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Where I–O Psychology Should Really (Re)start Its Investigation of Intelligence Constructs and Their Measurement

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We believe that Scherbaum, Goldstein, Yusko, Ryan, and Hanges (2012) come up short in (a) their portrayal of the current understanding of the nature of intelligence as it exists in the science of mental abilities and (b) their treatment of the measurement of intelligence constructs. We argue that their view on the nature of intelligence is outdated and that measuring constructs within the domain of intelligence should not be equated only with the use of traditional cognitive ability tests as alternative work-based measures of intelligence constructs have emerged and are in dire need of empirical scrutiny.

An Updated View of "Intelligence"

Scherbaum et al. appear to equate the terms "intelligence" and "*g*," and then argue that this perspective is too limited. If one equates "intelligence" with "*g*," we would agree. However, this strikes us as an outdated view. We would encourage industrial–organizational (I–O) psychologists to adopt a more up to date understanding of intelligence so as to better understand where to focus research efforts. As a first step, it is critical to understand that "intelligence" is not a single construct; rather, it is a generic term that refers to a nomological network of different constructs such as cognitive abilities, cognitive skills, and acculturated knowledge (Gottfredson, 2009; Reeve & Bonaccio, 2011). From a scientific perspective, then, it is more useful to study the nature and structure of specific constructs within this network.

There are two major components of intelligence, which are distinguishable and amenable to precise operational or empirical descriptions (see Jensen, 1998; Reeve & Bonaccio, 2011): (a) the *ability to learn* new things and solve novel problems (i.e., intelligence-as-process, mental abilities, and fluid intelligence) and (b) the *outcomes of learning*, namely the achievement of acquired knowledge and skills, which are dependent on prior experience within a specific cultural context (i.e., intelligence-as-knowledge, developed intellect, and crystallized intelligence). Whereas the former denotes general capacities for learning and solving novel problems, the latter category refers to the acquired information and skills that can be drawn on for use in domain-specific situations and can be improved by instruction, practice, or manipulation.

This distinction between intelligence-as-knowledge and intelligence-as-process is

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particularly useful for understanding some of the apparent discrepancy in definitions of intelligence. For example, contextualists have argued that the set of acquired skills and knowledge that are of greatest relevance to success in a specific situation should be considered to be the essence of intelligence. These types of domain-specific ''hot intelligences,'' as they have been called, focus on the outcome of learning from experience (i.e., intelligence-as-knowledge). In contrast, psychometric conceptualizations have tended to focus on the broad, cross-situational behavioral capacities (i.e., abilities) to acquire knowledge and skills. There is nothing inconsistent about these approaches to the study of ''intelligence''; basic abilities give rise to individual differences in the capacity to acquire domain-specific knowledge and skills from experience. Although these two approaches have tended to focus on different constructs within the intelligence network, one should not mistake them for competing approaches. Indeed, the Cattellian theory of fluid (Gf) and crystallized (Gc) intelligence was advanced on the premise that it provides a meaningful framework for integrating the psychometric models with developmental and process theories. Ackerman's (1996) ''intelligence-as-process, personality, interests, and intelligence-as-knowledge'' (PPIK) theory stands as a prime example of the potential natural synergy between these approaches and one that gives rise to a more complete understanding of ''intelligence'' and of its connections to other individual difference domains.

Clearly, our summary here cannot due the topic justice (see, e.g., Reeve & Bonaccio, 2011, for a full review). Our main point—alluded to by Scherbaum et al.—is that the typical treatment of the domain of intelligence in I–O psychology journals lags behind the science of mental abilities. If I–O psychologists are to reengage this domain, we believe it would behoove them to start with a more updated view. Similarly, we caution I–O psychologists against giving new names to existing constructs or applying existing terms to different concepts under the guise of innovation.

Reconnecting With the Science of Mental Abilities: Toward a Research Agenda

With this admittedly extremely brief clarification, we turn to the issue of outlining key areas ripe for discovery as well as areas unlikely to be productive. First, it is safe to conclude that a comprehensive picture of the psychometric structure of cognitive abilities has been established. Most experts today accept some form of a hierarchal model, with a single general cognitive ability factor at the apex (referred to as ''*g*'' or ''general mental ability'') in large part due to the exhaustive work of John Carroll (1993). Below this general factor, there are a small number of specific abilities; and each of these abilities, in turn, subsumes a large number of task-specific skills reflecting the effects of experience and learning (Carroll, 1993, pp. 633–634). Debate regarding the remaining distinctions among models is likely to be perceived by those outside the field largely as ''narcissisms of subtle difference'' (Lubinski, 2000, p. 7).

