TECHNICAL WHITE PAPER:
COMPLETE LIST OF GENES CHARACTERIZED BY *IN SITU* HYBRIDIZATION IN ADULT HUMAN BRAIN STUDIES

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
A2M	2	alpha-2-macroglobulin	extracellular matrix	Alzheimer's		VEC
AANAT	15	arylalkylamine N-acetyltransferase	metabolic enzyme		protein evolution	
AATF	26574	apoptosis antagonizing transcription factor	transcription factor	other neurodegenerative		
ABAT	18	4-aminobutyrate aminotransferase	metabolic enzyme	epilepsy		interneuron
ABCD1	215	ATP-binding cassette, sub-family D (ALD), member 1	transporter	other neurodegenerative		
ACCN1	40	amiloride-sensitive cation channel 1, neuronal (degenerin)	ion channel	autism		
ACE	1636	angiotensin I converting enzyme (peptidyl-dipeptidase A) 1	metabolic enzyme	Alzheimer's		
ACHE	43	acetylcholinesterase (Yt blood group)	metabolic enzyme	Alzheimer's		

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			Gene Family	Disease	Comparative Genomics	Marker Type
ACTB	60	actin, beta	cytoskeletal protein	intellectual disability		
ACTN2	88	actinin, alpha 2	cytoskeletal protein	schizophrenia		
ADAM23	8745	ADAM metallopeptidase domain 23	extracellular matrix	autism		
ADAMTS8	11095	ADAM metallopeptidase with thrombospondin type 1 motif, 8	extracellular matrix			
ADAMTSL5	339366	ADAMTS-like 5	extracellular matrix			
ADCY1	107	adenylate cyclase 1 (brain)	signal transduction			
ADCY2	108	adenylate cyclase 2 (brain)	signal transduction			
ADCYAP1	116	adenylate cyclase activating polypeptide 1 (pituitary)	peptide ligand	autism	protein evolution	
ADM	133	adrenomedullin	peptide ligand			interneuron or VEC
ADORA1	134	adenosine A1 receptor	GPCR			
ADORA2A	135	adenosine A2a receptor	GPCR	other neurodegenerative		
ADORA3	140	adenosine A3 receptor	GPCR			
ADRA1A	148	adrenergic, alpha-1A-, receptor	GPCR			
ADRA1D	146	adrenergic, alpha-1D-, receptor	GPCR			

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ADRA2A	150	adrenergic, alpha-2A-, receptor	GPCR	depression		layer 6b
ADRA2B	151	adrenergic, alpha-2B-, receptor	GPCR			
ADRB2	154	adrenergic, beta-2-, receptor, surface	GPCR	obesity		
ADRBK1	156	adrenergic, beta, receptor kinase 1	kinase			
ADRBK2	157	adrenergic, beta, receptor kinase 2	kinase	bipolar		
AFAP1	60312	actin filament associated protein 1	cytoskeletal protein			
AGAP1	116987	ArfGAP with GTPase domain, ankyrin repeat and PH domain 1	signal transduction	autism	human accelerated regions	
AGC1	176	aggrecan 1 (chondroitin sulfate proteoglycan 1, large aggregating proteoglycan, antigen identified by monoclonal antibody A0122)	extracellular matrix			
AGRN	375790	agrin	cell adhesion	other neurodegenerative		
AGTR1	185	angiotensin II receptor, type 1	GPCR			
AGTR2	186	angiotensin II receptor, type 2	GPCR	intellectual disability		
AHI1	54806	Abelson helper integration site (Ahi1)	other intracellular	schizophrenia	positive evolution	

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AKR1C2	1646	aldo-keto reductase family 1, member C2 (dihydrodiol dehydrogenase 2; bile acid binding protein; 3-alpha hydroxysteroid dehydrogenase, type III)	metabolic enzyme	obesity		layer 6
AKR1C3	8644	aldo-keto reductase family 1, member C3 (3-alpha hydroxysteroid dehydrogenase, type II)	metabolic enzyme			layer 6
AKT1	207	v-akt murine thymoma viral oncogene homolog 1	kinase	schizophrenia		
ALDH5A1	7915	aldhehyde dehydrogenase family 5, subfamily A1	metabolic enzyme	epilepsy		
ALDOC	230	aldolase C, fructose-bisphosphate	metabolic enzyme			
AMMECR1	9949	Alport syndrome, intellectual disability, midface hypoplasia and elliptocytosis chromosomal region, gene 1	other intracellular	intellectual disability		
AMPH	273	amphiphysin (Stiff-Man syndrome with breast cancer 128kDa autoantigen)	synaptic protein			
ANKHD1	54882	ankyrin repeat and KH domain containing 1	signal transduction	schizophrenia		
ANKRD34B	340120	ankyrin repeat domain 34B	signal transduction			
ANXA1	301	annexin A1	signal transduction			layer 6
APBA1	320	amyloid beta (A4) precursor protein-binding, family A, member 1 (X11)	signal transduction	Alzheimer's		
APBB2	323	amyloid beta (A4) precursor protein-binding, family B, member 2 (Fe65-like)	signal transduction	Alzheimer's		

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			Gene Family	Disease	Comparative Genomics	Marker Type
APLNR	187	apelin receptor	GPCR			
APLP1	333	amyloid beta (A4) precursor-like protein 1	other membrane protein	Alzheimer's		
APLP2	334	amyloid beta (A4) precursor-like protein 2	other membrane protein	Alzheimer's		
APOC1	341	apolipoprotein C-I	transporter	Alzheimer's		
APOL1	8542	apolipoprotein L, 1	transporter	schizophrenia		
APOL2	23780	apolipoprotein L, 2	transporter	schizophrenia		
APOL4	80832	apolipoprotein L, 4	transporter	schizophrenia		
APP	351	amyloid beta (A4) precursor protein (peptidase nexin-II, Alzheimer's disease)	other membrane protein	Alzheimer's		
ARC	23237	activity-regulated cytoskeleton-associated protein	cytoskeletal protein	epilepsy		
ARFGEF2	10564	ADP-ribosylation factor guanine nucleotide-exchange factor 2 (brefeldin A-inhibited)	signal transduction	microcephaly	microcephaly	
ARHGEF10	9639	Rho guanine nucleotide exchange factor (GEF) 10	signal transduction	epilepsy		
ARHGEF6	9459	Rac/Cdc42 guanine nucleotide exchange factor (GEF) 6	signal transduction	intellectual disability		

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ARHGEF9	23229	Cdc42 guanine nucleotide exchange factor (GEF) 9	signal transduction	intellectual disability		
ARL4C	10123	ADP-ribosylation factor-like 4C	signal transduction			
ARNTL2	56938	aryl hydrocarbon receptor nuclear translocator-like 2	transcription factor		Hapmap	
ASL	435	argininosuccinate lyase	metabolic enzyme	autism		
ASPM	259266	asp (abnormal spindle) homolog, microcephaly associated (Drosophila)	cytoskeletal protein	microcephaly	protein evolution; microcephaly	
ATBF1	463	AT-binding transcription factor 1	transcription factor		human accelerated regions	
ATF4	468	activating transcription factor 4 (tax-responsive enhancer element B67)	transcription factor	schizophrenia		
ATF5	22809	activating transcription factor 5	transcription factor	schizophrenia		
ATF7IP	55729	activating transcription factor 7 interacting protein	transcription factor	schizophrenia		
ATP10A	57194	ATPase, class V, type 10A	transporter	autism		
ATP1A2	477	ATPase, Na+/K+ transporting, alpha 2 (+) polypeptide	transporter	epilepsy		astrocyte
ATP1A3	478	ATPase, Na+/K+ transporting, alpha 3 polypeptide	transporter	Parkinson's		

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			Gene Family	Disease	Comparative Genomics	Marker Type
ATP2A2	488	ATPase, Ca++ transporting, cardiac muscle, slow twitch 2	transporter	epilepsy		
ATP2B4	493	ATPase, Ca++ transporting, plasma membrane 4	transporter			layer 2/3/6
ATP6AP2	10159	ATPase, H+ transporting, lysosomal accessory protein 2	transporter	intellectual disability		
ATP8B1	5205	ATPase, Class I, type 8B, member 1	transporter		positive selection	
ATR	545	ataxia telangiectasia and Rad3 related	kinase	microcephaly	microcephaly	
ATRX	546	alpha thalassemia/intellectual disability syndrome X-linked (RAD54 homolog, S. cerevisiae)	other nuclear protein	intellectual disability		
AUTS2	26053	autism susceptibility candidate 2	other intracellular	autism		
AVPR1A	552	arginine vasopressin receptor 1A	GPCR	autism		
AVPR1B	553	arginine vasopressin receptor 1B	GPCR	depression		
AVPR2	554	arginine vasopressin receptor 2 (nephrogenic diabetes insipidus)	GPCR			
B3GALT2	8707	UDP-Gal:betaGlcNAc beta 1,3-galactosyltransferase, polypeptide 2	metabolic enzyme			layer 5/6
BACE2	25825	beta-site APP-cleaving enzyme 2	other membrane protein	Alzheimer's		
BAD	572	BCL2-antagonist of cell death	signal transduction	other neurodegenerative		

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			Gene Family	Disease	Comparative Genomics	Marker Type
BAX	581	BCL2-associated X protein	signal transduction	other neurodegenerative		
BCAN	63827	brevican	extracellular matrix			astrocyte
BCHE	590	butyrylcholinesterase	metabolic enzyme	Alzheimer's		
BCL2	596	B-cell CLL/lymphoma 2	signal transduction	other neurodegenerative		
BCL2L1	598	BCL2-like 1	signal transduction	other neurodegenerative		
BCL6	604	B-cell CLL/lymphoma 6 (zinc finger protein 51)	transcription factor			
BCOR	54880	BCL6 co-repressor	other nuclear protein	intellectual disability		
BDNF	627	brain-derived neurotrophic factor	peptide ligand	schizophrenia		
BEND5	79656	BEN domain containing 5	other intracellular			layer 5
BLMH	642	bleomycin hydrolase	metabolic enzyme	Alzheimer's		
BRCA1	672	breast cancer 1, early onset	transcription factor	microcephaly		
BRD7	29117	bromodomain containing 7	other nuclear protein		positive selection	
BSN	8927	bassoon (presynaptic cytomatrix protein)	synaptic protein	other neurodegenerative		
BTBD11	121551	BTB (POZ) domain containing 11	other membrane protein			interneuron

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BTN2A1	11120	butyrophilin, subfamily 2, member A1	other membrane protein		positive selection	
C11orf87	399947	chromosome 11 open reading frame 87	other membrane protein		positive selection	
C1QL2	165257	complement component 1, q subcomponent-like 2	peptide ligand			layer 2/3
C20orf103	24141	chromosome 20 open reading frame 103	other membrane protein			layer 2/3
C21orf57	54059	Chromosome 21 open reading frame 57	other intracellular		HLS: (IMAGE clone ID) 50904	
C4orf31	79625	chromosome 4 open reading frame 31	extracellular matrix			interneuron/ layer1
C7orf44	55744	chromosome 7 open reading frame 44	other membrane protein		positive selection	
C8orf59	401466	chromosome 8 open reading frame 59	other intracellular		positive selection	
C8orf79	57604	chromosome 8 open reading frame 79	other intracellular			layer 5
CA2	760	carbonic anhydrase II	metabolic enzyme	intellectual disability	microarray expression	oligodendrocyte
CA3	761	carbonic anhydrase 3	metabolic enzyme	autism		
CACNA1B	774	calcium channel, voltage-dependent, L type, alpha 1B subunit	ion channel	pain		
CACNA1C	775	calcium channel, voltage-dependent, L type, alpha 1C subunit	ion channel	autism		
CACNA1D	776	calcium channel, voltage-dependent, L type, alpha 1D subunit	ion channel			
CACNA1E	777	calcium channel, voltage-dependent, alpha 1E subunit	ion channel			layer 2/3/6

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CACNA1F	778	calcium channel, voltage-dependent, alpha 1F subunit	ion channel			
CACNA1G	8913	calcium channel, voltage-dependent, alpha 1G subunit	ion channel			
CACNA1I	8911	calcium channel, voltage-dependent, alpha 1I subunit	ion channel			
CACNA1S	779	calcium channel, voltage-dependent, L type, alpha 1S subunit	ion channel			
CACNA2D1	781	calcium channel, voltage-dependent, alpha 2/delta subunit 1	ion channel			
CACNA2D2	9254	calcium channel, voltage-dependent, alpha 2/delta subunit 2	ion channel			interneuron
CACNA2D3	55799	calcium channel, voltage-dependent, alpha 2/delta 3 subunit	ion channel			
CACNA2D4	93589	calcium channel, voltage-dependent, alpha 2/delta subunit 4	ion channel			
CACNB1	782	calcium channel, voltage-dependent, beta 1 subunit	ion channel	epilepsy		
CACNB3	784	calcium channel, voltage-dependent, beta 3 subunit	ion channel			
CACNB4	785	calcium channel, voltage-dependent, beta 4 subunit	ion channel	epilepsy		
CACNG1	786	calcium channel, voltage-dependent, gamma subunit 1	ion channel			
CACNG2	10369	calcium channel, voltage-dependent, gamma subunit 2	ion channel			
CACNG3	10368	calcium channel, voltage-dependent, gamma subunit 3	ion channel			

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Gene Symbol	EntrezID	Gene Description	Category			
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CACNG4	27092	calcium channel, voltage-dependent, gamma subunit 4	ion channel			
CACNG5	27091	calcium channel, voltage-dependent, gamma subunit 5	ion channel			layer 4c
CACNG6	59285	calcium channel, voltage-dependent, gamma subunit 6	ion channel			
CACNG7	59284	calcium channel, voltage-dependent, gamma subunit 7	ion channel			
CACNG8	59283	calcium channel, voltage-dependent, gamma subunit 8	ion channel			
CADPS2	93664	Ca2+-dependent activator protein for secretion 2	synaptic protein	autism		
CALB1	793	calbindin 1, 28kDa	signal transduction			interneuron/ layer2
CALB2	794	calbindin 2, 29kDa (calretinin)	signal transduction			interneuron
CALY	50632	calcyon neuron-specific vesicular protein	other membrane protein			
CAMK2A	815	calcium/calmodulin-dependent protein kinase (CaM kinase) II alpha	kinase		microarray expression	
CAMK4	814	calcium/calmodulin-dependent protein kinase IV	kinase			
CAMKK2	10645	calcium/calmodulin-dependent protein kinase kinase 2, beta	kinase			
CARTPT	9607	CART prepropeptide	peptide ligand	obesity		layer 2/3
CASP1	834	caspase 1, apoptosis-related cysteine peptidase (interleukin 1, beta, convertase)	metabolic enzyme	other neurodegenerative		

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CASP3	836	caspase 3, apoptosis-related cysteine peptidase	metabolic enzyme	Alzheimer's	protein evolution	
CASP7	840	caspase 7, apoptosis-related cysteine peptidase	metabolic enzyme	other neurodegenerative		
CASP8	841	caspase 8, apoptosis-related cysteine peptidase	metabolic enzyme	other neurodegenerative		
CBLN2	147381	cerebellin 2 precursor	other membrane protein			layer 2/3/6
CC2D1A	54862	coiled-coil and C2 domain containing 1A	transcription factor	intellectual disability		
CCDC141	285025	coiled-coil domain containing 141	cytoskeletal protein	schizophrenia		
CCK	885	cholecystokinin	peptide ligand	anxiety		layer 2/3/5/6
CCKAR	886	cholecystokinin A receptor	GPCR			
CCKBR	887	cholecystokinin B receptor	GPCR			
CDH13	1012	cadherin 13, H-cadherin (heart)	cell adhesion			interneuron/ layer2
CDH24	64403	cadherin-like 24	cell adhesion			layer 6
CDH7	1005	cadherin 7, type 2	cell adhesion			interneuron
CDK5	1020	cyclin-dependent kinase 5	kinase	other neurodegenerative		
CDK5R1	8851	cyclin-dependent kinase 5, regulatory subunit 1 (p35)	signal transduction	other neurodegenerative		
CDK5R2	8941	cyclin-dependent kinase 5, regulatory subunit 2 (p39)	signal transduction	other neurodegenerative		
CDK5RAP1	51654	CDK5 regulatory subunit associated protein 1	signal transduction			

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CDK5RAP2	55755	CDK5 regulatory subunit associated protein 2	signal transduction	microcephaly	microcephaly	
CDK5RAP3	80279	CDK5 regulatory subunit associated protein 3	signal transduction			
CDKL5	6792	cyclin-dependent kinase-like 5	kinase	epilepsy		
CENPJ	55835	centromere protein J	cytoskeletal protein	microcephaly	microcephaly	
CEP290	80184	centrosomal protein 290kDa	other nuclear protein	autism		
CERK	64781	ceramide kinase	kinase			interneuron
CFC1	55997	Cripto, FRL-1, cryptic family 1	signal transduction		HLS: (IMAGE clone ID) 328821	
CFTR	1080	cystic fibrosis transmembrane conductance regulator (ATP-binding cassette sub-family C, member 7)	transporter			
CHEK1	1111	CHK1 checkpoint homolog (S. pombe)	kinase	microcephaly		
CHRM1	1128	cholinergic receptor, muscarinic 1	GPCR	schizophrenia		
CHRM2	1129	cholinergic receptor, muscarinic 2	GPCR	depression		
CHRM3	1131	cholinergic receptor, muscarinic 3	GPCR			
CHRM4	1132	cholinergic receptor, muscarinic 4	GPCR			
CHRM5	1133	cholinergic receptor, muscarinic 5	GPCR		protein evolution	
CHRNA10	57053	cholinergic receptor, nicotinic, alpha 10	ion channel			
CHRNA3	1136	cholinergic receptor, nicotinic, alpha 3	ion channel	Alzheimer's		layer 4c
CHRNA4	1137	cholinergic receptor, nicotinic, alpha 4	ion channel	epilepsy		layer 5/6
CHRNA5	1138	cholinergic receptor, nicotinic, alpha 5	ion channel		protein evolution	

