-S	turquoise
5839	ENSMUSG00000062861	Zfp28	scl0022690.2_132-S	turquoise
5840	ENSMUSG00000062908	Acadm	scl21370.9_11-S	brown
5841	ENSMUSG00000062908	Acadm	scl0001961.1_16-S	red
5842	ENSMUSG00000062931	B230315N10Rik	scl37686.5_631-S	turquoise
5843	ENSMUSG00000062963	Ufc1	scl15945.4.1_0-S	turquoise
5844	ENSMUSG00000062981	D10Ertd322e	scl067270.3_15-S	brown
5845	ENSMUSG00000062995	Ica1	scl29286.18.1_125-S	turquoise
5846	ENSMUSG00000063021	Hist1h2ak	GI_30061370-S	yellow
5847	ENSMUSG00000063049	Ing2	scl34842.3_222-S	grey
5848	ENSMUSG00000063065	Mapk3	scl026417.10_0-S	blue
5849	ENSMUSG00000063077	Kif1b	scl0016561.1_7-S	blue
5850	ENSMUSG00000063077	Kif1b	scl23508.1.1_311-S	turquoise
5851	ENSMUSG00000063077	Kif1b	scl23510.49_38-S	pink
5852	ENSMUSG00000063142	Kcnma1	scl016531.1_18-S	yellow
5853	ENSMUSG00000063160	Numbl	scl018223.10_5-S	blue
5854	ENSMUSG00000063171	1110033J19Rik	scl066184.1_108-S	turquoise
5855	ENSMUSG00000063229	Ldha	scl016828.6_330-S	turquoise
5856	ENSMUSG00000063235	Ptpmt1	scl19009.5.1_4-S	turquoise
5857	ENSMUSG00000063249	AV253706	GI_38077679-S	green
5858	ENSMUSG00000063273	Narg1	scl0074838.1_14-S	turquoise
5859	ENSMUSG00000063275	Ptpla	scl030963.1_56-S	turquoise
5860	ENSMUSG00000063297	Luzp2	scl00233271.2_256-S	blue
5861	ENSMUSG00000063297	Luzp2	scl32613.12_18-S	turquoise
5862	ENSMUSG00000063334	Krr1	scl0003784.1_7-S	red
5863	ENSMUSG00000063358	Mapk1	scl0001776.1_145-S	turquoise
5864	ENSMUSG00000063358	Mapk1	scl026413.2_16-S	red
5865	ENSMUSG00000063382	Bcl9l	scl37031.1_4-S	blue
5866	ENSMUSG00000063415	Cyp26b1	scl28780.8_93-S	blue
5867	ENSMUSG00000063430	Wscd2	scl27402.5_122-S	blue
5868	ENSMUSG00000063434	Sorcs3	scl0066673.2_192-S	blue
5869	ENSMUSG00000063434	Sorcs3	scl52928.27_344-S	blue
5870	ENSMUSG00000063439	B9d2	scl32922.5.1_20-S	turquoise
5871	ENSMUSG00000063445	Nmral1	scl48804.7.78_52-S	magenta
5872	ENSMUSG00000063511	Snrnp70	scl000125.1_16-S	turquoise
5873	ENSMUSG00000063531	Sema3e	scl28107.1.1_206-S	turquoise
5874	ENSMUSG00000063558	Aox1	scl17939.35.1_294-S	green
5875	ENSMUSG00000063564	Col23a1	scl0237759.29_189-S	grey
5876	ENSMUSG00000063568	Jazf1	scl00231986.2_210-S	blue
5877	ENSMUSG00000063576	Klhdc3	scl49857.14.1_9-S	blue
5878	ENSMUSG00000063594	Gng8	scl33043.5.1_34-S	grey
5879	ENSMUSG00000063600	6130401L20Rik	scl23316.19.1_266-S	brown
5880	ENSMUSG00000063632	Sox11	scl0067779.1_196-S	turquoise
5881	ENSMUSG00000063646	Jakmip1	scl076071.13_258-S	blue
5882	ENSMUSG00000063659	Zfp238	scl0030928.2_140-S	turquoise
5883	ENSMUSG00000063698	Sfxn4	scl52316.14.1_45-S	turquoise
5884	ENSMUSG00000063713	Klk1b24	scl016617.4_8-S	grey
5885	ENSMUSG00000063787	Chchd1	scl46593.3.1_27-S	blue
5886	ENSMUSG00000063800	Prpf38a	scl00230596.1_294-S	turquoise
5887	ENSMUSG00000063801	Ap3s2	scl011778.1_306-S	turquoise
5888	ENSMUSG00000063801	Ap3s2	scl31144.7_115-S	blue
5889	ENSMUSG00000063802	Hspbp1	scl31806.5.1_30-S	turquoise
5890	ENSMUSG00000063849	Ppcdc	scl066812.1_16-S	grey
5891	ENSMUSG00000063856	Gpx1	scl36472.2.242_20-S	brown
5892	ENSMUSG00000063870	Chd4	scl00107932.1_52-S	blue
5893	ENSMUSG00000063873	Slc24a3	scl20184.17.1_283-S	brown
5894	ENSMUSG00000063882	Uqcrh	scl066576.4_1-S	brown
5895	ENSMUSG00000063887	Nlgn1	scl22330.11.693_178-S	turquoise
5896	ENSMUSG00000063895	Nupl1	scl0071844.1_193-S	blue
5897	ENSMUSG00000064023	Klk8	scl32740.6.1_76-S	purple
5898	ENSMUSG00000064036	Mro	scl0071263.2_208-S	turquoise
5899	ENSMUSG00000064037	Gpn1	scl27951.13.1_20-S	brown
5900	ENSMUSG00000064065	Ipcef1	scl38237.12_618-S	blue
5901	ENSMUSG00000064068	Mtx1	scl21950.8.1_214-S	turquoise
5902	ENSMUSG00000064068	Mtx1	scl0002111.1_12-S	turquoise
5903	ENSMUSG00000064105	Cnnm2	scl0094219.1_300-S	blue
5904	ENSMUSG00000064125	BC068157	scl35142.2.1_36-S	brown
5905	ENSMUSG00000064127	Med14	GI_38086031-S	turquoise
5906	ENSMUSG00000064127	Med14	scl0026896.1_151-S	blue
5907	ENSMUSG00000064138	1110033M05Rik	scl0068675.1_24-S	turquoise
5908	ENSMUSG00000064168	Hist1h2bh	scl0319182.1_4-S	green
5909	ENSMUSG00000064179	Tnnt1	scl31814.9.1_5-S	grey
5910	ENSMUSG00000064208	ubcM4	GI_38090406-S	blue
5911	ENSMUSG00000064215	Ifi27l1	scl42842.7.1_0-S	green
5912	ENSMUSG00000064231		GI_38085726-S	turquoise
5913	ENSMUSG00000064246	Chi3l1	scl17458.10.1_1-S	grey
5914	ENSMUSG00000064289	Tank	scl0003091.1_92-S	brown
5915	ENSMUSG00000064289	Tank	scl20876.12.1_41-S	turquoise

5916	ENSMUSG00000064294	Aox3	scl17938.36.1_1-S	turquoise
5917	ENSMUSG00000064302	Clasp1	scl17563.43_11-S	turquoise
5918	ENSMUSG00000064307	Lrrc51	scl30956.5.1_91-S	green
5919	ENSMUSG00000064329	Scn1a	scl020265.1_263-S	yellow
5920	ENSMUSG00000064373	Sepp1	scl48140.10_39-S	turquoise
5921	ENSMUSG00000065950	Rpl27a	GI_38089172-S	blue
5922	ENSMUSG00000065954	Tacc1	scl00320165.1_190-S	black
5923	ENSMUSG00000065954	Tacc1	scl34998.4_500-S	yellow
5924	ENSMUSG00000065979	Cpped1	scl48750.6_548-S	greenyellow
5925	ENSMUSG00000065990	Aurkaip1	scl24605.2.1_63-S	brown
5926	ENSMUSG00000066043	Phactr4	scl00100169.1_330-S	magenta
5927	ENSMUSG00000066150	Slc31a1	scl25380.5_310-S	green
5928	ENSMUSG00000066150	Slc31a1	scl0002742.1_56-S	green
5929	ENSMUSG00000066189	Cacng3	scl054376.1_12-S	blue
5930	ENSMUSG00000066233	Tmem42	scl066079.4_60-S	turquoise
5931	ENSMUSG00000066235	C85492	scl0215494.1_125-S	blue
5932	ENSMUSG00000066278	Vps37b	scl26046.6_19-S	blue
5933	ENSMUSG00000066324	Impad1	scl00242291.2_165-S	yellow
5934	ENSMUSG00000066389	Rpl31	GI_38073597-S	brown
5935	ENSMUSG00000066392	Nrxn3	scl0002402.1_134-S	brown
5936	ENSMUSG00000066392	Nrxn3	scl0018191.2_279-S	yellow
5937	ENSMUSG00000066438	AK082841	scl43024.14.14_237-S	grey
5938	ENSMUSG00000066456	Hmgn3	scl0003556.1_11-S	turquoise
5939	ENSMUSG00000066515	Klk1b3	scl018050.1_7-S	grey
5940	ENSMUSG00000066516	Klk1b21	GI_23956055-S	grey
5941	ENSMUSG00000066551	Hmgb1	GI_31981688-S	blue
5942	ENSMUSG00000066568	Lsm14a	scl31481.11_594-S	grey
5943	ENSMUSG00000066607	6030419C18Rik	scl36883.5.1_219-S	brown
5944	ENSMUSG00000066621	Tecpr1	scl25795.24.1_9-S	blue
5945	ENSMUSG00000066705	Fxyd6	scl37011.7_65-S	purple
5946	ENSMUSG00000066829	Zfp810	scl36114.9_96-S	blue
5947	ENSMUSG00000066839	Ecsit	scl026940.2_4-S	blue
5948	ENSMUSG00000066877	Nck2	scl017974.6_299-S	blue
5949	ENSMUSG00000066900	Suds3	scl26137.12_266-S	black
5950	ENSMUSG00000067028	Cntnap5b	scl17603.19.1_280-S	turquoise
5951	ENSMUSG00000067148	Polr1c	scl0001631.1_196-S	turquoise
5952	ENSMUSG00000067161	EG433923	GI_38080405-S	turquoise
5953	ENSMUSG00000067279	Ppp1r3c	scl52526.2_193-S	blue
5954	ENSMUSG00000067338	Tuba3b	scl022147.3_29-S	turquoise
5955	ENSMUSG00000067365	Tmem128	scl27876.6.1_53-S	blue
5956	ENSMUSG00000067377	Tspan6	scl53842.9_93-S	brown
5957	ENSMUSG00000067430	Zfp763	scl50052.5_249-S	blue
5958	ENSMUSG00000067578	Cbln4	scl18271.3.1_14-S	purple
5959	ENSMUSG00000067713	Prkag1	scl46751.13_99-S	turquoise
5960	ENSMUSG00000067722	AK206957	scl0214489.1_247-S	blue
5961	ENSMUSG00000067736	mt-Nd4	mtDNA_ND4L-S	turquoise
5962	ENSMUSG00000067736	mt-Nd4	scl0017720.1_306-S	turquoise
5963	ENSMUSG00000067786	Nnat	scl0003133.1_10-S	grey
5964	ENSMUSG00000067786	Nnat	scl0018111.2_84-S	grey
5965	ENSMUSG00000067787	Blcap	scl18420.2_47-S	black
5966	ENSMUSG00000067847	2010100O12Rik	scl067067.1_49-S	brown
5967	ENSMUSG00000067851	Arfgef1	scl0226334.1_107-S	grey
5968	ENSMUSG00000067873	Htatsf1	scl54915.11_540-S	blue
5969	ENSMUSG00000067889	Spnb3	scl020743.1_114-S	blue
5970	ENSMUSG00000067928	AK079118	scl51052.7.1_176-S	turquoise
5971	ENSMUSG00000067995	Gtf2f2	scl45293.12.6_30-S	brown
5972	ENSMUSG00000068036	Mllt4	scl017356.2_28-S	yellow
5973	ENSMUSG00000068037	Mas1	scl50304.10_553-S	grey
5974	ENSMUSG00000068039	Tcp1	scl51111.10.24_9-S	brown
5975	ENSMUSG00000068039	Tcp1	scl0001621.1_13-S	turquoise
5976	ENSMUSG00000068040	Tm9sf4	scl20100.20_8-S	black
5977	ENSMUSG00000068115	4930519N13Rik	scl18515.2.486_1-S	turquoise
5978	ENSMUSG00000068184	Ndufa12l	scl075597.1_263-S	turquoise
5979	ENSMUSG00000068205	Macrod2	GI_38075135-S	grey
5980	ENSMUSG00000068206	Pick1	scl47748.8_4-S	turquoise
5981	ENSMUSG00000068220	Lgals1	scl47757.5.8_11-S	green
5982	ENSMUSG00000068221	Pdxp	scl47761.2_511-S	black
5983	ENSMUSG00000068264	2310035K24Rik	scl20267.4_3-S	blue
5984	ENSMUSG00000068267	Cenpb	scl18647.1_62-S	turquoise
5985	ENSMUSG00000068284	Gm608	scl49076.1_153-S	turquoise
5986	ENSMUSG00000068290	Ddrgk1	GI_38075745-S	turquoise
5987	ENSMUSG00000068290	Ddrgk1	scl18658.11.1_64-S	turquoise
5988	ENSMUSG00000068299	1700019G17Rik	scl075541.1_190-S	grey
5989	ENSMUSG00000068328	Aup1	scl29854.5.1_26-S	blue
5990	ENSMUSG00000068329	Htra2	GI_31980990-S	turquoise
5991	ENSMUSG00000068329	Htra2	scl28808.5.1_108-S	blue
5992	ENSMUSG00000068373	D430041D05Rik	GI_38074999-S	blue
5993	ENSMUSG00000068551	Zfp467	scl0068910.2_247-S	grey
5994	ENSMUSG00000068551	Zfp467	scl068910.1_219-S	grey
5995	ENSMUSG00000068696	Gpr88	scl21613.3_441-S	purple
5996	ENSMUSG00000068732	2010200O16Rik	scl0067495.2_241-S	turquoise
5997	ENSMUSG00000068735	Trp53i11	scl0277414.7_122-S	blue
5998	ENSMUSG00000068739	Sars	scl0002098.1_2-S	grey
5999	ENSMUSG00000068739	Sars	scl0020226.2_49-S	turquoise
6000	ENSMUSG00000068740	Celsr2	scl053883.1_70-S	blue
6001	ENSMUSG00000068742	Cry2	scl18986.12_141-S	blue
6002	ENSMUSG00000068748	Ptprz1	scl30318.32.1_9-S	blue
6003	ENSMUSG00000068823	Csde1	scl22797.19_196-S	blue
6004	ENSMUSG00000068855	Hist2h2ac	scl00319176.1_318-S	grey
6005	ENSMUSG00000068882	Ssb	scl000034.1_162-S	turquoise
6006	ENSMUSG00000068917	Clk2	scl22984.11.1_47-S	turquoise
6007	ENSMUSG00000068921	Dap3	scl0001977.1_31-S	turquoise
6008	ENSMUSG00000068921	Dap3	scl0065111.1_63-S	turquoise
6009	ENSMUSG00000068921	Dap3	scl065111.1_137-S	turquoise
6010	ENSMUSG00000068923	Syt11	scl21963.5_3-S	blue
6011	ENSMUSG00000069049	Eif2s3y	scl0026908.1_233-S	turquoise
6012	ENSMUSG00000069072	Slc7a14	scl00241919.1_47-S	grey
6013	ENSMUSG00000069072	Slc7a14	scl22275.9.1_193-S	greenyellow
6014	ENSMUSG00000069227	Gprin1	scl026913.1_318-S	blue
6015	ENSMUSG00000069271	Hist1h2bn	scl0319187.1_0-S	green
6016	ENSMUSG00000069274	Hist1h4f	scl00319157.1_0-S	grey
6017	ENSMUSG00000069302	Hist1h2ah	GI_30061326-S	yellow
6018	ENSMUSG00000069495	Epc2	scl20945.14_483-S	brown
6019	ENSMUSG00000069520	Tmem19	scl0067226.2_87-S	blue
6020	ENSMUSG00000069601	Ank3	scl011735.19_2-S	turquoise
6021	ENSMUSG00000069601	Ank3	scl073013.3_150-S	turquoise
6022	ENSMUSG00000069662	Marcks	scl017118.3_6-S	blue
6023	ENSMUSG00000069744	Psmb3	scl026446.4_108-S	brown
6024	ENSMUSG00000069769	Msi2	scl39740.21_10-S	brown
6025	ENSMUSG00000069833	Ahnak	scl0107095.2_127-S	green
6026	ENSMUSG00000069835	Sat2	scl0001527.1_23-S	turquoise
6027	ENSMUSG00000069895	Atxn1l	scl34341.1_107-S	turquoise
6028	ENSMUSG00000069899	Sft2d1	GI_38091607-S	turquoise
6029	ENSMUSG00000070000	Fcho1	scl34668.28.1_25-S	turquoise
6030	ENSMUSG00000070002	Ell	scl33724.12_676-S	blue
6031	ENSMUSG00000070003	Ssbp4	scl076900.1_165-S	brown

6032	ENSMUSG00000070047	Fat1	scl33862.17_310-S	grey
6033	ENSMUSG00000070283	Ndufaf3	scl0066706.2_314-S	brown
6034	ENSMUSG00000070287	Tmem22	GI_38090024-S	brown
6035	ENSMUSG00000070304	Scn2b	scl7525.1.1_191-S	blue
6036	ENSMUSG00000070306	BC038167	scl37041.7.1_1-S	green
6037	ENSMUSG00000070319	Eif3g	scl053356.4_13-S	turquoise
6038	ENSMUSG00000070343	Rpl11	GI_38079583-S	turquoise
6039	ENSMUSG00000070348	Ccnd1	scl0012443.2_180-S	blue
6040	ENSMUSG00000070348	Ccnd1	scl0012443.2_42-S	turquoise
6041	ENSMUSG00000070369	Itgad	GI_38087442-S	grey
6042	ENSMUSG00000070394	1810027O10Rik	scl41358.1_245-S	blue
6043	ENSMUSG00000070426	Rnf121	scl30951.12_249-S	turquoise
6044	ENSMUSG00000070461	Col20a1	scl19776.1_66-S	grey
6045	ENSMUSG00000070509	Rgma	scl32537.2.2118_88-S	turquoise
6046	ENSMUSG00000070520	Ndnl2	scl31245.1.43_5-S	blue
6047	ENSMUSG00000070544	Top1	scl0021969.2_45-S	red
6048	ENSMUSG00000070544	Top1	scl021969.20_26-S	red
6049	ENSMUSG00000070565	Rasal2	scl0320357.2_29-S	yellow
6050	ENSMUSG00000070565	Rasal2	scl000936.1_18-S	yellow
6051	ENSMUSG00000070570	Slc17a7	scl072961.4_93-S	blue
6052	ENSMUSG00000070730	Fam82a2	scl18812.14.127_2-S	grey
6053	ENSMUSG00000070733	Fryl	scl0072313.2_218-S	greenyellow
6054	ENSMUSG00000070733	Fryl	scl067021.1_328-S	turquoise
6055	ENSMUSG00000070738	mKIAA0145	scl0227333.5_1-S	brown
6056	ENSMUSG00000070780	BC013481	scl00245945.1_50-S	green
6057	ENSMUSG00000070822	LOC232875	GI_38085862-S	turquoise
6058	ENSMUSG00000070880	Gad1	scl20813.21_155-S	brown
6059	ENSMUSG00000070880	Gad1	scl0003045.1_120-S	turquoise
6060	ENSMUSG00000070923	Klhl9	scl00242521.1_200-S	brown
6061	ENSMUSG00000070923	Klhl9	scl24128.1.6_28-S	red
6062	ENSMUSG00000070939	Tgfbrap1	scl073122.1_292-S	blue
6063	ENSMUSG00000071042	Rasgrp3	scl0240168.18_64-S	magenta
6064	ENSMUSG00000071054	AK087504	scl00224903.1_12-S	blue
6065	ENSMUSG00000071072	Ptges3	scl0056351.1_126-S	turquoise
6066	ENSMUSG00000071073	Gm88	GI_38082513-S	turquoise
6067	ENSMUSG00000071074	Yipf3	scl50681.9.1_22-S	blue
6068	ENSMUSG00000071103	1700029J07Rik	scl34863.8.7_80-S	green
6069	ENSMUSG00000071180	2810008M24Rik	scl44416.3_31-S	blue
6070	ENSMUSG00000071265	AK005679	scl43092.8.1_221-S	blue
6071	ENSMUSG00000071286	Ankrd57	scl00268301.1_190-S	turquoise
6072	ENSMUSG00000071341	Egr4	scl860.2.1_228-S	brown
6073	ENSMUSG00000071415	Rpl23	scl065019.1_21-S	blue
6074	ENSMUSG00000071454	Dtnb	scl43441.25.1_42-S	blue
6075	ENSMUSG00000071477	Zfp777	scl072306.1_301-S	blue
6076	ENSMUSG00000071516	Hist1h2ai	GI_30061392-S	yellow
6077	ENSMUSG00000071533	Pcnp	GI_38079826-I	grey
6078	ENSMUSG00000071567	AK043847	scl45825.1.145_22-S	turquoise
6079	ENSMUSG00000071645	Tut1	scl53393.10_649-S	blue
6080	ENSMUSG00000071646	Mta2	scl53392.18_161-S	blue
6081	ENSMUSG00000071649	B3gat3	scl53399.4.220_1-S	blue
6082	ENSMUSG00000071650	Ganab	scl014376.17_49-S	blue
6083	ENSMUSG00000071650	Ganab	scl53398.18.1_7-S	red
6084	ENSMUSG00000071653	1810009A15Rik	scl066276.2_21-S	brown
6085	ENSMUSG00000071654	AI462493	GI_25054872-S	turquoise
6086	ENSMUSG00000071655	Ubxn1	scl53400.8.1_51-S	turquoise
6087	ENSMUSG00000071657	Bscl2	scl53403.26.13_76-S	blue
6088	ENSMUSG00000071659	Hnrnpul2	scl53404.1.1_41-S	turquoise
6089	ENSMUSG00000071662	Polr2g	scl52776.8.1_198-S	turquoise
6090	ENSMUSG00000071708	Sms	scl53675.10_10-S	black
6091	ENSMUSG00000071723	Gspt2	scl0014853.2_151-S	blue
6092	ENSMUSG00000071860	AK013700	scl52031.1.122_226-S	blue
6093	ENSMUSG00000072214	Sep-05	scl018951.1_6-S	blue
6094	ENSMUSG00000072235	Tuba1a	scl022142.1_236-S	turquoise
6095	ENSMUSG00000072501	Phf20l1	scl0002461.1_0-S	yellow
6096	ENSMUSG00000072501	Phf20l1	scl47856.20_571-S	blue
6097	ENSMUSG00000072772	Grcc10	scl014790.2_94-S	brown
6098	ENSMUSG00000072857	Ube2n	GI_38086826-S	black
6099	ENSMUSG00000072893	AK030920	scl074476.3_29-S	grey
6100	ENSMUSG00000072933	AK007597	scl0073158.1_64-S	brown
6101	ENSMUSG00000072964	Bhlhb9	scl54620.5_512-S	blue
6102	ENSMUSG00000072966	Gprasp2	scl54621.6_157-S	blue
6103	ENSMUSG00000073131	2610030H06Rik	scl067048.4_1-S	brown
6104	ENSMUSG00000073139	BC023829	scl54877.7_76-S	turquoise
6105	ENSMUSG00000073240	BC067010	scl069709.2_18-S	turquoise
6106	ENSMUSG00000073295	Nudt11	scl55059.2_77-S	grey
6107	ENSMUSG00000073387	Med20	scl056771.4_27-S	turquoise
6108	ENSMUSG00000073412	Lst1	scl016988.2_22-S	grey
6109	ENSMUSG00000073418	C4b	scl0020567.1_162-S	grey
6110	ENSMUSG00000073418	C4b	scl020567.3_14-S	turquoise
6111	ENSMUSG00000073422	H2-Ke6	scl014979.1_326-S	grey
6112	ENSMUSG00000073424	Cyp4f15	scl50860.12.324_21-S	grey
6113	ENSMUSG00000073433	Arhgdig	scl50150.4.1_163-S	blue
6114	ENSMUSG00000073435	Nme3	scl50997.3.1_2-S	brown
6115	ENSMUSG00000073563	Csnk1g3	scl070425.3_227-S	blue
6116	ENSMUSG00000073568	Gm949	GI_38083578-S	grey
6117	ENSMUSG00000073616	AK003315	scl16469.4.1_83-S	blue
6118	ENSMUSG00000073633	Fbxo36	scl17733.6.1_38-S	green
6119	ENSMUSG00000073639	Rab18	scl0002187.1_532-S	red
6120	ENSMUSG00000073647	LOC436177	GI_38093416-S	turquoise
6121	ENSMUSG00000073700	Klhl21	scl24663.4_10-S	blue
6122	ENSMUSG00000073792	Alg6	scl25243.13_475-S	blue
6123	ENSMUSG00000073872	AK029949	GI_38078272-S	grey
6124	ENSMUSG00000073888	Ccl27a	scl0020301.1_162-S	grey
6125	ENSMUSG00000073889	Il11ra1	scl0016157.2_292-S	green
6126	ENSMUSG00000073889	Il11ra2	scl0016158.2_239-S	blue
6127	ENSMUSG00000073982	Rhog	scl30947.3_219-S	magenta
6128	ENSMUSG00000074064	Mlycd	scl0056690.1_158-S	brown
6129	ENSMUSG00000074093	6620401M08Rik	scl31310.11_188-S	blue
6130	ENSMUSG00000074210	0610010E21Rik	scl31530.1_36-S	turquoise
6131	ENSMUSG00000074218	Cox7a1	scl0012865.1_86-S	green
6132	ENSMUSG00000074238	BC002199	GI_20875822-S	red
6133	ENSMUSG00000074238	BC002199	scl11702.1.1_1-S	turquoise
6134	ENSMUSG00000074264	Amy1	scl011722.3_4-S	turquoise
6135	ENSMUSG00000074340	Ovgp1	scl0012659.1_5-S	grey
6136	ENSMUSG00000074345	Tnfaip8l3	GI_28491497-S	grey
6137	ENSMUSG00000074396	Pex11b	scl018632.5_33-S	turquoise
6138	ENSMUSG00000074501	Map1lc3b	GI_38090278-S	turquoise
6139	ENSMUSG00000074505	Fat3	scl0270120.1_319-S	turquoise
6140	ENSMUSG00000074506	ubcM4	GI_38077558-S	blue
6141	ENSMUSG00000074513	Arfip1	scl0099889.1_5-S	turquoise
6142	ENSMUSG00000074578	1500012F01Rik	scl19890.4.1_85-S	blue
6143	ENSMUSG00000074637	Sox2	scl020674.7_60-S	turquoise
6144	ENSMUSG00000074649	AK158030	scl18449.2_107-S	brown
6145	ENSMUSG00000074657	Kif5a	scl016572.1_29-S	pink
6146	ENSMUSG00000074738	B930041F14Rik	scl24616.1.1396_49-S	turquoise
6147	ENSMUSG00000074754	Gm561	GI_25048036-S	blue

