(American Psychologist, in press)

APA Award for Distinguished Scientific Contribution: Robert Plomin

Robert Plomin was born 1948 in Chicago, Illinois. Although he grew up in a poor family without books, he was an avid reader from an early age, bringing bags of books home from his local public library. No one in his family went to college, including his sister and a dozen cousins who lived nearby, but Robert got a Ph.D. in psychology. These differences, as well as differences in temperament between Robert and his relatives, sparked his lifelong interest in why people are so different, especially children growing up in the same family.

Robert's parents sent him and his sister to a local Catholic elementary school, even though they were not religious, because the teaching was thought to be better than at the public school. Two unforeseen advantages of the Catholic school system in Chicago were their penchant for testing and their scholarship program. Because Robert performed well on these tests, he was given scholarships to attend at no cost an excellent Catholic high school (DePaul Academy) and college (DePaul University).

Robert worked almost full-time throughout high school and college. He had his first job while still in elementary school, delivering chickens on Saturdays from a live poultry shop where his pay was a chicken plus tips. At college he took courses that fit his work schedule, toying with English and film studies but eventually working towards a philosophy major.

Increasingly, philosophy didn't feel right. Robert found himself frustrated because the questions that defined his philosophy classes seemed unanswerable. He kept trying to come up with testable hypotheses to solve philosophical disputes. He finally realized why his questions about testable hypotheses were stonewalled: If you can come up with a testable hypothesis, it's no longer philosophy – it's psychology. So Robert switched his major to psychology. This experience primed him to stay close to data. To this day, his most overused phrase is 'it's empirical'.

Robert went to graduate school in the Department of Psychology at the University of Texas at Austin. He was accepted into the personality program but after taking a course in behavioral genetics in 1971, one of the only such courses in the world, he was hooked because the research pointed to very powerful effects of genetics. In contrast, in his previous studies and psychology courses, genetics had scarcely been mentioned.

Robert began his career in behavioral genetics by studying temperament in the offspring of wild mice that he trapped in the geographical extremes of Texas deserts, Colorado mountains, and temperate regions of Texas. The results, published in 1974 in *Behavior Genetics*, supported the evolutionary theory of drift rather than geographical adaptation because mice differed temperamentally as much within as between geographical regions. Working in a tiny unventilated lab space, Robert developed a severe allergy to mice within a year. His allergy forced him to give up

hands-on research with mice, although he regretted losing the experimental power afforded by mouse research to control and manipulate both genes and environments.

Robert wanted to continue to study genetic influences on temperament, so he switched to study individual differences in children's temperament using the twin method that compares identical and fraternal twins. Robert co-authored a book in 1975 with his PhD supervisor, Arnold Buss, on a temperament theory of personality development that used evolutionary, developmental and genetic criteria to propose emotionality, activity and sociability as temperaments.

In 1974, after finishing his PhD at Texas, Robert got his dream job at the University of Colorado at Boulder with a joint appointment in the Department of Psychology and the Institute for Behavioral Genetics, the only institute of its kind in the world. He worked on a textbook in behavioral genetics with Gerald McClearn and John DeFries, the only textbook in the field, which is now in its seventh edition (Knopik, Neiderhiser, DeFries & Plomin, 2017). With John DeFries, he began the longitudinal Colorado Adoption Project (CAP) of 250 children relinquished for adoption at birth and 250 matched nonadoptive children, which continues today with the children now in their forties. This project cemented Robert's abiding interest in development, described in his first sole-authored book, *Development, Genes and Psychology* (Plomin, 1986).

In 1986, he moved to the Department of Human Development and Family Studies at the Pennsylvania State University with his spouse, Judy Dunn, a British psychologist who studied social development in families. While continuing to work on the Colorado Adoption Project, Robert developed his behavioral genetic research programmed focusing on three large-scale longitudinal twin studies. He was involved in a study of older reared-apart twins in Sweden, the Swedish Adoption/Twin Study of Aging (SATSA), with Jerry McClearn who had also moved to Pennsylvania State University. With David Reiss and E. Mavis Hetherington, Robert began a study at the developmental interface between genes and environment called the Nonshared Environment and Adolescent Development (NEAD) project. Another long-term project initiated at that time was a collaboration with developmental psychologists Bob Emde, Jerry Kagan, Joe Campos and Carolyn Zahn-Waxler to study the development of temperament, emotion and cognition in a longitudinal twin study from infancy to early childhood, the MacArthur Longitudinal Twin Study (MALTS). In 1994, he published a book that crystallized his interest in the developmental interface between nature and nurture (Plomin, 1994).

In 1994, Robert and Judy moved to London, where, with Michael Rutter, they established the Social, Genetic and Developmental Psychiatry Centre at the Institute of Psychiatry, Psychology and Neuroscience, King's College London. In 1995, Robert initiated the Twins Early Development Study (TEDS) of 10,000 pairs of British twins born between 1994 and 1996. He studied the behavioral development of the TEDS twins for 25 years since infancy, the largest longitudinal twin study on psychological development in the world. He is now following the twins into their early adult years

to explore the relatively unexplored era of emerging adulthood. TEDS has produced more than 300 papers and 29 PhD dissertations supervised by Robert.