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CHRNA6	8973	cholinergic receptor, nicotinic, alpha 6	ion channel			
CHRNA7	1139	cholinergic receptor, nicotinic, alpha 7	ion channel	schizophrenia		layer 1/2
CHRNA9	55584	cholinergic receptor, nicotinic, alpha 9	ion channel			
CHRNB2	1141	cholinergic receptor, nicotinic, beta 2 (neuronal)	ion channel	epilepsy		
CHRNB3	1142	cholinergic receptor, nicotinic, beta 3	ion channel			
CHRNB4	1143	cholinergic receptor, nicotinic, beta 4	ion channel			
CHRND	1144	cholinergic receptor, nicotinic, delta	ion channel			
CHRNE	1145	cholinergic receptor, nicotinic, epsilon	ion channel			
CHRNG	1146	cholinergic receptor, nicotinic, gamma	ion channel			
CIT	11113	citron (rho-interacting, serine/threonine kinase 21)	kinase	schizophrenia		
CLCA1	1179	chloride channel, calcium activated, family member 1	ion channel		positive selection	
CLCA2	9635	chloride channel, calcium activated, family member 2	ion channel			
CLCA3	9629	chloride channel, calcium activated, family member 3	ion channel			
CLCA4	22802	chloride channel, calcium activated, family member 4	ion channel		positive selection	
CLCN1	1180	chloride channel 1, skeletal muscle (Thomsen disease, autosomal dominant)	ion channel			
CLCN2	1181	chloride channel 2	ion channel	epilepsy		
CLCN3	1182	chloride channel 3	ion channel			
CLCN4	1183	chloride channel 4	ion channel			

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CLCN5	1184	chloride channel 5 (nephrolithiasis 2, X-linked, Dent disease)	ion channel			
CLCN6	1185	chloride channel 6	ion channel			
CLCN7	1186	chloride channel 7	ion channel			
CLCNKA	1187	chloride channel Ka	ion channel			
CLCNKB	1188	chloride channel Kb	ion channel			
CLDN5	7122	claudin 5 (transmembrane protein deleted in velocardiofacial syndrome)	other membrane protein			VEC
CLIC1	1192	chloride intracellular channel 1	ion channel			
CLIC2	1193	chloride intracellular channel 2	ion channel			
CLIC3	9022	chloride intracellular channel 3	ion channel			
CLIC4	25932	chloride intracellular channel 4	ion channel			
CLIC5	53405	chloride intracellular channel 5	ion channel			
CLIC6	54102	chloride intracellular channel 6	ion channel			
CLN8	2055	ceroid-lipofuscinosis, neuronal 8 (epilepsy, progressive with mental retardation)	other membrane protein	epilepsy		
CLNS1A	1207	chloride channel, nucleotide-sensitive, 1A	ion channel			
CLOCK	9575	clock homolog (mouse)	transcription factor	bipolar		
CNGA1	1259	cyclic nucleotide gated channel alpha 1	ion channel			
CNGA2	1260	cyclic nucleotide gated channel alpha 2	ion channel			
CNGA4	1262	cyclic nucleotide gated channel alpha 4	ion channel			

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CNGB3	54714	cyclic nucleotide gated channel beta 3	ion channel			
CNP	1267	2',3'-cyclic nucleotide 3' phosphodiesterase	metabolic enzyme			oligodendrocyte
CNR1	1268	cannabinoid receptor 1 (brain)	GPCR	depression		interneuron/ layer1/2/6
CNTNAP2	26047	contactin associated protein-like 2	cell adhesion	epilepsy	frontal cortex expression	
CNTNAP4	85445	contactin associated protein-like 4	cell adhesion			interneuron+ laminar
COL12A1	1303	collagen, type XII, alpha 1	extracellular matrix			
COL24A1	255631	collagen, type XXIV, alpha 1	extracellular matrix			layer 2/3/5/6
COL5A1	1289	collagen, type V, alpha 1	extracellular matrix			
COL6A1	1291	collagen, type VI, alpha 1	extracellular matrix		microarray expression	layer 3/4/5/6
COL9A3	1299	collagen, type IX, alpha 3	extracellular matrix			interneuron
COMT	1312	catechol-O-methyltransferase	metabolic enzyme	schizophrenia		
CORT	1325	cortistatin	peptide ligand			interneuron
COX6A2	1339	cytochrome c oxidase subunit VIa polypeptide 2	metabolic enzyme			
COX8A	1351	cytochrome c oxidase subunit 8A (ubiquitous)	metabolic enzyme		energy demand	
CPLX3	594855	complexin 3	synaptic protein			interneuron

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CPNE7	27132	copine VII	signal transduction			interneuron/ layer5/6
CPOX	1371	coproporphyrinogen oxidase	metabolic enzyme		positive selection	
CRBN	51185	cereblon	other intracellular	intellectual disability		
CREB1	1385	cAMP responsive element binding protein 1	transcription factor	depression		
CRH	1392	corticotropin releasing hormone	peptide ligand	depression		
CRHBP	1393	corticotropin releasing hormone binding protein	secreted protein			interneuron
CRHR1	1394	corticotropin releasing hormone receptor 1	GPCR	depression		
CRHR2	1395	corticotropin releasing hormone receptor 2	GPCR	depression		
CRYM	1428	crystallin, mu	other intracellular			layer 2/3/5/6
CSMD1	64478	CUB and Sushi multiple domains 1	other membrane protein		CNV	
CSNK1D	1453	casein kinase 1, delta	kinase	other neurodegenerative		
CSPG3	1463	chondroitin sulfate proteoglycan 3 (neurocan)	extracellular matrix		protein evolution	
CSRP1	1465	cysteine and glycine-rich protein 1	other nuclear protein			oligodendrocyte
CST3	1471	cystatin C (amyloid angiopathy and cerebral hemorrhage)	secreted protein	epilepsy		astrocyte
CSTB	1476	cystatin B (stefin B)	other intracellular	epilepsy		
CTGF	1490	connective tissue growth factor	peptide ligand			layer 6b

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CTNNB1	1499	catenin (cadherin-associated protein), beta 1, 88kDa	cell adhesion			
CTNND2	1501	catenin (cadherin-associated protein), delta 2 (neural plakophilin-related arm-repeat protein)	cell adhesion	intellectual disability		
CTSB	1508	cathepsin B	metabolic enzyme	Alzheimer's		
CUX1	1523	cut-like homeobox 1	transcription factor			
CUX2	23316	cut-like homeobox 2	transcription factor	depression	Hapmap	layer 2/3/4
CXCL12	6387	chemokine (C-X-C motif) ligand 12 (stromal cell-derived factor 1)	peptide ligand			
CXCL14	9547	chemokine (C-X-C motif) ligand 14	peptide ligand			interneuron/ layer1
CYP26B1	56603	cytochrome P450, family 26, subfamily B, polypeptide 1	metabolic enzyme			
CYP39A1	51302	cytochrome P450, family 39, subfamily A, polypeptide 1	metabolic enzyme			
CYR61	3491	cysteine-rich, angiogenic inducer, 61	secreted protein			layer 6
DAO	1610	D-amino-acid oxidase	metabolic enzyme	schizophrenia		
DAOA	267012	D-amino acid oxidase activator	other intracellular	schizophrenia		
DBH	1621	dopamine beta-hydroxylase (dopamine beta-monooxygenase)	metabolic enzyme	Parkinson's		
DBN1	1627	drebrin 1	cytoskeletal protein	Alzheimer's		
DCX	1641	doublecortex; lissencephaly, X-linked (doublecortin)	cytoskeletal protein	intellectual disability		
DDC	1644	dopa decarboxylase	metabolic enzyme	Parkinson's		

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DDIT4L	115265	DNA-damage-inducible transcript 4-like	signal transduction			
DDT	1652	D-dopachrome tautomerase	metabolic enzyme			
DDX11	1663	DEAD/H (Asp-Glu-Ala-Asp/His) box polypeptide 11 (CHL1-like helicase homolog, S. cerevisiae)	other nuclear protein		HLS: (IMAGE clone ID) 470930	
DECR1	1666	2,4-dienoyl CoA reductase 1, mitochondrial	metabolic enzyme			
DEPDC6	64798	DEP domain containing 6	signal transduction			
DFNB31	25861	deafness, autosomal recessive 31	cytoskeletal protein	deafness		
DHCR7	1717	7-dehydrocholesterol reductase	metabolic enzyme	autism		
DHX9	1660	DEAH (Asp-Glu-Ala-His) box polypeptide 9	other nuclear protein		positive selection	
DISC1	27185	disrupted in schizophrenia 1	signal transduction	schizophrenia		layer 1
DKC1	1736	dyskeratosis congenita 1, dyskerin	other nuclear protein	microcephaly		
DKK3	27122	dickkopf homolog 3 (Xenopus laevis)	secreted protein			
DLEC1	9940	deleted in lung and esophageal cancer 1	other intracellular		positive selection	
DLG1	1739	discs, large homolog 1 (Drosophila)	synaptic protein			
DLG2	1740	discs, large homolog 2, chapsyn-110 (Drosophila)	synaptic protein			
DLG3	1741	discs, large homolog 3 (neuroendocrine-dlg, Drosophila)	synaptic protein	intellectual disability		

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
DLG4	1742	discs, large homolog 4 (Drosophila)	synaptic protein			
DLG5	9231	discs, large homolog 5 (Drosophila)	synaptic protein			
DLGAP1	9229	discs, large (Drosophila) homolog-associated protein 1	synaptic protein			
DLGAP2	9228	discs, large (Drosophila) homolog-associated protein 2	synaptic protein			
DLX1	1745	distal-less homeobox 1	transcription factor	autism		interneuron
DLX5	1749	distal-less homeobox 5	transcription factor	autism		
DPP6	1804	dipeptidyl-peptidase 6	other membrane protein		protein evolution	
DRD1	1812	dopamine receptor D1	GPCR	schizophrenia		
DRD3	1814	dopamine receptor D3	GPCR	schizophrenia		
DRD5	1816	dopamine receptor D5	GPCR	schizophrenia		
DSG1	1828	desmoglein 1	cell adhesion		positive selection	
DTNA	1837	dystrobrevin, alpha	synaptic protein			
DTNBP1	84062	dystrobrevin binding protein 1	synaptic protein	schizophrenia		
DVL1	1855	dishevelled, dsh homolog 1 (Drosophila)	signal transduction	autism	protein evolution	
DYM	54808	dymeclin	other intracellular	microcephaly		
DYNC1I2	1781	Dynein, cytoplasmic 1, intermediate chain 2	cytoskeletal protein		HLS: (IMAGE clone ID) 809714	
DYX1C1	161582	dyslexia susceptibility 1 candidate 1	other nuclear protein			
ECE2	9718	endothelin converting enzyme 2	metabolic enzyme			interneuron

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
EDNRA	1909	endothelin receptor type A	GPCR			
EDNRB	1910	endothelin receptor type B	GPCR	deafness		
EN2	2020	engrailed homeobox 2	transcription factor	autism		
ENC1	8507	ectodermal-neural cortex (with BTB-like domain)	cytoskeletal protein			layer 2/3/5/6
ENDOD1	23052	endonuclease domain containing 1	secreted protein			
EPHA6	285220	EPH receptor A6	kinase			layer 2
ERBB3	2065	v-erb-b2 erythroblastic leukemia viral oncogene homolog 3 (avian)	kinase	schizophrenia		
ERBB4	2066	v-erb-a erythroblastic leukemia viral oncogene homolog 4 (avian)	kinase	schizophrenia		interneuron
ERCC2	2068	excision repair cross-complementing rodent repair deficiency, complementation group 2 (xeroderma pigmentosum D)	other nuclear protein	microcephaly		
ERCC3	2071	excision repair cross-complementing rodent repair deficiency, complementation group 3 (xeroderma pigmentosum group B complementing)	other nuclear protein	microcephaly		
ERCC5	2073	excision repair cross-complementing rodent repair deficiency, complementation group 5 (xeroderma pigmentosum, complementation group G (Cockayne syndrome))	other nuclear protein	microcephaly		
ESCO2	157570	establishment of cohesion 1 homolog 2 (S. cerevisiae)	other nuclear protein	microcephaly		
ESR1	2099	estrogen receptor 1	transcription factor	Alzheimer's		
ESR2	2100	estrogen receptor 2 (ER beta)	transcription factor			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
ETV1	2115	ets variant gene 1	transcription factor			layer 5
EXT1	2131	exostoses (multiple) 1	metabolic enzyme	autism		
EYA4	2070	eyes absent homolog 4 (Drosophila)	other nuclear protein	deafness	hearing	interneuron
FABP7	2173	fatty acid binding protein 7	other intracellular			
FAM111A	63901	family with sequence similarity 111, member A	other intracellular		positive selection	
FAM111B	374393	family with sequence similarity 111, member B	other intracellular		positive selection	
FAM20A	54757	family with sequence similarity 20, member A	secreted protein			
FAM3C	10447	family with sequence similarity 3, member C	secreted protein			layer 5
FAM46A	55603	family with sequence similarity 46, member A				interneuron
FEZ1	9638	fasciculation and elongation protein zeta 1 (zygin I)	signal transduction	schizophrenia		
FGD1	2245	FYVE, RhoGEF and PH domain containing 1 (faciogenital dysplasia)	signal transduction	intellectual disability		
FGF1	2246	fibroblast growth factor 1 (acidic)	peptide ligand			
FGF14	2259	fibroblast growth factor 14	peptide ligand	other neurodegenerative		
FGF2	2247	fibroblast growth factor 2 (basic)	peptide ligand	other neurodegenerative		
FGF9	2254	fibroblast growth factor 9 (glia-activating factor)	peptide ligand			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
FGFR1	2260	fibroblast growth factor receptor 1 (fms-related tyrosine kinase 2, Pfeiffer syndrome)	kinase	intellectual disability		
FGFR2	2263	fibroblast growth factor receptor 2 (bacteria-expressed kinase, keratinocyte growth factor receptor, craniofacial dysostosis 1, Crouzon syndrome, Pfeiffer syndrome, Jackson-Weiss syndrome)	kinase			
FMR1	2332	fragile X intellectual disability 1	other intracellular	intellectual disability		
FOXP2	93986	forkhead box P2	transcription factor	autism	positive evolution	layer 6
FRA10AC1	118924	chromosome 10 open reading frame 4	other nuclear protein		positive selection	
FST	10468	follistatin	secreted protein			
FTSJ1	24140	FtsJ homolog 1 (E. coli)	other nuclear protein	intellectual disability		
FXYD6	53826	FXYD domain containing ion transport regulator 6	other membrane protein			layer 2/3/5/6
FYN	2534	Fyn proto-oncogene	kinase			
GABARAP	11337	GABA(A) receptor-associated protein	synaptic protein			
GABARAPL1	23710	GABA(A) receptor-associated protein like 1	synaptic protein			
GABARAPL2	11345	GABA(A) receptor-associated protein-like 2	synaptic protein			
GABBR1	2550	gamma-aminobutyric acid (GABA) B receptor, 1	GPCR	epilepsy		

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
GABBR2	9568	gamma-aminobutyric acid (GABA) B receptor, 2	GPCR	epilepsy		
GABRA1	2554	gamma-aminobutyric acid (GABA) A receptor, alpha 1	ion channel	epilepsy		
GABRA2	2555	gamma-aminobutyric acid (GABA) A receptor, alpha 2	ion channel	autism		
GABRA3	2556	gamma-aminobutyric acid (GABA) A receptor, alpha 3	ion channel			
GABRA4	2557	gamma-aminobutyric acid (GABA) A receptor, alpha 4	ion channel	autism		
GABRA5	2558	gamma-aminobutyric acid (GABA) A receptor, alpha 5	ion channel	autism		layer 5/6
GABRA6	2559	gamma-aminobutyric acid (GABA) A receptor, alpha 6	ion channel	schizophrenia		
GABRB1	2560	gamma-aminobutyric acid (GABA) A receptor, beta 1	ion channel	autism		
GABRB2	2561	gamma-aminobutyric acid (GABA) A receptor, beta 2	ion channel	schizophrenia		
GABRB3	2562	gamma-aminobutyric acid (GABA) A receptor, beta 3	ion channel	epilepsy		
GABRD	2563	gamma-aminobutyric acid (GABA) A receptor, delta	ion channel			
GABRE	2564	gamma-aminobutyric acid (GABA) A receptor, epsilon	ion channel	epilepsy		
GABRG1	2565	gamma-aminobutyric acid (GABA) A receptor, gamma 1	ion channel	autism		
GABRG2	2566	gamma-aminobutyric acid (GABA) A receptor, gamma 2	ion channel	epilepsy		

