Available online at www.sciencedirect.com
ScienceDirect
Intelligence 34 (2006) 507–510
INTELLIGENCE

g and the measurement of Multiple Intelligences: A response to Gardner

Beth A. Visser [a,*], Michael C. Ashton [a], Philip A. Vernon [b]

[a] *Department of Psychology, Brock University, St. Catharines, Ontario, Canada L2S 3A1*
[b] *Department of Psychology, University of Western Ontario, London, Ontario, Canada N6A 5C2*

Received 14 April 2006; accepted 17 April 2006
Available online 5 June 2006

Abstract

Gardner [Gardner, H. (2006-this issue). On failing to grasp the core of MI theory: A response to Visser et al. *Intelligence*] criticized some aspects of our empirical examination [Visser, B. A., Ashton, M. C., & Vernon, P. A. (2006-this issue). Beyond *g*: Putting multiple intelligences theory to the test. *Intelligence*] of his "Theory of Multiple Intelligences". Specifically, Gardner questioned the construct validity of *g*, and suggested that the measures we used to test his theory were contaminated with verbal and logical demands. In this reply, we explain that the construct validity of *g* is well established, pointing out (a) that *g* is expressed in a wide variety of tasks (not all of which are "school-like" tasks), (b) that *g* predicts many important criterion variables (not only academic achievement), and (c) that *g* has a well-established biological basis. With regard to the measures used in our study, we point out that the verbal content of those tasks is unlikely to contribute to individual differences in task performance, and that the logical content of those tasks is consistent with Gardner's description of his intelligence domains.

Keywords: Multiple intelligences; g; Mental abilities; Cognitive abilities

In response to our empirical investigation (Visser, Ashton, & Vernon, 2006-this issue) of Multiple Intelligences (MI) theory, Gardner (2006-this issue) has raised several criticisms, focusing mainly on the construct validity and utility of *g* and on the content of the tasks that we used to measure his multiple intelligences. He argued that *g* "is simply a statistical entity" and that "one can manipulate '*g*', depending on how 'school like' the task is". Gardner went on to claim that "even a century after Spearman introduced the term, we still have little understanding of what '*g*' – the positive manifold among various measures – actually is." With regard to our measures of his eight intelligence domains, Gardner objected to what he perceived as the logical/mathematical and verbal content of those tasks, suggesting that "those that are not logical typically foreground a verbal component". According to Gardner, these tasks involved logical and/or verbal demands that would not occur in "intelligence-fair" versions of these tests.

In this article, we address the above criticisms. We first examine the construct validity of *g*, by discussing (a) the diverse content and format of *g*-loaded tasks, (b) the conditions under which *g* is largely invariant, (c) the

* Corresponding author.
E-mail addresses: b.visser@cogeco.ca (B.A. Visser), mashton@brocku.ca (M.C. Ashton), vernon@uwo.ca (P.A. Vernon).

0160-2896/$ - see front matter © 2006 Elsevier Inc. All rights reserved.
doi:10.1016/j.intell.2006.04.006

practical, "real-world" criterion validity of *g*, and (d) the biological basis of *g*. We then respond to Gardner's arguments about the relevance of our measures to his "intelligence" domains, discussing his concerns about both the "verbal lens" and also the "strong logical component" of those tasks.

1. The construct validity of *g*

1.1. Content of g-loaded tasks

To begin, Gardner (2006-this issue) is mistaken in his suggestion that *g* can be understood simply in terms of task content areas or task demands that are common in Western school-like settings. On the contrary, rather high *g*-loadings are observed for many non-paper-and-pencil tasks that do not involve verbal or quantitative content (e.g., Block Design, Picture Concepts; Watkins, 2006), and task *g*-loadings remain high across timed (i.e., speeded) and untimed conditions (e.g., Vernon, Nador, & Kantor, 1985). In contrast, some tasks that do involve "school-like" demands of the kind listed by Gardner (i.e., speed of response, motivation to succeed, facility in manipulating symbols) tend not to show particularly high *g*-loadings (e.g., tasks that use numbers or words to assess clerical or perceptual speed and accuracy; Marshalek, Lohman, & Snow, 1983). Of course, some school-like tasks do show very high *g*-loadings (e.g., vocabulary, arithmetic reasoning), but the features described by Gardner are neither necessary nor sufficient conditions for a task to be highly *g*-loaded. In summary, the *g* factor cannot be understood in terms of any "school-like" content or demands of mental ability tasks.

