

Genetic and environmental influences on the Verbal-Perceptual-Image Rotation (VPR) model of the structure of mental abilities in the Minnesota study of twins reared apart

Wendy Johnson^{a,*}, Thomas J. Bouchard Jr.^a, Matt McGue, Nancy L. Segal^b,
Auke Tellegen^a, Margaret Keyes^a, Irving I. Gottesman^a

^a Department of Psychology, University of Minnesota-Twin Cities, 75 East River Road, Minneapolis, MN 55455, USA

^b California State University-Fullerton, USA

Received 22 February 2006; received in revised form 22 May 2006; accepted 31 October 2006

Available online 14 December 2006

Abstract

In previous papers [Johnson, W., & Bouchard Jr., T. J. (2005a). Constructive Replication of the Visual-Perceptual-Image Rotation (VPR) Model in Thurstone's (1941) Battery of 60 Tests of Mental Ability. *Intelligence*, 33, 417–430.] [Johnson, W., & Bouchard Jr., T. J. (2005b). The Structure of Human Intelligence: It's Verbal, perceptual, and image rotation (VPR), not Fluid and Crystallized. *Intelligence*, 33, 393–416.] we have proposed the Verbal, perceptual, and image rotation (VPR) model of the structure of mental abilities. The VPR model is hierarchical, with a *g* factor that contributes strongly to broad verbal, perceptual, and image rotation abilities, which in turn contribute to 8 more specialized abilities. The verbal and perceptual abilities, though separable, are highly correlated, as are the perceptual and mental rotation abilities. The verbal and mental rotation abilities are much less correlated. In this study we used the twin sample in the Minnesota Study of Twins Reared Apart to estimate the genetic and environmental influences and the correlations among them at each order of the VPR model. Genetic influences accounted for 67–79% of the variance throughout the model, with the exception of the second-stratum Content Memory factor, which showed 33% genetic influence. These influences could not be attributed to assessed similarity of rearing environment. Genetic correlations closely mirrored the phenotypic correlations. Together, these findings substantiate the theory that the entire structure of mental abilities is strongly influenced by genes.

© 2006 Elsevier Inc. All rights reserved.

Keywords: Genetic and environmental influences; Genetic and environmental correlations; Verbal and image rotation abilities; Intelligence; VPR model; *g* factor; Twin study

We recently demonstrated (Johnson & Bouchard, 2005a,b; Johnson, te Nijenhuis, & Bouchard, in press) that the Verbal-Perceptual-Image Rotation (VPR) model

of the structure of human intellectual abilities offers a more theoretically satisfactory description of that structure than the major competing theories. Based most closely on the ideas of Vernon (1964, 1965), the VPR model has firm roots in both ongoing discussions of theories regarding the nature and structure of intelligence since Spearman (1904) introduced the concept of *g*, and practical applications and observations

* Corresponding author. Tel.: +1 952 473 1673; fax: +1 952 473 1998.

E-mail address: john4350@umn.edu (W. Johnson).

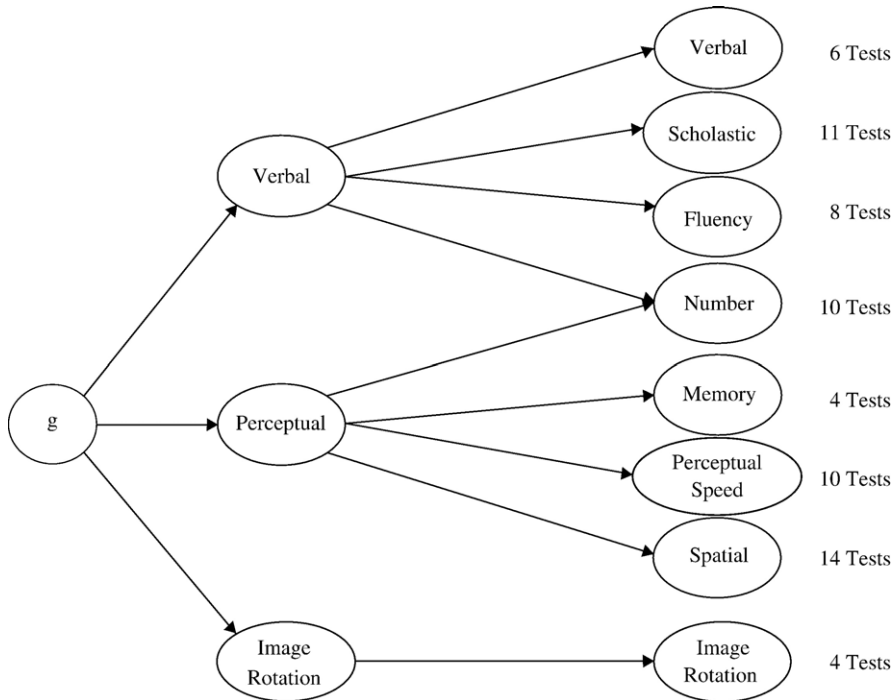


Fig. 1. Structural portion of verbal-perceptual-rotation (VPR) model.

related to occupational and academic aptitudes (Gottfredson, 2002; Humphreys & Lubinski, 1996). It includes a fourth stratum (Carroll, 1993) *g* factor that contributes strongly to broad third-stratum verbal, perceptual, and image rotation abilities. These contribute to 8 second-stratum factors representing more specialized abilities, which, in turn, contribute to specific test performance. The model is articulated in detail in Johnson and Bouchard (2005a), but we show it in Fig. 1 as well. In this implementation, the third-stratum verbal and perceptual abilities, though separable, were highly correlated (.80), as were the perceptual and image rotation abilities (.85). The verbal and image rotation abilities, however, were much less correlated (.41), though *g* contributed similarly to all of them. The third-stratum Verbal factor contributed to more specialized Verbal, Scholastic, Fluency, and Numerical abilities. The third-stratum Perceptual factor contributed to more specialized Numerical, Content Memory, Perceptual Speed, and Spatial abilities. Thus both the third-stratum Verbal and Perceptual Ability factors contributed to the specialized Numerical Ability factor, with Verbal Ability making the larger contribution. The third-stratum Image Rotation factor represented three-dimensional image rotation abilities.

This is the first formally presented four-stratum model in the intelligence domain. and some investiga-

tors have doubted the need for a fourth stratum (Jensen, 1998, pp. 67–68). Consequently we have carried out a number of replications (Johnson & Bouchard, 2005a,b). More recently we again constructively replicated the model using one of the largest data sets in the world. It consisted of a battery of 46 mental ability tests completed by 500 young Dutch seamen homogeneous in age and socioeconomic background. (Johnson et al., in press).

The purpose of this study was to make use of the twin pairs from the sample used to develop the VPR model to estimate the proportions of variance attributable to genetic and environmental influences and the relations among them at each factor level. This is important for several reasons. First, though the existence and relative magnitudes of genetic and environmental influences on both specialized and more general mental abilities as reflected in test scores are well established (Boomsma, Busjahn, & Peltonen, 2002; Bouchard, 1998; Devlin, Daniels, & Roeder, 1997; Jacobs et al., 2001; McClearn et al., 1997; Segal, 2000a; Segal & Hershberger, 2005; Teasdale & Owen, 1984; Toga & Thompson, 2005), we know much less about the relative magnitude of such influences on higher-order factors in the structure of mental abilities. That is, studies that have addressed the existence of genetic and environmental influences on mental ability structure have tended to limit the analysis

Download English Version:

<https://daneshyari.com/en/article/929415>

Download Persian Version:

<https://daneshyari.com/article/929415>

[Daneshyari.com](https://daneshyari.com)