

Vedlegg 3: FHF901340

Undersøkelse av kobling til biologi assosiert med ferskvannssoppvandringsevne for ett kandidat-SNP sett for hver av populasjonsgruppene: AquaGen, SalmoBreed, Mowi og Rauma.

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Til eksemplifisering valgte vi å bruke SNP-settet som ble produsert av parametersettet **EW = 10, A1_max = 20 og AW = 15 for alle avlspopulasjonene (se rapport for detaljer).**

Antallet SNPer i de fire kandidatsettene fordelte seg slik: AquaGen: 18, SalmoBreed: 13, Mowi: 16, Rauma 13.

AquaGen: ['ctg7180001900376_8301_SAG', 'ctg7180001335371_3683_SAC', 'ctg7180001805519_4864_SAG', 'ctg7180001281527_848_SCT', 'ctg7180001891409_3634_SCT', 'ctg7180001797454_43093_SAG', 'ctg7180001857660_10743_SAG', 'ctg7180001870716_3401_SCT', 'ctg7180001793773_4907', 'ctg7180001912369_4971_SAG', 'ctg7180001679281_5789_SAC', 'ctg7180001885038_4967_SAC', 'ctg7180001906456_6568_SGT', 'ctg7180001398466_7983_SAG', 'ctg7180001916146_1772_SCT', 'ctg7180001845082_7172_SAG', 'ctg7180001835143_8201_SGT', 'ctg7180001845450_3014_SAC']

SalmoBreed: ['ctg7180001851039_10290_SAC', 'ctg7180001878854_3628_SAG', 'ctg7180001364094_5295_SCT', 'ctg7180001903360_761_SAC', 'ctg7180001591304_4622_SGT', 'ctg7180001631827_192_SAC', 'ctg7180001208887_1776_SCT', 'ctg7180001937818_13928_SAG', 'ctg7180001853207_6271_SAG', 'ctg7180001668257_1374_SAG', 'ctg7180001827628_2639_SGT', 'ctg7180001827868_2803_SAC', 'ctg7180001474449_216_SGT']

Mowi: ['ctg7180001903803_1531_SCT', 'ctg7180001268296_4006_SCT', 'ctg7180001851039_10290_SAC', 'ctg7180001888084_235_SCT', 'ctg7180001863290_453_SCT', 'ctg7180001593480_3370_SAC', 'ctg7180001833869_486_SCT', 'ctg7180001591304_4622_SGT', 'ctg7180001538584_4406_SGT', 'ctg7180001809345_1074_SCT', 'ctg7180001626552_1091_SAG', 'ctg7180001631827_192_SAC', 'ctg7180001295039_234_SAG', 'ctg7180001925561_4576_SAC', 'ctg7180001933798_3460_SGT', 'ctg7180001721295_376_SCT']

Rauma:

['ctg7180001825403_10894_SAG', 'ctg7180001850393_8798_SCT', 'ctg7180001900396_1652_SCT', 'ctg7180001591304_4622_SGT', 'ctg7180001883233_10351', 'ctg7180001809345_1074_SCT', 'ctg7180001289769_2604_SCT', 'ctg7180001787680_1094_SAC', 'ctg7180001628780_3092_SAG', 'ctg7180001858455_7377_SAG', 'ctg7180001552685_1089_SGT', 'ctg7180001934773_3779_SCT', 'ctg7180001936744_2288_SCT']

SNPene markert i farger er felles.

For et gitt gen (eller protein) søkte vi spesifikt med stikkordene: neuronal, disease, sensory, olfactory, development. I enkelte tilfeller fulgte vi opp med mer spesifikke ord som dopamine, serotonin, etc der det var tydelige leads til neurotransmitter-biologien. I all hovedsak har treffene vært på pattedyr. Vi har ikke vært systematisk med å søke gjennom alle muligheter der det er ulike navn for ett gen.

For hver SNP er alle gener innenfor et vindu på ± 50 Kb listet og sjekket. I noen tilfeller er det ingen gener i dette området, og da er de to nærmeste flankerende genene sjekket.

Studien er å betrakte som innledende og ønsker kun å vise om det finnes evidens i litteraturen på at et gitt gen kan assosieres med biologi som er av betydning for ferskvannssoppvandringsevne. Den kan bli fulgt opp med bruk av mer avanserte verktøy for å avdekke fysiologiske krysskoblinger mellom gener.

AquaGen

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
7509	ctg7180001900376_8301_SAG	functional	ssa14	61498291	missense_variant	LOC106569887 c.547C>T

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	Pi
356848	106569883 14:61399221:61530689	ctg7180001900376_8301_SAG	14.0	61449221.0	61480689.0	LOC106569883	synaptotagmin-11-like	protein_coding	XI
356884	106569887 14:61439530:61549630	ctg7180001900376_8301_SAG	14.0	61489530.0	61499630.0	LOC106569887	GTP-binding protein Rit1-like	protein_coding	XI
356907	106569885 14:61449749:61554780	ctg7180001900376_8301_SAG	14.0	61499749.0	61504780.0	pex11b	peroxisomal membrane protein 11B isoform X2	protein_coding	XI

	References
synaptotagmin-11	<p>Wang, C., Kang, X., Zhou, L. <i>et al.</i> (2018) "Synaptotagmin-11 is a critical mediator of parkin-linked neurotoxicity and Parkinson's disease-like pathology" <i>Nature Communications</i>, 9: 81</p> <p>Wang, C., Wang, Y., Hu, M. <i>et al.</i> (2016) "Synaptotagmin-11 inhibits clathrin-mediated and bulk endocytosis" <i>EMBO reports</i>, 17: 47-63.</p> <p>Yeo, H., Kim, H., Mo, J. <i>et al.</i> (2012) "Developmental expression and subcellular distribution of synaptotagmin 11 in rat hippocampus" <i>Neuroscience</i>, 225: 35-43.</p> <p>Shimojo, M., Madara, J., Pankow, S. <i>et al.</i> (2019) "Synaptotagmin-11 mediates a vesicle trafficking pathway that is essential for development and synaptic plasticity" <i>Genes & Dev</i>, 33: 365-376.</p>
GTP-binding protein Rit1	No clear association
peroxisomal membrane protein 11B isoform X2	Ahlemeyer, B., Gottwald, M., and Baumgart-Vogt, E. (2012) "Deletion of a single allele of the Pex11 β gene is sufficient to cause oxidative stress, delayed differentiation and neuronal death in mouse brain" <i>Disease Models Mechanisms</i> , 5: 125-140.

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
16587	ctg7180001335371_3683_SAC	Distribution-SNP	ssa01	125843487	intergenic_region	LOC106565750-LOC106563392 n.125843487T>G

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	Protein_product	Strand	Len	Row_no	Gid
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	References
LOC106565750	No info
piggyBac transposable element-derived protein 4	Appears to have some link to neuro- and olfactory biology:

Dang, P., Fisher, S. A., Stefanik, D., Kim, J., & Raper, J. A. (2018) "Coordination of olfactory receptor choice with guidance receptor expression and function in olfactory sensory neurons" *PLoS Genetics*, 14: e1007164.

Khuansuwan, S. (2014) "A transcription factor network dictates neuronal cell fate decisions in the zebrafish dorsal diencephalon" PhD Thesis, Vanderbilt University, USA, <https://Etd.Library.Vanderbilt.Edu/Available/Etd-09242014-175729/Unrestricted/KhuansuwanDissertationFinal.Pdf>

Pavelitz, T., Gray, L. T., Padilla, S. L., Bailey, A. D., & Weiner, A. M. (2013) "PGBD5: A neural-specific intron-containing piggyBac transposase domesticated over 500 million years ago and conserved from cephalochordates to humans" *Mobile DNA*, 4: 23.

Yang, J., Yan, B., Fan, Y., Yang, L., Zhao, B., Zhu, F., ... Ma, X. (2019) "Identification of schizophrenia related biological pathways across eight brain regions" *Behavioural Brain Research*, 360: 1–6.

Matsunami, N., Hensel, C. H., Baird, L., Stevens, J., Otterud, B., Leppert, T., ... Leppert, M. F. (2014) "Identification of rare DNA sequence variants in high-risk autism families and their prevalence in a large case/control population" *Molecular Autism*, 5: 5.

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
276	ctg7180001805519_4864_SAG	rsb	ssa09	128631600	intron_variant	stim1 c.939+234A>G

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
234493	106613200 9:128543777:128650112	ctg7180001805519_4864_SAG	9.0	128593777.0	128600112.0	LOC106613200	short transient receptor potential channel 2-like	protein_coding
234524	100380565 9:128561136:128736931	ctg7180001805519_4864_SAG	9.0	128611136.0	128686931.0	stim1	stromal interaction molecule 1 isoform X2	protein_coding

	References
short transient receptor potential channel 2	<p>Williams, C., Gallagher, E., Dittman, A. <i>et al.</i> (2018) "Elevated carbon dioxide alters neural signaling and anti-predator behaviors in ocean phase coho salmon (<i>Oncorhynchus kisutch</i>)" Presentation 2018 Salish Sea Ecosystem Conference (Seattle, Wash.)</p> <p>Harteneck, C., Plant, T. D., & Schultz, G. (2000) "From worm to man: three subfamilies of TRP channels" <i>Trends Neurosci</i>, 23: 159–166.</p> <p>Vennekens, R., Voets, T., Bindels, R. J. M., Droogmans, G., & Nilius, B. (2002) "Current understanding of mammalian TRP homologues" <i>Cell Calcium</i>, 31: 253–264.</p>

Qiu, J., Fang, Y., Rønnekleiv, O. K., & Kelly, M. J. (2010) "Leptin excites proopiomelanocortin neurons via activation of TRPC channels" *The Journal of Neuroscience*, 30: 1560–1565.

Sohn, J. W., Xu, Y., Jones, J. E., Wickman, K., Williams, K. W., & Elmquist, J. K. (2011) "Serotonin 2C receptor activates a distinct population of arcuate pro-opiomelanocortin neurons via TRPC channels" *Neuron*, 71: 488–497.

Huang, W. C., Young, J. S., & Glitsch, M. D. (2007) "Changes in TRPC channel expression during postnatal development of cerebellar neurons" *Cell Calcium*, 42: 1–10.

El-Hassar, L., Hagenston, A. M., D'Angelo, L. B., & Yeckel, M. F. (2011) "Metabotropic glutamate receptors regulate hippocampal CA1 pyramidal neuron excitability via Ca²⁺ wave-dependent activation of SK and TRPC channels" *Journal of Physiology*, 589: 3211–3229.

Li, Y., Jia, Y., Cui, K., Li, N., Zheng, Z., Wang, Y., & Yan, X. (2005) "Essential role of TRPC channels in the guidance of nerve growth cones by brain-derived neurotrophic factor" *Nature*, 434: 894–898.

Selvaraj, S., Sun, Y., & Singh, B. (2010) "TRPC Channels and their Implications for Neurological Diseases" *CNS & Neurological Disorders - Drug Targets*, 9: 94–104.

Stroh, O., Freichel, M., Kretz, O., Birnbaumer, L., Hartmann, J., & Egger, V. (2012) "NMDA receptor-dependent synaptic activation of TRPC channels in olfactory bulb granule cells. *The Journal of Neuroscience*", 32: 5737–5746.

Davies, R., Hayat, S., Wigley, C. B., & Robbins, J. (2004) "The calcium influx pathway in rat olfactory ensheathing cells shows TRPC channel pharmacology" *Brain Research*, 1023: 154–156.

Wang, Y., Teng, H. L., Gao, Y., Zhang, F., Ding, Y. Q., & Huang, Z. H. (2016) "Brain-derived Neurotrophic Factor Promotes the Migration of Olfactory Ensheathing Cells Through TRPC Channels" *GLIA*, 64: 2154–2165.

Badsha, F., Kain, P., Prabhakar, S., Sundaram, S., Padinjat, R., Rodrigues, V., & Hasan, G. (2012) "Mutants in *Drosophila* TRPC Channels Reduce Olfactory Sensitivity to Carbon Dioxide" *PLoS ONE*, 7: e49848.

Freichel, M., Vennekens, R., Olausson, J., Hoffmann, M., Müller, C., Stolz, S., ... Flockerzi, V. (2004) "Functional role of TRPC proteins in vivo: lessons from TRPC-deficient mouse models" *Biochemical and Biophysical Research Communications*, 322: 1352–1358.

	<p>Zufall, F. (2005) "The TRPC2 ion channel and pheromone sensing in the accessory olfactory system" <i>Naunyn-Schmiedeberg's Archives of Pharmacology</i>, 371: 245–250.</p> <p>Zufall F. (2014) "TRPs in Olfaction". In: Nilius B., Flockerzi V. (eds) <i>Mammalian Transient Receptor Potential (TRP) Cation Channels. Handbook of Experimental Pharmacology</i>, vol 223. Springer, Cham</p>
stim1	<p>Skibinska-Kijek, M., Wisniewska, M. B., Gruszczynska-Biegala, J., <i>et al.</i> (2009) "Immunolocalization of STIM1 in the mouse brain" <i>Acta Neurobiol Exp (Wars)</i>, 69: 413-428.</p> <p>Sun, Y., Zhang, H., Selvaraj, S. <i>et al.</i> (2017) "Inhibition of L-type Ca²⁺ channels by TRPC1-STIM1 complex is essential for the protection of dopaminergic neurons" <i>The Journal of Neuroscience</i>, 37: 3364-3377.</p> <p>Shim, S., Zheng, J. Q., and Ming, G. (20013) "A critical role for STIM1 in filopodial calcium entry and axon guidance" <i>Molecular Brain</i>, 6: 51.</p>

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
29727	ctg7180001281527_848_SCT	Distribution-SNP	ssa11	91377549	intron_variant	LOC106563916 c.754+3603C>T

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	P
287222	106563914 11:91246349:91380703	ctg7180001281527_848_SCT	11.0	91296349.0	91330703.0	tmem135	transmembrane protein 135	protein_coding	X
287224	106563916 11:91320151:91498889	ctg7180001281527_848_SCT	11.0	91370151.0	91448889.0	LOC106563916	metabotropic glutamate receptor 5-like	protein_coding	X

	References
Tmem135	No clear association
metabotropic glutamate receptor 5	<p>Awad, H., Hubert, G., Smith, Y. et al. (2000) "Activation of metabotropic glutamate receptor 5 has direct excitatory effects and potentiates NMDA receptor currents in neurons of the subthalamic nucleus" <i>The Journal of Neuroscience</i>, 20: 7871-7879.</p> <p>Byrnes, K., Stoica, B., Loane, D. et al. (2009) "Metabotropic Glutamate Receptor 5 Activation Inhibits Microglial Associated Inflammation and Neurotoxicity" <i>GLIA</i>, 57: 550-560.</p> <p>Ferraguti, F. and Shigemoto, R. (2006) "Metabotropic glutamate receptors" <i>Cell Tissue Res</i>, 326: 483-504.</p> <p>Simonyi, A., Schachtman, T. R., and Christoffersen, G. R. (2005) "The role of metabotropic glutamate receptor 5 in learning and memory processes" <i>Drug News & Perspectives</i>, 18: 353-361.</p> <p>Rodrigues, S. M., Bauer, E. P, Farb, C. R. <i>et al.</i> (2002) "The Group I Metabotropic Glutamate Receptor mGluR5 Is Required for Fear Memory Formation and Long-Term Potentiation in the Lateral Amygdala" <i>The Journal of Neuroscience</i>, 22: 5219-5229.</p>

Lu, Y.-M., Jia, Z., Janus, J. <i>et al.</i> (1997) "Mice Lacking Metabotropic Glutamate Receptor 5 Show Impaired Learning and Reduced CA1 Long-Term Potentiation (LTP) But Normal CA3 LTP" <i>The Journal of Neuroscience</i> , 17: 5196-5205.
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Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_Info
6260	ctg7180001891409_3634_SCT	functional	ssa09	77924878	missense_variant	tmem173 c.643G>A

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
221069	106612112 9:77811366:77964559	ctg7180001891409_3634_SCT	9.0	77861366.0	77914559.0	LOC106612112	serine/threonine-protein phosphatase 2B cataly...	protein_coding
221078	106612120 9:77867692:77976027	ctg7180001891409_3634_SCT	9.0	77917692.0	77926027.0	tmem173	stimulator of interferon genes protein	protein_coding
221089	106612111 9:77881114:77984955	ctg7180001891409_3634_SCT	9.0	77931114.0	77934955.0	LOC106612111	DNA damage-inducible transcript 4-like protein	protein_coding
221096	106612110 9:77885241:77996262	ctg7180001891409_3634_SCT	9.0	77935241.0	77946262.0	LOC106612110	bromodomain-containing protein 8-like isoform X3	protein_coding
221107	106612109 9:77901443:78071805	ctg7180001891409_3634_SCT	9.0	77951443.0	78021805.0	LOC106612109	muscleblind-like protein 3 isoform X10	protein_coding

	References
serine/threonine-protein phosphatase 2B cataly..	<p>Gold, B. G. (1997) "FK506 and the Role of Immunophilins in Nerve Regeneration" <i>Molecular Neurobiolog</i>, 15: 285-306.</p> <p>Dimatelis, J. J., Hsieh, J. H., Sterley, T.-L. <i>et al.</i> (2015) "Impaired Energy Metabolism and Disturbed Dopamine and Glutamate Signalling in the Striatum and Prefrontal Cortex of the Spontaneously Hypertensive Rat Model of Attention-Deficit Hyperactivity Disorder" <i>J. Mol. Neurosci.</i>, 56: 696-707.</p> <p>Bernstein, H.-G., Dobrowolny, H., Schott, B. H. <i>et al.</i> (2013) "Increased density of AKAP5-expressing neurons in the anterior cingulate cortex of subjects with bipolar disorder" <i>Journal of Psychiatric Research</i>, 47: 699-705.</p>
tmem173	<p>No clear association, but a few relevant hits:</p> <p>Patel, S., & Jin, L. (2019) "TMEM173 variants and potential importance to human biology and disease" <i>Genes & Immunity</i>, 20: 82–89.</p> <p>Liu, Y., & Cherry, S. (2019) "Zika virus infection activates sting-dependent antiviral autophagy in the <i>Drosophila</i> brain" <i>Autophagy</i>, 15: 174–175.</p> <p>Hickman, S. E., Kingery, N. D., Ohsumi, T. K., Borowsky, M. L., Wang, L. C., Means, T. K., & El Khoury, J. (2013) "The microglial sensome revealed by direct RNA sequencing" <i>Nature Neuroscience</i>, 16: 1896–1905.</p>

	<p>LaFlamme, B. (2014) "NF-κB signaling disrupted in neurodevelopmental disorders" <i>Nature Genetics</i>, 46: 933.</p> <p>Liu, S., & Guan, W. (2018) "STING signaling promotes apoptosis, necrosis, and cell death: An overview and update" <i>Mediators of Inflammation</i>, 2018: 1202797.</p> <p>Ranoa, D. R. E., Widau, R. C., Mallon, S., Parekh, A. D., Nicolae, C. M., Huang, X., ... Weichselbaum, R. R. (2019) "STING promotes homeostasis via regulation of cell proliferation and chromosomal stability" <i>Cancer Research</i>, 79: 1465–1479.</p>
DNA damage-inducible transcript 4 protein	No clear association
bromodomain-containing protein 8	No clear association
muscleblind-like protein 3 isoform X10	No clear association

	Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info	
6582	ctg7180001797454_43093_SAG	functional	ssa10	79356907	missense_variant	nup93	c.1445A>G	

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep
255127	106560849 10:79249880:79368353	ctg7180001797454_43093_SAG	10.0	79299880.0	79318353.0	LOC106560849	cholesteryl ester transfer protein-like
255161	100380390 10:79269345:79387287	ctg7180001797454_43093_SAG	10.0	79319345.0	79337287.0	herp1	Homocysteine-responsive endoplasmic reticulum-...
255186	106560848 10:79288130:79396381	ctg7180001797454_43093_SAG	10.0	79338130.0	79346381.0	LOC106560848	solute carrier family 12 member 3-like
255214	100195319 10:79298829:79432071	ctg7180001797454_43093_SAG	10.0	79348829.0	79382071.0	nup93	nuclear pore complex protein Nup93 isoform X1
255240	100136581 10:79333857:79434867	ctg7180001797454_43093_SAG	10.0	79383857.0	79384867.0	LOC100136581	metallothionein B
255293	106560847 10:79343568:79451725	ctg7180001797454_43093_SAG	10.0	79393568.0	79401725.0	LOC106560847	UDP-GlcNAc:betaGal beta-1
255319	106560845 10:79353228:79462519	ctg7180001797454_43093_SAG	10.0	79403228.0	79412519.0	LOC106560845	UPF0183 protein C16orf70 homolog isoform X2

	References
cholesteryl ester transfer protein	No clear association
herp1	Shi, N., & Chen, S. Y. (2015) "From nerve to blood vessel: a new role of Olfm2 in smooth muscle differentiation from human embryonic stem cell-derived mesenchymal cells" <i>The Journal of Biomedical Research</i> , 29: 261–263.