1.2. Invariance of g

Next, let us consider Gardner's suggestion that *g* varies widely from one investigation to the next. First, individuals' scores on indicators of *g* tend to be very highly intercorrelated across batteries: for example, even in our own rather range-restricted sample (Visser et al., 2006-this issue), scores on the Wonderlic Personnel Test correlated .76 with scores on the *g* factor derived from the markers of the "multiple intelligences". Also, the *g*-loadings of a given task will be highly consistent from one battery to another (e.g., Thorndike, 1987), provided that the tasks of those batteries are sampled broadly and near-randomly from the domain of cognitive abilities. Furthermore, when a *g* factor is derived *within* any demographically homogeneous group, the *g*-loadings of tasks tend to be highly similar from one such group to the next (see Carretta & Ree, 1995, for comparisons of subtest *g*-loadings across sexes and racial/ethnic groups).

1.3. "Real-world" correlates of g

Gardner stated that *g* might merely reflect "what is valued in Western testing in a scholastic setting". Although *g* does, of course, relate to scholastic achievement (e.g., Deary, Strand, Smith, & Fernandes, in press), it also relates to a host of important non-academic outcomes. We know that *g* is the most consistent predictor of job performance, with validities increasing with job complexity (Hunter, 1983; Schmidt & Hunter, 2004), and also the best single predictor of future indicators of socioeconomic status, such as educational achievement, occupational status, poverty, and even incarceration and chronic welfare use (Gottfredson, 2002). For example, a large Scottish epidemiological study found that IQ at age 11 was correlated with men's social class at midlife even after controlling for father's social class (Deary et al., 2005). In this same sample, childhood IQ predicted adult morbidity and mortality even after controlling for socioeconomic variables (Gottfredson & Deary, 2004). Clearly, the social relevance of *g* extends far beyond the scholastic realm.

1.4. Biological basis of g

The construct validity of *g* as general cognitive ability is supported not only by its prediction of academic and real-world outcomes, but also by its biological basis. The *g* factor correlates highly with such biological variables as cerebral glucose metabolic rate (Haier et al., 1988), various parameters of averaged evoked potentials (Vernon, Wickett, Bazana, & Stelmack, 2000), and brain volume measured by MRI scans (McDaniel, 2005; Wickett, Vernon, & Lee, 2000), as well as reaction time (Vernon, 1989) and inspection time (Grudnik & Kranzler, 2001). These biological and basic cognitive correlates of *g* would seem to be prime examples of what Gardner (2006-this issue) refers to when he calls for measures that are "intelligence-fair".

1.5. Multiple intelligences and g

How can Gardner's multiple intelligences be understood in relation to *g*? Each of the domains proposed by Gardner appears to involve a blend of *g*, of cognitive abilities other than *g* (group factors), and, in some cases, of non-cognitive abilities or of personality characteristics. Those domains differ in the extent to which *g* is

implicated, but again, each domain contains both *g* and non-*g* variance. The non-*g* aspects of a given domain are likely to have an identifiable biological basis, and are likely to be predictive of some meaningful criteria. But those non-*g* elements have not shown the dense network of associations with *general* properties of the brain (e.g., volume, metabolism, information processing, etc.) or with life outcome variables having *general* significance (e.g., occupational status, longevity, etc.). It is for these reasons that one might describe *g* as "general intelligence" and describe each of the non-*g* abilities within Gardner's domains as "special talents", whether cognitive, non-cognitive, or a blend of both. Regardless of the roles of any "modules" in governing abilities in different domains, the importance of the *g* factor is evident.

