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Special Issue Article

"Social policy and intelligence" Redux: a tribute to Edward Zigler

Robert J. Sternberg

Department of Human Development, College of Human Ecology, Cornell University, Ithaca, NY, USA

Abstract

I present a theory of adaptive intelligence and discuss why I believe adaptive intelligence, rather than general intelligence, is the kind of intelligence upon which we should focus in today's world. Adaptive intelligence is the ability to adapt to, shape, and select real-world environments in ways that result in positive outcomes not only for oneself, but also for others and the world. Edward Zigler was among the first to recognize the importance of levels of adaptation to intellectual deficiency, arguing from early on that intellectual challenges needed to be recognized not just in terms of IQ but also in terms of adaptive functioning. Adaptive intelligence is compared to and contrasted with general intelligence, which is usually defined as the first factor in a factor analysis of psychometric tests. I first introduce the main issues in the article. Then I discuss how one even would decide what intelligence is. Next I discuss broader theories of intelligence and especially the theory of adaptive intelligence. Then I talk about the perishability of theories of intelligence and other things—to what extent are they set up so that people are willing and able to move beyond them? Finally, I discuss how individual outcomes do not necessarily predict collective outcomes.

Keywords: adaptive intelligence, creative intelligence, intellectual deficiency, practical intelligence, successful intelligence, wisdom

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Forty years ago, the first edition of my *Handbook of Human Intelligence* (Sternberg, 1980) included a chapter by Edward Zigler and Victoria Seitz entitled "Social policy and intelligence" (Zigler & Seitz, 1980). The chapter was an influential tour de force in recognizing that the study of intelligence and its application to society needed to be understood in their social-policy context. From my viewpoint, the main argument of the Zigler and Seitz chapter was that one could not satisfactorily study intelligence outside its societal context. The usual way of studying intelligence had been to study it in isolation and then to look at its societal consequences. Zigler, in his policy work, recognized that the study of intelligence in isolation from society and social policy was misguided, because society decides what it is that it will call "intelligent." Intelligence is always based on implicit folk theories, whether of novices or of experts (Sternberg, Conway, Ketron, & Bernstein, 1981). If society makes a mistake in how it conceives of intelligence, the consequences are profound and potentially devastating not only to individuals but also to that society as a whole.

Zigler and Seitz, in their chapter, took to task the notion that "Social science is presumably value-free, whereas policy decisions are made in a value-laden context" (p. 589). Zigler and Seitz argued, in contrast, that "Research in the social sciences is not value-free, and even the most basic research takes on the values of the investigators" (p. 589). Zigler and Seitz dealt primarily, in their chapter, with how intervention studies to increase intelligence and achievement and their interpretation reflected societal values, not some objective reality. But suppose we take their argument one step further back. The argument then would be that it is not just the intervention studies regarding intelligence, but the very nature of intelligence that is largely a societal invention (Berry, 1974; Sarason, 2001). Ironically, this is essentially what the next chapter immediately following Zigler and Seitz in the 1980 handbook argued—that we cannot even understand what intelligence is outside its cultural and societal contexts (Laboratory of Comparative Human Cognition, 1980). This view continues to be represented 40 years later in the current version of the intelligence handbook (Sternberg, 2020a; Suzuki, Larson-Konar, Short, & Lee, 2020; see also Sternberg, 2018a) and elsewhere (Sternberg, 2019a; in press). What does it mean for intelligence to be largely culturally and societally determined, and what are the implications of what it means?

Where Does One Start Answering the Question of What Does it Mean to be Intelligent?

Alfred Binet started answering the question of what it means to be intelligent in schools (Binet & Simon, 1916). This was a sensible place to start, given Binet's goal. In particular, his goal was to distinguish between those children who could thrive in regular schooling and those who needed special help and special schooling. This was a noble goal, because in the absence of a test, teachers sometimes tended to recommend for special placement

Author for Correspondence: Robert J. Sternberg, Department of Human Development, College of Human Ecology, Cornell University, Ithaca, NY 14853, USA; E-mail: robert.sternberg@cornell.edu.

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children who simply were challenging or unpleasant to have in a regular classroom, in particular, those with behavioral issues. In my view, Binet's innovation was too successful.

IQ testing spread like wildfire, not only into schools but also into business and the military (Zenderland, 2001). The tests were predictive of a variety of kinds of success and still are (Deary, Whalley, & Starr, 2008). Their modest success was good enough for psychometric testers. How could tests that predict so many things be inadequate? Some psychologists have made careers in substantial part out of showing just how many different things general intelligence, as measured by the tests, predict (cf. Sackett, Shewach, & Dahlke, 2020). I have no argument with their data. The question is whether that is enough to expect from a test of intelligence.

Now imagine starting in a different place, conceptually, from the question of the value of a test for predicting school performance—Binet's question. Consider instead the value of the test for predicting performance beyond the school—actually, way beyond the school.

Although definitions of intelligence have differed over the years, a common feature of most of these definitions has been that intelligence involves the ability to adapt to the environment (Gottfredson, 1997; "Intelligence and its measurement,", 1921; Sternberg & Detterman, 1986). Indeed, the main thesis of this article is that intelligence should be defined in terms of broad adaptation to the environment, as will be elaborated upon later. This includes the motivation to solve problems in the environment, something Edward Zigler recognized as crucial in understanding intellectual deficiency (Zigler, 1966). Solving multiple-choice problems on school-based material is adaptive only because societies have declared that the knowledge and skills involving these problems are worth having. In other words, for children, solving school-based problems is not a biological imperative but rather a cultural one. After schooling, most people never take another multiple-choice test again, so to the extent taking such tests is adaptive, it is primarily for an early stage of life. On this view, there is nothing "biological" about the definition of intelligence in terms of some general factor (Sternberg & Grigorenko, 2002). Rather, societies have decided they value the skills involved, and then look for correlated biological or cognitive or other skills that they value culturally. The stipulation of intelligence as a general factor originating in biology is false. It originates in cultural preferences.

