Table S1. Top 25 metabolites that correlate with age within either the ASD or the neurotypical children group.

ASD				Neurotypical			
	Spearman correlation				Spearman correlation		
Metabolites	r-value	2-tailed un-adj. p-value	2-tailed adjusted p-value	Metabolites	r-value	2-tailed un-adj. p-value	2-tailed adjusted p-value
Trimethylamine	-0.63	0.001	0.089	pH	-0.57	0.007	0.300
Malonate	-0.59	0.003	0.101	Histidine	-0.56	0.009	0.300
Methylamine	-0.53	0.009	0.205	Arginine	0.41	0.068	0.908
Choline	-0.50	0.014	0.239	GABA/glutamate	-0.39	0.083	0.908
p-Cresol	-0.47	0.022	0.300	Fumarate	0.38	0.088	0.908
3-Phenylpropionate	0.45	0.031	0.353	GABA	-0.36	0.106	0.908
pH/SCFA	0.42	0.046	0.443	Isopropanol	0.36	0.107	0.443
N-Acetylglycine	-0.40	0.058	0.496	Valerate	0.35	0.122	0.496
SCFA*	-0.39	0.069	0.520	o-Cresol	0.32	0.158	0.520
Acetate	-0.36	0.089	0.602	Aspartate	-0.32	0.161	0.602
pH	0.34	0.115	0.709	Methylamine	0.31	0.166	0.709
Xanthine	-0.31	0.157	0.820	2-Aminobutyrate	0.26	0.259	0.820
GABA	-0.30	0.163	0.820	Ethanol	-0.24	0.296	0.820
GABA/glutamate	-0.26	0.223	0.820	Lysine	-0.23	0.311	0.820
Butyrate	-0.26	0.235	0.820	Butyrate	0.23	0.321	0.820
Glucose	-0.25	0.243	0.820	Caprate	0.23	0.325	0.820
Methanol	-0.25	0.243	0.820	p-Cresol	-0.22	0.336	0.820
Nicotinate	-0.25	0.248	0.820	Threonine	-0.21	0.350	0.820
N,N-Dimethylglycine	0.25	0.256	0.820	Methionine	-0.21	0.370	0.820
Propionate	-0.24	0.265	0.820	SCFA*	0.20	0.381	0.820
Uracil	-0.23	0.302	0.820	N-Acetylglycine	0.19	0.397	0.820
Glutamate	-0.22	0.303	0.820	Glycerol	-0.18	0.427	0.820
Succinate	-0.22	0.313	0.820	Valine	-0.18	0.432	0.820
Thymine	-0.22	0.315	0.820	Valine	-0.18	0.432	0.820
Tyrosine	-0.22	0.317	0.820	pH/SCFA	-0.18	0.432	0.820

*SCFA stands for short chain fatty acid including acetate, butyrate, propionate, and valerate.

Table S2. Top 25 variable combinations with highest sensitivity and specificity.

