

Supplementary Table 11A: Top 50 SNPs in tests of $J_0^{(g)}$. Tests of $J_0^{(g)}$ and $\mathcal{M}_0^{(g)}$ were performed for G×R and Main effect models, respectively, for 488,200 SNPs of the learning performance scores over the PING sample (n=479). Both models included covariates for status of learning problem diagnosis and first two PCs of genotype data. Learning performance scores were, by construction, uncorrelated with age, sex, household income, and parental education. CHR, POS, MAF, and MA are chromosome, position, minor allele frequency (within PING sample), and minor allele, respectively, for given SNP. SNPs were genotyped with the Illumina Human660W-Quad Beadchip array and their positions correspond to HG build 19. F-tests of $J_0^{(g)}$ were performed with statistic having 2 and 472 df. F-tests of $\mathcal{M}_0^{(g)}$ were performed with statistic having 1 and 474 df. F-tests of $\mathcal{M}_{0;PNC}^{(g)}$ were performed with statistic having 1 and 2,322 df. Information gain are for respective G×R and Main effect models over the PING sample (n=479). It represents in the increase in adjusted R² for respective model fit over that of the non-genetic base model including only the covariates.

| Rank | SNP | CHR | POS | MAF | MA | P-values | | Information Gain | | Estimates | | | | Standard errors | | | |
|------|------------|-----|-----------|------|----|-------------|-----------------------|------------------|------|------------|-----------|------------|------------|-----------------|-----------|------------|------------|
| | | | | | | $J_0^{(g)}$ | $\mathcal{M}_0^{(g)}$ | G×R | Main | α_g | β_g | γ_g | θ_g | α_g | β_g | γ_g | θ_g |
| 1 | rs11633708 | 15 | 87050708 | 0.47 | G | 3.49E-08 | 2.28E-06 | 7.9 | 4.3 | -0.807 | -0.899 | 0.437 | -0.198 | 0.179 | 0.219 | 0.135 | 0.041 |
| 2 | rs4243100 | 15 | 87037559 | 0.45 | A | 4.01E-08 | 6.54E-05 | 7.8 | 3.0 | 0.244 | 1.025 | -0.534 | 0.168 | 0.173 | 0.214 | 0.132 | 0.042 |
| 3 | rs11853362 | 15 | 87057124 | 0.44 | A | 1.70E-07 | 7.66E-05 | 7.3 | 2.9 | -0.898 | -1.001 | 0.514 | -0.172 | 0.182 | 0.223 | 0.137 | 0.043 |
| 4 | rs11632104 | 15 | 87049894 | 0.45 | A | 2.04E-07 | 2.95E-04 | 7.2 | 2.4 | 0.241 | 1.009 | -0.532 | 0.152 | 0.174 | 0.215 | 0.133 | 0.042 |
| 5 | rs4887473 | 15 | 87053206 | 0.45 | A | 2.04E-07 | 2.95E-04 | 7.2 | 2.4 | 0.241 | 1.009 | -0.532 | 0.152 | 0.174 | 0.215 | 0.133 | 0.042 |