Robert's career in behavioral genetics has contributed to a remarkable shift in psychology from antipathy towards genetics to acceptance, as evidenced by this 2017 APA Award for Distinguished Scientific Contributions. The APA award caps five other lifetime achievement awards from the major research associations relevant to Robert's research.

Robert recently published a list of the top-10 findings from behavioral genetics research (Plomin, DeFries, Knopik & Neiderhiser, 2016). These top-10 findings are big findings both in terms of effect size and potential impact on psychology and society. And, as an antidote to the current replication crisis in psychology, these findings have consistently replicated. Robert has made important contributions to all 10 findings. He likes to point out that four of the top-10 findings are about the environment rather than about genetics. Two findings about the environment, areas that Robert pioneered, have come from using genetically sensitive designs: the importance of nonshared environment (Plomin & Daniels, 1987; Dunn & Plomin, 1990) and finding genetic influence on measures of the environment widely used in psychological research (Plomin & Bergeman, 1991; Plomin, 1994).

Just as the pace of findings like these was beginning to slow, along came the DNA revolution, and Robert was at the center of it. Most of his current research uses DNA variants that contribute to the ubiquitous heritability of psychological traits. Sequencing the three billion DNA base pairs of the human genome led to the discovery of millions of inherited DNA differences, especially single-nucleotide polymorphisms (SNPs). These DNA differences can be used to estimate heritability directly in unrelated individuals rather than inferring heritability indirectly from the resemblance of family members such as twins (Plomin et al., 2013).

Genome-wide association (GWA) attempts to identify specific inherited DNA differences associated with dimensions or disorders. Robert led the first GWA study of general cognitive ability (intelligence) in 2001. This and his subsequent GWA studies showed that the heritability of psychological dimensions and disorders is caused by thousands of DNA differences of miniscule effect size.

In 2005, Robert showed that these tiny effects can be aggregated to create polygenic scores analogous to composites of items used to create reliable psychological scales. He dubbed these DNA scales consisting of thousands of SNP 'items' *genome-wide polygenic scores* (GPS). He likes the acronym GPS because, like its namesake, global positioning system, he believes that the DNA version of GPS will guide us to the world of personal genomics.

Personal genomics begins with the power of GPS to predict individuals' genetic strengths and weaknesses. Robert has recently shown that GPS can predict 4% of the variance in general cognitive ability and 9% of the variance in educational achievement at age 16 (Selzam et al., 2017). Because nothing changes inherited DNA

sequence variation, GPS are just as predictive at birth or even prenatally as they are later in life.

Robert believes that the DNA revolution will be a game-changer for psychological science. This is the theme of his latest book, which describes the DNA revolution and its implications for individuals, psychology and society (Plomin, in press).

One of the best things in life is to find something you love to do. Robert fell in love with behavioral genetics in the 1970s, a love that is even stronger 40 years later. He feels lucky to have been in the right place at the right time to help bring genetics to psychology, first with twin and adoption studies and now with DNA. Because genetics is advancing faster than any area of science, the best is yet to come.

Selected bibliography

Robert Plomin

Plomin, R. (1986). *Development, genetics, and psychology.* Hillsdale, NJ: Erlbaum.

Plomin, R., & Daniels, D. (1987). Why are children in the same family so different from each other? (With Open Peer Commentary and Response) *Behavioral and Brain Sciences, 10,* 1-60. doi: 10.1017/S0140525X00055941

Dunn, J., & Plomin, R. (1990). *Separate lives: Why siblings are so different.* New York: Basic Books.

Plomin, R., & Bergeman, C. S. (1991). The nature of nurture: Genetic influence on "environmental" measures. (With Open Peer Commentary and Response). *Behavioral and Brain Sciences, 14,* 373-428. doi:10.1017/S0140525X00070278

Plomin, R. (1994). *Genetics and experience: The interplay between nature and nurture.* Newbury Park, CA: Sage Publications.

Plomin, R., Haworth, C. M. A., Meaburn, E. L., Price, T., Wellcome Trust Case Control Consortium 2, & Davis, O. S. P. (2013). Common DNA markers can account for more than half of the genetic influence on cognitive abilities. *Psychological Science, 24,* 568-568. doi: 10.1177/0956797612457952

Plomin, R., DeFries, J. C., Knopik, V. S., & Neiderhiser, J. M. (2016). Top 10 replicated findings from behavioral genetics. *Perspectives on Psychological Science*, 11, 3 – 23. doi: 10.1177/1745691615617439

Knopik, V. S., Neiderhiser, J. M., DeFries, J. C., & Plomin, R. (2017). *Behavioral genetics* (7th ed.). New York: Worth.

Selzam, S., Krapohl, E., von Stumm, S., O'Reilly, P., Rimfeld, K., Kovas, Y., Dale, P. S., Lee, J. J., & Plomin, R. (2017). Predicting educational achievement from DNA. *Molecular Psychiatry, 22,* 603-607. doi:10.1038/mp.2016.107

Plomin, R. (in press). *DNA matters: The essence of human individuality.* London: Allen Lane.