6148	ENSMUSG00000074766	AK077398	scl20223.6.1_258-S	blue
6149	ENSMUSG00000074781	Ube2n	scl0093765.1_4-S	brown
6150	ENSMUSG00000074781	Ube2n	scl38525.3.714_1-S	turquoise
6151	ENSMUSG00000074794	Arrdc3	scl00105171.1_137-S	turquoise
6152	ENSMUSG00000074872	AK141570	GI_38075640-S	brown
6153	ENSMUSG00000074892	B3galt5	scl48834.5_262-S	grey
6154	ENSMUSG00000074909	Ranbp6	scl0240614.1_286-S	red
6155	ENSMUSG00000075012	Fjx1	scl0014221.2_140-S	blue
6156	ENSMUSG00000075012	Fjx1	scl18949.1_10-S	blue
6157	ENSMUSG00000075043	Tmem223	scl066836.1_32-S	turquoise
6158	ENSMUSG00000075118	Tm7sf1	scl0083924.2_168-S	grey
6159	ENSMUSG00000075224	Lrrc55	scl19059.1.962_230-S	grey
6160	ENSMUSG00000075232	Amd1	scl011702.3_204-S	turquoise
6161	ENSMUSG00000075259	Tcba1	scl5506.1.1_125-S	blue
6162	ENSMUSG00000075273	Ttc30b	scl19112.1.2271_33-S	blue
6163	ENSMUSG00000075318	Scn2a1	GI_38074786-S	yellow
6164	ENSMUSG00000075318	Scn2a1	scl20862.4_81-S	turquoise
6165	ENSMUSG00000075334	Rprm	scl19271.1.36_133-S	turquoise
6166	ENSMUSG00000075392	Rpl29	GI_38073651-S	grey
6167	ENSMUSG00000075415	AK008697	scl19460.1.412_12-S	magenta
6168	ENSMUSG00000075415	Fnbp1	scl19459.18_395-S	turquoise
6169	ENSMUSG00000075419	Dolk	scl19473.1_35-S	blue
6170	ENSMUSG00000075528	Aarsd1	scl39534.12.3_104-S	turquoise
6171	ENSMUSG00000075581	Rps6	GI_38089415-S	turquoise
6172	ENSMUSG00000075585	AK018107	scl10895.1.1_41-S	blue
6173	ENSMUSG00000075602	Ly6a	scl47072.5_281-S	grey
6174	ENSMUSG00000075701	H47	scl00026.1_111-S	blue
6175	ENSMUSG00000075701	H47	scl32570.6.1_25-S	brown
6176	ENSMUSG00000075702	Selm	scl41904.3_0-S	grey
6177	ENSMUSG00000075705	Sepx1	scl51004.4_55-S	turquoise
6178	ENSMUSG00000076437	2700094K13Rik	scl19073.3.3_4-S	blue
6179	ENSMUSG00000076439	Mog	scl0001753.1_34-S	magenta
6180	ENSMUSG00000076439	Mog	scl017441.3_16-S	magenta
6181	ENSMUSG00000076441	Ass1	scl011898.16_99-S	blue
6182	ENSMUSG00000076609	M34473	scl0016071.1_62-S	green
6183	ENSMUSG00000076617	abParts	IGHM_V00818_Ig_heavy_constant_mu_941-S	grey
6184	ENSMUSG00000076617	abParts	scl016019.1_4-S	grey
6185	ENSMUSG00000077450	Rab11b	scl019326.1_315-S	blue
6186	ENSMUSG00000078108	Zdhhc17	scl37500.18_146-S	blue
6187	ENSMUSG00000078174	Mef2d	scl070179.1_291-S	turquoise
6188	ENSMUSG00000078201	C730025P13Rik	scl21187.1.18_12-S	turquoise
6189	ENSMUSG00000078202	Nrarp	scl21190.1.266_56-S	grey
6190	ENSMUSG00000078236	Pou3f1	scl24990.1.20_266-S	blue
6191	ENSMUSG00000078237	Rims3	scl25010.7_694-S	purple
6192	ENSMUSG00000078348	Sf3b5	scl0066125.2_261-S	grey
6193	ENSMUSG00000078351	AK138412	scl25526.10_573-S	grey
6194	ENSMUSG00000078429	Ctdsp2	scl052468.3_53-S	turquoise
6195	ENSMUSG00000078445	Col6a1	scl012833.1_126-S	grey
6196	ENSMUSG00000078445	Col6a1	scl37796.6_295-S	grey
6197	ENSMUSG00000078560	Psme2	scl0019191.1_143-S	turquoise
6198	ENSMUSG00000078570	AK004382	GI_38078795-S	turquoise
6199	ENSMUSG00000078572	1810043H04Rik	scl0208501.1_4-S	brown
6200	ENSMUSG00000078619	Smarcd2	scl083796.1_300-S	turquoise
6201	ENSMUSG00000078622	Ccdc47	scl0067163.1_100-S	red
6202	ENSMUSG00000078622	Ccdc47	scl067163.2_42-S	red
6203	ENSMUSG00000078652	Psme3	scl40885.12_6-S	blue
6204	ENSMUSG00000078656	Vps25	scl40889.7.141_9-S	turquoise
6205	ENSMUSG00000078667	1700094D03Rik	scl073545.3_30-S	turquoise
6206	ENSMUSG00000078670	A830073O21Rik	scl32535.4_60-S	blue
6207	ENSMUSG00000078676	Casc3	scl0192160.16_158-S	blue
6208	ENSMUSG00000078681	Tm2d3	scl068634.3_3-S	turquoise
6209	ENSMUSG00000078713	Tomm5	scl068512.1_6-S	brown
6210	ENSMUSG00000078771	Evi2a	scl0014017.1_112-S	magenta
6211	ENSMUSG00000078784	1810022K09Rik	scl069126.1_46-S	turquoise
6212	ENSMUSG00000078789	Dph1	scl00116905.1_79-S	turquoise
6213	ENSMUSG00000078789	Dph1	scl0116905.1_30-S	turquoise
6214	ENSMUSG00000078789	Dph1	scl0116905.1_46-S	turquoise
6215	ENSMUSG00000078812	Eif5a	scl00276770.1_2-S	pink
6216	ENSMUSG00000078812	Eif5a	scl0276770.1_104-S	blue
6217	ENSMUSG00000078816	Prkcc	scl0018752.1_62-S	blue
6218	ENSMUSG00000078908	Mon1b	scl33304.1.1_129-S	blue
6219	ENSMUSG00000078919	Dpm1	scl0003279.1_9-S	grey
6220	ENSMUSG00000078931	Cog8	scl068023.2_32-S	turquoise
6221	ENSMUSG00000079017	Ifi27l2a	scl0076933.2_252-S	green
6222	ENSMUSG00000079018	Ly6c1	scl47073.5.231_36-S	grey
6223	ENSMUSG00000079036	Alkbh1	scl42201.8_224-S	turquoise
6224	ENSMUSG00000079037	Prnp	scl019122.2_199-S	turquoise
6225	ENSMUSG00000079043	Fastkd5	scl0380601.1_239-S	blue
6226	ENSMUSG00000079056	Kcnip3	scl18706.10.1_133-S	turquoise
6227	ENSMUSG00000079157	Fam155a	scl35118.3_474-S	blue
6228	ENSMUSG00000079197	Psme2	scl0019188.1_50-S	brown
6229	ENSMUSG00000079215	Zfp664	scl0269704.1_26-S	turquoise
6230	ENSMUSG00000079283	2310009B15Rik	scl069549.2_9-S	turquoise
6231	ENSMUSG00000079317	Trappc2	scl0066226.1_62-S	blue
6232	ENSMUSG00000079351	ENSMUSG00000048936	scl52585.3_670-S	turquoise
6233	ENSMUSG00000079426	Ttll3	scl068089.7_12-S	blue
6234	ENSMUSG00000079435	Rpl36a	scl019982.5_48-S	brown
6235	ENSMUSG00000079477	AK197526	scl019349.2_45-S	yellow
6236	ENSMUSG00000079477	Rab7	scl0019349.1_40-S	turquoise
6237	ENSMUSG00000079477	Rab7	scl019349.7_39-S	turquoise
6238	ENSMUSG00000079478	Sssca1	scl056390.4_41-S	turquoise
6239	ENSMUSG00000079481	AK004352	scl8139.1.1_103-S	brown
6240	ENSMUSG00000079481	AK032250	scl54729.1.1_292-S	greenyellow
6241	ENSMUSG00000079484	Phyhd1	scl21094.18.34_0-S	turquoise
6242	ENSMUSG00000079487	Med12	scl54745.40.1_21-S	turquoise
6243	ENSMUSG00000079509	Zfx	scl0022764.1_60-S	brown
6244	ENSMUSG00000079557	Mar-02	scl0224703.1_41-S	brown
6245	ENSMUSG00000079562	Maea	scl059003.9_0-S	turquoise
6246	ENSMUSG00000079657	Rab26	scl0328778.3_29-S	turquoise
6247	ENSMUSG00000079657	Rab26	scl00328778.1_265-S	turquoise
6248	ENSMUSG00000079677	Fdx1l	scl0071766.1_324-S	turquoise
6249	ENSMUSG00000079714	Pcdha6	scl00116731.1_145-S	blue
6250	ENSMUSG00000079714	Pcdha6	scl012937.7_30-S	turquoise
6251	ENSMUSG00000079714	Pcdha6	scl012942.4_86-S	yellow
6252	ENSMUSG00000079734	BC032285	scl0077106.1_295-S	turquoise
6253	ENSMUSG00000079961	Tbl1xr1	scl0081004.1_169-S	brown
6254	ENSMUSG00000079971	Icmt	scl057295.5_220-S	turquoise
6255	ENSMUSG00000080000	Unc5c	scl022253.17_156-S	turquoise
6256	ENSMUSG00000080049	Exosc6	scl0072544.1_107-S	turquoise
6257	ENSMUSG00000080059	Rps19	GI_38079106-S	brown
6258	ENSMUSG00000080113	Pcsk2	scl0018549.1_176-S	turquoise
6259	ENSMUSG00000080238	Ubp1	scl36396.16_197-S	grey
6260	ENSMUSG00000080268	Brms1	scl0107392.1_305-S	turquoise
6261	ENSMUSG00000080316	4930546H06Rik	scl075202.4_27-S	turquoise
6262	ENSMUSG00000080715	Psma3	GI_38079801-S	brown
6263	ENSMUSG00000080774	Rps6	GI_38086534-S	turquoise

6264	ENSMUSG00000080836	Ndufb11	GI_38083052-S	blue
6265	ENSMUSG00000080865	Eif1	GI_38074858-S	blue
6266	ENSMUSG00000081113	Calm2	GI_38085251-S	blue
6267	ENSMUSG00000081527	Rpl31	GI_38078903-S	blue
6268	ENSMUSG00000081640		GI_38076704-S	turquoise
6269	ENSMUSG00000081906	Rpl9	GI_25056071-S	turquoise
6270	ENSMUSG00000081927	Cdh8	scl0012564.1_160-S	blue
6271	ENSMUSG00000082023	Rpl27a	GI_38075688-S	turquoise
6272	ENSMUSG00000082160	Lix1	GI_38049590-S	yellow
6273	ENSMUSG00000082179	X57780	mtDNA_ND5-S	blue
6274	ENSMUSG00000082196	Rpl9	GI_38075325-S	turquoise
6275	ENSMUSG00000082289	5730427N09Rik	GI_38083743-S	blue
6276	ENSMUSG00000082454	Ddx5	GI_38091620-S	turquoise
6277	ENSMUSG00000082675	Rbbp7	GI_38086812-S	turquoise
6278	ENSMUSG00000082691	Dynlt1	scl28291.1_56-S	turquoise
6279	ENSMUSG00000083012	2810453I06Rik	scl27011.2_30-S	turquoise
6280	ENSMUSG00000083282	Ctsf	scl52823.10.1_53-S	turquoise
6281	ENSMUSG00000083325	OTTMUSG00000015729	GI_38075313-S	turquoise
6282	ENSMUSG00000083367	Nono	GI_38086435-S	turquoise
6283	ENSMUSG00000083483	Rpl27a	GI_38076122-S	turquoise
6284	ENSMUSG00000083563	DQ539915	mtDNA_COXI-S	blue
6285	ENSMUSG00000083758	0610010K06Rik	GI_38085094-S	yellow
6286	ENSMUSG00000083965	Rpl27a	GI_38075662-S	brown
6287	ENSMUSG00000084050	Rpl27a	GI_38075768-S	turquoise
6288	ENSMUSG00000084187	Rps12	GI_38087255-S	turquoise
6289	ENSMUSG00000084299	Rps18	GI_38079911-S	turquoise
6290	ENSMUSG00000084331	Fdps	GI_38086320-S	grey
6291		Sep-03	scl0002540.1_6-S	brown
6292		Sep-03	scl078356.1_225-S	brown
6293		Sep-06	scl0056526.1_262-S	brown
6294		Sep-11	scl052398.2_175-S	grey
6295		100041668	scl10412.1.1_54-S	blue
6296		1700034M03Rik	scl0071488.1_74-S	turquoise
6297		1700129I04Rik	scl067368.1_6-S	brown
6298		5330439C02Rik	scl39650.2.1_198-S	grey
6299		5830427D03Rik	scl46761.2.17_45-S	turquoise
6300		5930403L14Rik	scl23451.1.2232_60-S	turquoise
6301		6230409E13Rik	scl0076132.2_327-S	blue
6302		AK003973	scl30677.2_0-S	grey
6303		AK005089	scl075700.1_113-S	brown
6304		AK005145	scl34899.1.1_147-S	turquoise
6305		AK006817	scl0001000.1_8-S	greenyellow
6306		AK008061	scl25330.1.1_0-S	turquoise
6307		AK009643	scl52978.1.1_228-S	yellow
6308		AK012053	scl35097.1.1_70-S	blue
6309		AK012546	GI_38086788-S	brown
6310		AK013171	scl20613.1.1_316-S	grey
6311		AK013375	scl0072812.1_330-S	blue
6312		AK013658	scl47239.2.1_290-S	yellow
6313		AK013682	scl53648.1.1_147-S	blue
6314		AK013743	scl26306.1.1_82-S	blue
6315		AK013747	scl48626.2.1_273-S	yellow
6316		AK013781	scl37523.1.1_132-S	yellow
6317		AK013824	scl21385.1.1_100-S	grey
6318		AK013968	scl25963.1.1_27-S	turquoise
6319		AK014088	scl19306.1.1_140-S	turquoise
6320		AK014129	scl35294.1.1_258-S	yellow
6321		AK014495	scl44741.1.302_252-S	turquoise
6322		AK014695	scl15977.1.2114_8-S	yellow
6323		AK015453	scl50414.1.1_103-S	greenyellow
6324		AK017280	scl40250.1.1_66-S	yellow
6325		AK017390	scl47301.1.1_254-S	blue
6326		AK017961	scl076036.1_45-S	red
6327		AK018031	scl45405.2.1_1-S	yellow
6328		AK018053	scl16946.1.1_98-S	blue
6329		AK018204	scl30334.1.1_64-S	blue
6330		AK018287	scl076210.1_87-S	brown
6331		AK018459	scl24524.1.1_329-S	blue
6332		AK018530	scl52577.1.1_188-S	turquoise
6333		AK018644	scl29255.1.1_180-S	grey
6334		AK019313	scl43531.1.1_35-S	black
6335		AK019331	scl459.1.1_110-S	yellow
6336		AK019348	scl16395.1.2_32-S	yellow
6337		AK019921	scl51579.1.1_134-S	grey
6338		AK019926	scl43611.1.1_320-S	blue
6339		AK020044	scl49516.1.2_228-S	turquoise
6340		AK020112	scl28091.1.1_165-S	turquoise
6341		AK020116	scl44354.1.1_177-S	yellow
6342		AK020136	scl20889.1.1_221-S	purple
6343		AK020287	scl25432.1.1_21-S	brown
6344		AK020412	scl23184.1.1_53-S	grey
6345		AK020474	scl38805.1.1_125-S	yellow
6346		AK020669	scl40326.1.1_146-S	grey
6347		AK020929	scl42917.1.3233_121-S	blue
6348		AK021009	scl7604.1.1_237-S	grey
6349		AK021084	scl077526.1_60-S	turquoise
6350		AK021090	scl37524.1.1_260-S	yellow
6351		AK028644	scl0106967.2_221-S	turquoise
6352		AK029093	scl0320188.1_7-S	blue
6353		AK029407	scl38801.3.1_98-S	yellow
6354		AK030345	scl20918.1.1_187-S	blue
6355		AK031865	scl54973.1.1243_164-S	blue
6356		AK032296	scl49579.1_673-S	yellow
6357		AK032319	scl00101179.1_301-S	turquoise
6358		AK032550	scl52878.1.594_203-S	blue
6359		AK032614	scl38183.1.1_301-S	blue
6360		AK033140	scl16913.1_153-S	blue
6361		AK033243	scl35347.1.1_116-S	yellow
6362		AK035477	scl48683.1.1_103-S	blue
6363		AK035691	scl21376.1.1211_204-S	yellow
6364		AK036798	scl00109880.1_164-S	blue
6365		AK037279	scl49804.1.18_12-S	blue
6366		AK037504	scl20802.1_626-S	yellow
6367		AK037806	scl33270.1.1_296-S	grey
6368		AK037886	scl37958.1_312-S	grey
6369		AK039212	scl17850.1.1_27-S	blue
6370		AK039878	scl44527.2.272_210-S	grey
6371		AK040245	scl42746.1.1_82-S	turquoise
6372		AK041970	scl50068.2_604-S	yellow
6373		AK042310	scl16563.1.1377_25-S	blue
6374		AK043128	scl19711.1.112_41-S	turquoise
6375		AK045843	scl52561.1_97-S	grey
6376		AK045959	scl42260.1.2629_30-S	turquoise
6377		AK046163	scl00319536.1_287-S	yellow
6378		AK046163	scl0319536.1_81-S	turquoise
6379		AK046444	scl42905.1.1_172-S	yellow

6380	AK046760	scl29099.1_374-S	blue
6381	AK047103	scl44402.1.28_53-S	brown
6382	AK047590	scl37663.1.1_197-S	grey
6383	AK048269	GI_28487552-S	grey
6384	AK049409	scl0071428.1_302-S	yellow
6385	AK049409	scl0078818.1_318-S	yellow
6386	AK049490	scl51102.1.1_269-S	blue
6387	AK049797	scl45236.1_85-S	blue
6388	AK051582	scl38377.2.2576_8-S	yellow
6389	AK051928	scl078495.2_180-S	grey
6390	AK052577	scl16687.1.1_249-S	grey
6391	AK053405	scl47409.1.605_8-S	yellow
6392	AK076606	scl0068965.1_205-S	blue
6393	AK077851	scl18996.1.1_237-S	grey
6394	AK078027	scl0109037.1_260-S	yellow
6395	AK079380	scl50975.2_304-S	turquoise
6396	AK079471	scl15856.1.1_107-S	yellow
6397	AK079792	scl49037.1.1_264-S	blue
6398	AK079841	scl0320892.1_97-S	turquoise
6399	AK079887	scl52271.2_211-S	blue
6400	AK081132	scl34643.1.1_311-S	yellow
6401	AK081553	scl50535.1_686-S	grey
6402	AK081934	scl45593.1_380-S	blue
6403	AK082104	scl42911.1.2608_77-S	blue
6404	AK082309	scl27733.1_114-S	yellow
6405	AK082948	scl0320324.2_94-S	grey
6406	AK083039	scl25696.1.1_219-S	grey
6407	AK083138	scl42281.2.1_281-S	blue
6408	AK083198	scl48088.1_576-S	green
6409	AK083451	scl0099047.1_137-S	blue
6410	AK084533	scl30182.1.1_178-S	yellow
6411	AK084899	scl51410.1.1_192-S	yellow
6412	AK085136	scl071358.8_30-S	yellow
6413	AK085529	scl36459.1.1_251-S	yellow
6414	AK085760	scl51789.1.1477_48-S	yellow
6415	AK086140	scl49892.1.1_210-S	grey
6416	AK086671	scl53278.1.1265_259-S	brown
6417	AK088440	scl53045.1.1_237-S	yellow
6418	AK088822	scl0052437.1_314-S	blue
6419	AK089087	scl54969.1.1_276-S	brown
6420	AK134354	scl069552.1_323-S	grey
6421	AK134382	scl25266.1.1_10-S	yellow
6422	AK156477	scl070526.1_69-S	blue
6423	AK169848	scl0319219.1_262-S	blue
6424	AK171764	scl37029.1_507-S	grey
6425	Ankmy2	scl00217473.2_274-S	yellow
6426	Ankrd11	scl000590.1_7-S	turquoise
6427	Ap2m1	scl011773.12_241-S	turquoise
6428	Arl2bp	scl000653.1_34-S	turquoise
6429	Arpp21	scl0003498.1_967-S	blue
6430	Atp2b1	scl0320831.1_209-S	blue
6431	B930011P16Rik	scl0403186.1_121-S	yellow
6432	B930095G15Rik	scl00320268.2_218-S	yellow
6433	B930095G15Rik	scl45942.1_12-S	turquoise
6434	Bin1	scl0002194.1_2265-S	yellow
6435	Brd8	scl0070787.1_319-S	blue
6436	Cab39l	scl46231.15_279-S	green
6437	Cab39l	scl000364.1_206-S	green
6438	Cacna1a	scl137.7.1_16-S	turquoise
6439	Cd59a	scl20534.5_360-S	green
6440	Clasp2	scl097514.1_206-S	blue
6441	Cox7a2	scl35560.5_28-S	turquoise
6442	Cttnbp2	scl068069.1_6-S	grey
6443	D930015E06Rik	scl0229473.1_11-S	turquoise
6444	Dclk1	scl072806.1_8-S	turquoise
6445	Dmd	scl0002996.1_29-S	yellow
6446	Dock4	scl0238130.31_47-S	red
6447	Dtna	scl0002207.1_183-S	blue
6448	E330018D03Rik	GI_33239384-S	yellow
6449	Edil3	GI_38074965-I	blue
6450	Eef1b2	scl000993.1_5-S	brown
6451	Enpp2	scl0002547.1_9-S	green
6452	Epb4.1	scl23745.1.1_303-S	yellow
6453	Fam115a	scl069233.1_299-S	yellow
6454	Fbxw7	scl0001968.1_9-S	yellow
6455	Flrt3	scl0071436.2_277-S	turquoise
6456	Gatad1	scl0067210.1_10-S	turquoise
6457	Gdap5	scl43122.1.1_70-S	yellow
6458	Gria2	scl22034.13_42-S	blue
6459	Grm7	scl29655.10_495-S	yellow
6460	Gtl2	scl000012.1_223-S	turquoise
6461	Gtl2	scl0017263.2_159-S	yellow
6462	Hcfc2	scl067933.1_19-S	red
6463	Hnrpdl	scl0050926.1_17-S	brown
6464	Kcnq2	GI_38075777-S	grey
6465	Kirrel3	scl072851.1_250-S	yellow
6466	Krit1	scl00320666.1_313-S	turquoise
6467	Lamp2	scl016784.1_5-S	blue
6468	Lphn1	scl00330814.1_43-S	blue
6469	Lrrc29	scl00234684.2_208-S	turquoise
6470	Lysmd4	scl000102.1_2-S	blue
6471	Masp1	scl0001849.1_2273-S	grey
6472	Meg3	scl42789.1.791_155-S	grey
6473	Mppe1	scl51323.13.1_30-S	grey
6474	Mysm1	scl24096.6_140-S	blue
6475	Naca	scl0017938.1_31-S	brown
6476	Nap1l1	scl0003917.1_104-S	red
6477	Ndufs4	scl0077728.1_328-S	grey
6478	Nipbl	scl0071175.1_302-S	brown
6479	NR_002864	scl47105.1.327_260-S	blue
6480	Ntrk2	scl018212.12_31-S	turquoise
6481	Ogt	scl0002975.1_346-S	yellow
6482	Olfm1	scl0003187.1_40-S	greenyellow
6483	Oxnad1	scl0218885.8_148-S	blue
6484	Oxr1	scl073184.1_37-S	blue
6485	Pcdh10	scl0002078.1_391-S	turquoise
6486	Pcdh10	scl0018526.1_200-S	blue
6487	Pdxdc1	scl0001819.1_72-S	turquoise
6488	Pdxdc1	scl094184.1_45-S	red
6489	Phactr3	scl073858.2_258-S	grey
6490	Pick1	scl018693.12_2-S	brown
6491	Ppm1a	scl069486.1_97-S	turquoise
6492	Ppm1b	scl0001709.1_980-S	grey
6493	Ppp2r5c	scl0002368.1_75-S	turquoise
6494	Prdx6	scl00320807.1_59-S	yellow
6495	Ptprz1	GI_38083676-S	blue