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
GABRG3	2567	gamma-aminobutyric acid (GABA) A receptor, gamma 3	ion channel	autism		
GABRP	2568	gamma-aminobutyric acid (GABA) A receptor, pi	ion channel			
GABRQ	55879	gamma-aminobutyric acid (GABA) receptor, theta	ion channel			
GABRR1	2569	gamma-aminobutyric acid (GABA) receptor, rho 1	ion channel			
GABRR2	2570	gamma-aminobutyric acid (GABA) receptor, rho 2	ion channel			
GABRR3	200959	gamma-aminobutyric acid (GABA) receptor, rho 3	ion channel			
GAD1	2571	glutamate decarboxylase 1 (brain, 67kDa)	metabolic enzyme	schizophrenia		interneuron
GAD2	2572	glutamate decarboxylase 2 (pancreatic islets and brain, 65kDa)	metabolic enzyme	depression		interneuron
GALR2	8811	galanin receptor 2	GPCR			
GAP43	2596	growth associated protein 43	synaptic protein	epilepsy		
GDI1	2664	GDP dissociation inhibitor 1	signal transduction	intellectual disability	protein evolution	
GFAP	2670	glial fibrillary acidic protein	cytoskeletal protein	other neurodegenerative		astrocyte
GIPR	2696	gastric inhibitory polypeptide receptor	GPCR			
GJA1	2697	gap junction protein, alpha 1, 43kDa (connexin 43)	other membrane protein	microcephaly		astrocyte
GLO1	2739	glyoxalase 1	metabolic enzyme	autism	CNV	

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
GLRA1	2741	glycine receptor, alpha 1 (startle disease/hyperekplexia, stiff man syndrome)	ion channel			
GLRA2	2742	glycine receptor, alpha 2	ion channel	autism		
GLRA3	8001	glycine receptor, alpha 3	ion channel	autism		layer 2
GLRB	2743	glycine receptor, beta	ion channel	autism		
GLUD2	2747	glutamate dehydrogenase 2	metabolic enzyme		brain evolution	
GM2A	2760	GM2 ganglioside activator	metabolic enzyme		microarray expression	
GMPR	2766	guanosine monophosphate reductase	metabolic enzyme			
GNB4	59345	guanine nucleotide binding protein (G protein), beta polypeptide 4	signal transduction			
GNG7	2788	guanine nucleotide binding protein (G protein), gamma 7	signal transduction			
GNRHR	2798	gonadotropin-releasing hormone receptor	GPCR			
GOSR1	9527	golgi SNAP receptor complex member 1	synaptic protein		microarray expression	
GPHN	10243	gephyrin	synaptic protein			
GPR101	83550	G protein-coupled receptor 101	GPCR			
GPR116	221395	G protein-coupled receptor 116	GPCR		HLS: (IMAGE clone ID)307337	
GPR12	2835	G protein-coupled receptor 12	GPCR			
GPR156	165829	G protein-coupled receptor 156	GPCR			
GPR161	23432	G protein-coupled receptor 161	GPCR			
GPR173	54328	G protein-coupled receptor 173	GPCR			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
GPR176	11245	G protein-coupled receptor 176	GPCR			
GPR19	2842	G protein-coupled receptor 19	GPCR			
GPR22	2845	G protein-coupled receptor 22	GPCR			
GPR3	2827	G protein-coupled receptor 3	GPCR			
GPR37	2861	G protein-coupled receptor 37 (endothelin receptor type B-like)	GPCR			
GPR50	9248	G protein-coupled receptor 50	GPCR	depression		
GPR56	9289	G protein-coupled receptor 56	GPCR			
GPR6	2830	G protein-coupled receptor 6	GPCR			
GPR78	27201	G protein-coupled receptor 78	GPCR			
GPR83	10888	G protein-coupled receptor 83	GPCR			
GPR85	54329	G protein-coupled receptor 85	GPCR			
GPR88	54112	G protein-coupled receptor 88	GPCR			
GPR98	84059	G protein-coupled receptor 98	GPCR	epilepsy		
GPRIN3	285513	GPRIN family member 3	signal transduction			
GRB2	2885	growth factor receptor-bound protein 2	signal transduction	other neurodegenerative	HLS: (IMAGE clone ID)384872	
GRIA1	2890	glutamate receptor, ionotropic, AMPA 1	ion channel	epilepsy		
GRIA2	2891	glutamate receptor, ionotropic, AMPA 2	ion channel	epilepsy		
GRIA3	2892	glutamate receptor, ionotrophic, AMPA 3	ion channel	epilepsy		
GRIA4	2893	glutamate receptor, ionotrophic, AMPA 4	ion channel			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
GRID1	2894	glutamate receptor, ionotropic, delta 1	ion channel			
GRID2	2895	glutamate receptor, ionotropic, delta 2	ion channel			
GRIK1	2897	glutamate receptor, ionotropic, kainate 1	ion channel	epilepsy		interneuron
GRIK2	2898	glutamate receptor, ionotropic, kainate 2	ion channel	intellectual disability		
GRIK3	2899	glutamate receptor, ionotropic, kainate 3	ion channel			
GRIK4	2900	glutamate receptor, ionotropic, kainate 4	ion channel		protein evolution	layer 4c/6
GRIK5	2901	glutamate receptor, ionotropic, kainate 5	ion channel			
GRIN1	2902	glutamate receptor, ionotropic, N-methyl D-aspartate 1	ion channel	schizophrenia		
GRIN2A	2903	glutamate receptor, ionotropic, N-methyl D-aspartate 2A	ion channel	schizophrenia	protein evolution	
GRIN2B	2904	glutamate receptor, ionotropic, N-methyl D-aspartate 2B	ion channel	schizophrenia		
GRIN2C	2905	glutamate receptor, ionotropic, N-methyl D-aspartate 2C	ion channel			
GRIN2D	2906	glutamate receptor, ionotropic, N-methyl D-aspartate 2D	ion channel			
GRIN3A	116443	glutamate receptor, ionotropic, N-methyl-D-aspartate 3A	ion channel			interneuron/ layer5/6
GRIN3B	116444	glutamate receptor, ionotropic, N-methyl-D-aspartate 3B	ion channel			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
GRINA	2907	glutamate receptor, ionotropic, N-methyl D-asparate-associated protein 1 (glutamate binding)	ion channel			
GRINL1A	81488	glutamate receptor, ionotropic, N-methyl D-aspartate-like 1A	other nuclear protein			
GRIP1	23426	glutamate receptor interacting protein 1	synaptic protein			
GRIP2	80852	glutamate receptor interacting protein 2	synaptic protein			
GRM1	2911	glutamate receptor, metabotropic 1	GPCR	epilepsy		
GRM2	2912	glutamate receptor, metabotropic 2	GPCR	schizophrenia		
GRM3	2913	glutamate receptor, metabotropic 3	GPCR	schizophrenia		
GRM4	2914	glutamate receptor, metabotropic 4	GPCR	epilepsy		
GRM6	2916	glutamate receptor, metabotropic 6 (GluR6)	GPCR			
GRM7	2917	glutamate receptor, metabotropic 7	GPCR	schizophrenia		
GRM8	2918	glutamate receptor, metabotropic 8	GPCR	autism		
GRPR	2925	gastrin releasing peptide receptor	GPCR	autism		
GSG1L	146395	GSG1-like	other membrane protein			layer 2/3
GSK3B	2932	glycogen synthase kinase 3 beta	kinase	Alzheimer's		
GSN	2934	gelsolin (amyloidosis, Finnish type)	cytoskeletal protein			oligodendrocyte
GTF2H2C	728340	general transcription factor IIH, polypeptide 2C	transcription factor		HLS: (IMAGE clone ID) 712622	

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
GTF2I	2969	general transcription factor II, i	transcription factor		microarray expression	
GXYLT2	727936	glucoside xylosyltransferase 2	extracellular matrix			
HAPLN1	1404	hyaluronan and proteoglycan link protein 1	extracellular matrix			
HBD	3045	hemoglobin, delta	other intracellular			VEC
HCN1	348980	hyperpolarization activated cyclic nucleotide-gated potassium channel 1	ion channel			
HCN2	610	hyperpolarization activated cyclic nucleotide-gated potassium channel 2	ion channel			
HCN3	57657	hyperpolarization activated cyclic nucleotide-gated potassium channel 3	ion channel			
HCN4	10021	hyperpolarization activated cyclic nucleotide-gated potassium channel 4	ion channel			
HCRTR1	3061	hypocretin (orexin) receptor 1	GPCR			
HCRTR2	3062	hypocretin (orexin) receptor 2	GPCR			
HOMER1	9456	homer homolog 1 (Drosophila)	synaptic protein	schizophrenia	microarray expression	
HPSE	10855	heparanase	extracellular matrix			interneuron
HRH1	3269	histamine receptor H1	GPCR			
HRH4	59340	histamine receptor H4	GPCR			
HSD11B1	3290	hydroxysteroid (11-beta) dehydrogenase 1	metabolic enzyme			
HSPG2	3339	heparan sulfate proteoglycan 2 (perlecan)	extracellular matrix			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
HTR1A	3350	5-hydroxytryptamine (serotonin) receptor 1A	GPCR	depression		
HTR1B	3351	5-hydroxytryptamine (serotonin) receptor 1B	GPCR	depression		
HTR1D	3352	5-hydroxytryptamine (serotonin) receptor 1D	GPCR	depression		
HTR1E	3354	5-hydroxytryptamine (serotonin) receptor 1E	GPCR			
HTR1F	3355	5-hydroxytryptamine (serotonin) receptor 1F	GPCR			
HTR2A	3356	5-hydroxytryptamine (serotonin) receptor 2A	GPCR	schizophrenia		
HTR2B	3357	5-hydroxytryptamine (serotonin) receptor 2B	GPCR			
HTR2C	3358	5-hydroxytryptamine (serotonin) receptor 2C	GPCR	schizophrenia		layer 5
HTR3A	3359	5-hydroxytryptamine (serotonin) receptor 3A	ion channel	depression		
HTR4	3360	5-hydroxytryptamine (serotonin) receptor 4	GPCR			
HTR5A	3361	5-hydroxytryptamine (serotonin) receptor 5A	GPCR	depression		
HTR6	3362	5-hydroxytryptamine (serotonin) receptor 6	GPCR	schizophrenia		
HTR7	3363	5-hydroxytryptamine (serotonin) receptor 7 (adenylate cyclase-coupled)	GPCR	autism		
HTRA2	27429	HtrA serine peptidase 2	metabolic enzyme	Parkinson’s		
ID2	3398	inhibitor of DNA binding 2	transcription factor			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
IGBP1	3476	immunoglobulin (CD79A) binding protein 1	signal transduction	intellectual disability		
IGF1	3479	insulin-like growth factor 1 (somatomedin C)	peptide ligand	intellectual disability		
IGFBP4	3487	insulin-like growth factor binding protein 4	secreted protein			
IGFN1	91156	immunoglobulin-like and fibronectin type III domain containing 1	cell adhesion			
IGSF11	152404	immunoglobulin superfamily, member 11	cell adhesion			layer 2/3
IGSF21	84966	immunoglobin superfamily, member 21	secreted protein			
IL1B	3553	interleukin 1, beta	peptide ligand	Alzheimer's		
IL1RAPL1	11141	interleukin 1 receptor accessory protein-like 1	other membrane protein	intellectual disability		
INPP1	3628	inositol polyphosphate-1-phosphatase	signal transduction	autism		
INPP4B	8821	inositol polyphosphate-4-phosphatase, type II, 105kDa	signal transduction			
INSR	3643	insulin receptor	kinase	other neurodegenerative		
ITGA5	3678	integrin, alpha 5 (fibronectin receptor, alpha polypeptide)	cell adhesion			
ITPR2	3709	inositol 1,4,5-triphosphate receptor, type 2	ion channel			
ITSN1	6453	intersectin 1 (SH3 domain protein)	signal transduction	schizophrenia		
JRK	8629	jerky homolog (mouse)	other nuclear protein	epilepsy		

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
KCNA1	3736	potassium voltage-gated channel, shaker-related subfamily, member 1 (episodic ataxia with myokymia)	ion channel	epilepsy		layer 3/5/6
KCNA10	3744	potassium voltage-gated channel, shaker-related subfamily, member 10	ion channel			
KCNA2	3737	potassium voltage-gated channel, shaker-related subfamily, member 2	ion channel			
KCNA3	3738	potassium voltage-gated channel, shaker-related subfamily, member 3	ion channel			
KCNA4	3739	potassium voltage-gated channel, shaker-related subfamily, member 4	ion channel			
KCNA5	3741	potassium voltage-gated channel, shaker-related subfamily, member 5	ion channel			
KCNA6	3742	potassium voltage-gated channel, shaker-related subfamily, member 6	ion channel			
KCNA7	3743	potassium voltage-gated channel, shaker-related subfamily, member 7	ion channel			
KCNAB1	7881	potassium voltage-gated channel, shaker-related subfamily, beta member 1	ion channel			interneuron
KCNAB2	8514	potassium voltage-gated channel, shaker-related subfamily, beta member 2	ion channel			
KCNAB3	9196	potassium voltage-gated channel, shaker-related subfamily, beta member 3	ion channel			
KCNB1	3745	potassium voltage-gated channel, Shab-related subfamily, member 1	ion channel			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
KCNB2	9312	potassium voltage-gated channel, Shab-related subfamily, member 2	ion channel			
KCNC1	3746	potassium voltage-gated channel, Shaw-related subfamily, member 1	ion channel			
KCNC2	3747	potassium voltage-gated channel, Shaw-related subfamily, member 2	ion channel			interneuron
KCNC3	3748	potassium voltage-gated channel, Shaw-related subfamily, member 3	ion channel			
KCNC4	3749	potassium voltage-gated channel, Shaw-related subfamily, member 4	ion channel			
KCND1	3750	potassium voltage-gated channel, Shal-related subfamily, member 1	ion channel			
KCND2	3751	potassium voltage-gated channel, Shal-related subfamily, member 2	ion channel			
KCND3	3752	potassium voltage-gated channel, Shal-related subfamily, member 3	ion channel			
KCNE1	3753	potassium voltage-gated channel, Isk-related family, member 1	ion channel			
KCNE2	9992	potassium voltage-gated channel, Isk-related family, member 2	ion channel			
KCNE3	10008	potassium voltage-gated channel, Isk-related family, member 3	ion channel			
KCNE4	23704	potassium voltage-gated channel, Isk-related family, member 4	ion channel			
KCNF1	3754	potassium voltage-gated channel, subfamily F, member 1	ion channel			
KCNG3	170850	potassium voltage-gated channel, subfamily G, member 3	ion channel			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
KCNG4	93107	potassium voltage-gated channel, subfamily G, member 4	ion channel			
KCNH1	3756	potassium voltage-gated channel, subfamily H (eag-related), member 1	ion channel			
KCNH2	3757	potassium voltage-gated channel, subfamily H (eag-related), member 2	ion channel			
KCNH3	23416	potassium voltage-gated channel, subfamily H (eag-related), member 3	ion channel			
KCNH4	23415	potassium voltage-gated channel, subfamily H (eag-related), member 4	ion channel			layer 2/3/6
KCNH5	27133	potassium voltage-gated channel, subfamily H (eag-related), member 5	ion channel			
KCNH6	81033	potassium voltage-gated channel, subfamily H (eag-related), member 6	ion channel	epilepsy		
KCNH7	90134	potassium voltage-gated channel, subfamily H (eag-related), member 7	ion channel			
KCNH8	131096	potassium voltage-gated channel, subfamily H (eag-related), member 8	ion channel			
KCNIP1	30820	Kv channel interacting protein 1	signal transduction			interneuron
KCNIP2	30819	Kv channel interacting protein 2	signal transduction			interneuron/ layer2/3
KCNIP3	30818	Kv channel interacting protein 3, calsenilin	signal transduction	Alzheimer's		
KCNJ1	3758	potassium inwardly-rectifying channel, subfamily J, member 1	ion channel			
KCNJ10	3766	potassium inwardly-rectifying channel, subfamily J, member 10	ion channel	epilepsy		