2. Measuring the "multiple intelligences"

2.1. The "verbal lens"

One of the concerns raised by Gardner with regard to the tasks used to assess the "intelligences" is that the purity of these tasks as indicators of each intelligence domain is compromised by some aspect of task content that involves another intelligence domain. In previous works, Gardner (1999) has suggested that most tests involve some linguistic stimuli, and therefore assess all abilities through a "verbal lens". Similarly, in his response to our article, Gardner described one of the Interpersonal ability tests (Social Translations) as "highly verbal".

We believe that the "lens" problem is vastly overstated. The important issue is *not* whether a task intended to measure a given ability also involves some stimulus associated with some other ability. Instead, what matters is whether *individual differences* in task performance will depend on the latter ability as a consequence of the use of that stimulus. Consider the Social Translations task that we used to measure Interpersonal ability. This task obviously does involve some linguistic stimuli – statements such as "that's mine" or "close the door" or "stop it" – but these stimuli are so simple that individual differences in specifically Linguistic ability are irrelevant to performance on the task, especially within a sample of literate young adults.

Finally, to take Gardner's "lens" argument to its logical conclusion, consider any ability task that involves a paper-and-pencil format. Given that the use of a pencil is a motor task requiring at least some minimal level of Bodily-Kinesthetic ability, Gardner's lens argument would suggest that any paper-and-pencil task should correlate substantially with any measure of Bodily-Kinesthetic intelligence, because the former is measured through a Bodily-Kinesthetic "lens". But of course, individual differences in the ability to handle a pencil are not an important source of variation in performance on paper-and-pencil tasks among normal adults or adolescents (except on tasks, such as Mark Making, that are specifically designed to measure motor speed).

2.2. Task content: logic demands and self-concept

In addition to discussing the "lens" issue, Gardner (2006-this issue) claimed that the ability tests selected for our study were "crypto logical-mathematical," pointing in particular to the logical demands of one of our tests of Naturalistic intelligence. As conceptualized by Gardner himself, however, the Naturalistic domain is inherently logical: his description (Gardner, 1999, p. 52) of the mental processes used in this "intelligence" included the words "distinguish", "discriminate", "classification", and "categorization", and he noted explicitly that these were abilities that he "had to ignore or smuggle in under spatial or logical-mathematical intelligence" prior to his identification of this eighth domain. Our tests of Naturalistic ability demanded the same mental processes as those listed by Gardner: one test required participants to make groups of like objects from a larger list of such items (i.e., to categorize and discriminate); the other required participants to choose the diagram of overlapping circles that best represented the relationships between items (i.e., to classify).

Gardner (2006-this issue) has similarly taken issue with the logical demands of one of our tests of Interpersonal ability, claiming that Interpersonal intelligence is best examined by observing individuals negotiating with others. But the act of negotiation would seem to have a strong reasoning component. Fulmer and Barry (2004, p. 255), in their analysis of the cognitive demands of negotiation, proposed that higher levels of cognitive ability would be associated not only with "more rapid learning about the underlying interests of one's negotiation partner" but also with "more rational decision-making performance and less judgment error in negotiation settings". We predict that elite negotiators – those who successfully resolve complex disputes in labor relations, in corporate law, or in international affairs – will score very high on tests of logical reasoning ability.

Finally, Gardner (2006-this issue) stated that he has never indicated that Intrapersonal intelligence is related

to strength of self-concept, which he notes is "clearly a dimension of personality, not intellect". However, Gardner (1983, pp. 242–243) stated in his discussion of the personal intelligences that a "developed sense of self often appears as the highest achievement of human beings," and referred to the developmental progression of the sense of self. Our measure of self-concept clarity – an index of consistency of self-description – was intended to tap directly into Gardner's notion of sense of self.

3. Conclusions

Gardner states that we have failed to grasp the core of MI theory, and perhaps in some sense he is right: it remains unclear to us what it is that MI theory can explain about intelligence, above and beyond what has already long been known. Gardner could clarify this "core" for us, by providing falsifiable, testable, MI-based hypotheses that would predict results different from those predicted by existing models of the structure of mental abilities. We encourage Gardner to provide "intelligence-fair" measures for his eight "intelligences" – tasks involving no extraneous personality, emotional, or sensory acuity content – so that MI theory can again be put to the test.

