Human Resource Management Review 25 (2015) 47–55

Contents lists available at ScienceDirect

Human Resource Management Review

journal homepage: www.elsevier.com/locate/humres

Implications of modern intelligence research for assessing intelligence in the workplace

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ARTICLE INFO

Keywords:
Intelligence
Cognitive ability
Test-design
Selection
Assessment
Intelligence in the workplace
Measurement of intelligence

ABSTRACT

Intelligence research has flourished recently with contributions from multiple sub-disciplines of psychology. However, the fields of Human Resources and I/O Psychology have lagged behind these other sub-disciplines in advancing what is known about intelligence and benefiting from modern improvements to both intelligence theory and test design. This is unfortunate as the increasing pace, complexity, and globalization of work demand a more precise and uncontaminated measurement of intelligence that remains effective across multiple contexts. The current paper attempts to fill this knowledge gap by providing an overview of some of the major intelligence theories and test design principles that have the potential to inform the use of intelligence in HR contexts. Advances in both theory and measurement from psychometric, neurocognitive, cross-cultural, and cognitive literatures are reviewed. Test and item design approaches such as reducing cultural content and content not relevant to the measured domain and increasing the use of non-entrenched items are highlighted.

1. Introduction

Intelligence has emerged as one of the most critical individual difference variables for success in the ever changing and increasingly complex world of business (Boal, 2004; Gatewood, Field, & Barrick, 2011). Organizations are relying more and more on the development of intellectual property through highly prized knowledge workers as a vehicle for long-term competitive success (Yusko, Goldstein, Scherbaum, & Hanges, 2012). Effective twenty-first century organizations will depend on constant innovation and the ability to solve ever more complex problems (Edmondson, 2012). These developments have placed a premium on hiring employees possessing competencies related to intelligence, such as the ability to learn, solve problems in ambiguous situations, and integrate information (Baum, Bird, & Singh, 2011; Scherbaum, Goldstein, Yusko, Ryan, & Hanges, 2012; Senge, 1990).

Thanks to a century of research in HR and I/O psychology, there is a solid groundwork for the application of intelligence assessment to practical employee selection issues including Schmidt and Hunter's research on validity generalization and predicting job performance (Schmidt & Hunter, 1998) and Fleishman's taxonomy of human behavior (Fleishman & Quaintance, 1984). However, traditional approaches to understanding intelligence in these fields have narrowed over time and not evolved with the changes in the modern world of work which has tended to limit their focus to important, but perhaps only incremental advancements, such as improving the ability to predict which job candidates will be successful on the job (Goldstein, Scherbaum, & Yusko, 2009; Scherbaum et al., 2012; Yusko et al., 2012).

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http://dx.doi.org/10.1016/j.hrmr.2014.09.007
1053-4822/

New developments in intelligence research outside of HR and I/O psychology have tended to be more ambitious in their scope, wrestling with bigger-picture issues that aim at fundamental issues such as understanding the foundation of intelligence (Scherbaum et al., 2014). Examples include refinements to the psychometric approach to intelligence (e.g., Horn & Blankson, 2012; McGrew, 1997; Schneider & McGrew, 2012), marked advances in identifying the neurocognitive correlates of intelligence and associated measures (Higgins, Peterson, Pihl, & Lee, 2007; Jung & Haier, 2007), a greater understanding of the cognitive processes underlying intelligence (Buehner, Krumm, Ziegler, & Pluecken, 2006; Kaufman, Kaufman, & Plucker, 2013; Shipstead, Redick, & Engle, 2012), and new statistical techniques for assessing the contributions of different facets of intelligence (Lang & Bliese, 2012; Lang, Kersting, Hülsheger, & Lang, 2010; van der Maas et al., 2006). With so many different streams of research, intelligence research is difficult to organize under a single rubric (Drasgow, 2003; Kaufman et al., 2013).

We now stand at an inflection point, where emerging developments in other fields have the potential to energize and advance HR and I/O psychology's aging research base by providing new routes to the improved understanding of intelligence. Those willing to embrace these approaches to intelligence have a fresh opportunity to "move the needle" and substantially enhance both our understanding and measurement of the construct of intelligence and how to leverage this information to improve practical objectives, such as enhancing predictive success while also promoting diversity (Scherbaum et al., 2012; Scherbaum et al., in press).

Thus, the goal of this paper is to outline some of the innovative approaches in the measurement of intelligence that have the potential to positively impact I/O psychology and HR's approach to the assessment of intelligence in the workplace. Specifically, we consider the implications of the developments in psychometric intelligence theory, cognitive intelligence theory, the neuropsychological intelligence theory, and test design principles for the conceptualization and measurement of intelligence.