	<p>Iso, T., Kedes, L., & Hamamori, Y. (2003) "HES and HERP families: Multiple effectors of the Notch signaling pathway" <i>Journal of Cellular Physiology</i>, 194: 237–255.</p> <p>Yoon, K., & Gaiano, N. (2005) "Notch signaling in the mammalian central nervous system: Insights from mouse mutants" <i>Nature Neuroscience</i>, 8: 709–715.</p> <p>Bianchi, S., Dotti, M. T., & Federico, A. (2006) "Physiology and Pathology of Notch Signalling System" <i>Journal of Cellular Physiology</i>, 207: 300–308.</p>
solute carrier family 12 member 3-like	No clear association
nup93	<p>Labade, A. S., Salvi, A., Karmodiya, K. <i>et al.</i> (2019) "Nup93 modulates spatiotemporal dynamics and function of the HOXA gene cluster during differentiation" <i>bioRxiv</i>, DOI: 10.1101/646224.</p> <p>Dacheta, F., Liua, J., Ravits, J. <i>et al.</i> (2019) "Predicting disease specific spinal motor neurons and glia in sporadic ALS" <i>Neurobiology of Disease</i>, 130: 104523.</p> <p>Shamseldin, H. E., Makhseed, N., Ibrahim, N. <i>et al.</i> (2019) "NUP214 deficiency causes severe encephalopathy and microcephaly in humans" <i>Human Genetics</i>, 138: 221-229.</p>
metallothionein B	No clear association
UDP-GlcNAc:betaGal beta-1,3-N-acetylglucosaminyltransferase 9	No clear association
UPF0183 protein C16orf70 homolog	<p>Hirokawa, N. and Takemura, R. (2005) "Molecular motors and mechanisms of directional transport in neurons" <i>Nature Reviews Neuroscience</i>, 6: 201-214.</p> <p>Namba, T., Nakamuta, S., Funahashi, Y. <i>et al.</i> (2011) "The Role of Selective Transport in Neuronal Polarization" <i>Developmental Neurobiology</i>, 71: 445-457.</p> <p>Tomita, S., Fujita, T., Kirino, Y. <i>et al.</i> (2000) "PDZ Domain-dependent Suppression of NF-κB/p65-induced Aβ42 Production by a Neuron-specific X11-like Protein" <i>The Journal of Biological Chemistry</i>, 275: 13056-13060.</p> <p>Spiegel, I, Salomon, D., Erne, B. <i>et al.</i> (2002) "Caspr3 and Caspr4, Two Novel Members of the Caspr Family Are Expressed in the Nervous System and Interact with PDZ Domains" <i>Molecular and Cellular Neuroscience</i>, 20: 283-297.</p> <p>Hirokawa, N., Noda, Y., Tanaka, Y. <i>et al.</i> (2009) "Kinesin superfamily motor proteins and intracellular transport" <i>Nature Reviews Molecular Cell Biology</i>, 10: 682-696.</p>

	<p>Collingridge, G. L., Volianskis, A., Bannister, N. <i>et al.</i> (2013) "The NMDA receptor as a target for cognitive enhancement" <i>Neuropharmacology</i>, 64:13-26.</p> <p>Schmid, A. (2006) "The role of glutamate receptors in formation and maturation of Drosophila neuromuscular synapses Dissertation" PhD thesis, Göttingen.</p> <p>Shantanu, P. A., Sharma, D., Sharma, M. <i>et al.</i> (2019) "Kinesins: Motor Proteins as Novel Target for the Treatment of Chronic Pain" <i>Molecular Neurobiology</i>, 56: 3854-3864.</p>
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Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
9459	ctg7180001857660_10743_SAG	functional	ssa27	4563122	missense_variant	LOC106588229 c.1276G>A

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	F
559901	106588227 27:4466072:4593305	ctg7180001857660_10743_SAG	27.0	4516072.0	4543305.0	fbxl6	F-box/LRR-repeat protein 6	protein_coding	>
559913	106588226 27:4493094:4598515	ctg7180001857660_10743_SAG	27.0	4543094.0	4548515.0	LOC106588226	uncharacterized protein LOC106588226	protein_coding	>
559932	106588228 27:4492197:4605706	ctg7180001857660_10743_SAG	27.0	4542197.0	4555706.0	slc52a2	solute carrier family 52	riboflavin transporter	
559959	106588229 27:4507526:4614443	ctg7180001857660_10743_SAG	27.0	4557526.0	4564443.0	LOC106588229	riboflavin transporter 2-like	protein_coding	>
560003	106588230 27:4526769:4699130	ctg7180001857660_10743_SAG	27.0	4576769.0	4649130.0	LOC106588230	nuclear factor of activated T-cells	cytoplasmic 1-like isoform X2	

	References
fbxl6	No clear association
LOC106588226	No info
slc52a2	<p>Possibly a slight association:</p> <p>Haack, T. <i>et al.</i> (2012) "Impaired riboflavin transport due to missense mutations in SLC52A2 causes Brown-Vialetto-Van Laere syndrome" <i>Journal of Inherited Metabolic Disease</i>, 35: 943-948.</p> <p>Babanejad, M. <i>et al.</i> (2018) "SLC52A2 mutations cause SCABD2 phenotype: A second report" <i>International Journal of Pediatric Otorhinolaryngology</i>, 104: 195-199.</p> <p>Yonezawa, A. and Inui, K. (2013) "Novel riboflavin transporter family RFVT/SLC52: Identification, nomenclature, functional characterization and genetic diseases of RFVT/SLC52" <i>Molecular Aspects of Medicine</i>, 34: 693-701.</p>
riboflavin transporter 2	Jaeger, B. and Bosch, A. M. (2016) "Clinical presentation and outcome of riboflavin transporter deficiency: mini review after five years of experience" <i>Journal of Inherited Metabolic Disease</i> , 39: 559-564.

	<p>Manole A. and Houlden H. (2015) Riboflavin transporter deficiency neuronopathy. In: Pagon RA, Adam MP, Ardinger HH (eds) GeneReviews® [Internet]. University of Washington, Seattle, 1993–2015. Available from http://www.ncbi.nlm.nih.gov/books/ Google Scholar</p> <p>Biswas, A. <i>et al.</i> (2013) “Identification and Functional Characterization of the <i>Caenorhabditis elegans</i> Riboflavin Transporters <i>rft-1</i> and <i>rft-2</i>” <i>PLoS ONE</i>, 8: e58190.</p> <p>O’Callaghan, B. <i>et al.</i> (2019) “An update on the genetics, clinical presentation, and pathomechanisms of human riboflavin transporter deficiency” <i>Journal of inherited metabolic disease</i>, 42: 598-607.</p>
<p>nuclear factor of activated T-cells, cytoplasmic 1 (NFATc1)</p>	<p>Hernández-Ochoa, E. O. <i>et al.</i> (2007) “Ca²⁺ signal summation and NFATc1 nuclear translocation in sympathetic ganglion neurons during repetitive action potentials” <i>Cell Calcium</i>, 41: 559-571.</p> <p>Vihma, H. <i>et al.</i> (2016) “Regulation of different human NFAT isoforms by neuronal activity” <i>Journal of Neurochemistry</i>, 137: 394-408.</p> <p>Pérez-Ortiz, J. M. <i>et al.</i> (2008) “Mechanical lesion activates newly identified NFATc1 in primary astrocytes: Implication of ATP and purinergic receptors” <i>European Journal of Neuroscience</i>, 27: 2453-2465.</p> <p>Luo, J. <i>et al.</i> (2014) “A calcineurin- and NFAT-dependent pathway is involved in α-synuclein-induced degeneration of midbrain dopaminergic neurons” <i>Hum. Mol. Genet.</i>, 23: 6567–6574.</p> <p>Vihma, H. and Timmusk, T. (2017) “Sumoylation regulates the transcriptional activity of different human NFAT isoforms in neurons” <i>Neuroscience Letters</i>, 653: 302-307.</p> <p>Shetty, R. S. <i>et al.</i> (2005) “Transcriptional changes during neuronal death and replacement in the olfactory epithelium” <i>Molecular and Cellular Neuroscience</i>, 30: 90-107.</p> <p>Vihma, H. <i>et al.</i> (2008) “Alternative splicing and expression of human and mouse NFAT genes” <i>Genomics</i>, 92: 279-291.</p> <p>Wong, K. S. <i>et al.</i> (2012) “Hedgehog signaling is required for differentiation of endocardial progenitors in zebrafish” <i>Developmental Biology</i>, 361: 377-391.</p>

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info					
6570	ctg7180001870716_3401_SCT	functional	ssa10	74406853	missense_variant	saps3	c.2149T>C				
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype			
253104	106560967 10:74295703:74409227	ctg7180001870716_3401_SCT	10.0	74345703.0	74359227.0	LOC106560967	protein lin-54 homolog isoform X1	protein_coding	}		
253132	106561117 10:74313642:74418031	ctg7180001870716_3401_SCT	10.0	74363642.0	74368031.0	LOC106561117	galanin peptides-like isoform X2	protein_coding	}		
253163	106560965 10:74319992:74447059	ctg7180001870716_3401_SCT	10.0	74369992.0	74397059.0	LOC106560965	sodium/hydrogen exchanger 10-like	protein_coding	}		
253187	100380307 10:74353119:74470679	ctg7180001870716_3401_SCT	10.0	74403119.0	74420679.0	saps3	SAPS domain family	member 3 isoform X5			
253202	106560964 10:74376206:74527993	ctg7180001870716_3401_SCT	10.0	74426206.0	74477993.0	LOC106560964	low-density lipoprotein receptor-related prote...	protein_coding	}		
596355	106560966 10:74318551:74419847	ctg7180001870716_3401_SCT	NaN	74368551.0	74369847.0	LOC106560966	NaN	lncRNA			
596550	106561118 10:74309816:74411378	ctg7180001870716_3401_SCT	NaN	74359816.0	74361378.0	LOC106561118	NaN	lncRNA			

	References
protein lin-54	No clear association
galanin peptides	<p>Gundlach, A. L. (2002) "Galanin/GALP and galanin receptors: Role in central control of feeding, body weight/obesity and reproduction?" <i>European Journal of Pharmacology</i>, 440: 255-268.</p> <p>De Lecea, L. <i>et al.</i> (1998) "The hypocretins: Hypothalamus-specific peptides with neuroexcitatory activity" <i>Proceedings of the National Academy of Sciences USA</i>, 95: 322-327.</p> <p>Lang, R. <i>et al.</i> (2015) "Physiology, Signaling, and Pharmacology of Galanin Peptides and Receptors: Three Decades of Emerging Diversity" <i>Pharmacological Reviews</i>, 67:118-175.</p> <p>Landry, M. <i>et al.</i> (2003) "Differential routing of coexisting neuropeptides in vasopressin neurons" <i>European Journal of Neuroscience</i>, 17: 579-589.</p>
sodium/hydrogen exchanger 10	No clear association
saps3	Pawlowski, T. L. <i>et al.</i> (2009) "Candidate Agtr2 influenced genes and pathways identified by expression profiling in the developing brain of Agtr2 ^{-/-} mice" <i>Genomics</i> , 94: 188-195.
low-density lipoprotein receptor-related protein 5	No clear association
LOC106560966	No info
LOC106561118	No info

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info				
5761	ctg7180001793773_4907	functional	ssa06	38936265	missense_variant	LOC106607255	c.1271T>C			
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype		
161534	106607256	6:38816261:38974305	ctg7180001793773_4907	6.0	38866261.0	38924305.0	LOC106607256	gap junction gamma-1 protein-like	protein_coding	
161577	106607255	6:38885676:38993848	ctg7180001793773_4907	6.0	38935676.0	38943848.0	LOC106607255	alpha-2 sialyltransferase 8E-like isoform X2	protein_coding	
161590	100196552	6:38932124:39034658	ctg7180001793773_4907	6.0	38982124.0	38984658.0	r19	60S ribosomal protein L19	protein_coding	

	References
gap junction gamma-1 protein	No clear association
alpha-2,8-sialyltransferase 8E	<p>Gouveia, R. <i>et al.</i> (2012) "Expression of glycogenes in differentiating human NT2N neurons. Downregulation of fucosyltransferase 9 leads to decreased Lewisx levels and impaired neurite outgrowth" <i>Biochimica et Biophysica Acta</i>, 1820: 2007-2019.</p> <p>Schengrund, C.-L. (2015) "Gangliosides: Glycosphingolipids essential for normal neural development and function" <i>Trends in Biochemical Sciences</i>, 40: 397-406.</p> <p>Schneider, J. S. (2018) "Altered expression of genes involved in ganglioside biosynthesis in substantia nigra neurons in Parkinson's disease" <i>PLoS ONE</i>, 13: e0199189.</p> <p>Yu R.K., Itokazu Y. (2014) Glycolipid and Glycoprotein Expression During Neural Development. In: Yu R., Schengrund CL. (eds) <i>Glycobiology of the Nervous System. Advances in Neurobiology</i>, vol 9. Springer, New York, NY.</p> <p>Sivasankaran, A. <i>et al.</i> (2015) "Split Hand/Foot Malformation Associated with 7q21.3 Microdeletion: A Case Report" <i>Molecular Syndromology</i>, 6: 287-296.</p>
r19	No clear association

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info				
470	ctg7180001912369_4971_SAG	rsb	ssa17	6071248	synonymous_variant	LOC106575232	c.2088G>A			
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype		
408296	106575232	17:5949168:6127556	ctg7180001912369_4971_SAG	17.0	5999168.0	6077556.0	LOC106575232	zinc finger E-box-binding homeobox 2-like isof...	protein_coding	

	References
<p>zinc finger E-box-binding homeobox 2</p>	<p>McKinsey, G. L. <i>et al.</i> (2013) "Dlx1&2-Dependent Expression of Zfhx1b (Sip1, Zeb2) Regulates the Fate Switch between Cortical and Striatal Interneurons" <i>Neuron</i>, 77: 83-98.</p> <p>Hegarty, S. V. <i>et al.</i> (2015) "Zeb2: A multifunctional regulator of nervous system development" <i>Progress in Neurobiology</i>, 132: 81-95.</p> <p>Yamada, Y. <i>et al.</i> (2014) "The spectrum of ZEB2 mutations causing the Mowat-Wilson syndrome in Japanese populations" <i>American Journal of Medical Genetics, Part A</i>, 164A: 1899-1908.</p> <p>Hegarty, S. V. <i>et al.</i> (2017) "Zeb2 is a negative regulator of midbrain dopaminergic axon growth and target innervation" <i>Scientific Reports</i>, 7: 8568.</p> <p>Quintes, S. <i>et al.</i> (2016) "Zeb2 is essential for Schwann cell differentiation, myelination and nerve repair" <i>Nature Neuroscience</i>, 19: 1050-1059.</p> <p>Kropivšek, K. <i>et al.</i> (2014) "Postnatal dynamics of zeb2 expression in rat brain: Analysis of novel 3' UTR sequence reveals a mir-9 interacting site" <i>Journal of Molecular Neuroscience</i>, 52: 138-147.</p> <p>Volk, D. W. and Lewis, D. A. (2014) "Early developmental disturbances of cortical inhibitory neurons: Contribution to cognitive deficits in schizophrenia" <i>Schizophrenia Bulletin</i>, 40: 952-957.</p> <p>Watanabe, Y. <i>et al.</i> (2017) "Differentiation of Mouse Enteric Nervous System Progenitor Cells Is Controlled by Endothelin 3 and Requires Regulation of Ednrb by SOX10 and ZEB2" <i>Gastroenterology</i>, 152: 1139-1150.</p> <p>Yang, S. <i>et al.</i> (2018) "A Zeb2-miR-200c loop controls midbrain dopaminergic neuron neurogenesis and migration" <i>Communications Biology</i>, 1:75.</p>

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
25482	ctg7180001679281_5789_SAC	Distribution-SNP	ssa09	67730491	upstream_gene_variant	LOC106611890 c.-4406G>T

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
218625	106611902 9:67614664:67739614	ctg7180001679281_5789_SAC	9.0	67664664.0	67689614.0	LOC106611902	serine/threonine-protein phosphatase 2A 55 kDa...	protein_coding
218630	106611897 9:67651772:67756927	ctg7180001679281_5789_SAC	9.0	67701772.0	67706927.0	LOC106611897	zinc finger protein 500-like isoform X2	protein_coding
218645	106611896 9:67660852:67767872	ctg7180001679281_5789_SAC	9.0	67710852.0	67717872.0	LOC106611896	zinc finger protein 878-like isoform X2	protein_coding
218656	106611890 9:67668813:67776488	ctg7180001679281_5789_SAC	9.0	67718813.0	67726488.0	LOC106611890	zinc finger protein 629-like	protein_coding
218666	106611891 9:67676894:67780898	ctg7180001679281_5789_SAC	9.0	67726894.0	67730898.0	LOC106611891	zinc finger protein 213-like isoform X1	protein_coding
218674	106611894 9:67682147:67783932	ctg7180001679281_5789_SAC	9.0	67732147.0	67733932.0	LOC106611894	zinc finger protein 782-like	protein_coding
218690	106611893 9:67684831:67787883	ctg7180001679281_5789_SAC	9.0	67734831.0	67737883.0	LOC106611893	zinc finger protein 629-like	protein_coding
218701	106611892 9:67688192:67790239	ctg7180001679281_5789_SAC	9.0	67738192.0	67740239.0	LOC106611892	zinc finger protein 232-like isoform X2	protein_coding
218712	100196518 9:67703329:67804472	ctg7180001679281_5789_SAC	9.0	67753329.0	67754472.0	mif	Macrophage migration inhibitory factor	protein_coding
218733	106611889 9:67707775:67811550	ctg7180001679281_5789_SAC	9.0	67757775.0	67761550.0	LOC106611889	uncharacterized protein LOC106611889	protein_coding
218749	106611888 9:67711705:67825173	ctg7180001679281_5789_SAC	9.0	67761705.0	67775173.0	LOC106611888	E3 ubiquitin-protein ligase BRE1A-like isoform X2	protein_coding
218753	100136522 9:67728285:67832819	ctg7180001679281_5789_SAC	9.0	67778285.0	67782819.0	aldob	fructose-bisphosphate aldolase B	protein_coding

	References
serine/threonine-protein phosphatase 2A 55 kDa regulatory subunit B gamma isoform	No clear association
zinc finger protein 500	No clear association
zinc finger protein 878	No clear association
finger protein 629	No clear association
myeloid zinc finger 1	Li, Z. <i>et al.</i> (2015) "Dorsal root ganglion myeloid zinc finger protein 1 contributes to neuropathic pain after peripheral nerve trauma" <i>Pain</i> , 156: 711-721. Kim, J. <i>et al.</i> (2015) "A regulatory gene network related to the porcine umami taste receptor (TAS1R1/TAS1R3)" <i>Animal Genetics</i> , 47: 114-119.
zinc finger protein 782	No clear association
zinc finger protein 629	No clear association
zinc finger protein 232	No clear association
Mif	Nishibori, M. <i>et al.</i> (1996) "Presence of macrophage migration inhibitory factor (MIF) in ependyma, astrocytes and neurons in the bovine brain" <i>Neuroscience Letters</i> , 213: 193-196.

	<p>Kostrzewa, R. M. <i>et al.</i> (1976) "Effects of L-prolyl-L-leucyl-glycine amide (MIF-I) on dopaminergic neurons" <i>Pharmacology, Biochemistry and Behavior</i>, 5: 125-127.</p> <p>Kostrzewa, R. M. <i>et al.</i> (1979) "Striatal dopamine turnover and MIF-I" <i>Brain Research Bulletin</i>, 4: 799-802.</p> <p>Kostrzewa, R. M. <i>et al.</i> (1979) "MIF-I and postsynaptic receptor sites for dopamine" <i>Brain Research Bulletin</i>, 4: 657-662.</p> <p>Hlinák, Z. and Krejčí, I. (1991) "Social recognition in male rats: Age differences and modulation by MIF-2 and Alaptide" <i>Physiol. Res.</i>, 40: 59-67.</p> <p>Hlinák, Z. and Krejčí, I. (1991) "Modulation of social memory in rats by alaptide, a derivative of MIF" <i>Homeostasis Health Dis.</i>, 33: 262–273.</p>
LOC106611889	No info
E3 ubiquitin-protein ligase BRE1A	No clear association
Aldob	No clear association

	Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info		
34	ctg7180001885038_4967_SAC	rsb	ssa02	9269382	upstream_gene_variant	acbd7	c.-2822T>G		
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	
43087	106576009 2:9141578:9272767	ctg7180001885038_4967_SAC	2.0	9191578.0	9222767.0	LOC106576009	multidrug resistance protein 1-like	protein_coding	
43093	106576069 2:9173944:9293888	ctg7180001885038_4967_SAC	2.0	9223944.0	9243888.0	LOC106576069	peroxisomal carnitine O-octanoyltransferase-like	protein_coding	
43094	100196088 2:9209079:9316642	ctg7180001885038_4967_SAC	2.0	9259079.0	9266642.0	acbd7	acyl-CoA-binding domain-containing protein 7	protein_coding	
43101	100196857 2:9217121:9319183	ctg7180001885038_4967_SAC	2.0	9267121.0	9269183.0	rpp38	ribonuclease P protein subunit p38 isoform X1	protein_coding	
43105	106576081 2:9220386:9329163	ctg7180001885038_4967_SAC	2.0	9270386.0	9279163.0	LOC106576081	glycylpeptide N-tetradecanoyltransferase 2 iso...	protein_coding	
43107	106576092 2:9223186:9368976	ctg7180001885038_4967_SAC	2.0	9283186.0	9318976.0	fam171a1	LOW QUALITY PROTEIN: protein FAM171A1	partial	
621084	106576075 2:9205629:9308605	ctg7180001885038_4967_SAC	NaN	9255629.0	9258605.0	LOC106576075	NaN	lncRNA	

	References
multidrug resistance protein 1	<p>A possible association</p> <p>Hirrlinger, J. <i>et al.</i> (2002) "Glutathione release from cultured brain cells: Multidrug resistance protein 1 mediates the release of GSH from rat astroglial cells" <i>Journal of Neuroscience Research</i>, 69: 318-326.</p> <p>Molinas, A: <i>et al.</i> (2012) "Functional evidence of multidrug resistance transporters (MDR) in rodent olfactory epithelium" <i>PLoS ONE</i>, 7: e36167.</p>
peroxisomal carnitine O-octanoyltransferase	No clear association

acbd7	<p>Lanfray D. and Richard D. (2017) "Emerging Signaling Pathway in Arcuate Feeding-Related Neurons: Role of the Acbd7" <i>Front. Neurosci.</i> 11: 328.</p> <p>Caron, A. and Richard, D. (2017) "Neuronal systems and circuits involved in the control of food intake and adaptive thermogenesis" <i>Annals of the New York Academy of Science</i>, 1391: 35– 53.</p> <p>Lanfray, D. <i>et al.</i> (2016) "Involvement of the Acyl-CoA binding domain containing 7 in the control of food intake and energy expenditure in mice" <i>eLife</i>, 5: e11742.</p> <p>Adan R. A. H. <i>et al.</i> (2006) "The MC4 receptor and control of appetite" <i>British Journal of Pharmacology</i>, 149: 815-827.</p>
rpp38	<p>Romanov, R. A. <i>et al.</i> (2017) "Molecular interrogation of hypothalamic organization reveals distinct dopamine neuronal subtypes" <i>Nature Neuroscience</i>, 20: 176-188.</p> <p>Ding, Q. <i>et al.</i> (2007) "Interplay between protein synthesis and degradation in the CNS: physiological and pathological implications" <i>Trends in Neurosciences</i>, 30: 31-36.</p> <p>Romanov, R. <i>et al.</i> (2017) "Molecular interrogation of hypothalamic organization reveals distinct dopamine neuronal subtypes" <i>Nature Neuroscience</i>, 20: 176-188.</p>
glycylpeptide N-tetradecanoyltransferase 2	No clear association
fam171a1	<p>Rasila, T. <i>et al.</i> (2019) "Astroprincin (FAM171A1, C10orf38): A Regulator of Human Cell Shape and Invasive Growth" <i>American Journal of Pathology</i>, 189: 177-189.</p> <p>Hook, P. <i>et al.</i> (2018) "Single-Cell RNA-Seq of Mouse Dopaminergic Neurons Informs Candidate Gene Selection for Sporadic Parkinson Disease" <i>American Journal of Human Genetics</i>, 102: 427-446.</p> <p>Castillo-Morales, A. <i>et al.</i> (2019) "Postmitotic cell longevity-associated genes: a transcriptional signature of postmitotic maintenance in neural tissues" <i>Neurobiology of Aging</i>, 74: 147-160.</p> <p>Nurnberger, J. <i>et al.</i> (2014) "Identification of pathways for bipolar disorder: A meta-analysis" <i>JAMA Psychiatry</i>, 71: 657-664.</p> <p>Poelmans G. (2011) "Genes and protein networks for neurodevelopmental disorders" PhD thesis, Radboud University.</p>
LOC106576075	No info

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info				
6249	ctg7180001906456_6568_SGT	functional	ssa09	74670550	missense_variant	tmem129	c.347G>T			
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype		
219925	100195398 9:74599054:74706544	ctg7180001906456_6568_SGT	9.0	74649054.0	74656544.0	al3a2	fatty aldehyde dehydrogenase isoform X1	protein_coding		
219945	106612006 9:74606354:74712462	ctg7180001906456_6568_SGT	9.0	74656354.0	74662462.0	ccdc142	coiled-coil domain-containing protein 142	protein_coding		
219960	101448012 9:74613031:74716542	ctg7180001906456_6568_SGT	9.0	74663031.0	74666542.0	slbp	Histone RNA hairpin-binding protein	protein_coding		
219976	100380489 9:74618141:74721227	ctg7180001906456_6568_SGT	9.0	74668141.0	74671227.0	tmem129	E3 ubiquitin-protein ligase TM129	protein_coding		
219984	106612007 9:74630690:74738123	ctg7180001906456_6568_SGT	9.0	74680690.0	74688123.0	atoh8	protein atonal homolog 8	protein_coding		
219994	106611962 9:74641074:74750809	ctg7180001906456_6568_SGT	9.0	74691074.0	74700809.0	st3gal5	lactosylceramide alpha-2	3-sialyltransferase		
220004	106611963 9:74652225:74762383	ctg7180001906456_6568_SGT	9.0	74702225.0	74712383.0	polar1a	LOW QUALITY PROTEIN: DNA-directed RNA polymera...	protein_coding		
220026	106611965 9:74662660:74768727	ctg7180001906456_6568_SGT	9.0	74712660.0	74718727.0	ptcd3	LOW QUALITY PROTEIN: pentatricopeptide repeat ...	mitochondrial		
220040	106611966 9:74668725:74785324	ctg7180001906456_6568_SGT	9.0	74718725.0	74735324.0	immt	MICOS complex subunit MIC60	protein_coding		

