Intelligence 50 (2015) 186–195

Contents lists available at ScienceDirect

Intelligence

Wonderlic, working memory capacity, and fluid intelligence☆

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ARTICLE INFO

Article history:
Received 26 February 2014
Received in revised form 14 March 2015
Accepted 23 March 2015
Available online 16 May 2015

Keywords:
Wonderlic
Working memory capacity
Fluid intelligence
Personnel selection
General mental abilities

ABSTRACT

Despite the widespread popularity of the Wonderlic Personnel Test, evidence of its validity as a measure of intelligence and personnel selection is limited. The present study sought to better understand the Wonderlic by investigating its relationship to multiple measures of working memory capacity and fluid intelligence. Our results show that Wonderlic has no direct relationship to fluid intelligence once its commonality to working memory capacity is accounted for. Further, we found that the Wonderlic was a significant predictor of working memory capacity for subjects with low fluid intelligence, but failed to discriminate as well among subjects with high fluid intelligence. These results suggest that the predictive power of the Wonderlic could depend on the characteristics of the sample it is administered to, whereas the relationship between fluid intelligence and working memory capacity is robust and invariant to the cognitive capabilities of the sample.

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1. Introduction

Despite numerous validation studies and over 200 million administrations in commercial and research domains, the validity of the Wonderlic is largely unknown. Its claim to quickly and easily measure intelligence might appeal to researchers and test-makers alike, but it is important that this claim first be substantiated with supporting research.

The present work seeks to understand this instrument in relation to working memory capacity and novel reasoning. Because of the predictive power of working memory capacity, researchers have begun to use it as a vehicle to understand the core mechanisms involved in reasoning and other constructs of interest (Oberauer et al., 2007). Using measures grounded in a solid theoretical framework such as working memory capacity and fluid intelligence, we can make better inferences about what drives performance on the Wonderlic.

2. The Wonderlic

Eldon Wonderlic's early research interests explored predictors of job performance. His first experiment was a large-scale, exploratory study including indicators of personality, intelligence, and supervisor ratings. The results showed that only the indicator of intelligence, the Otis Self-administering Test of Mental Ability was a significant predictor of job performance (Stevens & Wonderlic, 1934). Further evidence for the validity of the Otis Test for personnel selection was found when Wonderlic conducted a follow-up study in which the number of questions missed and omitted on the Otis Test was found to be significantly correlated with the job performance of office managers (Stevens & Wonderlic, 1934).

Despite these findings, the Otis Test drew criticism from researchers for having poor psychometric properties (Hovland & Wonderlic, 1939; Stevens & Wonderlic, 1934). For instance, although the Otis Test claimed to be a power test, item level analyses on several parallel forms of the test found that items were not ranked properly from easiest to most difficult (Hovland & Wonderlic, 1939). Further, the validity coefficients

☆ This research was supported by the Office of Naval Research Grant N00014121040.We would like to thank Zach Shipstead for helpful comments on the data analysis and to members of the Attention and Working Memory Lab at Georgia Tech for their help running subjects and collecting the data for the current study. Further, we thank Kasey Harris for helpful suggestions on revisions to the manuscript.

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http://dx.doi.org/10.1016/j.intell.2015.03.005
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for the Otis Test were found to be severely restricted due to an excess of easy items. This issue is reflected by the finding that the Otis Test is poor at discriminating at the extremes, particularly at the higher end of cognitive performance (Cattell, 1931). The Wonderlic test was adapted from the Otis Test and shortened into a 12-minute measure by selecting a subset of Otis items based on their psychometric properties. This new instrument was marketed specifically for personnel selection. However, early research on the Wonderlic Personnel Test found that it also suffered from an inability to discriminate at the upper end of the distribution (Buckley, 1957; Wonderlic & Hovland, 1939), a point that we will return to later.

3. Validation

Due to a growing concern for the lack of standards for testing in 1950, the APA appointed the Committee on Test Standards, led by Lee J. Cronbach. The group was tasked with developing test standards for psychological and educational measurement. Their report included recommendations for determining test validity (Cronbach & Meehl, 1955). Guided by this work, we consider two issues with the Wonderlic. First, the best demonstration of validity should be criterion validity, how well it predicts real world job performance. In addition, there should be a theoretical account for the underlying mechanisms responsible for performance on the Wonderlic.

Regarding the issue of criterion validity, results supporting the validity of the Wonderlic are almost exclusively demonstrated by their correlation with other intelligence measures (i.e. construct validity) rather than how well the test predicts actual job performance (i.e. criterion validity). When interpreting these correlations, it is important to consider that many of the intelligence tests used in the 20s and 30s such as the Army Alpha and Beta, Otis Self-administering Test, Wonderlic Personnel Test, and the Wechsler–Bellevue, originated from the Stanford–Binet. Therefore, correlations between the Wonderlic and other test batteries developed during this time will be inflated due to domain-specific overlap in item content.

