Detection and replication of epistasis influencing transcription in humans

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Abstract

Epistasis is the phenomenon whereby one polymorphism's effect on a trait depends on other polymorphisms present in the genome. The extent to which epistasis influences complex traits¹ and contributes to their variation^{2,3} is a fundamental question in evolution and human genetics. Though epistasis has been demonstrated in artificial gene manipulation studies in model organisms, 4,5 and some examples have been reported in other species,⁶ few convincing examples exist for epistasis amongst natural polymorphisms in human traits.^{7,8} Its absence from empirical findings may simply be due to its low incidence in the genetic control of complex traits,^{2,3} but an alternative view is that it has previously been too technically challenging to detect due to statistical power and computational issues.⁹ Here we show that, using advanced computation techniques¹⁰ and a gene expression study design, many instances of epistasis are found between common single nucleotide polymorphisms (SNPs). In a cohort of 846 individuals with data on 7339 gene expression levels in peripheral blood, we found 501 significant pairwise epistatic interactions between common SNPs acting on the expression levels of 238 genes $(p < 2.91 \times 10^{-16})$. We tested the discovery interactions for replication in two independent data sets. 11,12 Three hundred and forty-five interactions had replication interaction p-values that were more extreme than the 2.5% confidence interval of the distribution under the null hypothesis of no epistasis, with 30 significant at a conservative p < 0.05 Bonferroni level. There was evidence of functional enrichment for the interacting SNPs, for instance 44 of the genetic interactions are located within 2Mb of regions of known intra-cellular chromosome interactions¹³ ($p = 1.8 \times 10^{-10}$). Epistatic networks of three SNPs or more influence the expression levels of 129 genes, whereby one cis-acting SNP is modulated by several transacting SNPs. For example MBNL1 is influenced by an additive effect at rs13069559 which itself is masked by trans-SNPs on 14 different chromosomes, with nearly identical genotype-phenotype (GP) maps for each cis-trans interaction. This study presents the first evidence for multiple instances of epistatic genetic effects emerging from natural genetic variation in humans.

1 Main text

In the genetic analysis of complex traits it is usual for SNP effects to be estimated using an additive model where they are assumed to contribute independently and cumulatively to the mean of a trait. This framework has been successful in identifying thousands of associations, ¹⁴ but to date there is little empirical exploration of the role that epistasis plays in the architecture of complex traits in humans, ^{7,8} though its contribution to phenotypic variance is frequently the subject of debate. ^{1–3} Outside the prism of human association studies there is evidence for epistasis, not only at the molecular scale from artificially induced mutations ⁴ but also at the evolutionary scale in fitness adaptation ¹⁵ and speciation. ¹⁶

Methods are now available to overcome the computational problems involved in searching for epistasis, but its detection still remains problematic due to reduced statistical power. For example increased dependence on linkage disequilibrium (LD) between causal SNPs and observed SNPs, ^{17,18} increased model complexity in fitting interaction terms, ¹⁹ and more extreme significance thresholds to account for increased multiple testing⁹ all make it more difficult to detect epistasis in comparison to additive effects. Thus, when combined with small genetic effect sizes, as is expected in most complex traits of interest, ¹⁴ the power to detect epistasis diminishes rapidly. There are two simple ways to overcome this problem. One is by using extremely large sample sizes;²⁰ another is by analysing traits that are likely to have large effect sizes among common variants. Because our focus was to ascertain the extent to which instances of epistasis occur amongst natural genetic variation we designed a study around the latter approach and searched for epistatic genetic effects that influence gene expression levels. Transcription levels can be measured for thousands of genes. These traits are largely heritable but on average less polygenic than high level phenotypes,²¹ thus it is expected that many genetic effects will be relatively large, maximising the chance at detecting epistasis, should it exist.

In our discovery dataset (Brisbane Systems Genetics Study, BSGS²²) of 846 individuals genotyped at 528,509 SNPs, we exhaustively tested every pair of SNPs for genetic interactions against each of 7339 expression traits in peripheral blood. After stringent filtering and multiple testing correction (Methods) we identified 501 putative genetic interactions influencing the expression levels of 238 genes (Supplementary Table 5). Of the 501 discovery interactions, 434 had available data and passed filtering (Methods) in two independent replication datasets, Fehrmann¹² and the Estonian Genomics Centre University of Tartu (EGCUT),¹¹ in which we saw convincing evidence for replication. We used the summary statistics from the replication datasets to perform a meta analysis to obtain an independent p-value for the putative interactions, and 30 were significant after applying a Bonferroni correction for multiple testing (Table 1). These significant interactions exhibited remarkable similarity in GP maps between all three datasets (Figure 2).

In addition, using the meta analysis from the replication samples only, we observed that 316 of the remaining 404 discovery SNPs had replication interaction p-values more extreme than the 2.5% confidence interval of the distribution under the null distribution of no epistatic effects ($p << 1.0 \times 10^{-16}$, Figure 3 and Supplementary Figure S1). The congruence of the epistatic networks in discovery and replication datasets is shown in Figure 1, demonstrating that these complex genetic patterns are common even across independent datasets. A further replication was attempted using the Centre for Health Discovery and Wellbeing (CHDWB) dataset, ²³ but only 27 of the SNP pairs passed filtering because the sample size was small (n = 139), and likely due to insufficient power we found no evidence for replication. It should be noted that although it is a necessary step to establish the veracity of the signals from the discovery set, replication of epistasis is theoretically difficult because the dependence on LD between observed SNPs and causal variants is up to three orders of magnitude

higher than it is for independent additive effects.^{17,18} Therefore these results are encouraging with regards to the detection and replication of epistasis.

Though seldom the focus of association studies, SNPs with known main effects are often tested for additive \times additive genetic interactions, ⁹ but our analysis shows that this is unlikely to be the most effective strategy for its detection. The majority of our discovery interactions comprised of one SNP that was significantly associated with the gene expression level in the discovery dataset, and one SNP that had no previous association²¹ (439 out of 501, Methods). Only nine interactions were between SNPs that both had known main effects while 64 were between SNPs that had no known main effects. Additionally, we observed that the largest epistatic variance component for the 501 interactions was equally divided amongst additive \times additive, additive \times dominance, dominance \times additive and dominance \times dominance at the discovery stage (p=0.22 for departure from expectation). This is not surprising because the patterns of epistasis used for statistical decomposition are not designed to resemble biological function.²⁴

Of the discovery interactions, 47 were cis-cis acting (both SNPs were on the same chromosome as the expression gene), 441 were cis-trans-acting, and 13 were trans-trans-acting. We observed a wide range of significant GP maps (Figure 2) but the most common pattern of epistasis that we detected involved a trans-SNP masking the effect of an additive cis-SNP. For example, MBNL1 (involved in RNA modification and regulation of splicing²⁵) has a cis effect at rs13069559 which in turn is controlled by 13 trans-SNPs and one cis-SNP that each exhibit a masking pattern, such that when the trans-SNP is homozygous for the masking allele the decreasing allele of the cis-SNP no longer has an effect (Supplementary Figure S5. Each of these interactions have evidence for replication in at least one dataset and six are significant at the Bonferroni level (Supplementary Figure S2). We see similar epistatic networks involving multiple trans-acting SNPs for other gene expresson levels too, for example TMEM149 (Supplementary Figure S6), NAPRT1 (Supplementary Figure S7), TRAPPC5 (Supplementary Figure S8), and CAST (Supplementary Figure S9).

In total the 501 interactions comprised 781 unique SNPs, which we analysed for functional enrichment (Methods). We tested the SNPs for cell-type specific overlap with transcriptionally active chromatin regions, tagged by histone-3-lysine-4,3-methylation (H3K4me3) chromatin marks, in 34 cell types²⁶ (Supplementary Figure S4). There was significant enrichment for cis-acting SNPs in haematopoietic cell types only $(p < 1 \times 10^{-4}$ for the three tissues with the strongest enrichment after adjusting for multiple testing). However trans-acting SNPs did not show any tissue specific enrichment (p > 0.1 for all tissues). This difference between cis and trans SNPs suggests different roles in which epistasis might arise where the cis-SNPs provide tissue specificity in these interactions. There is also strong enrichment for SNPs to be localised in enhancer regions,²⁷ consistent for both cis and trans SNPs $(p < 1 \times 10^{-6})$.

We also demonstrate spacial organisation of interacting loci suggesting a mechanism by which biological function can lead to epistatic genetic variance. It has been shown that different chromosomal regions spatially colocalise in the cell through chromatin interactions.¹³ We cross-referenced our epistatic SNPs with a map of chromosome interacting regions (n=96,139) in K562 blood cell lines²⁸ (Methods) and found that 44 epistatic interactions mapped to within 2Mb $(p<1.8\times10^{-10})$, (Supplementary Figure S10). Interaction of distant loci may occur through physical proximity in transcriptional factories that organise across different chromosome regions and can regulate transcription of related genes.^{29,30}

Though we present many instances of epistasis, quantifying its relative importance to complex traits in humans remains an open question. In this study we are able to identify 238 gene expression traits with at least one significant interaction given our experiment-wide threshold. How does this compare to the number of traits influenced by additive effects? The BSGS dataset has been previously analysed for additive effects at all expression traits, 22 and if we take all the additive eQTLs that were significant at the epistatic threshold of $p < 2.91 \times 10^{-16}$ we find that 453 gene expression levels out of the 7339 analysed had at least one significant expression quantitative trait locus (eQTL). Therefore it can be argued that the number of instances of detectable epistasis are substantial.

However in terms of their contribution to complex traits a more important metric might be the proportion of the variance that the epistatic loci explain.² Ideally one would approach this question from a whole genome perspective³¹ but this is intractable for non-additive variance components. Nevertheless, some inference can be made from the ascertained effects in these analyses and it is evident that additive variance is overall a larger component than epistatic variance, as has been argued previously.^{2,3} Taking the additive effects detected in Powell et al (2012) at the $p < 2.91 \times 10^{-16}$ threshold, we calculate that on average they explain 1.73% of the phenotypic variance of each of the 7339 probes. By contrast, the epistatic variance from the interacting SNPs detected in this study on average explain 0.25% of phenotypic variance, approximately seven times lower than the additive variance (Methods). There are several caveats to this comparison. Firstly, the ratio of additive to epistatic variance may differ at different effect sizes, and our estimate is determined by the threshold used. Secondly, the power of a 1 d.f. test exceeds that of an 8 d.f. test. And thirdly, the non-additive variance at causal variants is expected to be underestimated by observed SNPs in comparison to estimates for additive variance, due to differences in the rate of decay of the estimate of the genetic variance of the causal SNPs as LD decreases with the observed SNPs.

Overall, we have demonstrated that it is possible to identify and replicate epistasis in complex traits amongst common human variants. The bioinformatic analysis of the significant epistatic loci suggests that there are a large number of possible mechanisms that can lead to non-additive genetic variation. Further research into such epistatic effects may provide a useful framework to understanding molecular mechanisms and complex trait variation in greater detail. With computational techniques and data now widely available the search for epistasis in larger datasets for traits of broader interest is warranted.

1.1 Methods Summary

We searched for pairwise epistasis exhaustively in the BSGS discovery dataset, ²² which comprises 846 individuals who are genotyped at 528,509 autosomal SNPs and who have gene expression levels measured in peripheral blood samples for 7,339 probes representing 6,158 RefSeq genes. Recent hardware and software ¹⁰ advances made it possible to perform the 1.03×10^{15} statistical tests to complete this analysis. We used permutation analysis³² to calculate an experiment-wide significance threshold of $T_e = 2.91 \times 10^{-16}$ at the 5% family-wise error rate (FWER). SNP pairs were modelled for full genetic effects, including marginal additive and dominance at both SNPs plus four interaction terms. Though we could have used a less complex model to improve statistical efficiency, we deemed it important to be agnostic about the type of epistasis that might exist, and therefore chose not to over-parameterise the test. 18,19 Because there are many large marginal effects present in these data it was necessary to perform several filtering steps to exclude SNP pairs that were significant due to marginal effects alone. All SNP pairs with LD $r^2 > 0.1$ and $D'^2 > 0.1$ were removed to minimise the possibility of haplotype effects. All SNP pairs were required to have at least five data points in all nine genotype classes. If multiple SNP pairs were present on the same chromosomes for a particular expression trait then only the sentinal SNP pair was retained. Finally, a nested test contrasting the full genetic model against the marginal additive and dominance model was performed for each remaining SNP pair (Methods), resulting in 501 significant interactions after Bonferroni correction for multiple testing of the filtered SNPs. The significant SNP pairs were carried forward for replication in two independent datasets that used the same expression assays for analysing transcription in peripheral blood, the Fehrmann dataset (n = 1240) and the Estonian Genome Centre University of the University of Tartu (EGCUT) dataset¹¹ (n = 891). Of these, 434 passed filtering in both replication datasets. A meta analysis on the interaction p-values from each replication dataset was performed to provide an overall replication statistic for each putative interaction.

1.2 Acknowledgements

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Tables 2

Table 1: Epistatic interactions significant at the Bonferroni level in two replication sets

	Gene (chr.)	SNP 1 (chr.)	SNP 2 (chr.)	BSGS^2		•	
1	ADK (10)	rs2395095 (10)	rs10824092 (10)	6.69^{1}	18.33^{1}	21.21^{1}	39.82^{1}
2	ATP13A1 (19)	rs4284750 (19)	rs873870 (19)	5.30	12.18	3.25	14.23
3	C21ORF57(21)	rs9978658 (21)	rs11701361 (21)	9.42	6.08	16.36	21.67
4	CSTB (21)	rs9979356 (21)	rs3761385 (21)	11.99	25.20	16.72	42.27
5	CTSC (11)	rs7930237 (11)	rs556895 (11)	7.16	18.76	15.06	33.53
6	FN3KRP (17)	rs898095 (17)	rs9892064 (17)	16.16	28.24	29.39	59.95
7	GAA(17)	rs11150847 (17)	rs12602462 (17)	13.91	19.98	12.99	32.60
8	HNRPH1 (5)	rs6894268 (5)	rs4700810 (5)	15.38	8.55	3.01	10.37
9	LAX1 (1)	rs1891432 (1)	rs10900520 (1)	19.16	18.60	11.22	29.24
10	MBNL1 (3)	rs16864367 (3)	rs13079208 (3)	13.49	16.25	24.74	41.56
11	MBNL1 (3)	rs7710738 (5)	rs13069559 (3)	7.92	2.55	7.89	9.28
12	MBNL1 (3)	rs2030926 (6)	rs13069559 (3)	7.10	0.91	5.80	5.53
13	MBNL1 (3)	rs2614467 (14)	rs13069559 (3)	5.74	4.13	2.22	5.30
14	MBNL1 (3)	rs218671 (17)	rs13069559 (3)	7.63	0.62	5.82	5.23
15	MBNL1 (3)	rs11981513 (7)	rs13069559 (3)	7.71	0.43	5.36	4.58
16	MBP (18)	rs8092433 (18)	rs4890876 (18)	5.40	7.06	21.91	28.73
17	NAPRT1 (8)	rs2123758 (8)	rs3889129 (8)	8.45	15.12	16.08	30.77
18	NCL(2)	rs7563453(2)	rs4973397 (2)	7.31	7.51	6.33	12.70
19	PRMT2 (21)	rs2839372 (21)	rs11701058 (21)	4.81	0.69	4.47	4.06
20	RPL13 (16)	rs352935 (16)	rs2965817 (16)	4.98	3.79	14.41	17.24
21	SNORD14A (11)	rs2634462 (11)	rs6486334 (11)	7.31	13.11	10.96	23.22
22	TMEM149 (19)	rs807491 (19)	rs7254601 (19)	12.16	81.55	45.78	145.78
23	TMEM149 (19)	rs8106959 (19)	rs6926382 (6)	5.80	3.06	8.80	10.72
24	TMEM149 (19)	rs8106959 (19)	rs914940 (1)	6.22	3.36	6.96	9.20
25	TMEM149 (19)	rs8106959 (19)	rs2351458 (4)	7.30	0.04	9.61	8.00
26	TMEM149 (19)	rs8106959 (19)	rs6718480 (2)	8.55	3.31	5.15	7.36
27	TMEM149 (19)	rs8106959 (19)	rs1843357 (8)	6.21	3.72	3.33	6.00
28	TMEM149 (19)	rs8106959 (19)	rs9509428 (13)	9.44	0.10	5.75	4.47
29	TRA2A (7)	rs7776572 (7)	rs11770192 (7)	8.23	3.19	1.89	4.09
30	VASP (19)	rs1264226 (19)	rs2276470 (19)	5.09	0.94	5.14	4.95

 $^{^{1}}$ $-\log_{10} p$ -values for 4 d.f. interaction tests 2 Discovery dataset

 ³ Independent replication dataset
 ⁴ Meta analysis of interaction terms between replication datasets only

3 Figures

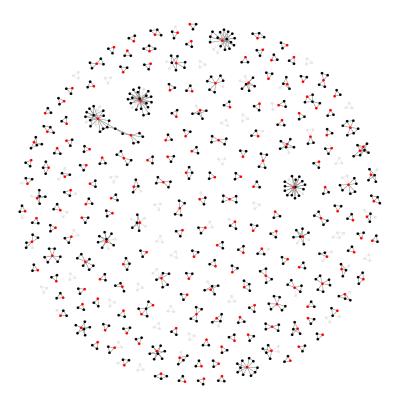


Figure 1: Discovery and replication of epistatic networks All 434 putative genetic interactions (edges) with data common to discovery and replication sets is shown, where black nodes represent SNPs and red nodes represent traits (gene expression probes). Three hundred and forty-five interactions had p-values exceeding the 2.5% confidence interval following meta analysis of the replication data, but the remaining 89 interactions that did not replicate are depicted in grey. It is evident that a large proportion of the complex networks identified in the discovery set also exist in independent populations.