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
KCNJ11	3767	potassium inwardly-rectifying channel, subfamily J, member 11	ion channel			
KCNJ12	3768	potassium inwardly-rectifying channel, subfamily J, member 12	ion channel			
KCNJ13	3769	potassium inwardly-rectifying channel, subfamily J, member 13	ion channel			
KCNJ14	3770	potassium inwardly-rectifying channel, subfamily J, member 14	ion channel			
KCNJ15	3772	potassium inwardly-rectifying channel, subfamily J, member 15	ion channel			
KCNJ16	3773	potassium inwardly-rectifying channel, subfamily J, member 16	ion channel			
KCNJ2	3759	potassium inwardly-rectifying channel, subfamily J, member 2	ion channel			
KCNJ3	3760	potassium inwardly-rectifying channel, subfamily J, member 3	ion channel	epilepsy		
KCNJ4	3761	potassium inwardly-rectifying channel, subfamily J, member 4	ion channel			
KCNJ5	3762	potassium inwardly-rectifying channel, subfamily J, member 5	ion channel			
KCNJ6	3763	potassium inwardly-rectifying channel, subfamily J, member 6	ion channel	epilepsy		
KCNJ8	3764	potassium inwardly-rectifying channel, subfamily J, member 8	ion channel			
KCNK1	3775	potassium channel, subfamily K, member 1	ion channel			
KCNK10	54207	potassium channel, subfamily K, member 10	ion channel			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
KCNK13	56659	potassium channel, subfamily K, member 13	ion channel			
KCNK15	60598	potassium channel, subfamily K, member 15	ion channel			
KCNK16	83795	potassium channel, subfamily K, member 16	ion channel			
KCNK17	89822	potassium channel, subfamily K, member 17	ion channel			
KCNK18	338567	potassium channel, subfamily K, member 18	ion channel			
KCNK2	3776	potassium channel, subfamily K, member 2	ion channel			layer 5/6
KCNK3	3777	potassium channel, subfamily K, member 3	ion channel			
KCNK4	50801	potassium channel, subfamily K, member 4	ion channel			
KCNK5	8645	potassium channel, subfamily K, member 5	ion channel			
KCNK6	9424	potassium channel, subfamily K, member 6	ion channel			
KCNK7	10089	potassium channel, subfamily K, member 7	ion channel			
KCNK9	51305	potassium channel, subfamily K, member 9	ion channel	epilepsy		
KCNMB1	3779	potassium large conductance calcium-activated channel, subfamily M, beta member 1	ion channel			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
KCNMB2	10242	potassium large conductance calcium-activated channel, subfamily M, beta member 2	ion channel			
KCNMB3	27094	potassium large conductance calcium-activated channel, subfamily M beta member 3	ion channel			
KCNMB4	27345	potassium large conductance calcium-activated channel, subfamily M, beta member 4	ion channel			
KCNN1	3780	potassium intermediate/small conductance calcium-activated channel, subfamily N, member 1	ion channel			
KCNN2	3781	potassium intermediate/small conductance calcium-activated channel, subfamily N, member 2	ion channel			
KCNN3	3782	potassium intermediate/small conductance calcium-activated channel, subfamily N, member 3	ion channel	schizophrenia		
KCNN4	3783	potassium intermediate/small conductance calcium-activated channel, subfamily N, member 4	ion channel			
KCNQ1	3784	potassium voltage-gated channel, KQT-like subfamily, member 1	ion channel			
KCNQ2	3785	potassium voltage-gated channel, KQT-like subfamily, member 2	ion channel	epilepsy		
KCNQ3	3786	potassium voltage-gated channel, KQT-like subfamily, member 3	ion channel	epilepsy		
KCNQ4	9132	potassium voltage-gated channel, KQT-like subfamily, member 4	ion channel			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
KCNQ5	56479	potassium voltage-gated channel, KQT-like subfamily, member 5	ion channel			
KCNS2	3788	potassium voltage-gated channel, delayed-rectifier, subfamily S, member 2	ion channel			
KCNS3	3790	potassium voltage-gated channel, delayed-rectifier, subfamily S, member 3	ion channel			interneuron
KCNT1	57582	potassium channel, subfamily T, member 1	ion channel			
KCNT2	343450	potassium channel, subfamily T, member 2	ion channel			
KCNV1	27012	potassium channel, subfamily V, member 1	ion channel	epilepsy		
KCNV2	169522	potassium channel, subfamily V, member 2	ion channel			
KCTD12	115207	potassium channel tetramerisation domain containing 12	signal transduction			interneuron
KCTD4	386618	potassium channel tetramerisation domain containing 4	signal transduction			
KIAA1024	23251	KIAA1024 protein	other membrane protein			
KIAA1199	57214	KIAA1199	other intracellular			interneuron
KIAA1279	26128	KIAA1279	cytoskeletal protein	microcephaly		
KIAA1370	56204	KIAA1370	other intracellular			
KIT	3815	v-kit Hardy-Zuckerman 4 feline sarcoma viral oncogene homolog	kinase			interneuron

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
KLK6	5653	kallikrein-related peptidase 6	metabolic enzyme	Alzheimer's		
KRT80	144501	keratin 80	cytoskeletal protein			
KRT9	3857	keratin 9 (epidermolytic palmoplantar keratoderma)	cytoskeletal protein			
L1CAM	3897	L1 cell adhesion molecule	cell adhesion	intellectual disability		
LARGE	9215	like-glycosyltransferase	metabolic enzyme	intellectual disability	Hapmap	
LAYN	143903	layilin	other membrane protein			
LDLR	3949	low density lipoprotein receptor (familial hypercholesterolemia)	other membrane protein			
LEPR	3953	leptin receptor	other membrane protein	obesity		
LGALS1	3956	lectin, galactoside-binding, soluble, 1 (galectin 1)	extracellular matrix			layer 3/5
LGI1	9211	leucine-rich, glioma inactivated 1	secreted protein	epilepsy		
LGI2	55203	leucine-rich repeat LGI family, member 2	secreted protein			interneuron
LGI3	203190	leucine-rich repeat LGI family, member 3	secreted protein	epilepsy		
LGR4	55366	leucine-rich repeat-containing G protein-coupled receptor 4	GPCR			
LGR5	8549	leucine-rich repeat-containing G protein-coupled receptor 5	GPCR			
LGR6	59352	leucine-rich repeat-containing G protein-coupled receptor 6	GPCR			
LHX1	3975	LIM homeobox 1	transcription factor		protein evolution	

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
LHX6	26468	LIM homeobox 6	transcription factor			interneuron
LIG4	3981	ligase IV, DNA, ATP-dependent	other nuclear protein	microcephaly		
LOC645166	645166	Similar to lymphocyte-specific protein 1 isoform 1			HLS: (IMAGE clone ID) 1592675	
LOC727820	727820	Hypothetical protein LOC727820			HLS: (IMAGE clone ID) 109123	
LOC727983	727983	Similar to Nuclear envelope pore membrane protein POM 121 (Pore membrane protein of 121 kDa)			HLS: (IMAGE clone ID) 234376	
LOC728377	728377	Similar to rho guanine nucleotide exchange factor 5	other intracellular		HLS: (IMAGE clone ID) 451095	
LRP1	4035	low density lipoprotein-related protein 1 (alpha-2-macroglobulin receptor)	other membrane protein	Alzheimer's		
LRP2	4036	low density lipoprotein-related protein 2	other membrane protein			
LRP8	7804	low density lipoprotein receptor-related protein 8, apolipoprotein e receptor	other membrane protein	autism		
LRRC1	55227	leucine rich repeat containing 1	signal transduction			
LRRC15	131578	leucine rich repeat containing 15	cell adhesion	Alzheimer's		
LRRK2	120892	leucine-rich repeat kinase 2	kinase	Parkinson's		
LRRN3	54674	leucine rich repeat protein 3, neuronal	cell adhesion	autism		
LSAMP	4045	limbic system-associated membrane protein	cell adhesion			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
LXN	56925	latexin	other intracellular			
LYNX1	66004	Ly6/neurotoxin 1	secreted protein		protein evolution	
LYPD1	116372	LY6/PLAUR domain containing 1	secreted protein			interneuron
LYPD6	130574	LY6/PLAUR domain containing 6	secreted protein			
MAD1L1	8379	MAD1 mitotic arrest deficient-like 1 (yeast)	other nuclear protein		human accelerated regions	
MAFB	9935	v-maf musculoaponeurotic fibrosarcoma oncogene homolog B (avian)	transcription factor			interneuron
MAOA	4128	monoamine oxidase A	metabolic enzyme	depression		
MAOB	4129	monoamine oxidase B	metabolic enzyme	other neurodegenerative	Hapmap	
MAP1A	4130	microtubule-associated protein 1A	cytoskeletal protein	schizophrenia		
MAPK1	5594	mitogen-activated protein kinase 1	kinase	other neurodegenerative		
MAPK10	5602	mitogen-activated protein kinase 10	kinase	epilepsy		
MAPT	4137	microtubule-associated protein tau	cytoskeletal protein	Alzheimer's		
MARCKSL1	65108	MARCKS-like 1	signal transduction			
MBP	4155	myelin basic protein	other intracellular	other neurodegenerative		oligodendrocyte
MC1R	4157	melanocortin 1 receptor (alpha melanocyte stimulating hormone receptor)	GPCR			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
MC2R	4158	melanocortin 2 receptor (adrenocorticotropic hormone)	GPCR			
MC3R	4159	melanocortin 3 receptor	GPCR	obesity		
MC5R	4161	melanocortin 5 receptor	GPCR			
MCHR1	2847	melanin-concentrating hormone receptor 1	GPCR			
MCHR2	84539	melanin-concentrating hormone receptor 2	GPCR			
MCM7	4176	minichromosome maintenance deficient 7 (S. cerevisiae)	other nuclear protein		positive selection	
MCPH1	79648	microcephaly, primary autosomal recessive 1	other intracellular	microcephaly	protein evolution; microcephaly	
MECP2	4204	methyl CpG binding protein 2 (Rett syndrome)	other nuclear protein	intellectual disability		
MEPCE	56257	methylphosphate capping enzyme	metabolic enzyme		positive selection	
MET	4233	met proto-oncogene (hepatocyte growth factor receptor)	kinase	autism		
MFGE8	4240	milk fat globule-EGF factor 8 protein	cell adhesion			layer 3
MME	4311	membrane metallo-endopeptidase (neutral endopeptidase, enkephalinase)	other membrane protein			
MOBP	4336	myelin-associated oligodendrocyte basic protein	other intracellular			oligodendrocyte
MOG	4340	myelin oligodendrocyte glycoprotein	other membrane protein		microarray expression	oligodendrocyte
MPDZ	8777	multiple PDZ domain protein	synaptic protein			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
MTDH	92140	metadherin	other nuclear protein		positive selection	
MYBPC1	4604	myosin binding protein C, slow type	cytoskeletal protein			interneuron
MYL4	4635	myosin, light polypeptide 4, alkali; atrial, embryonic	cytoskeletal protein			
NAIP	4671	NLR family, apoptosis inhibitory protein	other intracellular		HLS: (IMAGE clone ID)755093	
NBN	4683	nibrin	other nuclear protein	microcephaly		
NBPF14	25832	neuroblastoma breakpoint family, member 14	other intracellular		HLS: (IMAGE clone ID)843276	
NBPF3	84224	neuroblastoma breakpoint family, member 3	other intracellular		HLS amplification	
NCAM1	4684	neural cell adhesion molecule 1	cell adhesion			
NDE1	54820	nudE nuclear distribution gene E homolog 1 (A. nidulans)	cytoskeletal protein	schizophrenia		
NDEL1	81565	nudE nuclear distribution gene E homolog like 1 (A. nidulans)	cytoskeletal protein	schizophrenia		
NEFH	4744	neurofilament, heavy polypeptide 200kDa	cytoskeletal protein	other neurodegenerative		layer 5
NEFL	4747	neurofilament, light polypeptide 68kDa	cytoskeletal protein	other neurodegenerative		
NEFM	4741	neurofilament, medium polypeptide 150kDa	cytoskeletal protein			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
NEK2	4751	NIMA (never in mitosis gene a)-related kinase 2	kinase		HLS: (IMAGE clone ID) 415089 and 2301826	
NETO2	81831	neuropilin (NRP) and tolloid (TLL)-like 2	other membrane protein			
NGFB	4803	nerve growth factor, beta polypeptide	peptide ligand	other neurodegenerative		
NGFR	4804	nerve growth factor receptor (TNFR superfamily, member 16)	other membrane protein	other neurodegenerative		
NHEJ1	79840	nonhomologous end-joining factor 1	other nuclear protein	microcephaly		
NLGN1	22871	neuroligin 1	synaptic protein			
NLGN2	57555	neuroligin 2	synaptic protein			
NLGN3	54413	neuroligin 3	synaptic protein	autism		
NLGN4X	57502	neuroligin 4	synaptic protein	autism		
NMB	4828	neuromedin B	peptide ligand			
NNAT	4826	neuronatin	other intracellular			
NOS1	4842	nitric oxide synthase 1 (neuronal)	metabolic enzyme	epilepsy		interneuron
NOV	4856	nephroblastoma overexpressed gene	secreted protein			
NPAS1	4861	neuronal PAS domain protein 1	transcription factor			interneuron
NPAS3	64067	neuronal PAS domain protein 3	transcription factor	schizophrenia		interneuron
NPBWR2	2832	neuropeptides B/W receptor 2	GPCR			
NPIPL3	23117	nuclear pore complex interacting protein-like 3	other membrane protein			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
NPR3	4883	natriuretic peptide receptor C/guanylate cyclase C (atrionatriuretic peptide receptor C)	other membrane protein			
NPSR1	387129	neuropeptide S receptor 1	GPCR			
NPVF	64111	neuropeptide VF precursor	peptide ligand			
NPY	4852	neuropeptide Y	peptide ligand	other neurodegenerative	microarray expression	interneuron
NPY1R	4886	neuropeptide Y receptor Y1	GPCR	autism		
NPY2R	4887	neuropeptide Y receptor Y2	GPCR			layer 6
NPY5R	4889	neuropeptide Y receptor Y5	GPCR	epilepsy		
NR2F2	7026	nuclear receptor subfamily 2, group F, member 2	transcription factor			
NR3C1	2908	nuclear receptor subfamily 3, group C, member 1 (glucocorticoid receptor)	transcription factor			
NR4A2	4929	nuclear receptor subfamily 4, group A, member 2	transcription factor	Parkinson's		layer 6b
NRCAM	4897	neuron-glia-CAM-related cell adhesion molecule	cell adhesion	autism	protein evolution	
NRG1	3084	neuregulin 1	other membrane protein	schizophrenia		
NRIP3	56675	nuclear receptor interacting protein 3	other intracellular			interneuron
NRXN1	9378	neurexin I	synaptic protein	autism		
NTF3	4908	neurotrophin 3	peptide ligand			
NTNG2	84628	netrin G2	extracellular matrix			layer 6
NTRK2	4915	neurotrophic tyrosine kinase, receptor, type 2	kinase	epilepsy		

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
NTRK3	4916	neurotrophic tyrosine kinase, receptor, type 3	kinase		protein evolution	
NTS	4922	neurotensin	peptide ligand			
NTSR2	23620	neurotensin receptor 2	GPCR			
NUDT4	11163	Nudix (nucleoside diphosphate linked moiety X)-type motif 4	signal transduction		HLS: (IMAGE clone ID) 768643	
NXPH1	30010	neurexophilin 1	secreted protein			interneuron
OMG	4974	oligodendrocyte myelin glycoprotein	cell adhesion	autism		
OPHN1	4983	oligophrenin 1	synaptic protein	intellectual disability		
OPRD1	4985	opioid receptor, delta 1	GPCR			
OPRK1	4986	opioid receptor, kappa 1	GPCR	pain		layer 6
OPRL1	4987	opiate receptor-like 1	GPCR			
OPRM1	4988	opioid receptor, mu 1	GPCR	epilepsy	protein evolution	
OXT	5020	oxytocin, prepro- (neurophysin I)	peptide ligand			
OXTR	5021	oxytocin receptor	GPCR	autism		
PAFAH1B1	5048	platelet-activating factor acetylhydrolase, isoform Ib, alpha subunit 45kDa	metabolic enzyme	schizophrenia	protein evolution	
PAIP1	10605	Poly(A) binding protein interacting protein 1	signal transduction		HLS: (IMAGE clone ID) 231802	
PAK2	5062	P21 (CDKN1A)-activated kinase 2	kinase	epilepsy	HLS: (IMAGE clone ID) 136324	
PAK3	5063	p21 (CDKN1A)-activated kinase 3	kinase	intellectual disability		

