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16
CHAPTER

Robert J. Sternberg

Looking Back and Looking Forward on Intelligence: Toward a Theory of Successful Intelligence

Introduction

Although many different definitions of intelligence have been proposed over the years (see, e.g., "Intelligence and Its Measurement: A Symposium," 1921; Sternberg & Detterman, 1986), the conventional notion of intelligence is built around a loosely consensual definition of intelligence in terms of generalized adaptation to the environment. Theories of intelligence extend this definition by suggesting that there is a general factor of intelligence, often labeled *g*, that underlies all adaptive behavior. In many theories, including the theories most widely accepted today (e.g., Carroll, 1993; Gustafsson, 1994; Horn, 1994), other mental abilities are hierarchically nested under this general factor at successively greater levels of specificity. For example, Carroll suggests that three levels can nicely capture the hierarchy of abilities, whereas Cattell (1971) and Vernon (1971) suggested two levels were especially important. In the case

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of Cattell, nested under general ability are fluid abilities of the kind needed to solve abstract reasoning problems such as figural matrices or series completions and crystallized abilities of the kind needed to solve problems of vocabulary and general information. In the case of Vernon, the two levels corresponded to verbal-educational and practical-mechanical (that is, spatial) abilities. These theories and others like them are called into question in this essay.

In this essay I argue that the notion of intelligence as adaptation to the environment and as operationalized in narrowly based intelligence tests is inadequate. Rather I argue for a concept of successful intelligence, according to which intelligence is the ability to achieve success in life, given one's personal standards, within one's sociocultural context. One's ability to achieve success depends on one's capitalizing on one's strengths and correcting or compensating for one's weaknesses through a balance of analytical, creative, and practical abilities in order to adapt to, shape, and select environments.

The remainder of this essay is divided into three main parts. First, I argue that conventional notions of intelligence and its development are, at best, incomplete, and, at worst, wrong. Second, I suggest an alternative notion of successful intelligence that expands upon conventional notions of intelligence. The formulation presented here goes beyond that in previous work (Sternberg, 1997). Finally, I draw some conclusions about the nature of intelligence.

☐ Conventional Notions of Intelligence Are Inadequate

In this section I argue that conventional notions of intelligence are inadequate and certain modern ones also do not pass muster. I explain that intelligence is not a unitary construct, and so theories based on notions of general intelligence, dating back to Spearman (1904) and up to the present (e.g., Brand, 1996; Carroll, 1993; Jensen, 1998), cannot be correct either.

There now has accumulated a substantial body of evidence suggesting that, contrary to conventional notions, intelligence is not a unitary construct. This evidence is a variety of different kinds, most of which suggest that the positive manifold (pattern of positive correlations) among ability tests is not a function of some inherent structure of intellect. Rather, it reflects limitations in the interaction among the kinds of individuals tested, the kinds of tests used in the testing, and the situations in which the individuals are tested.

One kind of evidence suggests the power of situational contexts in testing (see also Ceci, 1996; Gardner, 1983; Lave, 1988; Nuñes, Schliemann, & Carraher, 1993). For example, Carraher, Carraher, and Schliemann (1985) (see also Ceci & Roazzi, 1994; Nuñes, 1994) studied a group of children that is especially relevant for assessing intelligence as adaptation to the environment. The group was of Brazilian street children. Brazilian street children are under great contextual pressure to form a successful street business. If they do not, they risk death at the hands of so-called death squads, which may murder children who, unable to earn money, resort to robbing stores (or who are suspected of resorting to robbing stores). The researchers found that the same children who are able to do the mathematics needed to run their street business are often little able or unable to do school mathematics. In fact, the more abstract and removed from real-world contexts the problems are in their form of presentation, the worse the children do on the problems. These results suggest that differences in context can have a powerful effect on performance.

Such differences are not limited to Brazilian street children. Lave (1988) showed that Berkeley housewives who successfully could do the mathematics needed for comparison shopping in the supermarket were unable to do the same mathematics when they were placed in a classroom and given isomorphic problems presented in an abstract form. In other words, their problem was not at the level of mental processes but at the level of applying the processes in specific environmental contexts.