My colleagues and I know this because we have worked in cultures where the skills required for adaptation are different (Sternberg, 2004). As an example, in rural Kenya, an important skill is utilizing natural herbal medicines that are used to combat parasitic illnesses. These medications are at least somewhat effective. They are widely used, especially in areas where Western medicines are not available (Sternberg et al., 2001). We designed a test that would measure directly—not through proxies like IQ—the adaptive knowledge and skills needed to cope in an environment where malaria, schistosomiasis, hookworm, whipworm, and other parasitic illnesses represent major threats to personal well-being and adaptation to the environment. Here is an example of an item we used (with correct answers indicated by asterisks):

- "A small child in your family has homa. She has a sore throat, headache, and fever. She has been sick for 3 days. Which of the following five Yadh nyaluo (Luo herbal medicines) can treat homa?
  i. Chamama. Take the leaf and fito (sniff medicine up the nose to sneeze out illness).*
  ii. Kaladali. Take the leaves, drink, and fito.*
  iii. Obuo. Take the leaves and fito.*
  iv. Ogaka. Take the roots, pound, and drink.
  v. Ahundo. Take the leaves and fito."

Western children would get items on this test correct only by chance. That is as it should be. Their adaptive demands are different. The question is why Westerners think that the kinds of items that appear on their tests apply anywhere, while not granting the same supposed universality to items that would make sense in other cultures. In this study, we actually found a *negative* correlation between scores on the tests of knowledge about use of natural herbal medicines and scores on standard tests of fluid and crystallized intelligence (with the tests translated into the participants' native dialect, Dholuo).

Of course, this example is taken from a country that to many would seem remote and far away. But consider the current COVID-19 pandemic. If people all over the world, including the United States, were more adept at thinking about how to prevent, treat, and cure an aggressive illness, whether parasitic, viral, or otherwise, many more people today might be alive and well. The skills we might tend to dismiss in the rural Kenyans are the very ones we lack and that, in limiting our adaptive inteligence, have caused over half a million deaths as of when I am reviewing the proofs of this article. The same principle applies in the United States as in rural Kenya. Consider the lives of Yup'ik Native Americans in settlements in Alaska. Adaptive skills for these people are again very different from those for most of us. Because they live in fishing villages, ice fishing, hunting, and gathering are important skills, as is the ability to travel between villages that are separated by large distances in the frozen tundra where, at least to us, there would be no visible landmarks. Here is an example from a test my colleagues and I administered to these children (Grigorenko et al., 2004):

"When Eddie runs to collect the ptarmigan that he's just shot, he notices that its front pouch (balloon) is full of ptarmigan food. This is a sign that:
- there's a storm on the way.*
- winter is almost over.
- it's hard to find food this season.
- it hasn't snowed in a long time."

Once again, a test item that would be fairly easy in terms of its adaptive requirements for the Yup'ik child would be very difficult for most readers of this article. We found that the Yup'ik participants performed better than the Westernized participants in small Alaskan cities but did worse on Western tests. However, we also have found that, if the Native American participants are taught some Western subjects, such as plane geometry, using items and concepts that are familiar in their environments, such as fish racks, their performance on Western-based test items improves (Sternberg, Lipka, Newman, Wildfeuer, & Grigorenko, 2007). Ed Zigler, of course, recognized the importance of local environment in the development of intelligence at a time that many researchers emphasized only genetics (Zigler, 1986; Zigler & Hodapp, 1986; Zigler, Hodapp, & Edison, 1990).

Of course, the extensive cross-cultural use of Westernized tests demanded some kind of justification. Such a justification was once believed to be provided by the notion that the use of only abstract symbols, as in the Raven scales—geometric symbols that presumably would mean the same thing to anyone, regardless

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of language—would render the tests culture-fair or even culture-free (e.g., Cattell, 1949). There was only one thing wrong with this widespread claim. It wasn't true. The work of James Flynn (e.g., Flynn, 1984, 1987, 2016) repeatedly showed that, around the world, intelligence-test scores increased during the 20th century. The greatest increases were not for tests such as vocabulary, which are measures of so-called crystallized intelligence, but rather for tests such as nonverbal figural-matrix problems, which are measures of so-called fluid intelligence. What this means is that, contrary to the notion that potential levels of fluid intelligence are fixed, they are malleable—at least across generations. And moreover, fluid-intelligence measures cannot be culture-free or culture-fair if they are susceptible to environmental forces, which may differ from one time or place or another.

There are numerous demonstrations of the cultural loading of intelligence tests (Daley & Onwuegbuzie, 2020; Laboratory of Comparative Human Cognition, 1980; Serpell, 1974, 2002; Sternberg, 2020b; Suzuki et al., 2020). Often, the criteria used to validate the tests have the same biases as the tests themselves, so that, statistically, the bias does not show up. The argument, again, is not that the tests used in African population have any particular generality; rather, the argument is that the generality of *any* test of intelligence goes only so far.

Broader Theories of Intelligence

Broader theories of intelligence have sought to deal with some of the limitations of conventional views of intelligence. These broader theories could be called "systems theories" (Sternberg, 2020c). Systems theories seek to explain intelligence in terms of broader systems of human functioning, always taking into account the interaction of the person, the society, and the natural environment. Examples of systems theories are Howard Gardner's (1983, 2011) theory of multiple intelligences and my own theory of successful intelligence (Sternberg, 1997, 2020a).