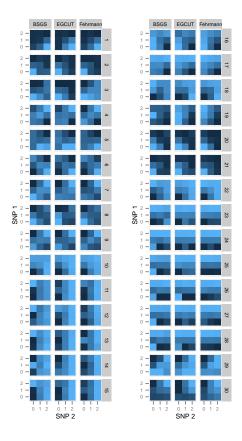


Figure 2: Replication of GP maps in two independent populations The GP maps for each epistatic interaction that is significant at the Bonferroni level in both replication datasets are shown. Each GP map consists of nine tiles where each tile represents the expression level for that two-locus genotype class. Phenotypes are for gene transcript levels (dark coloured tiles = low expression, light coloured tiles = high expression). Columns of GP maps are for each independent population. Rows of GP maps are for each of 30 significantly replicated interactions at the Bonferroni level, corresponding to the rows in Table 1. There is a clear trend of the GP maps replicating across all three datasets.

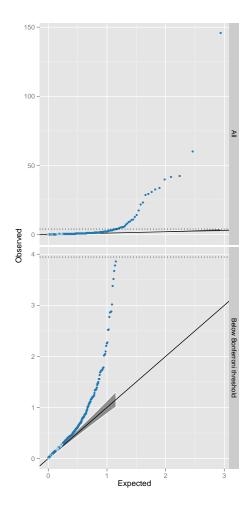


Figure 3: Q-Q plots of interaction p-values from replication datasets. The top panel shows all 434 discovery SNPs that were tested for interactions. Observed p-values (y-axis, $-\log_{10}$ scale) are plotted against the expected p-values (x-axis, $-\log_{10}$ scale). The multiple testing correction threshold for significance following Bonferroni correction is denoted by a dotted line. The bottom panel shows the same data as the top panel but excluding the 30 interactions that were significant at the Bonferroni level in the replication datasets. The shaded grey area represents the 5% confidence interval for the expected distribution of p-values. Dark blue points represent p-values that exceed the confidence interval, light blue are within the confidence interval.

4 Supplementary Figures

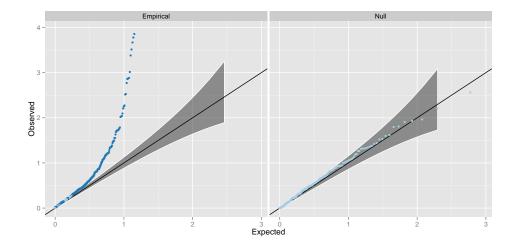


Figure S1: Q-Q plots of interaction p-values from replication datasets, excluding the 30 points significant at the Bonferroni level The right panel (Null) shows the interaction p-values from a meta analysis across two independent datasets on 434 randomly drawn SNP pairs. The left panel (Empirical) shows the interaction p-values from the 404 putative interactions that were not significant at the Bonferroni correction threshold. Dark blue points represent p-values that surpass the 2.5% FDR level, as in Figure 3.

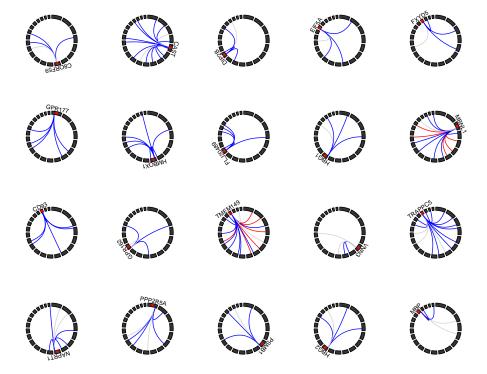


Figure S2: Gene expression traits with four or more genetic interactions Circle plots represent the genomic positions for SNPs (linking lines) and expression probes (red points). Chromosomes are represented by black blocks and ordered from 1 to 22 clockwise, starting from the top. Grey lines represent no evidence for replication, blue lines denote interactions that are outside the 97.5% confidence interval or the Q-Q plot (Figure 3), and red lines denote replication at the Bonferroni correction level. Most interactions are characterised as being *cis-trans* to the expression probe.

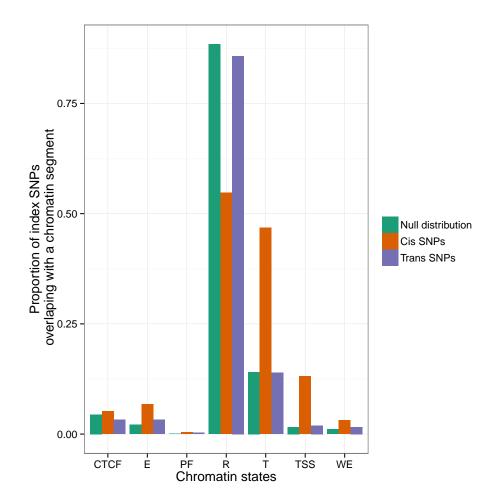


Figure S3: Location of SNPs relative to genomic features All SNPs within 1Mb and $r^2 > 0.8$ of each cis- and trans-SNP were taken to find which genomic features (x-axis) were covered by the SNPs that compose the 501 significant interactions. Green bars represent the proportion (y-axis) of the 528,509 SNPs used in the analysis that fall within the range of the different genomic features. There is enrichment for cis-acting SNPs (red bars) in promotor regions, but trans-acting SNPs (blue bars) are not enriched for genomic features. The labels on the x-axis are as follows: TSS = Predicted promoter region including TSS, PF = Predicted promoter flanking region, E = Predicted enhancer, WE = Predicted weak enhancer or open chromatin cis regulatory element, CTCF = CTCF enriched element, T = Predicted transcribed region, R = Predicted Repressed or Low Activity region

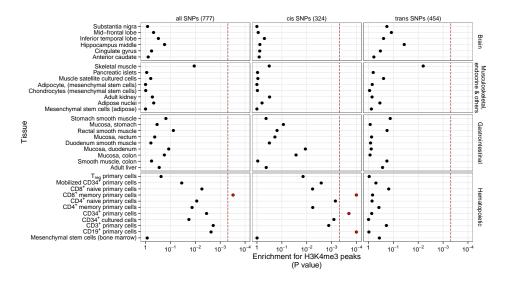


Figure S4: Tissue specific enrichment of SNPs in transcriptionally active regions The locations of transcriptional activity can be predicted by chromatin marks, assayed by H3K4me3.²⁶ Enrichment *p*-values are calculated using permutation analysis for 34 different cell types (*y*-axis) in four tissue types (Rows of boxes). There is enrichment for *cis*-acting SNPs in Haematopoietic tissue types only. *Trans*-acting SNPs have no tissue specificity.

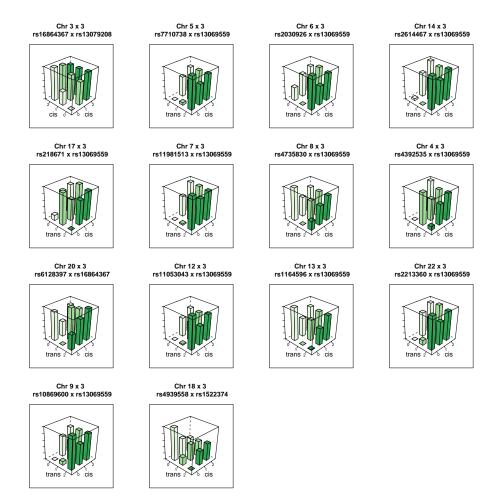


Figure S5: Genotype-phenotype maps for 14 interactions influencing the expression of MBNL1 Each bar represents the mean phenotypic value for individuals in that genotype class. The rs13069559 SNP typically has a *cis*-additive decreasing effect on the expression of MBNL1, but in many of these interactions the *cis* effect is masked when the *trans* SNP is homozygous.

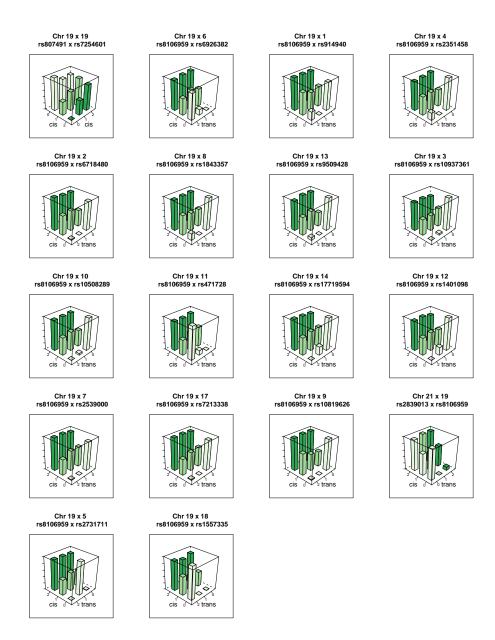


Figure S6: Genotype-phenotype maps for 19 interactions influencing the expression of TMEM149 Each bar represents the mean phenotypic value for individuals in that genotype class. The rs13069559 SNP typically has a *cis*-additive decreasing effect on the expression of TMEM149, but in many of these interactions the *cis* effect is masked when the *trans* SNP is homozygous.

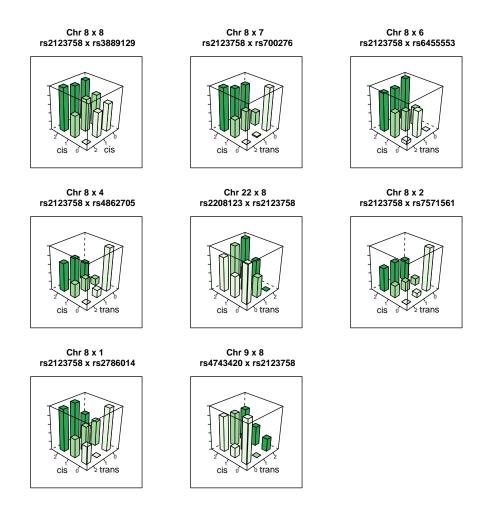


Figure S7: Genotype-phenotype maps for 8 interactions influencing the expression of NAPRT1 Each bar represents the mean phenotypic value for individuals in that genotype class.



Figure S8: Genotype-phenotype maps for 16 interactions influencing the expression of TRAPPC5 Each bar represents the mean phenotypic value for individuals in that genotype class.

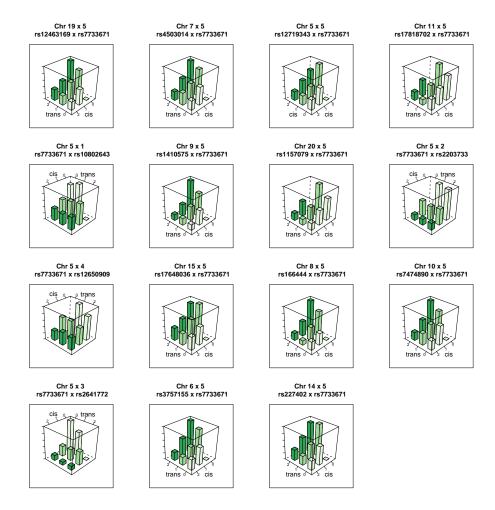


Figure S9: Genotype-phenotype maps for 15 interactions influencing the expression of CAST Each bar represents the mean phenotypic value for individuals in that genotype class.



Figure S10: Number of overlaps between chromosome interactions and epistatic interactions Interacting chromosome regions may be a possible mechanism underlying epistatic interactions. The number of epistatic interactions within 20kb, 500kb, 2Mb and 10Mb of known chromosome interacting regions are shown by red vertical lines. The histograms represent the null distribution based on random sampling of 10,000 datasets for each window size.

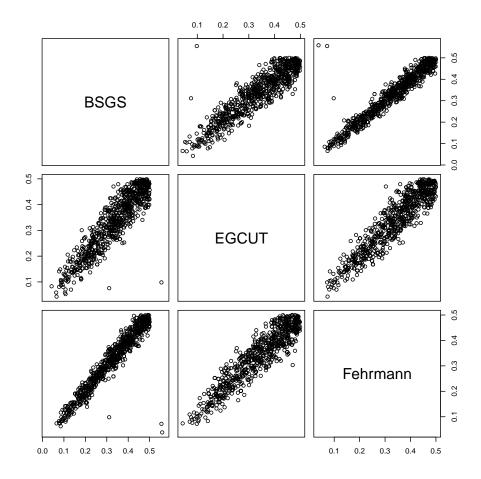


Figure S11: Comparison of allele frequencies for 781 SNPs involved in genetic interactions across independent populations Outliers were removed from the analysis as part of the filtering stage during replication.

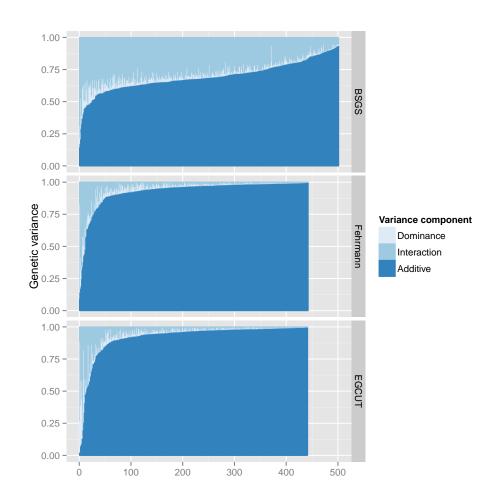


Figure S12: Comparison of variance distribution from different cohorts How does the estimated variance decomposition change in different cohorts? The cumulative proportion of the genetic variance that is additive, dominant, or epistatic for each putative interaction is shown on the y-axis. BSGS has 501 interactions whereas Fehrmann and EGCUT have 434 (x-axis). The variance estimates are ordered from lowest additive to highest additive proportion. This is done independently for each cohort to depict the distribution of estimated effects.

5 Supplementary Tables

Table S1: Details on 501 interactions discovered in BSGS dataset

	/ Mp						0.517			4.231								31.703					0.071																	0	0.263				$\bigg]$
	Distance																	e -																											7:00
values	Metag	0.09	0	2.02	0.87	2.02	39.82	88	0.94	0.57	0.42	0.23	1.01	0.04	0.90	0.26	1 16						14.23	0.14	0.50	0.54	0.22	0.85	0.24	0.35						0 10	0.13		0.37	0.28	21.67	0.07		0.21	3
$-\log_{10} p$ -values	$EGCUT^{\mathbf{f}}$	0.02	101	1.78	1.14	0.83	21.21	1 93	0.64	66'0	0.20	0.30	1.37	0.20	1.09	0.17	1 03						3.25	0.40	0.16	0.04	0.28	0.30	0.28	0.34						0	0.50	0.03	0.50	0.08	16.36	0.03	1	0.18	
Interaction statistic /	Fehrmann ^f	0.38	000	1.04	0.36	2.04	18.33	1.83	1.63	0.16	0.71	0.27	0.33	0.02	0.44	0.47	0.05						12.18	0.06	0.87	1.15	0.28	0.60	0.31	0.42						C 74.3	0.01		0.29	0.65	6.08	0.29	0.31	0.38	1
Interact	BSGSe	5.82	5.50	6.59	5.59	6.58	6.69	7 C	5.45	6.91	5.93	6.18	6.26	5.75	5.85	6.31	5.94	5.96	6.65	7.64	6.26	20.10 80.10 80.10	5.72	5.84	6.60	5.66	6.66	6.02	5.98	7.15	4.87	4.52	4.05	3.85	4.61	4.09	5.90	5.65	5.59	4.91	9.42 7.77	5.49	5.45	7.62	5
	Associationd					ADCK1			AHSA2	AKTIP								ARL17B	ARL17B								C13ORF18	C14ORF173	C14ORF173							C17OBE60	CIORF86	CIORF86	Clorf86	ZNF641	CROP EA	CSORF4	CSORF59	CSOBFEG	2000
SNP 2	Pos/Mbc	158100199	139522101	72001517	122933691	78088813	75929517	61119471	61388355	53489705	125543391	179323762	161996349	3032625	154511163	178019148	4818792 8 7018 5 2 8	44064851	44064851	94722497	125831219	99492045	19738554	129906275	248059423	189150656	46913416	105189504	105189504	238724741	77574438	63371601	63179138	77574438	77574438	0044101	2082566	2119833	2119833	48676038	47764477	86102223	86102223	55242625 86102223	0
01	Chr.	9	1 C	- o	4	14	10	00	10	16	1	4	3	ю	7	4.0	ကဝ	17	1.7	14	12	12	ი 61	12	1	4	13	1 4	14	н	14	n or		14	14	1.4		1	1	12	21 L r	o oc	· ∞	4 α)
	rs ID	rs596183	rs914737	rs4744894	rs4833241	rs12431896	rs10824092	rs842647	rs1177303	rs13332406	rs1362032	rs1473017	rs11720112	rs4866516	rs3823523	rs6846031	rs4684443	rs8079215	rs8079215	rs1950646	rs2197777	rs2684789	rs9834627	rs9804943	rs10888267	rs6553184	rs674754	rs4983382	rs4983382	rs10754644	rs2655991	rs6445340	rs9787151	rs2655991	rs2655991	rs2055991	rs2257182	rs2460002	rs2460002	rs901964	rs11701361	rs2896452	rs2896452	rs1004564	40000000
	Associationd	ABCA7	ABCA7	ACAT1	ADCK1		ADK	20220	HI.A.G		AKTIP	AKTIP	ALDH3A2	ANG	ANPEP	ANPEP	APSBI			ARL17B	ARL17B	ARL17B	AKLIG	BID		C110RF17	0100010	CISONFIS		C14ORF173														CSORF59	
SNP 1	Pos/Mbc	1047161	1047161	108207393	78088813	88462550	76446305	137112421	29938258	57721127	53536345	53536345	19581009	21153299	90363995	90363995	77508159	75768225	35932619	44064851	44064851	44064851	19810050	18213057	18233000	8886260	6259852	37575398	92276674	105189504	13819673	77574438	77574438	70416307	51151724	63509633	110577257	46384412	25711358	48052838	48027084	36577930	31272238	86102223	2000
	Chr.	19	1 1	1 :	14	16	10	0, 0	o (c	16	16	16	17	14	12	L5	o 5	17	21	17	17	17	161	22	22	11	16	22	12	14	8 7	# T	14	17	7.7	1 2	9	18	16	21	7.7	13	18	8 T	*
	rs ID	rs3752237	rs3752237	rs227064	rs12431896	rs8058066	rs2395095	rs2011312	rs2523971	rs2896940	rs7189819	rs7189819	rs3760489	rs9322855	rs11073891	rs11073891	rs6453374	rs12947580	rs2834541	rs8079215	rs8079215	rs8079215	rs4284750	rs8919	rs181405	rs2568061	rs2110603	rs11089825	rs3935344	rs4983382	rs1293455	rs2655991	rs2655991	rs4793445	rs6010061	rs/245800	rs2334323	rs2279474	rs7188668	rs4819271	rs9978658	rs12429804	rs12454561	rs2896452	101101
	Chr.	19	1 2	7 =	14	14	10	01	10	16	16	16	17	14	15	C.	o 5	17	17	17	17	1.7	- 61	22	22	11	13	2 41	14	14	4.2	. T	14	14	4.	7 1		-1	-	21		o oc	, x	∞ α	,
Expression trait	Probe ID ^b	ILMN_1743205	ILMIN_1743205	ILMN 1800008	ILMN_1698777	ILMN_1698777	ILMN_2358626	ILMN 1798308	II.MN 1798308	ILMN_1665982	ILMN_1665982	ILMN_1665982	ILMN_2401641	ILMN_1760727	ILMN_1763837	ILMIN_1763837	ILMIN_1768867	ILMN_3231952	ILMN_3231952	ILMN_3231952	ILMN_3231952	ILMN_3231952	ILMN 2134224	ILMN_1763386	ILMN_2372413	ILMN_1752988	ILMN_2196550	ILMN_2393450	ILMN_2393450	ILMN_2393450	ILMN_1804396	ILMN 1804396	ILMN_1804396	ILMN_1804396	ILMN_1804396	ILMIN-1504530	ILMN_1726989	ILMN_2097790	ILMN_2097790	ILMN_1795836	ILMN_1795836	ILMN_1653205	ILMN_1653205	ILMN_1653205	THINTI TOO TO THE TOO THE TOO THE TOO TO THE TOO THE T
Exp	Gene IDa	ABCA7	ABCA7	ACAT1	ADCK1	ADCK1	ADK	AGAFO	AHSA2	AKTIP	AKTIP	AKTIP	ALDH3A2	ANG	ANPEP	ANPEP	APSBI	ARL17B	ARL17B	ARL17B	ARL17B	ARL17B	ARLI'B ATP13A1	BID	BID	C110RF17	C13ORF18	C14ORF173	C14ORF173	C14ORF173	C14ORF4	C14ORF4	C14ORF4	C14ORF4	C14ORF4	C17ORF60	CIORF86	C1ORF86	C10RF86	C21ORF57	CZIORF57	CSORF59	CSORF59	CSORF59	2000