6496	Runx1t1	scl0002702.1_3805-S	grey
6497	Sec61b	scl0066212.1_0-S	blue
6498	Sfrs8	scl068937.1_113-S	turquoise
6499	Sh3gl2	scl0020404.1_267-S	blue
6500	Shisa5	scl0003546.1_11-S	pink
6501	Smg1	GI_38087127-S	blue
6502	Snrpd1	scl52252.1.58_3-S	brown
6503	Snx21	scl070479.3_193-S	blue
6504	Spag9	scl073163.1_3-S	turquoise
6505	Srebf2	scl020788.3_30-S	grey
6506	Strbp	scl19374.1.1_140-S	yellow
6507	Sympk	scl33016.3_89-S	grey
6508	Tbc1d19	scl27811.23.1_37-S	turquoise
6509	Tet2	scl21487.17_601-S	turquoise
6510	Tmcc1	scl00330401.1_289-S	yellow
6511	Tmem49	scl0078510.1_253-S	blue
6512	Tns3	scl00319939.1_268-S	grey
6513	Tollip	scl0054473.2_162-S	blue
6514	Tollip	scl054473.1_6-S	blue
6515	Trim9	scl0094090.1_135-S	grey
6516	Ttbk1	scl49868.1.1_330-S	brown
6517	Ube2b	scl067159.2_136-S	turquoise
6518	Unc80	scl14607.1.1_266-S	blue
6519	Vamp1	scl0022317.1_300-S	grey
6520	Vps24	scl29898.5_140-S	blue
6521	Whsc1l1	scl000688.1_865-S	blue
6522	Zcchc11	scl00320841.1_106-S	blue
6523	Zeb2	scl0319524.1_107-S	blue
6524	Zfp157	scl00320476.1_115-S	yellow
6525	Zfp40	scl068699.1_78-S	blue
6526	Zfp420	scl32830.4_10-S	blue
6527	Zmym5	scl000369.1_136-S	turquoise

APPENDIX F

GENE ONTOLOGY ENRICHMENT FOR GENE EXPRESSION MODULES

These are the details of any Gene Ontology terms that I found to be enriched in the both-sexes-together hippocampus gene co-expression modules identified in Chapter 4, ranked by p-value in Figure 4.16 and illustrated graphically in a series of figures (4.17 to 4.26). Any terms with p-value < .001 are included here. From 31408 tests across eleven network modules, a total of 101 GO term-module pairs were below this threshold.

module	GOID	Ontology	Term	p
turquoise	GO:0005622	cellular_component	intracellular	0.000674556
turquoise	GO:0044424	cellular_component	intracellular part	0.000528631
turquoise	GO:0043227	cellular_component	membrane-bounded organelle	0.000584844
turquoise	GO:0043231	cellular_component	intracellular membrane-bounded organelle	0.000468471
blue	GO:0012505	cellular_component	endomembrane system	0.000505128
brown	GO:0005739	cellular_component	mitochondrion	0.000200719
brown	GO:0070469	cellular_component	respiratory chain	0.000474747
brown	GO:0005746	cellular_component	mitochondrial respiratory chain	0.000740009
brown	GO:0044455	cellular_component	mitochondrial membrane part	7.01E-07
brown	GO:0009059	biological_process	macromolecule biosynthetic process	0.000953529
brown	GO:0034645	biological_process	cellular macromolecule biosynthetic process	0.000771696
brown	GO:0005839	cellular_component	proteasome core complex	0.000428749
brown	GO:0004298	molecular_function	threonine-type endopeptidase activity	0.000428749
brown	GO:0070003	molecular_function	threonine-type peptidase activity	0.000428749
brown	GO:0031307	cellular_component	integral to mitochondrial outer membrane	0.000697086
yellow	GO:0014069	cellular_component	postsynaptic density	0.000480499
yellow	GO:0044327	cellular_component	dendritic spine head	0.000480499
yellow	GO:0044456	cellular_component	synapse part	0.00079316
yellow	GO:0003676	molecular_function	nucleic acid binding	4.47E-05
red	GO:0030016	cellular_component	myofibril	0.000430189
red	GO:0030017	cellular_component	sarcomere	0.000197096
red	GO:0043292	cellular_component	contractile fiber	0.000759487
red	GO:0044449	cellular_component	contractile fiber part	0.000380779
red	GO:0031981	cellular_component	nuclear lumen	0.000791327
red	GO:0005093	molecular_function	Rab GDP-dissociation inhibitor activity	0.000963876
red	GO:0071636	biological_process	positive regulation of transforming growth factor beta production	0.000963876
black	GO:0031974	cellular_component	membrane-enclosed lumen	0.000581571
black	GO:0031981	cellular_component	nuclear lumen	0.000521473
black	GO:0043233	cellular_component	organelle lumen	0.000445593
black	GO:0070013	cellular_component	intracellular organelle lumen	0.000445593
pink	GO:0003674	molecular_function	molecular_function	0.000334987
pink	GO:0005488	molecular_function	binding	0.000215502
pink	GO:0006812	biological_process	cation transport	0.000880943
pink	GO:0015988	biological_process	energy coupled proton transport, against electrochemical gradient	0.000448358
pink	GO:0015991	biological_process	ATP hydrolysis coupled proton transport	0.000448358
pink	GO:0033176	cellular_component	proton-transporting V-type ATPase complex	0.000155097
pink	GO:0033177	cellular_component	proton-transporting two-sector ATPase complex, proton-transporting domain	0.000155097
pink	GO:0033179	cellular_component	proton-transporting V-type ATPase, V0 domain	1.73E-05
pink	GO:0000166	molecular_function	nucleotide binding	0.000144678
pink	GO:0036094	molecular_function	small molecule binding	0.00027929
pink	GO:0008021	cellular_component	synaptic vesicle	0.000117084
pink	GO:0044456	cellular_component	synapse part	4.02E-05
pink	GO:0045202	cellular_component	synapse	0.000192269
pink	GO:0033267	cellular_component	axon part	0.0009005
pink	GO:0043005	cellular_component	neuron projection	0.000120288
pink	GO:0044463	cellular_component	cell projection part	0.000116741
pink	GO:0043197	cellular_component	dendritic spine	0.000572448
pink	GO:0044309	cellular_component	neuron spine	0.00060717
pink	GO:0016471	cellular_component	vacuolar proton-transporting V-type ATPase complex	0.000421081
pink	GO:0015662	molecular_function	ATPase activity, coupled to transmembrane movement of ions, phosphorylative mech	0.000893828
pink	GO:0016462	molecular_function	pyrophosphatase activity	0.000344751
pink	GO:0016817	molecular_function	hydrolase activity, acting on acid anhydrides	0.000344751
pink	GO:0016818	molecular_function	hydrolase activity, acting on acid anhydrides, in phosphorus-containing anhydrides	0.000344751
pink	GO:0017111	molecular_function	nucleoside-triphosphatase activity	0.000288238
pink	GO:0009144	biological_process	purine nucleoside triphosphate metabolic process	0.000967422
pink	GO:0009199	biological_process	ribonucleoside triphosphate metabolic process	0.00085812
pink	GO:0009205	biological_process	purine ribonucleoside triphosphate metabolic process	0.000791017
pink	GO:0003924	molecular_function	GTPase activity	0.000480902
pink	GO:0043244	biological_process	regulation of protein complex disassembly	0.000689487
pink	GO:0003746	molecular_function	translation elongation factor activity	0.000229127
magenta	GO:0016020	cellular_component	membrane	0.000148514
magenta	GO:0005886	cellular_component	plasma membrane	5.39E-05
magenta	GO:0071944	cellular_component	cell periphery	0.000101716
magenta	GO:0009636	biological_process	response to toxin	0.000790727
magenta	GO:0001508	biological_process	regulation of action potential	8.35E-05
magenta	GO:0007272	biological_process	ensheathment of neurons	1.17E-05
magenta	GO:0008366	biological_process	axon ensheathment	1.17E-05
magenta	GO:0019228	biological_process	regulation of action potential in neuron	2.06E-05
magenta	GO:0042552	biological_process	myelination	0.000109767

magenta	GO:0043209	cellular_component	myelin sheath	1.03E-06
magenta	GO:0044304	cellular_component	main axon	3.86E-05
magenta	GO:0043218	cellular_component	compact myelin	8.59E-06
magenta	GO:0002020	molecular_function	protease binding	0.000571638
magenta	GO:0019911	molecular_function	structural constituent of myelin sheath	8.59E-06
magenta	GO:0046513	biological_process	ceramide biosynthetic process	0.000892269
magenta	GO:0032432	cellular_component	actin filament bundle	0.000389065
magenta	GO:0042805	molecular_function	actinin binding	0.000117397
magenta	GO:0051393	molecular_function	alpha-actinin binding	0.000117397
magenta	GO:0017022	molecular_function	myosin binding	0.000720643
greenyellow	GO:0016021	cellular_component	integral to membrane	0.000409198
greenyellow	GO:0031224	cellular_component	intrinsic to membrane	0.000660879
greenyellow	GO:0044425	cellular_component	membrane part	0.000921095
greenyellow	GO:0007275	biological_process	multicellular organismal development	0.000933589
greenyellow	GO:0048856	biological_process	anatomical structure development	0.000601646
greenyellow	GO:0009653	biological_process	anatomical structure morphogenesis	0.000129953
greenyellow	GO:0048731	biological_process	system development	0.000212369
greenyellow	GO:0040013	biological_process	negative regulation of locomotion	0.000466454
greenyellow	GO:0007431	biological_process	salivary gland development	0.000824082
greenyellow	GO:0007435	biological_process	salivary gland morphogenesis	0.000431903
greenyellow	GO:0022612	biological_process	gland morphogenesis	0.000269783
greenyellow	GO:0060445	biological_process	branching involved in salivary gland morphogenesis	0.000253515
greenyellow	GO:0032281	cellular_component	alpha-amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid selective glutamate recep	0.000992085
greenyellow	GO:0031623	biological_process	receptor internalization	0.000544971
greenyellow	GO:0048710	biological_process	regulation of astrocyte differentiation	0.000544971
greenyellow	GO:0044419	biological_process	interspecies interaction between organisms	0.000595725
greenyellow	GO:0034109	biological_process	homotypic cell-cell adhesion	8.83E-05
purple	GO:0032501	biological_process	multicellular organismal process	6.81E-05
purple	GO:0044057	biological_process	regulation of system process	0.00036657
purple	GO:0004871	molecular_function	signal transducer activity	0.000377376
purple	GO:0060089	molecular_function	molecular transducer activity	0.000377376
purple	GO:0004707	molecular_function	MAP kinase activity	0.000671814

APPENDIX G

Highest-Weighted Gene Expression Probes

As detailed in §5.2.4, a Bayesian computational technique, SPIV, was used to identify the hippocampus RNA expression probes with the strongest relationships with a given phenotype. The relationship of a given phenotype to these probes, as well as to genetic markers and unmeasured latent variables, were simultaneously modelled so the relationship of a single probe to a phenotype might be dramatically different than if that relationship were examined in isolation. Weights are given in Θ_{MAP} and any probes with $\Theta_{MAP} > .001$ (n = 190) are shown here. Sixteen phenotypes were analysed with SPIV and all of them bar "corticosterone levels after fear-associated cue" had probes above that Θ_{MAP} threshold.

Phenotype	Gene_name	Probe_name	Weight
Adrenal Gland Weight	Slc25a37	scl000296.1.62-S	0.05641
Adrenal Gland Weight	Lclat1	GI.38083242-S	0.03898
Adrenal Gland Weight	Mtmr11	scl0001985.1.48-S	0.03882
Adrenal Gland Weight	Phf20	scl20034.12.12.31-S	0.01636
Adrenal Gland Weight	Gipc1	scl000630.1.212-S	0.01156
Adrenal Gland Weight	Wdr41	scl0003723.1.3-S	0.00948
Adrenal Gland Weight	Olfr713	scl9369.1.1.297-S	0.00823
Adrenal Gland Weight	Ptcra	scl019208.2.25-S	0.00492
Adrenal Gland Weight	Sec13	scl28535.9.1.27-S	0.00485
Adrenal Gland Weight	D430041D05Rik	GI.38074999-S	0.00431
Adrenal Gland Weight	Ap2b1	scl0001360.1.1-S	0.00243
Adrenal Gland Weight	Gprin3	scl28954.1.1.54-S	0.00224
Adrenal Gland Weight	Ss18l1	scl0003207.1.594-S	0.00207
Adrenal Gland Weight	Kif5c	scl20943.27.672-S	0.00167
Burrowed Pellet Weight	AK018435	GI.38080828-S	0.04364
Burrowed Pellet Weight	Sf3b5	scl0066125.2.261-S	0.03605
Burrowed Pellet Weight	Dgki	scl29141.35.1.23-S	0.03195
Burrowed Pellet Weight	Lfng	scl0016848.2.246-S	0.02379
Burrowed Pellet Weight	Caly	scl30520.6.1.21-S	0.0224
Burrowed Pellet Weight	Spsb4	scl35482.3.1.198-S	0.02039
Burrowed Pellet Weight	MtPolB	scl39434.9.1.18-S	0.01109
Burrowed Pellet Weight	Ezr	scl0022350.2.262-S	0.01011
Burrowed Pellet Weight	AK030605	scl30343.1.26.89-S	0.00465
Burrowed Pellet Weight	Arrdc4	scl066412.2.22-S	0.00282
Burrowed Pellet Weight	Exd2	scl43030.13.217-S	0.00245
Burrowed Pellet Weight	Lman2l	scl0214895.1.30-S	0.00144
Burrowed Pellet Weight	Darc	scl15911.2.36-S	0.00105
Burrowed Pellet Weight	Cyp1b1	scl0013078.2.259-S	0.00104
Freeze Time to Fear-Associated Context	5930434B04Rik	scl0003131.1.3-S	0.02487
Freeze Time to Fear-Associated Context	Glt8d1	scl46500.10.1.48-S	0.01145
Freeze Time to Fear-Associated Context	Psmd8	scl0057296.1.256-S	0.00892
Freeze Time to Fear-Associated Context	Fras1	scl27563.74.239.16-S	0.0037
Freeze Time to Fear-Associated Context	Ablim3	scl00319713.1.52-S	0.00357
Freeze Time to Fear-Associated Context	Sdccag3	scl0003280.1.90-S	0.00333
Freeze Time to Fear-Associated Context	Fpr.rs6	scl0321020.1.67-S	0.00286
Freeze Time to Fear-Associated Context	Btn2a2	scl44215.8.45-S	0.00201
Freeze Time to Fear-Associated Context	Pax2	scl018504.9.4-S	0.00125
Boli Produced after Fear-Associated Cue	AK033222	scl077994.4.29-S	0.09165
Boli Produced after Fear-Associated Cue	Gchfr	scl0003189.1.25-S	0.05504
Boli Produced after Fear-Associated Cue	Slc35b3	scl0003682.1.25-S	0.04019
Boli Produced after Fear-Associated Cue	Slc35b3	scl44068.10.181-S	0.03846
Boli Produced after Fear-Associated Cue	Oas1c	scl26108.8.1.25-S	0.03578
Boli Produced after Fear-Associated Cue	Mettl1	scl0003887.1.47-S	0.03267
Boli Produced after Fear-Associated Cue	Maff	scl47746.6.104-S	0.02788
Boli Produced after Fear-Associated Cue	AK020086	scl28604.1.1.315-S	0.02482
Boli Produced after Fear-Associated Cue	Cmtm2b	scl33443.4.1.10-S	0.02095
Boli Produced after Fear-Associated Cue	Slc25a37	scl000296.1.62-S	0.02078
Boli Produced after Fear-Associated Cue	Ddx55	scl0067848.2.220-S	0.01807
Boli Produced after Fear-Associated Cue	Aco1	scl25550.21.1.18-S	0.01578
Boli Produced after Fear-Associated Cue	Dtx2	scl27123.13.129.18-S	0.00697
Boli Produced after Fear-Associated Cue	AK005784	scl069349.3.0-S	0.00655
Boli Produced after Fear-Associated Cue	Ppp1r2	scl0066849.1.145-S	0.00168
Freeze Time to Fear-Associated Cue	CLCN3	scl000703.1.52-S	0.06643
Freeze Time to Fear-Associated Cue	Mrgprx1	GI.46430535-S	0.06056
Freeze Time to Fear-Associated Cue	Znhit6	scl069746.7.1-S	0.04856
Freeze Time to Fear-Associated Cue	Fzd3	scl45417.7.1.19-S	0.04738
Freeze Time to Fear-Associated Cue	Kcnq1	scl0016535.1.193-S	0.03613
Freeze Time to Fear-Associated Cue	B930095G15Rik	scl00320268.2.218-S	0.02275
Freeze Time to Fear-Associated Cue	Tcerg1	scl056070.7.28-S	0.0214
Freeze Time to Fear-Associated Cue	Zfhx3	scl000049.1.523-S	0.01731
Freeze Time to Fear-Associated Cue	Dclre1c	scl0227525.14.166-S	0.00664
Freeze Time to Fear-Associated Cue	Ppm1b	scl0001709.1.980-S	0.00568
Freeze Time to Fear-Associated Cue	Ptpre	scl00018.1.3-S	0.0032
Freeze Time to Fear-Associated Cue	P4htm	scl35348.11.1.65-S	0.0026
Freeze Time to Fear-Associated Cue	Myo1c	scl41255.35.202-S	0.00165
Freeze Time to Fear-Associated Cue	Ihpk2	scl36454.7.1.119-S	0.00116
Freeze Time after Fear-Associated Cue	Spag4	scl20038.8.1.45-S	0.02006
Freeze Time after Fear-Associated Cue	Uts2	scl0002834.1.11-S	0.01824
Freeze Time after Fear-Associated Cue	Calu	scl0001174.1.68-S	0.01261

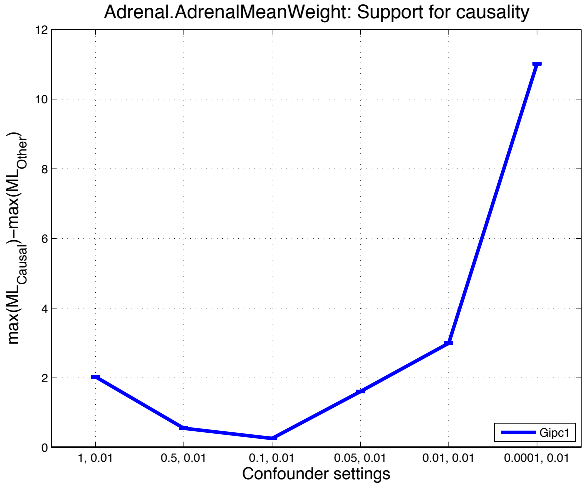
Freeze Time after Fear-Associated Cue	AK052547	scl19270.1.616.146-S	0.01245
Freeze Time after Fear-Associated Cue	Lactb	scl35671.6.128-S	0.00421
Freeze Time after Fear-Associated Cue	Fez1	scl37121.13.1.3-S	0.00199
Freeze Time after Fear-Associated Cue	Npdc1	scl012496.9.212-S	0.00178
Freeze Time after Fear-Associated Cue	Olfr1006	scl4354.1.1.53-S	0.00141
Freeze Time after Fear-Associated Cue	Nfatc3	scl0018021.2.84-S	0.00126
Distance Travelled in EPM Closed Arm	Renbp	scl54150.7.1.69-S	0.07557
Distance Travelled in EPM Closed Arm	Ube2t	scl17444.7.1.197-S	0.05065
Distance Travelled in EPM Closed Arm	Sult2b1	scl000224.1.0-S	0.04182
Distance Travelled in EPM Closed Arm	Fos	scl42959.4.58-S	0.03059
Distance Travelled in EPM Closed Arm	Pde10a	scl51145.31.1.12-S	0.02055
Distance Travelled in EPM Closed Arm	Edem2	scl0003019.1.66-S	0.01467
Distance Travelled in EPM Closed Arm	Dusp1	scl50147.4.283-S	0.01344
Distance Travelled in EPM Closed Arm	Dhx30	scl0003426.1.85-S	0.01127
Distance Travelled in EPM Closed Arm	Gpr108	scl078308.1.13-S	0.00759
Distance Travelled in EPM Closed Arm	Slc22a20	scl0381203.8.26-S	0.0044
Distance Travelled in EPM Closed Arm	Slc35a2	scl55066.4.1.68-S	0.00377
Distance Travelled in EPM Closed Arm	4930579J09Rik	scl52752.15.5.7-S	0.00257
Distance Travelled in EPM Closed Arm	Polr3gl	scl21804.7.1.3-S	0.00193
Distance Travelled in EPM Closed Arm	Rnf43	scl41080.12.669.137-S	0.00114
Distance Travelled in EPM Closed Arm	Tspan33	scl30285.8.1.23-S	0.0011
Distance Travelled in EPM Open Arm	Tnrc6c	scl40682.19.710-S	0.05438
Distance Travelled in EPM Open Arm	Tlk2	scl0001496.1.12-S	0.03787
Distance Travelled in EPM Open Arm	Slc27a2	scl20335.12.1.10-S	0.03286
Distance Travelled in EPM Open Arm	Abcc4	scl45160.32.9-S	0.0319
Distance Travelled in EPM Open Arm	QBRICK	scl0230344.1.198-S	0.02967
Distance Travelled in EPM Open Arm	Bcl9	GI.23621231-S	0.02612
Distance Travelled in EPM Open Arm	Akap12	scl30597.2.2-S	0.02326
Distance Travelled in EPM Open Arm	Znf580	scl33120.2.1.47-S	0.0231
Distance Travelled in EPM Open Arm	Mtmr11	scl0001985.1.48-S	0.01744
Distance Travelled in EPM Open Arm	Wdr91	scl29164.14.1.54-S	0.01734
Distance Travelled in EPM Open Arm	Il22ra2	scl39112.5.1.8-S	0.01654
Distance Travelled in EPM Open Arm	Agfg2	scl0004142.1.42-S	0.01404
Distance Travelled in EPM Open Arm	Psmb8	scl0016913.2.8-S	0.01015
Distance Travelled in EPM Open Arm	Accs	scl18975.13.1.98-S	0.00167
Faecal Corticosterone	Gpx7	scl24011.4.1.9-S	0.0508
Faecal Corticosterone	2610018G03Rik	scl54935.14.15.299-S	0.05046
Faecal Corticosterone	AK012573	scl0067192.1.182-S	0.01911
Faecal Corticosterone	Osbpl6	scl0099031.1.295-S	0.01323
Faecal Corticosterone	Fga	scl0001939.1.45-S	0.01298
Faecal Corticosterone	Zcchc8	scl0004095.1.33-S	0.01169
Faecal Corticosterone	2310033P09Rik	scl41505.7.1.14-S	0.00852
Faecal Corticosterone	Igsf1	scl0002911.1.19-S	0.00784
Faecal Corticosterone	Faf1	scl25126.19.1.29-S	0.00412
Faecal Corticosterone	Crebbp	scl48815.9.1.11-S	0.00343
Faecal Corticosterone	Rfc4	scl0001885.1.11-S	0.00343
Faecal Corticosterone	Gyk	scl0002927.1.17-S	0.00327
Faecal Corticosterone	Abi3bp	scl00320712.1.171-S	0.00133
Faecal Corticosterone	Prpf38a	scl0002736.1.2-S	0.00115
Startle Response	Itch	scl016396.2.0-S	0.04509
Startle Response	Rprm	scl19271.1.36.133-S	0.01303
Startle Response	Ube4a	scl35939.21.232-S	0.01268
Startle Response	AK032347	GI.38086173-S	0.01112
Startle Response	Cdh10	scl012551.6.46-S	0.00796
Startle Response	Zyg11a	scl24014.12.1.0-S	0.0076
Startle Response	Gdf3	scl28440.3.153-S	0.00667
Startle Response	D11Wsu47e	scl40755.5.1.55-S	0.0049
Startle Response	Gpr183	scl45133.3.447-S	0.0028
Startle Response	AK014628	scl24879.1.1.0-S	0.00227
Startle Response	Sec63	scl0140740.24.211-S	0.00176
Startle Response	Ambra1	scl20622.20.179-S	0.00124
KI-67 Antigen	AK006049	GI.20891894-S	0.04745
KI-67 Antigen	Zbtb2	GI.38088886-S	0.04355
KI-67 Antigen	Cdrt4	scl41438.2.1.10-S	0.02628
KI-67 Antigen	Ccdc137	scl0067291.1.12-S	0.02602
KI-67 Antigen	Ptpn12	scl0004009.1.14-S	0.02102
KI-67 Antigen	Pde4d	scl0238871.11.15-S	0.01507
KI-67 Antigen	Prc1	scl32477.13.570-S	0.01453
KI-67 Antigen	Padi1	scl23605.18.1.327-S	0.00871
KI-67 Antigen	Kcnk2	scl016526.1.311-S	0.00798

