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COMMENTARIES

The Problem Is in the Definition: *g* and Intelligence in I–O Psychology

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Scherbaum, Goldstein, Yusco, Ryan, and Hanges (2012) have aptly noted many challenges facing industrial–organizational (I–O) psychology in the consideration of modern research on intelligence. Yet, the source of the problems they identified is present in the title and first line of their abstract. Namely, the implication that ''intelligence'' is the same thing as ''*g*'' or ''general mental ability.'' As noted by the authors, *g* is typically considered to represent the source of common variance among ability measures (Spearman, 1904). Intelligence, as defined by many modern theories (e.g., Ackerman, 1996; Carroll, 1993), is a broader construct that incorporates not only the common variance associated with *g* but also a consideration of less general abilities, such as speed of processing and memory, and knowledge. In our view, intelligence is scientifically and theoretically more interesting than *g*. In the following sections, we discuss specific considerations for I–O psychologists and highlight specific areas that might inspire future research. We begin by examining the lack of new research on intelligence in I–O psychology.

We believe that denoting intelligence as *g* (i.e., equating the constructs), along with the corpus of data establishing validity generalization, are the dominant bases for the dearth of new research on intelligence in I–O psychology. That is, I–O psychologists know that *g* is a valid predictor of job performance, and there are a wide variety of ''pretty good'' measures of *g* that have been developed and refined over the course of the past century. Applied psychologists simply need to select the measure that meets the criteria of testing time, cost, reliability, and suitability for the applicant population and administer it. Validity generalization pretty much does the rest in terms of having a legally defensible procedure for selection.[1]

Considering intelligence more broadly requires an extensive analysis of both the predictor and criterion space and may take the I–O psychologist into uncharted territory. Developing, validating, and implementing new measures of intelligence requires time and effort, including an understanding of the specific job tasks and the knowledge and ability demands that might be associated with them. There is also no guarantee that the measures developed will be scalable or generalizable. I–O psychologists will risk developing measures

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1. It should be noted that applications of personality measurement such as for the Big Five have a similar etiology, but that is beyond the scope of the current article.

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that are too tailored for a specific application because optimizing a measure for one group may make it less than optimal elsewhere. Nonetheless, we maintain that such approaches are essential for progress in the use of intelligence measures in I–O psychology. Traditional measures of *g* have reached a plateau in terms of predictive validity for job-relevant criteria (surely <50% of job performance variance is accounted for by omnibus measures of intellectual ability). In the following sections, we highlight considerations for developing new measures of intelligence (and *g*): Brunswik symmetry, typical and maximal performance, and the dynamic nature of abilities.

Considerations for Intelligence Research

Brunswik Symmetry

Broad measures of *g* are particularly well suited for predicting broad occupational performance criteria. Maximal predictive validity is obtained, however, when both predictors and criteria are matched not only in terms of breadth (e.g., a question of bandwidth and fidelity) but also in terms of specific mapping of content. Wittmann and Süß (1999) called the matching of the predictor space and criterion space ''Brunswik symmetry'' and noted that although positive validity is found when broad predictors (e.g., a general mental ability assessment) are used to predict narrow criteria (e.g., one facet of job performance such as customer complaints), such validities will not account for all the reliable variance in the criterion. For example, a ''product knowledge'' predictor might be mapped to the criterion of ''customer complaints'' and would likely account for variance in job performance independent of *g*. Ultimately, consideration of Brunswik symmetry requires a focus on both the predictor space and an understanding of employee behavior. One important consideration is the type of performance we are trying to predict: typical or maximal.

Typical and Maximal Performance

There is a fundamental mismatch between what is measured by extant intelligence tests and the criteria one is most interested in, when predicting job-related performance measures, that is, the mismatch between typical and maximal behaviors. The foundation for intelligence assessment started by Binet and Simon (1905/1916) focuses on obtaining the individual's maximal effort during the assessment of intelligence. Current selection procedures are high-stakes tests and have the same general environmental press. Yet, I–O psychologists and managers are usually less interested in what the applicant *can do* when a proverbial gun is held to his or her head. Although assessments of what someone *can do* will serve as an assessment of the upper bound of a person's performance on the day that the applicant is assessed,[2] I–O psychologists and managers are most interested in what the applicant will do on a day-to-day basis on the job—that is, the individual's typical performance. Broadening the focus of the predictor to examine the signs and samples of the *results* of intellectual investment, such as broad and specific job knowledge, will ultimately result in better predictive validity and a sharper understanding of *why* individuals perform better or worse on the job. Job knowledge is gained through investment of resources over time, and as such, it is more representative of typical than maximal performance (Ackerman, 1994).

Intelligence Is Not Static Across the Working Life Span

If one broadens the conceptualization of intelligence beyond *g*, for example, to

2. It is important to keep in mind that no psychological assessment can actually measure an individual's ''capacity,'' simply because it is impossible to know the range of effects of future interventions, be they instructional, medical, or whatever (e.g., see Anastasi, 1983). With psychological assessments, one can only measure the individual's current knowledge and skills, and from those measures draw predictions of future behaviors, based on the current state of the art and science on training, education, medicine, and so on.