	Distance / Mbh							29.369																					14 697	T#:03.				i i	19.781												10000
alues	ಶ್ಚಿ	0.87	0.34		0.42	0.62	C/-T	1.20	0.78	0.37	0.41	1.09	0.01	0.10	1.12	0.23	0.93	0.50	0.54	0.15	0.22	0.31	0.14 0.02	0.02	1.20	0.42	80.0	1.16	0.45	10.0				0.11	0.45	1.44	0.12	0.09		0.44	0.36	0.67	0.73	0.03	1.39	0.01	Continued on next name
/ - log10 p-values	EGCUT	0.18	0.00		0.86	0.96	60.7	1.57	1.34	0.52	0.03	0.59	0.01	0 33	1.56	0.12	0.78	0.78	0.87	0.26	0.30	0.37	0.18 0.01	0.03	0.24	0.80	0.27	1.67	0.22	2.0				0.14	0.07	0.16	0.24	0.10		0.20	0.02	1.28	0.36	20.0	0.28	0.01	0.01
Interaction statistic	Fehrmannf	1.39	0.96		0.00	0.23	0.0	0.36	0.13	0.27	0.97	1.15	0.11	0.07	26.0	0.49	0.75	0.23	0.22	0.19	0.26	0.33	0.23	0.08	1.74	0.13	0.04	0.24	0.71	*0.0				0.21	0.93	2.16	0.15	0.23		0.72	0.92	0.07	0.85	0.07	1.92	0.10	00:00
Interacti	BSGSe	5.79	6.36	5.81	6.61	7.07	7.00	7.68	6.55	7.01	7.81	6.62	6.12	0.07	# 00 1 00	6.74	7.42	7.42	6.07	6.93	6.41	5.68	5.62	5.09	90.9	5.71	5.56	6.31	7.88	7.43	7.02	6.13	80.9	5.46	0.47 6.15	6.67	5.75	6.36	5.65	5.74	4.75	0.00	4 о. 4 и	7.56	6.33	6.34	9.74
	Associationd	C8ORF59	CABC1		INPP5E	CAST	CAST	CAST					CAT	CCDC88B	VAMPS	CD55					CD 03	CF as				CDC16	CEACAM91			ANAPC13		CHPT1		CLECIZA	a E	CFIP			CFVL								
SNP 2	Pos/Mb^{c}	86102223	227174210	82128660	139266496	96000269	96000269	96000269	96000269	96000269	96000269	96000269	96000269	96000269	96000269	96000269	238120177	170192890	224093101	195531841	34447586	64125142	96998193 85816334	207502534	157182040	7992632	196721395	125145394	38434472	238899903	136500554	74439542	77264482	115008038	30833162	158943044	180265266	134247706	235248562	102087844	81937002	10132283	134235588	63121080	67713633	61738094	29180410
	Chr.	∞ -			6	ហេដ	ט גט	υ	ю	D.	ю	ı,	ı, ı	ņι) 10	ı.	1	4	7	က	11	11.	10	-	4	4	3	15	13	9 -	+ oo	18	1.7	13	- 6	10	4	60	7	12	11	7.7	0 1	91	13	4 1	,
	rs ID	rs2896452	rs3738725	rs684040	rs4077515	rs7733671	rs//336/1	rs7733671	rs7733671	rs10802643	rs12650909	rs2203733	rs2641772	rs11032695	rs541207	rs12771349	rs6700168	rs10255470	rs4696726	rs7622580	rs838875	rs9576388	rs10925747	rs2873420	rs4328531	rs4789981	rs7324744	rs11055031	rs2421050	rs13132719	rs13079012	rs772788	rs2695290	rs867578	rs7313235	rs3903088	rs169130	rs7336017	rs1455268	FSZ45884							
	Associationd	0000	Caoneria	INPP5E													CAST	CAST	CAST	CAST			CCDC88B		CD93	CD93	CD93	CD93	CD93	CDd3	CD93	CD93	CD93	002011	HOABZ	CEACAM21	CEP192		CES1					ABCA7	ABCA7		
SNP 1	Pos/Mb^{c}	7188323	4353908	139289825	6026661	6778978	81840122	125369113	78255630	78392770	27311111	86107920	70496867	126458593	31149140	59590078	96000269	96000269	96000269	96000269	66175386	17099980	80280117	76033374	23074375	23074375	23074375	23074375	23074375	23076914	23076914	23076914	23076914	104162263	51956250	42066556	13069782	101350298	55861794	38838122	102277782	84471642	10155545	1047161	1047161	145569535	20119902
01	Chr.	16	g [6	Ξ;	7.0	16	'n	6	œ	12	11	14	7 (9	40	10	70	rO	ю	ro .	00 0	61.	11	11	20	20	20	20	0.70	0.00	20	20	20	4:	20	13	18	14	16	13	175	16	7 -	51	19	œ ç	οŢ
	rs ID	rs8051751	rs12765847	rs4266763	rs4573661	rs1157079	rs12599264	rs12719343	rs1410575	rs166444	rs17648036	rs17818702	rs227402	182022124 183757155	rs4503014	rs7474890	rs7733671	rs7733671	rs7733671	rs7733671	rs872311	rs2353203	rs694739	rs750801	rs1884655	rs1884655	rs1884655	rs1884655	rs1884655	rs4813479	rs4813479	rs4813479	rs4813479	rs861544	rs9905940	rs4803481	rs6505780	rs3825569	rs8192935	rs591967	rs6539014	rs429790	rs/305054	rs3752237	rs3752237	rs4333645	rs12596791
	Chr.	oo o	n -	6	6	iO H	0 10	'n	ю	r	ю	ı,	ı, ı	O M) IC	ıo	10	ю	Ŋ	n	11	11:	11	-	20	20	50	50	0 70	0.00	20	20	20	13	71	13	18	e	16	12	12	7 7	21 F	9	13	ο I	,
Expression trait	Probe ID ^b	ILMN_1653205	ILMN 1731064	ILMN_1712532	ILMN_1712532	ILMN-1717234	ILMN-1717234	ILMN_1717234	ILMN_1717234	ILMN_1717234	ILMN_1717234	ILMN_1717234	ILMN_1717234	ILMIN-1717534	II.MN 1717234	ILMN_1717234	ILMN_1717234	ILMN_1717234	ILMN_1717234	ILMN_1717234	ILMN_1651705	ILMN-1772208	ILMIN-1772208	ILMN_1800540	ILMN_1704730	ILMN_1704730	ILMN_1704730	ILMN_1704730	ILMN-1704730	II.MN 1704730	ILMN_1704730	ILMN_1704730	ILMN_1704730	ILMN_2339796	ILMIN-1730928	ILMN_1745949	ILMN_1703754	ILMN_1787808	ILMN_2359945	ILMN_2202940	ILMN_2202940	ILMN-1663142	ILMIN_2403228	ILMN 1770290	ILMN_1770290	ILMN_1654545	1LMIN_1682928
Exp	Gene IDa	CSORF59	Caone 12	CARD9	CARD9	CAST	CASI	CAST	CAST	CAST	CAST	CAST	CAST	CAT	CCDC88B	CCDC88B	CD55	CD93	CD93	CD93	CD93	CD93	CD 23	CD93	CD93	CD93	CDC16	CEACAM91	CEACAM21	CEP192	CEP63	CES1	CHPT1	CHPT1	CLECIZA	CLECIZA	CNN2	CNN2	CPSF1	CFVL							

	nce / Mb ^h			0.033			0.040						12.255																	66.920	0.052																		10 736	10.10
	Distance																																																	
values	Metag	0.04	0.15	42.27	0.11	1.03	33.73	00:00	0.34	40.0	1.47	0.36	0.44	09.0	0.44	0.14	0.42	0.44	0.16	0.29	0.58	0.32	0.37	0.03	0.10		0.19		0.01	0.11	0.97	1.12	0.0	1 6	0.79	0.10	0.24	0.41	0.02	0.53	0.11	0.41		0.35	0.81	0.09	0.08	1.06	0.44	0.23
- log10 p-values	EGCUT	0.03	0.36	16.72	0.41	0.74	15.06	0.01	0.00	0.02	1.87	0.83	0.10	0.86	0.41	0.58	0.25	0.29	0.41	0.02	1.17	0.34	0.04	0.11	0.05	0.58	0.22		0.02	0.00	1.45	0.27	1.18 8 2 6	0.00	0.47	0.11	0.08	0.59	0.05	1.12	0.04	0.40		0.58	1.20	0.11	0.04	1.03	0.19	0.30
<u> </u>	Fehrmann ^f 1	0.19	0.10	25.20	0.02	0.92	18.76	10.0	0.23	0.20	0.39	0.05	0.87	0.29	0.48	0.00	0.64	0.61	80.0	0.77	90.0	0.37	0.88	0.05	0.32		0.30	0.37	0.09	0.48	0.23	NO.10	0.15	0.64	0.90	0.23	0.56	0.28	80.0	0.05	0.36	0.45		0.20	0.25	0.20	0.29	0.67	0.74	0.97
Interaction statistic	BSGS ^e Fel	5.55	6.18	11.99	5.74	5.67	7.16	5 43	1 0	89.50	5.81	5.53	5.85	5.42	5.44	9.12	5.62	5.31	5.47	6.39	00.9	6.48	5.51	7.64	4.65	4.87	5.31	4.40	5.03	5.92	5.79	0.17	4.81 6.10	0 10 0 00 0 00	86.98	5.56	5.44	5.55	6.36	5.52	6.51	5.56	6.03	5.70	5.43	6.11	5.65	5.63	6.83 6.83	0.01
	Associationd	CPVL			CTNNA1	CoEC	2010	CWF19T.1	CYBBD1	CYBED1	CYBRD1	CYBRD1		CYP27A1	DAB2					COQ10A	DHRS9	DHRS9	DHRS9	DHRS9	LASS5		LASS5			LASS5	DNAJB6	בחקם	SCHOOL	ECHDC2	EHD4	EIF2B2					EMR2	EMR2		EPHX2	ERICH1	ERICH1	ERICH1	0	EXOC3	FARIDI
SNP 2	Pos/Mb ^c	29188475 46843631	62406408	45198355	138226767	108679892	_	102027407	172368120		_	172368120	160112881	219650616	39381357	82076988	187475208	32451144	88204888	137810259	169960422	169960422	169893419	169893419	50610976	153134888	50730458	61971140	115214154	51074199	157163614	16320360	64004670 F24025F2	53402552	42192040	75590340	99603119	49359676	129624067	126387391	14879034	14879034	102480759	27400604	578742	607161	578742	182786760	1972548	
01	Chr.	٥ - ٦	ıv	21	20	10	: :	1 .	6	10	1 (2)	2	. 61	2	ю	9	8	6	7	6	2	7	7	7	12	7	12	œ	10	12	٠ ،	n 0	χ-		1 10	14	14	7	œ	11	19	19	13	œ	œ	oo i	oo ·	4,1	ر د م	0,7
	rs ID	rs245884	rs1473927	rs3761385	rs176382	rs7079264	rs556895	rs12784396	rs888427	rs888427	rs888427	rs888427	rs7591849	rs933994	rs835223	rs1343244	rs2378341	rs7042042	rs2519515	rs10120023	rs7566044	rs7566044	rs2161037	rs2161037	rs11169322	rs2872008	rs7134595	rs1808634	rs4532958	rs12427378	rs3779589	rs1500972	rs4891884	rs11206043	rs1048166	rs175450	rs1269096	rs1553474	rs2197210	rs4471434	rs9305048	rs9305048	rs3007765	rs13269963	rs12115088	rs4735900	rs12115088	rs1517297	rs12188164	rs344303
	Associationd		CRLS1		0	CISC							CYBRD1				DDT		COQ10A							LASS5		LASS5	LASS5			100	ECGFI				EIF5A	EIF5A	EIF5A	EIF5A			EMR2					ERICH1		
SNP 1	Pos/Mb^{c}	39202070	5986234	45230974	69500505	88139983	88117962	11456027	129994690	140698856	12318284	23344590	172368120	36571928	110451383	43111688	24248761	125962645	137810259	106703727	89468283	147132505	29959453	187776431	29161503	50636364	41711815	50730458	50744171	117994348	157216093	93409054	50971266	17675900	53244938	60218334	7221707	7221707	7221707	7221707	23196249	18761714	14879034	127909396	134611176	45337329	31187910	600729	55228462	12/00/00
ß	Chr.	21	20	21	18	11	7 -	: :	4	+ O	10	20	2	20	1-	17	22	11	6	11	12	7	21	4	17	12	19	12	12	15	<u>-</u>	o 6	77 0	1 0	5	18	17	17	17	17	21	20	19	11	11	55	18	œ ç	010	0 7
	rs ID	rs2835998 rs2131290	rs6139887	rs9979356	rs924943	rs2457684	rs7930237	rs7108734	rs2592948	rs7852475	rs11257679	rs6137908	rs888427	rs6021982	rs7778910	rs9900173	rs5760102	rs4937097	rs10120023	rs12363827	rs1519956	rs1528529	rs2831914	rs7661304	rs11080134	rs11169335	rs338585	rs7134595	rs7312252	rs871257	rs2286842	rs12232308	rs140522	rs5992637	rs10403312	rs6567288	rs7216490	rs7216490	rs7216490	rs7216490	rs2827076	rs6132112	rs9305048	rs1107764	rs10894861	rs5766218	rs726145	rs4735895	rs187076	FS1300104
	Chr.	٥ - ١	20	21	ю ;	===		1 .	- 6	10	1 (2)	. 61	0	61	ıo	17	22	6	-	-	7	7	7	2	12	12	12	15	17	12	- c	n (77		1 10	14	17	17	17	17	19	19	19		∞			oo 1	٠ <u>۱</u>	97
Expression trait	Probe ID ^b	ILMN_1682928 ILMN_1813256	ILMN_1737685	ILMN_1761797	ILMN_1804854	ILMN_1696347	ILMN 2242463	II.MN 1651886	II.MN 1712305	II.MN 1712305	ILMN 2087692	ILMN 2087692	ILMN_2087692	ILMN_1704985	ILMN_2128428	ILMN_1811648	ILMN_1690982	ILMN_1797001	ILMN_1783996	ILMN_1783996	ILMN_1733998	ILMN_1733998	ILMN_2384181	ILMN_2384181	ILMN_1755589	ILMN_1755589	ILMN_1755589	ILMN_1755589	ILMN_1755589	ILMN_1755589	ILMN_1793770	ILMN_2349610	ILMN-2109708	II.MN 1671568	II.MN 1720083	ILMN_1713380	ILMN_1794522	ILMN_1794522	ILMN_1794522	ILMN_1794522	ILMN_2353633	ILMN_2353633	ILMN_2353633	ILMN_1709237	ILMN_1731001	ILMN_1731001	ILMN_1731001	ILMN_2104696	ILMN_1789419	ILIMIN 1668069
Exi	Gene ID ^a	CPVL	CRLS1	CSTB	CTNNA1	CISC	CEST	CWF191.1	CYBRD1	CYBRD1	CYBRD1	CYBRD1	CYBRD1	CYP27A1	DAB2	DCAKD	DDT	DDX58	DEM1	DEM1	DHRS9	DHRS9	DHRS9	DHRS9	DIP2B	DIP2B	DIP2B	DIP2B	DIP2B	DIP2B	DNAJB6	D7.55	ECGFI	ECHDO:	EHD4	EIF2B2	EIF5A	EIF5A	EIF5A	EIF5A	EMR2	EMR2	EMR2	EPHX2	ERICH1	ERICH1	ERICH1	ERICH1	EXOC3	FABDI