Second, a wide array of psychometric, biological, and behavioral genetic evidence has shown that mental abilities are not just statistical artifacts and that they have a significant and meaningful influence on important real-world outcomes (e.g., Deary, 2009; Jensen, 1998; Lubinski, 2004). Similarly, the nature of ''*g*'' is well known. The *g* factor that underlies human mental functioning is formally defined as the ''eduction of relations and correlates'' (Jensen, 1998); that is, the ability to infer or deduce meaningful principles and concepts from abstractness and from novel situations. Research on its biological and neurological basis confirms that it reflects something ''real'' (in a physical sense) about the brain. For example, *g* scores correlate with brain size and volume, complexity of average evoked potentials, and nerve conduction velocity (see Haier, 2009).

We see three issues that are ripe for significant progress (see also Reeve & Bonaccio, 2011). First is the consideration of the scientific significance of lower order dimensions of human abilities (those beyond *g*) and how best to appraise their scientific worth (see Lubinski, 2000). There is no question that individual differences in *g* are important. Yet, recent work confirms that specific abilities can be of importance in addition to ''*g*'' (e.g., Park, Lubinski, & Benbow, 2008; Reeve, 2004). However, we caution against adopting the ''horse race'' mentality seen in the past. Indeed, the value of specific abilities or skills can be demonstrated without futile attempts to discredit *g*. The work of Lubinski and colleagues (e.g., Park et al., 2008) concerning the importance of specific abilities among high-*g* populations is a salient example of how both *g* and narrow abilities function in tandem.

Second is the further development of the vertical and horizontal aspects of the *g* network (''g-nexus,'' Jensen, 1998; Lubinski, 2000). The vertical aspects seek to uncover more fundamental (i.e., biological and neurological) bases for *g* and to develop more ultimate (i.e., evolutionary) explanations (e.g., Deary, 2009). In addition to the value for basic science, such work has practical applications in the understanding of group differences on manifest indicators and the development of alternative measures of ''*g*'' (e.g., Jensen, 2006). The horizontal aspect seeks to better understand the practical significance of *g* via the breadth of its associations with an array of social, psychological, and health-related variables. The potential value and importance of this line of investigation have recently been realized with the emergence of the field of cognitive epidemiology (Deary, 2009). I–O psychologists interested in organizational attitudes and occupational health would be well advised to be aware of this literature.

Third is the further refinement of ''meta-theories'' that account for the interplay between the three broad domains of individual differences (intelligence, personality, and conative factors) on one hand and environmental affordances and demands in the development of adult intellect on the other. These more comprehensive models are likely not only to provide a more complete understanding of the nature and development of the nomological network of intelligence but also to help reintegrate the various domains of differential psychology. Among these are three important examples we believe to be the most well validated and theoretically coherent (and hence, hopefully, the most influential): Snow's (2002) final work regarding a comprehensive theory of aptitude, Ackerman's (1996) PPIK theory, and Chamorro-Premuzic and Furnham's (2005) emerging model of intellectual competence. For example, a theory such as PPIK provides a useful framework for understanding how a common, universal core of basic psychological characteristics functions cross-culturally to give rise to culturally differentiated and personally unique adult intellects.

Limitations of the Traditional View of Intelligence Measurement

Our second main issue with the lead article is that the avenues for future research on the measurement of ''intelligence'' focus almost exclusively on the use of traditional tests of ''*g*'' or broad abilities. This focus implies that measures of constructs within the intelligence network are equated with standardized cognitive ability tests. However, this view runs counter to not just *g*-theory, which states that *g* is ''indifferent to the indicator'' (Jensen, 1998), but more broadly, it also ignores the basic premise of measurement theory. As Aftanas (1988) succinctly explains, any mechanism, process, or situation that is arranged to denote (i.e., make manifest) a specific construct can and should be viewed as a standard system of measurement. The key is to arrange the situation such that behavior is predominantly a manifestation of one (or a few) target construct(s). This view, expressed in I–O psychology as the distinction between constructs and methods (Arthur & Villado, 2008), makes clear that intelligence constructs can be assessed via numerous approaches. For example, as long as the system requires the eduction of relations and correlates, or samples the results of that ability (i.e., acquired skills), it will measure ''*g*'' to some degree.

