Intelligence 42 (2014) 176–179

Contents lists available at ScienceDirect

Intelligence

Teaching about the nature of intelligence

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ARTICLE INFO

Article history:
Received 30 August 2013
Accepted 30 August 2013
Available online 29 September 2013

Keywords:
Intelligence
Teaching
Cognition

ABSTRACT

Since 1975, I have taught at irregular intervals a course on the nature of intelligence. In this essay, I describe 20 general principles I impart to students through the course.

Themes in a course on the nature of intelligence

Since the fall of 1975, I have taught at irregular intervals a course on the nature of intelligence. That first year I taught it, I offered it as an undergraduate seminar. The last time I taught it, in the spring of 2013, I offered it as a graduate seminar. At different times, I have used different textbooks, or no textbooks at all. In my most recent teaching of the course, I used Mackintosh (2010) as a main text, and Hunt (2010) and Sternberg and Kaufman (2011) as supplementary texts. All of the texts were successful at the graduate level and I would use them again.

The students who take my seminar come from a wide variety of backgrounds. Most of them will not actually enter the field of human intelligence and are interested in general ideas more than highly specific details. For this reason, I tend to emphasize understanding of certain themes across the course rather than to focus on memorization of specific research findings, which, in any case, change over time. Currently, there are 20 such themes.

1 Intelligence is the ability to adapt to, shape, and select environments.

There are many different definitions of intelligence (see Sternberg & Kaufman, 2011), but in the end, intelligence is about one's interactions with the environment in which one lives (Binet & Simon, 1916; Sternberg, 1985; Wechsler, 1974). It is characterized by the ability to adapt to the environment in which one finds oneself; if that environment is suboptimal, it further involves the ability to shape the environment to make it more suitable for one's skills and desires; and if that environment still does not work, it involves the ability to select a different environment, to the extent one is able. Such environments are not necessarily "geographic." For example, at work or even in an interpersonal relationship, one may first try to adapt to the environment, and then try to shape it to render the environment more congenial, and if neither of these efforts succeed, finally find a new job or a new relationship.

2 Intelligence is something that is both discovered and invented.

On the one hand, intelligence has characteristics of a discovery; researchers seek to discover what intelligence is. They do research aimed at discovering the nature and consequences of intelligence. On the other hand, intelligence has characteristics of an invention; it is a culturally and socially defined construct that is understood differently in different cultures (Sternberg et al., 2011; Sternberg & Kaufman, 2011). Some researchers emphasize the "discoverable" aspects, such as those who use cognitive or biological

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http://dx.doi.org/10.1016/j.intell.2013.08.010

approaches to intelligence; other researchers emphasize the "invented" aspects, such as those who use anthropological or sociological approaches (Sternberg, 1990).

3 Intelligence can be tested through so-called "intelligence tests," but such tests do not measure the whole of intelligence, nor did their originators think they did.

Intelligence tests have proven to be a useful tool for roughly characterizing the levels of intelligence of different individuals and groups. But it is important to realize that the inventors of such tests (Binet & Simon, 1916; Wechsler, 1974) had very broad conceptions of the nature of intelligence and viewed their tests as rough gages rather than as precise indices of intelligence. Another early investigator, Spearman (1927), seemed more to emphasize the precision of the tests, and at least among theorists emphasizing intelligence measurement, Spearman's notion of precise measurement seems more to have caught on. That said, individuals' scores vary somewhat over time and place, so one should be cautious about drawing very precise conclusions for any individual on the basis of a single testing.

4 Scores on intelligence tests predict academic and other kinds of success, but are incomplete predictors of that success.

Scores on intelligence tests are predictive of a great many kinds of performances (Mackintosh, 2011), but the prediction is incomplete. They predict academic performance up to about the .5–.6 level of correlation, but prediction of job performance uncorrected for attenuation and restriction of range is lower, generally at about the .3 correlational level. These figures mean that such tests predict somewhere between about 10% and 30% of the variation in real-world performances. Such levels of prediction suggest that, if one's goal is successfully to predict school, work, or other performances, it would make sense to supplement tests of intelligence with other kinds of tests.