Expression trait				SNP 1				SNP 2		Interact	Interaction statistic /	$-\log_{10} p$ -values	values	
Probe ID ^D	Chr.	rs ID	Chr.	Pos/Mb^{c}	Association ^d	rs ID	Chr.	Pos/Mb^{C}	Association	$BSGS^{e}$	$Fehrmann^{I}$	$EGCUT^{t}$	Metag	Distance / Mb ⁿ
ILMN_1739586 II.MN_1739586	2 12	rs2356400	19	44321776		rs13406184	61.6	36791226	FEZ2 FEZ2	5.78	0.14	0.33	0.16	
ILMN_2115005	1 9	rs4803848	19	46205050		rs831486	1 9	37001267	FGD2	5.69	0.12	0.25	0.11	
ILMN_2115005	9	rs902634	10	133943951		rs831489	9	36999682	FGD2	5.49	1.20	0.11	0.66	
ILMN_1778144	12	rs17615703	12	117036766		rs3782908	12	48169526	FLJ20489	5.81	90.0	0.70	0.29	68.867
ILMN_1778144	17	rs3782908	12	48169526	FLJ20489	rs897511	4	167695661		5.53	0.03	0.11	0.02	
ILMIN_1778144	2 5	rs4792199) T	7992118		rs3/82908	7 5	48169526	FLJ20489	5.74	0.19	0.02	0.04	
II.MN 1778144	1 5	rs7204140	91	50626195		183782908	1 0	48169526	FT 120489	64.0	380	0.47	0.00	
ILMN_1763663	191	rs9325634	21	43818790		rs2287197	91	50106594	FLJ20718	6.04	0.14	0.95	0.53	
ILMN_2123450	9	rs17112712	14	107276627		rs6906101	9	36667610	FLJ43093	5.48	0.39	0.06	0.13	
ILMN_2123450	9	rs6906101	9	36667610	FLJ43093	rs13214069	9	32705248		5.44	0.00	0.64	0.18	3.962
ILMN_1652333	17	rs898095	17	80890638		rs9892064	17	80827903		16.16	28.24	29.39	59.95	0.063
ILMN_1752728	-	rs4971478	7	1346063		rs12744386	1	24168019	FUCA1	6.41	0.01	0.30	90.0	
ILMN_2309848	19	rs1633921	19	35695200		rs788178	13	98328559		3.70	0.09	0.41	0.17	
ILMN_2309848	19	rs17398183	20	55609148		rs2285515	19	35660450	FXYD5	6.58	0.03	0.48	0.15	
ILMN_2309848	19	rs2285515	19	35660450	FXYD5	rs11739594	Ю	141709563		5.70	0.02	0.17	0.02	
ILMN_2309848	19	rs2285515	19	35660450	FXYD5	rs13067700	8	95331048		00.9	0.09	0.51	0.22	
ILMN_2309848	19	rs2285515	19	35660450	FXYD5	rs17036504	7	47567329		6.10	0.28			
ILMN_2381758	4	rs10230232	7	29390239		rs1553985	4	76554604		5.19	0.08	0.37	0.14	
ILMN_2410783	17	rs11150847	17	78153130		rs12602462	17	78146016		13.91	19.98	12.99	32.60	0.007
ILMN_2410783	17	rs8068856	17	78100731	GAA	rs10902506	12	132678089		5.65	0.11	0.39	0.17	
ILMN_1675191	ιΩ	rs10070522	ю	57786110	GAPT	rs7605821	7	235695228		5.85	0.01	0.78	0.28	
ILMN_1675191	'n	rs7082031	10	128038717		rs10070522	ю	57786110	GAPT	5.72	0.26	0.11	0.11	
ILMN_1699631	-	rs1147447	14	66460742		rs2950520	7	99827148	GATS	5.47	0.83	0.63	0.87	
ILMN_1699631	7	rs2425256	20	35056572		rs2950520	7	99827148	GATS	6.22		0.42		
ILMN_1774901	16	rs3809624	16	30102802	GDPD3	rs2197465	14	48572632		6.57	0.38	0.35	0.33	
ILMN_1774901	16	rs7204270	16	30156963	GDPD3	rs1015111	4	128972357		5.86	0.55	0.09	0.24	
ILMN_1790692	61	rs4145072	13	110899955		rs7577293	61	85935282	GNLY	5.78	0.05	0.45	0.13	
ILMN_3239426	12	rs7198646	16	26084476		rs7960552	12	111164237	GPN3	5.72			_	
ILMN_1730816	12	rs1860563	16	6478898		rs2707210	12	6902002	GPR162	5.49	0.36	0.46	0.39	
ILMN_1730816	12	rs2272500	12	79685913		rs2707210	12	6902002	GPR162	5.07	0.25	0.03	0.06	72.784
ILMN-1730816	12	rs2707210	13	6902002	GPR162	rs4740848	6	6554558		5.47	0.25	90.0	0.02	
ILMN-1730816	12	rs2707210	12	6902002	GPR162	rs9827054	က	188880113		6.21	96.0	90.0	0.44	
ILMN_1660549	-	rs11057383	12	124369421		rs12065581	1	68732819	GPR177	5.45	0.72	0.67	0.81	
ILMN_1660549	-	rs12527241	9	120468039		rs12065581	_	68732819	GPR177	5.76	0.17	0.40	0.22	
ILMN_1660549	-	rs12532999	۲-	127939793		rs12065581	-	68732819	GPR177	6.50	0.79	1.43	1.50	
ILMN_1660549		rs725613	16	11169683		rs12065581		68732819	GPR177	5.43	0.31	0.11	0.13	
ILMN-1660549	٠,	rs9575097	13	82986268		rs12065581		68732819	GPRITT	6.04	0.95	0.21	0.60	
ILMIN_2283325	٠,	rspspeppe	× 0	11090507		rs12065581		68732819	GPRIT	0.00	0.24	0.34	0.23	
1LMIN_2283323	- į	189290420	o į	1/1399321	4000	180000181	⊣ <u>1</u>	08/32819	GFRILL	00.00	0.01	0.24	0.04	
ILMIN_234/193	7,	100,001	7 7	58028634	GSDMD	1110100	CT	192806101		00.0	0.00	0.20	0.41	
ILMIN-2391901		1812240010	0 1	00194000		rs11101992		110966754	TM LOS	0.11	0.57	0.13	0.10	
TI MIN 2201E00		LSIO41014	0 0	0615056		FSI 1101392		1100500134	TWI CO	0.31	77:0	#T:T	 	
ILMN 1757467	1 66	15045550	000	38300070		re4853333	٠, ٥	77919015	TIMES	98.9	C 7 C	0.66	и С	
II.MN 1757467	1 0	rs139898	100	38399979		rs6497007	1 10	85877017		 	20:0	0.33	0.00	
II.MN 1757467	100	rs139898	010	38399979		re9983949		19532546		70.2	20.0	0.01	0.00	
II.MN 1796678	-	rs11078523	1 1-	4523167		re2855039	-	5271671	HBG2	7 4 7	00.0	0.66	0 0	
ILMN 1796678	-	re12075066	- 0	25723501		15250003	: :	5971671	HE CO	. r.	0.0	0.00	0.13	
II.MN 1796678	-	rs2855039		5271671	HBG2	rs12042181	-	213088494	LOK1	22.09	80.0	0.00	12.0	
ILMN_1796678	11	rs2855039	11	5271671	HBG2	rs12503379	4	141533832	· •	6.42	0.01	0.46	0.11	
ILMN_2084825	11	rs11078523	17	4523167		rs16912979	11	5309695	HBG2	90.9	0.01	0.41	0.10	
													Continu	Continued on next page

	Distance / Mb ^h										000	000.001			0.041														0.097																0.118				
-values	$Meta^g$	0.05	0.10		0.32	1.22	0.52	0.86	1.34	0.46	2.52	4.0	02.20	0.02	10.37					0.29	0.44	1.55	0.02	0.33	0.77	0.37	0.78	0.03	29.24		0.34	0.02		0.15	0.0	0.16	0.49	0.59	1.09		0.54	1.37	1.34	4.58	41.56	5.53	5.23	0.70	
$-\log_{10} p$ -values	$EGCUT^{f}$	0.13	0.46		0.59	0.34	0.16	0.47	1.11	1.01	3.13	46.0	0.03	0.00	3.01					0.50	0.23	0.84	0.26	0.13	0.89	0.80	0.08	0.0	11.22		0.40	0.03	0.13	0.35	0.13	0.03	0.36	0.88	1.11		0.27	2.21	0.63	5.36	24.74	5.80	5.82	0.72	
Interaction statistic /	$Fehrmann^{f}$	0.08	0.00		0.15	1.61	0.90	0.10	0.92	0.05	0.39	0.00	0.00	0.04	20.00					0.19	0.69	1.46	0.02	0.65	0.46	80.0	0.64	0.00	18.60		0.35	0.23		0.11	0.13	0.49	0.61	0.25	0.63	1.18	0.79	0.08	1.43	0.43	16.25	0.91	0.62	0.52	
Interacti	BSGSe	5.77	5.98	5.75	5.98	5.81	5.94	5.69	6.54	0.62	5.80	0.00	0.00	5.45	15.38	5.51	6.51	6.61	6.48	06.9	5.53	5.58	8.16	5.64	4.74	5.53	5.45	7.00 7.00	19.16	6.00	5.16	6.13	08.80	0.08 61	0. V	5.71	6.31	5.62	5.93	5.78	7.96	6.70	7.38	7.71	13.49	7.10	7.63	6.05	
	Associationd	HBG2	T CAN T	HDAC7		HEXDC	HLA-DRB6	HLA-H	HMBOXI	HMBOXI	HMBOXI	HMBOAL		HMBOX1		HSPC157	HSPC157	HSPC157	HSPC157		IL32	INPP5E				KTELC1	KTELCI	LADS	0 107	LDLRAP1			0	LKKCZS		LYZ	!		MAD2L1BP	MAP1LC3A	MBNL1	MBNL1	MBNL1	MBNL1		MBNL1	MBNL1	MBNL1	
SNP 2	$\mathrm{Pos/Mb}^{\mathrm{c}}$	5271671	141533832	48173352	135220622	80378939	32411646	29695713	28876221	28751381	28904086	1001001	159955772	28904086	178991794	22439520	22439520	22439520	22439520	131757163	3115628	139335599	28288174	5570771	189055298	119119433	119195913	17588050	203780591	25889632	179608360	71561497	127804531	78046870	15/13/15/	69734641	130319560	127011798	43528441	33351864	152187431	152187431	152187431	152187431	152116652	152187431	152187431	152187431	
J)	Chr.	11	4	12	œ	17	9 (٥٥	x 0 (ю (x 0 0	0 0	10	- ox	10	-	1	1	П	12	16	6	۲-	11	4	n	n -			-	ю	18	10	F -	- 1-	- 2		8	9	20	თ	თ	က	က	က	8	က	n	
	rs ID	rs2855039	rs12503379	rs4760636	rs17686635	rs7213057	rs7192	rs2523404	rs7837237	rs4732890	rs8180944	181001201	124000900	rs8180944	rs4700810	rs4654783	rs4654783	rs4654783	rs4654783	rs4759890	rs1554999	rs1127152	rs849341	rs424299	rs6419960	rs727905	rs6414283	re7658940	rs10900520	rs6687605	rs11749727	rs714789	rs1278387	rs8101804	re11981755	rs2168029	rs2253135	rs6414306	rs1096699	rs6060034	rs13069559	rs13069559	rs13069559	rs13069559	rs13079208	rs13069559	rs13069559	rs13069559	
	Associationd	000	HBG2		HEBP1							1 VOGATI	HMBOAI	HMDOVI					CWF19L1	IL32				KCNJ15	KIR2DL1		LOMBELO	DOMED LEA				LILRA5	LINS1	9001	172		LYZ	MAD1L1											
SNP 1	Pos/Mb^{c}	35723501	5271671	6036851	13145613	71237270	77532672	75467313	98670849	42112794	127237464	102/20/01	20004000	110897444	179032488	88882257	46486900	121229893	101884937	3115628	2560423	81603771	47970693	39606769	55324635	84597119	183109012	132602868	203877662	59971635	26083392	54827248	101120963	01101300	69734641	77276964	69734641	1923385	103203146	29435869	78225815	9932070	97100681	94648239	152234166	114067127	6604708	34291750	
J1	Chr.	19	: ::	16	12	18	14	χ.	14	17.	7.7	0 0	0 0	0 @	10	16	20	12	10	16	19	16	12	21	19	13	4 6	4 0	۰ -	15	17	19	12	71 (9	5	2 00	12	-1	13	21	6	12	13	-1	က	9	17	7.5	
	rs ID	rs12975066	rs2855039	rs2109029	rs3782567	rs1942719	rs4899635	rs11660982	rs12435486	182837803	rs4765451	rs50/059	rso100944	re9521666	rs6894268	rs555812	rs6063164	rs662739	rs7088558	rs1554999	rs765044	rs8044524	rs757355	rs2186344	rs649216	rs4349034	rs6815953	re7042087	rs1891432	rs1552032	rs12450521	rs3859532	rs11247226	rs0009951	re9168099	rs177820	rs2168029	rs7783715	rs7983718	rs974607	rs10869600	rs11053043	rs1164596	rs11981513	rs16864367	rs2030926	rs218671	rs2213360	
	Chr.	11	11	12	12	17	9 (٥٥	x 0 (x 0 (x 0 0	0 0	0 0	0 00) 10	-	1	П	П	16	16	6	-	21	19	n	n 6	4 4	-	-	17	19	12		5	2 2	17	-	9	20	n	n	<u>ო</u>	က	က	e	en 1	n	
Expression trait	Probe ID ^b	ILMN_2084825	ILMN_2084825	ILMN_3266186	ILMN_1802557	ILMN_1741180	ILMN_2157441	ILMN_1762861	ILMN_1720059	ILMIN_1720059	ILMN_1720059	ILMIN_1720059	ILMIN-1720059	II.MN 1720059	ILMN_2101920	ILMN_3194087	ILMN_3194087	ILMN_3194087	ILMN_3194087	ILMN_1778010	ILMN_2368530	ILMN_1811301	ILMN_1682727	ILMN_1675756	ILMN_1691803	ILMN_1811104	ILMN_1811104	ILMN 1683709	ILMN_1769782	ILMN_1809040	ILMN_2412214	ILMN-2357419	ILMN_2338197	ILMN-2150196	II.MN 1815205	ILMN 2162972	ILMN_2162972	ILMN_2358069	ILMN_1694711	ILMN_1776188	ILMN_2313158								
Exp	Gene ID ^a	HBG2	HBG2	HDAC7	HEBP1	HEXDC	HLA-DRA	HLA-F	HMBOXI	HMBOAI	HMBOXI	IMBOAI	HMBOA1	HMBOX1	HNRPH1	HSPC157	HSPC157	HSPC157	HSPC157	IL32	IL32	INPP5E	JAZF1	KCNJ15	KIR2DS5	KTELC1	KTELC1	LADS	LAX1	LDLRAP1	LGALS9	LILRA5	LINSI	LKKCZS	1.7.7	LYZ	LYZ	MAD1L1	MAD2L1BP	MAP1LC3A	MBNL1								