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include ''the entire repertoire of acquired skills, knowledge, learning sets, and generalization tendencies considered intellectual in nature that are available at any one point of time'' (Humphreys, 1971, p. 31), it should be clear that the notion that intelligence is ''fixed'' needs to be reconsidered when considering the span of working life (see e.g., Schaie, 1996, for a review). I–O psychologists have implicitly come down on the side of Spearman (who argued that *g* was innate and fixed) rather than on the side of Binet and later theorists who incorporate consideration of changing abilities (i.e., declines in memory and reasoning ability and increases in knowledge gained through experience and education) throughout the life span (e.g., Cattell, 1987). Moreover, completing an assessment of *g* at job entry only really establishes the individual's relative standing at that point in time. Although in the short term, raw intelligence test scores are relatively consistent in adults, over a 20 or 30+ year span of one's lifetime of work, both rank order and raw scores change in marked ways. Without the consideration of lifespan development issues, I–O psychology is likely to remain stuck in a rut when applying conceptions of intelligence to employee behavior in the workplace. Employers and I–O psychologists who take a view that they are only interested in the short-term future (e.g., a few months or a few years) don't take account of the fact that although many employees change jobs frequently, many others do indeed have careers over several years with a single employer.

Where to Find Inspiration for Intelligence Research

History

Ironically, major inspirations for the future of intelligence research in I–O psychology can be obtained from consulting the history of intelligence testing, especially as it relates to predicting employment outcomes. Perhaps the most intensive and extensive investigation of intellectual abilities for selection purposes took place about 65 years ago, yet we would guess that not more than a few currently living I–O psychologists are aware of the work. During World War II, more than a dozen of the most promising and accomplished applied differential psychologists were members of the U.S. Army Air Forces Aviation Psychology Research Program (e.g., John Flanagan, J. P. Guilford, L. G. Humphreys, and noted experimental psychologists, such as Arthur Melton, and also J. J. Gibson, who designed motion picture tests of spatial abilities). Two volumes in particular from the reports generated by this group, Guilford and Lacey's (1947) ''Printed Classification Tests'' and Melton's (1947) ''Apparatus Tests'' run about 1,000 pages each and contain information on more tests of intellectual and related abilities, with more examinees, than any other research program before or after. As Flanagan (1948) noted in his report, ''exploratory studies'' had samples of 100 examinees, but for ''decisions with respect to use,'' 1,600 examinees were assessed, and for ''decisions establishing precise regression weights,'' 6,400 examinees were assessed (p. 295)! Attention to the corpus of intelligence research and test development created in this program of research can be informative, both in terms of one's outlook on the nature and structure of intellectual abilities and in terms of generating ideas for new approaches to ability assessment in selection applications. For example, a modified version of the Dial and Table reading test developed by this group turned out to be one of the best predictors of air traffic controller performance, when a new battery was developed in the 1990s (e.g., see Ackerman & Kanfer, 1993). This is just one example—hundreds of other intelligence-related studies are documented in Carroll's (1993) book.

Look Beyond the Easy-to-Measure Aspects of Intelligence

Just as one can get a ''pretty good'' measure of length of a small object with a yardstick but a much better measure with

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a ruler with fine gradations, one can get a pretty good measure of intelligence in adults with a brief omnibus instrument but not a particularly fine-grained assessment. Improvements in the assessment of intelligence will require a greater investment of time and effort in assessments, something that has to be considered in the applied world. Nonetheless, technological advancements can remove some of the cost barriers to expand the assessment of intelligence beyond *g*. For example, in the 1950s, the U.S. Air Force abandoned the use of perceptual/psychomotor apparatus tests in their entry-level selection procedure *not because the tests were invalid but because the cost of apparatus tests did not justify their overall effectiveness in the overall selection process* (Fleishman, 1956). Tablet and touch-screen computers that were introduced widely in the 1990s have removed some of the apparatus and examiner-to-examinee ratio cost considerations to assess at least some of these abilities (e.g., see Ackerman & Beier, 2007), yet very little attention has been given to revisit the assessment of perceptual/psychomotor components of intelligence in selection applications. Ultimately, there is too little effort placed on innovation in the development and application of new testing methods for the assessment of intellectual abilities in workplace selection situations.

Other Areas of Psychology May Not Have the Answers to I–O Concerns

Although we agree with Scherbaum et al. that substantial strides have been made in other fields of psychology in terms of understanding the nature and processes that underlie intelligence, we think that many of those developments are largely irrelevant for I–O concerns, at least in the near-term future. For example, functional magnetic resonance imaging (fMRI) studies may tell us a great deal about what happens in the brain when an individual is confronted with an intelligence-test type of problem. But I–O psychologists should be, and typically are, most concerned about the behaviors that take place in the world of work, not what goes on *inside* the head of the individual exhibiting that behavior. Furthermore, some of the topics of research conducted in laboratory studies in areas such as cognitive psychology (e.g., multitasking efficiency, reasoning under stress, and team effectiveness in problem solving) are actually much better addressed in the real world because laboratory researchers cannot hope to replicate the kinds of constraints and background that real-world workers bring to the occupational environment. Moreover, it is relatively rare for laboratory studies of intelligence to scale up to real-world behaviors. Issues of Brunswik symmetry or typical behaviors can only be examined in the context of job performance criteria collected over a significant amount of time. I–O psychology as a profession has a unique real-world ''laboratory'' in which hypotheses about the role of intelligence on behavior can be observed. Although other fields of inquiry can provide useful hypotheses for what happens in the world of work, progress in I–O psychology requires *in situ* examination of the role of intelligence.

Conclusion

In addition to examining the contributions of other areas of psychology to the study of intelligence, we implore I–O psychologists to study the rich history of applied research in intelligence and intellectual abilities that took place before validity generalization effectively put an end to new sources of inquiry. Intelligence assessment and applications have a rich history in I–O psychology since the early part of the twentieth century, and there remains much progress that can be made by considering where the field has been in moving forward. Finally, do not be afraid to try something new. Aspects of I–O psychology are much like engineering. One can derive a satisficing solution to many engineering problems by referring to extant textbook knowledge, but this is not the source of innovation or notable progress.

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