	References
al3a2	No clear association
ccdc142	No clear association
slbp	<p>No convincing association, but:</p> <p>Li, D. K. <i>et al.</i> (2014) "SMN control of RNP assembly: From post-transcriptional gene regulation to motor neuron disease" <i>Seminars in Cell and Developmental Biology</i>, 32: 22-29.</p> <p>Correa, T. <i>et al.</i> (2018) "Cytogenomic Integrative Network Analysis of the Critical Region Associated with Wolf-Hirschhorn Syndrome" <i>BioMed Research International</i>, 2018: 5436187.</p> <p>Rutherford, E. L. and Lowery, L. A. (2016) "Exploring the developmental mechanisms underlying Wolf-Hirschhorn Syndrome: Evidence for defects in neural crest cell migration" <i>Developmental Biology</i>, 420: 1-10.</p>
tmem129	<p>No convincing association, but:</p> <p>Simon, R. and Bergmann, A. D. (2008) "Mouse models of Wolf-Hirschhorn syndrome" <i>American Journal of Medical Genetics, Part C</i>, 148C: 275-280.</p> <p>Zhu, B. <i>et al.</i> (2017) "ER-associated degradation regulates Alzheimer's amyloid pathology and memory function by modulating γ-secretase activity" <i>Nature Communications</i>, 8:1472.</p>
atoh8	No clear association

<p>st3gal5</p>	<p>Roet, K. C. D. <i>et al.</i> (2011) "A meta-analysis of microarray-based gene expression studies of olfactory bulb-derived olfactory ensheathing cells" <i>Experimental Neurology</i>, 229: 10-45.</p> <p>Mohieldin, A. M. <i>et al.</i> (2015) "Protein composition and movements of membrane swellings associated with primary cilia" <i>Cellular and Molecular Life Sciences</i>, 72: 2415-2429.</p> <p>Sturgill, E. R. <i>et al.</i> (2012) "Biosynthesis of the major brain gangliosides GD1a and GT1b" <i>Glycobiology</i>, 22: 1289-1301.</p> <p>Schnaar, R. <i>et al.</i> (2014) "Sialic Acids in the Brain: Gangliosides and Polysialic Acid in Nervous System Development, Stability, Disease, and Regeneration" <i>Physiological Reviews</i>, 94: 461-518.</p> <p>Boccutto, L. <i>et al.</i> (2014) "A mutation in a ganglioside biosynthetic enzyme, ST3GAL5, results in salt & pepper syndrome, a neurocutaneous disorder with altered glycolipid and glycoprotein glycosylation" <i>Human Molecular Genetics</i>, 23: 418-433.</p> <p>Li, T. A. <i>et al.</i> (2018) "Congenital Disorders of Ganglioside Biosynthesis" <i>Sirtuins in Health and Disease</i>, 156, 63-68.</p> <p>Schneider J.S. (2014) "Gangliosides and Glycolipids in Neurodegenerative Disorders" In: Yu R., Schengrund CL. (eds) <i>Glycobiology of the Nervous System. Advances in Neurobiology</i>, vol 9. Springer, New York, NY.</p> <p>Trottein, F. <i>et al.</i> (2009) "Glycosyltransferase and sulfotransferase gene expression profiles in human monocytes, dendritic cells and macrophages" <i>Glycoconjugate Journal</i>, 26: 1259-1274.</p> <p>Wang, H. <i>et al.</i> (2016) "Early growth and development impairments in patients with ganglioside GM3 synthase deficiency" <i>Clinical Genetics</i>, 89: 625-629.</p>
<p>polr1a</p>	<p>Noack Watt, K. E. (2016) "The Roles of RNA Polymerase I and III Subunits Polr1c and Polr1d in Craniofacial Development and in Zebrafish Models of Treacher Collins Syndrome" PhD thesis, The University of Kansas Medical Center.</p> <p>Weaver, K. <i>et al.</i> (2015) "Acrofacial dysostosis, cincinnati type, a mandibulofacial dysostosis syndrome with limb anomalies, is caused by POLR1A dysfunction" <i>The American Journal of Human Genetics</i>, 96: 765-774.</p> <p>Kara, B. <i>et al.</i> (2017) "Severe neurodegenerative disease in brothers with homozygous mutation in POLR1A" <i>European Journal of Human Genetics</i>, 25: 315-323.</p> <p>Dijkstra, A. <i>et al.</i> "Capter 5: Autophagic dysfunction and impaired proteasomal activity in the brainstem and olfactory bulb during</p>

	disease progression in Parkinson's" Manuscript in preparation. https://research.vumc.nl/ws/files/455063/chapter%205.pdf
ptcd3	No clear association, but possibly related to neurodegeneration
mmt	No clear association

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
8196	ctg7180001398466_7983_SAG	functional	ssa18	21420780	missense_variant	LOC106577055 c.161T>C

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
430080	106577053 18:21284967:21461826	ctg7180001398466_7983_SAG	18.0	21334967.0	21411826.0	ccser2	serine-rich coiled-coil domain- containing prot...	protein_coding
430119	106577055 18:21343600:21478213	ctg7180001398466_7983_SAG	18.0	21393600.0	21428213.0	LOC106577055	SPARC- like	protein_coding
430133	106577056 18:21382148:21494610	ctg7180001398466_7983_SAG	18.0	21432148.0	21444610.0	LOC106577056	protein NDNF-like	protein_coding
430137	106577057 18:21396206:21501857	ctg7180001398466_7983_SAG	18.0	21446206.0	21451857.0	LOC106577057	dnaJ homolog subfamily C member 9-like	protein_coding
430148	106577058 18:21404530:21512649	ctg7180001398466_7983_SAG	18.0	21454530.0	21462649.0	fam149b1	protein FAM149B1 isoform X3	protein_coding
622881	106577077 18:21413432:21520908	ctg7180001398466_7983_SAG	NaN	NaN	NaN	NaN	NaN	NaN

	References
ccser2	No clear association
SPARC	<p>Bhoopathi, P. <i>et al.</i> (2011) "SPARC Stimulates neuronal differentiation of medulloblastoma cells via the notch1/STAT3 pathway" <i>Cancer Research</i>, 71: 4908-4919.</p> <p>Gongidi, V. <i>et al.</i> (2004) "SPARC-like 1 Regulates the Terminal Phase of Radial Glia-Guided Migration in the Cerebral Cortex" <i>Neuron</i>, 41: 57-69.</p> <p>Kucukdereli, H. <i>et al.</i> (2011) "Control of excitatory CNS synaptogenesis by astrocyte-secreted proteins Hevin and SPARC" <i>Proceedings of the National Academy of Sciences</i>, 108: E440-E449.</p> <p>Albrecht, D. <i>et al.</i> (2012) "SPARC prevents maturation of cholinergic presynaptic terminals" <i>Molecular and Cellular Neuroscience</i>, 49: 364-374.</p> <p>Jones, E. <i>et al.</i> (2011) "Astrocytes Control Glutamate Receptor Levels at Developing Synapses through SPARC-Integrin Interactions" <i>The Journal of Neuroscience</i>, 31: 4154-4165.</p> <p>López-Murcia, F: <i>et al.</i> (2015) "SPARC triggers a cell-autonomous program of synapse elimination" <i>Proceedings of the National Academy of Sciences</i>, 112: 13366-13371.</p>

	<p>Au, E. <i>et al.</i> (2007) "SPARC from Olfactory Ensheathing Cells Stimulates Schwann Cells to Promote Neurite Outgrowth and Enhances Spinal Cord Repair" <i>The Journal of Neuroscience</i>, 27: 7208-7221.</p> <p>Vincent, A. <i>et al.</i> (2008) "SPARC is expressed by macroglia and microglia in the developing and mature nervous system" <i>Developmental Dynamics</i>, 237: 1449-1462.</p> <p>Pellitteri, R. <i>et al.</i> (2010) "Biomarkers expression in rat olfactory ensheathing cells" <i>Frontiers in Bioscience</i>, S2: 289-298.</p> <p>Zhu, Y. <i>et al.</i> (2010) "Olfactory ensheathing cells: Attractant of neural progenitor migration to olfactory bulb" <i>GLIA</i>, 58: 716-729.</p> <p>Sethi, R. <i>et al.</i> (2014) "Olfactory Ensheathing Cells Promote Differentiation of Neural Stem Cells and Robust Neurite Extension" <i>Stem Cell Reviews and Reports</i>, 10: 772-785.</p>
protein NDNF	No clear association
dnaJ homolog subfamily C member 9	No clear association
fam149b1	<p>No clear association, but one hit:</p> <p>Torgersbråten, A. (2014) "A homozygous missense mutation in SLCO1C1 may cause a novel progressive encephalopathy syndrome" A student thesis in medicine, UiO.</p>

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
23454	ctg7180001916146_1772_SCT	Distribution-SNP	ssa07	8952124	intron_variant	LOC106608572 c.1218+4151A>G

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	Protein_product
178445	106608572 7:8849913:9066496	ctg7180001916146_1772_SCT	7.0	8899913.0	9016496.0	LOC106608572	cGMP-specific 3'	5'-cyclic phosphodiesterase-like isoform X5	protein_coding
663660	106608574 7:8886933:9026482	ctg7180001916146_1772_SCT	NaN	8936933.0	8976482.0	LOC106608574	NaN	lncRNA	NaN

	References
5'-cyclic phosphodiesterase-like isoform X5	<p>No clear association, but related to retinal disease, so it might be of importance:</p> <p>Ahonen, S. <i>et al.</i> (2013) "A CNGB1 Frameshift Mutation in Papillon and Phalène Dogs with Progressive Retinal Atrophy " <i>PLoS ONE</i>, 8: e72122.</p> <p>Ye, G.J. <i>et al.</i> (2016) «Cone-specific promoters for gene therapy of achromatopsia and other retinal diseases" <i>Hum. Gene Ther.</i>, 27: 72–82.</p>

	<p>Semba, R. D. <i>et al.</i> (2015) "Priorities and trends in the study of proteins in eye research, 1924-2014" <i>Proteomics Clin. Appl.</i>, 9: 1105-1122.</p> <p>Swaroop, A. <i>et al.</i> (2010) "Transcriptional regulation of photoreceptor development and homeostasis in the mammalian retina" <i>Nature Reviews Neuroscience</i>, 11: 563-576.</p>
Inc RNA	No info

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info							
29040	ctg7180001845082_7172_SAG	Distribution-SNP	ssa11	47799462	intergenic_region	LOC106563007-LOC106562883	n.47799462T>C						
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	Protein_product	Strand	Len	Row_no	Gid

	References
LOC106563007	No info
LOC106562883	No info

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info				
7909	ctg7180001835143_8201_SGT	functional	ssa16	53681459	missense_variant	LOC106574182	c.250G>T			
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	I	
401016	106574180	16:53517338:53683304	ctg7180001835143_8201_SGT	16.0	53567338.0	53633304.0	kiaa0226	run domain Beclin-1 interacting and cysteine-r...	protein_coding	}
401020	106574179	16:53586494:53725956	ctg7180001835143_8201_SGT	16.0	53636494.0	53675956.0	LOC106574179	5-hydroxytryptamine receptor 3A-like	protein_coding	}
401028	106574182	16:53631098:53732008	ctg7180001835143_8201_SGT	16.0	53681098.0	53682008.0	LOC106574182	5-hydroxytryptamine receptor 3A-like isoform X2	protein_coding	}
401029	106574178	16:53632080:53739041	ctg7180001835143_8201_SGT	16.0	53682080.0	53689041.0	LOC106574178	5-hydroxytryptamine receptor 3A-like	protein_coding	}
401035	106574177	16:53655851:53778733	ctg7180001835143_8201_SGT	16.0	53705851.0	53728733.0	LOC106574177	uncharacterized protein LOC106574177	protein_coding	}

	References
kiaa0226	<p>McKnight NC, Mizushima N, Yue Z (2012) "The Cellular Process of Autophagy and Control of Autophagy in Neurons." In: Yue Z, Chu CT, editors. <i>Autophagy of the Nervous System</i>. Singapore: World Scientific Publishing Co. Pte. Ltd. pp. 3–35.</p> <p>Dasouki, M.J. <i>et al.</i> (2011) "The 3q29 microdeletion syndrome: report of three new unrelated patients and in silico "RNA binding" analysis of the 3q29 region" <i>Am. J. Med. Genet. Part A</i>, 155: 1654–1660.</p>

<p>5-hydroxytryptamine receptor 3A</p>	<p>Chen, R. <i>et al.</i> (2012) "Characterization of immature and mature 5-hydroxytryptamine 3A receptor-expressing cells within the adult SVZ-RMS-OB system" <i>Neuroscience</i>, 227: 180-190.</p> <p>Hansson, C. <i>et al.</i> (2014) "Influence of ghrelin on the central serotonergic signaling system in mice" <i>Neuropharmacology</i>, 79: 498-505.</p> <p>Davies, P. A. <i>et al.</i> (1999) "The 5-HT 3B subunit is a major determinant of serotonin-receptor function" <i>Nature</i>, 397: 359-363.</p> <p>Michel, K. <i>et al.</i> (2005) Serotonin excites neurons in the human submucous plexus via 5-HT 3 receptors. <i>Gastroenterology</i>, 128: 1317–1326.</p> <p>Bhatnagar, S., Sun, L. M., Raber, J., Maren, S., Julius, D., & Dallman, M. F. (2004). Changes in anxiety-related behaviors and hypothalamic-pituitary-adrenal activity in mice lacking the 5-HT-3A receptor. <i>Physiology and Behavior</i>, 81, 545–555.</p> <p>Bhatnagar, S., Sun, L. M., Raber, J., Maren, S., Julius, D., & Dallman, M. F. (2004). Changes in anxiety-related behaviors and hypothalamic-pituitary-adrenal activity in mice lacking the 5-HT-3A receptor. <i>Physiology and Behavior</i>, 81, 545–555.</p> <p>Bhatnagar, S., Sun, L. M., Raber, J., Maren, S., Julius, D., & Dallman, M. F. (2004). Changes in anxiety-related behaviors and hypothalamic-pituitary-adrenal activity in mice lacking the 5-HT-3A receptor. <i>Physiology and Behavior</i>, 81, 545–555.</p> <p>Sengupta, A., Bocchio, M., Bannerman, D. M., Sharp, T., & Capogna, M. (2017). Control of Amygdala Circuits by 5-HT Neurons via 5-HT and Glutamate Cotransmission. <i>The Journal of Neuroscience</i>, 37, 1785–1796.</p> <p>Sengupta, A., Bocchio, M., Bannerman, D. M., Sharp, T., & Capogna, M. (2017). Control of Amygdala Circuits by 5-HT Neurons via 5-HT and Glutamate Cotransmission. <i>The Journal of Neuroscience</i>, 37, 1785–1796.</p> <p>Smit-Rigter, L. A., Wadman, W. J., & van Hooft, J. A. (2010). Impaired Social Behavior in 5-HT3A Receptor Knockout Mice. <i>Frontiers in Behavioral Neuroscience</i>, 4, 169.</p> <p>Kondo, M., Nakamura, Y., Ishida, Y., Yamada, T., & Shimada, S. (2014). The 5-HT3A receptor is essential for fear extinction. <i>Learning & Memory</i>, 21, 1–4.</p>
<p>5-hydroxytryptamine receptor 3A</p>	<p>see above</p>
<p>LOC106574177</p>	<p>No info</p>

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
2678	ctg7180001845450_3014_SAC	env,wild	ssa14	54777236	missense_variant	LOC106570060 c.1116C>A

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
353959	106570147 14:54640757:54785108	ctg7180001845450_3014_SAC	14.0	54690757.0	54735108.0	LOC106570147	protein PRRC2A-like	protein_coding
353967	106570060 14:54709947:54839921	ctg7180001845450_3014_SAC	14.0	54759947.0	54789921.0	LOC106570060	sialidase-1-like	protein_coding
353972	106570059 14:54747115:54863795	ctg7180001845450_3014_SAC	14.0	54797115.0	54813795.0	LOC106570059	transmembrane protein C9orf91 homolog isoform X1	protein_coding
353981	106570058 14:54764948:54879864	ctg7180001845450_3014_SAC	14.0	54814948.0	54829864.0	LOC106570058	proline-rich transmembrane protein 1-like isof...	protein_coding

	References
protein PRRC2A	<p>No clear association, but some hits related to neuronal system:</p> <p>Wu, R., Li, A., Sun, B., Sun, J. G., Zhang, J., Zhang, T., ... Yuan, Z. (2019). A novel m 6 A reader Prrc2a controls oligodendroglial specification and myelination. <i>Cell Research</i>, 29, 23–41.</p> <p>Romanov, R. A., Zeisel, A., Bakker, J., Girach, F., Hellysaz, A., Tomer, R., ... Harkany, T. (2017). Molecular interrogation of hypothalamic organization reveals distinct dopamine neuronal subtypes. <i>Nature Neuroscience</i>, 20, 176–188.</p> <p>Sridhar, G. R., & Sanjana, N. S. N. (2016). Sleep, circadian dysrhythmia, obesity and diabetes. <i>World Journal of Diabetes</i>, 7, 515–522.</p>
sialidase-1	<p>Wielgat, P., Walesiuk, A., & Braszko, J. J. (2011). Effects of chronic stress and corticosterone on sialidase activity in the rat hippocampus. <i>Behavioural Brain Research</i>, 222, 363–367.</p> <p>Fiorilli, A., Venerando, B., Siniscalco, C., Monti, E., Bresciani, R., Caimi, L., ... Tettamanti, G. (1989). Occurrence in Brain Lysosomes of a Sialidase Active on Ganglioside. <i>Journal of Neurochemistry</i>, 53, 672–680.</p> <p>Mehta, N. R., Lopez, P. H. H., Vyas, A. A., & Schnaar, R. L. (2007). Gangliosides and Nogo receptors independently mediate myelin-associated glycoprotein inhibition of neurite outgrowth in different nerve cells. <i>Journal of Biological Chemistry</i>, 282, 27875–27886.</p> <p>Calhan, O. Y., & Seyrantepe, V. (2017). Mice with Catalytically Inactive Cathepsin A Display Neurobehavioral Alterations. <i>Behavioural Neurology</i>, 2017, 4261873.</p>
transmembrane protein C9orf91 homolog isoform X1	<p>No clear association, but one possibly relevant hit:</p> <p>Palacios-Reyes, C., Espinosa, A., Contreras, A., Ordonez, R., Hidalgo-Miranda, A., Rubio-Gayasso, I., ... I., P. (2013). Williams’ neural stem cells: new model for insight into microRNA dysregulation. <i>Frontiers in Bioscience</i>, E5, 1057–1073.</p>

<p>proline-rich transmembrane protein 1 (Prpt1)</p>	<p>Kirk, L. M., Ti, S. W., Bishop, H. I., Orozco-Llamas, M., Pham, M., Trimmer, J. S., & Díaz, E. (2016). Distribution of the SynDIG4/proline-rich transmembrane protein 1 in rat brain. <i>Journal of Comparative Neurology</i>, 524, 2266–2280.</p> <p>Chen, N., Pandya, N. J., Koopmans, F., Castelo-Székelv, V., Van Der Schors, R. C., Smit, A. B., & Li, K. W. (2014). Interaction proteomics reveals brain region-specific AMPA receptor complexes. <i>Journal of Proteome Research</i>, 13, 5695–5706.</p> <p>Bowden, N. A., Scott, R. J., & Tooney, P. A. (2008). Altered gene expression in the superior temporal gyrus in schizophrenia. <i>BMC Genomics</i>, 9, 199.</p> <p>Matt, L., Kirk, L. M., Chenuaux, G., Specca, D. J., Puhger, K. R., Pride, M. C., ... Díaz, E. (2018). SynDIG4/Prpt1 Is Required for Excitatory Synapse Development and Plasticity Underlying Cognitive Function. <i>Cell Reports</i>, 22, 2246–2253.</p> <p>Eshraghi, A. A., Liu, G., Kay, S.-I. S., Eshraghi, R. S., Mittal, J., Moshiree, B., & Mittal, R. (2018). Epigenetics and Autism Spectrum Disorder: Is There a Correlation? <i>Frontiers in Cellular Neuroscience</i>, 12, 78.</p> <p>Schmitz, L. J. M., Klaassen, R. V., Ruiperez-Alonso, M., Zamri, A. E., Stroeder, J., Rao-Ruiz, P., ... Spijker, S. (2017). The AMPA receptor-associated protein Shisa7 regulates hippocampal synaptic function and contextual memory. <i>ELife</i>, 6, e24192.</p> <p>Troyano-Rodriguez, E., Mann, S., Ullah, R., & Ahmad, M. (2019). PRRT1 regulates basal and plasticity-induced AMPA receptor trafficking. <i>Molecular and Cellular Neuroscience</i>, 98, 155–163.</p> <p>Chen, N., Pandya, N. J., Koopmans, F., Castelo-Székelv, V., Van Der Schors, R. C., Smit, A. B., & Li, K. W. (2014). Interaction proteomics reveals brain region-specific AMPA receptor complexes. <i>Journal of Proteome Research</i>, 13, 5695–5706.</p>
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Salmobreed

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info		
25311	ctg7180001851039_10290_SAC	Distribution-SNP	ssa09	55068124	intergenic_region	LOC106611576-LOC106611580 n.55068124T>G		
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
215345	106611580 9:55026673:55131334	ctg7180001851039_10290_SAC	9.0	55076673.0	55081334.0	LOC106611580	tryptophan 2	3-dioxygenase A-like
215386	106611581 9:55048962:55380563	ctg7180001851039_10290_SAC	9.0	55098962.0	55330563.0	LOC106611581	teneurin- 3-like isoform X7	protein_coding

Same as for Mowi.