KI-67 Antigen	Ttr	scl52209.6.1.16-S	0.00199
KI-67 Antigen	Srp14	scl020813.1.157-S	0.00152
Boli Produced in Open Field Test	Tbcc	scl50668.1.78.47-S	0.08166
Boli Produced in Open Field Test	Gatad2b	scl00229542.2.217-S	0.07145
Boli Produced in Open Field Test	Lxn	scl22088.5.1.88-S	0.07039
Boli Produced in Open Field Test	AK034614	scl0170624.1.278-S	0.06697
Boli Produced in Open Field Test	Dctn4	scl00319993.1.165-S	0.04805
Boli Produced in Open Field Test	Il17rb	scl45778.11.1.135-S	0.03956
Boli Produced in Open Field Test	Psg16	scl0026436.1.186-S	0.03942
Boli Produced in Open Field Test	Tulp3	scl28366.14.261-S	0.03571
Boli Produced in Open Field Test	Ubxn11	scl24852.14.1.95-S	0.01922
Boli Produced in Open Field Test	AK045440	scl42407.1.1.107-S	0.01658
Boli Produced in Open Field Test	Atp6v0a1	scl011975.20.15-S	0.01593
Boli Produced in Open Field Test	AK051928	scl078495.2.180-S	0.01382
Boli Produced in Open Field Test	Fras1	scl27563.74.239.16-S	0.00876
Boli Produced in Open Field Test	Vpreb1	scl0022362.1.271-S	0.00834
Boli Produced in Open Field Test	Krcc1	scl29903.3.37-S	0.00621
Time Spent in Centre of Open Field Test	Pde4d	scl0238871.11.15-S	0.04699
Time Spent in Centre of Open Field Test	Tatdn2	GI.38084987-S	0.04294
Time Spent in Centre of Open Field Test	Kank4	scl0242553.1.69-S	0.03179
Time Spent in Centre of Open Field Test	Ahi1	scl39099.27.528-S	0.03129
Time Spent in Centre of Open Field Test	Sorbs2	scl000668.1.6-S	0.02816
Time Spent in Centre of Open Field Test	Slc38a7	scl34448.12.474-S	0.00994
Time Spent in Centre of Open Field Test	Rbm39	scl0170791.2.95-S	0.00493
Time Spent in Centre of Open Field Test	Tubgcp2	scl30523.17.39.21-S	0.00339
Time Spent in Centre of Open Field Test	Ankrd11	GI.38089455-S	0.00127
Total Activity in Open Field Test	Rab5b	scl37351.6.4-S	0.06017
Total Activity in Open Field Test	Trmt2a	scl0001815.1.4-S	0.05098
Total Activity in Open Field Test	Olfr571	scl8889.1.1.230-S	0.04856
Total Activity in Open Field Test	Elmo1	scl0003672.1.54-S	0.04069
Total Activity in Open Field Test	Ppfibp1	scl29349.27.37-S	0.03282
Total Activity in Open Field Test	Olfr315	scl41515.1.1.98-S	0.02965
Total Activity in Open Field Test	Ap3b1	scl44512.30.1.14-S	0.02351
Total Activity in Open Field Test	Supt4h1	scl41079.4.35-S	0.02057
Total Activity in Open Field Test	Bend6	scl16889.8.555-S	0.00621
Total Activity in Open Field Test	Kank4	scl0242553.1.69-S	0.00531
Total Activity in Open Field Test	Cryz	scl0002125.1.16-S	0.0045
Total Activity in Open Field Test	Wnk2	scl43996.22.1.91-S	0.00209
Total Activity in Open Field Test	9030025P20Rik	scl078483.8.30-S	0.00108
Total Ambulation in New Home Cage	AK018519	scl47627.1.1.171-S	0.0456
Total Ambulation in New Home Cage	Wdr67	scl0002526.1.32-S	0.03095
Total Ambulation in New Home Cage	Il17rb	scl45778.11.1.135-S	0.02759
Total Ambulation in New Home Cage	Ttc21a	scl36345.29.1.111-S	0.02204
Total Ambulation in New Home Cage	Mfsd2	scl23864.14.1.204-S	0.01737
Total Ambulation in New Home Cage	Elmo1	scl0003672.1.54-S	0.01347
Total Ambulation in New Home Cage	Myst4	scl0054169.1.231-S	0.01317
Total Ambulation in New Home Cage	Emd	scl54837.5.1.4-S	0.00475
Total Ambulation in New Home Cage	Cpt2	scl24019.5.109-S	0.00382
Total Ambulation in New Home Cage	AK017390	scl47301.1.1.254-S	0.0023
Total Ambulation in New Home Cage	Fam107a	scl45912.6.183-S	0.002

APPENDIX H

PLOTS OF SUPPORT FOR CAUSALITY

As referenced in §5.3, these are the full results of SPIV's causal modelling across the top 109 hippocampus gene expression probes. On the y axis, the maximum likelihood for causal models has the maximum likelihood for all other models subtracted from it (max(ML_{causal})-max(ML_{other})), such that a more positive value indicates more support for a causal model where the gene expression probe appears to cause variation in the phenotype. For each phenotype-probe pair, this maximum likelihood statistic is shown across six weights of the confounder variable prior.


Adrenal.AdrenalMeanWeight: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
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0.05, 0.01
0.01, 0.01
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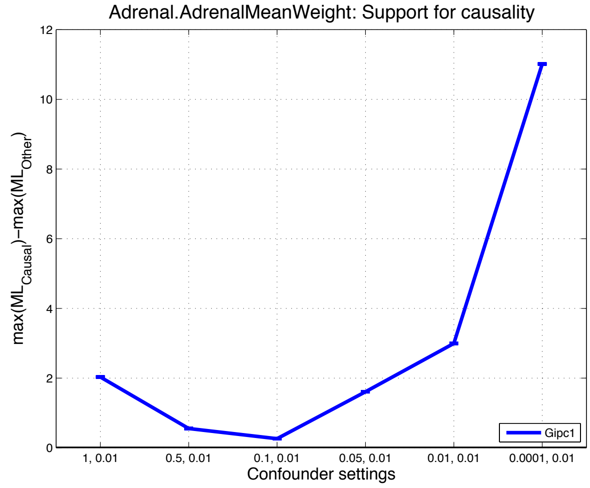
Adrenal.AdrenalMeanWeight: Support for causality
max(ML_Causal)−max(ML_Other)
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0.01, 0.01
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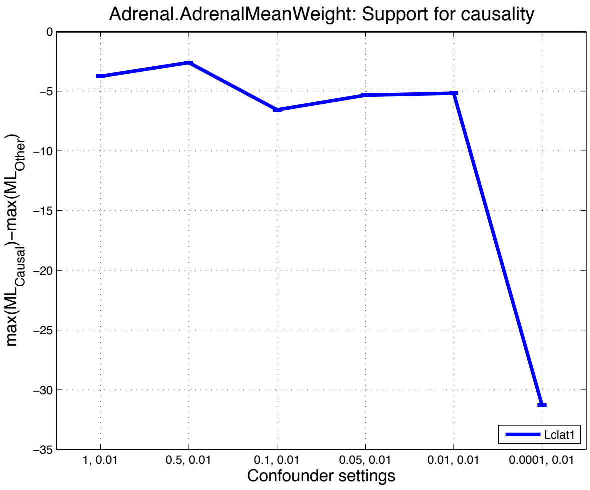
Gipc1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max(ML_Causal)−max(ML_Other)
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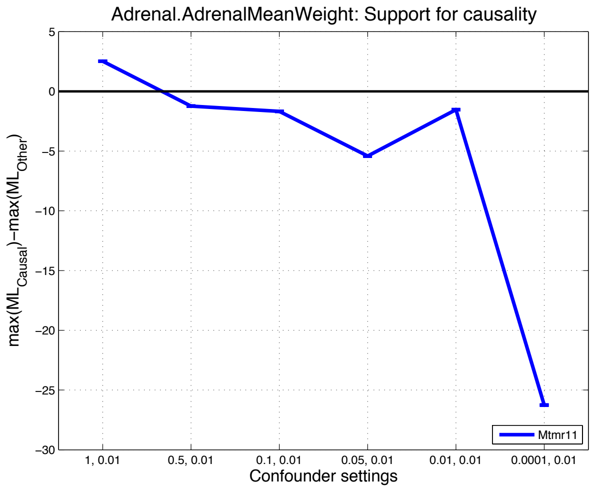
0.01, 0.01
0.0001, 0.01
Lclat1


Adrenal.AdrenalMeanWeight: Support for causality
max(ML_Causal)−max(ML_Other)
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0.01, 0.01
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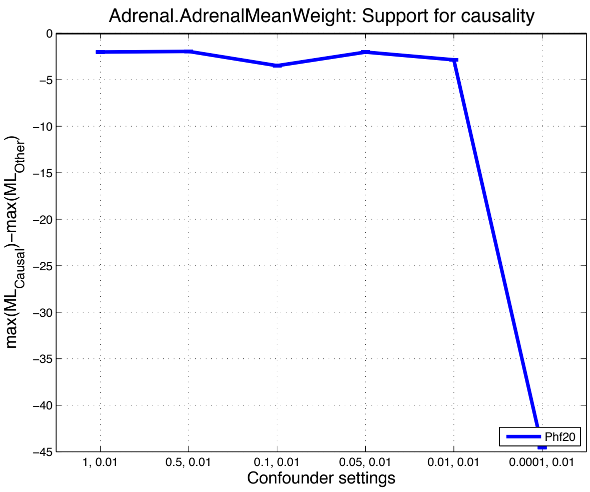
Mtmr11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max(ML_Causal)−max(ML_Other)
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0.01, 0.01
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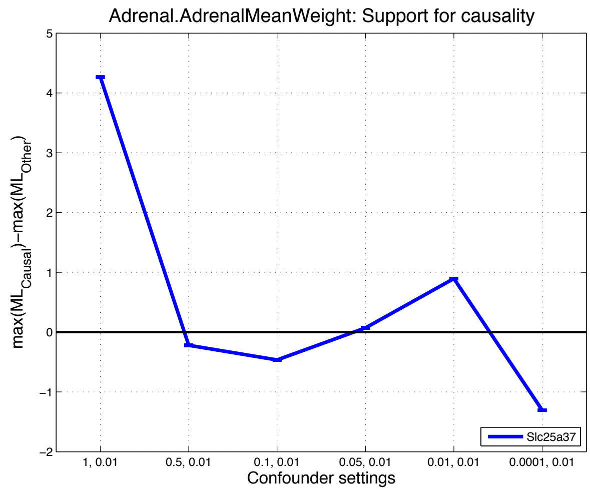
Phf20


Adrenal.AdrenalMeanWeight: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
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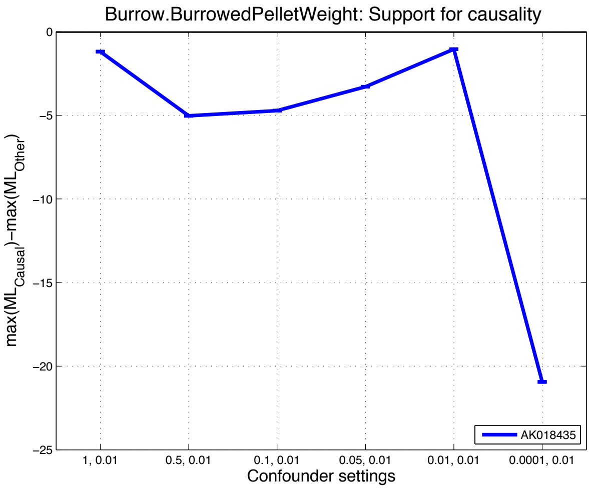
Burrow.BurrowedPelletWeight: Support for causality
0
−5
−10
−15
−20
−25
max(ML_Causal)−max(ML_Other)
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0.1, 0.01
0.05, 0.01
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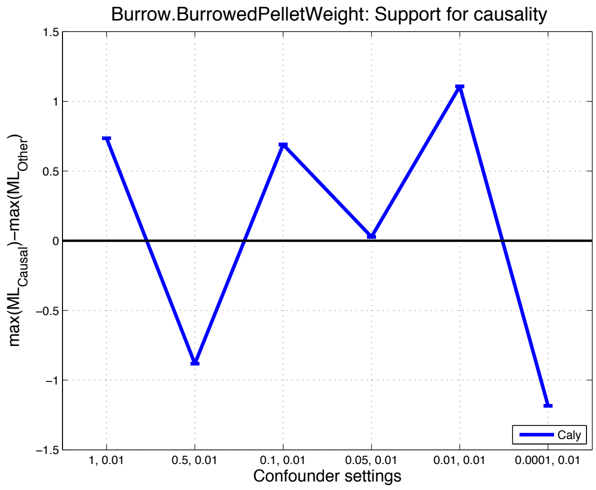
Confounder settings
AK018435


Burrow.BurrowedPelletWeight: Support for causality
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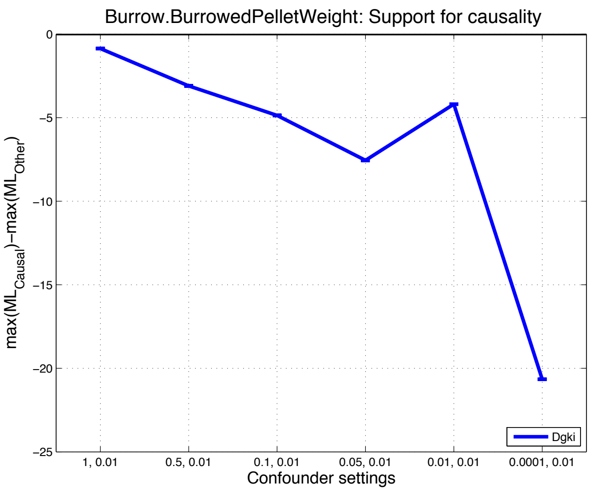
1
0.5
0
−0.5
−1
−1.5
max(ML_Causal)−max(ML_Other)
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Caly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−5
−10
−15
−20
−25
max(ML_Causal)−max(ML_Other)
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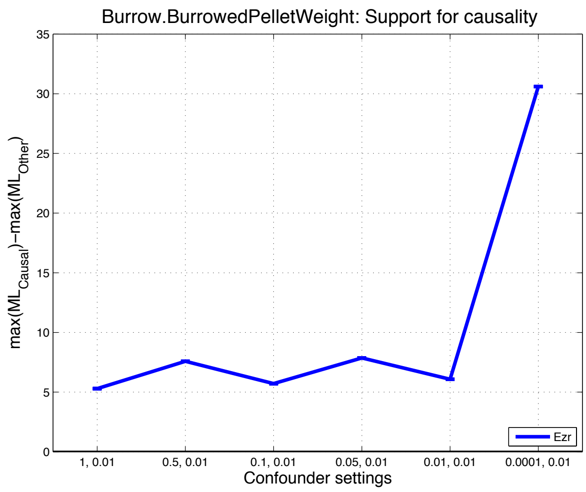
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Dgki


Burrow.BurrowedPelletWeight: Support for causality
35
30
25
20
15
10
5
0
max(ML_Causal)−max(ML_Other)
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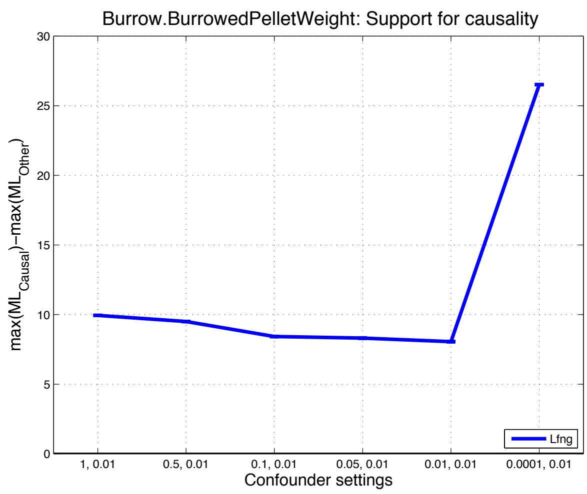
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Ezr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25
20
15
10
5
0
max(ML_Causal)−max(ML_Other)
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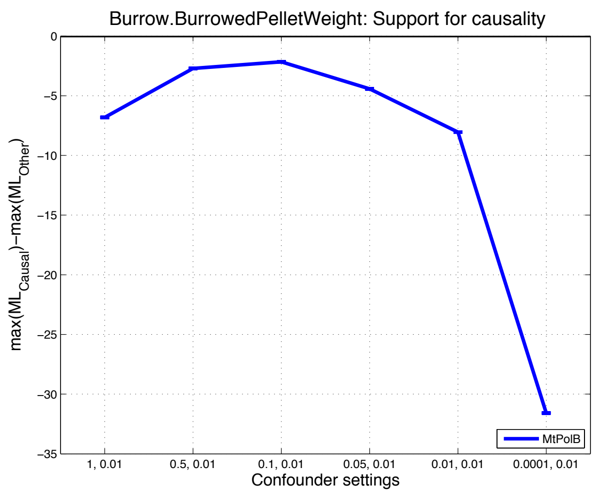
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Lfng


Burrow.BurrowedPelletWeight: Support for causality
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−5
−10
−15
−20
−25
−30
−35
max(ML_Causal)−max(ML_Other)
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0.1, 0.01
0.05, 0.01
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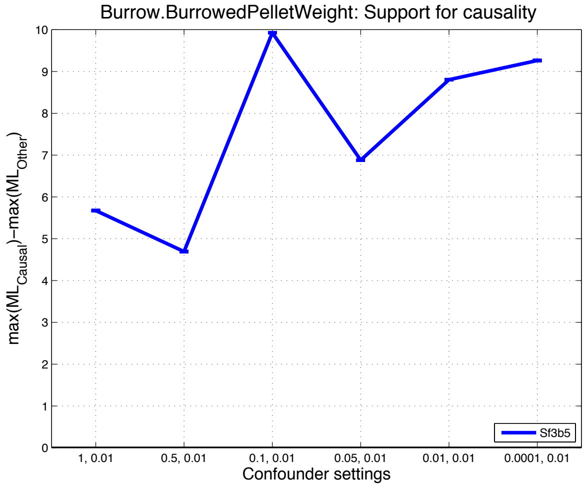
0.0001, 0.01
Confounder settings
MtPolB


Burrow.BurrowedPelletWeight: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
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0.1, 0.01
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0.01, 0.01
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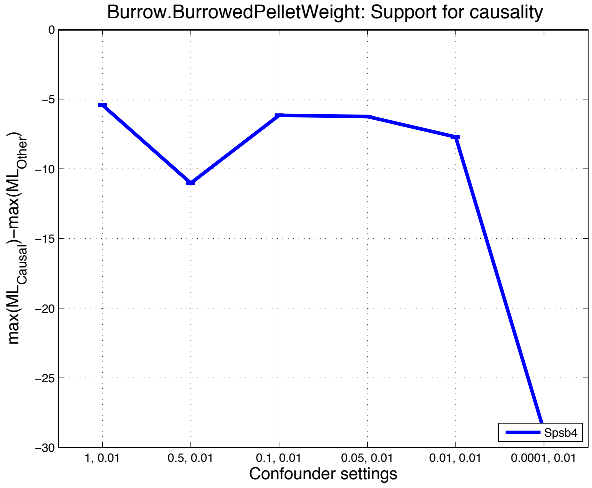
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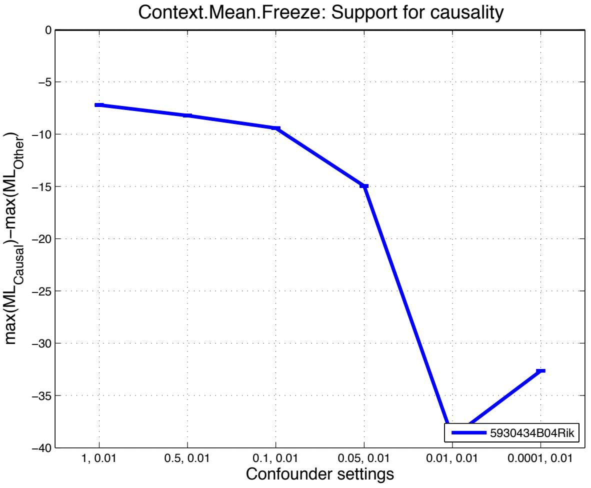
Context.Mean.Freeze: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
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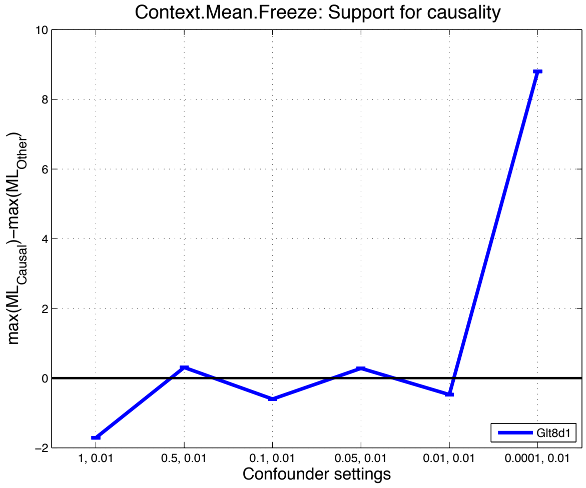
Context.Mean.Freeze: Support for causality
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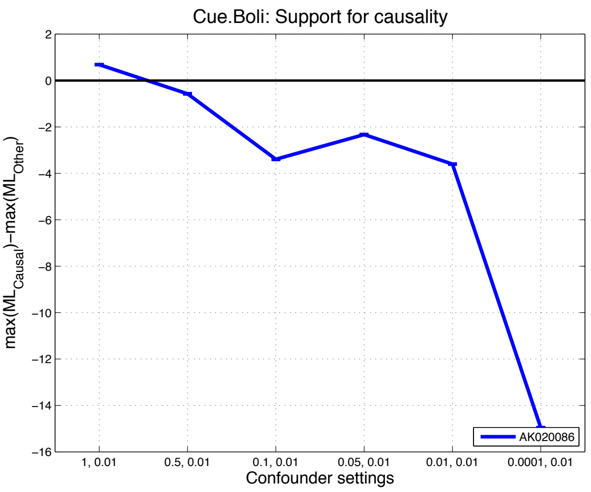
Glt8d1