| 6 | rs2011905 | 15 | 87053846 | 0.45 | A | 2.11E-07 | 3.08E-04 | 7.2 | 2.4 | 0.239 | 1.007 | -0.531 | 0.152 | 0.174 | 0.215 | 0.133 | 0.042 |
| 7 | rs6496338 | 15 | 86993635 | 0.48 | G | 1.79E-06 | 1.15E-04 | 6.4 | 2.8 | -0.747 | -0.878 | 0.441 | -0.167 | 0.166 | 0.227 | 0.140 | 0.043 |
| 8 | rs4887466 | 15 | 86995749 | 0.48 | G | 1.79E-06 | 1.15E-04 | 6.4 | 2.8 | -0.747 | -0.878 | 0.441 | -0.167 | 0.166 | 0.227 | 0.140 | 0.043 |
| 9 | rs9920533 | 15 | 60673192 | 0.10 | A | 5.71E-06 | 1.13E-05 | 6.0 | 3.7 | -1.172 | -0.429 | 0.477 | 0.319 | 0.437 | 0.378 | 0.235 | 0.072 |
| 10 | rs8042879 | 15 | 87093955 | 0.45 | G | 9.29E-06 | 1.03E-05 | 5.8 | 3.7 | -0.604 | -0.620 | 0.272 | -0.191 | 0.185 | 0.223 | 0.138 | 0.043 |
| 11 | rs17260000 | 1 | 209057061 | 0.13 | G | 9.90E-06 | 9.36E-06 | 5.7 | 3.7 | 0.401 | 0.335 | -0.401 | -0.283 | 0.382 | 0.331 | 0.212 | 0.063 |
| 12 | rs1533046 | 2 | 22594727 | 0.45 | A | 1.20E-05 | 5.06E-06 | 5.7 | 4.0 | -0.582 | -0.241 | 0.272 | 0.194 | 0.188 | 0.214 | 0.135 | 0.042 |
| 13 | rs10517873 | 4 | 166850443 | 0.09 | G | 1.32E-05 | 3.68E-01 | 5.6 | 0.0 | -2.401 | -1.728 | 1.158 | 0.067 | 0.457 | 0.389 | 0.246 | 0.074 |
| 14 | rs1110413 | 5 | 76223856 | 0.15 | A | 1.34E-05 | 2.71E-03 | 5.6 | 1.6 | 0.959 | 1.336 | -0.740 | 0.185 | 0.382 | 0.332 | 0.212 | 0.061 |
| 15 | rs10220773 | 15 | 86903044 | 0.48 | A | 1.52E-05 | 7.84E-04 | 5.6 | 2.1 | -0.732 | -0.838 | 0.423 | -0.151 | 0.167 | 0.232 | 0.143 | 0.045 |
| 16 | rs12482611 | 21 | 39417989 | 0.10 | A | 1.87E-05 | 2.83E-01 | 5.5 | 0.0 | 1.781 | 1.839 | -1.137 | 0.074 | 0.471 | 0.392 | 0.250 | 0.069 |
| 17 | rs10281072 | 7 | 11535903 | 0.08 | G | 2.08E-05 | 1.77E-04 | 5.5 | 2.6 | -1.833 | -1.553 | 0.815 | -0.302 | 0.563 | 0.460 | 0.294 | 0.080 |
| 18 | rs1341458 | 1 | 241583612 | 0.48 | C | 2.13E-05 | 2.19E-01 | 5.4 | 0.1 | 0.420 | 0.955 | -0.640 | -0.053 | 0.188 | 0.226 | 0.141 | 0.043 |
| 19 | rs6536942 | 4 | 166986194 | 0.08 | G | 2.95E-05 | 2.51E-05 | 5.3 | 3.4 | -0.925 | -0.870 | 0.328 | -0.338 | 0.486 | 0.419 | 0.260 | 0.079 |
| 20 | rs10749321 | 10 | 121207961 | 0.41 | A | 3.09E-05 | 1.35E-01 | 5.3 | 0.3 | -1.077 | -0.875 | 0.603 | 0.065 | 0.205 | 0.227 | 0.141 | 0.044 |
| 21 | rs9406769 | 9 | 19995895 | 0.16 | A | 4.37E-05 | 4.75E-05 | 5.2 | 3.1 | 0.379 | 0.850 | -0.398 | 0.230 | 0.316 | 0.292 | 0.181 | 0.056 |