Ceci and Liker (1986; see also Ceci, 1996) showed that, given tasks relevant to their lives, men would show the same kinds of effects as were shown by women in the Lave studies. These investigators studied men who successfully handicapped horse races. The complexity of their implicit mathematical formulas was unrelated to their IQ. Moreover, despite the complexity of these formulas, the mean IQ among these men was only at roughly the population average or slightly below. Ceci also subsequently found that the skills were really quite specific: The same men did not successfully apply their skills to computations involving securities in the stock market.

In our own research, we have found results consistent with those described above. These results have emanated from studies both in the United States and in other countries. We describe here our international studies because we believe they especially call into question the straightforward interpretation of results from conventional tests of intelligence that suggest the existence of a general factor.

In a study in Usenge, Kenya, near the town of Kisumu, we were interested in school-age children's ability to adapt to their indigenous environment (see Sternberg & Grigorenko, 1997). In collaboration with

Wenzel Geissler, Elena Grigorenko, Kate Nokes, Frederick Okatcha, and Ruth Prince, I was involved in devising a test of indigenous intelligence for adaptation to the environment. The test measured children's informal tacit knowledge for natural herbal medicines that the villagers believe can be used to fight various types of infections. We do not know if all or any of these medicines are actually effective. But from the standpoint of our study, the important thing is that the villagers think they are and therefore that knowledge about them is worth possessing.

We measured the children's ability to identify the medicines, what they are used for, and how they are dosed. Based on work we had done elsewhere, we expected that scores on this test would not correlate with scores on conventional tests of intelligence. In order to test this hypothesis, we also administered to the children the Raven Coloured Progressive Matrices Test, which is a measure of fluid or abstract-reasoning-based abilities, as well as the Mill Hill Vocabulary Scale, which is a measure of crystallized or formal-knowledge-based abilities. In addition, we gave the children a comparable test of vocabulary in their own Duluo language. The Duluo language is spoken in the home, English in the schools.

We did indeed find no correlation between the test of indigenous tacit knowledge and scores on the fluid-ability tests. But to our surprise, we found statistically significant correlations of the tacit-knowledge tests with the tests of crystallized abilities. The correlations, however, were negative. In other words, the higher the children scored on the test of tacit knowledge, the lower they scored, on average, on the tests of crystallized abilities. This surprising result can be interpreted in various ways, but based on the ethnographic observations of the cultural anthropologists on our team, Geissler and Prince, we concluded that a plausible scenario takes into account the expectations of families for their children.

Most families in the village do not particularly value formal Western schooling. There is no reason they should, as their children will for the most part spend their lives farming or engaged in other occupations that make little or no use of Western schooling. These families emphasize teaching their children the indigenous informal knowledge that will lead to successful adaptation in the environments in which they will really live. At the same time, there are some families in the village that have different expectations for their children. They hope that their children eventually may be able to leave the village and to go to a university, perhaps the University of Nairobi. These families tend to emphasize the value of Western education and to devalue indigenous informal knowledge. Thus the families typically value and emphasize one or the other kind of knowledge but not both.

The Kenya study suggests that the identification of a general factor of human intelligence may tell us more about patterns of schooling and especially Western patterns of schooling than it does about the structure of human abilities. In Western schooling, children typically study a variety of subject matters from an early age and thus develop skills in a variety of skill areas. This kind of schooling prepares the children to take a test of intelligence, which typically measures skills in a variety of areas. Often intelligence tests measure skills that children were expected to acquire a few years before taking the intelligence test. But as Rogoff (1990) and others have noted, this pattern of schooling is not universal and has not even been common for much of the history of humankind. Throughout history and in many places still, schooling, especially for boys, takes the form of apprenticeships in which children learn a craft from an early age. They learn what they will need to know in order to succeed in a trade, but not a lot more. They are not simultaneously engaged in tasks that require the development of the particular blend of skills measured by conventional intelligence tests. Hence it is less likely that one would observe a general factor in their scores, much as we discovered in Kenya. Some years back, Vernon (1971) pointed out that the axes of a factor analysis do not necessarily reveal a latent structure of the mind but rather represent a convenient way of characterizing the organization of mental abilities. Vernon believed that there was no one "right" orientation of axes, and indeed, mathematically, an infinite number of orientations of axes can be fit to any solution in an exploratory factor analysis. Vernon's point seems perhaps to have been forgotten or at least ignored by later theorists.