Variable Combination					> 20%		> 30%	
					Sensitivity	Specificity	Sensitivity	Specificity
Caprate	Nicotinate	Glutamine	Thymine	Aspartate	78.26	80.95	69.57	95.24
Caprate	Nicotinate	Glutamine	Aspartate	Taurine	69.57	57.14	69.57	95.24
Caprate	Nicotinate	Glutamine	Glutamate	Aspartate	78.26	66.67	69.57	90.48
Isopropanol	Caprate	Nicotinate	β-Alanine	Aspartate	73.91	66.67	69.57	90.48
Isopropanol	Caprate	Nicotinate	Glutamine	Aspartate	78.26	66.67	65.22	90.48
Caprate	Glutamine	Glutamate	Aspartate	Butyrate	78.26	61.90	65.22	90.48
Isopropanol	Caprate	Nicotinate	Trimethylamine	Aspartate	73.91	57.14	65.22	90.48
Isopropanol	Caprate	Nicotinate	Aspartate	Taurine	73.91	52.38	73.91	85.71
Caprate	Glycerol	Nicotinate	Glutamate	Aspartate	73.91	42.86	73.91	85.71
Isopropanol	Caprate	Glutamine	Glutamate	Aspartate	73.91	66.67	69.57	85.71
Lactate	Formate	Caprate	Nicotinate	Aspartate	78.26	61.90	69.57	85.71
Caprate	Nicotinate	Glutamine	Aspartate	Uracil	73.91	61.90	69.57	85.71
Caprate	Glycerol	Nicotinate	Thymine	Uracil	73.91	66.67	65.22	85.71
Caprate	Glutamine	Methylamine	Glutamate	Aspartate	78.26	66.67	60.87	85.71
Isopropanol	Formate	Caprate	Aspartate	Butyrate	78.26	71.43	73.91	80.95
Lactate	Caprate	Glutamine	Glutamate	Aspartate	82.61	61.90	73.91	80.95
Isopropanol	Caprate	Nicotinate	O-Phosphocholine	Aspartate	82.61	57.14	73.91	80.95
Caprate	Nicotinate	Glutamine	O-Phosphocholine	Aspartate	78.26	61.90	69.57	80.95
Caprate	Nicotinate	Glutamine	β-Alanine	Aspartate	78.26	61.90	69.57	80.95
Isopropanol	Formate	Caprate	Nicotinate	Aspartate	73.91	61.90	69.57	80.95
Caprate	Nicotinate	Glutamine	Methylamine	Aspartate	73.91	61.90	69.57	80.95
Caprate	Isobutyrate	Nicotinate	Glutamine	Aspartate	69.57	61.90	69.57	80.95
Caprate	Fumarate	Nicotinate	Glutamine	Aspartate	78.26	57.14	69.57	80.95
Caprate	Nicotinate	Glutamine	Aspartate	Butyrate	78.26	57.14	69.57	80.95
Caprate	Histidine	Glutamine	Glutamate	Aspartate	73.91	57.14	69.57	80.95

Table S3. Alpha diversity (Observed OTUs and PD) and relative abundances of *Prevotella* were significantly lower in feces of children with ASD, when 9 re-invited samples (3 neurotypical and 6 autistic) were excluded[*].

	Two-tailed Mann-Whitney U test p value[**]	Median[***] (25%/75%)	
		Neurotypical (n=18)	ASD (n=17)
Observed OTUs	0.001	990 (918/1,098)	763 (567/882)
PD index	0.004	60 (53/67)	48 (34/55)
Prevotella	0.04	0.02 (<0.01/6.28)	0 (0/0.03)
Coprococcus	0.18	0.77 (0.25/1.84)	0.23 (0.11/1.30)

[*] In order to confirm our previous observations (Kang et al 2013), we excluded 9 re-invited samples and performed the analyses with newly recruited samples (18 neurotypical and 17 autistic samples).

[**] P values are from two-tailed Mann-Whitney U-test in order to test the hypothesis.

Table S4. Paired metabolites and bacterial phylotypes that have correlations (un-adjusted *p* values less than 0.005 and adjusted *p* values less than 0.30).

Metabolites	Bacterial phylotypes (family/genus)	Correlations			Bacterial phylotype abundances (%) Median (25%/75%)		
		r-value	2-tailed un-adj. *p*-value	2-tailed adj. *p*-value	Neurotypical (n=21)	Autistic (n=23)	2-tailed un-adj. *p*-value
Lactate	*Ruminococcaceae/Butyricicoccus*	0.48	0.0001	0.16	0.04 (0.02/0.15)	<0.01 (0/0.03)	0.006
Formate	*Lachnospiraceae/Roseburia*	0.46	0.002	0.18	0.43 (0.13/1.44)	0.08 (0.03/0.26)	0.007
Lactate	*Rikenellaceae/unclassified*	-0.43	0.004	0.29	0.05 (0.03/0.14)	0.35 (0.08/0.60)	0.023
GABA	*Lachnospiraceae/Roseburia*	0.43	0.004	0.30	0.43 (0.13/1.44)	0.08 (0.03/0.26)	0.007

