



# Psychological Inquiry

An International Journal for the Advancement of Psychological Theory

ISSN: 1047-840X (Print) 1532-7965 (Online) Journal homepage: <http://www.tandfonline.com/loi/hpli20>

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To cite this article: Nelson Cowan (2016) Process Overlap Theory and First Principles of Intelligence Testing, *Psychological Inquiry*, 27:3, 190-191

To link to this article: <http://dx.doi.org/10.1080/1047840X.2016.1181998>



Published online: 02 Aug 2016.



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## Process Overlap Theory and First Principles of Intelligence Testing

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The purpose of this comment is to put the process overlap theory of Kristof Kovacs and Andrew Conway (this issue) in the broadest possible context. I briefly discuss the nature of intelligence testing and then relate it to the theory under consideration before making a few concluding comments.

### Nature of Intelligence Testing

Intelligence testing was supposed to be a means to determine who is most capable at school or work. School itself consists of educated guesses about what skills would be most important to teach and assess as precursors to a successful adult life, including but perhaps not limited to work. In the workplace, if the task involved is specific, the test can be commensurately specific. If the workplace includes a variety of jobs with a variety of complexity levels, the intelligence test justifiably comes into play to try to assess who is best able to learn a new skill and who has the best bank of knowledge applicable to a wide range of situations.

The criteria for intelligence tests ideally are success at school or at work. Usually, however, these criteria are hard to come by, a situation that has limited test development. Sometimes there is a good proxy that can be used as a criterion; in child testing, for example, the skills that increase with age in the typical child have served as good proxies. The reason is that it is a safe bet that if a child resembles the average child who is older (younger) than him- or herself, that particular child is relatively intelligent (unintelligent).

Still, a lot is left to be desired in intelligence testing because of compromises made in the name of practicality. We all know that social and emotional skills and wisdom in decision making are quite important in the workplace, as is creativity, though all of these have proven difficult to test in the conventional sit-down situation, and perhaps for that reason have been omitted from most conventional tests of intelligence.

### Process Overlap Theory in the Bigger Picture of Things

The authors' proposed theory is one example of what I see as the most important trend in intelligence testing since its inception in the late 1800s. At that point, test developers had hunches about what kinds of material to include in tests, resulting in a range of different, sometimes quirky, kinds of test items. Whatever "worked" was kept in the test, and items that

did not predict anything important were excluded. With the hindsight of about 150 years of experimental psychology, though, it has become possible to make more focused predictions about what kinds of test items will be most diagnostic. Moreover, theories of the mental structure related to the tests can be based on this knowledge. The process overlap theory tries to capitalize on this research base, in particular from cognitive psychology and cognitive neuroscience. It is hoped that the theory will consequently be of use in (a) guiding the kinds of test questions that would be most important to add; and (b) predicting performance on kinds of tests that are not even included within intelligence tests—at least not yet.

Considered most broadly, the key types of intelligence test items might be those that help to answer the question of the extent to which, observing the person in question, there is "anybody home" in there, and whether it's someone who could be useful in a work or school situation. As one such essential, high-level ability, working memory capacity indicates the amount of information that can be held in mind, which is related to the complexity of ideas that can be put across to the individual successfully. As a simple example relevant to young children, which I present because it is an easy example to explain, understanding of the meaning of the word *tiger* requires keeping in mind that it is a kind of cat, that it is large, and that it has stripes (or else, overlooking one of these characteristics, one could be talking about a zebra, a house cat, or a lion, respectively).

As a more complex and intertwined set of essential, high-level abilities, *executive functions* include various self-management skills that, applied to the workplace, might be needed in order to ensure that one can say what needs to be said (provided that one knows what that information is); avoid saying something at all, if it would be clearly unwise to do so; keep in mind the context in which one is working; avoid making statements without taking into account the feelings of coworkers; switch rapidly from one task to another when that is necessary; observe one's own behavior enough to know when to avoid harmful distractions; and so on. When a person puts those higher level executive skills to good use, then we indeed feel that someone is "at home" in there, and it may well be someone we would want in our workplace.

As the authors note, though, it would be a mistake to insist that these higher level management skills are all that a person needs. If the person is out of his or her element, there might be

knowledge missing so that the higher level skills cannot be well applied. Although most skills that have been tested tend to correlate fairly highly with one another, some people do seem to have more facility with, say, verbal materials than with spatial items, or vice versa. There are no doubt other individual specialties. The process overlap theory does a good job of pointing out that these skills are individually important but that the working memory and executive function skills serve as bottlenecks for all of them. As an analogy, a restaurant can make excellent food of various types, but the food quality doesn't matter unless the waiters are able to seat you and serve the food in a timely manner, before it gets cold or you have to leave.

If we had better test criteria, theories of intelligence would reveal other bottlenecks. For example, there are various sociopaths who function well on executive skills and have a lot of general knowledge and learning ability but whom you would not want in the workplace because of a personal defect in terms of antisocial motivation. Another kind of person not helpful in the workplace is one undergoing a sustained, debilitating depression that cannot soon be cured. Such key elements of the mind are omitted from the tests, and some of them are considered inappropriate for the tests (e.g., too personal, insensitive to cultural differences, considered medical disabilities to be accommodated). Therefore, they evade the theories based on the tests, including the authors' theory. What kind of test might allow us to determine who not only has fluid intelligence, working memory, and executive function but also who among the capable individuals are the ones most likely to

put their talents to effective use? That kind of additional bottleneck occupies the minds of college admissions board members, who therefore heavily consider things like essays and extracurricular activities.

### Concluding Remarks

The authors seem to have a good theory of intelligence tests, founded in the extant research on what factors predominate when a problem has to be solved. Individual interests and specific skills in a particular type of material can be important but cannot shine through without adequate memory and executive processes.

We must keep in mind for the future of intelligence testing that, at present, theories such as this one come across as theories founded on arbitrarily constructed tests. For improvement in the utility of the tests, we need to consider what additional human characteristics are important in determining who will make the most of an opportunity and who will waste it. When such tests are conceived, the process overlap theory may become a building block of a more general theory in which the boundary between intelligence and personality is pretty much blurred. For that to happen, of course, we will have to revisit issues about the purposes of the tests and the ethical constraints that should be placed on them.

### Funding

This research was supported by NIH Grant R01-HD21338.