2. Developments in psychometric theories of intelligence

Perhaps the oldest and most established perspective on intelligence, and the approach traditionally endorsed by the fields of HR and I/O psychology is the psychometric perspective (Goldstein et al., 2009; Scherbaum et al., 2012). Originating from the work of Spearman (1927), at its broadest level this perspective suggested that a general factor of intelligence exists that underlies "all branches of intellectual activity" (p. 284). Spearman referred to this general factor, or *g*, as an "amount of general mental energy" (p. 137) and positioned it as the overlapped, or shared variance, which permeates batteries of cognitive/intelligence tests (Wasserman & Tulsky, 2005).

The concept of *g* and its existence as a latent, psychological construct versus an emergent psychometric phenomenon has long been debated (Goldstein et al., 2009; van der Maas et al., 2006; Wasserman & Tulsky, 2005). Still, this approach has long been regarded as the dominant model of intelligence, at least within the field of HR. Despite the stable manner in which psychometric theory and measurement have predominantly been viewed in HR research and practice, it is actually an area rich in new developments (Deary, 2012; Hunt, 2011). In particular, research outside the HR and I/O psychology fields has pushed the psychometric perspective forward and has moved beyond the simple Spearman conceptualization.

This new development in psychometric theory has taken vastly different paths. Some of this work has offered a reinterpretation of what *g* actually is (van der Maas et al., 2006). For example, the dynamical model of intelligence proposed by van der Maas et al. (2006) attempts to explain the positive correlations between tests of intelligence (known as positive manifold) in a way that does not rely on a traditional interpretation *g*. Their early research suggests that *g* is more of an emergent psychometric phenomenon rather than a latent psychological construct that underlies all other sub-forms of intelligence. By borrowing a technique more commonly used to model the functioning of ecosystems, van der Maas et al. (2006) suggest that the positive manifold is the result of reciprocal causation or mutualism rather than *g*. Specifically, the authors suggest that rather than the positive manifold having any one source such as *g* or working memory, it is caused by mutually beneficial interactions between cognitive processes that become more synchronized and interdependent as a human develops.

Along these same lines is research examining the relationship between *g* and working memory. From the information processing perspective of intelligence, working memory often takes a central role (Kyllonen & Christal, 1990) and it is debated whether *g* is just another name for working memory or vice versa (Ackerman, Beier, & Boyle, 2005; Colom, Abad, Quiroga, & Flores-Mendoza, 2008; Colom, Flores-Mendoza, & Rebollo, 2003; Kane, Hambrick, & Conway, 2005; Oberauer, Schulze, Wilhelm, & Süß, 2005; Oberauer, Süß, Wilhelm, & Wittmann, 2008). Recent research has demonstrated that working memory may be trainable and improvements in working memory produce score gains on intelligence tests (e.g., Jaeggi, Buschkuehl, Jonides, & Shah, 2011; Shipstead et al., 2012).

Other work suggests that *g* is neither at the top of the intelligence hierarchy nor is it necessarily more predictive than other facets of intelligence (Lang & Bliese, 2012; Lang et al., 2010). For example, Lang and Bliese (2012) discuss the utility of the nested-factor conceptualizations of intelligence. In the nested-factors models, it is not necessary to assume that *g* causes the cognitive abilities at lower levels of the intelligence hierarchy. Instead, they can be viewed as cognitive abilities that are parallel to *g*, but differ in their scope. Thus, they can be equally if not more useful for predicting important criteria. Lang et al. (2010) found that when modern analytical techniques are used to examine the contribution of narrow cognitive abilities, *g* can account for much less of the explainable variance in job performance than previously believed. In fact, in some cases the narrow cognitive abilities were more important than *g* for predicting job performance.

However, the most notable developments in this area are more aligned with traditional psychometric conceptualizations. The best examples of these developments has been the emergence of the Cattell–Horn–Carroll (CHC) theory of intelligence (Schneider & McGrew, 2012; Schneider & Newman, 2014), which focuses on hierarchically arranged taxonomies of cognitive abilities. The CHC theory of intelligence is the combination of the Cattell–Horn theory of fluid and crystallized intelligence (Horn & Cattell, 1966) with Carroll's (1993) Three-Stratum Theory of intelligence (Flanagan, Ortiz, & Alfonso, 2007; Schneider & McGrew, 2012). This theory