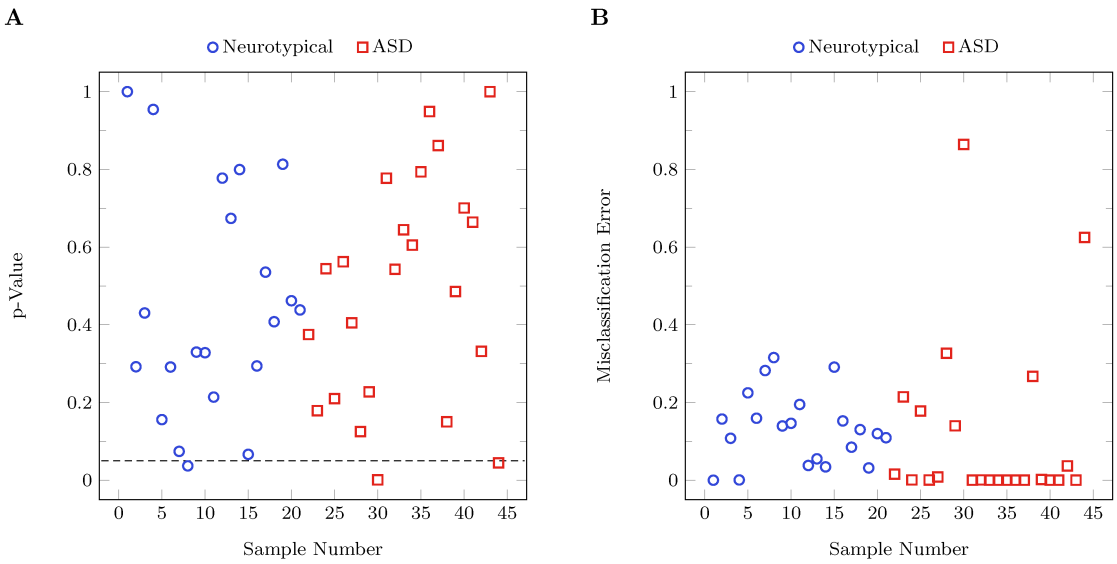

Figure S1. Results of leave-one-out cross-validation analysis of the FDA model: (A) individual *p* values that the individual belongs to their true group and (B) misclassification errors or the probabilities that the individuals belong to the opposite group.

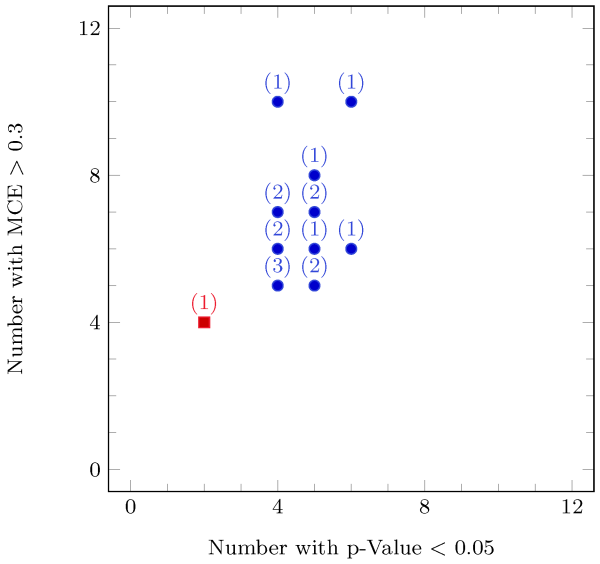

Figure S2. Performance of the top-performing five variable combinations. Numbers in parentheses indicate the number of different variable combinations that produced the same performance result based on *p* values and Misclassification Errors (MCEs). The Pareto-optimal variable combination, denoted by a red square, was selected for further analysis.