5 At the present time, there is no way completely independently to measure intelligence and achievement.

Although we like to think of ability tests and achievement tests as qualitatively different, in fact, the difference is quantitative. They are on a continuum of when one learned the kind of material on the test. Intelligence tests tend to measure achievement that an individual was supposed to have attained further back than that which would be measured by an achievement test. I have argued (Sternberg, 1999) that intelligence is a form of developing expertise—that it is merely one of many kinds of achieved forms of expertise. On this view, intelligence tests measure knowledge and skills at a level of expertise less recently acquired than the level measured by achievement tests.

Some might think that at least abstract reasoning tests, such as the Raven tests, are somehow pure intelligence tests, unlike verbal and mathematical ones, which largely measure knowledge and reasoning with that knowledge. But the greater susceptibility of tests such as the Raven to the Flynn effect (Flynn, 2009) suggests that abstract-reasoning tests, even more than verbal ones, are achievement based, with the achievement, in their base, being knowledge of how to encode and operate on abstract geometric figures.

6 There is no one "right" way to study intelligence, but rather, different ways of studying intelligence are complementary.

Intelligence researchers, to some extent, "slug it out" regarding how to study intelligence (Sternberg, 1990; Sternberg & Kaufman, 2011). But in the end, there is no one right way to study intelligence, but rather, a set of complementary approaches. Gardner (1983) recognized this fact when he adduced multiple sources of evidence, from multiple paradigms, to support his theory of multiple intelligences. The theory may or may not be valid, but at the very least it is based on evidence adduced from multiple converging operations rather than on evidence adduced from a single paradigm, such as the psychometric one.

7 Intelligence can be studied and understood in terms of diverse "metaphors of mind".

Corresponding to the different ways of studying intelligence are different metaphors of mind that generate these research methods (Sternberg, 1990). Examples of such metaphors are the geographic (psychometric methods), the computational (information-processing methods), the biological (physiological methods for studying the brain and nervous system), and the anthropological (cultural and cross-cultural methods). A comprehensive theory of intelligence ultimately would have to account for data yielded by all of these different methods. At the current time, however, different methods tend to define different problems in research so that the results obtained by the different methods often do not "speak" to one another.

8 Intelligence can be characterized in part by a general factor, or *g*. What is less clear is how general the general factor is.

If there is one finding in psychology that has been replicated more than any other, it may be the general (*g*) factor that results from factor analyses of large numbers of psychometric tests of intelligence. This finding, attributed to Spearman (1927), seems to emerge almost without regard to the surface-structure (cosmetic appearance) of the tests that serves as input. Many researchers accept some version of Carroll's (1993) taxonomy of abilities as representing the relationship between the *g* factor and more specific abilities. The remaining question is just how general the general factor is (Sternberg & Grigorenko, 2002). Some theorists, like Jensen (1998), believe that *g* and the various subfactors under it account for most or all of intelligence; others, like Sternberg (1985, 2003) and Gardner (1983), believe that general ability only scratches the surface of the range of human intellectual abilities.

9 Intelligence also can be characterized by components of information processing. However, it is not clear how comprehensive such a characterization is in terms of the phenomenon as a whole.

Beginning in the early 1970s, researchers began to try to identify cognitive information-processing components that might, in some sense, "account" for general intelligence. The pioneer in this field was Hunt (Hunt et al., 1975), followed by Sternberg (1977). For some years, it appeared that this approach

would lead eventually to some kind of catalog of cognitive components that underlay intelligence. However, the research, at least so far, has not fulfilled that promise. There seems to be more to intelligence than a set of information-processing components.

10 Research has successfully localized many and diverse various parts of the brain responsible, in part, for intelligent behavior, but these parts work together in complex ways that are not fully understood.

Some investigators have suggested that understanding of human intelligence will come from studies of the brain and nervous system (e.g., Deary, 2000). And great insights certainly have come from studies of the brain. But these approaches, like the cognitive ones, have proven to be incomplete. Like all other approaches, they are good at answering some questions (e.g., what parts of the brain are most involved in learning lists of words?) and not so good at answering others (e.g., why do some people consider shaking of hands to be socially smart while others do not?).

11 General intelligence and various other aspects of intelligence are heritable in some degree and the degree of heritability increases with age.

Human intelligence is heritable in some degree (Plomin et al., 2012). Somewhat counterintuitively, heritability rises with age, meaning that early environmental effects begin to dissipate and genetic effects become more prominent. Attempts to localize the genes responsible for the heritability of intelligence generally have not been very successful, with purported findings failing to replicate. Current thinking is that this failure suggests that intelligence is both polygenetic and epigenetic in its expression.