	References
tryptophan 2,3-dioxygenase A	<p>Breda, C., Sathyaikumar, K. V., Idrissi, S. S., Notarangelo, F. M., Estranero, J. G., Moore, G. G., ... Giorgini, F. (2016). Tryptophan-2,3-dioxygenase (TDO) inhibition ameliorates neurodegeneration by modulation of kynurenine pathway metabolites. <i>PNAS</i>, 113, 5435–5440.</p> <p>Kanai, M., Funakoshi, H., Takahashi, H., Hayakawa, T., Mizuno, S., Matsumoto, K., & Nakamura, T. (2009). Tryptophan 2,3-dioxygenase is a key modulator of physiological neurogenesis and anxiety-related behavior in mice. <i>Molecular Brain</i>, 2, 8.</p> <p>Stone, T. W., Stoy, N., & Darlington, L. G. (2013). An expanding range of targets for kynurenine metabolites of tryptophan. <i>Trends in Pharmacological Sciences</i>, 34, 136–143.</p> <p>Ohira, K., Hagihara, H., Toyama, K., Takao, K., Kanai, M., Funakoshi, H., ... Miyakawa, T. (2010). Expression of tryptophan 2,3-dioxygenase in mature granule cells of the adult mouse dentate gyrus. <i>Molecular Brain</i>, 3, 26.</p>
teneurin-3	<p>Antinucci, P., Nikolaou, N., Meyer, M. P., & Hindges, R. (2013). Teneurin-3 specifies morphological and functional connectivity of retinal ganglion cells in the vertebrate visual system. <i>Cell Reports</i>, 5, 582–592.</p> <p>Kenzelmann, D., Chiquet-Ehrismann, R., & Tucker, R. P. (2007). Teneurins, a transmembrane protein family involved in cell communication during neuronal development. <i>Cellular and Molecular Life Sciences</i>, 64, 1452–1456.</p> <p>Mosca, T. J., Hong, W., Dani, V. S., Favaloro, V., & Luo, L. (2012). Trans-synaptic Teneurin signalling in neuromuscular synapse organization and target choice. <i>Nature</i>, 484, 237–241.</p> <p>Berns, D. S., DeNardo, L. A., Pederick, D. T., & Luo, L. (2018). Teneurin-3 controls topographic circuit assembly in the hippocampus. <i>Nature</i>, 554, 328–333.</p>

Hong, W., Mosca, T. J., & Luo, L. (2012). Teneurins instruct synaptic partner matching in an olfactory map. *Nature*, 484, 201–207.

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info				
6326	ctg7180001878854_3628_SAG	functional	ssa09	102397307	missense_variant	LOC106612683	c.1630T>C			
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	F	
225691	100194580 9:102288552:102403219	ctg7180001878854_3628_SAG	9.0	102338552.0	102353219.0	LOC100194580	zgc:113149-like isoform X4	protein_coding	>	
225712	106612530 9:102303493:102405437	ctg7180001878854_3628_SAG	9.0	102353493.0	102355437.0	LOC106612530	ras-related protein ORAB-1-like	protein_coding	>	
225727	106612684 9:102306563:102432891	ctg7180001878854_3628_SAG	9.0	102356563.0	102382891.0	LOC106612684	mitochondrial import inner membrane translocase...	protein_coding	>	
225752	106612683 9:102343386:102449409	ctg7180001878854_3628_SAG	9.0	102393386.0	102399409.0	LOC106612683	delta-like protein C	protein_coding	>	
225777	100196093 9:102394588:102498304	ctg7180001878854_3628_SAG	9.0	102444588.0	102448304.0	chp2	calcineurin B homologous protein 2 isoform X1	protein_coding	>	

	References
zgc:113149-like isoform X4	No clear association
ras-related protein ORAB-1	No clear association
mitochondrial import inner membrane translocase	No clear association, but may be related to olfaction
delta-like protein C	Ebnet, K. (2017). Junctional Adhesion Molecules (JAMs): Cell Adhesion Receptors With Pleiotropic Functions in Cell Physiology and Development. <i>Physiological Reviews</i> , 97, 1529–1554.
chp2	Ukarapong, S., Bao, Y., Perera, E. M., & Berkovitz, G. D. (2012). Megakaryocyte development is normal in mice with targeted disruption of Tescalcin. <i>Experimental Cell Research</i> , 318, 662–669. Winstein, E., Cui, X., & Simmons, P. (2011). GENOMIC EDITING OF NEURODEVELOPMENTAL GENES IN ANIMALS. Patent Application Publication (10) Pub . No . : US 2011 / 0218172 A1. 1(61).

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info				
41794	ctg7180001364094_5295_SCT	Distribution-SNP	ssa21	2283284	intergenic_region	dach1-gpr18	n.2283284C>T			
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	F	
477143	106581635 21:1820057:2306744	ctg7180001364094_5295_SCT	21.0	1870057.0	2256744.0	dach1	dachshund homolog 1 isoform X1	protein_coding	>	

	References
dach1	<p>Castiglioni, V., Faedo, A., Onorati, M., Bocchi, V. D., Li, Z., Iennaco, R., ... Cattaneo, E. (2019). Dynamic and cell-specific DACH1 expression in human neocortical and striatal development. <i>Cerebral Cortex</i>, 29, 2115–2124.</p> <p>Machon, O., van den Bout, C. J., Backman, M., Røsok, Ø., Caubit, X., Fromm, S. H., ... Krauss, S. (2002). Forebrain-specific promoter/enhancer D6 derived from the mouse Dach1 gene controls expression in neural stem cells. <i>Neuroscience</i>, 112, 951–966.</p> <p>Heanue, T. A., Davis, R. J., Rowitch, D. H., Kispert, A., McMahon, A. P., Mardon, G., & Tabin, C. J. (2002). Dach1, a vertebrate homologue of <i>Drosophila dachshund</i>, is expressed in the developing eye and ear of both chick and mouse and is regulated independently of Pax and Eya genes. <i>Mechanisms of Development</i>, 111, 75–87.</p> <p>Purcell, P., Oliver, G., Mardon, G., Donner, A. L., & Maas, R. L. (2005). Pax6-dependence of Six3, Eya1 and Dach1 expression during lens and nasal placode induction. <i>Gene Expression Patterns</i>, 6, 110–118.</p> <p>Colosimo, M. E., Brown, A., Mukhopadhyay, S., Gabel, C., Lanjuin, A. E., Samuel, A. D. T., & Sengupta, P. (2004). Identification of Thermosensory and Olfactory Neuron-Specific Genes via Expression Profiling of Single Neuron Types. <i>Current Biology</i>, 14, 2245–2251.</p>
GPR18	<p>McHugh, D. (2012). GPR18 in microglia: Implications for the CNS and endocannabinoid system signalling. <i>British Journal of Pharmacology</i>, 167, 1575–1582.</p> <p>Kanageswaran, N., Demond, M., Nagel, M., Schreiner, B. S. P., Baumgart, S., Scholz, P., ... Gisselmann, G. (2015). Deep sequencing of the murine olfactory receptor neuron transcriptome. <i>PLoS ONE</i>, 10, e0113170.</p> <p>Penumarti, A., & Abdel-Rahman, A. A. (2014). The Novel Endocannabinoid Receptor GPR18 Is Expressed in the Rostral Ventrolateral Medulla and Exerts Tonic Restraining Influence on Blood Pressure. <i>Journal of Pharmacology and Experimental Therapeutics</i>, 349, 29–38.</p> <p>McHugh, D., Roskowski, D., Xie, S., & Bradshaw, H. B. (2014). Δ^9-THC and N-arachidonoyl glycine regulate BV-2 microglial morphology and cytokine release plasticity: Implications for signaling at GPR18. <i>Frontiers in Pharmacology</i>, 4, 162.</p>

Luongo, L., Maione, S., & Di Marzo, V. (2014). Endocannabinoids and neuropathic pain: Focus on neuron-glia and endocannabinoid-neurotrophin interactions. *European Journal of Neuroscience*, 39, 401–408.

Reyes-Resina, I., Navarro, G., Aguinaga, D., Canela, E. I., Schoeder, C. T., Zafuski, M., ... Franco, R. (2018). Molecular and functional interaction between GPR18 and cannabinoid CB2 G-protein-coupled receptors. Relevance in neurodegenerative diseases. *Biochemical Pharmacology*, 157, 169–179.

Ramírez-Orozoco, R. E., García-Ruiz, R., Morales, P., Villalón, C. M., Villafán-Bernal, J. R., & Marichal-Cancino, B. A. (2019). Potential metabolic and behavioural roles of the putative endocannabinoid receptors GPR18, GPR55 and GPR119 in feeding. *Curr. Neuropharmacol.*, Epub Ahead of Print.

Burokas, A. (2013). New Behavioural Models to Investigate Eating Disorders. PhD Thesis, Universitat Pompeu Fabra, Barcelona. Retrieved from <http://hdl.handle.net/10803/126535>

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
24625	ctg7180001903360_761_SAC	Distribution-SNP	ssa08	26237329	intron_variant	melk c.-25+32T>G

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
202802	106610568 8:26139111:26240634	ctg7180001903360_761_SAC	8.0	26189111.0	26190634.0	LOC106610568	histidine-rich glycoprotein-like	protein_coding
202806	106610569 8:26179057:26287526	ctg7180001903360_761_SAC	8.0	26229057.0	26237526.0	melk	maternal embryonic leucine zipper kinase	protein_coding

	References
histidine-rich glycoprotein	No clear association, probably immunology.
maternal embryonic leucine zipper kinase	Fike, J. R., Rosi, S., & Limoli, C. L. (2009). Neural Precursor Cells and Central Nervous System Radiation Sensitivity. <i>Seminars in Radiation Oncology</i> , 19, 122–132. Nakano, I., Masterman-Smith, M., Saigusa, K., Paucar, A. A., Horvath, S., Shoemaker, L., ... Kornblum, H. I. (2008). Maternal embryonic leucine zipper kinase is a key regulator of the proliferation of malignant brain tumors, including brain tumor stem cells. <i>Journal of Neuroscience Research</i> , 86, 48–60.

	<p>Jiang, P., & Zhang, D. (2013). Maternal embryonic leucine zipper kinase (MELK): A novel regulator in cell cycle control, embryonic development, and cancer. <i>International Journal of Molecular Sciences</i>, 14, 21551–21560.</p> <p>Nakano, I., Paucar, A. A., Bajpai, R., Dougherty, J. D., Zewail, A., Kelly, T. K., ... Kornblum, H. I. (2005). Maternal embryonic leucine zipper kinase (MELK) regulates multipotent neural progenitor proliferation. <i>Journal of Cell Biology</i>, 170, 413–427.</p>
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Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info				
7431	ctg7180001591304_4622_SGT	functional	ssa14	34030280	missense_variant	LOC106569383	c.580C>A			
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	P	
350113	106569394 14:33942803:34046266	ctg7180001591304_4622_SGT	14.0	33992803.0	33996266.0	LOC106569394	zinc finger protein 333-like	protein_coding	X	
350134	106569382 14:33954230:34079291	ctg7180001591304_4622_SGT	14.0	34004230.0	34029291.0	tep1	telomerase protein component 1	protein_coding	X	
350145	106569383 14:33979334:34081305	ctg7180001591304_4622_SGT	14.0	34029334.0	34031305.0	LOC106569383	zinc finger protein 233-like	protein_coding	X	
350153	106569381 14:33997947:34102341	ctg7180001591304_4622_SGT	14.0	34047947.0	34052341.0	LOC106569381	zinc finger protein 436-like isoform X2	protein_coding	X	
350170	106569380 14:34002462:34112753	ctg7180001591304_4622_SGT	14.0	34052462.0	34062753.0	LOC106569380	nectin-4-like	protein_coding	X	
350180	106569423 14:34027812:34130055	ctg7180001591304_4622_SGT	14.0	34077812.0	34080055.0	LOC106569423	high affinity immunoglobulin epsilon receptor ...	protein_coding	X	

Same as for both Rauma and Mowi

	References
zinc finger protein 333	No clear association, probably immunology
telomerase protein component 1	No clear association
zinc finger protein 233	No clear association
zinc finger protein 436	Obayashi, S., Tabunoki, H., Kim, S. U., & Satoh, J. I. (2009). Gene expression profiling of human neural progenitor cells following the serum-induced astrocyte differentiation. <i>Cellular and Molecular Neurobiology</i> , 29, 423–438.
nectin-4	<p>Mizoguchi, A., Nakanishi, H., Kimura, K., Matsubara, K., Ozaki-Kuroda, K., Katata, T., ... Takai, Y. (2002). Nectin: An adhesion molecule involved in formation of synapses. <i>Journal of Cell Biology</i>, 156, 555–565.</p> <p>Lim, S. T., Lim, K.-C., Giuliano, R. E., & Federoff, H. J. (2008). Temporal and Spatial Localization of Nectin-1 and I-Afadin during Synaptogenesis in Hippocampal Neurons. <i>The Journal of Comparative Neurology</i>, 507, 1228–1244.</p> <p>Takai, Y., & Nakanishi, H. (2003). Nectin and afadin: novel organizers of intercellular junctions. <i>Journal of Cell Science</i>, 116, 17–27.</p>

	<p>Ogita, H., & Takai, Y. (2006). Nectins and nectin-like molecules: Roles in cell adhesion, polarization, movement, and proliferation. <i>IUBMB Life</i>, 58, 334–343.</p> <p>Katsunuma, S., Honda, H., Shinoda, T., Ishimoto, Y., Miyata, T., Kiyonari, H., ... Togashi, H. (2016). Synergistic action of nectins and cadherins generates the mosaic cellular pattern of the olfactory epithelium. <i>Journal of Cell Biology</i>, 212, 561–575.</p>
high affinity immunoglobulin epsilon receptor	No clear association

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
18970	ctg7180001631827_192_SAC	Distribution-SNP	ssa03	56012380	intron_variant	gbgt1 c.68+24842G>T

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
83764	100194757 3:55915832:56087519	ctg7180001631827_192_SAC	3.0	55965832.0	56037519.0	gbgt1	globoside alpha-1	3-N-acetylgalactosaminyltransferase 1 isoform X2
83773	106600864 3:55974738:56075461	ctg7180001631827_192_SAC	3.0	56024738.0	56025461.0	LOC106600864	globoside alpha-1	3-N-acetylgalactosaminyltransferase 1-like
83782	106600863 3:56012132:56148043	ctg7180001631827_192_SAC	3.0	56062132.0	56098043.0	LOC106600863	integrin alpha-3-like isoform X1	protein_coding

Same as for Mowi.

	References
gbgt1	No clear association
LOC106600664 – globoside alpha-1	No clear association
integrin alpha-3	<p>Huang, A.-M., Wang, H. L., Tang, Y. P., & Lee, E. H. Y. (1998). Expression of Integrin-Associated Protein Gene Associated with Memory Formation in Rats. <i>The Journal of Neuroscience</i>, 18, 4305–4313.</p> <p>Clegg, D. O., Wingerd, K. L., Hikita, S. T., & Tolhurst, E. C. (2003). Integrins in the development, function and dysfunction of the nervous system. [<i>Frontiers in Bioscience</i>, 8, d723-750.</p> <p>Stipp, C. S., & Hemler, M. E. (2000). Transmembrane-4-superfamily proteins CD151 and CD81 associate with $\alpha 3\beta 1$ integrin, and selectively contribute to $\alpha 3\beta 1$-dependent neurite outgrowth. <i>Journal of Cell Science</i>, 113, 1871–1882.</p> <p>Chang, H. P., Lindberg, F. P., Wang, H. L., Huang, A. M., & Lee, E. H. Y. (1999). Impaired memory retention and decreased long-term potentiation in integrin-associated protein-deficient mice. <i>Learning and Memory</i>, 6, 448–457.</p>

	Stanco, A., Szekeres, C., Patel, N., Rao, S., Campbell, K., Kreidberg, J. A., ... Anton, E. S. (2009). Netrin-1– $\alpha 3\beta 1$ integrin interactions regulate the migration of interneurons through the cortical marginal zone. PNAS, 106, 7595–7600.
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Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info				
34972	ctg7180001208887_1776_SCT	Distribution-SNP	ssa15	46306150	intron_variant	LOC106571584	c.1969+34T>C			
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	P	
376046	106571585 15:46112583:46308125	ctg7180001208887_1776_SCT	15.0	46162583.0	46258125.0	LOC106571585	serine/threonine-protein kinase MRCK alpha-lik...	protein_coding	X	
376049	106571598 15:46208825:46313660	ctg7180001208887_1776_SCT	15.0	46258825.0	46263660.0	LOC106571598	left-right determination factor 2-like	protein_coding	X	
376069	106571586 15:46216717:46326658	ctg7180001208887_1776_SCT	15.0	46266717.0	46276658.0	LOC106571586	heterogeneous nuclear ribonucleoprotein U-like	protein_coding	X	
376086	106571584 15:46234816:46369550	ctg7180001208887_1776_SCT	15.0	46284816.0	46319550.0	LOC106571584	kinesin-like protein KIF26B	protein_coding	X	
376094	106571597 15:46272414:46392783	ctg7180001208887_1776_SCT	15.0	46322414.0	46342783.0	LOC106571597	consortin-like	protein_coding	X	
376104	106571596 15:46292942:46403873	ctg7180001208887_1776_SCT	15.0	46342942.0	46353873.0	LOC106571596	saccharopine dehydrogenase-like oxidoreductase	protein_coding	X	

	References
serine/threonine-protein kinase MRCK alpha	No clear association
left-right determination factor 2	No clear association
heterogeneous nuclear ribonucleoprotein U	<p>Liu, Q., & Dreyfuss, G. (1996). A novel nuclear structure containing the survival of motor neurons protein. The EMBO Journal, 15, 3555–3565.</p> <p>Taniura, H., & Yoshikawa, K. (2002). Necdin interacts with the ribonucleoprotein hnRNP U in the nuclear matrix. Journal of Cellular Biochemistry, 84, 545–555.</p> <p>Xiao, R., Tang, P., Yang, B., Huang, J., Zhou, Y., Shao, C., ... Fu, X. D. (2012). Nuclear Matrix Factor hnRNP U/SAF-A Exerts a Global Control of Alternative Splicing by Regulating U2 snRNP Maturation. Molecular Cell, 45, 656–668.</p> <p>Liu, P., Wang, S. J., Wang, Z.-W., & Chen, B. (2018). HRP-U-2, a Homolog of Mammalian hnRNP U, Regulates Synaptic Transmission by Controlling the Expression of SLO-2 Potassium Channel in Caenorhabditis elegans. The Journal of Neuroscience, 38, 1073–1084.</p> <p>Poot, M. (2019). HNRNPU: Key to Neurodevelopmental Disorders such as Intellectual Delay, Epilepsy, and Autism. Molecular Syndromology, 9, 275–278.</p>

	Ticozzi, N., Ratti, A., & Silani, V. (2010). Protein Aggregation and Defective RNA Metabolism as Mechanisms for Motor Neuron Damage. <i>CNS 6 Neurological Disorders - Drug Targets</i> , 9, 285–296.
kinesin-like protein KIF26B	No clear association
consortin	Chabrat, A., Lacassagne, E., Billiras, R., Landron, S., Pontisso-Mahout, A., Darville, H., ... Mannoury la Cour, C. (2019). Pharmacological Transdifferentiation of Human Nasal Olfactory Stem Cells into Dopaminergic Neurons. <i>Stem Cells International</i> , 2019, 2945435. Chabrat, A., Lacassagne, E., Billiras, R., Landron, S., Pontisso-Mahout, A., Darville, H., ... Mannoury la Cour, C. (2019). Pharmacological Transdifferentiation of Human Nasal Olfactory Stem Cells into Dopaminergic Neurons. <i>Stem Cells International</i> , 2019, 2945435.
saccharopine dehydrogenase-like oxidoreductase	No clear association.

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
33706	ctg7180001937818_13928_SAG	Distribution-SNP	ssa14	59744977	intron_variant	LOC106569936 c.1180+54T>C

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
355840	106569937 14:59640254:59745475	ctg7180001937818_13928_SAG	14.0	59690254.0	59695475.0	LOC106569937	LIM/homeobox protein Lhx9-like	protein_coding
355844	106569938 14:59648588:59774522	ctg7180001937818_13928_SAG	14.0	59698588.0	59724522.0	LOC106569938	H-2 class I histocompatibility antigen	Q10 alpha chain-like
355849	106569936 14:59685521:59808313	ctg7180001937818_13928_SAG	14.0	59735521.0	59758313.0	LOC106569936	H-2 class I histocompatibility antigen	Q10 alpha chain-like isoform X1
355858	106569935 14:59717932:59829224	ctg7180001937818_13928_SAG	14.0	59767932.0	59779224.0	LOC106569935	major histocompatibility complex class I-relat...	protein_coding
355870	106569933 14:59744364:59852214	ctg7180001937818_13928_SAG	14.0	59794364.0	59802214.0	LOC106569933	zinc finger and SCAN domain-containing protein...	protein_coding
611338	106569941 14:59659212:59767016	ctg7180001937818_13928_SAG	NaN	59709212.0	59717016.0	LOC106569941	NaN	lncRNA

	References
LIM/homeobox protein Lhx9	<p>Peukert, D., Weber, S., Lumsden, A., & Scholpp, S. (2011). Lhx2 and Lhx9 determine neuronal differentiation and compartment in the caudal forebrain by regulating Wnt signaling. <i>PLoS Biology</i>, 9, e1001218.</p> <p>Bertuzzi, S., Porter, F. D., Pitts, A., Kumar, M., Agulnick, A., Wassif, C., & Westphal, H. (1999). Characterization of Lhx9, a novel LIM/homeobox gene expressed by the pioneer neurons in the mouse cerebral cortex. <i>Mechanisms of Development</i>, 80, 193–198.</p> <p>Liu, J., Merkle, F. T., Gandhi, A. V., Gagnon, J. A., Woods, I. G., Chiu, C. N., ... Prober, D. A. (2015). Evolutionarily conserved regulation of hypocretin neuron specification by Lhx9. <i>Development</i>, 142, 1113–1124.</p>

	<p>Avraham, O., Hadas, Y., Vald, L., Zisman, S., Schejter, A., Visel, A., & Klar, A. (2009). Transcriptional control of axonal guidance and sorting in dorsal interneurons by the Lim-HD proteins Lhx9 and Lhx1. <i>Neural Development</i>, 4, 21.</p> <p>Alunni, A., Blin, M., Deschet, K., Bourrat, F., Vernier, P., & Rétaux, S. (2004). Cloning and developmental expression patterns of Dlx2, Lhx7 and Lhx9 in the medaka fish (<i>Oryzias latipes</i>). <i>Mechanisms of Development</i>, 121, 977–983.</p> <p>Miyasaka, N., Morimoto, K., Tsubokawa, T., Higashijima, S. -i., Okamoto, H., & Yoshihara, Y. (2009). From the Olfactory Bulb to Higher Brain Centers: Genetic Visualization of Secondary Olfactory Pathways in Zebrafish. <i>The Journal of Neuroscience</i>, 29, 4756–4767.</p> <p>Huilgol, D., & Tole, S. (2016). Cell migration in the developing rodent olfactory system. <i>Cellular and Molecular Life Sciences</i>, 73, 2467–2490.</p> <p>Abellán, A., Legaz, I., Vernier, B., Rétaux, S., & Medina, L. (2009). Olfactory and amygdalar structures of the chicken ventral pallium based on the combinatorial expression patterns of LIM and other developmental regulatory genes. <i>Journal of Comparative Neurology</i>, 516, 166–186.</p>
H-2 class I histocompatibility antigen, Q10 alpha chain	<p>No convincing association, but a couple of relevant hits:</p> <p>Tarakanov, A. O., & Fuxe, K. G. (2013). Integrin triplets of marine sponges in the murine and human MHCI-CD8 interface and in the interface of human neural receptor heteromers and subunits. <i>SpringerPlus</i>, 2, 128.</p> <p>Renthal, N. E., Guidry, P. A., Shanmuganad, S., Renthal, W., & Stroynowski, I. (2011). Isoforms of the nonclassical class I MHC antigen H2-Q5 are enriched in brain and encode Qdm peptide. <i>Immunogenetics</i>, 63, 57–64.</p>
H-2 class I histocompatibility antigen, Q10 alpha chain	See above
major histocompatibility complex class I-related gene protein	No clear association
zinc finger and SCAN domain-containing protein 2	No clear association, but one possibly relevant hit: Koemans, T. S. (2018). Converging molecular networks affected in Kleefstra syndrome and related neurodevelopmental disorders. PhD Thesis, Radboud University Nijmegen.
LOC106569941	No info