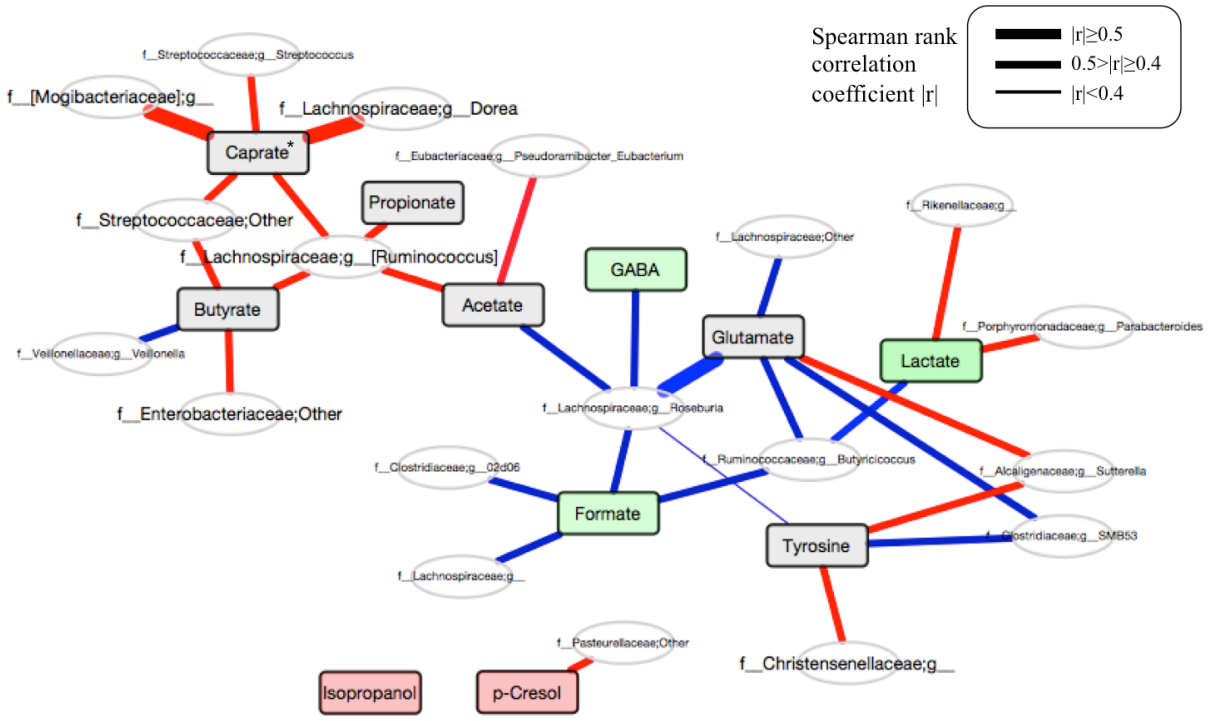

Figure S3. Co-occurrence network between microbial phylotypes and metabolites listed in Table 2. Microbiota-metabolite pairs that show relevant correlation (adjusted *p* values less than 0.35) are presented in the network. Green- and red-shaded nodes indicate higher and lower levels in neurotypical children, respectively (one-tailed Mann-Whitney U test, un-adjusted *p* values <0.05 listed in Table 2). Grey-shaded nodes indicate metabolites that have comparable levels between groups. The edge colors represent either positive (blue) or negative (red) correlation based on Spearman-rank correlation test. Thicker edges indicate stronger correlations based on Spearman rank correlation coefficient (r) (please see the legend in the figure). For phylotypes, 'f__' and 'g__' indicate family and genus level classification, respectively. * Caprate assignment is tentative.

Kang DW, Park JG, Ilhan ZE, Wallstrom G, Labaer J, Adams JB *et al* (2013). Reduced incidence of *Prevotella* and other fermenters in intestinal microflora of autistic children. *PLoS One* **8:** e68322.