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
PARK2	5071	Parkinson's disease (autosomal recessive, juvenile) 2, parkin	other intracellular	Parkinson's		
PARK7	11315	Parkinson's disease (autosomal recessive, early onset) 7	other intracellular	Parkinson's		
PARM1	25849	prostate androgen-regulated mucin-like protein 1	other membrane protein			
PAX6	5080	paired box gene 6 (aniridia, keratitis)	transcription factor	microcephaly		
PCDH17	27253	protocadherin 17	cell adhesion		frontal cortex expression	layer 6
PCDH18	54510	protocadherin 18	cell adhesion			interneuron
PCDH20	64881	protocadherin 20	cell adhesion			layer 5/6
PCDHA6	56142	protocadherin alpha 6	cell adhesion			
PCNT	5116	pericentrin (kendrin)	cytoskeletal protein	schizophrenia		
PCP4	5121	Purkinje cell protein 4	other intracellular			layer 5/6
PDE10A	10846	phosphodiesterase 10A	signal transduction			
PDE1A	5136	phosphodiesterase 1A, calmodulin-dependent	signal transduction	depression		layer 5/6
PDE4B	5142	phosphodiesterase 4B, cAMP-specific (phosphodiesterase E4 dunce homolog, Drosophila)	signal transduction	schizophrenia		
PDE4DIP	9659	phosphodiesterase 4D interacting protein (myomegalin)	signal transduction		microarray expression; HLS (IMAGE clone ID) 2170455	
PDE5A	8654	phosphodiesterase 5A, cGMP-specific	signal transduction			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
PDHX	8050	pyruvate dehydrogenase complex, component X	metabolic enzyme	intellectual disability		
PDLIM5	10611	PDZ and LIM domain 5	cytoskeletal protein	schizophrenia		
PDYN	5173	prodynorphin	peptide ligand	epilepsy	promoter	interneuron/ layer4
PEG3	5178	paternally expressed 3	transcription factor		protein evolution	
PENK	5179	proenkephalin 1	peptide ligand			layer 2/3/6
PHF8	23133	PHD finger protein 8	other nuclear protein	intellectual disability		
PHGDH	26227	phosphoglycerate dehydrogenase	metabolic enzyme	microcephaly		
PIK3CB	5291	phosphoinositide-3-kinase, catalytic, beta polypeptide	kinase			
PIK3CG	5294	phosphoinositide-3-kinase, catalytic, gamma polypeptide	kinase	autism		
PINK1	65018	PTEN induced putative kinase 1	kinase	Parkinson's		
PLAU	5328	plasminogen activator, urokinase	extracellular matrix	Alzheimer's		
PLAUR	5329	urokinase plasminogen activator receptor	extracellular matrix	autism		
PLTP	5360	phospholipid transfer protein	secreted protein			VEC
PLXNA2	5362	plexin A2	kinase	schizophrenia		
PLXND1	23129	plexin D1	kinase			
PMCH	5367	pro-melanin-concentrating hormone	peptide ligand			
PNOC	5368	prepronociceptin	peptide ligand			interneuron

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
POM121	9883	POM121 membrane glycoprotein (rat)	other nuclear protein		HLS: (IMAGE clone ID) 548957	
POMT1	10585	protein-O-mannosyltransferase 1	metabolic enzyme	microcephaly		
PPAP2B	8613	phosphatidic acid phosphatase type 2B	signal transduction			astrocyte
PPP1R1B	84152	protein phosphatase 1, regulatory (inhibitor) subunit 1B (dopamine and cAMP regulated phosphoprotein, DARPP-32)	signal transduction	schizophrenia		
PPP3CA	5530	protein phosphatase 3 (formerly 2B), catalytic subunit, alpha isoform (calcineurin A alpha)	signal transduction	schizophrenia		
PPP3CB	5532	protein phosphatase 3 (formerly 2B), catalytic subunit, beta isoform	signal transduction			
PPP3CC	5533	protein phosphatase 3 (formerly 2B), catalytic subunit, gamma isoform	signal transduction	schizophrenia		
PQBP1	10084	polyglutamine binding protein 1	other nuclear protein	intellectual disability		
PRKCB	5579	protein kinase C, beta	kinase	autism		
PRKCG	5582	protein kinase C, gamma	kinase	other neurodegenerative		
PRLH	51052	prolactin releasing hormone	peptide ligand			
PRLHR	2834	prolactin releasing hormone receptor	GPCR			
PRODH	5625	proline dehydrogenase (oxidase) 1	metabolic enzyme	schizophrenia	CNV	interneuron
PRSS12	8492	protease, serine, 12 (neurotrypsin, motopsin)	secreted protein	intellectual disability	CNV	layer 5/6
PRSS23	11098	protease, serine, 23	secreted protein			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
PSEN1	5663	presenilin 1 (Alzheimer's disease 3)	other membrane protein	Alzheimer's		
PSEN2	5664	presenilin 2 (Alzheimer's disease 4)	other membrane protein	Alzheimer's		
PTEN	5728	phosphatase and tensin homolog	signal transduction	autism		
PTGS2	5743	prostaglandin-endoperoxide synthase 2 (Ptgs2)	metabolic enzyme	autism		
PTHLH	5744	parathyroid hormone-like hormone	peptide ligand			interneuron
PVALB	5816	Parvalbumin	signal transduction	schizophrenia		interneuron
PVRL3	25945	poliovirus receptor-related 3	cell adhesion			layer 2/3
QDPR	5860	quinoid dihydropteridine reductase	metabolic enzyme	microcephaly		oligodendrocyte
QRFPR	84109	pyroglutamylated RFamide peptide receptor	GPCR			
RAB3B	5865	RAB3B, member RAS oncogene family	signal transduction			
RAB3C	115827	RAB3C, member RAS oncogene family	signal transduction			interneuron
RAB3GAP1	22930	RAB3 GTPase activating protein subunit 1 (catalytic)	signal transduction	intellectual disability		
RAB3IP	117177	RAB3A interacting protein (rabin3)	signal transduction		positive selection	
RAB6A	5870	RAB6A, member RAS oncogene family	signal transduction		HLS: (IMAGE clone ID) 321470	
RANBP9	10048	RAN binding protein 9	signal transduction	schizophrenia		

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
RAPGEF4	11069	Rap guanine nucleotide exchange factor (GEF) 4	signal transduction	autism		
RASGRF2	5924	Ras protein-specific guanine nucleotide-releasing factor 2	signal transduction			layer 2/3
RASSF7	8045	Ras association (RalGDS/AF-6) domain family 7	signal transduction	schizophrenia		
RELN	5649	reelin	extracellular matrix	autism		interneuron
REST	5978	RE1-silencing transcription factor (Rest)	transcription factor			
RGS10	6001	regulator of G-protein signalling 10	signal transduction			
RGS4	5999	regulator of G-protein signalling 4	signal transduction	schizophrenia		
RNASEH2A	10535	ribonuclease H2, subunit A	other nuclear protein	microcephaly		
RNASEH2B	79621	ribonuclease H2, subunit B	other nuclear protein	microcephaly		
RNASEH2C	84153	ribonuclease H2, subunit C	other nuclear protein	microcephaly		
RND2	8153	Rho family GTPase 2	signal transduction			
RNF144B	255488	ring finger protein 144B	other membrane protein			interneuron
ROCK1	6093	Rho-associated, coiled-coil containing protein kinase 1	kinase		HLS: (IMAGE clone ID) 824758	

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
RORB	6096	RAR-related orphan receptor B	transcription factor		microarray expression	layer 4
RPRM	56475	reprimo, TP53 dependent G2 arrest mediator candidate	signal transduction			layer 5/6
RPS6KA3	6197	ribosomal protein S6 kinase, 90kDa, polypeptide 3	kinase	intellectual disability		
RRP8	23378	ribosomal RNA processing 8, methyltransferase, homolog (yeast)	other nuclear protein		positive selection	
RSPO1	284654	R-spondin homolog (Xenopus laevis)	secreted protein			
RTN4	57142	reticulon 4	other membrane protein	schizophrenia		
RTN4R	65078	reticulon 4 receptor	other membrane protein	schizophrenia		
RXFP1	59350	relaxin/insulin-like family peptide receptor 1	GPCR			layer 5/6
RXFP3	51289	relaxin/insulin-like family peptide receptor 3	GPCR			
RXFP4	339403	relaxin/insulin-like family peptide receptor 4	GPCR			
S100A10	6281	S100 calcium binding protein A10	signal transduction			
S100B	6285	S100 calcium binding protein B	signal transduction	other neurodegenerative		oligodendrocyte
SCN10A	6336	sodium channel, voltage-gated, type X, alpha	ion channel			
SCN11A	11280	sodium channel, voltage-gated, type XI, alpha	ion channel			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
SCN1A	6323	sodium channel, voltage-gated, type I, alpha	ion channel	epilepsy		
SCN1B	6324	sodium channel, voltage-gated, type I, beta	ion channel	epilepsy		
SCN2A	6326	sodium channel, voltage-gated, type II, alpha subunit	ion channel	epilepsy		
SCN2B	6327	sodium channel, voltage-gated, type II, beta	ion channel	epilepsy		
SCN3A	6328	sodium channel, voltage-gated, type III, alpha	ion channel			
SCN3B	55800	sodium channel, voltage-gated, type III, beta	ion channel			layer 2/3/6
SCN4A	6329	sodium channel, voltage-gated, type IV, alpha	ion channel			
SCN4B	6330	sodium channel, voltage-gated, type IV, beta	ion channel			layer 3/5
SCN5A	6331	sodium channel, voltage-gated, type V, alpha (long QT syndrome 3)	ion channel	epilepsy		
SCN7A	6332	sodium channel, voltage-gated, type VII, alpha	ion channel			
SCN8A	6334	sodium channel, voltage gated, type VIII, alpha	ion channel			
SCN9A	6335	sodium channel, voltage-gated, type IX, alpha	ion channel			
SCNN1A	6337	sodium channel, nonvoltage-gated 1 alpha	ion channel			
SCNN1B	6338	sodium channel, nonvoltage-gated 1, beta (Liddle syndrome)	ion channel			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
SCNN1D	6339	sodium channel, nonvoltage-gated 1, delta	ion channel			
SCNN1G	6340	sodium channel, nonvoltage-gated 1, gamma	ion channel			
SCRT1	83482	scratch homolog 1, zinc finger protein (Drosophila)	transcription factor			
SDK1	221935	sidekick homolog 1 (chicken)	cell adhesion		CNV	
SEMA3C	10512	sema domain, immunoglobulin domain (Ig), short basic domain, secreted, (semaphorin) 3C	secreted protein			interneuron/ layer6
SEMA3F	6405	sema domain, immunoglobulin domain (Ig), short basic domain, secreted, (semaphorin) 3F	secreted protein			
SEMA4G	57715	sema domain, immunoglobulin domain (Ig), transmembrane domain (TM) and short cytoplasmic domain, (semaphorin) 4G	secreted protein			
SEMA5B	54437	sema domain, seven thrombospondin repeats (type 1 and type 1-like), transmembrane domain (TM) and short cytoplasmic domain, (semaphorin) 5B	secreted protein			
SERF1A	8293	Small EDRK-rich factor 1A (telomeric)	other intracellular		HLS: (IMAGE clone ID) 767345 and 305677 and 191877	
SGK	6446	serum/glucocorticoid regulated kinase	kinase	other neurodegenerative		

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
SLA	6503	Src-like-adaptor	signal transduction			
SLC17A7	57030	solute carrier family 17 (sodium-dependent inorganic phosphate cotransporter), member 7	transporter	schizophrenia		
SLC17A8	246213	solute carrier family 17 (sodium-dependent inorganic phosphate cotransporter), member 8	transporter			layer 5
SLC18A1	6570	solute carrier family 18 (vesicular monoamine), member 1	transporter			
SLC18A2	6571	solute carrier family 18 (vesicular monoamine), member 2	transporter			
SLC18A3	6572	solute carrier family 18 (vesicular acetylcholine), member 3	transporter			
SLC1A1	6505	solute carrier family 1 (neuronal/epithelial high affinity glutamate transporter, system Xag), member 1	transporter	other neurodegenerative		
SLC1A2	6506	solute carrier family 1 (glial high affinity glutamate transporter), member 2	transporter	epilepsy		astrocyte
SLC1A3	6507	solute carrier family 1 (glial high affinity glutamate transporter), member 3	transporter	epilepsy		astrocyte
SLC1A4	6509	solute carrier family 1 (glutamate/neutral amino acid transporter), member 4	transporter			
SLC1A5	6510	solute carrier family 1 (neutral amino acid transporter), member 5	transporter			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
SLC1A6	6511	solute carrier family 1 (high affinity aspartate/glutamate transporter), member 6	transporter	epilepsy		
SLC1A7	6512	solute carrier family 1 (glutamate transporter), member 7	transporter			
SLC20A1	6574	solute carrier family 20 (phosphate transporter), member 1	transporter			
SLC23A3	151295	solute carrier family 23 (nucleobase transporters), member 3	transporter	microcephaly		
SLC24A3	57419	solute carrier family 24 (sodium/potassium/calcium exchanger), member 3	transporter			
SLC25A22	79751	solute carrier family 25 (mitochondrial carrier: glutamate), member 22	transporter	epilepsy		
SLC2A1	6513	solute carrier family 2 (facilitated glucose transporter), member 1	transporter	microcephaly		VEC
SLC32A1	140679	solute carrier family 32 (GABA vesicular transporter), member 1	transporter			interneuron
SLC6A1	6529	solute carrier family 6 (neurotransmitter transporter, GABA), member 1	transporter	autism		interneuron
SLC6A11	6538	solute carrier family 6 (neurotransmitter transporter, GABA), member 11	transporter	epilepsy		
SLC6A12	6539	solute carrier family 6 (neurotransmitter transporter, betaine/GABA), member 12	transporter	autism		interneuron/glia