| 22 | rs13142383 | 4 | 133561788 | 0.37 | G | 4.63E-05 | 6.63E-06 | 5.1 | 3.9 | -0.250 | 0.245 | -0.034 | 0.196 | 0.206 | 0.229 | 0.144 | 0.043 |
| 23 | rs13134454 | 4 | 133530329 | 0.37 | G | 4.86E-05 | 6.93E-06 | 5.1 | 3.9 | -0.204 | 0.297 | -0.068 | 0.194 | 0.203 | 0.225 | 0.141 | 0.043 |
| 24 | rs12054223 | 3 | 137528884 | 0.07 | G | 4.97E-05 | 2.32E-02 | 5.1 | 0.8 | 1.584 | 1.790 | -1.022 | 0.192 | 0.512 | 0.428 | 0.270 | 0.084 |
| 25 | rs6665593 | 1 | 2140261 | 0.14 | A | 5.09E-05 | 2.57E-04 | 5.1 | 2.5 | -1.084 | -0.946 | 0.457 | -0.223 | 0.340 | 0.309 | 0.193 | 0.061 |

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| Rank | SNP | CHR | POS | MAF | MA | P-values | | Information Gain | | Estimates | | | | Standard errors | | | |
|------|------------|-----|-----------|------|----|-------------|-----------------------|------------------|------|------------|-----------|------------|------------|-----------------|-----------|------------|------------|
| | | | | | | $J_0^{(g)}$ | $\mathcal{M}_0^{(g)}$ | G×R | Main | α_g | β_g | γ_g | θ_g | α_g | β_g | γ_g | θ_g |
| 26 | rs5766424 | 22 | 45502533 | 0.50 | G | 5.17E-05 | 3.70E-04 | 5.1 | 2.4 | 0.056 | 0.407 | -0.366 | -0.162 | 0.186 | 0.243 | 0.152 | 0.045 |
| 27 | rs2279604 | 5 | 34687911 | 0.35 | G | 5.29E-05 | 6.01E-06 | 5.1 | 3.9 | -0.378 | -0.312 | 0.073 | -0.206 | 0.226 | 0.240 | 0.152 | 0.045 |
| 28 | rs6958208 | 7 | 48984046 | 0.24 | G | 5.44E-05 | 1.40E-04 | 5.1 | 2.7 | -0.835 | -0.320 | 0.339 | 0.195 | 0.278 | 0.267 | 0.170 | 0.051 |
| 29 | rs1875341 | 4 | 7237092 | 0.44 | A | 5.70E-05 | 1.12E-01 | 5.1 | 0.3 | -0.949 | -0.981 | 0.582 | -0.068 | 0.184 | 0.223 | 0.139 | 0.043 |
| 30 | rs10771958 | 12 | 32638162 | 0.33 | C | 5.73E-05 | 6.01E-03 | 5.1 | 1.3 | -0.971 | -0.698 | 0.523 | 0.126 | 0.215 | 0.235 | 0.147 | 0.046 |
| 31 | rs17793675 | 9 | 82869545 | 0.09 | G | 5.79E-05 | 5.45E-04 | 5.1 | 2.2 | 0.908 | 1.297 | -0.667 | 0.261 | 0.464 | 0.392 | 0.249 | 0.075 |
| 32 | rs9406760 | 9 | 19971287 | 0.47 | A | 5.86E-05 | 2.43E-02 | 5.1 | 0.8 | 0.260 | 0.911 | -0.517 | 0.098 | 0.183 | 0.220 | 0.138 | 0.043 |
| 33 | rs17050441 | 4 | 139402774 | 0.14 | G | 6.17E-05 | 5.07E-03 | 5.0 | 1.4 | -1.441 | -0.863 | 0.665 | 0.177 | 0.351 | 0.316 | 0.197 | 0.063 |
| 34 | rs11726117 | 4 | 113353285 | 0.35 | A | 7.12E-05 | 6.52E-05 | 5.0 | 3.0 | -0.545 | -0.060 | 0.157 | 0.176 | 0.222 | 0.234 | 0.147 | 0.044 |