Gardner's theory of multiple intelligences

Gardner (2011) argued that there are eight multiple intelligences: linguistic, logical/mathematical, spatial, bodily-kinesthetic, musical, naturalist, interpersonal, and intrapersonal. Gardner (1983, 2011) proposed particular criteria for identifying an intelligence. These criteria, with the italicized passages paraphrasing Gardner, were:

1. *Potential isolation of a particular intelligence by brain damage.* The damage presumably would then isolate where the intelligence originates in the brain.
2. *The existence of exceptional and highly distinctive individuals.* Extremely bright or intellectually challenged people in a specific area would show that the area might operate as a module.
3. *An identifiable core operation or set of core operations*. These would be the mental processes underlying performance in the particular intelligence.
4. *A distinctive developmental history leading an individual from the level of novice to the level of master*. These data would indicate a unique trajectory of development for an intelligence.
5. *A distinctive evolutionary history of the intelligence*. These data would indicate a unique evolutionary path for an intelligence that separates it from other intelligences.
6. *Supportive evidence from cognitive-experimental investigations.* These investigations would help provide evidence of how people process information when they think and act intelligently in a given domain.
7. *Supportive evidence from psychometric tests pointing to differentiable and discrete intelligences.* Such evidence from factor-analytic studies would show whether individual differences from the various intelligences are statistically independent.
8. *Susceptibility to encoding of information in a symbol system.* Each intelligence presumably would have its own symbol system, such as words for linguistic intelligence, numbers for logical-mathematical intelligence, and musical notes for musical intelligence.

The list of criteria for Gardner's theory makes it clear both how Gardner's view is similar to that of the present article—intelligence needs to be defined more broadly than it conventionally has been defined—and also how Gardner's view is different from the present view. None of the criteria Gardner lists explicitly mentions adaptation to the environment. The closest is the fifth criterion—distinctive evolutionary history—but an ability or set of abilities could have a distinctive evolutionary history without being necessary for adaptation. In particular, so-called "musical intelligence" does seem to represent a distinct set of skills, but in few if any cultures would these skills be necessary for adaptation. Someone who is deaf from birth or from early childhood—Helen Keller, for example—might not show much musical intelligence, as we understand it, and yet find effective ways of adapting to the environment. Similarly, someone with severe motor problems—the late Stephen Hawking, for example—might lack much in the way of bodily-kinesthetic intelligence, but in modern cultural milieus around the world, find ways of adapting very effectively.

Sternberg's theory of adaptive intelligence

The theory of adaptive intelligence (Sternberg, 2019a, in press), a successor to the previous theory of successful intelligence (Sternberg, 1997), places more emphasis on the adaptive function of abilities. Edward Zigler recognized from early on the importance of adaptive behavior for diagnosing intellectual deficiency, at a time that many psychologists relied largely or solely on IQ (Raver & Zigler, 1991; Zigler, 1971). In particular, the theory specifies that intelligence involves creating a set of goals and a path through life that enables one to achieve one's goals, to the extent to which one is capable, and at the same time create the same possibilities for one's contemporaries and successors. That is, one contributes in some way, no matter how small, to creating a better world—one that will be inhabitable for future generations. Because if we do not do so, given how things are going now, at some point in the near future, there will be no future generations, at least of humans. Climate change, air pollution, water pollution, water scarcity, food scarcity, war, or whatever will seriously compromise the future for subsequent generations, as they are for the current generation.

In the theory of adaptive intelligence, adaptation is defined more broadly than in its conventional sense. *Broad adaptation* consists of three elements. First, the conventional sense is what I will call here *narrow adaptation*, which means changing oneself to fit the environment in which one lives. Second, sometimes one does not wish to or cannot adapt. For example, individuals who care about the world and not just about themselves and their personal prospects might decide that there are certain jobs they will not take or stay in, because to do so would sell out all they hold

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dear. In that case, they may try to *shape* the environment—to make it better for themselves and potentially for others. This is what many current residents of Hong Kong are doing right now (e.g., Ives, Jacobs, & May, 2019) and what some disgruntled members of the Trump presidential administration have attempted to do (Anonymous, 2019). Third, if shaping fails, some people may decide to *select* a different environment—for example, the now countless individuals who have left the Trump administration, realizing that they could not find a way to stay in it and adhere to their ethical or other principles (Diehm, Petulla, & Wolf, 2019). Thus, the broader notion of adaptation includes narrow adaptation to, but also, shaping and selection of environments.

In the theory of adaptive intelligence, there are four sets of skills that are key for broad adaptation. These are creative skills, analytical skills, practical skills, and wisdom-based skills. Creative skills are used to generate novel and somehow useful ideas. Analytical skills are used to ascertain whether one's ideas (and others') are logically sound and defensible. Practical skills are used to put ideas into practice and also to persuade others of the value of the ideas. Wisdom-based skills are used to ensure that the ideas one generates help, in some way, to achieve a common good, over the long-term as well as the short-term, by balancing one's own, others', and larger interests, over the long- as well as the short-term, through the infusion of positive ethical values. I will further discuss each of these skill sets shortly.

The world is facing unprecedented challenges for which it appears to be largely or even entirely unprepared. For example, at the time I am writing these words, there are massive wildfires in Australia that are causing unprecedented levels of economic harm and human suffering. Sydney is engulfed in smoke. We can pretend that the problem came out of nowhere, but of course it didn't. Such wildfires have occurred as well in my own country, the United States, especially in California and Oregon. I know because a preplanned summer vacation we took in these two states in the summer of 2018 had to be re-planned entirely on a day-by-day basis as we sought to escape the wildfires that were engulfing these two states that summer. More recently, wildfires have spread to and ravaged the Los Angeles area ("California wildfires map," 2019).

In Australia, the frankly idiotic reaction of politicians is telling. The Deputy Prime Minister, Michael McCormick, commented that anyone who talks about climate change during the fires is a "bloody disgrace" (Smith & Crowe, 2019). This is somewhat reminiscent of the thoughts and prayers opponents of gun control offer to the victims' families after each school shooting in the United States (Mazza, 2018). In the first 46 weeks of 2019, there were 45 school shootings in the United States (Wolfe & Walker, 2019). This is quite remarkable. In the entire United Kingdom, after handguns were banned in 1996, there were no school shootings whatsoever (LaCapria, 2018). "Thoughts and prayers"? Is that a serious response? Is gathering in tightly-congregated large groups without masks on beaches an adaptive response to COVID-19?