Ex	Expression trait				SNP 1				SNP 2		Interac	Interaction statistic /	- log10 p-values	values	
Gene ID ^a	Probe ID ^b	Chr.	rs ID	Chr.	Pos/Mb ^c	Associationd	rs ID	Chr.	Pos/Mb ^c	Associationd	BSGSe	Fehrmann ^f	$EGCUT^{f}$	Metag	Distance / Mbh
MBNL1	ILMN_2313158	3	rs4392535	4	41513423		rs13069559	33	152187431	MBNL1	8.39	0.02	4.33	3.02	
MBNL1	ILMN_2313158	က	rs4735830	œ	895841		rs13069559	က	152187431	MBNL1	6.74	0.32	4.21	3.38	
MBNL1	ILMN_2313158	3	rs4939558	18	46278591		rs1522374	က	152235530		7.72	0.03	0.27	0.07	
MBNL1	ILMN_2313158	8	rs6128397	20	57253132		rs16864367	က	152234166		7.22	1.34	1.15	1.73	
MBNL1	ILMN_2313158	3	rs7710738	IJ	22101322		rs13069559	က	152187431	MBNL1	7.92	2.55	7.89	9.28	
MBP	ILMN_2331544	18	rs6079849	20	15462611		rs2051344	18	74715653	MBP	6.26	0.10	0.03	0.02	
MBP	ILMN_2398939	18	rs139568	22	42210985		rs2051344	18	74715653	MBP	5.56	0.03	0.23	0.02	
MBP	ILMN_2398939	18	rs2051344	18	74715653	MBP	rs1125539	က	155204939		5.79	0.02	0.76	0.27	
MBP	ILMN_2398939	18	rs2051344	18	74715653	MBP	rs2619046	io.	55097534		6.03	0.15	0.50	0.26	
MBP	ILMN_2398939	18	rs4805021	19	33436367		rs2051344	18	74715653	MBP	5.82	0.03	0.47	0.14	
MBP	ILMN_2398939	18	rs8092433	18	74747424		rs4890876	18	74732087		5.40	2.06	21.91	28.73	0.015
MEGF9	ILMN_2290118	0	rs13039689	20	51922071		rs966396	6	123453281	MEGF9	4.63	1.13	1.33	1.71	
MFN2	ILMN_1651385	-	rs7989895	13	109401737		rs4846085	-	12050634	MFN2	5.76	0.61	0.25	0.41	
MGC13057	ILMN_1787526	7	rs12718598	7	50428445	MGC13057	rs11725347	4	171860973		5.81	0.13	0.30	0.14	
MGC13057	ILMN_1787526	21	rs674608	18	69070772		rs12718598	<u>-</u>	50428445	MGC13057	5.57	0.07	1.03	0.50	
MGC13057	ILMN_1787526	21 5	rs8058318	16	82628245		rs12718598		50428445	MGC13057	7.05	0.11	0.12	0.02	
MGC72104	ILMN-1688318	50	rs845787	207	26197931	MGC72104	rs2660665	ю.	137526799		4.17	0.05	0.08	0.02	
MGST3	ILMN-1751956	٦,	rs740441	1.7	55779644		rs4147592	⊣ 1	165600146	MGST3	5.45	0.57	0.27	0.40	
MPZL2	ILMN_1752932	Ξ;	rs1805	11	118076069	MPZL2	rs11771552	٠;	154708716		5.90	0.01	0.23	0.04	
MPZLZ	ILMN-1752932	Ι,	rs/316716	7 .	19953193		rs1805	Ξ,	118076069	MPZLZ	5.64	0.97	1.08	1.35	
MRPL36	ILMN_1800197	٠.	rs17469061	10	8436432		rs750495	٠. د	1782046	MRPL36	6.89	0.34	0.18	0.19	
MRPL43	ILMIN-2258774	10	rs6564769	97	80641040		rs2863095	07;	102746503	MRPL43	5.71	0.26		0	
MRPL52	ILMN_1713966	14	rs1950857	14	26710271		rs3811188	14	0.00	MRPL52	6.56	0.14	0.44	0.22	
MRFSIO	ILMIN_1663664	٥	rs10955512	000	110202230		rs/22269	٥٥	42194916	MRPSIO	7.48	0.46	0.70	0.64	
MRPS10	ILMN_1663664	9 0	rs11698155	50	15063214		rs2395803	9 0	42158596	MRPS10	6.85	0.31	0.63	0.46	
MRPS10	ILMN_1663664	9 ;	rs1420537	16	52453567		rs13217993	9	42164401	MRPS10	6.21	0.41	0.25	0.28	
MTMR15	ILMN_2152178	15	rs7178375	15	31215935	M.I.MK10	rs12431444	4.	42068689		5.18	1.87	1.87	2.86	
MXI	ILMN_1662358	7.7	rs459498	77.	42795027		rs11160227	14	95514596		6.31	0.46	0.52	0.50	
MAI	TIMIN_1002358	7 5	rs459498	77.5	42795027		rs4973801	ء د	26706382		0.00	0.11	0.50	0.73	10 401
MAI	ILMIN_1662556	7 -	rs409490	77-	61509110		rsoloui20	7 -	47466666	MVDDC	0 11	0.29	0.92	0.00	10.401
MVBDC3	II.MN 1781184	: :	1510154030	# C	100550561		re7194681		47490993	MYBDC3	0.00 100 100 100 100 100 100 100 100 100	0.13	80.0	0.00	
MYOMI	ILMIN 1680344	1 0	181322100 264708075	2 0	3047056	MVOM1	18/124001 ve9737499	- o	13.485937	MIDECS	0.0	0.0	0.00	0.0	
N4BP1	II.MN 2201966	91	rs12444224	91	87580855	TATE CIVIT	rs11649236	9 9	48632478	N4BP1	2 2 2	2.00	62.0	1.77	38.948
NAAA	ILMN_1668605	4	rs2707575	-	147638723		rs6826085	4	76870229	NAAA	5.65	0.20	0.03	0.04	
NAAA	ILMN_2391512	4	rs2071856	22	37770630		rs6826085	4	76870229	NAAA	5.46	0.27	0.43	0.30	
NAPRT1	ILMN_1710752	œ	rs2123758	œ	144663661	NAPRT1	rs2786014		234897243		80.9	0.07	0.48	0.18	
NAPRTI	ILMN_1710752	x 0 (rs2123758	oo o	144663661	NAPRTI	rs3889129	οo •	144613680		8.45	15.12	16.08	30.77	0.050
NAPKII	ILMIN-1710752	x 0 0	rs2123758	x 0 0	144663661	NAPRII	rs4862705	4.0	187445552		0.62	1.27	0.19 0.76	18.0	
NAPRTI	ILMN 1710752	0 00	re9193758	0 00	144663661	NAPRTI	rs0400333	4 c	146189057		0.12	0.07	0.70	2 77	
NAPRT1	ILMN_1710752	000	rs2123758	000	144663661	NAPRTI	rs7571561	. 61	213386267		6,03	0.13	0.47	0.23	
NAPRT1	ILMN_1710752	œ	rs2208123	22	48214812		rs2123758	œ	144663661	NAPRT1	6.60	0.29	0.88	0.63	
NAPRT1	ILMN_1710752	œ	rs4743420	6	103488089		rs2123758	œ	144663661	NAPRT1	5.50	0.12	0.17	80.0	
NAPSA	ILMN_1784040	19	rs1405655	19	50882619	NAPSB	rs930280	6	98391111		5.58	0.82	0.10	0.40	
NAPSB	ILMN_2109416	19	rs1405655	19	50882619	NAPSB	rs10882406	10	95976932		5.58	0.67	1.10	1.12	
NAPSB	ILMN_2109416	19	rs1405655	19	50882619	NAPSB	rs7577137	C1 (234721287		5.58 8.50 8.50 8.50	2.11	0.44	1.71	0
NCL	ILMN_2121437	21 5	rs7563453	21 6	232301670		rs4973397	21 0	232291471	0.44	7.31	7.51	6.33	12.70	0.010
NDOFAL	ILMIN_1737738	7 5	rs2/469/1	77.	37101890	NIMETO	rs11107847	21 0	163114006	NDOFAIZ	80.00	0.39	0.18	0.72	
NODS	ILMN 1762594	19	rs2967636	61	7067773	7 7 77 7 7	rs9302752	9	50719103	NOD2	# 06:25 06:25	0.24	0.04	90.0	
NRBF2	ILMN_3237385	10	rs11063498	12	5209048		rs7923609	10	65133822	NRBF2	5.45				
NRBF2	ILMN_3237385	10	rs2375269	11	69876894		rs7923609	10	65133822	NRBF2	5.53				

