Crystallized intelligence as a product of speed and drive for experience: the relationship of inspection time and openness to *g* and Gc

Timothy C. Bates*, Alexandra Shieles

Macquarie Centre for Cognitive Science, Macquarie University, Sydney NSW 2109, Australia

Abstract

The five-factor model personality domain of openness (O) is theoretically independent of intelligence and thus should not correlate with information-processing speed markers of general ability (g). Simultaneously, if information-processing speed is basic to g, then computational speed should correlate not only with g but also with subsidiary facets of intelligence, such as crystallized intelligence (G_C). These important relationships were explored using the inspection time (IT) measure of information-processing speed together with the O scale of the NEO-PI R (Costa & McCrae, 1995) and separate psychometric tests of g (Raven's Matrices) and G_C (vocabulary and comprehension). Raven's and the Gc measure correlated .598, while IT correlated with both Ravens ($r = -.558$) and G_C ($r = -.401$) supporting a basic role of computational speed in g. O correlated significantly with G_C ($r = .338$), but not with Raven's nor with IT. Structural equation modeling supported two models in which O was independent of g, with IT being basic to g, and with G_C reflecting the joint action of g and O. Paths from O to IT or to Raven's were not significant, suggesting that any apparent relationship of O to intelligence is due not to effects of O on ability, but rather to the effects of O on interest in knowledge, a joint final path with ability.
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* Corresponding author. Tel.: +61-2-9850-7111; fax: +61-2-9850-6059.
E-mail address: tim@maccs.mq.edu.au (T.C. Bates).

1. Introduction

This paper explores the relationship of cognitive processing speed (Deary, 2000) and openness (Goldberg, 1993; McCrae & Costa, 1997a) to fluid reasoning and crystallized intelligence (Cattell, 1971, 1998). These relationships are of interest because, while openness (O) correlates modestly with IQ scores (Holland, Dollinger, Holland, & MacDonald, 1995), it is theoretically independent of intelligence (McCrae, 1994). And, while factor analyses suggest speed is subsidiary to g (Carroll, 1993), speed-of-processing theories of intelligence suggest that processing speed is basic to g and unrelated to personality (Bates & Rock, submitted for publication). In this paper, we test a model in which O and fluid reasoning are independent constructs, which jointly determine knowledge. A cognitive-experimental measure of speed: inspection time (IT) (Deary & Stough, 1996) is used to test the theory that O has no direct relationship to ability while g is directly related to processing speed. To background the research, we first briefly introduce the hierarchical psychometric model of intelligence and cognitive-experimental processing-speed tasks, followed by a description of O and previous studies of its relationship to IQ scores.

1.1. General ability, speed of processing, and knowledge

The g or general ability factor of intelligence (Brody, 2000; Spearman, 1927) reflects correlations among diverse abilities. However, among this wealth of correlations, two very different types of cognitive tests in particular have assumed a theoretical role in explaining intelligence, speed-of-information-processing tasks (Deary, 2000), and measures of crystallized intelligence (G_C), knowledge tasks with little or no dependence on on-line reasoning (Cattell, 1998). In his initial work, Cattell argued for a distinction between crystallized knowledge (G_C) and fluid reasoning ability (G_F), which Spearman thought characteristic of g and which loads tests such as the Raven's Matrices. Much evidence now suggests that G_F and g are indistinguishable factorially (Undheim & Gustafsson, 1987). As Horn (1998) noted, G_F "best represent[s] Spearman's substantive theory of intelligence and model for g," a view supported by the high G_F loadings of the matrices tests designed by Spearman's student Raven (1958) to explicitly embody Spearman's model of g, as the "education of relations and correlates." The distinction between g and G_C allows a powerful test of processing-speed theories of g because, if cognitive processing speed is basic to g, then it should correlate with "Stratum-II" measures such as G_C in which speed and reasoning requirements are minimized.

Taxonomic data on "group" or Stratum-II factors (Brody, 2000; Carroll, 1993) show G_C appearing beneath g together with additional factors such as (in order of their g loading) memory and learning, visual perception, auditory perception, retrieval, cognitive speed, and, lastly, processing speed (Carroll, 1993). On the face of it, these factor analytic data suggest that information-processing speed may not be basic to intelligence, but may instead reflect specific or group-factor variance with only a derivative relation to g.