The larger question is why people's reactions to massive and imminent threats is so feeble. According to the United Nations, the world has squandered any reasonable attempt to deal with climate change and the world is paying with the consequences of its feeble and oftentimes counterproductive response (Dennis, 2019). This is not the usual warning that bad things are ahead. The bad things are happening *now* and they are only going to get worse. Essentially, we will be leaving a wasteland to our children and grandchildren, whether we will them a lot of money or none at all. Does anyone expect that the world will actually respond in a "drastic" way? Of course not. A more typical reaction will be that of Donald Trump, who has done what is in his power to aggravate the conditions that lead to climate change (Meyer, 2019). Perhaps his attitude is best represented by a sign he held up in a photo reprinted in the Meyer (2019) article, "Trump digs coal."

How can we talk about intelligence as measured by IQ tests, SATs, ACTs, GREs, and assorted alphabet-soup tests when individuals, many with high IQs, are busy creating the conditions that threaten to destroy the world as we know it? If we define intelligence in the only way that is biologically defensible—as adaptation to the environment—then IQ seems to be an exceptionally *poor* measure of intelligence as adaptation. It took high IQs to create many of the causes of instability in the world—the carbon-emitting machines largely behind human-induced global climate change, nuclear weapons, overuse of antibiotics causing bacterial resistance to those antibiotics, combustion engines responsible in part for air pollution, industrial waste responsible in part for water pollution, guns that kill untold numbers of children and adults, the markets at which COVID-19 passed from nonhuman animals to human ones, and onward the list goes. The equation of IQ with intelligence has been an assertion with truly tragic consequences, because it has led us to select a cohort of leaders who have failed not only us humans, but the million other species that we have caused to go extinct or to be on the way toward extinction (Gerretsen, 2019).

Elements of the Theory of Adaptive Intelligence

According to the theory of adaptive intelligence, as noted above, there are four components of adaptive intelligence. All of them are necessary for broad adaptation—that is, one could not survive with zero levels of any of them (unlike, say, musical skills). These four components are creative intelligence, analytical intelligence, practical intelligence, and wisdom.

Creative intelligence

Creative intelligence refers to one's (modifiable) ability to formulate ideas that are novel and useful in some way (Kaufman & Sternberg, 2019). Creative intelligence is involved when one creates, invents, discovers, innovates, designs, imagines, or supposes. Creative intelligence is not merely an ability but also, in large part, an attitude toward life—namely, that one is willing to be defiant in the face of various existing beliefs. There are three kinds of defiance, according to a triangular theory of creativity (Sternberg, 2018b): defiance of the self, defiance of the crowd, and defiance of the Zeitgeist.

Defiance of the self refers to one's willingness and ability to let go of past beliefs and ideology in favor of new ones in the face of new knowledge that indicates that one's prior beliefs and ideology have become obsolete. Although this would seem easy to do in theory, in practice, it is quite challenging. Most people do not want to let go of their past beliefs. They have too much invested in them, and when those beliefs are challenged, they often resort to confirmation bias and myside bias, which leave their prior beliefs in place (Baron, 2007). When Donald Trump said, "I could stand in the middle of 5th Avenue and shoot somebody and I wouldn't lose voters" ("Trump: I could murder and not lose votes", 2016), he was not stating his belief that people condone senseless killing. Rather, in effect, he was saying that people are

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so stuck to their ideology that they will retain it in the face of major refutation of their beliefs. He appears likely to have been largely correct.

Creative individuals acquire a reputation by doing work that is bold and innovative. But once they have done such work, it is hard to let it go. After all, they have staked their reputation on that work. The result is that some people prove to be "one-idea people," that is, people who have an idea and then are never able to let go of it (Sternberg & Lubart, 1995). To let go of the idea might be viewed as telling their supporters that the supporters' faith in the individuals has been a huge mistake—that the idea or ideas in which they believed are in fact not tenable. Not all creators are willing to admit they were wrong or at least incomplete in their ideas, so they lose their creativity through their unwillingness to defy themselves.

Defiance of the crowd refers to a willingness to place oneself against common beliefs. This also proves to be extremely hard to do. We see it today in people's unwillingness to let go of the illiberal and sometimes neo-fascist governments they elect that then create very strong social pressure to conform. For example, at the time I am writing, it has become clear that it does not matter what Trump did or did not do—few, if any, Republican members of the House of Representatives will vote to impeach him. Probably none in the Senate will vote to convict him (Samuels, 2019) [in fact, just one did, as it later turned out]. Whatever the particular senators may believe, many simply lack the courage to defy the crowd, even if they believe Trump's offenses are serious and should result in his removal as president. Their lack of conviction and courage is not atypical but rather common. People fall in line, much as did Germans in the days of Hitler (which is not to say that Trump's sins, whatever they are, are tantamount to Hitler's). When we experience social pressure, most of us fall in line, a phenomenon elegantly illustrated by Asch (1951, 1956). In the Asch experiments, experimental participants were asked which of several lines was longest. Unbeknownst to the participants, those who answered in a line before them were confederates of the experimenter. They all lied. Overall, three-quarters of the participants who were not confederates gave at least one wrong answer out of 12 trials. In other words, even though the correct answers were obvious, they gave at least one wrong answer regarding which line was longest as a result of social pressure.

Analytical intelligence

Analytical intelligence refers to one's ability to understand how to solve problems. To solve problems, one may analyze, judge, critique, compare and contrast, or evaluate. Analytical intelligence is the kind of intelligence measured by standardized tests of intelligence and their proxies. For example, such tests may have one analyze and solve mathematics problems, logical problems, spatial-relations problems, antonyms problems, inductive-reasoning problems such as number series, and related kinds of problems.