Acknowledgments

This research was supported by the Social Sciences and Humanities Research Council of Canada grant 410-2003-0946.

References

Carretta, T. R., & Ree, M. J. (1995). Near identity of cognitive structure in sex and ethnic groups. *Personality and Individual Differences*, *19*, 149–155.

Deary, I. J., Taylor, M. D., Hart, C. L., Wilson, V., Smith, G. D., Blane, D., et al. (2005). Intergenerational social mobility and mid-life status attainment: Influences of childhood intelligence, childhood social factors, and education. *Intelligence*, *33*, 455–472.

Deary, I. J., Strand, S., Smith, P., & Fernandes, C. (in press). Intelligence and educational achievement. *Intelligence*.

Fulmer, I. S., & Barry, B. (2004). The smart negotiator: Cognitive ability and emotional intelligence in negotiation. *International Journal of Conflict Management*, *15*, 245–272.

Gardner, H. (1983). *Frames of mind.* New York: BasicBooks.

Gardner, H. (1999). *Intelligence reframed.* New York: BasicBooks.

Gardner, H. (2006). On failing to grasp the core of MI theory: A response to Visser et al. *Intelligence*, *34*, 503–505. doi:10.1016/j.intell.2006.04.002.

Gottfredson, L. S. (2002). *g*: Highly general and highly practical. In R. J. Sternberg, & E. L. Grigorenko (Eds.), *The general factor of intelligence: How general is it?* (pp. 331–380). Mahwah, NJ: Erlbaum.

Gottfredson, L. S., & Deary, I. J. (2004). Intelligence predicts health and longevity, but why? *Current Directions in Psychological Science*, *13*, 1–4.

Grudnik, J. L., & Kranzler, J. H. (2001). Meta-analysis of the relationship between intelligence and inspection time. *Intelligence*, *29*, 523–535.

Haier, R. J., Siegel, B. V., Nuechterlein, K. H., Hazlett, E., Wu, J. C., Paek, J., et al. (1988). Cortical glucose metabolic rate correlates of abstract reasoning and attention studied with positron emission tomography. *Intelligence*, *12*, 199–217.

Hunter, J. E. (1983). *Overview of validity generalization for the U.S. Employment Service. USES Test Research Report*, *vol. 43.* Washington, DC: U.S. Department of Labor.

Marshalek, B., Lohman, D. F., & Snow, R. E. (1983). The complexity continuum in the radex and hierarchical models of intelligence. *Intelligence*, *7*, 107–127.

McDaniel, M. A. (2005). Big-brained people are smarter: A meta-analysis of the relationship between in vivo brain volume and intelligence. *Intelligence*, *22*, 337–346.

Schmidt, F. L., & Hunter, J. (2004). General mental ability in the world of work: Occupational attainment and job performance. *Journal of Personality and Social Psychology*, *86*, 162–173.

Thorndike, R. L. (1987). Stability of factor loadings. *Personality and Individual Differences*, *8*, 585–586.

Vernon, P. A. (1989). The generality of *g*. *Personality and Individual Differences*, *10*, 803–804.

Vernon, P. A., Nador, S., & Kantor, L. (1985). Reaction times and speed-of-processing: Their relationship to timed and untimed measures of intelligence. *Intelligence*, *9*, 357–374.

Vernon, P. A., Wickett, J. C., Bazana, P. G., & Stelmack, R. M. (2000). The neuropsychology and psychophysiology of human intelligence. In R. J. Sternberg (Ed.), *Handbook of intelligence*. New York: Cambridge University Press.

Visser, B. A., Ashton, M. C., & Vernon, P. A. (2006). Beyond *g*: Putting multiple intelligences theory to the test. *Intelligence*, *34*, 487–502. doi:10.1016/j.intell.2006.02.004.

Watkins, M. W. (2006). Orthogonal higher order structure of the Wechsler Intelligence Scale for Children – Fourth Edition. *Psychological Assessment*, *18*, 123–125.

Wickett, J. C., Vernon, P. A., & Lee, D. H. (2000). Relationships between factors of intelligence and brain volume. *Personality and Individual Differences*, *29*, 1095–1122.