A single piece of evidence is frequently cited as ample reliability and validity evidence for the Wonderlic. In this study, the Wonderlic and the Wechsler Adult Intelligence Scale — Revised (WAIS-R) were administered to 120 community subjects (Dodrill, 1981). The results of this study found that the Wonderlic and the WAIS-R were almost perfectly correlated ($r = .91–.93$). Despite this evidence, earlier work comparing the Wonderlic to the WAIS failed to find such a strong correlation ($r = .65$), suggesting that the two tests are related, but far from isomorphic (Buckley, 1957). This finding is also supported by other researchers who have failed to find correlations between the Wonderlic and WAIS at the magnitude of Dodrill's earlier work (Edinger, Shipley, Watkins, & Hammett, 1985).

The validation research mentioned thus far has only compared performance on the Wonderlic to the WAIS. As we have mentioned before this is problematic because the items are inherently related. Further, discrepancies in correlations reported so far may have arisen due to differences in the composition of the studies' samples, or it may be the case that the Wonderlic fails to systematically predict certain aspects of intelligence. The Cattell–Horn model of *g* specifies two distinct aspects of intelligence that drive cognitive performance. The first is referred to as crystallized intelligence (gC), which taps general knowledge and education such as knowledge of vocabulary definitions or state capitals. The second, fluid intelligence (gF), taps the ability to derive logical solutions to novel problems (Carroll, 1982; Cattell, 1963).

To date only two studies have reported correlations between the Wonderlic and distinct gC and gF subscales. Bell, Matthews, Lassiter, and Leverett (2002) assessed the Wonderlic and the Kaufman Adult and Adolescent Intelligence Test (KAIT), and found the Wonderlic to be a significant predictor of both crystallized and fluid abilities. However, more recent work correlating the Wonderlic and the Woodcock–Johnson — Revised (Matthews & Lassiter, 2007) demonstrated that the Wonderlic was related to gC, but not gF. From a theoretical perspective, this result suggests that while the Wonderlic is a reliable predictor of learned knowledge, it has failed to reliably predict gF, the ability to learn and adapt in situations that require novel reasoning.

Despite researchers submitting the Wonderlic to rigorous validation studies, little is known about the specific cognitive mechanisms responsible for individual differences on the test (Bosco & Allen, 2011; Culbertson, Huffcutt, & Goebl, 2013). This question is difficult to assess, as the Wonderlic was not developed from an underlying theory of cognitive performance. This and the proprietary nature of the test make revealing specific cognitive mechanisms, or processes, difficult. This is, in part, a result of ability testing beginning outside of psychological theory (Cronbach & Meehl, 1955; Anastasi, 1967; Sternberg, 1982; Sternberg & Kaufman, 2011; Embretson & Reise, 2000).

Working memory capacity captures specific aptitudes beyond gF (Bosco & Allen, 2011; Hambrick, Oswald, Darowski, Rench, & Brou, 2010; König, 2005). Recent work in this area challenges the idea that the Wonderlic is the best indicator of performance in the laboratory or on the job. For instance, previous research shows that working memory capacity predicts performance on air traffic control simulations (as cited in Ackerman, Beier, & Boyle, 2007), SAT performance (Engle, Kane, & Tuholski, 1999; Turner & Engle, 1989), academic performance, job performance, and in multi-tasks designed to simulate high-stakes work environments (Hambrick et al., 2010). In contrast, research finds that Wonderlic fails to predict academic performance (Chamorro-Premuzic & Furnham, 2008; Furnham, Chamorro-Premuzic, & McDougall, 2002; McKelvie, 1994) and has an inconsistent relationship to predictors of job performance such as customer service or sales volume (Barrick, Mount, & Strauss, 1993; Frei & McDaniel, 1998; Hogan & Hogan, 1995; Rode, Arthaud-Day, Mooney, Near, & Baldwin, 2008).

In addition to inconsistent findings in traditional job settings, research on the Wonderlic and NFL performance does not support the validity of the instrument in sports settings, despite widespread use in this field. Research in this area finds that the Wonderlic does not predict future NFL performance, selection decisions during the draft, or the number of games started (Lyons, Hoffman, & Michel, 2009). Conversely, experimental research has demonstrated that tactical decision making in sports is dependent on working memory capacity (Furley & Memmert, 2012). Additional work shows that working memory is also critical for coordinating activities in groups. For instance, Furley & Memmert (2013) found that attention control guides decision making in tasks that simulate the role of football quarterback. As the number of interactions the quarterback had

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