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
SLC6A13	6540	solute carrier family 6 (neurotransmitter transporter, GABA), member 13	transporter		HLS: (IMAGE clone ID) 2029176	interneuron/glia
SLC6A14	11254	solute carrier family 6 (amino acid transporter), member 14	transporter	obesity		
SLC6A2	6530	solute carrier family 6 (neurotransmitter transporter, noradrenalin), member 2	transporter	depression		
SLC6A3	6531	solute carrier family 6 (neurotransmitter transporter, dopamine), member 3	transporter	Parkinson's		
SLC6A4	6532	solute carrier family 6 (neurotransmitter transporter, serotonin), member 4	transporter	depression		
SLC6A7	6534	solute carrier family 6 (neurotransmitter transporter, L-proline), member 7	transporter			
SLC6A8	6535	solute carrier family 6 (neurotransmitter transporter, creatine), member 8	transporter	intellectual disability		
SMA3	10571	SMA3			HLS: (IMAGE clone ID) 470261	
SMAD1	4086	SMAD, mothers against DPP homolog 1 (Drosophila)	transcription factor		microarray expression	
SMCX	8242	Smcy homolog, X-linked (mouse)	transcription factor	intellectual disability		
SMS	6611	spermine synthase	metabolic enzyme	intellectual disability		
SNAP23	8773	synaptosomal-associated protein, 23kDa	synaptic protein			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
SNAP25	6616	synaptosomal-associated protein, 25kDa	synaptic protein			
SNAP29	9342	synaptosomal-associated protein, 29kDa	synaptic protein			
SNAP91	9892	synaptosomal-associated protein, 91kDa homolog (mouse)	synaptic protein			
SNAPIN	23557	SNAP-associated protein	synaptic protein			
SNCA	6622	synuclein, alpha (non A4 component of amyloid precursor)	signal transduction	Parkinson's		
SNCAIP	9627	synuclein, alpha interacting protein (synphilin)	signal transduction	Parkinson's		
SNCB	6620	synuclein, beta	signal transduction	Parkinson's		
SNCG	6623	synuclein, gamma (breast cancer-specific protein 1)	signal transduction	other neurodegenerative		layer 5/6
SNPH	9751	syntaphilin	synaptic protein			
SNTA1	6640	syntrophin, alpha 1 (dystrophin-associated protein A1, 59kDa, acidic component)	cytoskeletal protein			
SNTB1	6641	syntrophin, beta 1 (dystrophin-associated protein A1, 59kDa, basic component 1)	cytoskeletal protein			layer 6
SNTB2	6645	syntrophin, beta 2 (dystrophin-associated protein A1, 59kDa, basic component 2)	cytoskeletal protein			
SNTG1	54212	syntrophin, gamma 1	cytoskeletal protein			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
SNTG2	54221	syntrophin, gamma 2	cytoskeletal protein			
SNX3	8724	sorting nexin 3	signal transduction	microcephaly		
SOD1	6647	superoxide dismutase 1, soluble (amyotrophic lateral sclerosis 1 (adult))	metabolic enzyme	other neurodegenerative		
SORL1	6653	sortilin-related receptor, L(DLR class) A repeats-containing	other membrane protein	Alzheimer's		
SPARC	6678	secreted protein, acidic, cysteine-rich (osteonectin)	extracellular matrix			
SPP1	6696	secreted phosphoprotein 1 (osteopontin, bone sialoprotein I, early T-lymphocyte activation 1)	secreted protein			interneuron/glia
SPTBN4	57731	spectrin, beta, non-erythrocytic 4	cytoskeletal protein	schizophrenia		
SPTLC1	10558	serine palmitoyltransferase, long chain base subunit 1	metabolic enzyme	other neurodegenerative	microarray expression	
SRP9	6726	Signal recognition particle 9kDa	other intracellular		HLS: (IMAGE clone ID)32257	
SST	6750	somatostatin	peptide ligand	depression		interneuron
SSTR1	6751	somatostatin receptor 1	GPCR			
SSTR3	6753	somatostatin receptor 3	GPCR			
SSTR4	6754	somatostatin receptor 4	GPCR			
STARD8	9754	START domain containing 8	signal transduction			
STEAP2	261729	six transmembrane epithelial antigen of the prostate 2	other membrane protein			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
STRN	6801	striatin, calmodulin binding protein	signal transduction			
STX10	8677	syntaxin 10	synaptic protein			
STX11	8676	syntaxin 11	synaptic protein			
STX12	23673	syntaxin 12	synaptic protein			
STX16	8675	syntaxin 16	synaptic protein			
STX17	55014	syntaxin 17	synaptic protein			
STX18	53407	syntaxin 18	synaptic protein			
STX19	415117	syntaxin 19	synaptic protein			
STX1B	112755	syntaxin 1B	synaptic protein			
STX2	2054	syntaxin 2	synaptic protein			
STX3	6809	syntaxin 3	synaptic protein			
STX4	6810	syntaxin 4	synaptic protein			
STX5	6811	syntaxin 5	synaptic protein			
STX6	10228	syntaxin 6	synaptic protein			
STX7	8417	syntaxin 7	synaptic protein			
STX8	9482	syntaxin 8	synaptic protein			
STXBP1	6812	syntaxin binding protein 1	synaptic protein			
STXBP2	6813	syntaxin binding protein 2	synaptic protein			
STXBP4	252983	syntaxin binding protein 4	synaptic protein			
STXBP5	134957	syntaxin binding protein 5 (tomosyn)	synaptic protein			
STXBP6	29091	syntaxin binding protein 6 (amisyn)	synaptic protein			
SULF1	23213	sulfatase 1	metabolic enzyme			layer 4/5/6
SV2A	9900	synaptic vesicle glycoprotein 2A	synaptic protein			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
SV2B	9899	synaptic vesicle glycoprotein 2B	synaptic protein			
SV2C	22987	synaptic vesicle glycoprotein 2C	synaptic protein			layer 3
SYN1	6853	synapsin I	synaptic protein	epilepsy		
SYN2	6854	synapsin II	synaptic protein	schizophrenia		
SYN3	8224	synapsin III	synaptic protein			
SYNE1	23345	spectrin repeat containing, nuclear envelope 1	cytoskeletal protein	schizophrenia		
SYNGAP1	8831	synaptic Ras GTPase activating protein 1 homolog (rat)	synaptic protein			
SYNGR1	9145	synaptogyrin 1	synaptic protein			
SYNGR2	9144	synaptogyrin 2	synaptic protein			
SYNGR3	9143	synaptogyrin 3	synaptic protein			
SYNGR4	23546	synaptogyrin 4	synaptic protein			
SYNJ1	8867	synaptojanin 1	synaptic protein			
SYNJ2	8871	synaptojanin 2	synaptic protein			
SYNPO2	171024	synaptopodin 2	synaptic protein			
SYNPR	132204	synaptoporin	synaptic protein			interneuron/ layer6
SYP	6855	synaptophysin	synaptic protein	intellectual disability		
SYPL1	6856	synaptophysin-like protein	synaptic protein			
SYPL2	284612	synaptophysin-like 2	synaptic protein			
SYT1	6857	synaptotagmin I	synaptic protein	epilepsy		
SYT10	341359	synaptotagmin X	synaptic protein			layer 6
SYT11	23208	synaptotagmin XI	synaptic protein			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
SYT12	91683	synaptotagmin XII	synaptic protein			
SYT13	57586	synaptotagmin XIII	synaptic protein			
SYT14	255928	synaptotagmin XIV	synaptic protein			
SYT15	83849	synaptotagmin XV	synaptic protein			
SYT16	83851	synaptotagmin XVI	synaptic protein			
SYT17	51760	synaptotagmin XVII	synaptic protein			layer 2/3/5
SYT2	127833	synaptotagmin II	synaptic protein			layer 3/5
SYT3	84258	synaptotagmin III	synaptic protein			
SYT4	6860	synaptotagmin IV	synaptic protein		microarray expression	
SYT5	6861	synaptotagmin V	synaptic protein			
SYT6	148281	synaptotagmin VI	synaptic protein			layer 6
SYT7	9066	synaptotagmin VII	synaptic protein			
SYT9	143425	synaptotagmin IX	synaptic protein			
SYTL1	84958	synaptotagmin-like 1	synaptic protein			
SYTL2	54843	synaptotagmin-like 2	synaptic protein			
SYTL4	94121	synaptotagmin-like 4	synaptic protein			
TAAR6	319100	trace amine associated receptor 6	GPCR	schizophrenia		
TAC1	6863	tachykinin, precursor 1 (substance K, substance P, neurokinin 1, neurokinin 2, neuromedin L, neurokinin alpha, neuropeptide K, neuropeptide gamma)	peptide ligand	depression		interneuron
TAC3	6866	tachykinin 3 (neuromedin K, neurokinin beta)	peptide ligand			interneuron
TACR1	6869	tachykinin receptor 1	GPCR			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
TACR2	6865	tachykinin receptor 2	GPCR			
TACR3	6870	tachykinin receptor 3	GPCR			
TAP1	6890	transporter 1, ATP-binding cassette, sub-family B (MDR/TAP)	transporter			
TAP2	6891	transporter 2, ATP-binding cassette, sub-family B (MDR/TAP)	transporter			
TDO2	6999	tryptophan 2,3-dioxygenase	metabolic enzyme	autism		
TF	7018	transferrin	transporter	epilepsy		
TGFB1	7040	transforming growth factor, beta 1 (Camurati-Engelmann disease)	peptide ligand	other neurodegenerative		
TH	7054	tyrosine hydroxylase	metabolic enzyme	Parkinson's		interneuron
THBS2	7058	thrombospondin 2	extracellular matrix			interneuron
THSD7B	80731	thrombospondin, type I, domain containing 7B	extracellular matrix			
TIAM1	7074	T-cell lymphoma invasion and metastasis 1	signal transduction			
TITF1	7080	thyroid transcription factor 1	transcription factor			
TLE4	7091	transducin-like enhancer of split 4 (E(sp1) homolog, Drosophila)	transcription factor			layer 6
TM6SF1	53346	transmembrane 6 superfamily member 1	other membrane protein			
TMEM145	284339	transmembrane protein 145	other membrane protein			
TMEM150C	441027	transmembrane protein 150C	other membrane protein			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
TMEM163	81615	transmembrane protein 163	other membrane protein			layer 5/6
TMEM200A	114801	transmembrane protein 200A	other membrane protein			
TMEM215	401498	transmembrane protein 215	other membrane protein			layer 4c
TNF	7124	tumor necrosis factor (TNF superfamily, member 2)	peptide ligand	schizophrenia		
TNFAIP8L3	388121	tumor necrosis factor, alpha-induced protein 8-like 3	other intracellular			interneuron
TNMD	64102	tenomodulin	other membrane protein			
TNNC1	7134	troponin C type 1 (slow)	cytoskeletal protein			
TNNT1	7138	troponin T type 1 (skeletal, slow)	cytoskeletal protein			
TOX	9760	thymus high mobility group box protein TOX	transcription factor			layer 5/6
TPBG	7162	trophoblast glycoprotein	cell adhesion			layer 3/5/6
TPH1	7166	tryptophan hydroxylase 1	metabolic enzyme	depression		
TPH2	121278	tryptophan hydroxylase 2	metabolic enzyme	depression		
TRH	7200	thyrotropin-releasing hormone	peptide ligand			
TRHR	7201	thyrotropin-releasing hormone receptor	GPCR			
TRIB2	28951	tribbles homolog 2 (Drosophila)	kinase			layer 5a
TRPC4	7223	transient receptor potential cation channel, subfamily C, member 4	ion channel			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
TRPC6	7225	transient receptor potential cation channel, subfamily C, member 6	ion channel			
TRPM6	140803	transient receptor potential cation channel, subfamily M, member 6	ion channel	epilepsy		
TSC1	7248	tuberous sclerosis 1	signal transduction	autism		
TSC2	7249	tuberous sclerosis 2	signal transduction	autism		
TSPAN8	7103	tetraspanin 8	cell adhesion		positive selection	
TTR	7276	transthyretin (prealbumin, amyloidosis type I)	secreted protein	other neurodegenerative	protein evolution	
TUT1	64852	terminal uridylyl transferase 1, U6 snRNA-specific	other nuclear protein		positive selection	
UBASH3B	84959	ubiquitin associated and SH3 domain containing, B	signal transduction			interneuron
UBE3A	7337	ubiquitin protein ligase E3A	other intracellular	intellectual disability		
UCHL1	7345	ubiquitin carboxyl-terminal esterase L1 (ubiquitin thiolesterase)	other intracellular	Parkinson's		
USP10	9100	Ubiquitin specific peptidase 10	other intracellular		HLS: (IMAGE clone ID) 814792	
VAMP1	6843	vesicle-associated membrane protein 1 (synaptobrevin 1)	synaptic protein			
VAMP2	6844	vesicle-associated membrane protein 2 (synaptobrevin 2)	synaptic protein			
VAMP3	9341	vesicle-associated membrane protein 3 (cellubrevin)	synaptic protein			

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
VAMP4	8674	vesicle-associated membrane protein 4	synaptic protein			
VAMP8	8673	vesicle-associated membrane protein 8 (endobrevin)	synaptic protein			
VAPA	9218	VAMP (vesicle-associated membrane protein)-associated protein A, 33kDa	synaptic protein			
VAT1L	57687	vesicle amine transport protein 1 homolog (T. californica)-like	other intracellular			layer 5
VIP	7432	vasoactive intestinal peptide	peptide ligand	epilepsy		interneuron
VIPR1	7433	vasoactive intestinal peptide receptor 1	GPCR			
VIPR2	7434	vasoactive intestinal peptide receptor 2	GPCR	autism		
VLDLR	7436	very low density lipoprotein receptor	other membrane protein	intellectual disability		
VRK3	51231	vaccinia related kinase 3	kinase		positive selection	
WFS1	7466	Wolfram syndrome 1 (wolframin)	other membrane protein	other neurodegenerative		
WNK1	65125	WNK lysine deficient protein kinase 1	kinase		human accelerated regions	
WNT2	7472	wingless-type MMTV integration site family member 2	secreted protein	autism		
XBP1	7494	X-box binding protein 1	transcription factor	bipolar		
YJEFN3	374887	YjeF N-terminal domain containing 3	other intracellular			interneuron
ZDHHC15	158866	zinc finger, DHHC-type containing 15	other membrane protein	intellectual disability		
ZFHX1B	9839	zinc finger homeobox 1b	transcription factor	intellectual disability		

Table 1. Genes characterized by ISH in 1,000 gene survey in cortex (Cortex Study).

Gene Symbol	EntrezID	Gene Description	Category			
			Gene Family	Disease	Comparative Genomics	Marker Type
ZNF197	10168	zinc finger protein 197	transcription factor		positive selection	
ZNF41	7592	zinc finger protein 41	transcription factor	intellectual disability		
ZNF674	641339	zinc finger protein 674	transcription factor	intellectual disability		
ZNRF4	148066	zinc and ring finger 4	other membrane protein		positive selection	

Table 2. Genes characterized by ISH in autism study.

Gene Symbol	EntrezID	Gene Description	Category	
			Gene Family	Marker Type
AIF1	199	allograft inflammatory factor 1	inflammatory response	glial
CALB1	793	calbindin 1, 28kDa	signal transduction	interneuron
CALB2	794	calbindin 2	signal transduction	interneuron
CTGF	1490	connective tissue growth factor	peptide ligand	layer
GAD1	2571	glutamate decarboxylase 1 (brain, 67kDa)	metabolic	interneuron
MBP	4155	myelin basic protein	other intracellular	oligodendrocyte
MFGE8	4240	milk fat globule-EGF factor 8 protein	cell adhesion	layer
NEFL	4747	neurofilament, light polypeptide	cytoskeletal protein	layer
PCP4	5121	Purkinje cell protein 4	cytoskeletal protein	layer
PDE1A	5136	phosphodiesterase 1A, calmodulin-dependent	signal transduction	layer
PRKCB	5579	protein kinase C, beta	kinase	autism candidate gene
RELN	5649	reelin	extracellular matrix	interneuron
PVALB	5816	parvalbumin	signal transduction	interneuron
RORB	6096	RAR-related orphan receptor B	transcription factor	layer
SLC1A2	6506	solute carrier family 1 (glial high affinity glutamate transporter), member 2	transporter	astrocyte
SST	6750	somatostatin	peptide ligand	interneuron
VIP	7432	vasoactive intestinal peptide	peptide ligand	interneuron
NRXN1	9378	neurexin 1	synaptic protein	autism candidate gene
CXCL14	9547	chemokine (C-X-C motif) ligand 14	peptide ligand	interneuron and layer
CNTNAP2	26047	contactin associated protein-like 2	cell adhesion	autism candidate gene
VAT1L	57687	vesicle amine transport protein 1 homolog (T. californica)-like	other intracellular	layer

Table 2. Genes characterized by ISH in autism study.

Gene Symbol	EntrezID	Gene Description	Category	
			Gene Family	Marker Type
NDNF (C4orf31)	79625	neuron-derived neurotrophic factor	extracellular matrix	interneuron and layer
NTNG2	84628	netrin G2	extracellular matrix	layer
FOXP2	93986	forkhead box P2	transcription factor	layer
SYNPR	132204	synaptoporin	synaptic protein	interneuron and layer

Table 3. Genes Characterized by ISH in Neurotransmitter Study.

Gene Symbol	Entrez ID	Gene Description	Characterized In Cortex (C) or Subcortex (SC)	Category		
				Neurotransmitter System	Gene Family	Marker Type
AANAT	15	arylalkylamine N-acetyltransferase	C	serotonin	metabolic enzyme	
ABAT	18	4-aminobutyrate aminotransferase	C,SC	GABA	metabolic enzyme	
ACHE	43	acetylcholinesterase	C,SC	acetylcholine	metabolic enzyme	
ADCYAP1	116	adenylate cyclase activating polypeptide 1	C,SC	neuropeptide	peptide ligand	
ADORA1	134	adenosine A1 receptor	C	adenosine	GPCR	
ADORA2A	135	adenosine A2a receptor	C,SC	adenosine	GPCR	
ADRA1A	148	adrenergic, alpha-1A-, receptor	C	epinephrine, norepinephrine	GPCR	
ADRA1B	147	adrenergic, alpha-1B-, receptor	C	epinephrine, norepinephrine	GPCR	
ADRA1D	146	adrenergic, alpha-1D-, receptor	C	epinephrine, norepinephrine	GPCR	
ADRA2A	150	adrenergic, alpha-2A-, receptor	C	epinephrine, norepinephrine	GPCR	
ADRA2B	151	adrenergic, alpha-2B-, receptor	C	epinephrine, norepinephrine	GPCR	
ADRA2C	152	adrenergic, alpha-2C-, receptor	C	epinephrine, norepinephrine	GPCR	
ALDH1A1	216	aldehyde dehydrogenase 1	C	serotonin	metabolic enzyme	
ALDH2	217	Aldehyde dehydrogenase 2	C,SC	serotonin	metabolic enzyme	

Table 3. Genes Characterized by ISH in Neurotransmitter Study.

Gene Symbol	Entrez ID	Gene Description	Characterized In Cortex (C) or Subcortex (SC)	Category		
				Neurotransmitter System	Gene Family	Marker Type
ALDH4A1	8659	aldehyde dehydrogenase 4 family, member A1	C	glutamate	metabolic enzyme	
AMT	275	aminomethyltransferase	C	glycine	metabolic enzyme	
BCHE	590	butyrylcholinesterase	C	acetylcholine	metabolic enzyme	
BDNF	627	brain derived neurotrophic factor	C,SC	neuropeptide	peptide ligand	
CALB1	793	calbindin 1	C,SC		signal transduction	interneuron/layer2
CALB2	794	calbindin 2, 29kDa (calretinin)	C,SC		signal transduction	interneuron
CARTPT	9607	cocaine and amphetamine regulated transcript prepropeptide	C,SC	neuropeptide	peptide ligand	layer 2/3
CBLN2	147381	cerebellin 2 precursor	C,SC	neuropeptide	other membrane protein	layer 2/3/6
CHAT	1103	choline O-acetyltransferase	SC	acetylcholine	metabolic enzyme	
CHRM1	1128	cholinergic receptor, muscarinic 1	C	acetylcholine	GPCR	
CHRM2	1129	cholinergic receptor, muscarinic 2	C,SC	acetylcholine	GPCR	
CHRM3	1131	cholinergic receptor, muscarinic 3	C,SC	acetylcholine	GPCR	
CHRM4	1132	cholinergic receptor, muscarinic 4	C	acetylcholine	GPCR	
CHRM5	1133	cholinergic receptor, muscarinic 5	C	acetylcholine	GPCR	
CHRNA1	1134	cholinergic receptor, nicotinic, alpha 1 (muscle)	C	acetylcholine	ion channel	

Table 3. Genes Characterized by ISH in Neurotransmitter Study.