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_Info					
18035	ctg7180001853207_6271_SAG	Distribution-SNP	ssa02	65620891	intron_variant	LOC106593154	c.2175-30411T>C				
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	Protein_product		
64256	106593154	2:65529955:65843864	ctg7180001853207_6271_SAG	2.0	65579955.0	65793864.0	LOC106593154	myosin heavy chain	fast skeletal muscle-like	protein_coding	
64258	106593163	2:65415647:65729867	ctg7180001853207_6271_SAG	2.0	65465647.0	65679867.0	LOC106593163	myosin heavy chain	fast skeletal muscle-like isoform X1	protein_coding	

	References
myosin heavy chain, fast skeletal muscle	No clear association
myosin heavy chain, fast skeletal muscle	<p>No clear association, with regard to neuronal, olfactory etc. But:</p> <p>Pandya, K., & Smithies, O. (2011). β-MyHC and cardiac hypertrophy: Size does matter. <i>Circulation Research</i>, 109, 609–610.</p> <p>Tajsharghi, H., & Oldfors, A. (2013). Desminopathies: Pathology and mechanisms. <i>Acta Neuropathologica</i>, 125, 3–18.</p> <p>Mariner, P. D., Luckey, S. W., Long, C. S., Sucharov, C. C., & Leinwand, L. A. (2005). Yin Yang 1 represses α-myosin heavy chain gene expression in pathologic cardiac hypertrophy. <i>Biochemical and Biophysical Research Communications</i>, 326, 79–86.</p> <p>Harrison, B. C., Roberts, C. R., Hood, D. B., Sweeney, M., Gould, J. M., Bush, E. W., & McKinsey, T. A. (2004). The CRM1 Nuclear Export Receptor Controls Pathological Cardiac Gene Expression. <i>Molecular and Cellular Biology</i>, 24, 10636–10649.</p> <p>Schoser, B. G. H., Schneider-Gold, C., Kress, W., Goebel, H.-H., Reilich, P., Koch, M. C., ... Ricker, K. (2004). Muscle pathology in 57 patients with myotonic dystrophy type 2. <i>Muscle Nerve</i>, 29, 275–281.</p>

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
6396	ctg7180001668257_1374_SAG	functional	ssa09	127219319	missense_variant	LOC106613166 c.142C>T

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
234167	106613174 9:127120919:127221760	ctg7180001668257_1374_SAG	9.0	127170919.0	127171760.0	LOC106613174	uncharacterized protein LOC106613174	protein_coding
234177	106613164 9:127129750:127255263	ctg7180001668257_1374_SAG	9.0	127179750.0	127205263.0	LOC106613164	ephexin-1-like isoform X2	protein_coding
234180	106613165 9:127157654:127268389	ctg7180001668257_1374_SAG	9.0	127207654.0	127218389.0	LOC106613165	lysophosphatidic acid receptor 6-like	protein_coding
234193	106613166 9:127169154:127271067	ctg7180001668257_1374_SAG	9.0	127219154.0	127221067.0	LOC106613166	lysophosphatidic acid receptor 4-like	protein_coding
234202	106613167 9:127171281:127276887	ctg7180001668257_1374_SAG	9.0	127221281.0	127226887.0	LOC106613167	integral membrane protein 2C-like	protein_coding
234213	106613169 9:127177173:127289687	ctg7180001668257_1374_SAG	9.0	127227173.0	127239687.0	LOC106613169	calcium-binding protein 39	protein_coding
234224	106613159 9:127191600:127293904	ctg7180001668257_1374_SAG	9.0	127241600.0	127243904.0	LOC106613159	uncharacterized protein LOC106613159	protein_coding
234232	106613170 9:127203932:127306264	ctg7180001668257_1374_SAG	9.0	127253932.0	127256264.0	LOC106613170	transcription factor HES-1-like	protein_coding
234251	106613171 9:127209178:127310916	ctg7180001668257_1374_SAG	9.0	127259178.0	127260916.0	LOC106613171	transcription cofactor HES-6-like	protein_coding
234255	106613160 9:127214991:127321536	ctg7180001668257_1374_SAG	9.0	127264991.0	127271536.0	LOC106613160	uncharacterized protein LOC106613160	protein_coding
671675	106613158 9:127121760:127224319	ctg7180001668257_1374_SAG	NaN	NaN	NaN	NaN	NaN	NaN

	References
LOC106613174	No info
ephexin-1	<p>Triplett, J. W., & Feldheim, D. A. (2012). Eph and ephrin signaling in the formation of topographic maps. <i>Seminars in Cell and Developmental Biology</i>, 23, 7–15.</p> <p>Klein, R. (2012). Eph/ephrin signalling during development. <i>Development</i>, 139, 4105–4109.</p> <p>Defourny, J., Poirrier, A. L., Lallemand, F., Sánchez, S. M., Neef, J., Vanderhaeghen, P., ... Malgrange, B. (2013). Ephrin-A5/EphA4 signalling controls specific afferent targeting to cochlear hair cells. <i>Nature Communications</i>, 4, 1438.</p> <p>Anand, A., Tyagi, R., Mohanty, M., Goyal, M., Ranil D De Silva, K., & Wijekoon, N. (2015). Dystrophin induced cognitive impairment: Mechanisms, models and therapeutic strategies. <i>Annals of Neurosciences</i>, 22, 108–118.</p> <p>Beg, A. A., Sommer, J. E., Martin, J. H., & Scheiffele, P. (2007). α2-Chimaerin Is an Essential EphA4 Effector in the Assembly of Neuronal Locomotor Circuits. <i>Neuron</i>, 55, 768–778.</p> <p>Ng, Y. P., Wu, Z., Wise, H., Tsim, K. W. K., Wong, Y. H., & Ip, N. Y. (2009). Differential and synergistic effect of nerve growth factor and cAMP on the regulation of early response genes during neuronal differentiation. <i>NeuroSignals</i>, 17, 111–120.</p>

	<p>Berzat, A., & Hall, A. (2010). Cellular responses to extracellular guidance cues. <i>The EMBO Journal</i>, 29, 2734–2745.</p> <p>Kania, A., & Klein, R. (2016). Mechanisms of ephrin-Eph signalling in development, physiology and disease. <i>Nature Reviews Molecular Cell Biology</i>, 17, 240–256.</p>
lysophosphatidic acid receptor 6	Related to the neuronal system, but ..
lysophosphatidic acid receptor 4	<p>Yung, Y. C., Stoddard, N. C., Mirendil, H., & Chun, J. (2015). Lysophosphatidic Acid Signaling in the Nervous System. <i>Neuron</i>, 85, 669–682.</p> <p>Kremer, A. E., Gebhardt, L., Robering, J., Kühn, H., Wolf, K., & Fischer, M. M. J. (2019). Lysophosphatidic acid activates peripheral glial cells. <i>Z Gastroenterol</i>, 57, e46–e47.</p> <p>Furuta, D., Yamane, M., Tsujiuchi, T., Moriyama, R., & Fukushima, N. (2012). Lysophosphatidic acid induces neurite branch formation through LPA 3. <i>Molecular and Cellular Neuroscience</i>, 50, 21–34.</p> <p>Sheng, X., Yung, Y. C., Chen, A., & Chun, J. (2015). Lysophosphatidic acid signalling in development. <i>Development</i>, 142, 1390–1395.</p> <p>Lin, M. E., Rivera, R. R., & Chun, J. (2012). Targeted deletion of LPA5 identifies novel roles for lysophosphatidic acid signaling in development of neuropathic pain. <i>Journal of Biological Chemistry</i>, 287, 17608–17617.</p> <p>Robering, J. W., Gebhardt, L., Wolf, K., Kühn, H., Kremer, A. E., & Fischer, M. J. M. (2019). Lysophosphatidic acid activates satellite glia cells and Schwann cells. <i>GLIA</i>, 67, 999–1012.</p> <p>Geach, T. J., Faas, L., Devader, C., Gonzalez-Cordero, A., Tabler, J. M., Brunsdon, H., ... Dale, L. (2014). An essential role for LPA signalling in telencephalon development. <i>Development</i>, 141, 940–949.</p> <p>Ingrassia, A., Dijkstra, A. A., Bochdanovits, Z., Drukarch, B., Voorn, P., Berendse, H. W., ... van de Berg, W. D. J. (n.d.). Chapter 4: Transcriptome analysis of the olfactory bulb of aged individuals with Parkinson neuropathology. Retrieved from https://research.vu.nl/ws/portalfiles/portal/42128794/chapter+4.pdf</p> <p>Lee, S.-J., Tsao, K.-C., Cherng, B.-W., & Liao, Y.-H. (2015). Lysophospholipid receptor signaling in zebrafish development. <i>Translational Cancer Research</i>, 4, 544–556.</p>
integral membrane protein 2C-like	Connected to the neuronal system, but no clear association
calcium-binding protein 39	No clear association

LOC106613159	No info
transcription factor HES-1	No clear association, but a few relevant hits: Jessen, U., Novitskaya, V., Walmod, P. S., Berezin, V., & Bock, E. (2003). Neural cell adhesion molecule-mediated neurite outgrowth is repressed by overexpression of HES-1. <i>Journal of Neuroscience Research</i> , 71, 1–6. Im, S. Y., & Moon, C. (2015). Transcriptional regulatory network during development in the olfactory epithelium. <i>BMB Reports</i> , 48, 599–608. Ristori, E., & Nicoli, S. (2017). Comparative Functions of miRNAs in Embryonic Neurogenesis and Neuronal Network Formation. In <i>Essentials of Noncoding RNA in Neuroscience: Ontogenetics, Plasticity of the Vertebrate Brain</i> (pp. 265–282). https://doi.org/10.1016/B978-0-12-804402-5.00015-7
transcription cofactor HES-6	No clear association, but inhibitor of HES 1
LOC106613160	No info

	Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info		
34861	ctg7180001827628_2639_SGT	Distribution-SNP	ssa15	38579942	intron_variant	LOC106571504	c.73+18029T>G		
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	
374183	106571498 15:38344217:38584145	ctg7180001827628_2639_SGT	15.0	38394217.0	38534145.0	LOC106571498	disheveled-associated activator of morphogenes...	protein_coding	
374222	106571502 15:38482783:38588502	ctg7180001827628_2639_SGT	15.0	38532783.0	38538502.0	l3hypdh	trans-3-hydroxy-L-proline dehydratase isoform X1	protein_coding	
374241	106571503 15:38491933:38597663	ctg7180001827628_2639_SGT	15.0	38541933.0	38547663.0	LOC106571503	potassium channel subfamily K member 1-like	protein_coding	
374260	106571504 15:38511547:38754062	ctg7180001827628_2639_SGT	15.0	38561547.0	38704062.0	LOC106571504	potassium voltage-gated channel subfamily H member 1-like	protein_coding	

	References
disheveled-associated activator of morphogenesis 1	Salomon, S. N., Haber, M., Murai, K. K., & Dunn, R. J. (2008). Localization of the Diaphanous-related formin Daam1 to neuronal dendrites. <i>Neuroscience Letters</i> , 447, 62–67. Wagh, D., Terry-Lorenzo, R., Waites, C. L., Leal-Ortiz, S. A., Maas, C., Reimer, R. J., & Garner, C. C. (2015). Piccolo directs activity dependent F-actin assembly from presynaptic active zones via daam1. <i>PLoS ONE</i> , 10, e0120093.

	<p>Kida, Y., Shiraishi, T., & Ogura, T. (2004). Identification of chick and mouse Daam1 and Daam2 genes and their expression patterns in the central nervous system. <i>Developmental Brain Research</i>, 153, 143–150.</p> <p>Luo, W., Lieu, Z. Z., Manser, E., Bershadsky, A. D., & Sheetz, M. P. (2016). Formin DAAM1 organizes actin filaments in the cytoplasmic nodal actin network. <i>PLoS ONE</i>, 11, e0163915.</p> <p>Kawabata Galbraith, K., Fujishima, K., Mizuno, H., Lee, S. J., Uemura, T., Sakimura, K., ... Kengaku, M. (2018). MTSS1 Regulation of Actin-Nucleating Formin DAAM1 in Dendritic Filopodia Determines Final Dendritic Configuration of Purkinje Cells. <i>Cell Reports</i>, 24, 95–106.</p> <p>Wang, Q., Titlow, W. B., McClintock, D. A., Stromberg, A. J., & McClintock, T. S. (2017). Activity-dependent gene expression in the Mammalian olfactory epithelium. <i>Chemical Senses</i>, 42, 611–624.</p>
I3hypdh	No clear association
potassium channel subfamily K member 1	No clear association(?)
potassium voltage-gated channel subfamily H member 5	No clear association, but: Jeong, S. G., Ohn, T., Kim, S. H., & Cho, G. W. (2013). Valproic acid promotes neuronal differentiation by induction of neuroprogenitors in human bone-marrow mesenchymal stromal cells. <i>Neuroscience Letters</i> , 554, 22–27.

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
32574	ctg7180001827868_2803_SAC	Distribution-SNP	ssa13	90658249	intron_variant	LOC106568138 n.234+7483G>T

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	F
333958	106568136 13:90625721:90740231	ctg7180001827868_2803_SAC	13.0	90675721.0	90690231.0	LOC106568136	serine/threonine-protein phosphatase 2B cataly...	protein_coding	X
333966	106568137 13:90627100:90730983	ctg7180001827868_2803_SAC	13.0	90677100.0	90680983.0	LOC106568137	uncharacterized protein LOC106568137 isoform X2	protein_coding	X
333969	106568134 13:90643642:90773901	ctg7180001827868_2803_SAC	13.0	90693642.0	90723901.0	LOC106568134	dematin-like isoform X4	protein_coding	X
608187	106568138 13:90589436:90716870	ctg7180001827868_2803_SAC	NaN	90639436.0	90666870.0	LOC106568138	NaN	lncRNA	

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serine/threonine-protein phosphatase 2B catalytic subunit gamma isoform (PPP3CC)	<p>Sarnay, Z. and Guest, P. C. Connecting brain proteomics with behavioural neuroscience in translational animal models of neuropsychiatric disorders. In Guest, P. C. (2017). <i>Proteomic Methods in Neuropsychiatric Research</i> (P. C. Guest, ed.). Springer International Publishing AG 2017.</p> <p>Wesseling, H., Xu, B., Want, E. J., Holmes, E., Guest, P. C., Karayiorgou, M., ... Bahn, S. (2017). System-based proteomic and metabonomic</p>

	<p>analysis of the Df(16)A+/- mouse identifies potential miR-185 targets and molecular pathway alterations. <i>Molecular Psychiatry</i>, 22, 384–395.</p> <p>Kautzky, A., Baldinger, P., Souery, D., Montgomery, S., Mendlewicz, J., Zohar, J., ... Kasper, S. (2015). The combined effect of genetic polymorphisms and clinical parameters on treatment outcome in treatment-resistant depression. <i>European Neuropsychopharmacology</i>, 25, 441–453.</p> <p>Gerber, D. J., Hall, D., Miyakawa, T., Demars, S., Gogos, J. A., Karayiorgou, M., & Tonegawa, S. (2003). Evidence for association of schizophrenia with genetic variation in the 8p21.3 gene, PPP3CC, encoding the calcineurin gamma subunit. <i>Proceedings of the National Academy of Sciences</i>, 100, 8993–8998.</p> <p>Mathieu, F., Miot, S., Etain, B., El Khoury, M. A., Chevalier, F., Bellivier, F., ... Tzavara, E. T. (2008). Association between the PPP3CC gene, coding for the calcineurin gamma catalytic subunit, and bipolar disorder. <i>Behavioral and Brain Functions</i>, 4, 2.</p> <p>Ambrozkiwicz, M. C., Ripamonti, S., Borisova, E., & Schwark, M. (2019). The Kaufman oculocerebrofacial syndrome protein Ube3b regulates synapse number by ubiquitinating Ppp3cc. <i>BioRxiv</i>, http://dx.doi.org/10.1101/672923</p> <p>Hammond, D. R., & Udvardi, A. J. (2010). Cabin1 expression suggests roles in neuronal development. <i>Developmental Dynamics</i>, 239, 2443–2451.</p> <p>Lee, J. II, & Ahnn, J. (2004). Calcineurin in animal behavior. <i>Molecules and Cells</i>, 17, 390–396.</p> <p>Collier, D. A., & Li, T. (2003). The genetics of schizophrenia: Glutamate not dopamine? <i>European Journal of Pharmacology</i>, 480, 177–184.</p>
LOC106568137	No info
dematin	<p>No clear association, but one hit related to brain expression:</p> <p>Schnack, C., Danzer, K. M., Hengerer, B., & Gillardon, F. (2008). Protein array analysis of oligomerization-induced changes in alpha-synuclein protein-protein interactions points to an interference with Cdc42 effector proteins. <i>Neuroscience</i>, 154, 1450–1457.</p>
LOC106568138	No info

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info		
43412	ctg7180001474449_216_SGT	Distribution-SNP	ssa22	48503098	upstream_gene_variant	LOC106583629 c.-170840A>C		
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
502212	106583629 22:48202819:48550517	ctg7180001474449_216_SGT	22.0	48252819.0	48500517.0	LOC106583629	plexin-B1-like isoform X2	protein_coding
502216	100136508 22:48494612:48599738	ctg7180001474449_216_SGT	22.0	48544612.0	48549738.0	LOC100136508	ubiquitin-conjugating enzyme E2 variant 1-like	protein_coding

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plexin-B1	<p>Swiercz, J. M., Kuner, R., Behrens, J., & Offermanns, S. (2002). Plexin-B1 directly interacts with PDZ-RhoGEF/LARG to regulate RhoA and growth cone morphology. <i>Neuron</i>, 35, 51–63.</p> <p>Oinuma, I., Katoh, H., & Neigishi, M. (2004). Molecular Dissection of the Semaphorin 4D Receptor Plexin-B1-Stimulated R-Ras GTPase-Activating Protein Activity and Neurite Remodeling in Hippocampal Neurons. <i>Journal of Neuroscience</i>, 24, 11473–11480.</p> <p>Aurandt, J., Vikis, H. G., Gutkind, J. S., Ahn, N., & Guan, K.-L. (2002). The semaphorin receptor plexin-B1 signals through a direct interaction with the Rho-specific nucleotide exchange factor, LARG. <i>Proceedings of the National Academy of Sciences</i>, 99, 12085–12090.</p> <p>Saito, Y., Oinuma, I., Fujimoto, S., & Negishi, M. (2009). Plexin-B1 is a GTPase activating protein for M-Ras, remodelling dendrite morphology. <i>EMBO Reports</i>, 10, 614–621.</p> <p>Lin, X., Ogiya, M., Takahara, M., Yamaguchi, W., Furuyama, T., Tanaka, H., ... Inagaki, S. (2007). Sema4D-plexin-B1 implicated in regulation of dendritic spine density through RhoA/ROCK pathway. <i>Neuroscience Letters</i>, 428, 1–6.</p>
ubiquitin-conjugating enzyme E2 variant 1	No clear association

Rauma

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info			
37679	ctg7180001825403_10894_SAG	Distribution-SNP	ssa17	27027265	intergenic_region	LOC106575831-LOC106575832 n.27027265G>A			
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	F
415529	106575832 17:27007867:27111372	ctg7180001825403_10894_SAG	17.0	27057867.0	27061372.0	LOC106575832	serine/threonine-protein kinase 24-like	protein_coding	>
415539	106575833 17:27026815:27133882	ctg7180001825403_10894_SAG	17.0	27076815.0	27083882.0	LOC106575833	R3H domain-containing protein 1-like	protein_coding	>

	References
serine/threonine-protein kinase 24	No clear association
R3H domain-containing protein 1	<p>Ching, A.-S., & Ahmad-Annuar, A. (2015). A Perspective on the Role of microRNA-128 Regulation in Mental and Behavioral Disorders. <i>Frontiers in Cellular Neuroscience</i>, 9, 465.</p> <p>Franzoni, E., Booker, S. A., Parthasarathy, S., Rehfeld, F., Grosser, S., Srivatsa, S., ... Wulczyn, F. G. (2015). miR-128 regulates neuronal migration, outgrowth and intrinsic excitability via the intellectual disability gene Phf6. <i>ELife</i>, 4, e04263.</p> <p>Hook, P. W., McClymont, S. A., Cannon, G. H., Law, W. D., Morton, A. J., Goff, L. A., & McCallion, A. S. (2018). Single-Cell RNA-Seq of Mouse Dopaminergic Neurons Informs Candidate Gene Selection for Sporadic Parkinson Disease. <i>The American Journal of Human Genetics</i>, 102, 427–446.</p> <p>Peebles, C. L. (2009). The Role of Arc in Regulating Spine Morphology and Neural Network Stability In Vivo. PhD Thesis, University of California, San Francisco. Retrieved from https://escholarship.org/uc/item/3p57f9fz</p> <p>Lanz, T. A., Guilmette, E., Gosink, M. M., Fischer, J. E., Fitzgerald, L. W., Stephenson, D. T., & Pletcher, M. (2013). Transcriptomic analysis of genetically defined autism candidate genes reveals common mechanisms of action. <i>Molecular Autism</i>, 4, 45.</p> <p>Bondar, N., Bryzgalov, L., Ershov, N., Gusev, F., Reshetnikov, V., Avgustinovich, D., ... Merkulova, T. (2018). Molecular Adaptations to Social Defeat Stress and Induced Depression in Mice. <i>Molecular Neurobiology</i>, 55, 3394–3407.</p>

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
40474	ctg7180001850393_8798_SCT	Distribution-SNP	ssa20	403615	upstream_gene_variant	LOC106579799 c.-774G>A

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	F
456539	106579799 20:354265:456391	ctg7180001850393_8798_SCT	20.0	404265.0	406391.0	LOC106579799	somatostatin-1A	protein_coding	>

	References
somatostatin-1A	<p>Lin, X., Otto, C. J., Cardenas, R., & Peter, R. E. (2000). Somatostatin family of peptides and its receptors in fish. <i>Canadian Journal of Physiology and Pharmacology</i>, 78, 1053–1066.</p> <p>Slagter, B. J., Kittilson, J. D., & Sheridan, M. A. (2004). Somatostatin receptor subtype 1 and subtype 2 mRNA expression is regulated by nutritional state in rainbow trout (<i>Oncorhynchus mykiss</i>). <i>General and Comparative Endocrinology</i>, 139, 236–244.</p> <p>Olias, G., Viollet, C., Kusserow, H., Epelbaum, J., & Meyerhof, W. (2004). Regulation and function of somatostatin receptors. <i>Journal of Neurochemistry</i>, 89, 1057–1091.</p> <p>Lin, X., Janovick, J. A., Brothers, S., Conn, P. M., & Peter, R. E. (1999). Molecular cloning and expression of two type one somatostatin receptors in goldfish brain. <i>Endocrinology</i>, 140, 5211–5219.</p> <p>Canosa, L. F., Cerdá-Reverter, J. M., & Peter, R. E. (2004). Brain mapping of three somatostatin encoding genes in the goldfish. <i>Journal of Comparative Neurology</i>, 474, 43–57.</p>

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
37722	ctg7180001900396_1652_SCT	Distribution-SNP	ssa17	29730369	intron_variant	LOC106575937 c.147+62T>C

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	F
415992	106575937 17:29677813:29785307	ctg7180001900396_1652_SCT	17.0	29727813.0	29735307.0	LOC106575937	C5a anaphylatoxin chemotactic receptor 1-like	protein_coding	>

	References
C5a anaphylatoxin chemotactic receptor 1	<p>Nomaru, H., Sakumi, K., Katogi, A., Ohnishi, Y. N., Kajitani, K., Tsuchimoto, D., ... Nakabeppu, Y. (2014). Fosb gene products contribute to excitotoxic microglial activation by regulating the expression of complement C5a receptors in microglia. <i>GLIA</i>, 62, 1284–</p> <p>Murgoci, A.-N., Mallah, K., Aboulouard, S., Lefebvre, C., Kobeissy, F., Fournier, I., ... Salzet, M. (2019). The Brain Origin of Neonatal Microglia Determines 3 the Content of Exosomes and Biological Function. Preprints - Not Peer-Reviewed, https://doi.org/10.2139/ssrn.3188437</p>

Bajic, G., Degn, S. E., Thiel, S., & Andersen, G. R. (2015). Complement activation, regulation, and molecular basis for complement-related diseases. *The EMBO Journal*, 34, 2735–2757.