Cue.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
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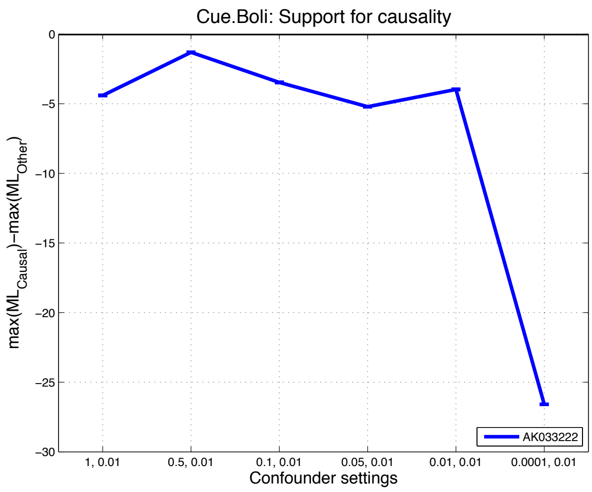
Cue.Boli: Support for causality
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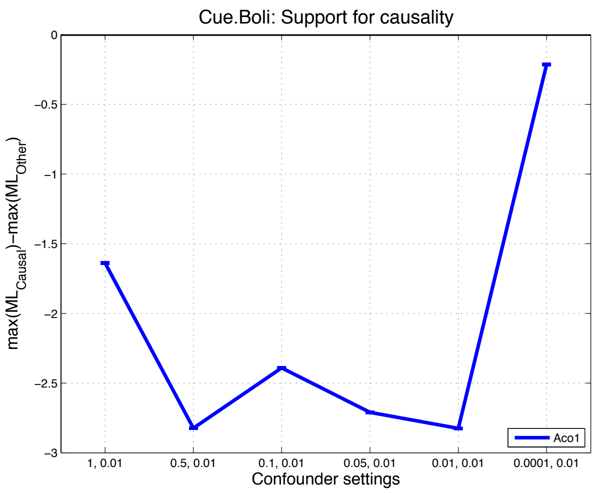
Cue.Boli: Support for causality
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Confounder settings
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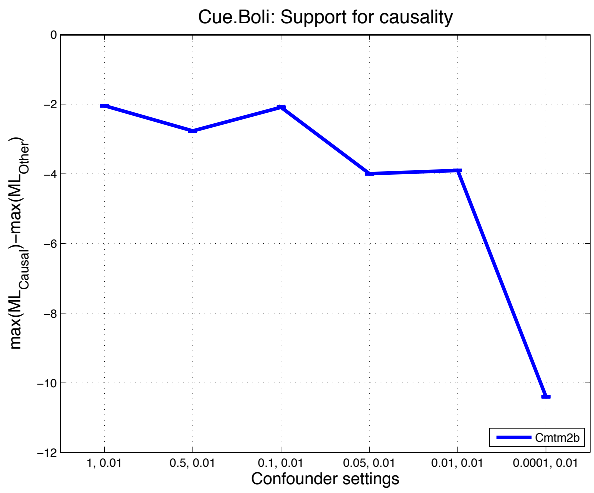
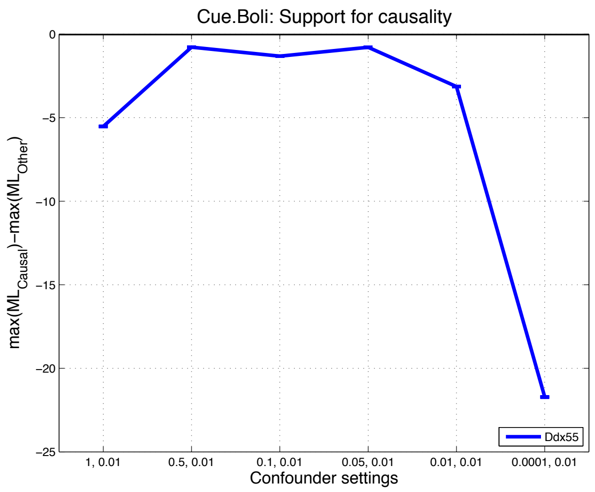
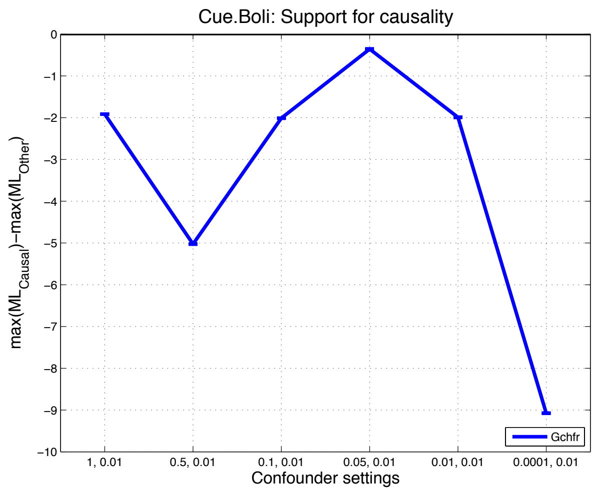
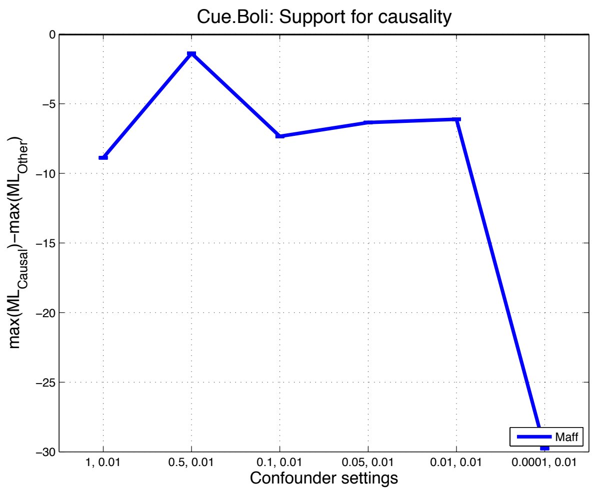
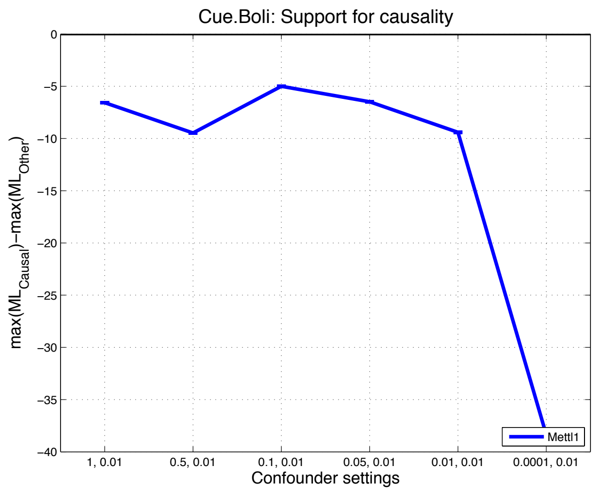
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Aco1


Cue.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Cmtm2b


Cue.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Ddx55


Cue.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Gchfr


Cue.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Maff


Cue.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
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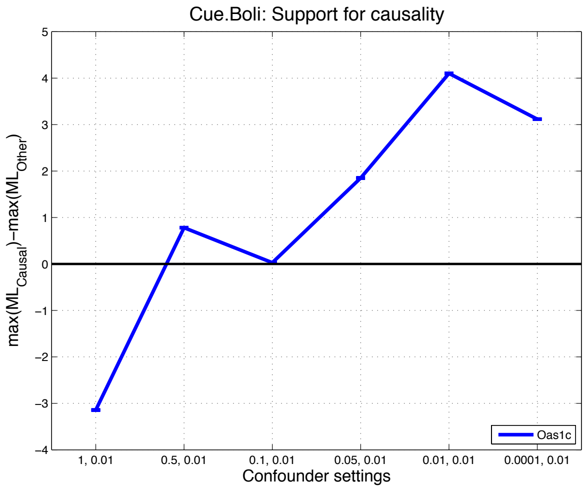
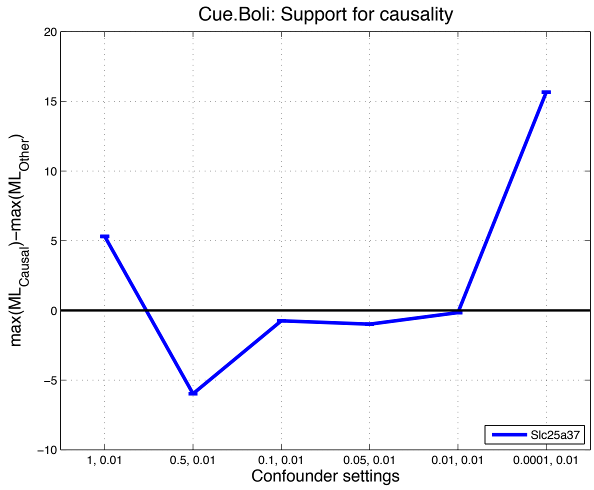
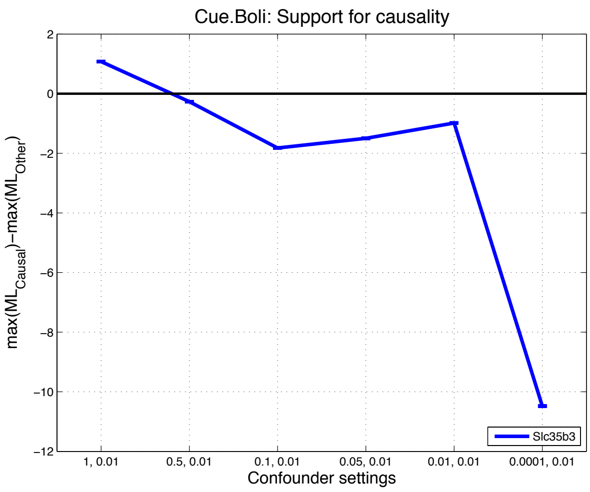
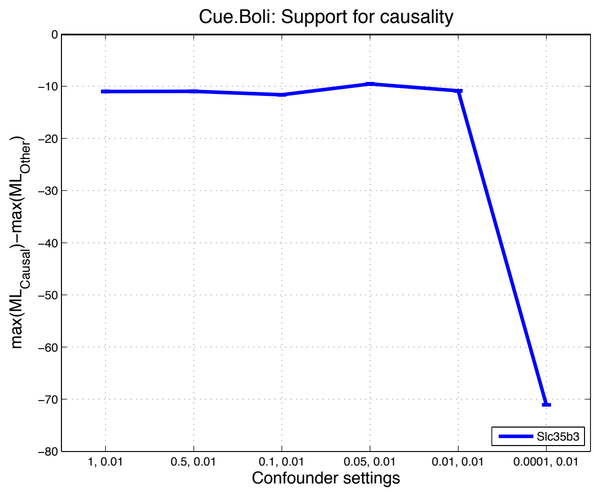
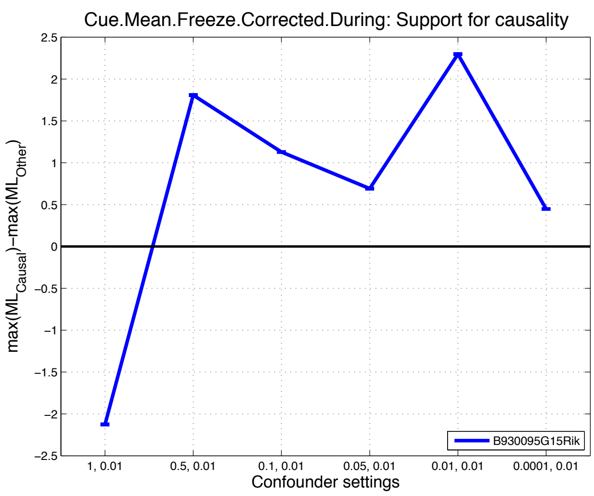
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Mettl1

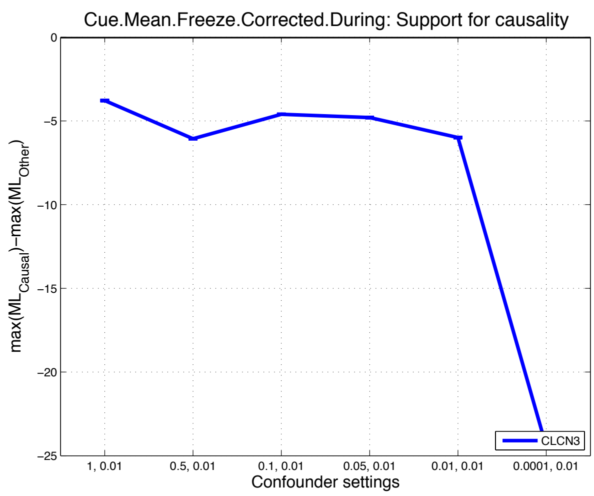

Cue.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
5
4
3
2
1
0
−1
−2
−3
−4
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Oas1c

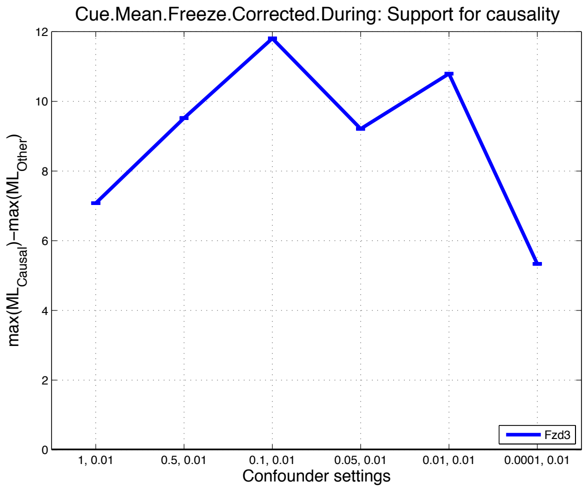

Cue.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
20
15
10
5
0
−5
−10
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Slc25a37

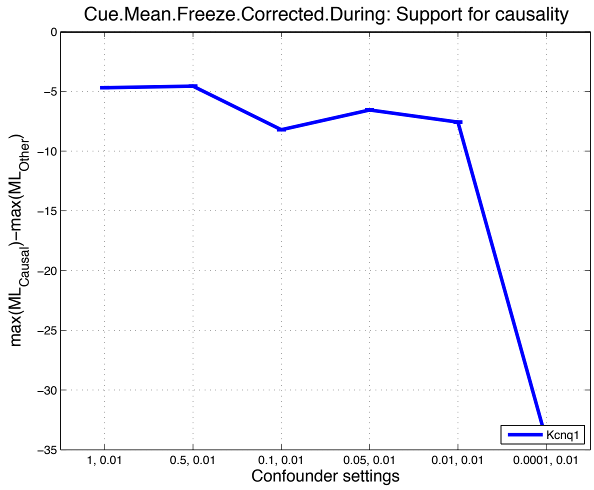

Cue.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
2
0
−2
−4
−6
−8
−10
−12
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Slc35b3

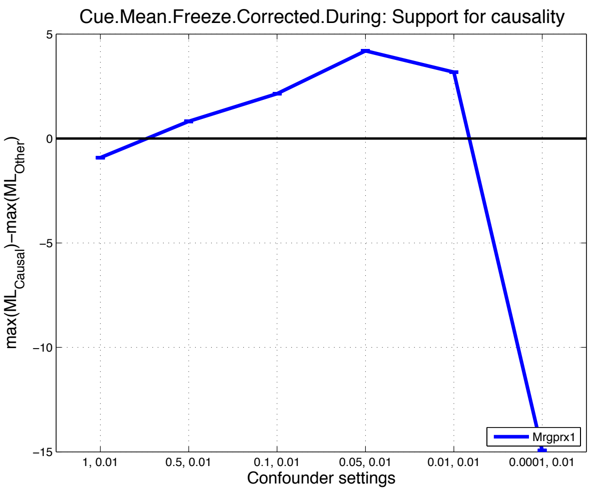

Cue.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
0
−10
−20
−30
−40
−50
−60
−70
−80
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Slc35b3


Cue.Mean.Freeze.Corrected.During: Support for causality
max(ML_Causal)−max(ML_Other)
2.5
2
1.5
1
0.5
0
−0.5
−1
−1.5
−2
−2.5
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
B930095G15Rik


Cue.Mean.Freeze.Corrected.During: Support for causality
max(ML_Causal)−max(ML_Other)
0
−5
−10
−15
−20
−25
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
CLCN3


Cue.Mean.Freeze.Corrected.During: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Fzd3


Cue.Mean.Freeze.Corrected.During: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Kcnq1


Cue.Mean.Freeze.Corrected.During: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
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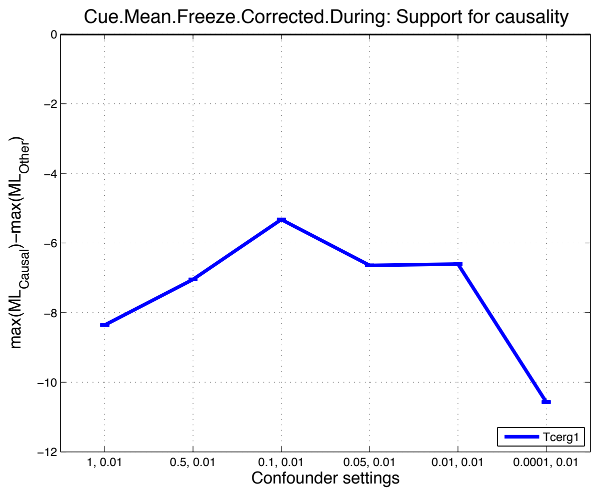
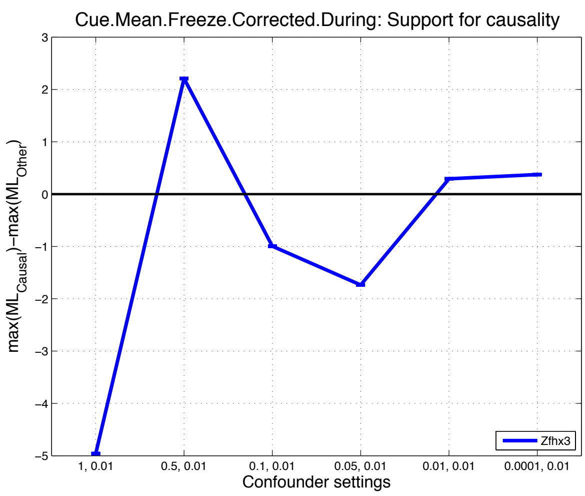
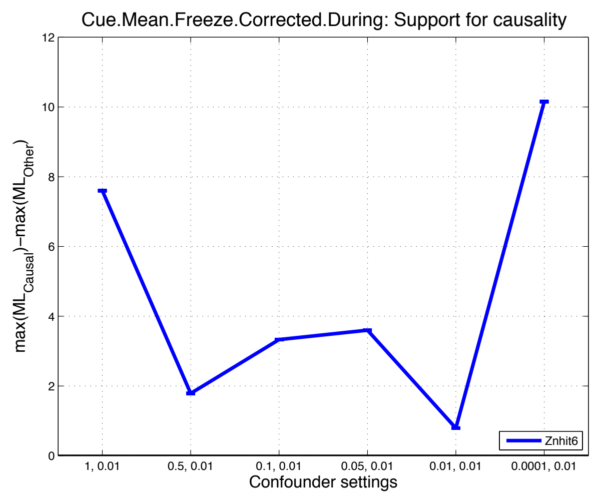
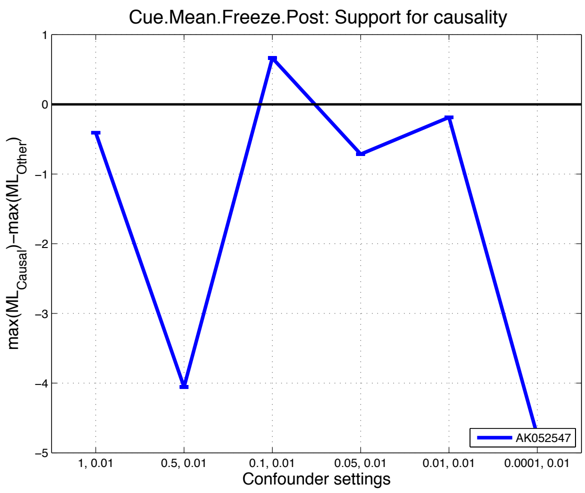
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Mrgprx1


Cue.Mean.Freeze.Corrected.During: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Tcerg1


Cue.Mean.Freeze.Corrected.During: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Zfhx3


Cue.Mean.Freeze.Corrected.During: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Znhit6



Cue.Mean.Freeze.Post: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
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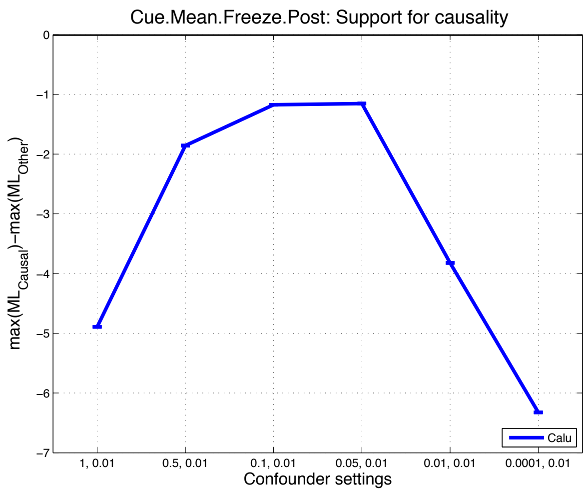
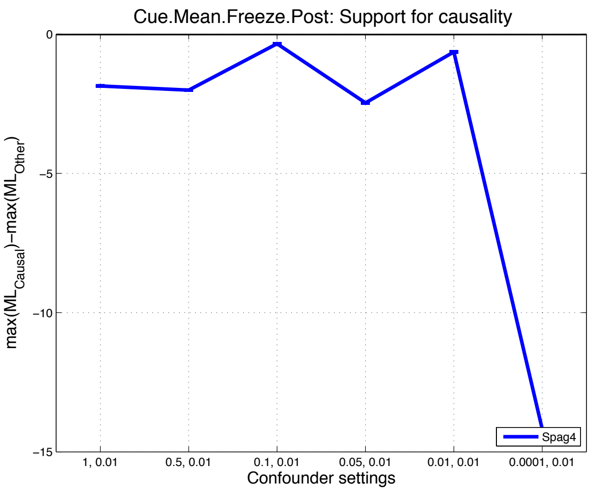
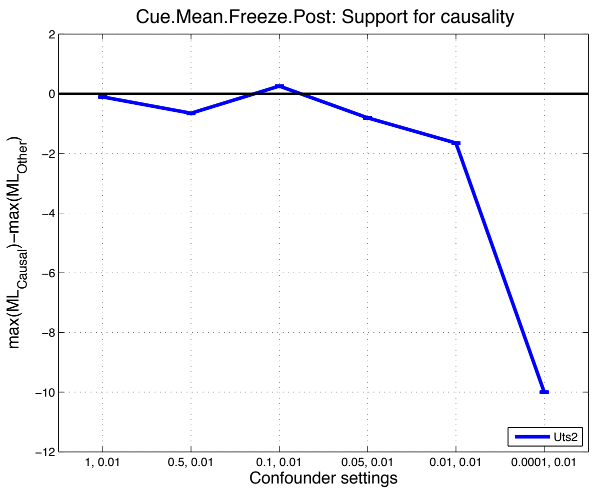
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
AK052547



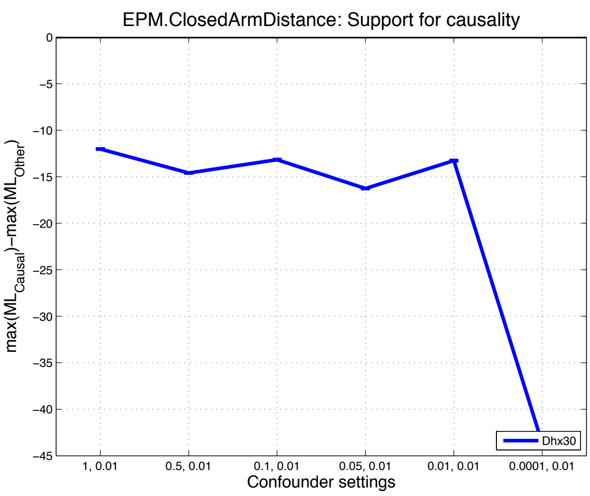
Cue.Mean.Freeze.Post: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Calu



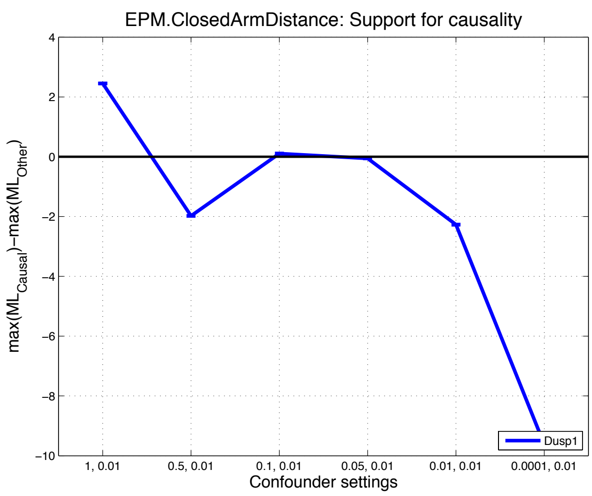
Cue.Mean.Freeze.Post: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Spag4