Gene Symbol	Entrez ID	Gene Description	Characterized In Cortex (C) or Subcortex (SC)	Category		
				Neurotransmitter System	Gene Family	Marker Type
CHRNA10	57053	cholinergic receptor, nicotinic, alpha 10	C	acetylcholine	ion channel	
CHRNA2	1135	cholinergic receptor, nicotinic, alpha 2	C,SC	acetylcholine	ion channel	
CHRNA3	1136	cholinergic receptor, nicotinic, alpha 3	C,SC	acetylcholine	ion channel	layer 4c
CHRNA4	1137	cholinergic receptor, nicotinic, alpha 4	C	acetylcholine	ion channel	layer 5/6
CHRNA5	1138	cholinergic receptor, nicotinic, alpha 5	C	acetylcholine	ion channel	
CHRNA6	8973	cholinergic receptor, nicotinic, alpha 6	C	acetylcholine	ion channel	
CHRNA7	1139	cholinergic receptor, nicotinic, alpha 7	C,SC	acetylcholine	ion channel	layer 1/2
CHRNB1	1140	cholinergic receptor, nicotinic, beta 1 (muscle)	C	acetylcholine	ion channel	
CHRNB2	1141	cholinergic receptor, nicotinic, beta 2	C,SC	acetylcholine	ion channel	
CHRNB3	1142	cholinergic receptor, nicotinic, beta 3	C	acetylcholine	ion channel	
CHRNB4	1143	cholinergic receptor, nicotinic, beta 4	C	acetylcholine	ion channel	
CHRNE	1145	cholinergic receptor, nicotinic, epsilon (muscle)	C	acetylcholine	ion channel	
CNR1	1268	cannabinoid receptor 1 (brain)	C,SC	cannabinoid	GPCR	interneuron/layer1/2/6
CNRIP1	25927	cannabinoid receptor interacting protein 1	C,SC	cannabinoid	GPCR	
COMT	1312	catechol-O-methyltransferase	C	dopamine	metabolic enzyme	
CRYM	1428	crystallin, mu	C,SC		other intracellular	layer 2/3/5/6
CUX2	23316	cut-like homeobox 2	C		transcription factor	layer 2/3/4

Table 3. Genes Characterized by ISH in Neurotransmitter Study.

Gene Symbol	Entrez ID	Gene Description	Characterized In Cortex (C) or Subcortex (SC)	Category		
				Neurotransmitter System	Gene Family	Marker Type
DAO	1610	diamine oxidase	C	histamine	metabolic enzyme	
DLD	1738	dihydrolipoamide dehydrogenase	C,SC	glycine	metabolic enzyme	
DRD1	1812	dopamine receptor D1	C	dopamine	GPCR	
DRD2	1813	dopamine receptor D2	C,SC	dopamine	GPCR	
DRD3	1814	dopamine receptor D3	C	dopamine	GPCR	
DRD5	1816	dopamine receptor D5	C	dopamine	GPCR	
GABBR1	2550	gamma-aminobutyric acid (GABA-B) receptor, 1	C	GABA	GPCR	
GABBR2	9568	gamma-aminobutyric acid (GABA) B receptor 2	C	GABA	GPCR	
GABRA1	2554	gamma-aminobutyric acid (GABA-A) receptor, subunit alpha 1	C,SC	GABA	ion channel	
GABRA2	2555	gamma-aminobutyric acid (GABA-A) receptor, subunit alpha 2	C,SC	GABA	ion channel	
GABRA3	2556	gamma-aminobutyric acid (GABA-A) receptor, subunit alpha 3	C	GABA	ion channel	
GABRA4	2557	gamma-aminobutyric acid (GABA-A) receptor, subunit alpha 4	C,SC	GABA	ion channel	
GABRA5	2558	gamma-aminobutyric acid (GABA-A) receptor, subunit alpha 5	C,SC	GABA	ion channel	layer 5/6
GABRA6	2559	gamma-aminobutyric acid (GABA-A) receptor, subunit alpha 6	C	GABA	ion channel	

Table 3. Genes Characterized by ISH in Neurotransmitter Study.

Gene Symbol	Entrez ID	Gene Description	Characterized In Cortex (C) or Subcortex (SC)	Category		
				Neurotransmitter System	Gene Family	Marker Type
GABRB1	2560	gamma-aminobutyric acid (GABA-A) receptor, subunit beta 1	C,SC	GABA	ion channel	
GABRB2	2561	gamma-aminobutyric acid (GABA-A) receptor, subunit beta 2	C,SC	GABA	ion channel	
GABRB3	2562	gamma-aminobutyric acid (GABA-A) receptor, subunit beta 3	C,SC	GABA	ion channel	
GABRD	2563	gamma-aminobutyric acid (GABA-A) receptor, subunit delta	C,SC	GABA	ion channel	
GABRE	2564	gamma-aminobutyric acid (GABA-A) receptor, subunit epsilon	C,SC	GABA	ion channel	
GABRG1	2565	gamma-aminobutyric acid (GABA-A) receptor, subunit gamma 1	C,SC	GABA	ion channel	
GABRG2	2566	gamma-aminobutyric acid (GABA-A) receptor, subunit gamma 2	C,SC	GABA	ion channel	
GABRG3	2567	gamma-aminobutyric acid (GABA-A) receptor, subunit gamma 3	C	GABA	ion channel	
GABRQ	55879	gamma-aminobutyric acid (GABA-A) receptor, subunit theta	C,SC	GABA	ion channel	
GABRR1	2569	gamma-aminobutyric acid (GABA-C) receptor, subunit rho 1	C	GABA	ion channel	
GABRR2	2570	gamma-aminobutyric acid (GABA-C) receptor, subunit rho 2	C	GABA	ion channel	
GABRR3	200959	gamma-aminobutyric acid (GABA) receptor, rho 3	C	GABA	ion channel	
GAD1	2571	glutamate decarboxylase 1	C,SC	GABA	metabolic enzyme	interneuron

Table 3. Genes Characterized by ISH in Neurotransmitter Study.

Gene Symbol	Entrez ID	Gene Description	Characterized In Cortex (C) or Subcortex (SC)	Category		
				Neurotransmitter System	Gene Family	Marker Type
GAD2	2572	glutamate decarboxylase 2	C,SC	GABA	metabolic enzyme	interneuron
GCSH	2653	glycine cleavage system protein H (aminomethyl carrier)	C	glycine	metabolic enzyme	
GFAP	2670	glial fibrillary acidic protein	C,SC		cytoskeletal protein	astrocyte
GJA1	2697	gap junction protein, alpha 1, 43 kDa	C		other membrane protein	astrocyte
GLDC	2731	glycine dehydrogenase (decarboxylating)	C	glycine	metabolic enzyme	
GLRA1	2741	glycine receptor, alpha 1 subunit	C,SC	glycine	ion channel	
GLRA2	2742	glycine receptor, alpha 2 subunit	C	glycine	ion channel	
GLRA3	8001	glycine receptor, alpha 3 subunit	C,SC	glycine	ion channel	layer 2
GLRB	2743	glycine receptor, beta subunit	C,SC	glycine	ion channel	
GLS	2744	glutaminase	C,SC	glutamate	metabolic enzyme	
GLS2	27165	glutaminase2	C	glutamate	metabolic enzyme	
GLUD2	2747	glutamate dehydrogenase 2	C	glutamate	metabolic enzyme	
GLUL	2752	glutamate-ammonia ligase (glutamine synthetase)	C	glutamate	metabolic enzyme	
GOT1	2805	glutamic-oxaloacetic transaminase 1, soluble (aspartate aminotransferase 1)	C,SC	glutamate	metabolic enzyme	

Table 3. Genes Characterized by ISH in Neurotransmitter Study.

Gene Symbol	Entrez ID	Gene Description	Characterized In Cortex (C) or Subcortex (SC)	Category		
				Neurotransmitter System	Gene Family	Marker Type
GOT2	2806	glutamic-oxaloacetic transaminase 2, mitochondrial (aspartate aminotransferase 2)	C,SC	glutamate	metabolic enzyme	
GRIA1	2890	glutamate receptor, ionotropic, AMPA 1	C,SC	glutamate	ion channel	
GRIA2	2891	glutamate receptor, ionotropic, AMPA 2	C,SC	glutamate	ion channel	
GRIA3	2892	glutamate receptor, ionotropic, AMPA 3	C	glutamate	ion channel	
GRIA4	2893	glutamate receptor, ionotropic, AMPA 4	C,SC	glutamate	ion channel	
GRIK1	2897	glutamate receptor, ionotropic, kainate 1	C,SC	glutamate	ion channel	interneuron
GRIK2	2898	glutamate receptor, ionotropic, kainate 2	C,SC	glutamate	ion channel	
GRIK3	2899	glutamate receptor, ionotropic, kainate 3	C	glutamate	ion channel	
GRIK4	2900	glutamate receptor, ionotropic, kainate 4	C	glutamate	ion channel	layer 4c/6
GRIK5	2901	glutamate receptor, ionotropic, kainate 5	C	glutamate	ion channel	
GRIN1	2902	glutamate receptor, ionotropic, N-methyl-D-aspartate 1	C,SC	glutamate	ion channel	
GRIN2A	2903	glutamate receptor, ionotropic, N-methyl-D-aspartate 2A	C,SC	glutamate	ion channel	
GRIN2B	2904	glutamate receptor, ionotropic, N-methyl-D-aspartate 2B	C,SC	glutamate	ion channel	
GRIN3A	116443	glutamate receptor, ionotropic, N-methyl-D-aspartate 3A	C,SC	glutamate	ion channel	interneuron/layer5/6
GRM1	2911	glutamate receptor, metabotropic 1	C,SC	glutamate	GPCR	
GRM2	2912	glutamate receptor, metabotropic 2	C	glutamate	GPCR	
GRM3	2913	glutamate receptor, metabotropic 3	C	glutamate	GPCR	

Table 3. Genes Characterized by ISH in Neurotransmitter Study.

Gene Symbol	Entrez ID	Gene Description	Characterized In Cortex (C) or Subcortex (SC)	Category		
				Neurotransmitter System	Gene Family	Marker Type
GRM4	2914	glutamate receptor, metabotropic 4	C	glutamate	GPCR	
GRM5	2915	glutamate receptor, metabotropic 5	C	glutamate	GPCR	
GRM7	2917	glutamate receptor, metabotropic 7	C	glutamate	GPCR	
GRM8	2918	glutamate receptor, metabotropic 8	C	glutamate	GPCR	
HRH1	3269	histamine receptor H1	C	histamine	GPCR	
HRH2	3274	histamine receptor H2	C	histamine	GPCR	
HRH3	11255	histamine receptor H3	C	histamine	GPCR	
HTR1A	3350	5-hydroxytryptamine (serotonin) receptor 1A	C,SC	serotonin	GPCR	
HTR1B	3351	5-hydroxytryptamine (serotonin) receptor 1B	C	serotonin	GPCR	
HTR1D	3352	5-hydroxytryptamine (serotonin) receptor 1D	C	serotonin	GPCR	
HTR1F	3355	5-hydroxytryptamine (serotonin) receptor 1F	C	serotonin	GPCR	
HTR2A	3356	5-hydroxytryptamine (serotonin) receptor 2A	C,SC	serotonin	GPCR	
HTR2B	3357	5-hydroxytryptamine (serotonin) receptor 2B	C	serotonin	GPCR	
HTR2C	3358	5-hydroxytryptamine (serotonin) receptor 2C	C,SC	serotonin	GPCR	layer 5
HTR3A	3359	5-hydroxytryptamine (serotonin) receptor 3A	C,SC	serotonin	ion channel	
HTR3B	9177	5-hydroxytryptamine (serotonin) receptor 3B	C,SC	serotonin	ion channel	

Table 3. Genes Characterized by ISH in Neurotransmitter Study.

Gene Symbol	Entrez ID	Gene Description	Characterized In Cortex (C) or Subcortex (SC)	Category		
				Neurotransmitter System	Gene Family	Marker Type
HTR3C	170572	5-hydroxytryptamine (serotonin) receptor 3, family member C	C	serotonin	ion channel	
HTR3D	200909	5-hydroxytryptamine (serotonin) receptor 3 family member D	C	serotonin	ion channel	
HTR3E	285242	5-hydroxytryptamine (serotonin) receptor 3, family member E	C	serotonin	ion channel	
HTR5A	3361	5-hydroxytryptamine (serotonin) receptor 5A	C	serotonin	GPCR	
HTR6	3362	5-hydroxytryptamine (serotonin) receptor 6	C	serotonin	GPCR	
HTR7	3363	5-hydroxytryptamine (serotonin) receptor 7	C	serotonin	GPCR	
MAOA	4128	monoamine oxidase A	C	dopamine	metabolic enzyme	
MAOB	4129	monoamine oxidase B	C,SC	dopamine	metabolic enzyme	
MBP	4155	myelin basic protein	C,SC		other intracellular	oligodendrocyte
MFGE8	4240	milk fat globule-EGF factor 8 protein	C,SC		cell adhesion	layer 3
NEFH	4744	neurofilament, heavy polypeptide 200kDa	C,SC		cytoskeletal protein	layer 5
NGB	58157	neuroglobin	C,SC		transporter	
NNAT	4826	neuronatin	C,SC		other intracellular	
NPY1R	4886	neuropeptide Y receptor Y1	C,SC	neuropeptide	GPCR	

Table 3. Genes Characterized by ISH in Neurotransmitter Study.

Gene Symbol	Entrez ID	Gene Description	Characterized In Cortex (C) or Subcortex (SC)	Category		
				Neurotransmitter System	Gene Family	Marker Type
NTS	4922	neurotensin	C,SC	neuropeptide	peptide ligand	
NXPH1	30010	neurexophilin 1	C,SC	neuropeptide	secreted protein	interneuron
OXTR	5021	oxytocin receptor	C,SC	neuropeptide	GPCR	
PCP4	5121	Purkinje cell protein 4	C,SC		other intracellular	layer 5/6
PDYN	5173	prodynorphin	C,SC	neuropeptide	peptide ligand	interneuron/layer4
PENK	5179	proenkephalin	C,SC	neuropeptide	peptide ligand	layer 2/3/6
PNOC	5368	prepronociceptin	C,SC	neuropeptide	peptide ligand	interneuron
PVALB	5816	parvalbumin	C,SC		signal transduction	interneuron
RORB	6096	RAR-related orphan receptor B	C		transcription factor	layer 4
SCG2	7857	secretogranin II	C,SC	neuropeptide	secreted protein	
SCG3	29106	secretogranin III	C	neuropeptide	secreted protein	
SHMT1	6470	serine hydroxymethyl transferase 1 (soluble)	C	glycine	metabolic enzyme	
SHMT2	6472	serine hydroxymethyl transferase 2 (mitochondrial)	C	glycine	metabolic enzyme	
SLC17A6	57084	solute carrier family 17 (sodium-dependent inorganic phosphate cotransporter), member 6 (VGLUT2)	C,SC	glutamate	transporter	

Table 3. Genes Characterized by ISH in Neurotransmitter Study.

Gene Symbol	Entrez ID	Gene Description	Characterized In Cortex (C) or Subcortex (SC)	Category		
				Neurotransmitter System	Gene Family	Marker Type
SLC17A7	57030	solute carrier family 17 (sodium-dependent inorganic phosphate cotransporter), member 7 (VGLUT1)	C	glutamate	transporter	
SLC17A8	246213	solute carrier family 17 (sodium-dependent inorganic phosphate cotransporter), member 8 (VGLUT3)	C,SC	glutamate	transporter	layer 5
SLC18A2	6571	solute carrier family 18 (vesicular monoamine), member 2	C	dopamine	transporter	
SLC18A3	6572	solute carrier family 18 (vesicular acetylcholine), member 3	C	acetylcholine	transporter	
SLC1A1	6505	solute carrier family 1 (glial high affinity glutamate transporter, member 1	C,SC	glutamate	transporter	
SLC1A2	6506	solute carrier family 1 (glial high affinity glutamate transporter, member 2	C,SC	glutamate	transporter	astrocyte
SLC1A3	6507	solute carrier family 1 (glial high affinity glutamate transporter, member 3	C,SC	glutamate	transporter	astrocyte
SLC1A4	6509	solute carrier family 1 (glutamate/neutral amino acid transporter), member 4	C,SC	glutamate	transporter	
SLC1A5	6510	solute carrier family 1 (glutamate/neutral amino acid transporter), member 5	C	glutamate	transporter	
SLC1A7	6512	solute carrier family 1 (glial high affinity glutamate transporter, member 7	C	glutamate	transporter	
SLC29A4	222962	solute carrier family 29 (nucleoside transporters), member 4**	C	serotonin	transporter	
SLC32A1	140679	solute carrier family 32 (GABA vesicular transporter), member 1	C,SC	GABA	transporter	interneuron
SLC38A5	92745	solute carrier family 38, member 5	C	glycine	transporter	

Table 3. Genes Characterized by ISH in Neurotransmitter Study.

Gene Symbol	Entrez ID	Gene Description	Characterized In Cortex (C) or Subcortex (SC)	Category		
				Neurotransmitter System	Gene Family	Marker Type
SLC44A1	23446	solute carrier family 44, member 1 (putative)	C	acetylcholine	transporter	
SLC44A2	57153	solute carrier family 44, member 2 (putative)	C	acetylcholine	transporter	
SLC44A5	204962	solute carrier family 44, member 5 (putative)	C	acetylcholine	transporter	
SLC5A7	60482	solute carrier family 5 (choline transporter), member 7	C	acetylcholine	transporter	
SLC6A1	6529	solute carrier family 6 (neurotransmitter transporter, GABA), member 1	C,SC	GABA	transporter	interneuron
SLC6A11	6538	solute carrier family 6 (neurotransmitter transporter, GABA), member 11	C	GABA	transporter	
SLC6A13	6540	solute carrier family 6 (neurotransmitter transporter, GABA), member 13	C	GABA	transporter	interneuron/glia
SLC6A9	6536	solute carrier family 6 (neurotransmitter transporter, glycine), member 9	C	glycine	transporter	
SYT2	127833	synaptotagmin II	C,SC		synaptic protein	layer 3/5
SYT6	148281	synaptotagmin VI	C		synaptic protein	layer 6
TAC1	6863	tachykinin precursor 1	C,SC	neuropeptide	peptide ligand	interneuron
TAC3	6866	tachykinin precursor 2	C,SC	neuropeptide	peptide ligand	interneuron
TH	7054	Tyrosine hydroxylase	C,SC	dopamine	metabolic enzyme	interneuron
TRH	7200	thyrotropin releasing hormone	C,SC	neuropeptide	peptide ligand	

Table 3. Genes Characterized by ISH in Neurotransmitter Study.

