Immediate Communication

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Genome-wide association studies establish that human intelligence is highly heritable and polygenic

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General intelligence is an important human quantitative trait that accounts for much of the variation in diverse cognitive abilities. Individual differences in intelligence are strongly associated with many important life outcomes, including educational and occupational attainments, income, health and lifespan. Data from twin and family studies are consistent with a high heritability of intelligence, but this inference has been controversial. We conducted a genome-wide analysis of 3511 unrelated adults with data on 549 692 single nucleotide polymorphisms (SNPs) and detailed phenotypes on cognitive traits. We estimate that 40 of the variation in crystallized-type intelligence and 51 of the variation in fluid-type intelligence between individuals is accounted for by linkage disequilibrium between genotyped common SNP markers and unknown causal variants. These estimates provide lower bounds for the narrow-sense heritability of the traits. We partitioned genetic variation on individual chromosomes and found that, on average,

longer chromosomes explain more variation. Finally, using just SNP data we predicted ~1 of the variance of crystallized and fluid cognitive phenotypes in an independent sample (P 0.009 and 0.028, respectively). Our results unequivocally confirm that a substantial proportion of individual differences in human intelligence is due to genetic variation, and are consistent with many genes of small effects underlying the additive genetic influences on intelligence.

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