Cue.Mean.Freeze.Post: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Uts2



EPM.ClosedArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Dhx30



EPM.ClosedArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
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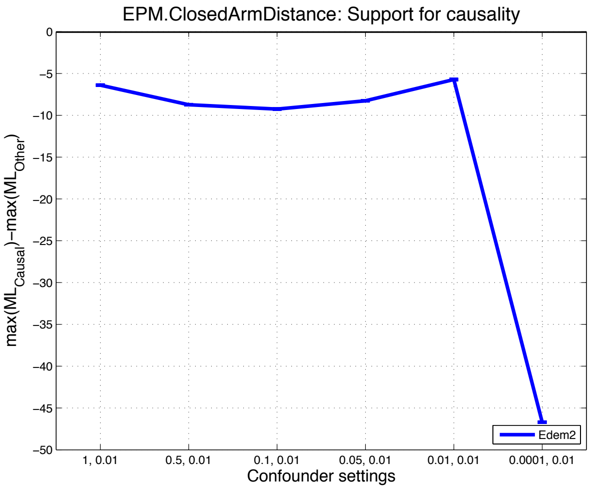
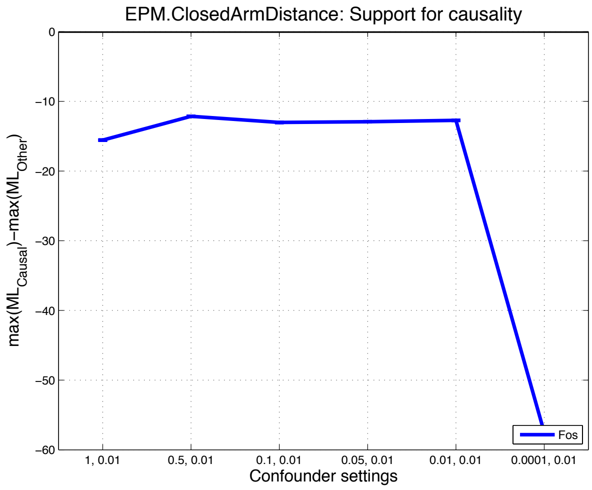
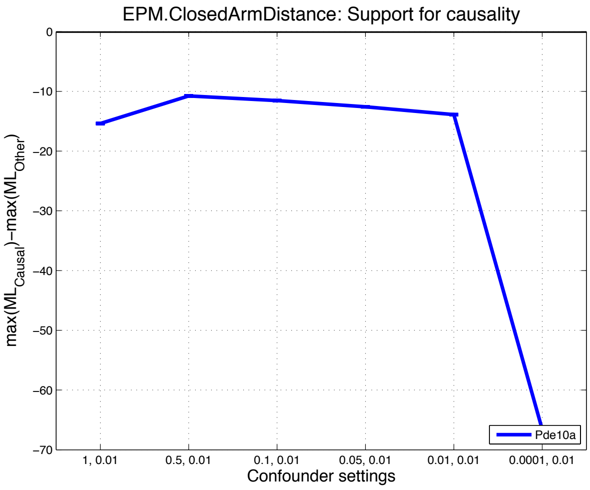
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Dusp1


EPM.ClosedArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Edem2


EPM.ClosedArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Fos


EPM.ClosedArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
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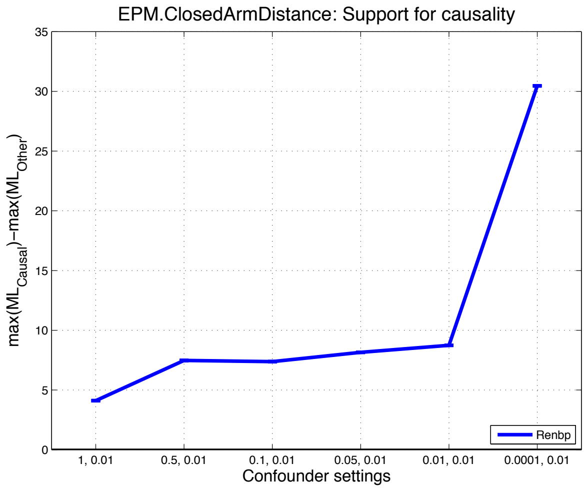
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Pde10a


EPM.ClosedArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
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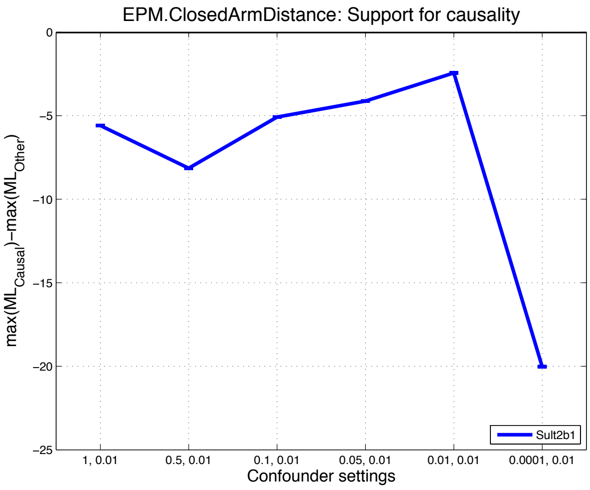
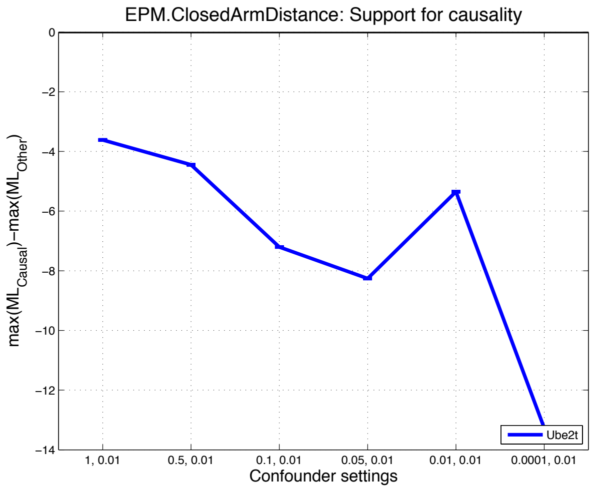
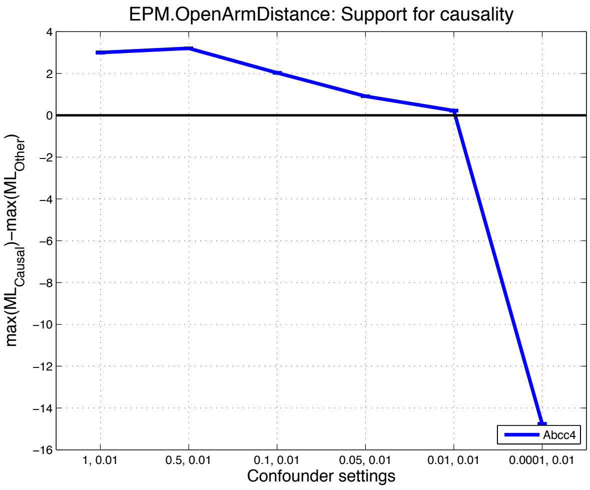
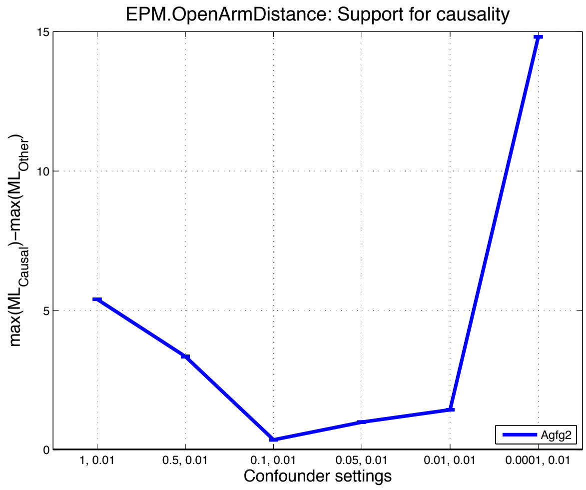
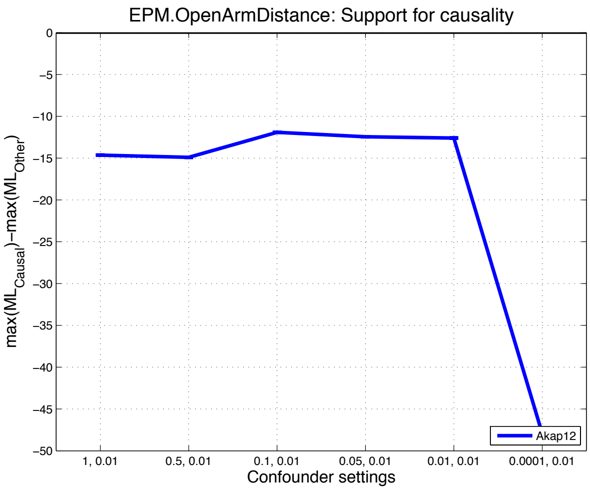
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Renbp

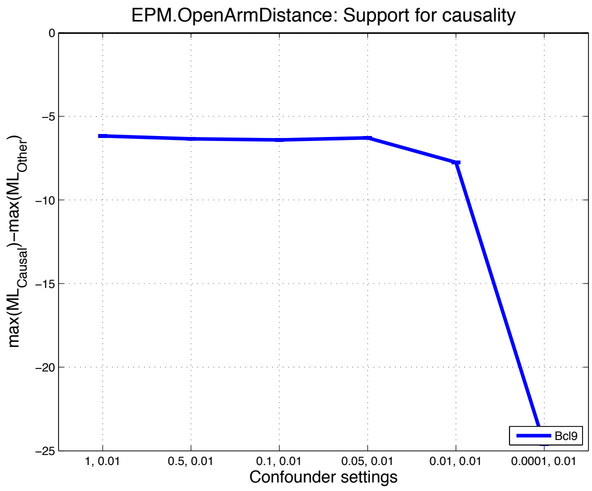

EPM.ClosedArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Sult2b1

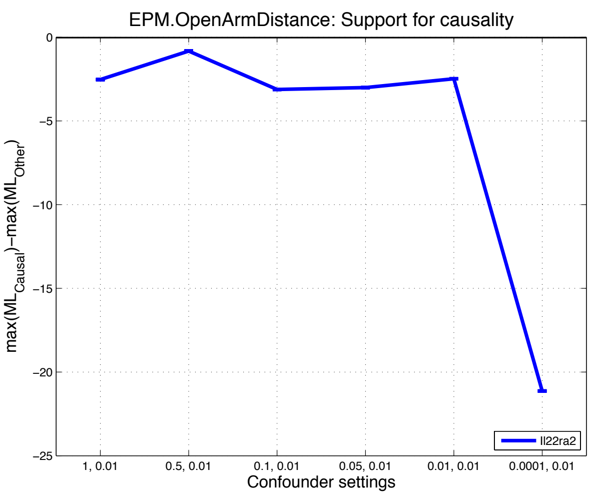

EPM.ClosedArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Ube2t

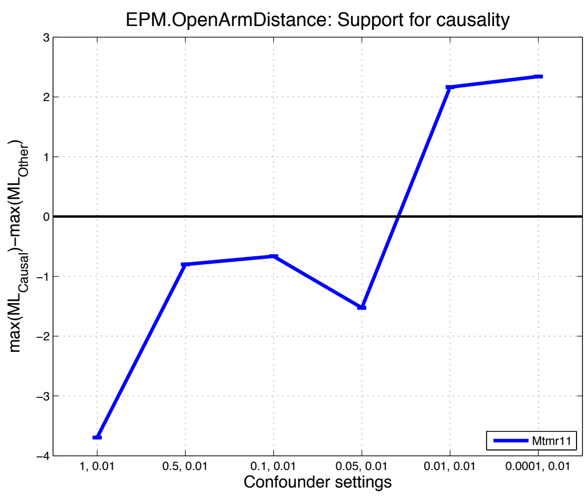

EPM.OpenArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
4
2
0
−2
−4
−6
−8
−10
−12
−14
−16
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Abcc4

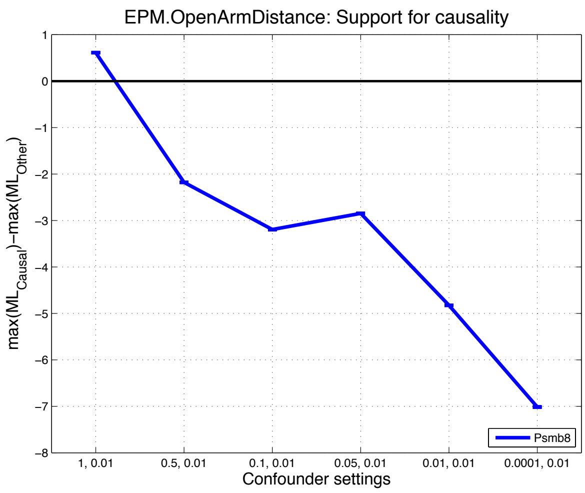

EPM.OpenArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
15
10
5
0
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Agfg2

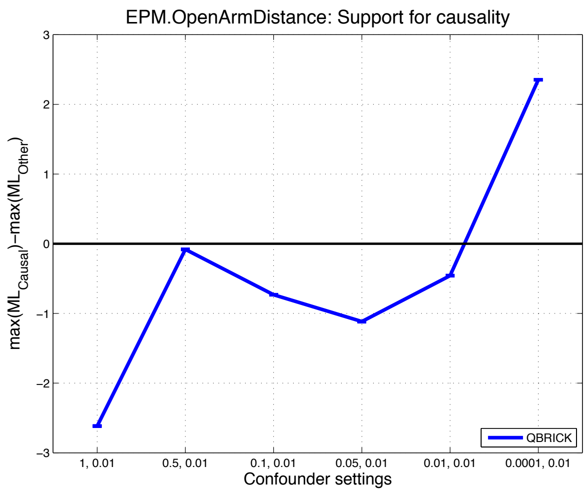

EPM.OpenArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
0
−5
−10
−15
−20
−25
−30
−35
−40
−45
−50
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Akap12

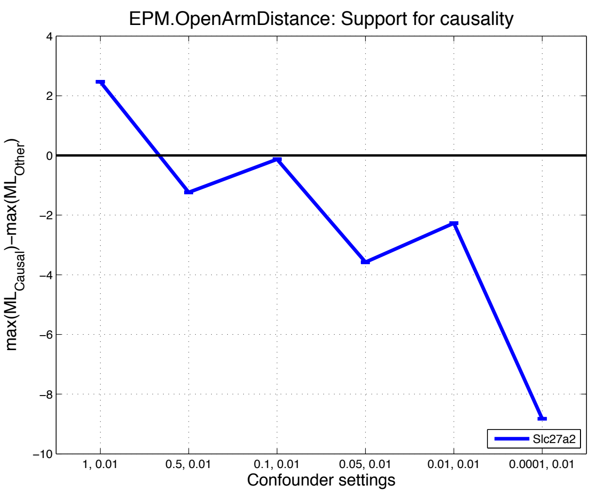

EPM.OpenArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
0
−5
−10
−15
−20
−25
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Bcl9

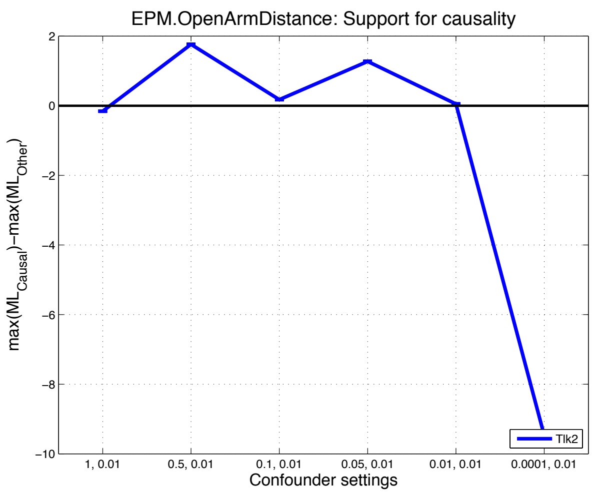

EPM.OpenArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
0
−5
−10
−15
−20
−25
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Il22ra2

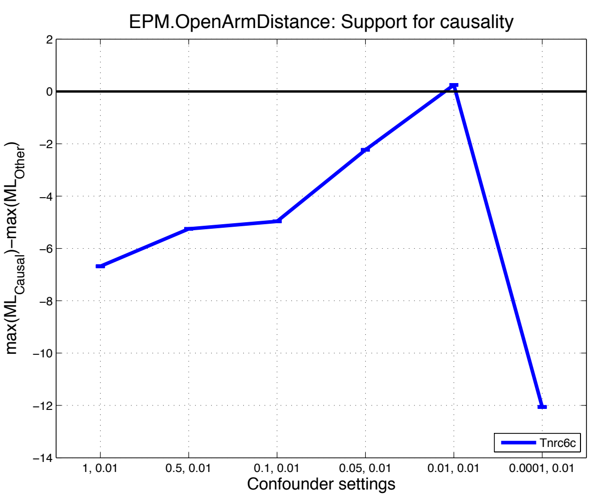

EPM.OpenArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
3
2
1
0
−1
−2
−3
−4
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Mtmr11