| 35 | rs2003880 | 8 | 6788102 | 0.18 | A | 7.17E-05 | 5.93E-02 | 5.0 | 0.5 | 0.935 | 1.263 | -0.742 | 0.105 | 0.329 | 0.297 | 0.187 | 0.056 |
| 36 | rs699096 | 5 | 162100311 | 0.50 | G | 7.53E-05 | 7.51E-01 | 5.0 | -0.2 | -0.925 | -0.964 | 0.622 | 0.014 | 0.173 | 0.225 | 0.141 | 0.044 |
| 37 | rs17014035 | 1 | 206841857 | 0.20 | C | 7.76E-05 | 2.47E-02 | 4.9 | 0.8 | -1.266 | -0.881 | 0.623 | 0.116 | 0.274 | 0.265 | 0.164 | 0.052 |
| 38 | rs2060060 | 15 | 86900992 | 0.49 | G | 7.99E-05 | 1.59E-03 | 4.9 | 1.8 | -0.699 | -0.767 | 0.387 | -0.142 | 0.170 | 0.231 | 0.143 | 0.045 |
| 39 | rs4609816 | 15 | 87102625 | 0.47 | A | 8.20E-05 | 4.25E-05 | 4.9 | 3.2 | -0.534 | -0.519 | 0.219 | -0.174 | 0.181 | 0.220 | 0.136 | 0.042 |
| 40 | rs9407951 | 9 | 19959158 | 0.50 | G | 8.47E-05 | 2.84E-02 | 4.9 | 0.8 | -0.790 | -0.881 | 0.500 | -0.094 | 0.164 | 0.217 | 0.137 | 0.043 |
| 41 | rs1032725 | 12 | 32641200 | 0.33 | G | 8.65E-05 | 6.96E-03 | 4.9 | 1.3 | -0.947 | -0.671 | 0.505 | 0.122 | 0.213 | 0.232 | 0.146 | 0.045 |
| 42 | rs417342 | 4 | 139282314 | 0.39 | G | 8.65E-05 | 5.12E-02 | 4.9 | 0.6 | 0.290 | 0.897 | -0.512 | 0.083 | 0.188 | 0.216 | 0.135 | 0.043 |
| 43 | rs17484454 | 4 | 149209008 | 0.27 | G | 8.72E-05 | 4.96E-05 | 4.9 | 3.1 | -0.721 | -0.646 | 0.305 | -0.192 | 0.258 | 0.253 | 0.165 | 0.047 |
| 44 | rs7597588 | 2 | 216486659 | 0.11 | A | 8.97E-05 | 5.08E-04 | 4.9 | 2.2 | -1.433 | -0.769 | 0.630 | 0.239 | 0.439 | 0.382 | 0.237 | 0.068 |
| 45 | rs1071501 | 16 | 54131681 | 0.18 | G | 9.02E-05 | 5.53E-03 | 4.9 | 1.4 | 0.822 | 1.172 | -0.656 | 0.153 | 0.357 | 0.314 | 0.200 | 0.055 |
| 46 | rs872072 | 14 | 20859013 | 0.45 | A | 9.45E-05 | 1.75E-03 | 4.9 | 1.8 | -0.742 | -0.542 | 0.425 | 0.139 | 0.178 | 0.228 | 0.140 | 0.044 |
| 47 | rs1550883 | 8 | 94305178 | 0.13 | G | 9.49E-05 | 3.51E-02 | 4.9 | 0.7 | -1.706 | -1.389 | 0.794 | -0.133 | 0.384 | 0.338 | 0.210 | 0.063 |
| 48 | rs2339518 | 2 | 22598926 | 0.45 | G | 9.51E-05 | 4.15E-05 | 4.9 | 3.2 | -0.579 | -0.250 | 0.265 | 0.173 | 0.191 | 0.217 | 0.137 | 0.042 |
| 49 | rs12771377 | 10 | 22717779 | 0.06 | G | 9.68E-05 | 7.37E-03 | 4.9 | 1.3 | -2.065 | -1.757 | 0.940 | -0.253 | 0.545 | 0.466 | 0.288 | 0.094 |
| 50 | rs12421046 | 11 | 36354576 | 0.06 | C | 9.68E-05 | 4.38E-05 | 4.9 | 3.2 | 0.631 | 0.366 | -0.487 | -0.396 | 0.592 | 0.487 | 0.309 | 0.096 |