Table S1 - continued from previous page

Probe Prop. Prop	Expression trait				SNP 1				SNP 2		Interact	Interaction statistic /	- log10 p-values	values	
10 reduction decided 4	Probe ID ^b	Chr.	rs ID	Chr.	Pos/Mb^{c}	Associationd	rs ID	Chr.	Pos/Mb^{c}	Associationd		Fehrmann ^f	EGCUT	Metag	Distance / Mbh
1 10,000	ILMN_3237385	10	rs6025645	20	56157341		rs7923609	10	65133822	NRBF2 NRBF2	5.45				
8 minoson mino	ILMN_1800897	1	rs4852124	- 61	240680022		rs6588415	1	52334047	MINDE	6.13	0.47	0.05	0.17	
12 nillididadi ilitatis 11 11486050 nillididadi ilitatis 11 11486050 nillididadi ilitatis 11 11486050 0AST 413 0.55 0.00 0AST 0.00 0AST 0.00 <td< td=""><td>ILMN_1787885</td><td>œ</td><td>rs5017351</td><td>11</td><td>25453482</td><td></td><td>rs1005901</td><td>œ</td><td>21964378</td><td>NUDT18</td><td>5.44</td><td>0.03</td><td>0.46</td><td>0.15</td><td></td></td<>	ILMN_1787885	œ	rs5017351	11	25453482		rs1005901	œ	21964378	NUDT18	5.44	0.03	0.46	0.15	
12 mistages m	ILMN_1658247	12	rs11613438	12	113480510		rs1047944	9	163997467		8.59	1.27	1.55	2.03	
10. 1.00 1	ILMN_1658247	17	rs13311	12	113448652		rs2072133	12	113409260		4.13	4.12	0.81	3.86	0.039
1 17,8555507 2 17,755469 CSPP1 CSP	ILMN_1675640	12	rs2892233	13	49160255		rs3741981	15	00000	OASI	4.38	0.87	0.46	0.76	
11 17,220,079 2.1 2.00,024.23 2.00,024.24 2.00	ILMN-2381899	01;	rs7192613	16	74286646		rs17512962	01	13169066	OFTN	5.64	0.42	0.06	0.14	
9 FATABOLIS DE CONTRILIS PATABOLIS DE CONTRILICATION FATABOLIS DE CONTRILICATION </td <td>ILMN_2307032</td> <td>11</td> <td>rs2829679</td> <td>21</td> <td>26662543</td> <td></td> <td>rs998639</td> <td>11</td> <td>3149249</td> <td>OSBPL5</td> <td>5.00</td> <td>0.36</td> <td>0.00</td> <td>0.07</td> <td></td>	ILMN_2307032	11	rs2829679	21	26662543		rs998639	11	3149249	OSBPL5	5.00	0.36	0.00	0.07	
1 FAZZASTYO 10 CAPTA NAME CSTF11 PATABLES 171080823 OVERPL 5.42 1.20 0.03 1 FAZZASTYO 1 20123008 3 101040447 5.64 0.08 0.12 0.12 1 FAZZASATO 1 146726182 PCYOXIL r624030 3 0.08 0.08 0.09 0.01 12 FAZZASAGA 2 40167333 PCYOXIL r624042 PEXA 6.0 0.00 0.01 13 FAZZASAGA 1 776442 PEXA 6.0 0.0 0.0 0.0 13 FAZZASAGA 1 1.208207 PEXA 6.0 0.0	ILMIN_I742456	. מ	rs17780195	Į.Į	70624189		rs22/3/70	ומ	77755469	CSTFI	5.42	0.16	0.87	0.49	
1 0.00000000 1.00000000 1.00000000 1.000000000 1.0000000000	ILMN-1742456	n ,	rs2273770	n ,	77755469	OSTFI	rs7718088	Ω,	179590952		5.42	1.20	80.0	0.62	000
1 1	ILMN_1734542	-	rs10802822	-	240132968		rs1264898	_	111992823	OVGP1	5.43	0.13	1.48	0.88	128.140
5 ##3248340 5 ##324840 6 ##324840 6 ##324840 7 ##324840 7 ##324840 7 ##324840 8 ##324840 9 PAM ##32440 PAM ##324840 PAM PAM PAM PAM <t< td=""><td>ILMN_1734542</td><td>-</td><td>rs347331</td><td>n :</td><td>140148107</td><td></td><td>rs1264894</td><td>-</td><td>111969719</td><td>CVGFI</td><td>6.04</td><td>0.25</td><td>1.21</td><td>0.82</td><td></td></t<>	ILMN_1734542	-	rs347331	n :	140148107		rs1264894	-	111969719	CVGFI	6.04	0.25	1.21	0.82	
15 FRANKSHOUND 1 JARY 2019 PEX.D A.18 A.18 <td>ILMN_2313901</td> <td>io i</td> <td>rs28092</td> <td>io i</td> <td>102149795</td> <td>PAM</td> <td>rs784600</td> <td>- 0</td> <td>40139553</td> <td>HPCAL4</td> <td>5.59</td> <td>0.66</td> <td>0.44</td> <td>0.59</td> <td></td>	ILMN_2313901	io i	rs28092	io i	102149795	PAM	rs784600	- 0	40139553	HPCAL4	5.59	0.66	0.44	0.59	
12 12 12 12 12 12 12 12	ILMN_1815951	ro.	rs2438490	o	148726162	PCYOXIL	rs2731939	n	21395989		6.20	0.19	0.26	0.16	
12 Fig405797 15 74,246,642 Fig4328748 12 7364442 PEX 5 5.74 0.34 0.09 11 rest3288233 12 49151303 rest3284233 12 49151404 rest3284233 19 40029446 PGLYRP1 rest3288233 19 40029446 PGLYRP1 rest3288233 19 40029446 PGLYRP1 rest3288233 19 40029446 PGLYRP1 rest328233 19 70000 0.00 </td <td>ILMN_1660232</td> <td>12</td> <td>rs10444467</td> <td>12</td> <td>128052636</td> <td></td> <td>rs4329748</td> <td>12</td> <td>7364442</td> <td>PEX5</td> <td>5.85</td> <td>0.09</td> <td>0.71</td> <td>0.32</td> <td>120.688</td>	ILMN_1660232	12	rs10444467	12	128052636		rs4329748	12	7364442	PEX5	5.85	0.09	0.71	0.32	120.688
13 18131090 22 401511030 PGTAPRA 5.64 0.87 0.36 21 18131090 22 140151030 PGCS9467 1.4 2195267 PGAPA 6.51 0.65 0.65 22 1847072 22 3167518 PHKZH 1778808 PHCA 6.51 0.69 0.60 22 1847072 22 3167518 PHKZH 18208887 PKZH 0.50 0.00 0.00 22 1867672 22 3199917 PHKZH 18208687 0.00 0.00 0.00 22 1867672 22 3199917 PHKZH 18208687 0.00 0.00 0.00 0.00 24 186887808 16 4027109 18208787 18 18188089 18 1818808 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	ILMN_1660232	12	rs7495797	15	27246462		rs4329748	12	7364442	PEX5	5.74	0.34	0.09	0.13	
11 pt.2082333 19 4652466 PCLYRP1 rsi2082336 PCTARBO Feb. 55.1 0.03 0.05 22 rst2082333 11 23097368 PCLYRP1 rsi208634 1 7670806 PPCA 5.51 0.03 0.09 22 rst40440 2 3157185 PPISD rsi206834 1 7778697 PPCA 5.53 0.02 0.09 22 rst40440 2 3157186 PPISD rsi204881 1 1 0.00 </td <td>ILMN_1797893</td> <td>13</td> <td>rs131969</td> <td>22</td> <td>49151303</td> <td></td> <td>rs7328733</td> <td>13</td> <td>33126737</td> <td>PFAAP5</td> <td>5.64</td> <td>0.87</td> <td>0.36</td> <td>0.67</td> <td></td>	ILMN_1797893	13	rs131969	22	49151303		rs7328733	13	33126737	PFAAP5	5.64	0.87	0.36	0.67	
11 response PRADE PRADE <th< td=""><td>ILMN_1704870</td><td>19</td><td>rs12982353</td><td>19</td><td>46529456</td><td>PGLYRP1</td><td>rs1263806</td><td>14</td><td>21982957</td><td></td><td>6.51</td><td>0.03</td><td>0.65</td><td>0.24</td><td></td></th<>	ILMN_1704870	19	rs12982353	19	46529456	PGLYRP1	rs1263806	14	21982957		6.51	0.03	0.65	0.24	
22 read/14/104 22 21/20/51 read/18/52 22 11/20/51 read/18/52 22 11/20/51 read/18/52 22 11/20/51 read/18/52 22 21/20/51 22/20/51 11/20/51 read/18/52 22/20/51 21/20/51 22/20/51 21	ILMN_1812552	11	rs493642	11	123097386		rs10736812	11	76708086	PHCA	5.51	0.36	06.0	0.70	46.389
22 re470072 22 33265131 PISD re1049831 14 3038876 5.23 0.02 0.04 22 re470072 22 33263131 PISD re654874 1 30397775 PISD 4.12 0.00 0.00 22 re715572 22 33234031 PISD re675844 2 32097775 PISD 4.12 0.00 0.00 0.00 2 re11639998 16 46271604 re675844 2 1.018470 6.13 0.01 0.00 0.00 11 re1163998 16 4668225 re102000 1 1.018470 6.14 0.01 0.01 0.04 14 re103908 16 4668225 1 1.0184871 0.01 </td <td>ILMN_1719986</td> <td>22</td> <td>rs4141404</td> <td>22</td> <td>31675185</td> <td>PIK3IP1</td> <td>rs2065841</td> <td>-</td> <td>61728597</td> <td></td> <td>5.60</td> <td>0.20</td> <td>0.01</td> <td>0.03</td> <td></td>	ILMN_1719986	22	rs4141404	22	31675185	PIK3IP1	rs2065841	-	61728597		5.60	0.20	0.01	0.03	
22 rid51875 2 3199917 PISD rid51875 2 3199917 PISD rid51875 2 100 110 2 rid51875 2 3199917 PISD rid51875 2 10182481 PINED 6.35 0.16 0.42 1 rid589411 5 18781004 rid587 PINED 6.35 0.16 0.13 0.04 1 rid50308 6 457109 rid588048 1 0.18 0.13 0.13 0.03 1 rid5030170 1 5885086 rid5120009 1 2144716 PPPRARA 6.16 0.03 0.13 1 rid528677 1 12244716 PPPRARA 5.75 0.05 0.13 1 rid580083 rid5120009 1 21244716 PPPRARA 5.75 0.03 0.13 1 rid580084 rid5120009 1 21244716 PPPRARA 5.75 0.03 0.13 1 <td>II.MN 1793934</td> <td>66</td> <td>rs470072</td> <td>22</td> <td>32263131</td> <td>PISD</td> <td>rs10498313</td> <td>14</td> <td>30398876</td> <td></td> <td>5 23</td> <td>0.00</td> <td>0.87</td> <td>0.33</td> <td></td>	II.MN 1793934	66	rs470072	22	32263131	PISD	rs10498313	14	30398876		5 23	0.00	0.87	0.33	
22 re651875 2 32097775 PISD 4.12 0.05 0.42 2 re715572 2 3324931 re6518784 2 219087775 PISD 4.12 0.05 0.04 9 re16880411 5 18781004 re572109 re572844 2 219182481 PNRLA 6.35 0.05 0.04 14 re101019 2 45682056 re11156875 1 755930 PPPERS 4.44 0.23 0.04 14 re10230375 2 12559064 re1120009 1 21244767 PPPERS 4.44 0.23 0.05 1 re623861 1 1747278 1 1747278 1 0.05 0.05 0.04 1 re623863 13 16622864 re1120009 1 21244767 PPPERS 5.44 0.05 0.05 1 re622864 1 17120009 1 21244767 PPPERS 5.25 0.05 0	II.MN 1793934		re6518752	000	31999197	DISD	re954697	-	18236681		1.0	00.0	01.1	0.00	
2 residential 2 188781004 residential 2 198781004 residential 2 198781004 residential residential 2 19878100 residential	II M 1702034		100010101	100	22024021		100000		2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Gord	11.1	20.0	0.43	. C	1 197
9 Figure 100 Common Name Figure 100	II MIN 1774604	4 0	1110012	4 4 1	150701504		190019104	4 0	10101010	GING	1 0	91.0	7.0	0.10	101.1
11 FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF	TIMIN TOUGHOUT	110	110000411		100/01004		184012004	N (140401100	LIND TATUM	0.5	0.10	70.0	70.0	
11 FF911019 20 49902230 FFF1010 7.5199310 FFF1010 0.29 0.442 0.429 0.429 0.442 0.429 0.442 0.429 0.442 0.442 0.442 0.444	ILMIN-1662587	, .	rs11039998	910	4527109		rs928046	n -	14048/108	PNFLA/	0.10	0.31	0.0	0.00	
14 FF12914003 15 38201891 FF121014003 16 2301891 FF12741401 FFP2RAG 5.81 0.12 0.48 1 F81202003 1 212447167 PPP2RAG 5.63 0.72 0.48 1 F81202003 1 212447167 PPP2RAG 5.61 0.08 0.03 1 F81202003 1 212447167 PPP2RAG 5.63 0.03 0.03 1 F8767178 6 135030045 F812120009 1 212447167 PPP2RAG 5.63 0.03 0.03 1 F8767178 9 271448475 F812120009 1 212447167 PPP2RAG 5.63 0.05 0.03 1 F87619823 14 2344767 PPP2RAG 5.61 0.06 0.13 2 F87619823 14 23447167 PPP2RAG 5.62 0.16 0.03 2 F87619823 14 23447167 PPP2RAG 5.73 0.16 <	1LMIN_16/5656	1;	1901199	07:	49008255		rs4/58001	1;	0.000000	PFFIBF2	4.44	0.29	0.33	0.20	
1 FF12030170 2 10539404 FF12120009 1 21447167 FFP2R5A 5.03 0.72 0.75 1 FF12032150 2 15505064 FF12120009 1 21447167 PPP2R5A 5.72 0.03 0.75 1 FF1203205 1 12447167 PPP2R5A 5.61 0.03 0.03 1 FF1203004 1 21447167 PPP2R5A 5.65 1.06 0.03 1 FF120304 1 21447167 PPP2R5A 5.65 1.03 0.03 1 FF120304 1 21447167 PPP2R5A 5.65 0.05 0.03 1 FF120304 1 21447167 PPP2R5A 5.65 0.05 0.01 1 FF120304 1 21447167 PPP2R5A 5.72 0.05 0.04 1 FF120304 1 21447167 PPP2R5A 5.72 0.01 0.04 1 FF120304 1 2144716	ILMIN_1662617	14	10000170	CI C	58350896		rs11156875	14	35619816	PPPZK3C	10.01	0.12	0.42	0.19	
1 F812429633 1 C12324064 F812120009 1 212447167 PPP2R5A 5.77 0.08 0.13 1 F8582334 1 107417238 F812120009 1 212447167 PPP2R5A 5.61 0.08 0.13 1 F8582334 1 107417238 F812120009 1 212447167 PPP2R5A 5.65 0.16 0.03 1 F87871778 9 27144847 F812120009 1 212447167 PPP2R5A 5.65 0.16 0.03 1 F8787177 9 27144876 F812120009 1 212447167 PPP2R5A 5.60 0.16 0.03 1 F88019823 1 95040482 F812120009 1 212447167 PPP2R5A 5.61 0.06 0.13 1 F8801982 1 4508830 1 4508830 1 1.0741739 1.00 0.03 0.01 2 1 F88018 1 1 1.244716	ILMIN_1,50,04	٠,	0/1000181	۷ (100288401		FS12120009	٠,	101144717	FFFZNSA	0.00	0.72	0.40	00.00	
1 rs682934 13 06222091 rs12120009 1 212447167 PPP2R6A 5.61 0.36 0.13 1 rs623304 3 13 107417238 rs12120009 1 212447167 PPP2R6A 5.65 1.06 0.28 1 rs6757871 6 135030045 rs12120009 1 212447167 PPP2R6A 5.65 0.06 0.028 1 rs6019823 14 95040482 rs11200009 11 61447167 PPP2R6A 5.65 0.37 0.06 1 rs2883357 16 28867776 rs10600990 11 61482807 PPP2R6A 5.65 0.37 0.06 2 rs2883372 2 47931652 rs10600990 11 6148280 7.34 0.53 0.03 2 rs2883377 2 47836864 5 7.84 0.53 0.03 4 rs386064 18 439883854 rs61 rs60384 rs11 7.74 <	ILMIN_1738784	-	rs12423255	7.7	123595064		rs12120009	-	212447167	PPPZR5A	5.72	0.08	0.95	0.46	
1 rse622334 1 10741738 rse12120009 1 212447167 PPP2R5A 5.65 1.69 0.28 1 rse7871374 9 27144475 rse12120009 1 21447167 PPP2R5A 5.65 0.16 0.06 1 rse7871378 9 27144475 rse12120009 1 21447167 PPP2R5A 5.95 0.16 0.06 1 rse1218355 16 23867776 rse10600990 1 21447167 PPP2R5A 5.72 0.16 0.06 1 rse1283571 2 1 47931663 C21ORF57 rse10492793 16 12639807 6.73 0.01 0.14 2 rse266937 1 47931663 C21ORF57 rse1204044 PSMB1 5.73 0.01 0.03 6 rse3660937 2 47931663 1 4775824 4.81 0.03 0.04 0.14 6 rse610936 2 1 4775824 4.81	ILMN_1738784	-	rs1889083	13	66222691		rs12120009	-	212447167	PPP2R5A	5.61	0.36	0.13	0.17	
1 rsy757871 6 136030045 rsy12120009 1 212447167 PPP2R5A 5.95 0.37 0.06 11 rs98019823 14 95040482 rs11600990 11 64082807 PRDX5 5.95 0.37 0.01 11 rs8019823 14 95040482 rs11600990 11 64082807 PRDX5 6.43 0.31 0.14 1 rs28039323 21 47931653 C21ORF57 rs98817 6.43 0.03 0.03 2 rs28239372 21 4508362 C21ORF57 rs958174 PSMB1 0.00 0.03 6 rs2839372 22 14083682 C21ORF57 rs958174 PSMB1 0.00 0.03 6 rs4890648 18 43983954 rs922843 6 170890384 PSMB1 5.79 0.04 0.04 6 rs6069890 10 170829379 1 170829379 PSMB1 5.79 0.04 0.04	ILMN_1738784	-	rs682334	11	107417238		rs12120009	-	212447167	PPP2R5A	5.65	1.69	0.28	1.21	
1 rsp87193178 9 27144475 rs12120009 1 21244167 PPP2R5A 5.72 0.16 0.30 1 rs20198375 16 2286776 rs1040970 1 6.443807 F.73 0.16 0.13 21 rs2188355 16 2286776 rs1049773 16 1263880 7.34 0.15 0.14 21 rs2288372 21 47931653 C210RF57 rs11701058 1 4.776882 C210RF57 4.81 0.63 4.47 21 rs28802648 1 121774705 rs11701058 1 4.776882 C210RF57 4.81 0.05 0.13 6 rs28602603 2 3034782 rs1170144 FSMB1 5.79 0.04 0.26 6 rs6060330 2 3034782 rs1082375 FSMB1 5.44 0.44 0.21 7 1 1.7685423 rs1080384 FSMB1 rs127444 FSMB1 5.44 0.44 0.21	ILMN_1738784	-	rs7757871	9	135030045		rs12120009	-	212447167	PPP2R5A	5.95	0.37	90.0	0.12	
11 rs8818352 14 95040482 rs1160990 11 64082807 PRDX5 6.43 0.81 0.11 21 rs2188352 1 47931653 C210RF57 18 1497346 7.34 0.53 0.11 21 rs21829331 21 47931653 C210RF57 1811701058 21 4777334 5.79 0.19 0.03 6 rs4800648 18 43983364 rs10701058 21 4777444 PSMB1 5.79 0.44 6 rs4800648 18 43983364 PSMB1 17087444 PSMB1 5.74 0.09 0.26 6 rs6028843 6 170890344 PSMB1 5.42 0.44 0.21 6 rs6028843 6 170890344 PSMB1 rs12679767 4.45 0.00 0.26 6 rs6028843 6 170890344 PSMB1 rs12679767 4.45 0.00 0.26 12 rs6028843 6 1	ILMN_1738784	-	rs7871178	6	27148475		rs12120009	-	212447167	PPP2R5A	5.72	0.16	0.30	0.16	
16 res288355 16 22867776 res1049273 16 12639360 7.34 0.53 0.11 21 res1089355 16 4381653 C210RF57 res10497346 5.60 0.03 0.03 21 res283972 21 48063862 C210RF57 res17714 6 7.84 0.69 4.47 6 res806033 20 3034782 res0205415 6 17087744 PSMB1 5.14 0.09 0.26 6 res060030 20 3034782 res0295415 6 17087744 PSMB1 5.14 0.00 0.26 6 res060030 20 3034782 res0295415 6 17087744 PSMB1 5.14 0.04 0.26 12 res060030 20 3034782 res1020714 6 17087744 PSMB1 5.44 0.04 0.05 12 res060030 20 3034782 res1020714 6 17087744 PSMB1 6.26	ILMN_1711606	11	rs8019823	14	95040482		rs11600990	11	64082807	PRDX5	6.43	0.81	0.14	0.44	
21 rss1292921 21 47931653 C21ORF57 rss95817 18 31497368 C21ORF57 48 14 0.03 0.19 0.03 6 rss286267 11 12177470 rss13207114 6 17089034 5.60 0.19 0.44 6 rss286267 11 12177470 rss12207114 6 17089034 5.14 0.00 0.26 6 rss286267 11 121774762 rss286245 6 17089034 5.14 0.00 0.21 6 rss6228843 6 17089034 8 17089034 9.01 0.21 0.21 6 rs6228843 6 17089034 9 1.03 0.21 0.	ILMN_1713603	16	rs2188355	16	23867776		rs10492793	16	12639800		7.34	0.53	0.11	0.25	11.228
21 rs2839372 21 48063862 rs1710158 21 4777632 C210RE57 4.81 0.69 4.47 6 rs3839372 11 12/74705 rs13207114 6 170890384 PSMB1 5.79 0.04 0.44 6 rs608030 10 3034782 rs6928843 6 170890384 PSMB1 5.14 0.00 0.26 6 rs608030 20 30347822 rs6080384 6 170890384 PSMB1 5.14 0.00 0.26 6 rs608030 20 30347822 rs7080345 6 170890384 PSMB1 5.14 0.04 0.26 1 rs6080384 1 405478823 rs11036212 11 5221825 FDDSS1 5.00 0.03 0.03 1 rs631562 1 7658423 rs11036212 11 521825 FDDSS1 5.00 0.03 0.03 1 rs631562 1 1 7521825 FDDSS1	ILMN_1675038	21	rs1029231	21	47931653	C21ORF57	rs958127	18	31497346		5.60	0.19	0.03	0.04	
6 res8862667 11 121774705 res13207114 6 17087744 PSMB1 5.79 0.44 6 res606036 20 31347832 re6928843 6 170823379 PSMB1 5.14 0.00 0.26 6 re606036 20 31347832 re9295415 6 170823379 PSMB1 5.14 0.04 0.21 6 re606036 20 31347832 re2769689 1 22579787 4.58 1.98 1.36 12 re40692843 6 170850324 re10327144 PSMB1 5.42 0.44 0.21 12 re40692843 1 131727816 re11036212 1 5221825 PTDSS1 5.00 0.03 0.04 12 re4031562 1 1 2658423 re11036212 1 5221825 PTDSS1 5.00 0.03 0.04 12 re4046705 6 106348246 1 1 7221825 PTDSS1	ILMN_1675038	21	rs2839372	21	48063862		rs11701058	21	47776382	C21ORF57	4.81	0.69	4.47	4.06	0.287
6 rs4890648 18 4988954 rs6928843 6 170890384 PSMB1 5.14 0.00 0.26 6 rs6928843 6 rs6928843 6 170890384 PSMB1 5.14 0.00 0.26 6 rs6928843 6 170890384 PSMB1 rs2799547 4.58 1.95 0.021 7 rs7233674 12 13772786 rs779088 1 225797957 4.58 1.95 0.04 0.21 12 rs4253667 17 7559123 rs11038212 11 5221825 PTDSS1 5.00 0.03 0.48 12 rs631562 17 7559123 rs11038212 11 5221825 PTDSS1 5.00 0.03 0.48 12 rs631562 17 7559123 11 5221825 PTDSS1 5.70 0.03 0.04 12 rs631562 17 7553125 77 77 77 77 77 77 77<	ILMN_1789176	9	rs3862607	11	121774705		rs13207114	9	170877444	PSMB1	5.79		0.44		
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6 rs6028843 6 rs70298743 6 rs6028843 6 4.58 1.95 0.64 12 rs7029749 19 170890384 PSMB1 rs27697677 4 4.58 1.95 0.03 0.32 12 rs2653667 14 94478823 rs1036212 11 521825 PTDSS1 5.00 0.03 0.48 12 rs631662 11 126852438 rs11036212 11 521825 PTDSS1 5.00 0.03 0.48 12 rs631662 11 126852438 rs11036212 11 521825 PTDSS1 5.70 0.02 0.40 12 rs631662 11 126852438 rs10036212 11 521825 PTDSS1 5.70 0.02 0.40 12 rs631662 11 126852438 RABACI rs7505028 QDPR 5.75 0.25 0.02 0.03 13 rs1075728 19 42462788 RABACI rs1863644 <	ILMN_1789176	9	rs6060930	20	30347832		rs9295415	9	170823379	PSMB1	5.44	0.44	0.21	0.27	
6 F87299749 12 137727816 F81230714 6 17087744 PSMB1 5.42 1.18 0.32 12 re24299749 14 94748823 re11036212 11 5221825 PTDSS1 5.00 0.08 0.08 12 re43969205 17 76598123 re11036212 11 5221825 PTDSS1 5.00 0.08 0.08 12 re43969205 17 76598123 re11036212 11 5221825 PTDSS1 5.70 0.03 0.08 12 re631562 17 76598238 re100302773 1 77238726 QDPR 5.70 0.03 0.04 12 re3047702 6 1063422424 re7050527 12 77023872 QDPR 6.55 0.25 0.05 16 re304702 16 55326551 AKTIP re1663344 17023879 6.38 0.34 0.34 11 re4082579 11 32136436 RCN1 re11474	ILMN_1789176	9	rs6928843	9	170890384	PSMB1	rs2769689	1	225797957		4.58	1.95	0.64	1.78	
12 rs2553567 14 95478823 rs11036212 11 5221825 PTDSS1 5.00 0.03 0.48 12 rs4659267 14 95478823 rs11036212 11 5221825 PTDSS1 5.00 0.03 0.04 12 rs631562 11 128852438 rs11036212 11 5221825 PTDSS1 5.70 0.02 0.03 12 rs4946705 6 106348246 rs10020773 4 1752682 QDPR 5.75 1.03 0.04 12 rs4046705 2 33375704 rs7561628 11 70263776 0.25 0.05 0.05 16 rs9037702 16 5526551 AKTIP rs1863344 15 20638488 RCNI 6.38 0.03 0.31 11 rs4922579 11 32136436 RCNI rs1146997 8 1102740645 5.40 0.04 0.09	ILMN_1789176	9	rs7299749	12	131727816		rs13207114	9	170877444	PSMB1	5.42	1.18	0.32	98.0	
12 res4669205 17 76598123 res11036212 11 5221825 PTDSS1 5.90 0.08 0.08 12 res431562 11 126852438 res1036212 11 5221825 PTDSS1 5.70 0.02 0.04 14 res4946705 6 105348246 res10020773 4 17526882 QDPR 5.77 0.02 0.40 12 res247704 12 res246882 QDPR 6.55 0.25 0.05 16 res931702 16 53526551 AKTIP res1863464 15 26938488 RCNI 6.32 0.03 0.31 11 res10877913 12 4114775 res4022579 11 32136436 RCNI res1341899 1 102740645 6.32 0.04 0.04 0.06	ILMN_1743049	12	rs2353567	14	95478823		rs11036212	11	5221825	PTDSS1	5.00	0.03	0.48	0.15	
12 re631562 11 122656438 re11036212 11 5221825 FTDSS1 5.70 0.02 0.02 0.04 12 re3401730 22 33375704 re7305307 12 70235726 6.55 0.25 0.08 0.08 19 re1075728 19 42462788 RABACI re7305307 12 70235726 6.55 0.25 0.08 19 re1075728 19 42462788 RAFILP re1863344 15 20433488 6.38 0.03 0.31 11 re10877913 12 4114715 RFMIL re18633448 15 2043488 RCNI 6.38 0.03 0.31 11 re4922579 11 32136436 RCNI re11047468 RCNI 4.32 0.41 0.09 11 re4922579 11 22136436 RCNI re110474045 0.04 0.04 0.26	ILMN_1743049	12	rs4969205	17	76598123		rs11036212	11	5221825	PTDSS1	5.90	08.0	80.0	0.38	
4 res4946705 6 106348246 res10020773 4 17526682 QDPR 5.75 1.03 1.25 12 res421730 22 33375704 res736507 12 70235726 6.55 0.28 0.28 0.084 19 res045788 19 45462788 RABACI res1863464 15 226938488 6.38 0.03 0.31 11 res0831702 16 55526551 AKTIP res1863464 15 226938488 6.38 0.03 0.31 11 res10875911 12 213343486 RCNI res192579 11 32136436 RCNI 8 141174488 0.58 0.03 0.03 11 res4922579 11 32136436 RCNI res11417468 RCNI 6.38 0.04 0.04 0.06	ILMN_1743049	12	rs631562	11	126852438		rs11036212	11	5221825	PTDSS1	5.70	0.05	0.40	0.11	
12 rs241730 22 33375704 rs7305307 12 70235726 6.55 0.25 0.08 19 rs1075728 16 43262788 RAFAP rs765344 15 26938488 6.38 0.03 0.31 11 rs1087702 16 5352651 AKTIP rs4892879 11 32136436 RCNI 6.38 0.03 0.31 11 rs4922579 11 32136436 RCNI rs11416997 8 11177468 4.32 0.41 0.09 11 rs4922579 11 32136436 RCNI rs1341899 1 102740645 5.40 0.04 0.26	ILMN_1672443	4	rs4946705	9	106348246		rs10020773	4	17526682	QDPR	5.75	1.03	1.25	1.55	
19 rs1075728 19 42467788 RABACI rs7951628 11 120161117 6.42 0.28 0.84 16 rs9931702 16 53526551 AKTIP rs1863364 15 26938488 6.42 0.28 0.31 11 rs1927313 12 41147155 rs1427557 11 32136436 RCN1 rs11177468 4.32 0.41 0.09 11 rs4922579 11 32136436 RCN1 rs1341899 1 102740645 5.40 0.04 0.26	ILMN_1803197	12	rs241730	22	33375704		rs7305307	12	70235726		6.55	0.25	0.08	0.09	
16 re9931702 16 5552555 AKTIP rs1863464 15 296934488 6.38 0.03 0.31 11 rs102879131 12 41147155 RCN1 rs19292579 11 32136436 RCN1 5.23 0.58 0.37 11 rs4922579 11 32136436 RCN1 rs11166957 8 14177468 4.32 0.41 0.09 11 rs4922579 11 32136436 RCN1 rs1341899 1 102740645 5.40 0.04 0.26	ILMN_2207363	19	rs1075728	19	42462788	RABACI	rs7951628	11	120161117		6.42	0.28	0.84	0.59	
11 rs1087931 12 41147155 RCNI rs4922579 11 32136436 RCNI 65.23 0.58 0.37 11 rs4922579 11 32136436 RCNI rs11169957 8 14177468 A.32 0.41 0.09 11 rs4922579 11 32136436 RCNI rs1341899 1 102740645 5.40 0.04 0.26	ILMN_1756999	16	rs9931702	16	53526551	AKTIP	rs1863464	15	26938488		6.38	0.03	0.31	80.0	
11 rs4922579 11 32136436 RCN1 rs11166957 8 141177468 4.32 0.41 0.09 11 rs4922579 11 32136436 RCN1 rs1341899 1 102740645 5.40 0.04 0.26	ILMN_1800276	11	rs10879131	12	41147155		rs4922579	11	32136436	RCN1	5.23	0.58	0.37	0.47	
11 rs4922579 11 32136436 RCN1 rs1341899 1 102740645 5.40 0.04 0.26	ILMN_1800276	11	rs4922579	11	32136436	RCN1	rs11166957	œ	141177468		4.32	0.41	0.09	0.17	
	ILMN_1800276	11	rs4922579	11	32136436	RCN1	rs1341899	1	102740645		5.40	0.04	0.26	0.02	