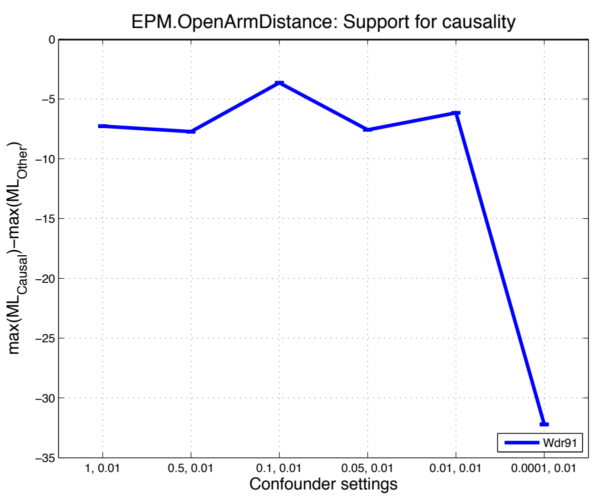

EPM.OpenArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Psmb8

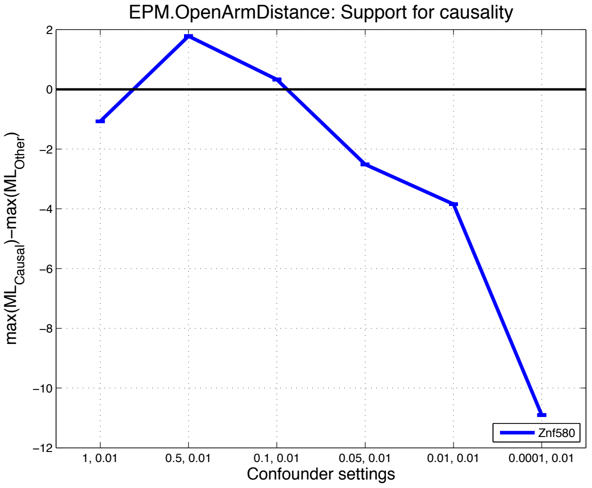

EPM.OpenArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
QBRICK

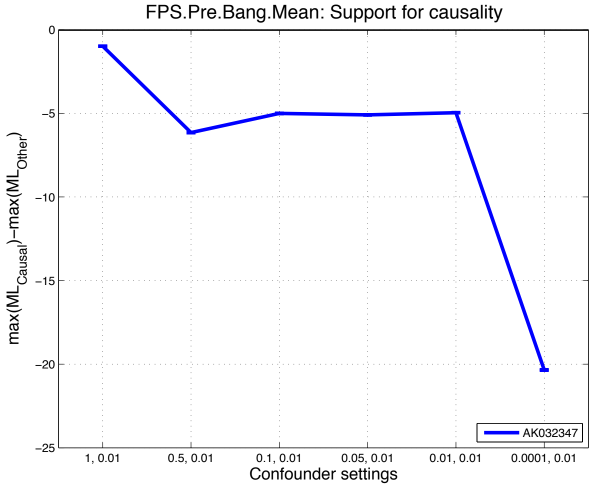

EPM.OpenArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Slc27a2

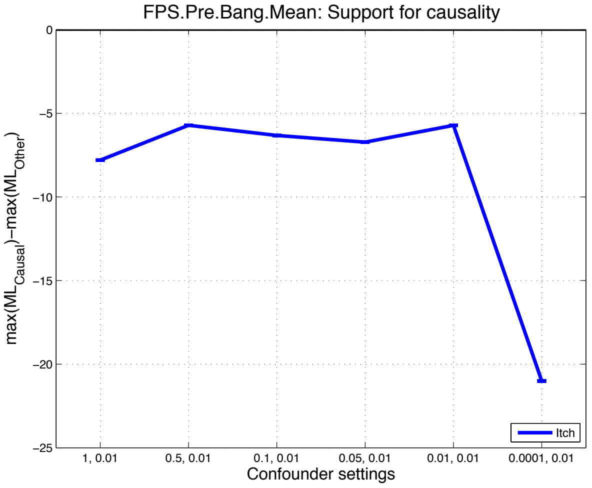

EPM.OpenArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Tlk2

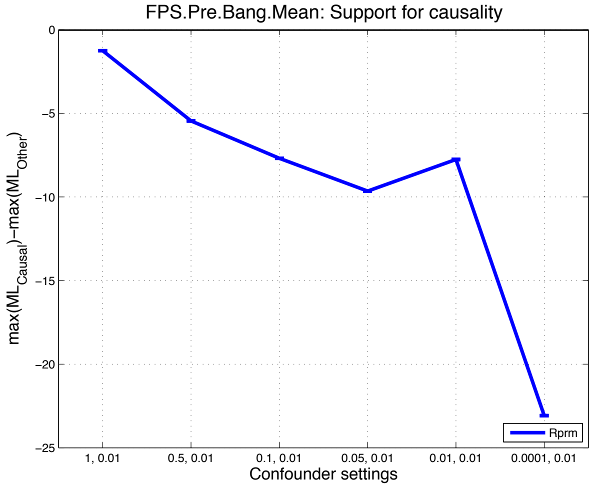

EPM.OpenArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Tnrc6c

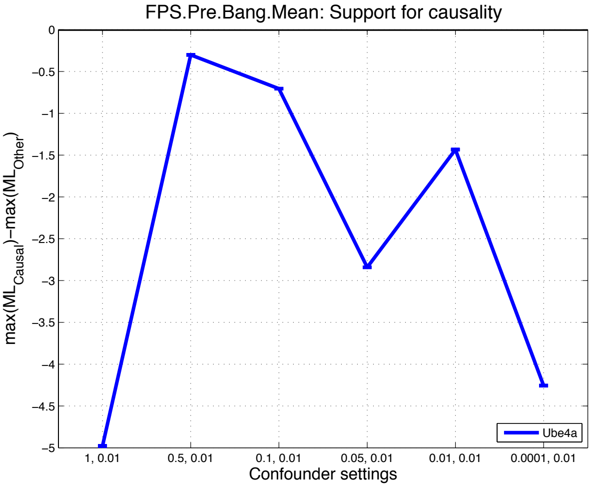

EPM.OpenArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Wdr91

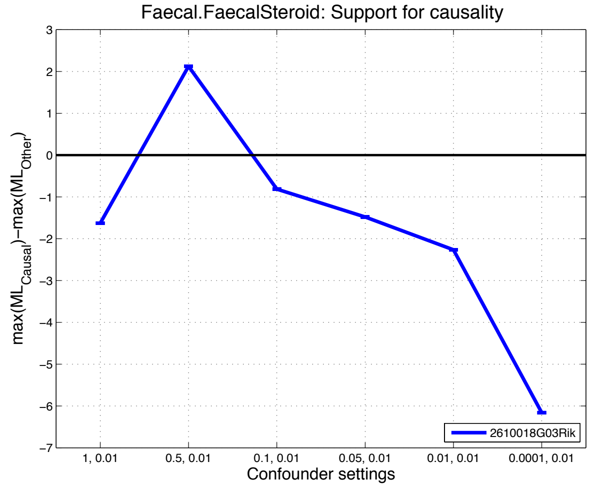

EPM.OpenArmDistance: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Znf580

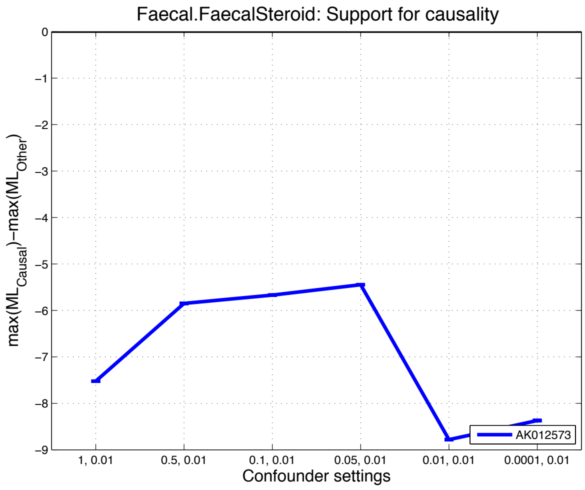

FPS.Pre.Bang.Mean: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
AK032347

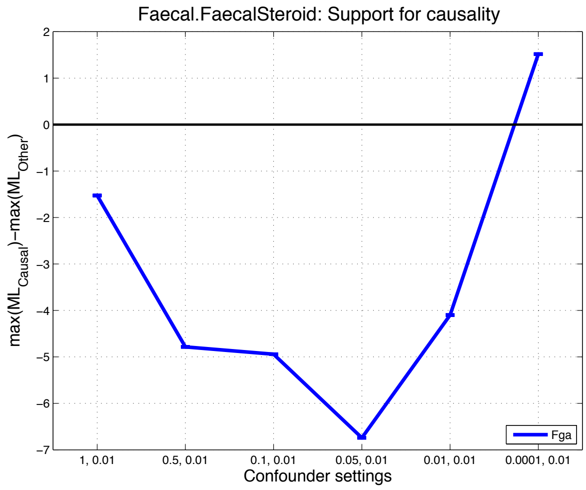

FPS.Pre.Bang.Mean: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Itch

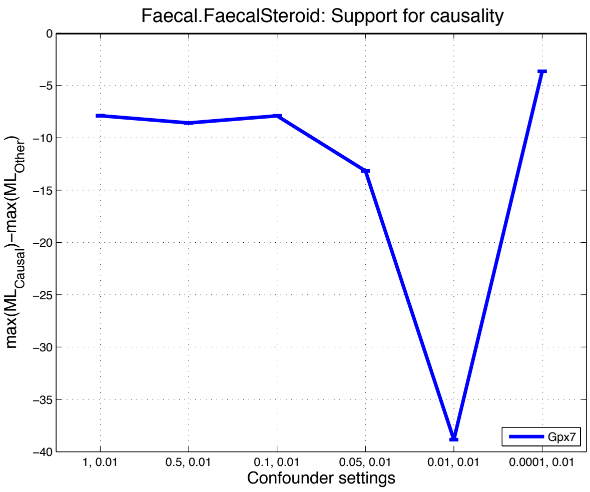

FPS.Pre.Bang.Mean: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Rprm

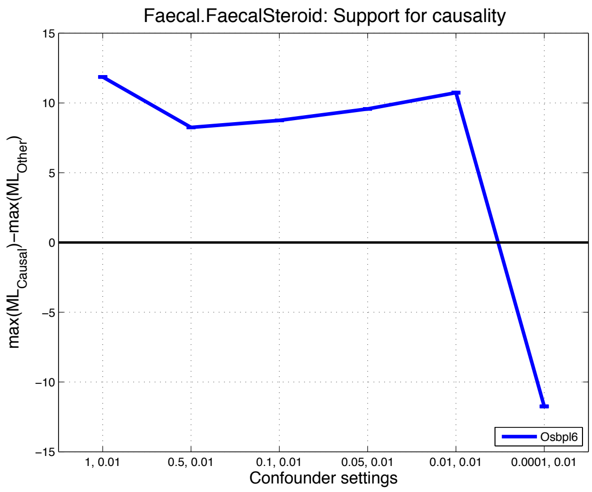

FPS.Pre.Bang.Mean: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Ube4a

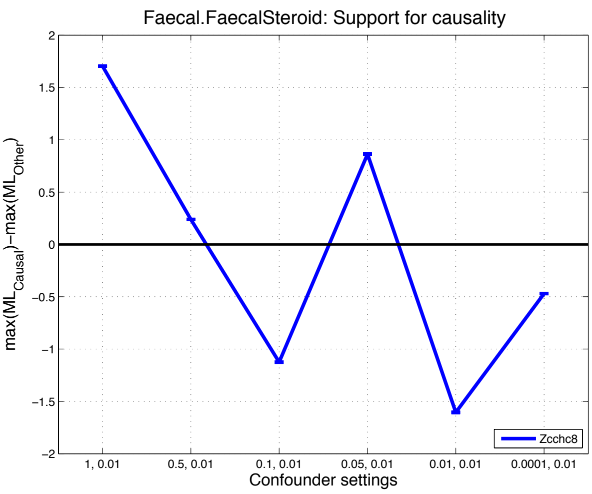

Faecal.FaecalSteroid: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
2610018G03Rik

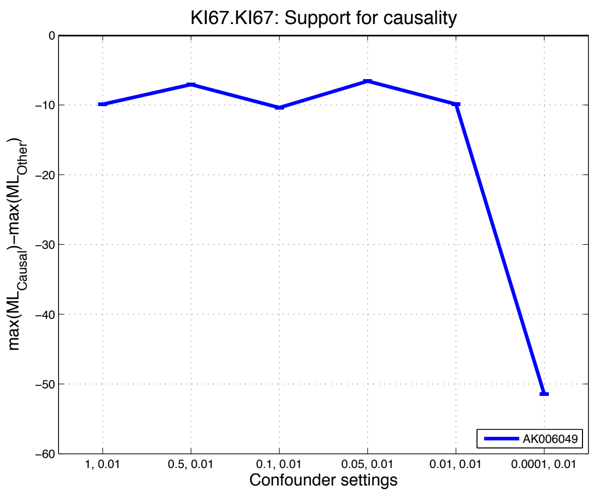

Faecal.FaecalSteroid: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
AK012573

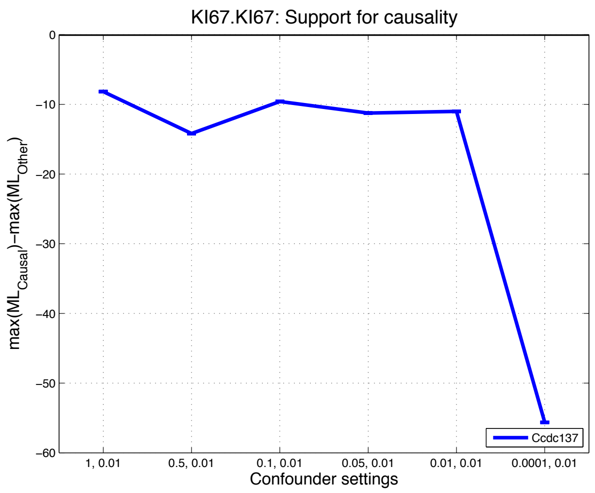

Faecal.FaecalSteroid: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Fga

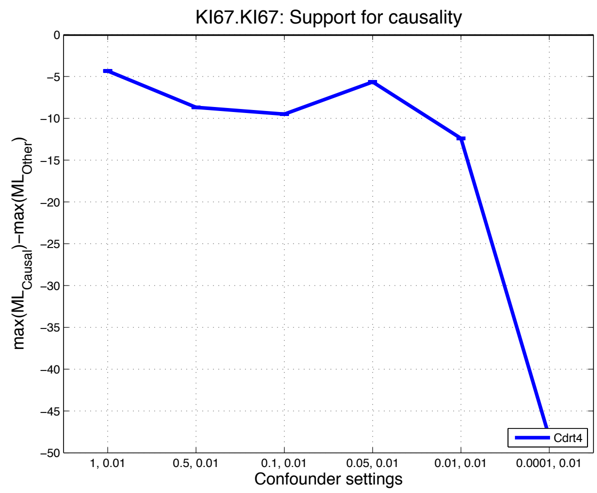

Faecal.FaecalSteroid: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Gpx7

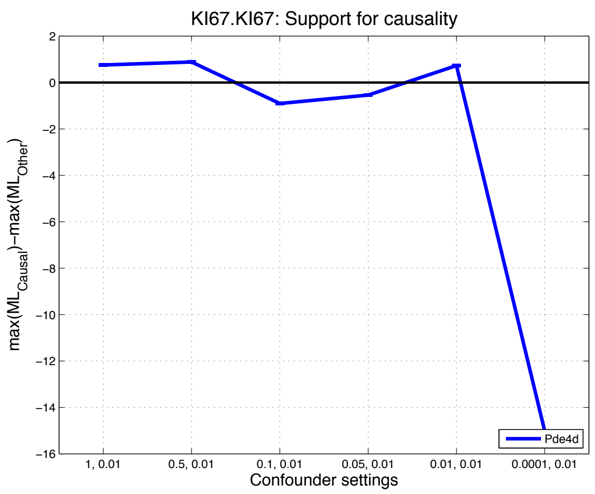

Faecal.FaecalSteroid: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Osbpl6

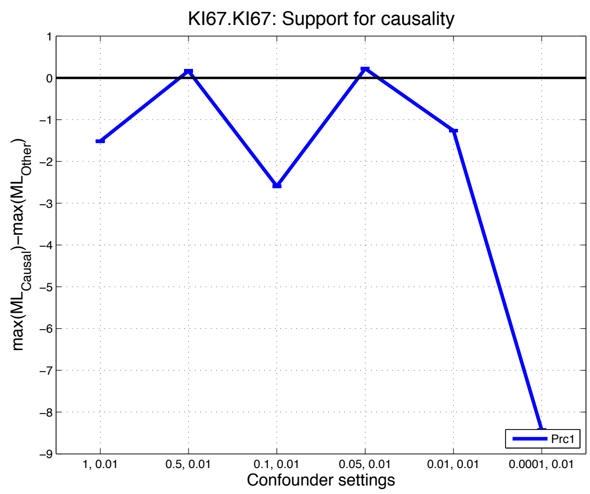

Faecal.FaecalSteroid: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Zcchc8

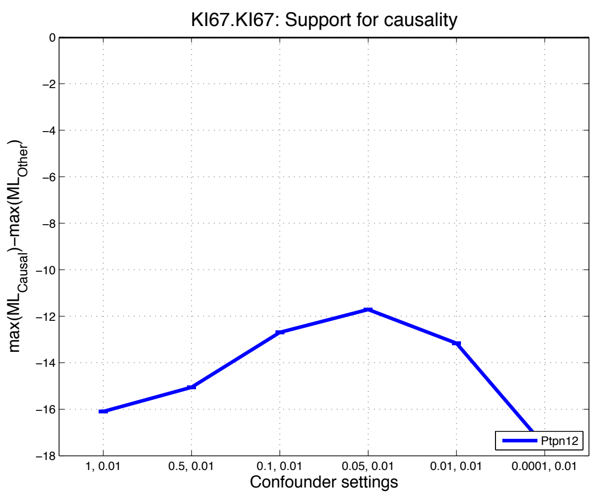

KI67.KI67: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
AK006049

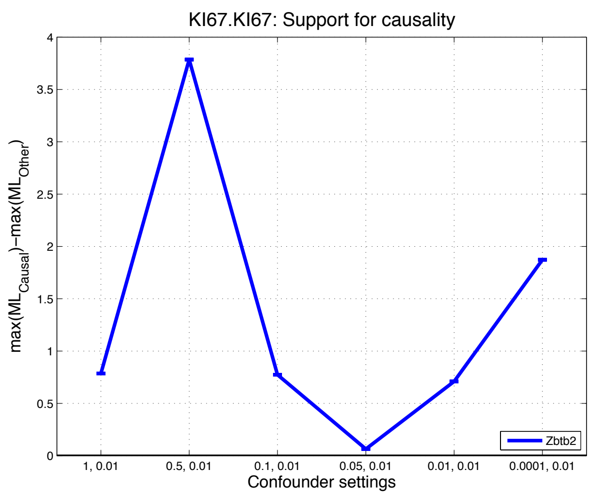

KI67.KI67: Support for causality
max(ML_Causal)−max(ML_Other)
0
−10
−20
−30
−40
−50
−60
Ccdc137
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings

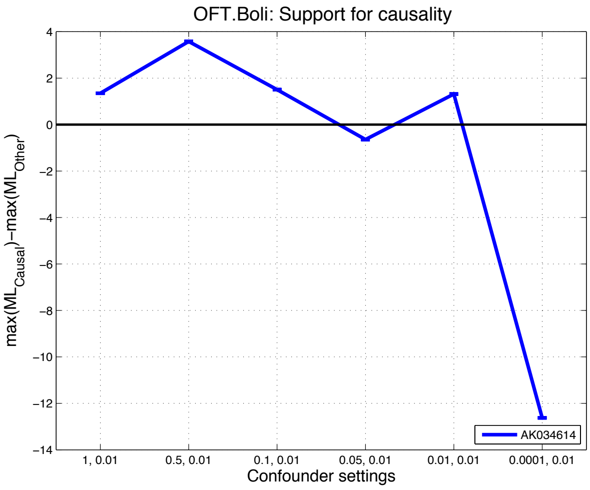

KI67.KI67: Support for causality
max(ML_Causal)−max(ML_Other)
0
−5
−10
−15
−20
−25
−30
−35
−40
−45
−50
Cdrt4
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings

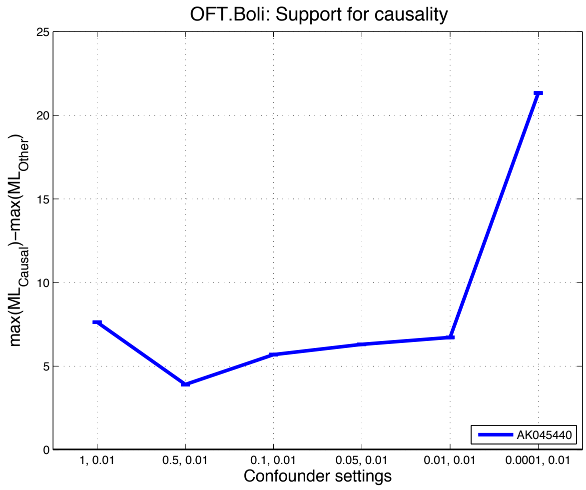

KI67.KI67: Support for causality
max(ML_Causal)−max(ML_Other)
2
0
−2
−4
−6
−8
−10
−12
−14
−16
Pde4d
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings

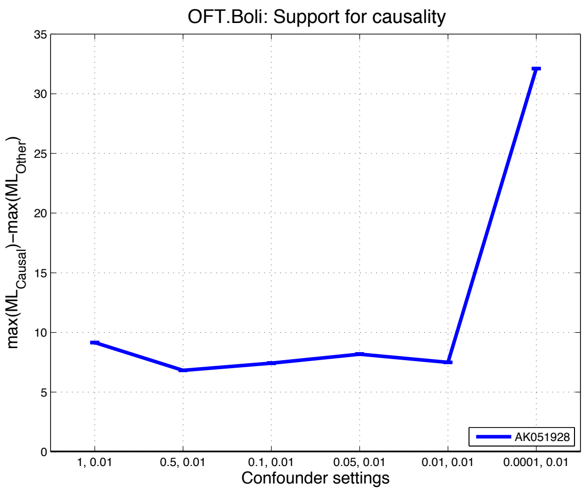

KI67.KI67: Support for causality
max(ML_Causal)−max(ML_Other)
1
0
−1
−2
−3
−4
−5
−6
−7
−8
−9
Prc1
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings

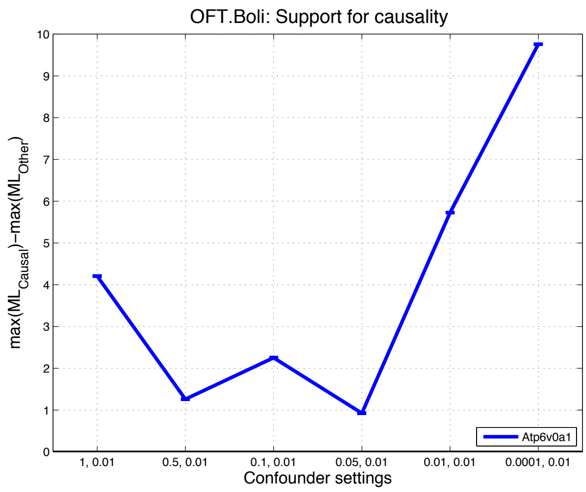

KI67.KI67: Support for causality
max(ML_Causal)−max(ML_Other)
0
−2
−4
−6
−8
−10
−12
−14
−16
−18
Ptpn12
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings

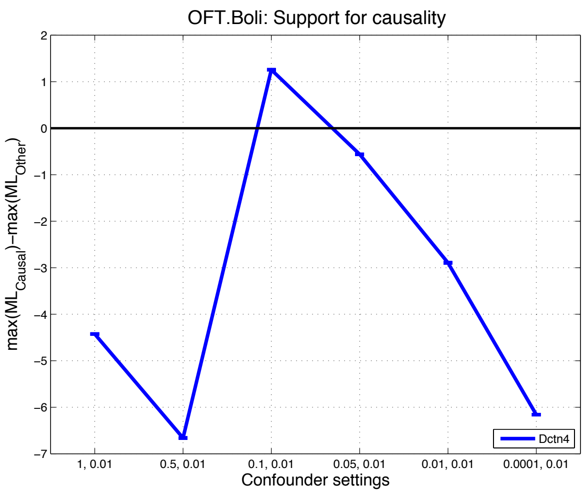

KI67.KI67: Support for causality
max(ML_Causal)−max(ML_Other)
4
3.5
3
2.5
2
1.5
1
0.5
0
Zbtb2
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings

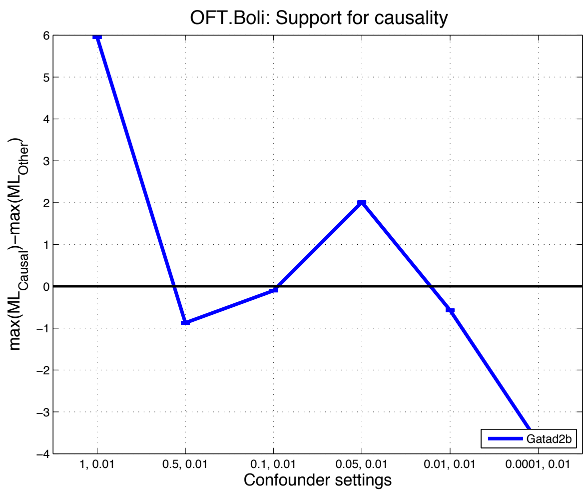

OFT.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
4
2
0
−2
−4
−6
−8
−10
−12
−14
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
AK034614

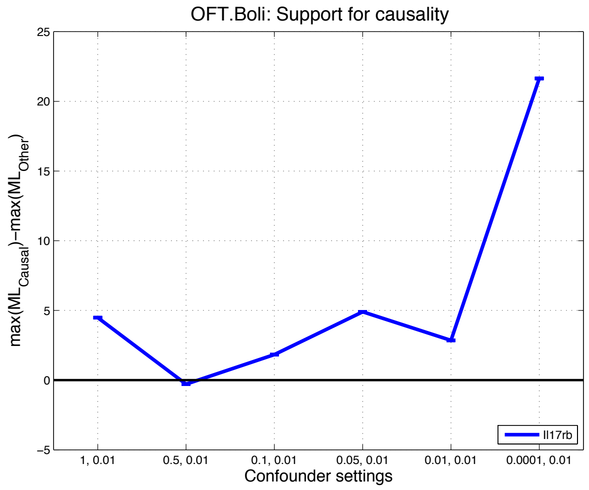

OFT.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
25
20
15
10
5
0
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
AK045440

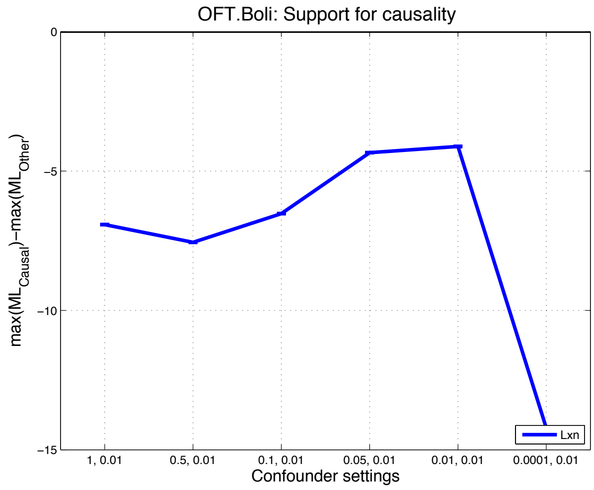

OFT.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
35
30
25
20
15
10
5
0
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
AK051928

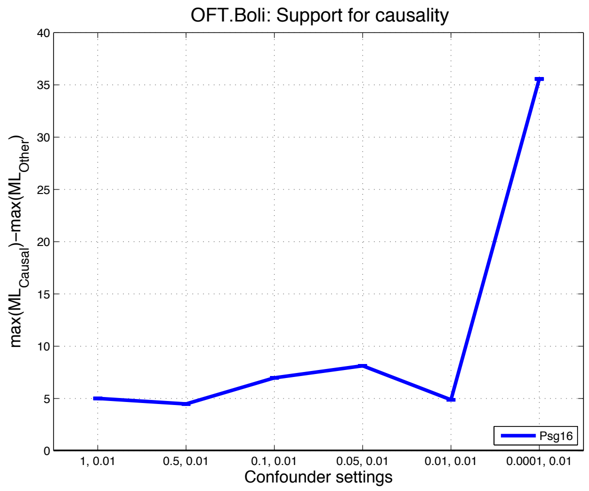

OFT.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
10
9
8
7
6
5
4
3
2
1
0
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Atp6v0a1

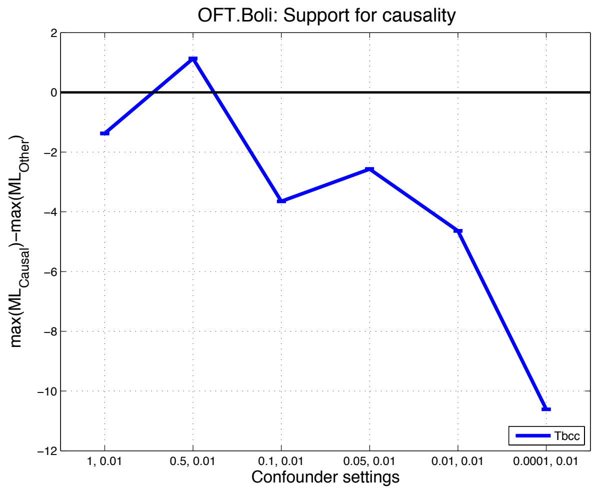

OFT.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
2
1
0
−1
−2
−3
−4
−5
−6
−7
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Dctn4

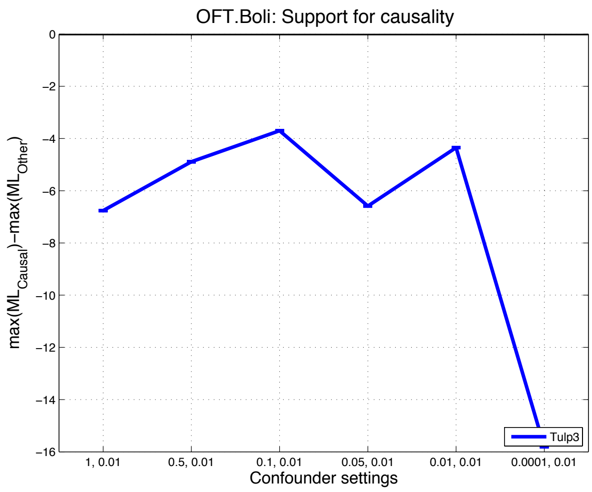

OFT.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
6
5
4
3
2
1
0
−1
−2
−3
−4
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Gatad2b