A second limitation is that traditional ability tests as a measurement approach are often criticized as ''old-fashioned,'' ''decontextualized,'' and ''restricted'' (especially by managers), although there is still widespread agreement on the importance of the intelligence constructs themselves (e.g., inclusion of problem solving, analyzing, decision-making, or the so-called intellectual horsepower in competency models). Thus, if we equate the measurement of intelligence constructs with traditional standardized tests, we risk of further distancing ourselves from how intelligence constructs are assessed in practice (e.g., among managers).

Work-Based Measurement of Mental Abilities: Examples and a Research Agenda

By disentangling constructs within the intelligence network from the use of traditional tests, it becomes clear that there are various potential standard systems of measurement. In fact, several work-based and contextualized measurement approaches have already been originated. For instance, Klingner and Schuler (2004) developed a 1-hour work sample for clerical positions in which business-related material (commercial texts, business facts, coworker names, and balance values) had to be reviewed, compared, sorted, corrected, memorized, and recalled. The work sample correlated highly with observed scores from standard intelligence tests (corrected correlation of .87), had higher predictive validity (for supervisory ratings), and was seen as more realistic and transparent. Additionally, existing selection procedures such as assessment centers (Arthur, Day, McNelly, & Edens, 2003), situational judgment tests (Christian, Edwards, & Bradley, 2010), and interviews (Huffcutt, Conway, Roth, & Stone, 2001) have already been shown to denote intelligence constructs.

Another option is contextualized ability tests. In educational psychology, there is a tradition of assessing complex problem solving via PC simulations (e.g., Program for International Student Assessment Wirth & Klieme, 2003). Similarly, in health psychology and medicine, there is a tradition of measuring basic abilities via ''health literacy'' tests (a combination of contextualized cognitive ability items and applied problem solving scenarios). Such ideas have also been adapted to business situations. For example, applicants might be required to make inferences about a series of business-related graphs or tables (Hattrup, Schmitt, & Landis, 1992). Perhaps in the future, serious games might enable to assess adaptive problem solving in simulated dynamic work situations.

We believe that a programmatic line of research is needed in this domain of alternative measurement of intelligence constructs. Hereby, we should not only focus on predictive validity and subgroup differences but in particular on construct-related validity. Conceptually, it is important to examine whether alternative measures denote cognitive dimensions highlighted in ''metatheories'' such as planning, attention, simultaneous, and successive theory (Naglieri & Das, 2005) or PPIK (Ackerman, 1996). Little research has also aimed to enhance the alternative measurement of intelligence constructs. For example, there is no research on how to increase or decrease the *g* loading of assessment exercises. At a practical level, we should investigate how the alternative methods converge in measuring the same cognitive dimensions. Similarly, it is important to examine the overlap and incremental value of these approaches to traditional ability tests. Finally, we should scrutinize the perceptions of these measures among relevant stakeholders.

Conclusion

We agree with Scherbaum et al. to reinvigorate research on intelligence constructs and measurement but we differ in (a) where the research on its nature should start and (b) how the measurement of intelligence should proceed. We recommend that I–O psychology study the extant literature in the science of mental abilities before starting such investigations. With a renewed and updated understanding of the theoretical nature of the nomological network of intelligence, we further believe that research into alternative work-oriented measures of intelligence constructs constitutes a tremendous opportunity to put intelligence again on the research agenda of I–O psychology.

References

Ackerman, P. L. (1996). A theory of adult intellectual development: Process, personality, interests, and knowledge. *Intelligence*, *22*, 227–257.

Aftanas, M. S. (1988). Theories, models, and standard systems of measurement. *Applied Psychological Measurement*, *12*, 325–338.