Analytical intelligence is essential to the kind of critical thinking we need to analyze information presented in newspaper or magazine articles, in newscasts on television, or in any kind of opinion-based presentation. Despite the 30-point rise in IQs during the 20th century (Flynn, 2016), people today appear to be remarkably weak in critical thinking. Politicians have learned, for example, that if you repeat a statement often enough, even if it is patently false, many people will come to believe it. It apparently takes an extra step for people to disconfirm what they hear. Initially, they believe it (Gilbert, 1991). Many, if not most people, are too intellectually lazy to take that extra step. So, when media pundits or politicians or anyone else with any credibility at all, no matter how minimal, lies to them, many of them simply accept it, especially if it fits their prior beliefs. The upshot is that countries no longer need coups d'état to install dictators. The dictators get themselves elected and then just never leave. As we are seeing in the 21st century, it can happen anywhere, a point made by Sinclair Lewis (2014) in his book, *It Can't Happen Here,* the point of which is that, regardless of where "here" is, a populist fascist dictatorship can come into power.

Lack of critical thinking has shown itself in the astonishing inattention the world has paid to global climate change. Even when it stares us right in the face, many people act as though the problem either does not exist, or is not important, or can be dealt with down the road. The same is true for COVID-19, a much quicker killer than climate change. As we all find out in our individual lives, the problem with kicking the can down the road is that, eventually we all, individually or collectively, reach the point down the road to which we kicked the can. We can kick it only so many times before there is no more road down which to kick it.

I used to believe that intelligence tests and their proxies were limited in that they measured only analytical intelligence, but that at least they measured that fairly well for people who were middle to upper middle class, native English speakers, and who had good schooling. I was wrong.

In a series of recent studies, my collaborators and I investigated scientific reasoning of the kinds that scientific and other STEM (science, technology, engineering, mathematics) researchers use in their work (Sternberg & Sternberg, 2017; Sternberg, Sternberg, & Todhunter, 2017; Sternberg, Wong, & Sternberg, 2019). In particular, we had participants generate alternative hypotheses to explain scientific data, generate experiments to answer scientific questions, and draw conclusions from scientific data. We found that these tests all intercorrelated with each other and typically formed a single psychometric factor. We also found that standardized tests of fluid intelligence formed a single factor. However, the scientific-reasoning tests showed generally weak relationships, if any, with the tests of fluid intelligence. In some cases, the relationships were negative. The bottom line was that, at least for scientific reasoning, the tests typically used to measure general intelligence and used for undergraduate and graduate admissions in science are not particularly good measures of scientific reasoning and may provide misleading data.

Practical intelligence

Practical intelligence is the use of one's abilities to adapt to, shape, and select environments. Practical intelligence is involved when one applies what one knows, implements something, puts something into practice, uses something, or attempts to persuade someone of something. Practical intelligence is often manifested through tacit knowledge or what one needs to know to succeed in an environment that is not explicitly taught and that usually is not even verbalized (Hedlund, 2020; Sternberg et al., 2000; Sternberg & Hedlund, 2002). For example, in an employment setting, many of the secrets to getting promoted or to getting a larger raise are not written in any employees' handbook. In school, formal knowledge is expressed through books, lectures, and discussions, but students have to learn on their own the tacit knowledge needed to study for exams, write papers, and petition for higher grades when they feel they have been treated unfairly.

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In our research on practical intelligence, we have found that practical intelligence is distinct from the more academic, analytical intelligence measured by conventional tests of intelligence (Sternberg & Hedlund, 2002). In particular, first, correlations of practical-intelligence tests with conventional tests of intelligence are trivial. Second, practical-intelligence tests of a given type (e.g., situational-judgment tests) tend to correlate with each other. Third, practical-intelligence tests can contribute to the prediction of success in academic settings, because academic settings, like others, require practical skills (Sternberg, 2010). Fourth, practical-intelligence tests are not personality tests—they show trivial correlations with tests of personality. Finally, practical intelligence increases, on average, with experience, but not directly as a function of experience but rather of what one has learned from that experience.

Although I use the term "practical intelligence," this is another term for what is often called "common sense." Common sense in today's world is anything but common, an observation that many have made before. Is racial discrimination a manifestation of common sense, or discrimination against people of various sexual orientations? Is run-away industrialization that deprives people of clean air and clean water common sense? Is a country with increasing numbers of billionaires but also with 40% of its people who could not find $400 in case of an emergency common sense (Bahney, 2018)? Is a country with income disparities at the level of the Gilded Age common sense (Eichler & McAuliff, 2011/2017)?

As a society, we have become so fixated on IQ and its proxies that we seem to have lost track of the importance of common sense, a set of skills that perhaps was more recognized for its importance in times past. The cost has been a society of people who may be intelligent in an abstract-analytical sense but who never develop the level of common sense that could improve their lives and the lives of those around them.

Wisdom

Wisdom, as noted above, involves using one's knowledge and abilities to achieve a common good. Problems on standardized tests do not involve wisdom because wisdom-based problems always require judgments about balancing interests—your own, others', and higher level interests—those of different groups of humans, and human interests balanced with those of non-humans. Real-world problems of any consequence almost inevitably involve such balancing of interests. These problems bear little relation to test problems because wisdom-based problems are (a) open ended, never multiple choice, (b) complex rather than simple, (c) high-stakes rather than low-stakes, (d) time- and labor-intensive rather than being answerable within seconds, (e) lacking in clearcut right or wrong answers rather than being clearly answerable as right or wrong, (f) messy rather than neat, (g) ill-structured, having no clear path to solution, rather than well-structured with a clear path to solution, and (h) value-laden rather than ostensibly value-neutral. Is it any wonder that expertise in solving test problems does not transfer well to real-world problems with real consequences? If anything, the belief that real-world problems can be solved like test problems is likely to lead to negative transfer.