RANSEG	Chr. rs ID Chr. Pos/Mb ^c	Chr.		Pos/Mb		Associationd	rs ID	Chr.	SNF 2 Pos/Mb ^c	Associationd	Interac	Interaction statistic / SGS ^e Fehrmann ^f	$-\log_{10} p$ -values EGCUT ^f Met	values	Distance / Mb ^h
1 17097201 1 1714012 17140	II.MN 1802380	-	rs4982958	14	24987865		rs301819	-	8501786	RERE	5 66	0.61	1.23	1 17	\
1	ILMN_1802380		rs7697290	4	135248366		rs301819		8501786	RERE	5.74	0.14	0.10	0.06	
1 11,000,000 1 1 11,000,000 1 11,000,000 1 1 11,000,000 1 1 11,000,000 1 1 11,000,000 1 1 11,000,000 1 1 11,000,000 1 1 11,000,000 1 1 11,000,000 1 1 11,000,000 1 1 11,000,000 1 1 11,000,000 1 1 11,000,000 1 1 11,000,000 1 1 1 11,000,000 1 1 1 1 1 1 1 1 1	ILMN_2327795	-1	rs11085829	19	13174312		rs301819	1	8501786	RERE	5.12	0.21	0.33	0.21	
14 1110 12 12 12 12 12 12	ILMN_2327795	П	rs3852011	3	112844086		rs301819	1	8501786	RERE	5.71	0.08	09.0	0.26	
1	ILMN_1780533	14	rs11628398	14	21182800	RNASE6	rs7324365	13	100601327	0	5.48	0.42	0.21	0.26	
1	ILMN-1780533	17	rs56603134	13	8106521		rs11628398	4 5	54668512	KN ASE6	5.11	0.09	0.22	0.08	
1 result of the control of	ILMN_1794726	17	rs400688	17	4839930	RNF167	rs11706900	9 00	36348968		5.59	0.71	0.46	0.64	
11 responses 1 control	ILMN_1738347	1	rs1107121	21	46127549		rs2819365	1	201983242		6.27	0.11	0.30	0.13	
15 resistants 16 selection resistants 16 selection resistants 16 selection resistants 17 14 17 14 17 14 17 14 17 14 14 16 selection 17 17 17 17 18 selection 16	ILMN_1738347	-	rs8071611	17	67153386		rs2819365	1	201983242		4.32	1.48	0.52	1.28	
4 11 11 11 11 11 11 11 11 12 11 12 12 13 0.38 0.38 0.38 1 1 15000703 1 6 0010810 BPLEAGAL 1010860 0 <td< td=""><td>ILMN_2413278</td><td>16</td><td>rs352935</td><td>16</td><td>89648580</td><td></td><td>rs2965817</td><td>16</td><td>89513234</td><td></td><td>4.98</td><td>3.79</td><td>14.41</td><td>17.24</td><td>0.135</td></td<>	ILMN_2413278	16	rs352935	16	89648580		rs2965817	16	89513234		4.98	3.79	14.41	17.24	0.135
14 FANDONOSS 14 CONTROLOGY 14 CONTROLOGY 15	ILMN_2222750	73	rs1401202	16	80320056		rs4849261	61	114450028	RPL23AP7	5.55	0.13	0.73	0.38	
4 15 16 15 16 15 16 </td <td>ILMN_2189933</td> <td>14</td> <td>rs3007033</td> <td>14</td> <td>50103816</td> <td>RPL36AL</td> <td>rs17495030</td> <td>6</td> <td>138038093</td> <td></td> <td>5.46</td> <td>0.09</td> <td>0.06</td> <td>0.02</td> <td></td>	ILMN_2189933	14	rs3007033	14	50103816	RPL36AL	rs17495030	6	138038093		5.46	0.09	0.06	0.02	
9 rightstate 20 74741934 Free plane Free plane <t< td=""><td>ILMN_2189936</td><td>410</td><td>rs4900928</td><td>4.0</td><td>1450817</td><td>RPL36AL</td><td>rs1502991</td><td>φ-</td><td>9945857260</td><td></td><td>5.86 7.00 7.00</td><td>0.32</td><td>0.20</td><td>0.19</td><td></td></t<>	ILMN_2189936	410	rs4900928	4.0	1450817	RPL36AL	rs1502991	φ-	9945857260		5.86 7.00 7.00	0.32	0.20	0.19	
9 rid880214 10 rid80214 rid8021	ILMN 1764721	0 00	182908462	000	7741304	111.00	181019600	H OX	145084615	8 10 0	4.03	0.10	0.0	0.10	
117768428	ILMN 3297880	0 6	154143014 ve/880314	07-	\$001304 \$0013046		1829309402	0 0	10345876	AT L0	4.00	01:0	0.4.0	9.0	
11 11/2147460 14 104412137 197884866 11 194060111 SEEN3 5.40 0.02 0.05 0.05 12 11/2147460 15 46561778 46561778 46466011 SEEN3 5.40 0.02 0.05 0.05 13 1468886 11 45889878 14 458898888 14 458898888 14 458898888 14 45889888 14 458898888 14 458898888 14 458898888 14 458898888 14 458898888 14 458898888 14 458898888 14 458898888 14 458898888 14 458898888 14 4588988888 14 458898888 14 458898888 14 458898888 14 45889888 14 458898888 14 458898888 14 458898888 14 458898888 14 458898888 14 458898888 14 458898888 14 458898888 14 458898888 14 458898888 14 458898888 14 458898888 14 458898888 14 458898888 14 4588	II.MN 1702787	- 0	rs17085428	, ro	95388015		rs7695	o -	156147326	SEMAAA	5.70	0.55	1 73	1 17	
11 1 1 1 1 1 1 1 1	ILMN 1694027	-	rs12147460	4	104412137		rs684856	' <u>=</u>	94906111	SESNS	0.50	0.02	0.51	0.15	
11 reseases 6 11 special series resease 6 11 special series resease 6 12 0.21 0.51 0.51 0.51 0.35 6 resease 6 resease 6 resease 6 6 resease 6 0.02 0.01 0.01 0.03 0.01 0.03 0.01 0.03 0.01 0.03 0.01 0.03 0.01 0.03 0.01 0.03 0.01 0.03 0.01 0.03 0.01 0.03 0.01 0.03 0.03 0.01 0.03 0.03 0.01 0.03 0.03 0.01 0.03	ILMN_1694027	11	rs355391	127	46591793		rs684856	1 1	94906111	SESN3	5.67	0.31	0.06	0.10	
6 res084589 1 43893668 Res084740 PPBP 5.52 0.70 0.51 0.35 6 res0843364 4 8826062 Res084740 PPBP 5.74 0.29 0.51 0.35 9 res643344 4 8826062 Res04740 PPBP 5.74 0.29 0.51 0.35 10 res643344 4 8826062 Res4736 res147455 7 0.02 0.13 0.13 11 res643346 19 5181708 Res64736 10 2023826 SLC22A18 res17084 0.14 0.09 0.24 0.13 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 <td>ILMN_1694027</td> <td>11</td> <td>rs684856</td> <td>11</td> <td>94906111</td> <td>SESN3</td> <td>rs7004947</td> <td>00</td> <td>134606425</td> <td></td> <td>5.60</td> <td>0.21</td> <td>0.51</td> <td>0.31</td> <td></td>	ILMN_1694027	11	rs684856	11	94906111	SESN3	rs7004947	00	134606425		5.60	0.21	0.51	0.31	
6 reach45354 6 6688890 realighted 7 66840749 PPBP PRPRAGE 5.97 0.02 0.51 0.53 9 real/034120 21 18196920 SIRPG real/164634 3 66840749 PPBP PRPRAGE 5.74 0.02 0.71 0.53 0.51 0.53 0.53 0.51 0.53 0.53 0.54 0.53 0.54 0.53 0.54 0.54 0.02 0.51 0.51 0.03 0.71 0.53 0.01 0.01 0.01 0.01 0.02 0.01 0.02 0.01 0.01 0.02 0.01<	ILMN_1762764	9	rs10838191	11	43893658		rs1354034	က	56849749	PPBP	5.52	0.70	0.12	0.35	
6 res645304 4 SESSOSOSO res1345304 4 SESSOSOSO 7 0.53 20 res10445304 4 SESSOSOSO res6445304 4 SESSOSOSO 0.12 SER) 0.71 0.53 20 res1045883 20 1612819 SIRTAS res647730 4 6048801 5.74 0.02 0.18 0.17 0.53 20 res1055883 11 2023326 SLC22A18 res1071064 7 1.01 0.02 0.18 0.13 0.13 0.13 0.13 0.01 0.02 0.18 0.01 0.02 0.18 0.02 0.01 0.01 0.02 0.01 0.01 0.02 0.01 0.02 0.01 0.02 0.01 0.02 0.01 0.02 0.01 0.02 0.01 0.02 0.01 0.02 0.01 0.02 0.01 0.02 0.01 0.03 0.01 0.02 0.01 0.01 0.02 0.01 0.02 0.01 <td< td=""><td>ILMN_1762764</td><td>9</td><td>rs2545385</td><td>ю</td><td>66383979</td><td></td><td>rs1354034</td><td>3</td><td>56849749</td><td>PPBP</td><td>5.97</td><td>0.20</td><td>0.51</td><td>0.30</td><td></td></td<>	ILMN_1762764	9	rs2545385	ю	66383979		rs1354034	3	56849749	PPBP	5.97	0.20	0.51	0.30	
9 re1055820 21 1819692 Re1745517 9 131785569 SH3CLB2 7.40 0.29 0.18 0.13 20 re155882 20 felt 167220 1612819 SINPG re847735 11 2923826 SLC22A18 5.74 0.09 0.18 0.17 11 re867035 11 2923826 SLC22A18 re51701084 2 0.00 0.01 0.01 3 re1912136 11 2923826 SLC22A18 re51701084 2 0.00 0.01 0.01 4 re1912136 11 2923826 SLC22A18 re51701087 1 1.00 0.00 0.01 0.00 11 re1912136 11 re3770108 1 1.7459877 SLC2A18 1.00 0.00 0.01 0.00 1 re104108 1 1.7459877 1 1.7459877 1 1.7459874 1 1.00 0.01 0.01 0.01 0.01 0.01 0.01<	ILMN_1762764	9	rs6845304	4	88280502		rs1354034	က	56849749	PPBP	5.23	0.32	0.71	0.53	
10 Fig. 1673883 1612819 SIRPG re8684779 4 00489510 5.74 0.29 0.18 0.17 11 re367358 11 2933826 SLC22A18 re367035 11 2933826 SLC22A18 re367035 11 2933826 SLC2AA18 re377040 0.15 0.05 0.01 0.06 0.06 0.07 0.06 0.07 0.06 0.07 0.06 0.07 0.06 0.07 0.06 0	ILMN_2158336	6	rs1034120	21	18196922		rs17455517	6	131785369	SH3GLB2	7.40	0.22	0.18	0.13	
11 res1673260 19 5218179 res263286 SLC22A18 res367035 11 5293826 SLC22A18 res367035 11 2993829 SLC22A18 res367035 11 2918329 SLC22A18 res377054 7 15322417 0.09 0.09 0.09 1 res667035 11 2461744 res77104 7 15322417 0.19 0.09 0.09 0.09 1 res667035 11 2461744 res77104 7 15260104 0.10 0.05 0.09 0.09 1 res698508 17 246074 17 15600082 SLC2AA 0.17 0.09 0.05 0.06 0.09 0.00 0.	ILMN_1771801	20	rs1535883	20	1612819	SIRPG	rs6842739	4	60489510		5.74	0.29	0.18	0.17	
11 resolvations 11 resolvations 11 resolvations 11 resolvations 11 resolvations 12 resolvations resolvations<	ILMN_2382505	11	rs11673260	19	52181798		rs367035	11	2923826	SLC22A18	5.47	0.09	0.24	0.09	
1	ILMN_2382505	11	rs367035	11	2923826	SLC22A18	rs3110874	-1	153224179		5.70	0.15	0.10	0.06	
8 Fig912136 11 243377434 Fig91701916 3 12241433 5.58 1.10 0.82 1.24 13 reg085508 11 243377434 SLC45A4 ref980190 13 2926344 5.52 0.09 0.58 0.26 1 reg081555 17 55602091 ref981190 13 29269349 SLC46A3 5.52 0.09 0.58 0.26 2 res1011333 1 25800982 SLC46A3 5.52 0.09 0.58 0.02 2 res1016321 9 13300223 SMOX res1061133 1 17221494 6.01 0.09 0.58 0.52 11 res1042863 1 17221499 NARDA 6.01 0.29 0.52 0.52 2 res1045863 1 17221498 NARDA 6.01 0.29 0.52 0.52 2 res1045863 2 101889306 SNORDS 6.03 0.29 0.52	ILMN_2382505	11	rs367035	Ξ;	2923826	SLC22A18	rs3772054	01 0	241678528		6.15	0.39	0.13	0.19	
8 F199385308 7 5 400 0.07 0.40 0.07 0.40 1 r8943805 1 5 400 1 5 400 0.07 0.04 0.04 0.07 0.04 0.07 0.04 0.04 0.07 0.04 0.07 0.04 0.05 0.07 0.04 0.06 0.07 0.04 0.06 0.07 0.04 0.06 0.07 0.04 0.06 0.07 0.04 0.06 0.07 0.04 0.06 0.07 0.04 0.06 0.07 0.04 0.06 0.07 0.06 0.07 0.04 0.06 0.07 0.06 0.06 0.07 0.06 0.06 0.07 0.06 0.06 0.07 0.06 0.07 0.04 0.06 0.07 0.04 0.06 0.07 0.04 0.06 0.07 0.04 0.06 0.07 0.04 0.06 0.07 0.04 0.06 0.06 0.07 0.04 0.06 0.06 0.07 0.04	ILMN_2356111	n (rs1912136	Ξ °	24616743		rs6771703	က၊	125801067	SLC41A3	10 1 20 0 10 1	1.10	0.82	1.24	
13 179434809 17 20002091 1814800 13 20002091 18148800 13 20002091 1914091	ILMN_1745778	x ç	rs6985508	χį	142337734	SLC45A4	rs7701916	0 0	174598073	0 4 0 7 0 10	5.95 10.10	0.86	0.07	0.40	
1 F88035229 1 P34049203 SMG7 6.52 0.17 0.09 0.06 20 4 14015021 9 130167381 2 13167781 0.39 0.07 0.09 0.06 11 18203425 15 13016781 4 191505291 0.39 0.05 0.05 0.05 0.05 0.05 0.05 0.06 0.05	ILMN_1658639	13	rs949805	1.1	55602091		rs7981190	13	29259349	SLC46A3	5.52	0.09	0.58	0.26	
4 FIRIDSCALA 5 FIRIDSCALA 5 FIRIDSCALA 5 FIRIDSCALA 6	ILMN_1706553	٦ و	rs8035259	12	97403923	CMO	rs10911353	- c	183489203	SMG7	6.52	0.17 0.30	0.09	0.06	
11 F1520429 15 40259028 F151004 F151004863 F	ILMN-1775380	0.4	rsollos13	070	4161500	YOME	rs11077013	N =	119225940	SUHUS	0.00	0.09	0.02	0.02	
11 re20243462 11 17339127 re648833 11 1701557 7.31 13.11 10.96 23.22 2 re10445863 2 115929241 re750783 2 101889306 SNORD89 6.08 1.31 10.96 23.22 2 re104045863 2 1159298241 re750783 2 101889306 SNORD89 6.08 1.31 1.06 23.22 2 res113064 2 2 20178362 2 101889306 SNORD89 6.03 0.03 0.00 0.06 15 res113060 2 1 46376528 SNUPN re1470575 3 193706323 SNORD89 6.33 0.03 0.00 0.06 15 res113060 13 41117869 re1474580 15 4565086 SPATALL 5.44 0.00 0.06 16 res11700063 1 4011768 1 101768 1 1.046 0.01 0.01 0.01 0.0	ILMN_1799381	11	rs1520429	12.	46259108		rs214097	1	17291499	SNORD14A	6.60	0.29	1.03	0.72	
2 res10d48663 2 115298829241 res707783 2 1018889306 SNORD89 6.08 2 res10d48663 1 122988326 res70783 2 1018889306 SNORD89 6.08 1 res1346de 5 2777806 res776782 2 1018889306 SNORD89 6.38 0.00 0.06 15 res1346de 21 4637628 SNUPN res177480 1 81070829 6.38 0.01 0.06 15 res13146de 21 4637628 SNUPN res177480 1 81070829 6.38 0.01 0.06 15 res13146de 21 4637628 SNUPN res174480 1 4637629 0.34 0.00 0.06 10 res1170063 20 40115768 7 766105 STYLL 5.86 0.57 0.17 0.31 10 res1170063 20 4015344 1 778509713 TVFM 7.86 0.01	ILMN_1799381	11	rs2634462	11	17339127		rs6486334	11	17015557		7.31	13.11	10.96	23.22	0.324
2 res1160582 11 122986336 res750783 2 101889306 SNORDS9 6.36 9.66 15 res134646 21 46376528 SNUPN re750783 1 0.03 6.33 0.03 15 res134646 21 46376528 SNUPN re7185362 16 81888905 6.33 0.03 0.00 15 res134646 21 46376528 SNUPN re7185362 16 81888905 6.45 0.13 1.41 15 res134646 21 46376528 SNUPN re7478536 16 81888905 6.45 0.13 1.41 15 res147020 13 90174526 re1000620 11 72509713 5.65 0.67 0.17 20 res1470816 14 104947517 res39294 4 10494286 5.51 0.67 0.17 16 res146865 18 7 75616105 TVFM 7.05 0.01 0.05	ILMN_3238662	7	rs10445863	7	115929241		rs750783	7	101889306	SNORD89	80.9				14.040
2 res1335664 5 20778066 Fre570783 2 101889306 SNORDS9 6.33 1.41 15 res1335664 21 46376528 SNUPN res1447075 3 193706323 6.43 0.13 1.41 15 res133464 21 46376528 SNUPN res1447007 3 193706323 6.55 0.34 0.00 15 res133464 21 46376528 SNUPN res147680 15 4562086 SPATA5L1 5.44 0.00 11 res223404 13 90174526 res1000620 1 75616105 STYXL1 5.88 0.57 0.12 16 res107365 18 74332954 res17685 1 7056 0.01 0.05 16 res286667 21 40113768 res378354 16 2850667 TUFM 5.83 0.01 1 res286667 21 40113768 res378354 16 2850667 TUFM 5.83 <td>ILMN_3238662</td> <td>7</td> <td>rs11605822</td> <td>11</td> <td>122986326</td> <td></td> <td>rs750783</td> <td>7</td> <td>101889306</td> <td>SNORD89</td> <td>5.96</td> <td></td> <td></td> <td></td> <td></td>	ILMN_3238662	7	rs11605822	11	122986326		rs750783	7	101889306	SNORD89	5.96				
15 788134646 21 49376528 SNUPN F81/8305 15 10 10 10 10 10 10	ILMN_3238662	67 ;	rs2135064	. c	26778066		rs750783	01 9	101889306	SNORD89	6.33		;	0	
15 15 15 15 15 15 15 15	ILMIN_I 1 035952	C 1	rss134040	7 5	403/0028	NULL	TS/180502	01	000000000000000000000000000000000000000		0.4°	0.13	1.41	0.00	
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7 rs4073164 14 104947517 rs47865 7 7 5616105 STYXL1 5.88 0.57 0.17 20 rs1170063 28 7435254 16 2850667 TUFM 5.83 0.57 0.17 16 rs283667 21 40119768 rs378534 16 2850667 TUFM 7.05 0.05 19 rs0009266 20 5013994 18 136281763 SURF6 6.14 0.26 0.16 11 rs1375719 13 104410782 rs4052067 1155194990 THBS3 5.55 0.03 0.76 1 rs9014956 14 2068778 155194990 THBS3 5.55 0.33 0.76	ILMN_1717052	11	rs2221406	13	90174526		rs1000620	11	72509713		5.65	0.67	0.12	0.33	
20 rs1700063 20 40153148 SULF2 rs939994 4 18043926 551 0.46 0.24 16 rs2463865 18 r4329254 r53785354 16 28550667 TUFM r7.05 0.01 0.05 16 rs2463867 21 40119768 rs378354 16 28550667 TUFM r7.05 0.01 0.05 1 rs609926 20 56013994 rs3118663 9 136281753 SURFG 6.14 0.26 0.16 1 rs1375719 13 103410782 rs485455 11 58495269 SYTL2 5.47 0.28 0.15 1 rs9014956 14 20687978 155194990 THBS3 5.55 0.33 0.76	ILMN_2210729	4	rs4073164	14	104947517		rs17685	-1	75616105	STYXL1	5.88	0.57	0.17	0.31	
16 rs1463965 18 74332954 rs2783554 16 2850667 TUFM 7.05 0.01 0.05 16 rs2839667 20 56013994 rs3188354 16 2850667 TUFM 5.83 0.01 0.05 1 rs2939667 20 56013994 rs318863 136281753 SURF6 6.14 0.26 0.16 1 rs1375719 13 103410782 rs485485 1 85495286 0.28 0.28 0.16 1 rs1975719 13 103410782 rs4072867 1 155194080 THBS3 5.55 0.03 0.15 1 rs8014956 14 20687978 rs104980 1 155194080 THBS3 5.65 0.31 0.76	ILMN_2345142	20	rs11700063	20	46153148	SULF2	rs939294	4	180439236		5.51	0.46	0.24	0.30	
16 rs2836657 21 40119768 rs3788354 16 2850667 TUFM 5.83 9 rs6099626 20 56013994 rs318663 9 136281753 SURF6 6.14 0.26 0.16 1 rs1939875 11 95422867 rs4072037 1 155162067 THBS3 5.55 0.03 0.15 1 rs8014956 14 2068778 rs4072037 1 15519490 THBS3 5.65 0.31 0.76	ILMN_2336133	16	rs1463965	18	74332954		rs3785354	16	28550667	TUFM	7.05	0.01	0.02	00.00	
1 181375719 13 103410782 13455345 11 185495269 13 13452867 13 13452867 14 13452867 15 13452867 14 13519456 13 13519456 13 13519456 13 13519456 13 13519456 13 13519456 13 13519456 13 13519456 13 13519456	ILMN_2336133	16	rs2836657	21	40119768		rs3785354	16	28550667	TUFM	5.83				
1 181375719 13 103410782 13485445 11 1547 12 13 13 13 13 13 13 13	ILMN_1778032	6	rs6099626	20	56013994		rs3118663	6	136281753	SURF6	6.14	0.26	0.16	0.14	
1 rs1939875 11 95422867 rs4072037 1 155162067 THBS3 5.55 0.03 0.15 1 rs8014966 14 20688978 rs2048805 1 15514980 THBS3 5.65 0.31 0.76 1 rs8014966 14 20688978 rs8048805 rs80488	ILMN_2336609	11	rs1375719	13	103410782		rs485485	11	85495269	SYTL2	5.47	0.28	0.31	0.24	
1 r88014956 14 20687978 r82049805 1 155194980 THBS3 5.65 0.31 0.76	ILMN_1804663	-	rs1939875	11	95422867		rs4072037	-	155162067	THBS3	5.55	0.03	0.15	0.03	
	ILMN_1804663		rs8014956	14	20687978		rs2049805	н.	155194980	THBS3	7. 10. 10. 10. 10. 10. 10. 10. 10. 10. 10	0.31	0.76	0.55	

