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# New Model of IQ Development Accounts for Ways That Even Small Environmental Changes Can Have a Big Impact, While Still Crediting the Influence of Genes

*Implications for enrichment programs for school-aged children*

WASHINGTON - A new mathematical model could help explain how certain environments can trigger changes in a person's IQ as well as the relative influence of genes and the environment on IQ by exploring how internal and external factors might interact. The model helps explain the puzzling finding that IQ scores have risen over time and suggests a larger environmental role in IQ than previously thought. The model and an extensive discussion appear in the April issue of *Psychological Review*, published by the American Psychological Association (APA).

William T. Dickens of The Brookings Institution in Washington, D.C. and James R. Flynn of the department of political studies, University of Otago, Dunedin, New Zealand, applied their statistical expertise to an unresolved paradox in IQ research: If most variation between people's IQs are due to differences in their genes, as has been widely argued, then why have IQs risen over several generations in some 20 nations? In other words, if IQ is highly heritable (75%), and the gene pool is stable, why does IQ change so much? Could it be that the environment -- such as a powerful "social multiplier" across a group of people -- amounts to much more than what's "left over" after genes? What's more, would environmental factors have to be impossibly large, or could mathematical laws uphold the power of small changes to have large effects?

To understand what explains IQ differences in everything from adoption and cross-racial parenting to enriched pre-schooling, Dickens and Flynn review IQ theory and studies to date. Flynn's previous finding that "massive IQ gains over time signal the existence of environmental factors of enormous potency" prompted Dickens and Flynn to develop a sophisticated model that measures both multiple influences on IQ and a self-perpetuating interplay among them. They use the analogy of a rise in Americans' basketball-playing ability since 1945, as the sport has begun to transcend baseball in popularity. Given that peoples' genes didn't improve in favor of shooting hoops, Dickens and Flynn explore how environmental influences -- from more practice and better coaching, to able players' putting themselves in more challenging settings -- would interact with capability. Their conclusion: Even a modest change in the environment, such as the introduction of basketball on TV, could trigger a process in which one rise in skills can lead to another rise, which causes another rise, and so on -- upward snowball effects they describe as "individual multipliers" and "social multipliers."

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Heritability Estimates Versus Large Environmental Effects (/pubs/journals/releases/rev1082346.pdf) (PDF, 1.0MB)

Similarly, the authors theorize about how industrialization's rising cognitive demands, at work and leisure, could in fact be the kind of widespread (but not necessarily large), steadily changing environmental factor that could account for the higher IQ scores across so many nations. Their model incorporates the variables of measured intelligence, genetic endowment and environmental influences to demonstrate how this might work. And in fact they find that the math bears out their reasoning: Small but steady changes in a population's environment could explain the kinds of IQ gains observed, without discounting genetics.

The model also examines the power of the "social multiplier" effect to shape individual IQ in accordance with the average IQs of one's social circle and society at large. What's more, say the authors, the mathematical model makes it possible to account for very large environmental effects that occur despite large genetic effects. By this new thinking, the importance of environment is not limited by the importance of genes, and vice versa. The model permits researchers to sidestep the seemingly insoluble debate over the exact contributions of genetics and environment, by instead viewing the two as contributing differently to a process that itself changes depending on a person's age and circumstances.

"Heritability isn't a very useful number for thinking about the direct impact of genes on IQ," says Dickens. "Changes in environment can produce changes in IQ that are several times as large when both are measured relative to their variation in the population."

Accordingly, the model enabled the researchers to reexamine IQ findings in special populations and in education. The authors' equations are consistent with findings that adopted and non-adopted siblings have highly correlated IQs while they share an environment but differentiate as they age and have more control over their environments, coming to match their biological parents more closely. The model also helps account for how early education programs rapidly raise the IQ scores of low-income children -- again, while they are in them, with slow decays after they leave. The authors suggest that childhood enrichment programs could produce long-term gains "if they taught children how to replicate outside the program the kinds of cognitively demanding experiences that produce IQ gains while they are in the program and motivate them to persist in that replication long after they have left the program."

Dickens and Flynn suggest a way for experimentation to test their model's "potential for surprising or even novel predictions," for example by testing IQ before and after radical environmental change -- such as time in jail or in a restrictive cult. Further, they remind readers that most environmental effects are relatively short-lived, suggesting that "improving IQs in childhood is not the way to raise the IQs of adults. Adult IQ is influenced mainly by adult environment."

**Article:** "Heritability Estimates Versus Large Environmental Effects: The IQ Paradox Resolved," William T. Dickens, The Brookings Institution; James R. Flynn, University of Otago (Dunedin, New Zealand); Psychological Review, Vol. 108, No. 2.

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