Synthesis

I have suggested that creative, analytical, practical, and wisdom-based skills are necessary (although not sufficient) for adaptation to the environment. Without any creative skills, one could not cope with problems having any degree of novelty. But in life, no matter how impoverished one's environment, one constantly has to deal with novelty. An impoverished environment itself can become a problem one has to deal with creatively. Without any analytical skills, one could not analyze the smallest and simplest problem—as simple as what to eat for breakfast or when to go to sleep. Without any practical skills, one would be totally unable to interact with others and would have no self-insight. Without any wisdom-based skills, one would have no ability to balance one's own needs against one's own needs. One would become like those politicians who blatantly use their jobs solely to advance their own economic or personal interests. Thus, the aspects of adaptive intelligence are different from those in Gardner's theory of multiple intelligences, in that all of them are needed for adequate adaptation to the environment.

Perishability of Theories

Scientific theories need to be perishable, like good food. They need to have within them the mechanisms that allow them to become obsolescent, or as we sometimes say of automobiles, they need to allow for planned obsolescence. Whereas planned obsolescence may be bad for cars, it is good for scientific theories. The reason is that none of our scientific theories, not even Einstein's theory of relativity, accounts for all known phenomena. For example, the theory of relativity is not fully commensurable with quantum theory, and yet there is a lot of evidence to support both theories. Eventually, a theory will need to be developed that incorporates both relativity and quantum theory.

The problem with general-intelligence theory is that planned obsolescence has failed—at least so far, it has not proved to be sufficiently perishable. Rather, it sits like a "Twinkie," which can last year after year without showing the normal decay that natural foods show. Some might see this as a good sign. But nutritional researchers see it as a bad sign, showing that even bacteria and molds are uninterested in feeding off it. Arguably, they understand something that Twinkie eaters do not understand.

The argument of general-intelligence theorists has been a simple one: The theory of general intelligence (Spearman, 1927) and the specific variants of it that have been proposed over the years (e.g., Carroll, 1993; McGrew, 2005) are largely correct, and although the details may change over the years, the basic hierarchical structure proposed first by Spearman and then by others correctly characterizes the nature of intelligence. But are they correct?

What are the reasons the *g*-based models are so widely accepted? I believe there are three major reasons, all of them questionable.

Historical precedent

The theory of general intelligence extends back more than a century to a paper written by Spearman (1904). Since then, the theory has been modified in various ways, culminating perhaps most recently in what has come to be called the CHC (Cattell–Horn–Carroll) model (McGrew, 2009). This model incorporates modifications made to Spearman's theory over the years, especially by Carroll (1993). The model is hierarchical, placing general intelligence (*g*) at the top, group-level abilities at a second level of the hierarchy, and very specific abilities at the lowest level.

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The more historical precedent a theory has, the harder it is to overturn it. But many incomplete or incorrect scientific theories have had great historical precedent and then proved to be less than adequate. As an example, Newton's theory was fine as far as it went, but was shown by Einstein's theory of relativity to be incomplete. Newton's theory was a great theory—it just did not go far enough. Other theories, such as Freud's or Piaget's, also were very useful for many years but proved to be flawed in a number of respects.

My argument here is not that *g*-based theories are wrong, per se, but rather that they do not go far enough. So, there is nothing to "overturn," but rather something to build upon.

General-intelligence tests all correlate with each other

The stunning observation that gave rise to *g*-based theories was Spearman's (1904) observation that all mental-ability tests tend to correlate positively with each other. It was this observation that led Spearman to believe that there must be some kind of single underlying core. Thomson (1916) showed that positive intercorrelations do not necessarily imply a single underlying general factor. But most models based upon Spearman's findings have incorporated the general factor as showing some single thing underlying intelligence.

The question is what, exactly, it shows that tests intercorrelate modestly to moderately with each other. Tests of musical skills or athletic skills are likely to intercorrelate positively with each other, for the most part, but the mere fact of their intercorrelating with each other does not render them measures of general intelligence or general anything else. Clearly, there needs to be something more. There is.

General-intelligence tests tend to correlate with many consequential outcomes, both inside and outside school settings

Sackett et al. (2020), in their review of the literature on general intelligence, show the very wide range of life outcomes with which *g*-based tests correlate. These correlations are indeed impressive. The tests predict individual outcomes with regard to school grades, graduation rates, job performance, health outcomes, marital outcomes, and much more (see also Herrnstein & Murray, 1994). But are the correlations indicative of causation?

Imagine a situation in which resources are scarce. Say, 1000 children who are candidates for a prestigious educational program take a test. Only the top 200 overall will be allowed to admission to the program. The other 800 will have educational opportunities, but not at the same level as the top 200. So, 200 people are chosen, but for varied reasons. Some were chosen because they were naturally very talented at whatever the test measured. Others were chosen because, through error of measurement, they just squeaked by. Still others were chosen because their parents had substantial resources and invested heavily in their preparation for the test, beginning early in their lives and continuing up to right before the test, when the parents purchased training programs for the test. At the same time, some who failed the test failed because they truly were not talented, but others failed through error of measurement, or through not having parents with resources, or whatever. These 800 will be given fewer opportunities, and it will be much harder for them to recover the ground they lost by not being admitted to the prestigious educational program. After some number of years, the 200 chosen people will again be subjected to another test, and 20 people will be chosen again for an even more prestigious program. The other 180 will have opportunities, but not at the same level. With every culling, society gives more and more opportunities to some children, and fewer and fewer opportunities to others.