Gerard, N. P., & Gerard, C. (1991). The chemotactic receptor for human C5a anaphylatoxin. *Nature*, 349, 614–617.

Lacy, M., Jones, J., Whittemore, S. R., Haviland, D. L., Wetsel, R. A., & Barnum, S. R. (1995). Expression of the receptors for the C5a anaphylatoxin, interleukin-8 and FMLP by human astrocytes and microglia. *Journal of Neuroimmunology*, 61, 71–78.

Mukherjee, P., & Pasinetti, G. M. (2000). The role of complement anaphylatoxin C5a in neurodegeneration: implications in Alzheimer’s disease. *Journal of Neuroimmunology*, 105, 124–130.

Osaka, H., McGinty, A., Höpken, U. E., Lu, B., Gerard, C., & Pasinetti, G. M. (1999). Expression of C5a receptor in mouse brain: Role in signal transduction and neurodegeneration. *Neuroscience*, 88, 1073–1082.

Gerard, N. P., Bao, L., Xiao-Ping, H., Eddy, R. L., Shows, T. B., & Gerard, C. (1993). Human Chemotaxis Receptor Genes Cluster at 19q13.3–13.4. Characterization of the Human C5a Receptor Gene. *Biochemistry*, 32, 1243–1250.

Tsu, R. C., Allen, R. A., & Wong, Y. H. (1995). Stimulation of type II adenylyl cyclase by chemoattractant formyl peptide and C5a receptors. *Molecular Pharmacology*, 47, 835–841.

	Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info			
7431	ctg7180001591304_4622_SGT	functional	ssa14	34030280	missense_variant	LOC106569383	c.580C>A			
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	P	
350113	106569394 14:33942803:34046266	ctg7180001591304_4622_SGT	14.0	33992803.0	33996266.0	LOC106569394	zinc finger protein 333-like	protein_coding	X	
350134	106569382 14:33954230:34079291	ctg7180001591304_4622_SGT	14.0	34004230.0	34029291.0	tep1	telomerase protein component 1	protein_coding	X	
350145	106569383 14:33979334:34081305	ctg7180001591304_4622_SGT	14.0	34029334.0	34031305.0	LOC106569383	zinc finger protein 233-like	protein_coding	X	
350153	106569381 14:33997947:34102341	ctg7180001591304_4622_SGT	14.0	34047947.0	34052341.0	LOC106569381	zinc finger protein 436-like isoform X2	protein_coding	X	
350170	106569380 14:34002462:34112753	ctg7180001591304_4622_SGT	14.0	34052462.0	34062753.0	LOC106569380	nectin-4-like	protein_coding	X	
350180	106569423 14:34027812:34130055	ctg7180001591304_4622_SGT	14.0	34077812.0	34080055.0	LOC106569423	high affinity immunoglobulin epsilon receptor ...	protein_coding	X	

Same as for both SalmoBreed and Mowi.

	References
zinc finger protein 333	No clear association, probably immunology

telomerase protein component 1	No clear association
zinc finger protein 233	No clear association
zinc finger protein 436	Obayashi, S., Tabunoki, H., Kim, S. U., & Satoh, J. I. (2009). Gene expression profiling of human neural progenitor cells following the serum-induced astrocyte differentiation. <i>Cellular and Molecular Neurobiology</i> , 29, 423–438.
nectin-4	<p>Mizoguchi, A., Nakanishi, H., Kimura, K., Matsubara, K., Ozaki-Kuroda, K., Katata, T., ... Takai, Y. (2002). Nectin: An adhesion molecule involved in formation of synapses. <i>Journal of Cell Biology</i>, 156, 555–565.</p> <p>Lim, S. T., Lim, K.-C., Giuliano, R. E., & Federoff, H. J. (2008). Temporal and Spatial Localization of Nectin-1 and I-Afadin during Synaptogenesis in Hippocampal Neurons. <i>The Journal of Comparative Neurology</i>, 507, 1228–1244.</p> <p>Takai, Y., & Nakanishi, H. (2003). Nectin and afadin: novel organizers of intercellular junctions. <i>Journal of Cell Science</i>, 116, 17–27.</p> <p>Ogita, H., & Takai, Y. (2006). Nectins and nectin-like molecules: Roles in cell adhesion, polarization, movement, and proliferation. <i>IUBMB Life</i>, 58, 334–343.</p> <p>Katsunuma, S., Honda, H., Shinoda, T., Ishimoto, Y., Miyata, T., Kiyonari, H., ... Togashi, H. (2016). Synergistic action of nectins and cadherins generates the mosaic cellular pattern of the olfactory epithelium. <i>Journal of Cell Biology</i>, 212, 561–575.</p>
high affinity immunoglobulin epsilon receptor	No clear association

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
21377	ctg7180001883233_10351	Distribution-SNP	ssa05	41056260	synonymous_variant	LOC106604953 c.1248T>G

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	F
134200	106604951 5:40924817:41089395	ctg7180001883233_10351	5.0	40974817.0	41039395.0	LOC106604951	histone-lysine N-methyltransferase 2D-like iso...	protein_coding	>
134209	106604953 5:40995740:41106883	ctg7180001883233_10351	5.0	41045740.0	41056883.0	LOC106604953	histone deacetylase 3	protein_coding	>
134227	106604954 5:41007857:41138484	ctg7180001883233_10351	5.0	41057857.0	41088484.0	LOC106604954	palladin-like	protein_coding	>
134233	100196367 5:41039181:41197755	ctg7180001883233_10351	5.0	41089181.0	41147755.0	LOC100196367	mitogen-activated protein kinase kinase kinase...	protein_coding	>

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histone-lysine N-methyltransferase 2D	Christianson, J., & D, J. O. P. (2017). The Role of Development in Kabuki Syndrome : A Review. Poster, https://Scholarworks.Boisestate.Edu/Cgi/Viewcontent.Cgi?Referer=https://Scholar.Google.Com/&httpspredir=1&article=1054&context=as_17

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histone deacetylase 3	<p>McQuown, S. C., Barrett, R. M., Matheos, D. P., Post, R. J., Rogge, G. A., Alenghat, T., ... Wood, M. A. (2011). HDAC3 Is a Critical Negative Regulator of Long-Term Memory Formation. <i>The Journal of Neuroscience</i>, 31, 764–774.</p> <p>Nott, A., Cheng, J., Gao, F., Lin, Y. T., Gjoneska, E., Ko, T., ... Tsai, L. H. (2016). Histone deacetylase 3 associates with MeCP2 to regulate FOXO and social behavior. <i>Nature Neuroscience</i>, 19, 1497–1505.</p> <p>Sahar, S., & Sassone-Corsi, P. (2012). Circadian rhythms and memory formation: regulation by chromatin remodeling. <i>Frontiers in Molecular Neuroscience</i>, 5, 37.</p> <p>Zhu, X., Wang, S., Yu, L., Jin, J., Ye, X., Liu, Y., & Xu, Y. (2017). HDAC3 negatively regulates spatial memory in a mouse model of Alzheimer's disease. <i>Aging Cell</i>, 16, 1073–1082.</p>
Paladin	<p>Boukhelifa, M., Hwang, S. J., Valtschanoff, J. G., Meeker, R. B., Rustioni, A., & Otey, C. A. (2003). A critical role for palladin in astrocyte morphology and response to injury. <i>Molecular and Cellular Neuroscience</i>, 23, 661–668.</p> <p>Hwang, S. J., Pagliardini, S., Boukhelifa, M., Parast, M. M., Otey, C. A., Rustioni, A., & Valtschanoff, J. G. (2001). Palladin is expressed preferentially in excitatory terminals in the rat central nervous system. <i>Journal of Comparative Neurology</i>, 436, 211–224.</p> <p>Boukhelifa, M., Parast, M. M., Valtschanoff, J. G., LaMantia, A. S., Meeker, R. B., & Otey, C. A. (2001). A Role for the Cytoskeleton-associated Protein Palladin in Neurite Outgrowth. <i>Molecular Biology of the Cell</i>, 12, 2721–2729.</p> <p>Luo, H., Liu, X., Wang, F., Huang, Q., Shen, S., Wang, L., ... Wang, Z. (2005). Disruption of palladin results in neural tube closure defects in mice. <i>Molecular and Cellular Neuroscience</i>, 29, 507–515.</p> <p>Umegaki, Y., Brotons, A. M., Nakanishi, Y., Luo, Z., Zhang, H., Bonni, A., & Ikeuchi, Y. (2018). Palladin Is a Neuron-Specific Translational Target of mTOR Signaling That Regulates Axon Morphogenesis. <i>The Journal of Neuroscience</i>, 38, 4985–4995.</p>
mitogen-activated protein kinase kinase	<p>Traverse, S., Gomez, N., Paterson, H., Marshall, C., & Cohen, P. (1992). Sustained activation of the mitogen-activated protein (MAP) kinase cascade may be required for differentiation of PC12 cells. Comparison of the effects of nerve growth factor and epidermal growth factor. <i>Biochemical Journal</i>, 288, 351–355.</p>

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Learish, R. D., Bruss, M. D., & Haak-frendscho, M. (2000). Inhibition of mitogen-activated protein kinase kinase blocks proliferation of neural progenitor cells. *Developmental Brain Research*, 122, 97–109.

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
44228	ctg7180001809345_1074_SCT	Distribution-SNP	ssa23	36182565	upstream_gene_variant	LOC106584531 c.-5173G>A

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	F
514064	100195695 23:36053225:36188764	ctg7180001809345_1074_SCT	23.0	36103225.0	36138764.0	urah	5-hydroxyisourate hydrolase	protein_coding	▶
514078	106584530 23:36088860:36203079	ctg7180001809345_1074_SCT	23.0	36138860.0	36153079.0	LOC106584530	AFG3-like protein 1	protein_coding	▶
514084	106584529 23:36102962:36310627	ctg7180001809345_1074_SCT	23.0	36152962.0	36260627.0	LOC106584529	voltage-dependent calcium channel subunit alph...	protein_coding	▶
514118	106584531 23:36137419:36240741	ctg7180001809345_1074_SCT	23.0	36187419.0	36190741.0	LOC106584531	leucine-rich repeat and transmembrane domain-c...	protein_coding	▶

Same as for Mowi.

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5-hydroxyisourate hydrolase	No clear association
AFG3-like protein 1	<p>No clear association, but a few relevant hits:</p> <p>Rugarli, E. I., & Langer, T. (2012). Mitochondrial quality control: A matter of life and death for neurons. <i>The EMBO Journal</i>, 31, 1336–1349.</p> <p>Rugarli, E. I., & Langer, T. (2006). Translating m-AAA protease function in mitochondria to hereditary spastic paraplegia. <i>Trends in Molecular Medicine</i>, 12, 262–269.</p> <p>Ferreirinha, F., Pirozzi, M., Valsecchi, V., Broccoli, V., Auricchio, A., Ballabio, A., ... Rugarli, E. I. (2004). Axonal degeneration in paraplegin-deficient mice is associated with abnormal mitochondria and impairment of axonal transport. <i>Journal of Clinical Investigation</i>, 113, 231–242.</p> <p>Tanner, A. J., & Dice, J. F. (1996). Batten Disease and mitochondrial pathways of proteolysis. <i>Biochemical and Molecular Medicine</i>, 57, 1–9.</p>

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voltage-dependent calcium channel subunit alpha	Hirasawa, M., Xu, X., Trask, R. B., Maddatu, T. P., Johnson, B. A., Naggert, J. K., ... Ikeda, A. (2007). Carbonic anhydrase related protein 8 mutation results in aberrant synaptic morphology and excitatory synaptic function in the cerebellum. <i>Mol. Cell. Neurosci.</i> , 35, 161–170.
leucine-rich repeat and transmembrane domain-c...	<p>Sarria, I., Cao, Y., Wang, Y., Kefalov, V. J., Sampath, A. P., Martemyanov, K. A., ... Kamasawa, N. (2018). LRIT1 Modulates Adaptive Changes in Synaptic Communication of Cone Photoreceptors. <i>Cell Reports</i>, 22, 3562–3573.</p> <p>Cobb, C. A. (2018). Functional and structural impact of the loss of the leucine-rich repeat protein LRIT1 in the mouse retina . <i>Electronic Theses and Dissertations</i>. Paper 2968. Retrieved from https://doi.org/10.18297/etd/2968</p> <p>Winther M., Walmod P.S. (2014) Neural Cell Adhesion Molecules Belonging to the Family of Leucine-Rich Repeat Proteins. In: Berezin V., Walmod P. (eds) <i>Cell Adhesion Molecules. Advances in Neurobiology</i>, vol 8. Springer, New York, NY</p> <p>Ueno, A., Omori, Y., Sugita, Y., Watanabe, S., Chaya, T., Kozuka, T., ... Furukawa, T. (2018). Lrit1, a Retinal Transmembrane Protein, Regulates Selective Synapse Formation in Cone Photoreceptor Cells and Visual Acuity. <i>Cell Reports</i>, 22, 3548–3561.</p>

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
23606	ctg7180001289769_2604_SCT	Distribution-SNP	ssa07	19281860	intron_variant	LOC106608718 c.-467-20101T>C

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
182498	106608718 7:19171509:19396231	ctg7180001289769_2604_SCT	7.0	19221509.0	19346231.0	LOC106608718	neuroigin-2-like isoform X2	protein_coding

	References
neuroigin-2-isoform X2	Gollan, L., & Sheiffele, P. (2006). Assembly of Synapses in the Vertebrate Central Nervous System In: <i>Protein trafficking in neurons</i> (A. J. Bean, ed.). Elsevier Science & Technology.

Varoqueaux, F., Jamain, S., & Brose, N. (2004). Neuroligin 2 is exclusively localized to inhibitory synapses. *European Journal of Cell Biology*, 83, 449–456.

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Hines, R. M., Wu, L., Hines, D. J., Steenland, H., Mansour, S., Dahlhaus, R., ... El-Husseini, A. (2008). Synaptic Imbalance, Stereotypies, and Impaired Social Interactions in Mice with Altered Neuroligin 2 Expression. *The Journal of Neuroscience*, 28, 6055–6067.

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
10958	ctg7180001787680_1094_SAC	WildSouth-Aqua	ssa09	17186275	downstream_gene_variant	LOC106610816 c.*4229G>T

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	F
207039	106610815 9:17076968:17197366	ctg7180001787680_1094_SAC	9.0	17126968.0	17147366.0	LOC106610815	serine/arginine repetitive matrix protein 1-li...	protein_coding	X
207072	106610816 9:17102483:17233987	ctg7180001787680_1094_SAC	9.0	17152483.0	17183987.0	LOC106610816	chloride intracellular channel protein 4	protein_coding	X
207115	106610744 9:17149952:17250514	ctg7180001787680_1094_SAC	9.0	17199952.0	17200514.0	LOC106610744	classical arabinogalactan protein 11-like	protein_coding	X
207130	106610745 9:17154118:17255030	ctg7180001787680_1094_SAC	9.0	17204118.0	17205030.0	LOC106610745	uncharacterized protein LOC106610745	partial	
207155	106610822 9:17154984:17256101	ctg7180001787680_1094_SAC	9.0	17204984.0	17206101.0	LOC106610822	uncharacterized protein LOC106610822	protein_coding	X
207175	106610817 9:17174098:17340780	ctg7180001787680_1094_SAC	9.0	17224098.0	17290780.0	LOC106610817	runt-related transcription factor 3-like isofo...	protein_coding	X

	References
serine/arginine repetitive matrix protein 1	Kim, Y. J., Kim, H., & Noh, K. (2014). Investigation on lipopolysaccharide activated microglia by phosphoproteomics and phosphoinositide lipidomics. <i>Mass Spectrometry Letters</i> , 5, 70–78.
chloride intracellular channel protein 4	Padmakumar, V., Masiuk, K. E., Luger, D., Lee, C., Coppola, V., Tessarollo, L., ... Yuspa, S. H. (2014). Detection of differential fetal and adult expression of chloride intracellular channel 4 (CLIC4) protein by analysis of a green fluorescent protein knock-in mouse line. <i>BMC Developmental Biology</i> , 14, 24.
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	<p>circulation. American Journal of Physiology-Heart and Circulatory Physiology, 309, H1141–H1150.</p> <p>Suginta, W., Karoulias, N., Aitken, A., & Ashley, R. H. (2001). Chloride intracellular channel protein CLIC4 (p64H1) binds directly to brain dynamin I in a complex containing actin, tubulin and 14-3-3 isoforms. Biochem. J., 359, 55–64.</p> <p>Shukla, A., & Yuspa, S. H. (2010). CLIC4 and Schnurri-2: A dynamic duo in TGFβ signaling with broader implications in cellular homeostasis and disease. Nucleus, 1, 144–149.</p> <p>Maryoung, L. A., Blunt, B., Tierney, K. B., & Schlenk, D. (2015). Sublethal toxicity of chlorpyrifos to salmonid olfaction after hypersaline acclimation. Aquatic Toxicology, 161, 94–101.</p> <p>Waddell, B. (2016). CLIC5 maintains lifelong structural integrity of sensory stereocilia by promoting Radixin phosphorylation in hair cells of the inner ear. Thesis Bachelor of Science (BS), Ohio University, Biological Sciences, http://Rave.Ohiolink.Edu/Etdc/View?Acc_num=ouhonors1461332124</p>
classical arabinogalactan protein 11	No clear association
runt-related transcription factor 3-like isofo..	Marmigère, F., & Ernfors, P. (2007). Specification and connectivity of neuronal subtypes in the sensory lineage. Nature Reviews Neuroscience, 8, 114–127.

	Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info		
10959	ctg7180001628780_3092_SAG	WildSouth-Aqua	ssa09	17216431	Intergenic_region	LOC106610822-LOC106610817	n.17216431G>A		
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	F
207062	106610816 9:17102483:17233987	ctg7180001628780_3092_SAG	9.0	17152483.0	17183987.0	LOC106610816	chloride intracellular channel protein 4	protein_coding	>
207102	106610744 9:17149952:17250514	ctg7180001628780_3092_SAG	9.0	17199952.0	17200514.0	LOC106610744	classical arabinogalactan protein 11-like	protein_coding	>
207119	106610745 9:17154118:17255030	ctg7180001628780_3092_SAG	9.0	17204118.0	17205030.0	LOC106610745	uncharacterized protein LOC106610745	partial	
207147	106610822 9:17154984:17256101	ctg7180001628780_3092_SAG	9.0	17204984.0	17206101.0	LOC106610822	uncharacterized protein LOC106610822	protein_coding	>
207162	106610817 9:17174098:17340780	ctg7180001628780_3092_SAG	9.0	17224098.0	17290780.0	LOC106610817	runt-related transcription factor 3-like isofo...	protein_coding	>

Closely linked to the panel above.

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
23766	ctg7180001858455_7377_SAG	Distribution-SNP	ssa07	30522174	intron_variant	LOC100306760 c.764+238G>A

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
186594	100306760 7:30446359:30624146	ctg7180001858455_7377_SAG	7.0	30496359.0	30574146.0	LOC100306760	ubiquitin carboxyl- terminal hydrolase 15 isofo...	protein_coding

	References
ubiquitin carboxyl-terminal hydrolase 15	<p>Cheng, P. H., Li, C. L., Chang, Y. F., Tsai, S. J., Lai, Y. Y., Chan, A. W. S., ... Yang, S. H. (2013). MiR-196a ameliorates phenotypes of huntington disease in cell, transgenic mouse, and induced pluripotent stem cell models. <i>American Journal of Human Genetics</i>, 93, 306–312.</p> <p>Filipović, D., Costina, V., Perić, I., Stanisavljević, A., & Findeisen, P. (2017). Chronic fluoxetine treatment directs energy metabolism towards the citric acid cycle and oxidative phosphorylation in rat hippocampal nonsynaptic mitochondria. <i>Brain Research</i>, 1659, 41–54.</p> <p>Chou, C. K., Chang, Y. T., Korinek, M., Chen, Y. T., Yang, Y. T., Leu, S., ... Chiu, C. C. (2017). The regulations of deubiquitinase USP15 and its pathophysiological mechanisms in diseases. <i>International Journal of Molecular Sciences</i>, 18, 483.</p>

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
26059	ctg7180001552685_1089_SGT	Distribution-SNP	ssa09	108793201	intron_variant	ift80 c.859-3986C>A

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
228856	106612911 9:108704207:108806313	ctg7180001552685_1089_SGT	9.0	108754207.0	108756313.0	cssa09h3orf80	uncharacterized membrane protein C3orf80 homolog	protein_coding
228869	106612779 9:108730236:108896900	ctg7180001552685_1089_SGT	9.0	108780236.0	108846900.0	ift80	LOW QUALITY PROTEIN: intraflagellar transport ...	protein_coding
671260	106612912 9:108699451:108829988	ctg7180001552685_1089_SGT	NaN	108749451.0	108779988.0	LOC106612912	NaN	lncRNA

	References
ift80	<p>Hudak, L. M., Lunt, S., Chang, C. H., Winkler, E., Flammer, H., Lindsey, M., & Perkins, B. D. (2010). The intraflagellar transport protein Ift80 is essential for photoreceptor survival in a zebrafish model of jeune asphyxiating thoracic dystrophy. <i>Investigative Ophthalmology & Visual Science</i>, 51, 3792–3799.</p> <p>Bogert, B. (2007). Genetic Analyses of the Development and Function of Sensory Neurons. PhD Thesis, University of California, San Francisco. Retrieved from https://escholarship.org/uc/item/9ff1276t</p> <p>Bizaoui, V., Huber, C., Kohaut, E., Roume, J., Bonnière, M., Attié-Bitach, T., & Cormier-Daire, V. (2019). Mutations in IFT80 cause SRPS</p>

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Heron, P. M., Stromberg, A. J., Breheny, P., & McClintock, T. S. (2013). Molecular events in the cell types of the olfactory epithelium during adult neurogenesis. *Molecular Brain*, 6, 49.