Arthur, W., Jr., Day, E. A., McNelly, T. L., & Edens, P. S. (2003). A meta-analysis of the criterion-related validity of assessment center dimensions. *Personnel Psychology*, *56*, 125–154.

Arthur, W., Jr., & Villado, A. J. (2008). The importance of distinguishing between constructs and methods when comparing predictors in personnel selection research and practice. *Journal of Applied Psychology*, *93*, 435–442.

Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies.* New York: Cambridge University Press.

Chamorro-Premuzic, T., & Furnham, A. (2005). *Personality and intellectual competence*. Mahwah, NJ: Erlbaum.

Christian, M. S., Edwards, B. D., & Bradley, J. C. (2010). Situational judgment tests: Constructs assessed and a meta-analysis of their criterion-related validities. *Personnel Psychology*, *63*, 83–117.

AQ3 Deary, I. (Ed.). (2009). Intelligence, health and death: The emerging field of cognitive epidemiology. *Intelligence*, *37*.

Gottfredson, L. (2009). Logical fallacies used to dismiss the evidence on intelligence testing. In R. Phelps (Ed.), *Correcting fallacies about educational and psychological testing* (pp. 11–65). Washington, DC: American Psychological Association.

Haier, R. J. (2009). Neuro-intelligence, neuro-metrics and the next phase of brain imaging studies. *Intelligence*, *37*, 121–123.

Hattrup, K., Schmitt, N., & Landis, R. S. (1992). Equivalence of constructs measured by job-specific and commercially available aptitude tests. *Journal of Applied Psychology*, *77*, 298–308.

Huffcutt, A. I., Conway, J. M., Roth, P. L., & Stone, N. J. (2001). Identification and meta-analytic assessment of psychological constructs measured in employment interviews. *Journal of Applied Psychology*, *86*, 897–913.

Jensen, A. R. (1998). *The g factor: The science of mental ability*. Westport, CT: Praeger.

Jensen, A. R. (2006). *Clocking the mind: Mental chronometry and individual differences.* Amsterdam: Elsevier.

Klingner, Y., & Schuler, H. (2004). Improving participants' evaluations while maintaining validity by a work sample–intelligence test hybrid. *International Journal of Selection and Assessment*, *12*, 120–134.

Lubinski, D. (2000). Scientific and social significance of assessing individual differences: ''Sinking shafts at a few critical points.'' *Annual Review of Psychology*, *51*, 405–444.

Lubinski, D. (Ed.). (2004). Cognitive abilities: 100 years after Spearman's (1904) 'General intelligence,' objectively determined and measured. *Journal of Personality and Social Psychology*, *86*, 96–199.

Naglieri, J. A., & Das, J. P. (2005). Planning, attention, simultaneous, successive (PASS) theory: A revision of the concept of intelligence. In D. P. Flanagan & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (2nd ed., pp. 120–135). New York: Guilford Press.

Park, G., Lubinski, D., & Benbow, C. P. (2008). Ability differences among people who have commensurate degrees matter for scientific creativity. *Psychological Science*, *19*, 957–961.

Reeve, C. L. (2004). Differential ability antecedents of general and specific dimensions of declarative knowledge: More than *g*. *Intelligence*, *32*, 621–652.

Reeve, C. L., & Bonaccio, S. (2011). The nature and structure of ''intelligence''. In T. Chamorro-Premuzic, A. Furnham, & S. von Stumm (Eds.), *Handbook of individual differences* (pp. 187–216). Oxford, England: Wiley-Blackwell.

Scherbaum, C. A., Goldstein, H. W., Yusko, K. P., Ryan, R., & Hanges, P. J. (2012). Intelligence 2.0: Reestablishing a research program on *g* in I–O psychology. *Industrial and Organizational Psychology: Perspectives on Science and Practice.*

Snow, R. E. (2002). *Remaking the concept of aptitude: Extending the legacy of Richard E. Snow* (work completed by L. Corno, L. J. Cronbach, H. Kupermintz, D. F. Lohman, E. B. Mandinach, A. W. Porteus, & J. E. Talbert). Mahwah, NJ: Erlbaum.

Wirth, J., & Klieme, E. (2003). Computer-based assessment of problem solving competence. *Assessment in Education: Principles, Policy, & Practice*, *10*, 329–345.