Gene Symbol	Entrez ID	Gene Description	Characterized In Cortex (C) or Subcortex (SC)	Category		
				Neurotransmitter System	Gene Family	Marker Type
TRHR	7201	thyrotropin releasing hormone receptor	C,SC	neuropeptide	GPCR	
VGF	7425	VGF nerve growth factor inducible	C	neuropeptide	secreted protein	

Table 4. Genes characterized by ISH in schizophrenia study.

Gene Symbol	EntrezID	Gene Description	Category		
			Gene Family	Disease	Marker Type
AKT1	207	v-akt murine thymoma viral oncogene homolog 1	kinase	schizophrenia candidate	
ARC	23237	activity-regulated cytoskeleton-associated protein	cytoskeletal protein	schizophrenia candidate	
B3GALT2	8707	UDP-Gal:betaGlcNAc beta 1,3-galactosyltransferase, polypeptide 2	metabolic enzyme		layer 5/6
BDNF	627	brain-derived neurotrophic factor	peptide ligand	schizophrenia candidate	
C1QL2	165257	complement component 1, q subcomponent-like 2	peptide ligand		
C4orf31	79625	chromosome 4 open reading frame 31	extracellular matrix		layer 1
C8orf79	57604	chromosome 8 open reading frame 79	other intracellular		layer 4/5/6
CALB1	793	calbindin 1, 28kDa	signal transduction		interneuron
CALB2	794	calbindin 2, 29kDa (calretinin)	signal transduction		interneuron
CAMK2A	815	calcium/calmodulin-dependent protein kinase (CaM kinase) II alpha	kinase	schizophrenia candidate	
CARTPT	9607	CART prepropeptide	peptide ligand		layer 2/3
CHRNA7	1139	cholinergic receptor, nicotinic, alpha 7	ion channel	schizophrenia candidate	
CIT	11113	citron (rho-interacting, serine/threonine kinase 21)	kinaase	schizophrenia candidate	
CLDN5	7122	claudin 5 (transmembrane protein deleted in velocardiofacial syndrome)	other membrane protein		vascular

Table 4. Genes characterized by ISH in schizophrenia study.

Gene Symbol	EntrezID	Gene Description	Category		
			Gene Family	Disease	Marker Type
CNP	1267	2',3'-cyclic nucleotide 3' phosphodiesterase	metabolic enzyme		
CNR1	1268	cannabinoid receptor 1 (brain)	GPCR	schizophrenia candidate	layer 1/2+
COMT	1312	catechol-O-methyltransferase	metabolic enzyme	schizophrenia candidate	
CTGF	1490	connective tissue growth factor	peptide ligand		layer 6b
CTNND2	1501	catenin (cadherin-associated protein), delta 2 (neural plakophilin-related arm-repeat protein)	cell adhesion		
CUX2	23316	cut-like homeobox 2	transcription factor		layer 2/3
DISC1	27185	disrupted in schizophrenia candidate 1	signal transduction	schizophrenia candidate	
DLG4	1742	discs, large homolog 4 (Drosophila)	synaptic protein	schizophrenia candidate	
DTNBP1	84062	dystrobrevin binding protein 1	synaptic protein		
ERBB3	2065	v-erb-b2 erythroblastic leukemia viral oncogene homolog 3 (avian)	kinase	schizophrenia candidate	myelination
ERBB4	2066	v-erb-a erythroblastic leukemia viral oncogene homolog 4 (avian)	kinase	schizophrenia candidate	interneuron
FEZ1	9638	fasciculation and elongation protein zeta 1 (zygin I)	signal transduction	schizophrenia candidate	
GAD1	2571	glutamate decarboxylase 1 (brain, 67kDa)	metabolic enzyme	schizophrenia candidate	interneuron
GAD2	2572	glutamate decarboxylase 2 (pancreatic islets and brain, 65kDa)	metabolic enzyme		interneuron
GAP43	2596	growth associated protein 43	synaptic protein		

Table 4. Genes characterized by ISH in schizophrenia study.

Gene Symbol	EntrezID	Gene Description	Category		
			Gene Family	Disease	Marker Type
GRIK1	2897	glutamate receptor, ionotropic, kainate 1	ion channel		interneuron
GRIK4	2900	glutamate receptor, ionotropic, kainate 4	ion channel	schizophrenia candidate	
GSN	2934	gelsolin (amyloidosis, Finnish type)	cytoskeletal protein		
KCNH2	3757	potassium voltage-gated channel, subfamily H (eag-related), member 2	ion channel		
KIT	3815	v-kit Hardy-Zuckerman 4 feline sarcoma viral oncogene homolog	kinase		
MAP2	4130	microtubule-associated protein 21	kinase anchor protein		
MBP	4155	myelin basic protein	other intracellular		oligodendrocyte
MFGE8	4240	milk fat globule-EGF factor 8 protein	cell adhesion		layer 3
MOG	4340	myelin oligodendrocyte glycoprotein	other membrane protein		
MTHFR	92140	methylenetetrahydrofolate reductase (NAD(P)H)	metabolic enzyme		
NDE1	54820	nudE nuclear distribution gene E homolog 1 (A. nidulans)	cytoskeletal protein		
NDEL1	81565	nudE nuclear distribution gene E homolog like 1 (A. nidulans)	cytoskeletal protein	schizophrenia candidate	
NEFH	4744	neurofilament, heavy polypeptide 200kDa	cytoskeletal protein		layer 3/5
NEFM	4741	neurofilament, medium polypeptide 150kDa	cytoskeletal protein		
NOS1AP	4842	nitric oxide synthase 1 (neuronal) adaptor protein	protein binding		
NPY	4852	neuropeptide Y	peptide ligand		interneuron

Table 4. Genes characterized by ISH in schizophrenia study.

Gene Symbol	EntrezID	Gene Description	Category		
			Gene Family	Disease	Marker Type
NR4A2	4929	nuclear receptor subfamily 4, group A, member 2	transcription factor		layer 6
NRG1	3084	neuregulin 1	other membrane protein		
NTNG2	84628	netrin G2	extracellular matrix		layer 6
PAFAH1B1	5048	platelet-activating factor acetylhydrolase, isoform Ib, alpha subunit 45kDa	metabolic enzyme	schizophrenia candidate	
PCP4	5121	Purkinje cell protein 4	other intracellular		layer 5/6
PDE1A	5136	phosphodiesterase 1A, calmodulin-dependent	signal transduction		layer 5/6
PENK	5179	proenkephalin 1	peptide ligand		layer 2+
PLDN	5329	pallidin homolog (mouse), (syntaxin 13-interacting protein pallid)	celllular component		
PPP1R1B	84152	protein phosphatase 1, regulatory (inhibitor) subunit 1B (dopamine and cAMP regulated phosphoprotein, DARPP-32)	signal transduction	schizophrenia candidate	
PRODH	5625	proline dehydrogenase (oxidase) 1	metabolic enzyme	schizophrenia candidate	
PVALB	5816	Parvalbumin	signal transduction		interneuron
RASGRF2	5924	Ras protein-specific guanine nucleotide-releasing factor 2	signal transduction		layer 2/3
RELN	5649	reelin	extracellular matrix	schizophrenia candidate	layer 1
RGS4	5999	regulator of G-protein signalling 4	signal transduction	schizophrenia candidate	
RORB	6096	RAR-related orphan receptor B	transcription factor		layer 3/4/5

Table 4. Genes characterized by ISH in schizophrenia study.

Gene Symbol	EntrezID	Gene Description	Category		
			Gene Family	Disease	Marker Type
S100B	6285	S100 calcium binding protein B	signal transduction		
SCN4B	6330	sodium channel, voltage-gated, type IV, beta	ion channel		layer 3/5
SLC12A2	6503	solute carrier family 12 (sodium/potassium/chloride transporters), member 21	transporter	schizophrenia candidate	
SLC17A7	57030	solute carrier family 17 (sodium-dependent inorganic phosphate cotransporter), member 7	transporter	schizophrenia candidate	
SLC1A2	6506	solute carrier family 1 (glial high affinity glutamate transporter), member 2	transporter	schizophrenia candidate	astrocyte
SLC6A1	6529	solute carrier family 6 (neurotransmitter transporter, GABA), member 1	transporter	schizophrenia candidate	interneuron
SNCG	6623	synuclein, gamma (breast cancer-specific protein 1)	signal transduction		layer 3/5
SST	6750	somatostatin	peptide ligand		interneuron
SYNPR	132204	synaptoporin	synaptic protein		layer 6
TAC1	6863	tachykinin, precursor 1 (substance K, substance P, neurokinin 1, neurokinin 2, neuromedin L, neurokinin alpha, neuropeptide K, neuropeptide gamma)	peptide ligand	schizophrenia candidate	interneuron
TAC3	6866	tachykinin 3 (neuromedin K, neurokinin beta)	peptide ligand		interneuron
VAMP1	6843	vesicle-associated membrane protein 1 (synaptobrevin 1)	synaptic protein		layer 3/5

Table 4. Genes characterized by ISH in schizophrenia study.

Gene Symbol	EntrezID	Gene Description	Category		
			Gene Family	Disease	Marker Type
VAT1L	57687	vesicle amine transport protein 1 homolog (T. californica)-like	other intracellular		
VIP	7432	vasoactive intestinal peptide	peptide ligand		interneuron

Table 5. Genes characterized by ISH in subcortex study.

Gene Symbol	EntrezID	Gene Description	Category	
			Gene Family	Target Region
ABAT	18	4-aminobutyrate aminotransferase	metabolic enzyme	subcortex
BDNF	627	brain-derived neurotrophic factor	peptide ligand	subcortex
CALB1	793	calbindin 1, 28kDa	signal transduction	subcortex
CALB2	794	calbindin 2, 29kDa (calretinin)	signal transduction	subcortex
CARTPT	9607	CART prepropeptide	peptide ligand	hypothalamus
GABBR1	2550	gamma-aminobutyric acid (GABA) B receptor, 1	GPCR	subcortex
GABBR2	9568	gamma-aminobutyric acid (GABA) B receptor, 2	GPCR	subcortex
GABRA1	2554	gamma-aminobutyric acid (GABA) A receptor, alpha 1	ion channel	subcortex
GABRA2	2555	gamma-aminobutyric acid (GABA) A receptor, alpha 2	ion channel	subcortex
GABRA3	2556	gamma-aminobutyric acid (GABA) A receptor, alpha 3	ion channel	subcortex
GABRA4	2557	gamma-aminobutyric acid (GABA) A receptor, alpha 4	ion channel	subcortex
GABRA5	2558	gamma-aminobutyric acid (GABA) A receptor, alpha 5	ion channel	subcortex
GABRB1	2560	gamma-aminobutyric acid (GABA) A receptor, beta 1	ion channel	subcortex
GABRB2	2561	gamma-aminobutyric acid (GABA) A receptor, beta 2	ion channel	subcortex
GABRB3	2562	gamma-aminobutyric acid (GABA) A receptor, beta 3	ion channel	subcortex
GABRD	2563	gamma-aminobutyric acid (GABA) A receptor, delta	ion channel	subcortex

Table 5. Genes characterized by ISH in subcortex study.

Gene Symbol	EntrezID	Gene Description	Category	
			Gene Family	Target Region
GABRE	2564	gamma-aminobutyric acid (GABA) A receptor, epsilon	ion channel	subcortex
GABRG1	2565	gamma-aminobutyric acid (GABA) A receptor, gamma 1	ion channel	subcortex
GABRG2	2566	gamma-aminobutyric acid (GABA) A receptor, gamma 2	ion channel	subcortex
GABRG3	2567	gamma-aminobutyric acid (GABA) A receptor, gamma 3	ion channel	subcortex
GABRQ	55879	gamma-aminobutyric acid (GABA) receptor, theta	ion channel	subcortex
GAD1	2571	glutamate decarboxylase 1 (brain, 67kDa)	metabolic enzyme	subcortex
GAD2	2572	glutamate decarboxylase 2 (pancreatic islets and brain, 65kDa)	metabolic enzyme	subcortex
GAL	51083	galanin prepropeptide	peptide ligand	hypothalamus
GLS2	27165	glutaminase 2 (liver, mitochondrial	metabolic enzyme	subcortex
GRIA1	2890	glutamate receptor, ionotropic, AMPA 1	ion channel	subcortex
GRIA2	2891	glutamate receptor, ionotropic, AMPA 2	ion channel	subcortex
GRIA3	2892	glutamate receptor, ionotrophic, AMPA 3	ion channel	subcortex
GRIA4	2893	glutamate receptor, ionotrophic, AMPA 4	ion channel	subcortex
GRIK1	2897	glutamate receptor, ionotropic, kainate 1	ion channel	subcortex
GRIK2	2898	glutamate receptor, ionotropic, kainate 2	ion channel	subcortex
GRIK3	2899	glutamate receptor, ionotropic, kainate 3	ion channel	subcortex
GRIK4	2900	glutamate receptor, ionotropic, kainate 4	ion channel	subcortex
GRIK5	2901	glutamate receptor, ionotropic, kainate 5	ion channel	subcortex
GRIN1	2902	glutamate receptor, ionotropic, N-methyl D-aspartate 1	ion channel	subcortex
GRIN2A	2903	glutamate receptor, ionotropic, N-methyl D-aspartate 2A	ion channel	subcortex
GRIN2B	2904	glutamate receptor, ionotropic, N-methyl D-aspartate 2B	ion channel	subcortex
GRIN2C	2905	glutamate receptor, ionotropic, N-methyl D-aspartate 2C	ion channel	subcortex
GRIN2D	2906	glutamate receptor, ionotropic, N-methyl D-aspartate 2D	ion channel	subcortex

Table 5. Genes characterized by ISH in subcortex study.

Gene Symbol	EntrezID	Gene Description	Category	
			Gene Family	Target Region
GRM1	2911	glutamate receptor, metabotropic 1	GPCR	subcortex
GRM2	2912	glutamate receptor, metabotropic 2	GPCR	subcortex
GRM3	2913	glutamate receptor, metabotropic 3	GPCR	subcortex
GRM4	2914	glutamate receptor, metabotropic 4	GPCR	subcortex
GRM5	2915	glutamate receptor, metabotropic 5	GPCR	subcortex
GRM6	2916	glutamate receptor, metabotropic 6 (GluR6)	GPCR	subcortex
GRM7	2917	glutamate receptor, metabotropic 7	GPCR	subcortex
GRM8	2918	glutamate receptor, metabotropic 8	GPCR	subcortex
NPY	4852	neuropeptide Y	peptide ligand	hypothalamus
NPY1R	4886	neuropeptide Y receptor Y1	GPCR	hypothalamus
PDYN	5173	prodynorphin	peptide ligand	hypothalamus
PMCH	5367	pro-melanin-concentrating hormone	peptide ligand	hypothalamus
PVALB	5816	parvalbumin	signal transduction	hypothalamus
SLC17A6	57084	solute carrier family 17 (sodium-dependent inorganic phosphate cotransporter), member 6	transporter	subcortex
SLC17A7	57030	solute carrier family 17 (sodium-dependent inorganic phosphate cotransporter), member 7	transporter	subcortex
SLC17A8	246213	solute carrier family 17 (sodium-dependent inorganic phosphate cotransporter), member 8	transporter	subcortex
SLC1A1	6505	solute carrier family 1 (neuronal/epithelial high affinity glutamate transporter, system Xag), member 1	transporter	subcortex
SLC1A2	6506	solute carrier family 1 (glial high affinity glutamate transporter), member 2	transporter	subcortex
SLC1A3	6507	solute carrier family 1 (glial high affinity glutamate transporter), member 3	transporter	subcortex

Table 5. Genes characterized by ISH in subcortex study.

Gene Symbol	EntrezID	Gene Description	Category	
			Gene Family	Target Region
SLC1A4	6509	solute carrier family 1 (glutamate/neutral amino acid transporter), member 4	transporter	subcortex
SLC32A1	140679	solute carrier family 32 (GABA vesicular transporter), member 1	transporter	subcortex
SLC6A1	6529	solute carrier family 6 (neurotransmitter transporter, GABA), member 1	transporter	subcortex
SLC6A11	6538	solute carrier family 6 (neurotransmitter transporter, GABA), member 11	transporter	subcortex
SST	6750	somatostatin	peptide ligand	hypothalamus
TAC1	6863	tachykinin, precursor 1 (substance K, substance P, neurokinin 1, neurokinin 2, neuromedin L, neurokinin alpha, neuropeptide K, neuropeptide gamma)	peptide ligand	hypothalamus
TRH	7200	thyrotropin-releasing hormone	peptide ligand	hypothalamus