Uytingco, C. R., Green, W. W., & Martens, J. R. (n.d.). Olfactory loss and dysfunction in ciliopathies: Molecular mechanisms and potential therapies. *Current Medicinal Chemistry*, E-Pub Ahead of Print.
<https://doi.org/10.1016/j.bbi.2017.04.008>

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
27707	ctg7180001934773_3779_SCT	Distribution-SNP	ssa10	76986708	intron_variant	zfp1 c.40+4170C>T

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
254516	106560885 10:76912069:77115517	ctg7180001934773_3779_SCT	10.0	76962069.0	77065517.0	zfp1	zinc finger protein ZFPM1 isoform X2	protein_coding

	References
zinc finger protein ZFPM1 isoform X2	<p>Lahti, L., Achim, K., & Partanen, J. (2013). Molecular regulation of GABAergic neuron differentiation and diversity in the developing midbrain. <i>Acta Physiologica</i>, 207, 616–627.</p> <p>Hwang, C. H., Simeone, A., Lai, E., & Wu, D. K. (2009). Foxg1 is required for proper separation and formation of sensory cristae during inner ear development. <i>Developmental Dynamics</i>, 238, 2725–2734.</p> <p>Yang, Y., Li, B., Zhang, X., Zhao, Q., & Lou, X. (2019). The zinc finger protein Zfp1 modulates ventricular trabeculation through Neuregulin-ErbB signalling. <i>Developmental Biology</i>, 446, 142–150.</p> <p>Lahti, L., Haugas, M., Tikker, L., Airavaara, M., Voutilainen, M. H., Anttila, J., ... Partanen, J. (2016). Differentiation and molecular heterogeneity of inhibitory and excitatory neurons associated with midbrain dopaminergic nuclei. <i>Development</i>, 143, 516–529.</p> <p>Goold, R., Hubank, M., Hunt, A., Holton, J., Menon, R. P., Revesz, T., ... Matilla-Dueñas, A. (2007). Down-regulation of the dopamine receptor D2 in mice lacking ataxin 1. <i>Human Molecular Genetics</i>, 16, 2122–2134.</p> <p>Galazo, M. J., Emsley, J. G., & Macklis, J. D. (2016). Corticothalamic Projection Neuron Development beyond Subtype Specification: Fog2</p>

and Intersectional Controls Regulate Intraclass Neuronal Diversity. *Neuron*, 91, 90–106.

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info	
37673	ctg7180001936744_2288_SCT	Distribution-SNP	ssa17	26667003	intergenic_region	LOC106575824-LOC106575825	n.26667003G>A

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	
415512	106575823	17:26565531:26692762	ctg7180001936744_2288_SCT	17.0	26615531.0	26642762.0	LOC106575823	microtubule-associated protein 2-like	protein_coding
415516	106575824	17:26595813:26702335	ctg7180001936744_2288_SCT	17.0	26645813.0	26652335.0	LOC106575824	protein unc-80 homolog	partial
415524	106575825	17:26666129:26784780	ctg7180001936744_2288_SCT	17.0	26716129.0	26734780.0	LOC106575825	DNA-binding protein SATB2-like isoform X1	protein_coding

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microtubule-associated protein 2	<p>Viereck, C., Tucker, R., & Matus, A. (1989). The adult rat olfactory system expresses microtubule-associated proteins found in the developing brain. <i>The Journal of Neuroscience</i>, 9, 3547–3557.</p> <p>Johnson, G. V., & Jope, R. S. (1992). The role of microtubule-associated protein 2 (MAP-2) in neuronal growth, plasticity, and degeneration. <i>J. Neurosci. Res.</i>, 33, 502–512.</p> <p>Bernhardt, R., & Matus, A. (1984). Light and electron microscopic studies of the distribution of microtubule-associated protein 2 in rat brain: a difference between dendritic and axonal cytoskeletons. <i>J. Comp. Neurol.</i>, 226, 203–221.</p> <p>Tucker, R. P. (1990). The roles of microfilament-associated proteins, drebrins, in brain morphogenesis: A review. <i>Brain Research Reviews</i>, 15, 101–120.</p> <p>Rioux, L., Ruscheinsky, D., & Arnold, S. E. (2004). Microtubule-associated protein MAP2 expression in olfactory bulb in schizophrenia. <i>Psychiatry Research</i>, 128, 1–7.</p> <p>Sánchez, C., Díaz-Nido, J., & Avila, J. (2000). Phosphorylation of microtubule-associated protein 2 (MAP2) and its relevance for the regulation of the neuronal cytoskeleton function. <i>Progress in Neurobiology</i>, 61, 133–168.</p>
unc-80	<p>Yeh, E., Ng, S., Zhang, M., Bouhours, M., Wang, Y., Wang, M., ... Zhen, M. (2008). A putative cation channel, NCA-1, and a novel protein, UNC-80, transmit neuronal activity in <i>C. elegans</i>. <i>PLoS Biology</i>, 6, e55.</p> <p>Chen, B., Liu, Q., Ge, Q., Xie, J., & Wang, Z. W. (2007). UNC-1 Regulates Gap Junctions Important to Locomotion in <i>C. elegans</i>. <i>Current Biology</i>, 17, 1334–1339.</p>

	<p>Lu, B., Su, Y., Das, S., Wang, H., Wang, Y., Liu, J., & Ren, D. (2009). Peptide neurotransmitters activate a cation channel complex of NALCN and UNC-80. <i>Nature</i>, 457, 741–744.</p>
SATB2	<p>Britanova, O., de Juan Romero, C., Cheung, A., Kwan, K. Y., Schwark, M., Gyorgy, A., ... Tarabykin, V. (2008). <i>Satb2</i> Is a Postmitotic Determinant for Upper-Layer Neuron Specification in the Neocortex. <i>Neuron</i>, 57, 378–392.</p> <p>Gyorgy, A. B., Szemes, M., De Juan Romero, C., Tarabykin, V., & Agoston, D. V. (2008). SATB2 interacts with chromatin-remodeling molecules in differentiating cortical neurons. <i>European Journal of Neuroscience</i>, 27, 865–873.</p> <p>Leone, D. P., Heavner, W. E., Ferenczi, E. A., Dobрева, G., Huguenard, J. R., Grosschedl, R., & McConnell, S. K. (2015). <i>Satb2</i> regulates the differentiation of both callosal and subcerebral projection neurons in the developing cerebral cortex. <i>Cerebral Cortex</i>, 25, 3406–3419.</p> <p>Shimizu, T., & Hibi, M. (2009). Formation and patterning of the forebrain and olfactory system by zinc-finger genes <i>Fezf1</i> and <i>Fezf2</i>. <i>Development Growth and Differentiation</i>, 51, 221–231.</p> <p>Diodato, A., Ruinart De Brimont, M., Yim, Y. S., Derian, N., Perrin, S., Pouch, J., ... Fleischmann, A. (2016). Molecular signatures of neural connectivity in the olfactory cortex. <i>Nature Communications</i>, 7, 12238.</p> <p>Kawasawa, Y. I., Salzberg, A. C., Li, M., Šestan, N., Greer, C. A., & Imamura, F. (2016). RNA-seq analysis of developing olfactory bulb projection neurons. <i>Molecular and Cellular Neuroscience</i>, 74, 78–86.</p> <p>Amaniti, E. M., Kelman, A., Mason, J. O., & Theil, T. (2015). Cerebral cortex expression of <i>Gli3</i> is required for normal development of the lateral olfactory tract. <i>PLoS ONE</i>, 10, e0141525.</p>

Mowi

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info			
47482	ctg7180001903803_1531_SCT	Distribution-SNP	ssa28	18550835	intron_variant	cdrt1	c.977-494C>T		

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
580832	106589630 28:18482572:18610561	ctg7180001903803_1531_SCT	28.0	18532572.0	18560561.0	cdrt1	CMT1A duplicated region transcript 1 protein l...	protein_coding
580841	106589631 28:18511212:18616448	ctg7180001903803_1531_SCT	28.0	18561212.0	18566448.0	LOC106589631	histone-lysine N-methyltransferase PRDM9-like ...	protein_coding
580850	100380747 28:18516456:18644660	ctg7180001903803_1531_SCT	28.0	18566456.0	18594660.0	LOC100380747	neurabin-2	protein_coding
580869	106589634 28:18545759:18659443	ctg7180001903803_1531_SCT	28.0	18595759.0	18609443.0	LOC106589634	alpha-sarcoglycan-like isoform X1	protein_coding

	References
cdrt1	No clear association
PRDM9	<p>No convincing association, but:</p> <p>Shulha, H. P., Crisci, J. L., Reshetov, D., Tushir, J. S., Cheung, I., Bharadwaj, R., ... Akbarian, S. (2012). Human-Specific Histone Methylation Signatures at Transcription Start Sites in Prefrontal Neurons. <i>PLoS Biology</i>, 10, e1001427.</p> <p>Wu, H., Mathioudakis, N., Diagouraga, B., Dong, A., Dombrovski, L., Baudat, F., ... Kadlec, J. (2013). Molecular Basis for the Regulation of the H3K4 Methyltransferase Activity of PRDM9. <i>Cell Reports</i>, 5, 13–20.</p>
neurabin-2	<p>Nakanishi, H., Obaishi, H., Satoh, A., Wada, M., Mandai, K., Satoh, K., ... Takai, Y. (1997). Neurabin: A novel neural tissue-specific actin filament-binding protein involved in neurite formation. <i>The Journal of Cell Biology</i>, 139, 951–961.</p> <p>Stoneham, E. T., Sanders, E. M., Sanyal, M., & Dumas, T. C. (2010). Rules of engagement: Factors that regulate activity-dependent synaptic plasticity during neural network development. <i>Biological Bulletin</i>, 219, 81–99.</p> <p>Sarrouilhe, D., di Tommaso, A., Métafé, T., & Ladeveze, V. (2006). Spinophilin: from partners to functions. <i>Biochimie</i>, 88, 1099–1113.</p> <p>Li, K. W., Hornshaw, M. P., Van der Schors, R. C., Watson, R., Tate, S., Casetta, B., ... Smit, A. B. (2004). Proteomics Analysis of Rat Brain Postsynaptic Density. <i>Journal of Biological Chemistry</i>, 279, 987–1002.</p>
alpha-sarcoglycan	<p>No convincing association:</p> <p>Xiao, J., & LeDoux, M. S. (2003). Cloning, developmental regulation and neural localization of rat ε-sarcoglycan. <i>Molecular Brain Research</i>, 119, 132–143.</p>

Cai, H., Erdman, R. A., Zweier, L., Chen, J., Shaw IV, J. H., Baylor, K. A., ... Chan, Y. mo M. (2007). The sarcoglycan complex in Schwann cells and its role in myelin stability. *Experimental Neurology*, 205, 257–269.

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Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
46880	ctg7180001268296_4006_SCT	Distribution-SNP	ssa27	23010617	intron_variant	LOC106588773 c.-2557+9614G>A

Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
196397:23013179	ctg7180001268296_4006_SCT	27.0	22946397.0	22963179.0	LOC106588772	wiskott-Aldrich syndrome protein family member...	protein_coding
113564:23070328	ctg7180001268296_4006_SCT	27.0	22963564.0	23020328.0	LOC106588773	methyltransferase-like protein 24 isoform X3	protein_coding
170243:23070874	ctg7180001268296_4006_SCT	27.0	23020243.0	23020874.0	LOC106588774	uncharacterized histidine-rich protein DDB_G02...	protein_coding
171006:23117381	ctg7180001268296_4006_SCT	27.0	23021006.0	23067381.0	LOC106588724	AT-hook DNA-binding motif-containing protein 1...	protein_coding
122089:23023883	ctg7180001268296_4006_SCT	NaN	22972089.0	22973883.0	LOC106588775	NaN	lncRNA

	References
wiskott-Aldrich syndrome protein family	<p>Tsuchiya, D., Kitamura, Y., Takata, K., Sugisaki, T., Taniguchi, T., Uemura, K., ... Shimohama, S. (2006). Developmental expression of neural Wiskott-Aldrich syndrome protein (N-WASP) and WASP family verprolin-homologous protein (WAVE)-related proteins in postnatal rat cerebral cortex and hippocampus. <i>Neuroscience Research</i>, 56, 459–469.</p> <p>Nozumi, M., Nakagawa, H., Miki, H., Takenawa, T., & Miyamoto, S. (2003). Differential localization of WAVE isoforms in filopodia and lamellipodia of the neuronal growth cone. <i>Journal of Cell Science</i>, 116, 239–246.</p> <p>Ito, H., Morishita, R., Shinoda, T., Iwamoto, I., Sudo, K., Okamoto, K., & Nagata, K. (2010). Dysbindin-1, WAVE2 and Abi-1 form a complex that regulates dendritic spine formation. <i>Molecular Psychiatry</i>, 15, 976–986.</p>

methyltransferase 24	No clear association
DDB_G02	No clear association
AT-hook DNA-binding motif-containing protein 1	<p>Yang, H., Douglas, G., Monaghan, K. G., Retterer, K., Cho, M. T., Escobar, L. F., ... Chung, W. K. (2015). De novo truncating variants in the AHDC1 gene encoding the AT-hook DNA-binding motif-containing protein 1 are associated with intellectual disability and developmental delay. <i>Cold Spring Harb Mol Case Stud</i>, 1, a000562.</p> <p>Wang, Q., Huang, X., Liu, Y., Peng, Q., Zhang, Y., Liu, J., & Yuan, H. (2019). Microdeletion and microduplication of 1p36.11p35.3 involving AHDC1 contribute to neurodevelopmental disorder. <i>European Journal of Medical Genetics</i>, Article in Press. https://doi.org/10.1016/j.ejmg.2019.01.001</p>

	Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info		
25311	ctg7180001851039_10290_SAC	Distribution-SNP	ssa09	55068124	intergenic_region	LOC106611576-LOC106611580	n.55068124T>G		
	GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
215345	106611580	9:55026673:55131334	ctg7180001851039_10290_SAC	9.0	55076673.0	55081334.0	LOC106611580	tryptophan 2	3-dioxygenase A-like
215386	106611581	9:55048962:55380563	ctg7180001851039_10290_SAC	9.0	55098962.0	55330563.0	LOC106611581	teneurin- 3-like isoform X7	protein_coding

Same as for SalmoBreed.

	References
tryptophan 2,3-dioxygenase A	<p>Breda, C., Sathyaikumar, K. V, Idrissi, S. S., Notarangelo, F. M., Estranero, J. G., Moore, G. G., ... Giorgini, F. (2016). Tryptophan-2,3-dioxygenase (TDO) inhibition ameliorates neurodegeneration by modulation of kynurenine pathway metabolites. <i>PNAS</i>, 113, 5435–5440.</p> <p>Kanai, M., Funakoshi, H., Takahashi, H., Hayakawa, T., Mizuno, S., Matsumoto, K., & Nakamura, T. (2009). Tryptophan 2,3-dioxygenase is a key modulator of physiological neurogenesis and anxiety-related behavior in mice. <i>Molecular Brain</i>, 2, 8.</p> <p>Stone, T. W., Stoy, N., & Darlington, L. G. (2013). An expanding range of targets for kynurenine metabolites of tryptophan. <i>Trends in Pharmacological Sciences</i>, 34, 136–143.</p> <p>Ohira, K., Hagihara, H., Toyama, K., Takao, K., Kanai, M., Funakoshi, H., ... Miyakawa, T. (2010). Expression of tryptophan 2,3-dioxygenase in mature granule cells of the adult mouse dentate gyrus. <i>Molecular Brain</i>, 3, 26.</p>
teneurin-3	<p>Antinucci, P., Nikolaou, N., Meyer, M. P., & Hindges, R. (2013). Teneurin-3 specifies morphological and functional connectivity of retinal ganglion cells in the vertebrate visual system. <i>Cell Reports</i>, 5, 582–592.</p>

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Mosca, T. J., Hong, W., Dani, V. S., Favaloro, V., & Luo, L. (2012). Trans-synaptic Teneurin signalling in neuromuscular synapse organization and target choice. *Nature*, 484, 237–241.

Berns, D. S., DeNardo, L. A., Pederick, D. T., & Luo, L. (2018). Teneurin-3 controls topographic circuit assembly in the hippocampus. *Nature*, 554, 328–333.

Hong, W., Mosca, T. J., & Luo, L. (2012). Teneurins instruct synaptic partner matching in an olfactory map. *Nature*, 484, 201–207.

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
17230	ctg7180001888084_235_SCT	Distribution-SNP	ssa02	9446772	upstream_gene_variant	LOC106576116 c.-2112A>G

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
43111	106576116 2:9398861:9499571	ctg7180001888084_235_SCT	2.0	9448861.0	9449571.0	LOC106576116	SPRY domain-containing SOCS box protein 1-like	protein_coding
43119	106576347 2:9426484:9627865	ctg7180001888084_235_SCT	2.0	9476484.0	9577865.0	LOC106576347	glutamate receptor ionotropic	kainate 5-like
621101	106576102 2:9387844:9488531	ctg7180001888084_235_SCT	NaN	9437844.0	9438531.0	LOC106576102	NaN	lncRNA

	References
SPRY domain-containing SOCS box protein	No clear association, probably immunology
glutamate receptor ionotropic	<p>Glutamate reseptor hiten er identisk med AquaGen? Nei, forskjellig kromosom 2 og 11</p> <p>Adams, J., Crosbie, J., Wigg, K., Ickowicz, A., Pathare, T., Roberts, W., ... Barr, C. L. (2004). Glutamate receptor, ionotropic, N-methyl D-aspartate 2A (GRIN2A) gene as a positional candidate for attention-deficit/hyperactivity disorder in the 16p13 region. <i>Molecular Psychiatry</i>, 9, 494–499.</p> <p>Oh, D. H., Son, H., Hwang, S., & Kim, S. H. (2012). Neuropathological abnormalities of astrocytes, GABAergic neurons, and pyramidal neurons in the dorsolateral prefrontal cortices of patients with major depressive disorder. <i>European Neuropsychopharmacology</i>, 22, 330–338.</p>

Kocerha, J., Faghihi, M. A., Lopez-Toledano, M. A., Huang, J., Ramsey, A. J., Caron, M. G., ... Wahlestedt, C. (2009). MicroRNA-219 modulates NMDA receptor-mediated neurobehavioral dysfunction. *Proceedings of the National Academy of Sciences*, 106, 3507–3512.

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Martínez, G., Vidal, R. L., Mardones, P., Serrano, F. G., Ardiles, A. O., Wirth, C., ... Hetz, C. (2016). Regulation of Memory Formation by the Transcription Factor XBP1. *Cell Reports*, 14, 1382–1394.

Lalouette, A., Lohof, A., Sotelo, C., Guénet, J. L., & Mariani, J. (2001). Neurobiological effects of a null mutation depend on genetic context: Comparison between two hotfoot alleles of the delta-2 ionotropic glutamate receptor. *Neuroscience*, 105, 443–455.

Ramanan, V. K., Kim, S., Holohan, K., Shen, L., Nho, K., Risacher, S. L., ... Saykin, A. J. (2012). Genome-wide pathway analysis of memory impairment in the Alzheimer's Disease Neuroimaging Initiative (ADNI) cohort implicates gene candidates, canonical pathways, and networks. *Brain Imaging and Behavior*, 6, 634–648.

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
9051	ctg7180001863290_453_SCT	functional	ssa23	35950060	missense_variant	mettl20 c.703G>A

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	F
513940	106584539 23:35836930:35958472	ctg7180001863290_453_SCT	23.0	35886930.0	35908472.0	LOC106584539	uncharacterized protein LOC106584539 isoform X1	protein_coding	>
513948	106584538 23:35892463:35998188	ctg7180001863290_453_SCT	23.0	35942463.0	35948188.0	amn1	protein AMN1 homolog isoform X4	protein_coding	>
513968	106584537 23:35898930:36001220	ctg7180001863290_453_SCT	23.0	35948930.0	35951220.0	mettl20	protein N-lysine methyltransferase METTL20	protein_coding	>
513985	106584536 23:35903856:36015924	ctg7180001863290_453_SCT	23.0	35953856.0	35965924.0	LOC106584536	mixed lineage kinase domain-like protein	protein_coding	>
513988	106584535 23:35916027:36030930	ctg7180001863290_453_SCT	23.0	35966027.0	35980930.0	LOC106584535	E3 ubiquitin-protein ligase RFWD3-like	protein_coding	>
514012	106584534 23:35932154:36072426	ctg7180001863290_453_SCT	23.0	35982154.0	36022426.0	LOC106584534	Golgi apparatus protein 1-like	protein_coding	>

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AMN1	<p>Cervantes-Sandoval, I., & Davis, R. L. (2012). Distinct traces for appetitive versus aversive olfactory memories in DPM neurons of <i>Drosophila</i>. <i>Current Biology</i>, 22, 1247–1252.</p> <p>Keene, A. C., Stratmann, M., Keller, A., Perrat, P. N., Vosshall, L. B., & Waddell, S. (2004). Diverse odor-conditioned memories require</p>

	uniquely timed dorsal paired medial neuron output. <i>Neuron</i> , 44, 521–533.
METTL20	No clear association
mixed lineage kinase domain protein	No clear association
RFWD3	No clear association
Golgi apparatus protein	No clear association

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info							
17337	ctg7180001593480_3370_SAC	Distribution-SNP	ssa02 16771122	intergenic_region	LOC106579240-LOC106579246	n.16771122C>A							
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	Protein_product	Strand	Len	Row_no	Gid

	References
R-spondin-3	<p>Ohkawara, B., Glinka, A., & Niehrs, C. (2011). Rspo3 Binds Syndecan 4 and Induces Wnt/PCP Signaling via Clathrin-Mediated Endocytosis to Promote Morphogenesis. <i>Developmental Cell</i>, 20, 303–314.</p> <p>Ota, S., Ishitani, S., Shimizu, N., Matsumoto, K., Itoh, M., & Ishitani, T. (2012). NLK positively regulates Wnt/β-catenin signalling by phosphorylating LEF1 in neural progenitor cells. <i>The EMBO Journal</i>, 31, 1904–1915.</p> <p>Rong, X., Chen, C., Zhou, P., Zhou, Y., Li, Y., Lu, L., ... Duan, C. (2014). R-spondin 3 regulates dorsoventral and anteroposterior patterning by antagonizing Wnt/β-catenin signaling in zebrafish embryos. <i>PLoS ONE</i>, Vol. 9, p. e99514.</p> <p>de Lau, W. B. M., Snel, B., & Clevers, H. C. (2012). The R-spondin protein family. <i>Genome Biology</i>, 13, 242.</p> <p>de Lau, W., Peng, W. C., Gros, P., & Clevers, H. (2014). The R-spondin/Lgr5/Rnf43 module: Regulator of Wnt signal strength. <i>Genes and Development</i>, 28, 305–316.</p> <p>Li, J. Y., Chai, B., Zhang, W., Fritze, D. M., Zhang, C., & Mulholland, M. W. (2014). LGR4 and its ligands, R-spondin 1 and R-spondin 3, regulate food intake in the hypothalamus of male rats. <i>Endocrinology</i>, 155, 429–440.</p> <p>Yu, Y., Moberly, A. H., Bhattarai, J. P., Duan, C., Zheng, Q., Li, F., ... Ma, M. (2017). The Stem Cell Marker Lgr5 Defines a Subset of Postmitotic Neurons in the Olfactory Bulb. <i>The Journal of Neuroscience</i>, 37, 9403–9414.</p>

	Barrios-Camacho, C. M. (2018). Expression of Bona Fide Epithelial Stem Cell Marker in Postmitotic Olfactory Bulb Neurons Suggest Novel Roles for Wnt Signaling in the Brain. <i>The Journal of Neuroscience</i> , 38, 2920–2922.
tRNA (guanine(10)-N2)-methyltransferase	No clear association

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
36633	ctg7180001833869_486_SCT	Distribution-SNP	ssa16	47245536	intergenic_region	LOC106574075-LOC106574044 n.47245536G>A

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
400080	106574075 16:46991789:47285906	ctg7180001833869_486_SCT	16.0	47041789.0	47235906.0	LOC106574075	nuclear factor 1 A-type-like	protein_coding
400091	106574044 16:47228465:47346192	ctg7180001833869_486_SCT	16.0	47278465.0	47296192.0	LOC106574044	TM2 domain-containing protein 1-like	protein_coding

	References
nuclear factor 1 A-type	<p>Zhang, J., & Jiao, J. (2015). Molecular Biomarkers for Embryonic and Adult Neural Stem Cell and Neurogenesis. <i>BioMed Research International</i>, 2015, 727542.</p> <p>Sanosaka, T., Imamura, T., Hamazaki, N., Chai, M. C., Igarashi, K., Ideta-Otsuka, M., ... Nakashima, K. (2017). DNA Methylome Analysis Identifies Transcription Factor-Based Epigenomic Signatures of Multilineage Competence in Neural Stem/Progenitor Cells. <i>Cell Reports</i>, 20, 2992–3003.</p> <p>Tyssowski, K., Kishi, Y., & Gotoh, Y. (2014). Chromatin regulators of neural development. <i>Neuroscience</i>, 264, 4–16.</p> <p>Schwarz, T. J. (2012). Examining new interactors of Notch / RBPJ signalling in adult neural stem cells. PhD Thesis, Technische Universität, München. Retrieved from https://mediatum.ub.tum.de/1098778</p>
TM2 domain-containing protein 1	No clear association

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
7431	ctg7180001591304_4622_SGT	functional	ssa14	34030280	missense_variant	LOC106569383 c.580C>A

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
350113	106569394 14:33942803:34046266	ctg7180001591304_4622_SGT	14.0	33992803.0	33996266.0	LOC106569394	zinc finger protein 333-like	protein_coding
350134	106569382 14:33954230:34079291	ctg7180001591304_4622_SGT	14.0	34004230.0	34029291.0	tep1	telomerase protein component 1	protein_coding
350145	106569383 14:33979334:34081305	ctg7180001591304_4622_SGT	14.0	34029334.0	34031305.0	LOC106569383	zinc finger protein 233-like	protein_coding
350153	106569381 14:33997947:34102341	ctg7180001591304_4622_SGT	14.0	34047947.0	34052341.0	LOC106569381	zinc finger protein 436-like isoform X2	protein_coding
350170	106569380 14:34002462:34112753	ctg7180001591304_4622_SGT	14.0	34052462.0	34062753.0	LOC106569380	nectin-4-like	protein_coding
350180	106569423 14:34027812:34130055	ctg7180001591304_4622_SGT	14.0	34077812.0	34080055.0	LOC106569423	high affinity immunoglobulin epsilon receptor ...	protein_coding

Same as for both SalmoBreed and Rauma.