- 1	Distance / Mb ⁿ					0.122																				0.031		12.131				7. 0.00	0000														45.345		
	Metag Dis	0.70	0.26			145.78	3.67	08.0	3.78	2.52	0.03	2.87	00.9	8.00	2.27	0.19	3.51	7.36	10.72	2.10	9.20	4.47	0	0.32	0.07	4.09	0.29	0.36	1.07	0.68	0.08	0.59	0.44	0.25	0.22	0.16	80.0	1.01	0.56	0.02	0.13	0.40	0.69	1.69	0.39	90.0			
assis d'Olesa	EGCUT	1.34	0.48			45.78	3.09	0.99	1.18	1.00	0.07	0.77	3.33	9.61	1.52	0.33	3.62	5.15	8.80	3.14	96.9	5.75		0.12	0.15	1.89	0.40	0.01	1.60	0.87	0.18	0.47	0.38	0.65	0.36	0.33	0.07	0.78	0.55	0.02	0.26	0.86	0.90	1.23	0.91	0.18			
٠l	Fehrmann ^f	90.0	0.16		0.76	81.55	1.55	0.40	3.61	2.41	0.08	3.06	3.72	0.04	1.57	0.19	0.90	3.31	3.06	0.07	3.36	0.10		0.64	1.03	1.03 3.19	0.28	0.93	0.21	0.37	0.12	0.63	0.50	0.04	0.20	0.15	0.24	0.85	0.51	0.14	0.14	0.08	0.36	1.20	0.04	0.07			
	BSGS ^e F	5.70	8.11	6.79	11.09	12.16	8.12	8.02	8.39	7.37	6.95	6,93	6.21	7.30	6.70	5.92	8.89	8.55	5.80	5.49	6.22	9.44	5.60	5.79	5.01	20.08	5.61	5.52	5.97	6.92	7.79	0.43 38	6.51	7.08	5.86	6.27	0.73 7.83	7.73	8.10	6.71	7.34	7.05	7.41	20.00	6.46	00.9	5.01	5.51	6.34
	Associationd	TMED4	TMEM149	TMEM149	TMEM149	TMEM149																	TMEM63A	TMEMSO	IRF5	IRFO	TRAPPC4	TRAPPC4									TR A DDC 5	TRAPPCS	TRAPPC5			RAPGEF1	TP EM1	TREMI	TRIM38	TSPAN14	TSPAN32		
	Pos/Mb^{c}	44581986	36219525	36219525	36219525	36147315	4799159	133025756	188359436	128884559	64268976	90932598	13822381	113317583	147619772	171792273	129595460	233879066	161683974	80357420	242889492	21473952	226027323	656845	128593948	23498358	118887887	118887887	166970604	132022957	156404902	242329791	57495457	129644342	9947811	146690926	85439550	7758194	7758194	228504503	30408765	134635088	157393770	41264577	26044369	82273079	2317951	137947208	238746880
	Chr.	7	19	19	19	19	10	6	8	12	8	14	00	4	7	10	11	73	9	17	1	13	- ;	11	1 ~	- 1-	- 11	11	IJ	oo i	9 -	1 01	17	12	4	۲- ;	19	6.1	19	7	16	6	ကဖ	9 (2	9	10	11	9	c
	rs ID	rs17725246	rs8106959	rs8106959	rs8106959	rs7254601	rs10508289	rs10819626	rs10937361	rs1401098	rs1557335	rs17719594	rs1843357	rs2351458	rs2539000	rs2731711	rs471728	rs6718480	rs6926382	rs7213338	rs914940	rs9509428	rs4149226	rs4963126	rs10488630	rs11770192	rs3916581	rs3916581	rs10059004	rs1023095	rs1375714	rs1393299	rs4968328	rs7313362	rs7694997	rs7800935	rs856638	rs17159840	rs17159840	rs10179572	rs12921440	rs1887778	rs963354	rs2395771	rs2032447	rs10748526	rs12800998	rs620607	re1198819
	Associationd					SNX26	TMEM149							TRAPPC5	TRAPPC5	TRAPPC5	TRAPPOS	TRAPPCS	TRAPPC5	TRAPPC5	TRAPPC5	TRAPPOS										MYBPC3	TSPAN32	100 E															
	Pos/Mb^{c}	132389627	47248981	27925288	45207005	36268923	36219525	36219525	36219525	36219525	36219525	36219525	36219525	36219525	36219525	36219525	36219525	36219525	36219525	36219525	36219525	36219525	72890603	58058246	4859303	23528927	113531675	131018917	7758194	7758194	7758194	7758194	7758194	7758194	7758194	7758194	7758194	45128454	11272861	7762978	7762978	7762978	852478	108256422	158808416	27194634	47663049	2317951	50971266
	Chr.	11	21	22	20	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	13	19	5 0	7	- 62	11	19	19	13	S C	13	19	19	13	19	2 2	20	19	19	19	5 C	3 5	-1	17	11	11	22
	rs ID	rs1940400	rs2839013	rs5762235	rs6090518	rs807491	rs8106959	rs1254086	rs1548475	rs1537146	rs199795	rs1278760	rs1793823	rs17159840	rs3916995	rs6040514	rs7246264	rs7246264	rs7246264	rs/246264	rs12412964	rs2527180	rs968726	rs10838738	rs12800998	rs140522																							
	Chr.	7	19	19	19	19	19	19	19	19	16	19	19	19	19	19	19	19	19	19	19	19	- ;	11	- 1	- 1-	- []	11	19	19	13	D 0	19	19	19	19	. o	61	19	19	19	19	 	 o @	9	10	11	11	55
	Probe ID ^D	ILMN_1804148	ILMN_1786426	ILMN_1719649	ILMN_1708482	TI MM 1693611	ILMN-1683811 II.MN 1731043	ILMN_1814650	ILMN_1814650	ILMN_2372639	ILMN_2372639	ILMN_2372639	ILMN-2372639	ILMN_2372639	ILMN_2372639	ILMN_2372639	ILMN_2372639	ILMN-2372639	ILMN 2372639	ILMN_2372639	ILMN_2372639	ILMN_2372639	ILMN_2372639	ILMN-2372639	II.MN 1688231	ILMN_1697971	ILMN_1785060	ILMN_1718621	ILMN_2389970	II.MN 3223126																			
ı	Gene ID ^a	TMED4	TMEM149	TMEM63A	TMEMSO	TNFO3	TBA2A	TRAPPC4	TRAPPC4	TRAPPC5	TRAPPC5	TRAPPC5	TRAFFCS	TRAPPCS	TRAPPC5	TRAPPC5	TRAPPC5	TRAPPOS TRAPPOS	TRAPPCS	TRAPPC5	TRAPPC5	TRAPPC5	TRAPPC5	TRAFFC5	TREMI	TRIM38	TSPAN14	TSPAN32	TSPAN32	TYMP																			

_																										
	Distance / Mbh			1.643	0.088																					
values	Metag	0.52	1.10	0.03	4.95	0.46	0.57		0.19	0.41	0.31	0.17	0.04	1.21	0.16	0.57	0.26	1.47	0.09	1.22	0.35	2.25	1.63	0.15	0.46	0.05
$-\log_{10} p$ -values	$EGCUT^{f}$	0.42	1.29	0.14	5.14	0.15	0.69		0.19	0.74	0.48	0.17	0.19	1.15	0.05	0.54	0.17	1.38	0.13	1.35	0.61	1.43	0.17	0.36	0.27	0.01
Interaction statistic /	Fehrmann ^f	0.59	0.48	0.03	0.94	0.84	0.39		0.33	0.16	0.23	0.31	0.03	0.73	0.46	0.53	0.48	0.81	0.19	0.57	0.18	1.64	2.38	0.09	0.67	0.26
Interacti	BSGSe	5.91	6.01	5.71	5.09	5.64	5.44	5.72	5.77	6.44	5.74	6.44	5.82	6.12	4.83	5.60	5.71	5.88	5.88	6.34	5.85	4.86	5.48	5.79	5.29	6.04
	Associationd					VNN2	VNN2	VNN2	VNN2	VNN3	VNN3	VNN3	VNN3	VNN3	VNN3			VSTM1	WDR48	WDR48	WDR48	WDR6		ZFP90	ZNF500	ZYX
SNP 2	Pos/Mb ^c	83600397	214514361	75151717	45974668	133077063	133072650	133072650	133072650	133067782	133067782	133067782	133067782	133067782	133067782	71024750	123098249	54553697	39091812	39067925	39044116	49194331	93119799	68573945	4799041	143093824
	Chr.	16	1	17	19	9	9	9	9	9	9	9	9	9	9	18	10	19	8	8	8	8	15	16	16	7
	rs ID	rs7201194	rs7512594	rs7225546	rs2276470	rs1883613	rs1883617	rs1883617	rs1883617	rs2267952	rs2267952	rs2267952	rs2267952	rs2267952	rs2267952	rs4552100	rs7895870	rs10500316	rs6778963	rs883349	rs7619193	rs11715581	rs12591171	rs1182968	rs2290560	rs2242601
	Associationd	UBASH3A	UBASH3A	USP36												VSTM1	VSTM1			RAPGEF1			XAF1			
SNP 1	Pos/Mb^{c}	43855067	43855067	76794981	46063167	105252718	9116155	49927332	16834510	151662184	73006453	75547169	83262064	16594253	51692548	54553697	54553697	30261219	188927822	134635088	102624790	123371708	6673170	37040648	48283177	8935312
S	Chr.	21	21	17	19	7	20	22	11	7	œ	6	14	21	13	19	19	22	4	6	13	11	17	21	22	20
	rs ID	rs1893592	rs1893592	rs2279308	rs1264226	rs10435352	rs13044386	rs134447	rs216495	rs10278073	rs1443946	rs348462	rs7157055	rs2823165	rs9596457	rs10500316	rs10500316	rs9625870	rs1388935	rs1887778	rs9554833	rs12362253	rs1533031	rs909446	rs4823723	rs6056281
	Chr.	21	21	17	19	9	9	9	9	9	9	9	9	9	9	19	19	19	8	8	8	8	17	16	16	-
Expression trait	Probe ID ^b	ILMN_2338348	ILMN_2338348	ILMN_1697227	ILMN_1743646	ILMN_1678939	ILMN_1678939	ILMN_1678939	ILMN_1678939	ILMN_1804935	ILMN_1804935	ILMN_1804935	ILMN_1804935	ILMN_2387680	ILMN_2387680	ILMN_1763455	ILMN_1763455	ILMN_1763455	ILMN_1762103	ILMN_1762103	ILMN_1762103	ILMN_1669484	ILMN_2370573	ILMN_1684628	ILMN_1700238	ILMN_1701875
Ex	Gene ID ^a	UBASH3A	UBASH3A	USP36	VASP	VNN2	VNN2	VNN2	VNN2	VNN3	VNN3	VNN3	VNN3	VNN3	VNN3	VSTM1	VSTM1	VSTM1	WDR48	WDR48	WDR48	WDR6	XAF1	ZFP90	ZNF500	ZYX

Table S1 - continued from previous page

a Phenotypes are expression levels of RefSeq Genes billumina probe ID used to measure gene expression by Illumina probe ID used to measure gene expression of Physical SNP position in base pairs (HG19) defeded Gene ID of gene expression level that is influenced by the SNP (BSGS discovery dataset, 10^{-11}), the reaction $-\log_{10} p$ -value from replication dataset for interaction $-\log_{10} p$ -value from meta analysis of replication datasets functaction $-\log_{10} p$ -value from meta analysis of replication bases only historice in Mb between interacting SNPs for cis-cis acting SNP pairs

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