Change the numbers and you have the educational system of the US and some other countries. The particular tests used by the universities are proxies for tests of general mental abilities (Sackett et al., 2020), and it does not matter much which test is used. There is one key feature here. People can make it through the system, whether by skill, by chance, or most likely, by some combination of both, but when they do, at each step their opportunities in life increase greatly. Your chances of a good job are greater if you get a Harvard BA, regardless of whether you got into Harvard because you are a good student or because you were a good candidate for the golf team (suggesting your parents had the resources for you to be taught to be an excellent golfer) or because your parents donated a building to the university. If you can make the next cut, say, a PhD or a law or medical degree from Harvard, you will have opportunities that people without comparably prestigious degrees never will have. In each case, your credentials are based on speculation: In all likelihood, you have never done a major independent research project, or argued a case in court, or practiced medicine in a meaningfully independent way. But the mere fact of having the degree provides you with fabulous opportunities.

Now someone finds that there is a correlation between high scores on the aforementioned test, which was used for admission to Harvard or wherever, and success in later life. But correlation, as a first-semester statistics student knows, does not imply causation. To some extent, the success students later show may reflect abilities of some kind. But almost certainly, to some extent, perhaps to a larger extent, those correlations reflect the differential opportunities bestowed upon students who scored differently on the tests and who had other advantages. In other words, in large part, the correlations are inventions of a societal system that provides many more benefits to those who test well—for whatever reason—than to those who do not. The studies suffer from the same problem as all epidemiological studies: They are not designed to tell us anything about causation. The same tests that got you into better universities later will enable you to garner more resources, and in turn, to have a better health plan, to be able to pay for better food, and, through assortative mating, to find spouses who also have more resources, magnifying the effects of the selection system upon future generations as well as on the present generation. This is not to say that conventional abilities do not matter. It is to say that society's reaction to what may start off as small differences in these abilities magnifies the differences and eventually leads to very different life opportunities (see also Flynn, 2016). Correlations between test scores and later outcomes are in part societal creations, not natural phenomena of some kind.

The question then arises of how much the correlations mean? There is a way to find out. If universities were willing to do a true experiment, and to admit students at random, and later to follow up on their graduates as well as control groups that are not admitted, we would learn something. The problem is that all the universities would have to do it. Otherwise, students not admitted by random admissions to Harvard, might be admitted to another highly prestigious university based on their test scores, meaning that the experiment would be for naught because the opportunities not provided in one place would be provided in another.

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There are at least three conclusions that can be drawn from this analysis. First, correlations are often interpreted causally when they do not necessarily tell us much, if anything causal—for example, about the relation of *g*-based test scores to later successes. Second, the correlations themselves are partly invented—the educational and social systems, in part, create the correlations. Third, Zigler and Seitz's (1980) concern with social policy and intelligence was prescient. Unlike many contemporary intelligence researchers, Zigler realized that social policies are not only effects, but also causes of individual differences in levels of success in outcomes. Scores on tests of general intelligence have to be understood in the social context in which they occur.

If social context is so important to what intelligence is and how it manifests itself, why, then, do so many intelligence researchers continue to believe in acontextual *g*-based theories of intelligence? I would argue that they do so because they have become members of what Fleck (1981) called a *thought collective*. A thought collective is a group of individuals, in this case of intelligence researchers and also of educators, who develop a common way of thinking and of communicating in an idiom that is mutually comprehensible. The group essentially develops a mind of its own and is relatively impervious to thoughts from the outside. It might seem odd that a thought collective of eminent scientists could be wrong, but they have been in the past. For example, many scientists disregarded the notion that germs cause disease and, much more recently, many nutritional researchers, doctors, and most scientists as well as laypeople believed that fat rather than sugar is at the root of the current obesity epidemic (Leslie, 2016). Even as more and more people around the world became obese, scientists continued to believe in a false hypothesis regarding the cause of the epidemic. They had developed a thought collective that was largely immune to what was going on. Those who dissented, such as the eminent nutritional scientist John Yudkin, were derided and essentially viewed as deranged (Leslie, 2016). I believe that, today, a thought collective has produced similar results with the concept of intelligence, with even worse results in terms of the danger to the world.

Excellent Individual Outcomes do not Necessarily Predict Excellent Collective Outcomes

I have written here about educational outcomes, but the logic applies to any measure at any level. For example, people end up as adults, in the United States, with various amounts of credit-worthiness. It might be that they got the good jobs that test scores indirectly or directly helped them get, or it may be that the luck of the draw gave them wealthy parents who could afford to provide their children with substantial financial resources. If they have good credit ratings, their opportunities to increase their success are increased. If they have poor credit ratings, whatever the reason, their opportunities are decreased. Eventually, though, the two groups—those with better ratings and those with worse ratings—sort themselves out financially (Sternberg Greene, 2017). One could conclude that there is an underlying factor of general credit-worthiness, or rather, that the social system sorts people and then magnifies the effects of the successive sortings. For example, Kennedy or Clinton or Trump children simply have different opportunities to get good credit ratings than do children of parents in rural Appalachia. But if one were to give a number of tests of financial credit-worthiness, one might conclude that, because they are positively intercorrelated, there is some underlying general factor that explains the differences by some kind of "financial ability." Again, the social system magnifies initial differences to create entirely different opportunities for the different groups (see also Flynn, 2016). In effect, the credit ratings take over from the standardized tests and continue to sort people for what they are allowed to accomplish in life, as Sternberg Greene implies.

Prediction of Individual Outcomes is Different from Prediction of Collective Outcomes

I noted earlier that *g*-based intelligence tests are predictors, usually at a modest to moderate level, of many kinds of individual life outcomes. The key word in the preceding sentence is "individual." Even if a measure is excellent at predicting individual outcomes, it may actually not predict or negatively predict outcomes for collectivities. The typical way of showing that individual outcomes do not necessarily predict collective outcomes is through the example of the tragedy of the commons. The tragedy of the commons was originated specifically to show how short-term individual outcomes can be negatively predictive of long-term collective outcomes. One imagines cows, sheep, or whatever grazing on grass in a New England commons in colonial times. The smart farmers have their cattle graze as much as possible because it fattens them up and renders them worth more when they are sold at market. But if everyone maximizes their individual outcomes, then eventually, the grass will run out and everyone will lose. Typical examples of the tragedy of the commons with regard to humans are traffic jams (cars are good for individuals, except when too many people use them, resulting in no one getting anywhere fast), availability of drinking water in areas where water is scarce, and availability of housing when housing is in short supply, as in San Francisco, driving prices up so few people can afford to live in the now-expensive places.