	References
zinc finger protein 333	No clear association, probably immunology
telomerase protein component 1	No clear association
zinc finger protein 233	No clear association
zinc finger protein 436	Obayashi, S., Tabunoki, H., Kim, S. U., & Satoh, J. I. (2009). Gene expression profiling of human neural progenitor cells following the serum-induced astrocyte differentiation. <i>Cellular and Molecular Neurobiology</i> , 29, 423–438.
nectin-4	Mizoguchi, A., Nakanishi, H., Kimura, K., Matsubara, K., Ozaki-Kuroda, K., Katata, T., ... Takai, Y. (2002). Nectin: An adhesion molecule involved in formation of synapses. <i>Journal of Cell Biology</i> , 156, 555–565. Lim, S. T., Lim, K.-C., Giuliano, R. E., & Federoff, H. J. (2008). Temporal and Spatial Localization of Nectin-1 and I-Afadin during Synaptogenesis in Hippocampal Neurons. <i>The Journal of Comparative Neurology</i> , 507, 1228–1244. Takai, Y., & Nakanishi, H. (2003). Nectin and afadin: novel organizers of intercellular junctions. <i>Journal of Cell Science</i> , 116, 17–27. Ogita, H., & Takai, Y. (2006). Nectins and nectin-like molecules: Roles in cell adhesion, polarization, movement, and proliferation. <i>IUBMB Life</i> , 58, 334–343. Katsunuma, S., Honda, H., Shinoda, T., Ishimoto, Y., Miyata, T., Kiyonari, H., ... Togashi, H. (2016). Synergistic action of nectins and cadherins generates the mosaic cellular pattern of the olfactory epithelium. <i>Journal of Cell Biology</i> , 212, 561–575.
high affinity immunoglobulin epsilon receptor	No clear association

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info	
44199	ctg7180001538584_4406_SGT	Distribution-SNP	ssa23	34429256	intergenic_region	LOC106584451-LOC106584480	n.34429256A>C

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	Protein_product	
513701	106584451	23:34247228:34454817	ctg7180001538584_4406_SGT	23.0	34297228.0	34404817.0	LOC106584451	potassium voltage-gated channel subfamily KQT ...	partial	protein_coding

	References
potassium voltage-gated channel subfamily KQT..	<p>Klemmer, P., Smit, A. B., & Li, K. W. (2009). Proteomics analysis of immuno-precipitated synaptic protein complexes. <i>Journal of Proteomics</i>, 72, 82–90.</p> <p>Lu, A., Wisniewski, J. R., & Mann, M. (2009). Comparative proteomic profiling of membrane proteins in rat cerebellum, spinal cord, and sciatic nerve. <i>Journal of Proteome Research</i>, 8, 2418–2425.</p> <p>Sheffield, A. M., & Smith, R. J. H. (2018). The Epidemiology of Deafness. <i>Cold Spring Harbor Perspectives in Medicine</i> doi: 10.1101/Cshperspect.A033258.</p> <p>Yang, Y., Wang, X., Liu, Y., Fu, Q., Tian, C., Wu, C., ... Liu, Z. (2018). Transcriptome analysis reveals enrichment of genes associated with auditory system in swimbladder of channel catfish. <i>Comparative Biochemistry and Physiology - Part D</i>, 27, 30–39.</p> <p>Kumar, D., Ambasta, R. K., & Kumar, P. (2014). Mutational Consequences of Aberrant Ion Channels in Neurological Disorders. <i>Journal of Membrane Biology</i>, 247, 1083–1127.</p>

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info	
44228	ctg7180001809345_1074_SCT	Distribution-SNP	ssa23	36182565	upstream_gene_variant	LOC106584531	c.-5173G>A

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	Protein_product
514064	100195695	23:36053225:36188764	ctg7180001809345_1074_SCT	23.0	36103225.0	36138764.0	urah	5-hydroxyisourate hydrolase	protein_coding
514078	106584530	23:36088860:36203079	ctg7180001809345_1074_SCT	23.0	36138860.0	36153079.0	LOC106584530	AFG3-like protein 1	protein_coding
514084	106584529	23:36102962:36310627	ctg7180001809345_1074_SCT	23.0	36152962.0	36260627.0	LOC106584529	voltage-dependent calcium channel subunit alph...	protein_coding
514118	106584531	23:36137419:36240741	ctg7180001809345_1074_SCT	23.0	36187419.0	36190741.0	LOC106584531	leucine-rich repeat and transmembrane domain-c...	protein_coding

Same as for Rauma.

	References
5-hydroxyisourate hydrolase	No clear association
AFG3-like protein 1	<p>No clear association, but a few relevant hits:</p> <p>Rugarli, E. I., & Langer, T. (2012). Mitochondrial quality control: A matter of life and death for neurons. <i>The EMBO Journal</i>, 31, 1336–1349.</p> <p>Rugarli, E. I., & Langer, T. (2006). Translating m-AAA protease function in mitochondria to hereditary spastic paraplegia. <i>Trends in Molecular Medicine</i>, 12, 262–269.</p> <p>Ferreirinha, F., Pirozzi, M., Valsecchi, V., Broccoli, V., Auricchio, A., Ballabio, A., ... Rugarli, E. I. (2004). Axonal degeneration in paraplegin-deficient mice is associated with abnormal mitochondria and impairment of axonal transport. <i>Journal of Clinical Investigation</i>, 113, 231–242.</p> <p>Tanner, A. J., & Dice, J. F. (1996). Batten Disease and mitochondrial pathways of proteolysis. <i>Biochemical and Molecular Medicine</i>, 57, 1–9.</p> <p>Nolden, M., Ehses, S., Koppen, M., Bernacchia, A., Rugarli, E. I., & Langer, T. (2005). The m-AAA protease defective in hereditary spastic paraplegia controls ribosome assembly in mitochondria. <i>Cell</i>, 123, 277–289.</p> <p>Burté, F., Carelli, V., Chinnery, P. F., & Yu-Wai-Man, P. (2015). Disturbed mitochondrial dynamics and neurodegenerative disorders. <i>Nature Reviews Neurology</i>, 11, 11–24.</p>
voltage-dependent calcium channel subunit alpha	Hirasawa, M., Xu, X., Trask, R. B., Maddatu, T. P., Johnson, B. A., Naggert, J. K., ... Ikeda, A. (2007). Carbonic anhydrase related protein 8 mutation results in aberrant synaptic morphology and excitatory synaptic function in the cerebellum. <i>Mol. Cell. Neurosci.</i> , 35, 161–170.
leucine-rich repeat and transmembrane domain-c...	<p>Sarria, I., Cao, Y., Wang, Y., Kefalov, V. J., Sampath, A. P., Martemyanov, K. A., ... Kamasawa, N. (2018). LRIT1 Modulates Adaptive Changes in Synaptic Communication of Cone Photoreceptors. <i>Cell Reports</i>, 22, 3562–3573.</p> <p>Cobb, C. A. (2018). Functional and structural impact of the loss of the leucine-rich repeat protein LRIT1 in the mouse retina . <i>Electronic Theses and Dissertations</i>. Paper 2968. Retrieved from https://doi.org/10.18297/etd/2968</p> <p>Winther M., Walmod P.S. (2014) Neural Cell Adhesion Molecules Belonging to the Family of Leucine-Rich Repeat Proteins. In: Berezin V., Walmod P. (eds) <i>Cell Adhesion Molecules</i>. <i>Advances in Neurobiology</i>, vol 8. Springer, New York, NY</p>

	Ueno, A., Omori, Y., Sugita, Y., Watanabe, S., Chaya, T., Kozuka, T., ... Furukawa, T. (2018). <i>Lrit1</i> , a Retinal Transmembrane Protein, Regulates Selective Synapse Formation in Cone Photoreceptor Cells and Visual Acuity. <i>Cell Reports</i> , 22, 3548–3561.
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Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
28165	ctg7180001626552_1091_SAG	Distribution-SNP	ssa10	107341104	intron_variant	LOC106561641 c.-75-12234G>A

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
261911	106561641 10:107205810:107459430	ctg7180001626552_1091_SAG	10.0	107255810.0	107409430.0	LOC106561641	contactin-1a-like	protein_coding

	References
contactin-1a	<p>Miura, Y., Devaux, J. J., Fukami, Y., Manso, C., Belghazi, M., Wong, A. H. Y., ... Yamamoto, T. (2015). Contactin 1 IgG4 associates to chronic inflammatory demyelinating polyneuropathy with sensory ataxia. <i>Brain</i>, 138, 1484–1491.</p> <p>Lamprianou, S., Chatzopoulou, E., Thomas, J.-L., Bouyain, S., & Harroch, S. (2011). A complex between contactin-1 and the protein tyrosine phosphatase PTPRZ controls the development of oligodendrocyte precursor cells. <i>PNAS</i>, 108, 17498–17503.</p> <p>Colakoglu, G., Bergstrom-Tyrberg, U., Berglund, E. O., & Ranscht, B. (2014). Contactin-1 regulates myelination and nodal/paranodal domain organization in the central nervous system. <i>PNAS</i>, 111, E394–E403.</p> <p>Zacharias, U., & Rauch, U. (2006). Competition and cooperation between tenascin-R, lecticans and contactin 1 regulate neurite growth and morphology. <i>Journal of Cell Science</i>, 119, 3456–3466.</p> <p>Bouyain, S., & Watkins, D. J. (2010). The protein tyrosine phosphatases PTPRZ and PTPRG bind to distinct members of the contactin family of neural recognition molecules. <i>PNAS</i>, 107, 2443–2448.</p> <p>Rush, A. M., Craner, M. J., Kageyama, T., Dib-Hajj, S. D., Waxman, S. G., & Ranscht, B. (2005). Contactin regulates the current density and axonal expression of tetrodotoxin-resistant but not tetrodotoxin-sensitive sodium channels in DRG neurons. <i>European Journal of Neuroscience</i>, 22, 39–49.</p> <p>Schwarting, G. A., & Henion, T. R. (2011). Regulation and function of axon guidance and adhesion molecules during olfactory map formation. <i>Journal of Cellular Biochemistry</i>, 112, 2663–2671.</p> <p>Puzzo, D., Bizzoca, A., Privitera, L., Furnari, D., Giunta, S., Girolamo, F., ... Palmeri, A. (2013). F3/Contactin promotes hippocampal</p>

neurogenesis, synaptic plasticity, and memory in adult mice.
Hippocampus, 23, 1367–1382.

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info					
18970	ctg7180001631827_192_SAC	Distribution-SNP	ssa03	56012380	intron_variant	gbgt1	c.68+24842G>T				
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	Pro		
83764	100194757 3:55915832:56087519	ctg7180001631827_192_SAC	3.0	55965832.0	56037519.0	gbgt1	globoside alpha-1	acetylgalactosaminyltransferase 1 isoform X2	3-N-1-like	p	
83773	106600864 3:55974738:56075461	ctg7180001631827_192_SAC	3.0	56024738.0	56025461.0	LOC106600864	globoside alpha-1	acetylgalactosaminyltransferase 1-like	3-N-1-like	p	
83782	106600863 3:56012132:56148043	ctg7180001631827_192_SAC	3.0	56062132.0	56098043.0	LOC106600863	integrin alpha-3-like isoform X1		protein_coding	XP	

Same as for SalmoBreed.

	References
gbgt1	No clear association
globoside alpha-1	No clear association
integrin alpha-3	<p>Huang, A.-M., Wang, H. L., Tang, Y. P., & Lee, E. H. Y. (1998). Expression of Integrin-Associated Protein Gene Associated with Memory Formation in Rats. <i>The Journal of Neuroscience</i>, 18, 4305–4313.</p> <p>Clegg, D. O., Wingerd, K. L., Hikita, S. T., & Tolhurst, E. C. (2003). Integrins in the development, function and dysfunction of the nervous system. [Frontiers in Bioscience, 8, d723-750.</p> <p>Stipp, C. S., & Hemler, M. E. (2000). Transmembrane-4-superfamily proteins CD151 and CD81 associate with $\alpha 3\beta 1$ integrin, and selectively contribute to $\alpha 3\beta 1$-dependent neurite outgrowth. <i>Journal of Cell Science</i>, 113, 1871–1882.</p> <p>Chang, H. P., Lindberg, F. P., Wang, H. L., Huang, A. M., & Lee, E. H. Y. (1999). Impaired memory retention and decreased long-term potentiation in integrin-associated protein-deficient mice. <i>Learning and Memory</i>, 6, 448–457.</p> <p>Stanco, A., Szekeres, C., Patel, N., Rao, S., Campbell, K., Kreidberg, J. A., ... Anton, E. S. (2009). Netrin-1– $\alpha 3\beta 1$ integrin interactions regulate the migration of interneurons through the cortical marginal zone. <i>PNAS</i>, 106, 7595–7600.</p>

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info				
17249	ctg7180001295039_234_SAG	Distribution-SNP	ssa02	10562168	intron_variant	LOC106576689	c.55-797C>T			
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype		
43470	106576689 2:10503163:10627272	ctg7180001295039_234_SAG	2.0	10553163.0	10577272.0	LOC106576689	chloride channel protein 1-like isoform X3	protein_coding		
43482	106576719 2:10528250:10640006	ctg7180001295039_234_SAG	2.0	10578250.0	10590006.0	LOC106576719	caspase-2-like isoform X1	protein_coding		
43493	106576972 2:10558900:10664678	ctg7180001295039_234_SAG	2.0	10608900.0	10614678.0	LOC106576972	rap1 GTPase-activating protein 2-like	protein_coding		
621527	106576318 2:10552772:10656750	ctg7180001295039_234_SAG	NaN	NaN	NaN	NaN	NaN	NaN		

	References
chloride channel protein 1	No clear association
caspase-2	<p>Troy, C. M., Rabacchi, S. A., Hohl, J. B., Angelastro, J. M., Greene, L. A., & Shelanski, M. L. (2001). Death in the Balance: Alternative Participation of the Caspase-2 and -9 Pathways in Neuronal Death Induced by Nerve Growth Factor Deprivation. <i>The Journal of Neuroscience</i>, 21, 5007–5016.</p> <p>Suzuki, Y., & Farbman, A. I. (2000). Tumor necrosis factor-α-induced apoptosis in olfactory epithelium in vitro: Possible roles of caspase 1 (ICE), caspase 2 (ICH-1), and caspase 3 (CPP32). <i>Experimental Neurology</i>, 165, 35–45.</p> <p>Cowan, C. M., & Roskams, A. J. (2002). Apoptosis in the mature and developing olfactory neuroepithelium. <i>Microscopy Research and Technique</i>, 58, 204–215.</p> <p>Suzuki, Y. (2007). Apoptosis and the insulin-like growth factor family in the developing olfactory epithelium. <i>Anatomical Science International</i>, 82, 200–206.</p> <p>Dash, P. K., Blum, C. A. S., & Moore, A. N. (2000). Caspase activity plays an essential role in long-term memory. <i>Neuroreport</i>, 11, 2811–2816.</p> <p>Pozueta, J., Lefort, R., Ribe, E. M., Troy, C. M., Arancio, O., & Shelanski, M. (2013). Caspase-2 is required for dendritic spine and behavioural alterations in J20 APP transgenic mice. <i>Nature Communications</i>, 4, 1939.</p> <p>Zhao, X., Kotilinek, L. A., Smith, B., Hlynialuk, C., Zaks, K., Ramsden, M., ... Ashe, K. H. (2016). Caspase-2 cleavage of tau reversibly impairs memory. <i>Nature Medicine</i>, 22, 1268–1276.</p>
rap1 GTPase-activating protein 2	No clear association

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
42679	ctg7180001925561_4576_SAC	Distribution-SNP	ssa22	1397901	intron_variant	LOC106582631 c.1241-3111A>C

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype
488543	106582631 22:1069117:1757593	ctg7180001925561_4576_SAC	22.0	1119117.0	1707593.0	LOC106582631	receptor-type tyrosine-protein phosphatase T-I...	protein_coding

	References
receptor-type tyrosine-protein phosphatase T/PTPRT	<p>Zheng, J. J., Li, W. X., Liu, J. Q., Guo, Y. C., Wang, Q., Li, G. H., ... Huang, J. F. (2018). Low expression of aging-related NRXN3 is associated with Alzheimer disease: A systematic review and meta-analysis. <i>Medicine (Baltimore)</i>, 97, e11343.</p> <p>Mattheus, T., Kukla, K., Zimmermann, T., Tenzer, S., & Lutz, B. (2016). Cell Type-Specific Tandem Affinity Purification of the Mouse Hippocampal CB1 Receptor-Associated Proteome. <i>Journal of Proteome Research</i>, 15, 3585–3601.</p> <p>Lim, S. H., Moon, J., Lee, M., & Lee, J. R. (2013). PTPRT regulates the interaction of Syntaxin-binding protein 1 with Syntaxin 1 through dephosphorylation of specific tyrosine residue. <i>Biochemical and Biophysical Research Communications</i>, 439, 40–46.</p> <p>Lee, J. R. (2015). Protein tyrosine phosphatase PTPRT as a regulator of synaptic formation and neuronal development. <i>BMB Reports</i>, 48, 249–255.</p> <p>Thirtamara Rajamani, K., O’Neill, B., Han, D. D., Frosthalm, A., Rotter, A., & Gu, H. H. (2015). Inactivation of the catalytic phosphatase domain of PTPRT/RPTPp increases social interaction in mice. <i>Autism Research</i>, 8, 19–28.</p> <p>Besco, J. A., Hooft van Huijsduijnen, R., Frosthalm, A., & Rotter, A. (2006). Intracellular substrates of brain-enriched receptor protein tyrosine phosphatase rho (RPTPp/PTPRT). <i>Brain Research</i>, 1116, 50–57.</p>

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info
17077	ctg7180001933798_3460_SGT	Distribution-SNP	ssa01	158726051	intergenic_region	trnaa-ugc-LOC106572858 n.158726051G>T

GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	Protein_product
616377	106572858 1:158682988:158802626	ctg7180001933798_3460_SGT	NaN	NaN	NaN	NaN	NaN	NaN	NaN

	References
tRNA-UGC	De Abreu, Diana Andrea Fernandes, Salinas-Giegé, Thalia, Maréchal-Drouard, Laurence, and Remy, Jean-Jacques (2019). Alanine tRNA Translate Environment into Behavior in <i>Caenorhabditis Elegans</i> Available at SSRN: https://ssrn.com/abstract=3310818 or http://dx.doi.org/10.2139/ssrn.3310818
hydroxysteroid dehydrogenase protein 2 (HSDL2)	No clear association, but a few relevant hits: Hales, C. M., Dammer, E. B., Deng, Q., Duong, D. M., Gearing, M., Troncoso, J. C., ... Seyfried, N. T. (2016). Changes in the detergent-insoluble brain proteome linked to amyloid and tau in Alzheimer's Disease progression. <i>Proteomics</i> , 16, 3042–3053. Kousa, Y. A., Mansour, T. A., Seada, H., Matoo, S., & Schutte, B. C. (2017). Shared molecular networks in orofacial and neural tube development. <i>Birth Defects Research</i> , 109, 169–179.

Cigene_id	Criteria	Chrom	Position	Annotation	Loc_info	SNP_info							
47672	ctg7180001721295_376_SCT	Distribution-SNP	ssa28 30107494	intergenic_region	LOC106589868-LOC106589902	n.30107494T>C							
GeneID	Range	SNP_ID	Chr	Gene_start	Gene_end	Gene_symbol	Pep	Biotype	Protein_product	Strand	Len	Row_no	Gid

	References
RNA binding protein fox-1 homolog 1 (RBFox1)	Smith, R. M., & Sadee, W. (2011). Synaptic signaling and aberrant RNA splicing in autism spectrum disorders. <i>Frontiers in Synaptic Neuroscience</i> , 3, 1. Guo, Y., Mo, D., Zhang, Y., Zhang, Y., Cong, P., Xiao, S., ... Chen, Y. (2012). MicroRNAome Comparison between Intramuscular and Subcutaneous Vascular Stem Cell Adipogenesis. <i>PLoS ONE</i> , 7, e45410. Xiong, W., & Zhou, D. (2017). Progress in unraveling the genetic etiology of rolandic epilepsy. <i>Seizure</i> , 47, 99–104. Wamsley, B., Jaglin, X. H., Favuzzi, E., Quattrocchio, G., Nigro, M. J., Yusuf, N., ... Fishell, G. (2018). Rbfox1 Mediates Cell-type-Specific Splicing in Cortical Interneurons. <i>Neuron</i> , 100, 846–859. Fernández-Castillo, N., Gan, G., van Donkelaar, M. M. J., Vaht, M., Weber, H., Retz, W., ... Cormand, B. (2017). RBFox1, encoding a splicing regulator, is a candidate gene for aggressive behavior. <i>European Neuropsychopharmacology</i> , In Press, Corrected Proof. https://doi.org/10.1016/j.euroneuro.2017.11.012
charged multivesicular body protein 6	No clear association