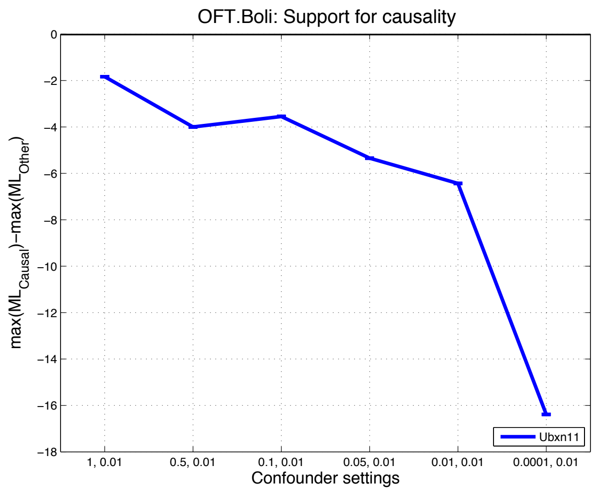

OFT.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Il17rb

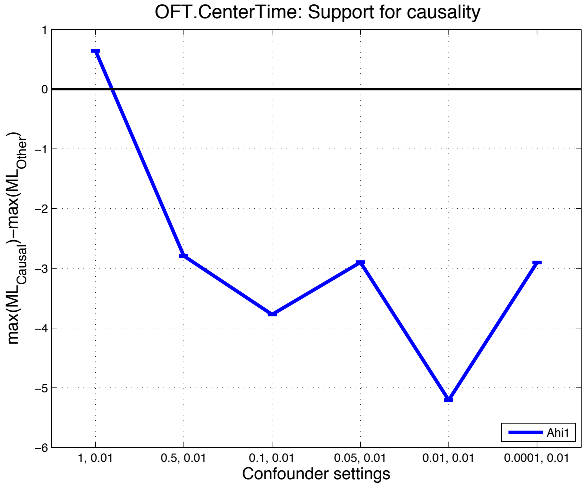

OFT.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Lxn

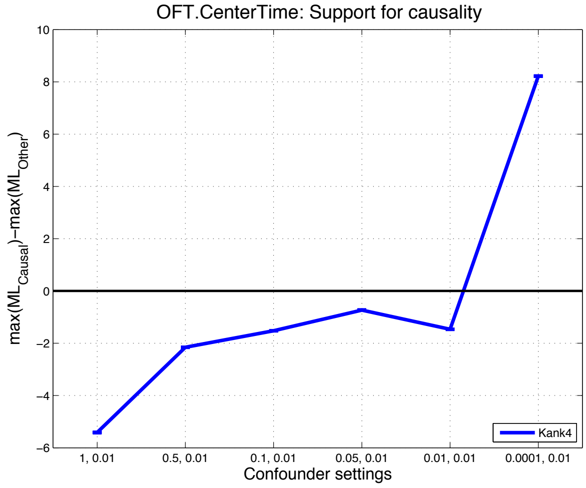

OFT.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Psg16

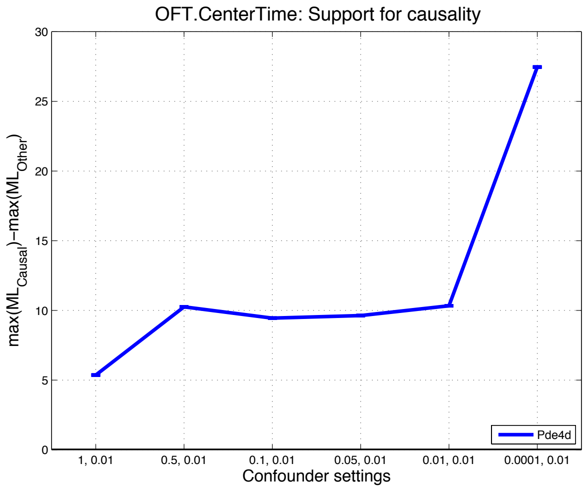

OFT.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Tbcc

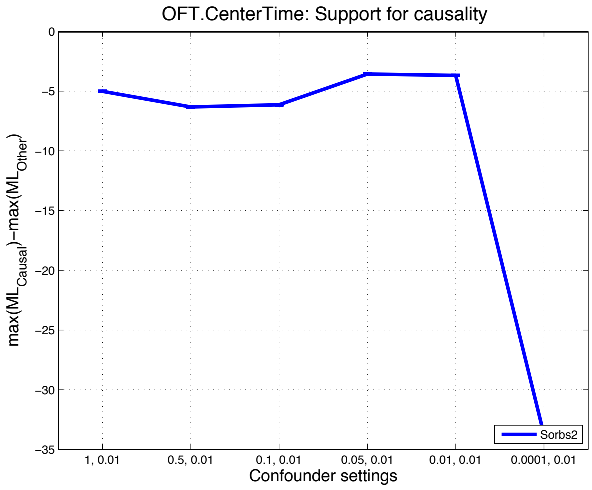

OFT.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Tulp3

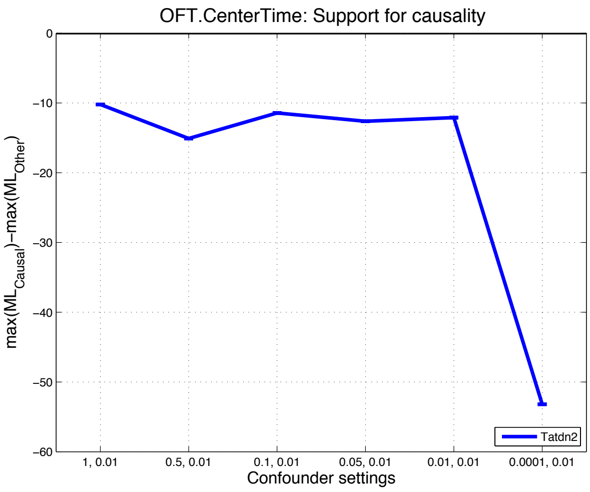

OFT.Boli: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Ubxn11

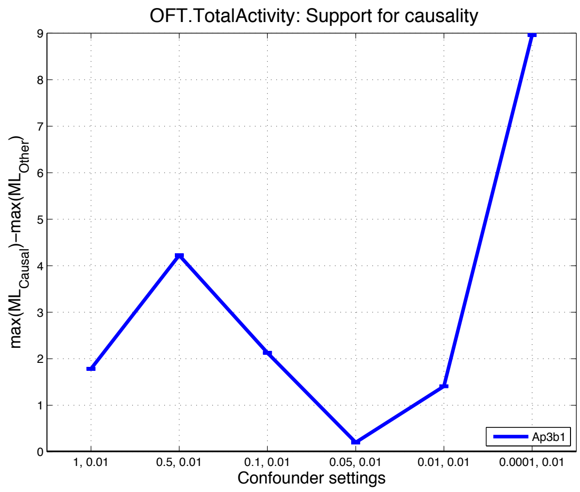

OFT.CenterTime: Support for causality
max(ML_Causal)−max(ML_Other)
Ahi1
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings

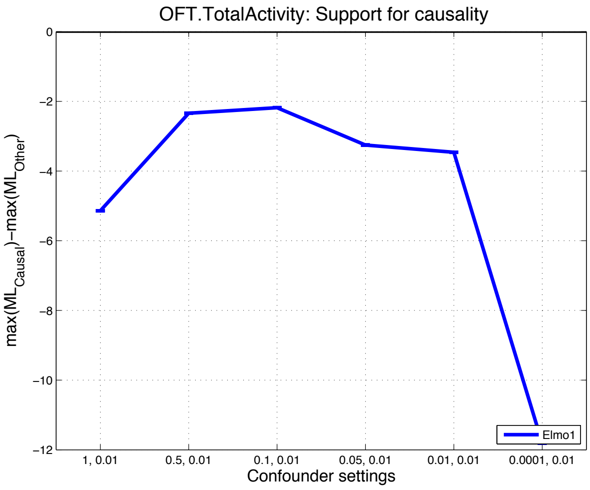

OFT.CenterTime: Support for causality
max(ML_Causal)−max(ML_Other)
Kank4
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings

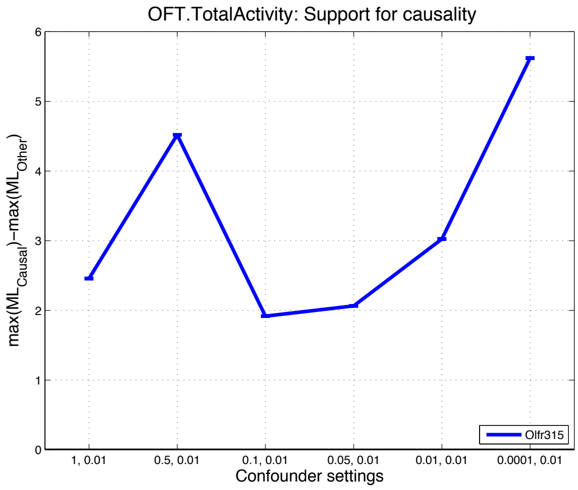

OFT.CenterTime: Support for causality
max(ML_Causal)−max(ML_Other)
Pde4d
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings

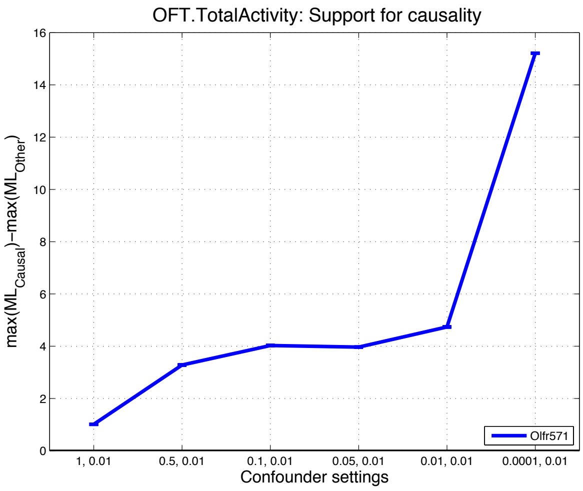

OFT.CenterTime: Support for causality
max(ML_Causal)−max(ML_Other)
Sorbs2
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings

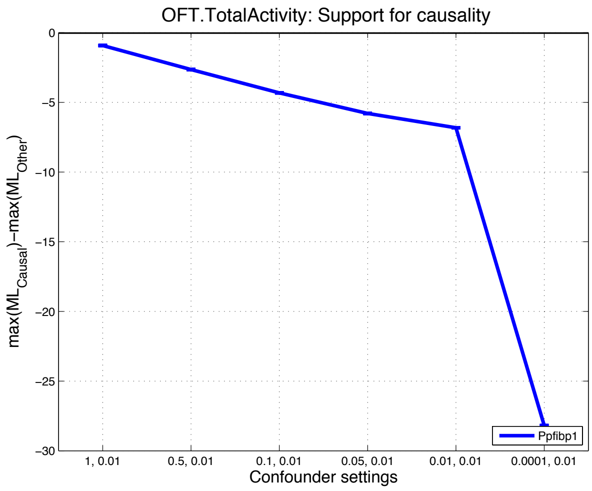

OFT.CenterTime: Support for causality
max(ML_Causal)−max(ML_Other)
Tatdn2
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings

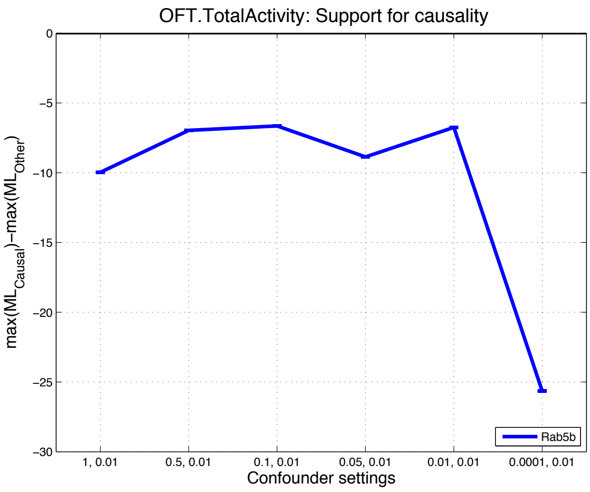

OFT.TotalActivity: Support for causality
max(ML_Causal)−max(ML_Other)
Ap3b1
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings

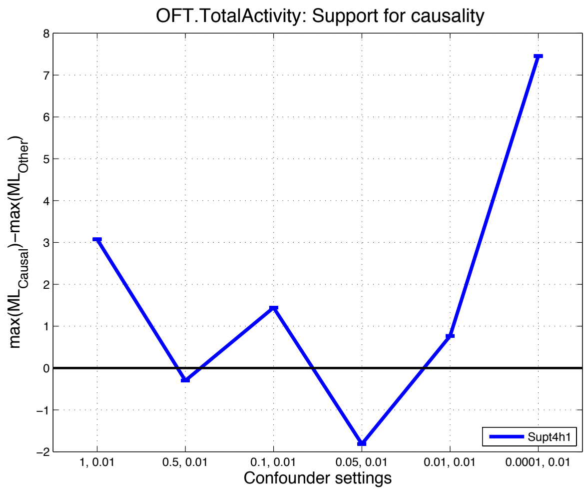

OFT.TotalActivity: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Elmo1

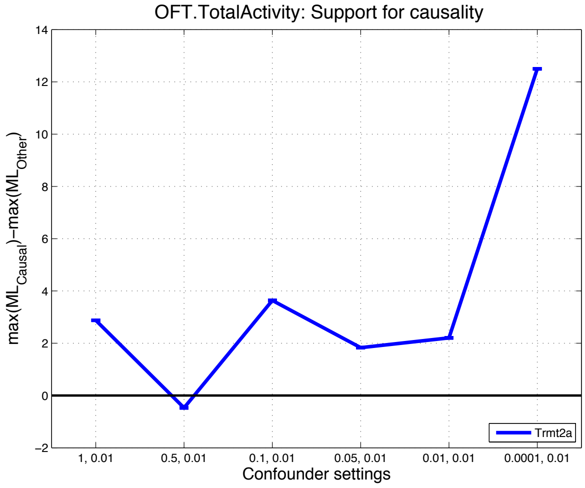

OFT.TotalActivity: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Olfr315

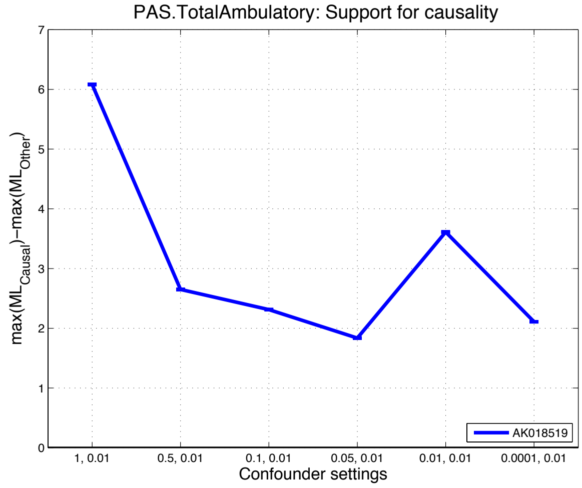

OFT.TotalActivity: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Olfr571

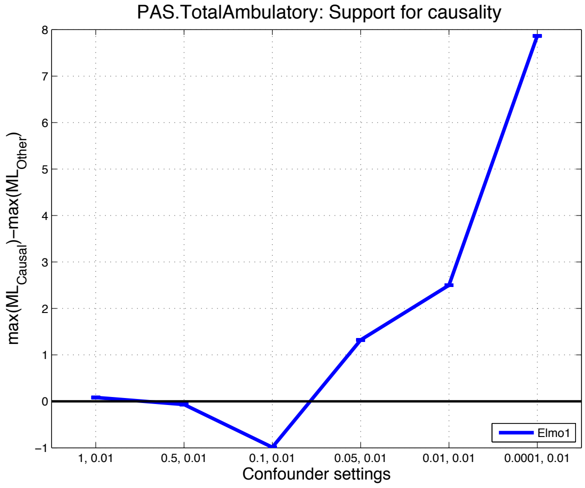

OFT.TotalActivity: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Ppfibp1

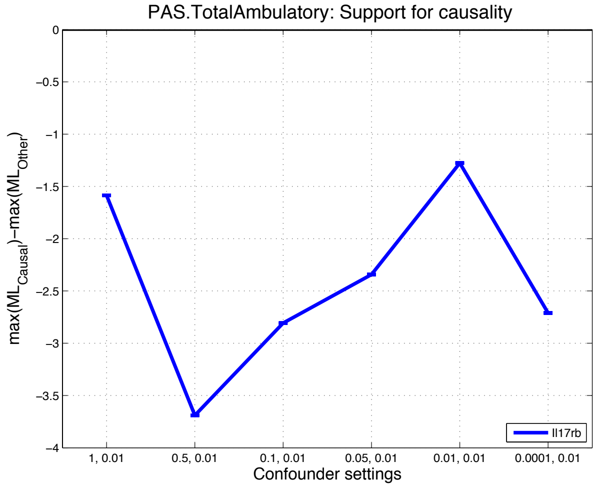

OFT.TotalActivity: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Rab5b

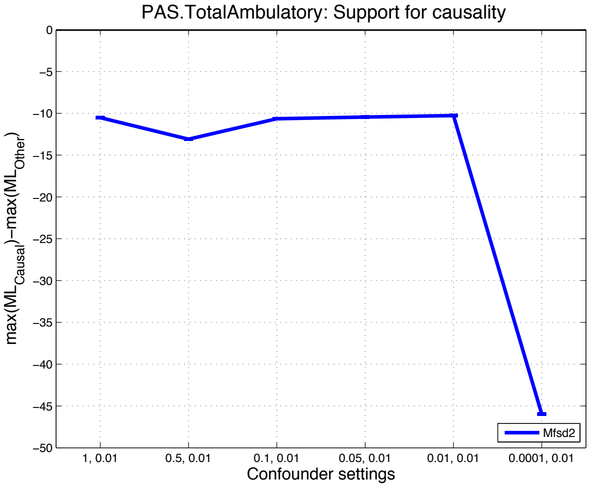

OFT.TotalActivity: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Supt4h1

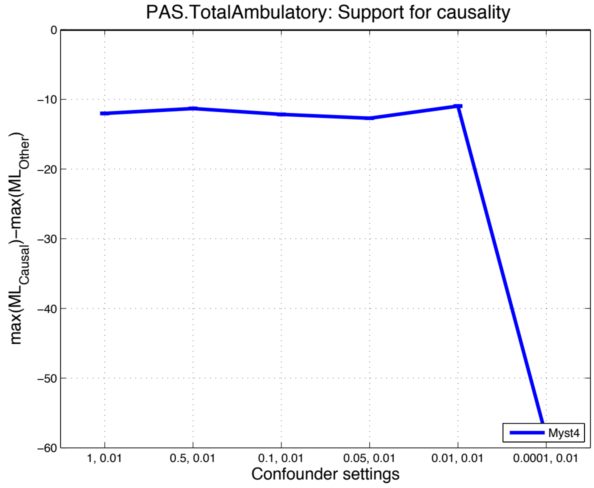

OFT.TotalActivity: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Trmt2a

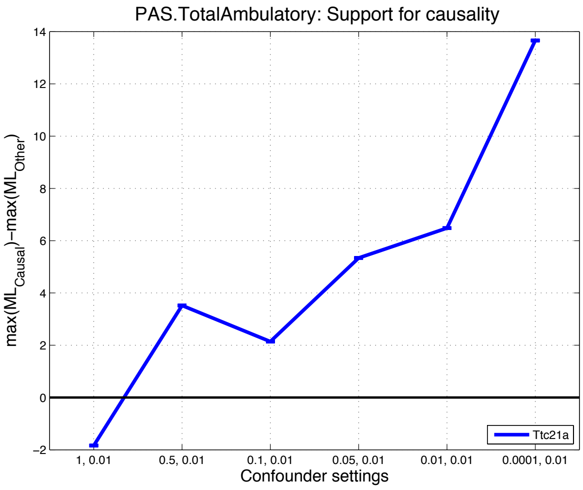

PAS.TotalAmbulatory: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
AK018519

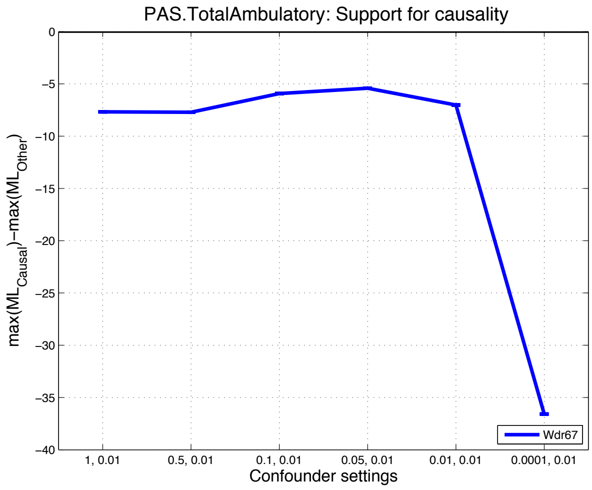

PAS.TotalAmbulatory: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Elmo1


PAS.TotalAmbulatory: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Il17rb


PAS.TotalAmbulatory: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Mfsd2


PAS.TotalAmbulatory: Support for causality
max(ML_Causal)−max(ML_Other)
Confounder settings
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Myst4


PAS.TotalAmbulatory: Support for causality
max(ML_Causal)−max(ML_Other)
14
12
10
8
6
4
2
0
−2
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Ttc21a


PAS.TotalAmbulatory: Support for causality
max(ML_Causal)−max(ML_Other)
0
−5
−10
−15
−20
−25
−30
−35
−40
1, 0.01
0.5, 0.01
0.1, 0.01
0.05, 0.01
0.01, 0.01
0.0001, 0.01
Confounder settings
Wdr67

APPENDIX I

Table of "Causal"-Flagged Genes and their Expression

This is a table of the "causal"-flagged genes in Figure 5.12, but with more detail, specifically columns indicating the full names of gene expression probes and data how much these probes were expressed in the hippocampi of the Oxford HS mice. The "n_express" column indicates how many mice had significant expression levels for a given probe in the hippocampus while the "pct_express" column is the same statistic expressed as a percentage of the 468 mice that had hippocampus gene expression assayed.

Phenotype_long	Gene_name	Probe_name	conf_1.0	conf_0.5	conf_0.1	conf_0.05	conf_0.01	conf_0.0001	conf_max	n_express	pct_express
Boli Produced in Open Field Test	Psg16	scl0026436.1_186-S	5.01	4.47	6.97	8.13	4.87	35.57	35.57	78	16.7
Boli Produced in Open Field Test	AK051928	scl078495.2_180-S	9.16	6.82	7.42	8.18	7.49	32.11	32.11	381	81.4
Burrowed Pellet Weight	Ezr	scl0022350.2_262-S	5.29	7.59	5.71	7.86	6.08	30.6	30.6	468	100
Distance Travelled in EPM Closed Arm	Renbp	scl54150.7.1_69-S	4.11	7.48	7.38	8.15	8.74	30.46	30.46	166	35.5
Time Spent in Centre of Open Field Test	Pde4d	scl0238871.11_15-S	5.36	10.25	9.44	9.63	10.33	27.46	27.46	160	34.2
Burrowed Pellet Weight	Lfng	scl0016848.2_246-S	9.94	9.5	8.42	8.31	8.06	26.52	26.52	43	9.2
Boli Produced in Open Field Test	Il17rb	scl45778.11.1_135-S	4.48	-0.3	1.83	4.9	2.85	21.64	21.64	63	13.5
Boli Produced in Open Field Test	AK045440	scl42407.1.1_107-S	7.63	3.9	5.69	6.3	6.72	21.33	21.33	62	13.2
Boli Produced after Fear-Associated Cue	Slc25a37	scl000296.1_62-S	5.31	-5.98	-0.75	-0.99	-0.16	15.66	15.66	93	19.9
Total Activity in Open Field Test	Olfr571	scl8889.1.1_230-S	1.01	3.28	4.03	3.97	4.74	15.21	15.21	24	5.1
Distance Travelled in EPM Open Arm	Agfg2	scl0004142.1_42-S	5.4	3.35	0.36	0.99	1.43	14.81	14.81	119	25.4
Total Ambulation in New Home Cage	Ttc21a	scl36345.29.1_111-S	-1.84	3.52	2.14	5.34	6.48	13.66	13.66	40	8.5
Total Activity in Open Field Test	Trmt2a	scl0001815.1_4-S	2.88	-0.47	3.64	1.83	2.21	12.5	12.5	366	78.2
Faecal Corticosterone	Osbpl6	scl0099031.1_295-S	11.87	8.24	8.75	9.57	10.74	-11.75	11.87	468	100
Freeze Time to Fear-Associated Cue	Fzd3	scl45417.7.1_19-S	7.08	9.52	11.81	9.21	10.79	5.34	11.81	244	52.1
Adrenal Gland Weight	Gipc1	scl000630.1_212-S	2.03	0.55	0.26	1.61	2.99	11.01	11.01	132	28.2
Freeze Time to Fear-Associated Cue	Znhit6	scl069746.7_1-S	7.6	1.79	3.33	3.6	0.79	10.15	10.15	467	99.8
Burrowed Pellet Weight	Sf3b5	scl0066125.2_261-S	5.67	4.69	9.93	6.88	8.8	9.26	9.93	468	100
Boli Produced in Open Field Test	Atp6v0a1	scl011975.20_15-S	4.21	1.26	2.25	0.92	5.73	9.76	9.76	468	100
Total Activity in Open Field Test	Ap3b1	scl44512.30.1_14-S	1.78	4.22	2.13	0.2	1.41	8.96	8.96	468	100
Freeze Time to Fear-Associated Context	Glt8d1	scl46500.10.1_48-S	-1.72	0.3	-0.6	0.28	-0.48	8.8	8.8	468	100
Time Spent in Centre of Open Field Test	Kank4	scl0242553.1_69-S	-5.41	-2.15	-1.52	-0.73	-1.47	8.22	8.22	53	11.3
Total Ambulation in New Home Cage	Elmo1	scl0003672.1_54-S	0.08	-0.07	-0.99	1.32	2.5	7.87	7.87	347	74.1
Total Activity in Open Field Test	Supt4h1	scl41079.4_35-S	3.07	-0.3	1.44	-1.82	0.77	7.45	7.45	71	15.2
Total Ambulation in New Home Cage	AK018519	scl47627.1.1_171-S	6.08	2.65	2.31	1.84	3.61	2.11	6.08	459	98.1
Boli Produced in Open Field Test	Gatad2b	scl00229542.2_217-S	5.95	-0.87	-0.1	2.01	-0.57	-3.74	5.95	48	10.3
Total Activity in Open Field Test	Olfr315	scl41515.1.1_98-S	2.46	4.52	1.92	2.06	3.02	5.62	5.62	59	12.6