The worst current examples of the tragedy of the commons may be the many facets of industrialization whose waste products have led to so many unfortunate consequences. For example, it is estimated that humans have produced 8.3 billion metric tons of plastic since World War II, when plastic production became a worldwide enterprise (Castillo, N.D.). That is the weight of more than 1 billion elephants or 25,000 Empire State Buildings. Only 9% of this plastic is recycled, meaning that the rest ends up in landfills, in oceans, or in our bodies. Much of the plastic certainly ends up in the bodies of aquatic animals. It is estimated that 5.25 trillion particles (244,000 metric tons) of plastics are floating around in the world's oceans (Castillo, N.D.); 79,000 metric tons can be found in the so-called "Pacific Garbage Patch." Much of the plastic is ingested by sea animals, and it is in turn ingested by humans who eat the sea animals.

Water pollution of this kind is more than matched by air pollution. Many of the most polluted cities are now in India. Some cities have become practically unlivable. For example, Delhi, India, with about 19 million people, is the sixth most polluted city in the world ("Most polluted cities in the world, ranked," n.d.). One in eight deaths in India in 2017 is estimated to have been a result of air pollution, and of course that does not count the myriad illnesses ("Around 12.4 lakh deaths in India in 2017 attributable to air pollution", 2018). Radiation poisoning has also exacted a great toll, with some cities, such as Chernobyl, essentially becoming uninhabitable because the half-life of radiation is so long. For example, the half-life of uranium-235 is 700 million years; the half-life of uranium-238 is 4.5 billion years. More than 99% of all ambient

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uranium is of the 238 isotope ("Uranium 238 and 235", N.D.). No one is going to outlive contamination at that level.

The point is that inventions that have highlighted individual intelligence and brought benefits to countless individuals also can exact a staggering toll. The examples above, however awful they are, pale before the effects of human-induced climate change. An untenable situation has been created by many of the gadgets and trinkets we use in our lives; by most of the automobile, buses, and trains; and by our own carelessness in release of carbon to heating or air conditioning. Some politicians and their followers who know no better have believed that scientists have been erroneous in their warnings about climate change. They are correct, but for the wrong reason. Until recently, scientists greatly underestimated the severity of the situation, with the effects of global warming occurring far more quickly and at far worse levels than they anticipated (Oreskes, Oppenheimer, & Jamieson, 2019). The world we are leaving for our children and grandchildren will be increasingly barely habitable or uninhabitable, and we already feel many of the effects of climate change through hurricane and other storm activity, as well as through rapidly rising temperatures. Worse, flooding is resulting not only in towns and cities, but even in countries such as Haiti being threatened by the rising waters.

The question is how so many people can care so much about predictors of individual performance (often at the expense of other individuals) when those same predictors also predict successfully the skills that put humanity's future at risk. Wisdom involves seeing long-term, not just short-term consequences (Sternberg, 2019b). Society is proving itself to be remarkably lacking in wisdom—one even might venture to say, foolish—by its focus on individual short-term consequences at the expense of collective long-term consequences. Can we afford to continue to ignore the long-term consequences of what we have called "general intelligence"? If, as a result of individual intelligence, we have created a catastrophic tragedy of the commons, would we still say that intelligence is our ability to solve relatively simple multiple-choice numerical or verbal problems at the expense of our being able to solve highly complex problems that have no multiple choices and not even unique solutions? Interestingly, the Head Start program, which Ed Zigler was instrumental in co-creating, recognized that children required developing their broader skills of adaptation to the world, not just their narrow IQ-based skills (Zigler, 1973, 1978).

Returning to the concept of *adaptive intelligence,* I would propose that our conceptualizing intelligence in terms of predictors of short-term individual consequences has been both foolish and, potentially, fatal to humankind. If we keep doing what we are doing, the world will not end. Quite the contrary. The Earth will still be here, but the remaining species will not look much like us humans. The beneficiaries will be multitudinous kinds of bacteria, cockroaches, and other animals that manage to withstand the horrors we have created for ourselves while commending ourselves as being at the top of some anthropomorphic "great chain of being" (Lovejoy, 1971), a book, ironically, published by Harvard University Press, the press of a university at or near the top of the academic food chain. In what meaningful sense are humans the top species? Because we are highest in *g*? But is *g* even meaningful in other species? And if we are responsible for eradicating ourselves and the species supposedly lower than us in the great chain of being, how smart are we? If that is smart, what is stupid?

I suggest that we return to the original conception of intelligence as adaptive. I further suggest we follow Zigler and Seitz's (1980) advice that intelligence only be viewed in conjunction with social context and social policy. If we do not change our social policies, we will have no future as a species. And any definition of intelligence that allows that outcome is fatuous at best. If and when beings from another planet land on Earth and find our remnants along with those of the dinosaurs, who will they think were more intelligent, the dinosaurs, who lasted for 165 million years and were erased only by a fluke, or the humans, who lasted a mere 200,000 years and then successfully wiped out both themselves and many other species? Is there really any contest? Edward Zigler saw much of what was coming down the pike as a result of the imaginary separation of a hypothetical construct of intelligence from society and social policy. The field did not, for the most part, listen. And now we have situation where much of the field has become somewhat like the musicians on the Titanic, playing the same old familiar comfortable mind-lulling music while the ship slowly sinks.

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