12 Attempts to understand extremely high and low levels of intelligence need to go beyond IQ.

Some investigators have sought to understand intellectual giftedness as well as intellectual disability solely in terms of IQ (e.g., Terman, 1925; Terman & Oden, 1959) have somewhat missed the mark. For intellectual giftedness to manifest itself among adults, far more is needed than just high IQ, including passion, resilience, a sense of destiny, and other characteristics (Sternberg et al., 2005). Similarly, intellectual disability is far broader than an IQ (Sternberg & Spear, 1985), manifesting itself additionally in failure of everyday adaptive behavior.

13 Intelligence manifests itself in different ways and in different cultures, with the result that the characteristics that lead to successful adaptation across different cultures may be somewhat different.

What is adaptive in one culture may or may not be adaptive in another (Sternberg, 2004). For example, children in rural Kenya may exhibit their adaptive intelligence by knowing the names of natural herbal medications used to combat parasitic illnesses. Such knowledge would be irrelevant in most of the United States. But skill in manipulation of abstract symbols appearing on an IQ test would be more important to children growing up in the US than it would be to children growing up in rural Kenya. It is important, in measuring intelligence, to measure it in ways that are responsive to the enculturation and socialization of the individuals being tested.

14 Folk conceptions of intelligence differ rather widely across cultures.

Studies of folk conceptions of intelligence reveal that what is considered smart in one culture may be considered not so smart in another. For example, mental speed may be valued in one culture but devalued in another (Sternberg, 2004). Because the large majority of judgments of intelligence in societies are based on informal interactions rather than on intelligence-test scores, it is important for researchers of intelligence to understand what people mean by intelligence in their daily interactions.

15 Different socially defined races show different average levels of scores on conventional intelligence tests but it is not entirely clear why and these differences depend on how one socially defines “race”.

Different ethnic and socially defined racial groups show different averaged scores on tests of intelligence. But these groups are defined by social, and not by biological groupings (Sternberg et al., 2005). Hence, it is important to be careful in drawing generalizations about group differences. What constitutes a group is a social categorization and may not even apply in a culture other than one's own.

16 Although there is evidence of average patterns of differences in intelligence across the sexes, there is no evidence, overall, of sex differences in levels of intelligence.

There is no evidence of average sex differences in human intelligence (Halpern, 2011). That said, there is evidence of different patterns of abilities, with women tending to score higher on many kinds of verbal tests and men tending to score higher on many kinds of spatial tasks, especially those involving mental rotation. These differences may be partly hormonal.

17 That part of intelligence measured by IQ tests increased around much of the world during the years of the 20th century and is still increasing in some places, for reasons that are not entirely clear.

Flynn (2009) has shown that intelligence test scores increased during the 20th century all around the world. In some places, these increases are continuing but in other places they are not. The causes of the differences are probably multiple, including better education, prenatal care, nutrition, technological innovation, and other unknown elements. Some people have interpreted this increase as calling into question whether intelligence tests in fact measure intelligence or rather measure something else.

18 There appears to be some continuity in the nature of intelligence throughout the lifespan, contrary to earlier theorizing.

It was once thought that intelligence represented a discontinuous program throughout the lifespan, with sensorimotor abilities dominating during infancy and more cognitive abilities coming to the fore later on (Piaget, 1972). Researchers now believe that intelligence is continuous throughout the lifespan, with preference for novelty and habituation to familiar stimuli serving as valid measures throughout the lifetime (Fagan, 1985).

19 Intelligence is modifiable in some degree, although there is no consensus on just what this degree is.

Intelligence can be increased in some degree (Detterman & Sternberg, 1982; Jaeggi et al., 2008; Sternberg & Grigorenko, 2007; Sternberg et al., 2011). Researchers differ in their inferences as to how much of an increase is possible. Certainly the Flynn effect suggests that environmental factors can result in increases in IQ.

20 Research on intelligence needs to be vetted carefully because researchers with different ideological predispositions tend to find different and often contradictory things.

Intelligence researchers go into their research with what appear to be different ideological predispositions. These predispositions seem to predict the kinds of findings that emerge from their research. Thus, in intelligence research as in so much else, *caveat emptor* applies.

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