The developing world provides a particularly interesting laboratory for testing theories of intelligence because many of the assumptions that are held as dear in the developed world simply do not apply. A study we have done in Tanzania (see Sternberg & Grigorenko, 1997) points out the risks of giving tests, scoring them, and interpreting the results as measures of some latent intellectual ability or abilities. We administered to young school children in Bagamoyo, Tanzania, tests such as a form-board test and a Twenty Questions Test, which measure the kinds of skills required on conventional tests of intelligence. Of course, we obtained scores that we could analyze and evaluate, ranking the children in terms of their supposed general or other abilities. However, we administered the tests dynamically rather than statically (Feuerstein, 1979; Grigorenko & Sternberg, 1998; Vygotsky, 1978). Dynamic testing is like conventional static testing in that individuals are tested and inferences about their abilities made. But dynamic tests differ in that children are given some kind of feedback in order to help them improve their scores. Vygotsky (1978) suggested that the children's ability to profit from the guided instruction the children received during the testing session could serve as a measure of children's zone of proximal development (ZPD), or the difference between their developed abilities and their latent capacities. In other words, testing and instruction are treated as being of one piece rather than as being distinct processes.

In our assessments, children first were given the ability tests. Then they were given a brief period of instruction in which they were able to learn skills that would potentially enable them to improve their scores. Then they were tested again. Because the instruction for each test lasted only about 15 minutes, one would not expect dramatic gains. Yet, on average, the gains were statistically significant. More importantly, scores on the pretest showed only weak although significant correlations with scores on the posttest. These correlations, at about the .3 level, suggested that when tests are administered statically to children in developing countries, they may be rather unstable and easily subject to influences of training. The reason, of course, is that the children are not accustomed to taking Western-style tests, and so profit quickly even from small amounts of instruction as to what is expected from them. Of course, the more important question is not whether the scores changed or even correlated with each other, but rather how they correlated with other cognitive measures. In other words, which test was a better predictor of transfer to other cognitive performance, the pretest score or the gain from the pretest score to the posttest score? We found the gain score to be the better predictor, by a factor of 4. In other words, any general-factor score, or, really, any other factor score obtained from the pretest, which was equivalent to a typical statically administered test, would be of substantially lower validity than would be a gain score measuring learning at the time of the test as obtained from a dynamically administered test.

If intelligence is not just a single thing that can be measured by a conventional static test of intelligence, what is it? I argue that it comprises three things, each of which is a different aspect of intelligence.

☐ Three Aspects of Intelligence

The intelligence one needs to attain success in life comprises analytical, creative, and practical aspects. According to the proposed theory of human intelligence and its development (Sternberg, 1984, 1985, 1997), a common set of processes underlies these three aspects of intelligence.

Metacomponents, or executive processes, plan what to do, monitor things as they are being done, and evaluate things after they are done. Examples of metacomponents are recognizing the existence of a problem, defining the nature of the problem, deciding on a strategy for solving the problem, monitoring the solution of the problem, and evaluating the solution after the problem is solved. Performance components execute the instructions of the metacomponents. For example, inference is used to decide how two stimuli are related and application is used to apply what one has inferred (Sternberg, 1977). Knowledge-acquisition components are used to learn how to solve problems or simply to acquire declarative knowledge in the first place. For example, selective encoding is used to decide what information is relevant in the context of one's learning and selective comparison is used to bring old information to bear on new problems.

Although the same processes are used for all three aspects of intelligence, these processes are applied to different kinds of tasks and situations depending on whether a given problem requires analytical thinking, creative thinking, practical thinking, or a combination of these kinds of thinking.

Analytical Intelligence

Analytical intelligence is involved when the components of intelligence are applied to analyze, evaluate, judge, or compare and contrast. It typically is involved when components are applied to relatively familiar kinds of problems where the judgments to be made are of an abstract nature.

In some of my early work, I showed how analytical kinds of problems, such as analogies or syllogisms, can be analyzed componentially (Sternberg, 1977, 1983; Sternberg & Gardner, 1983), with response times or error rates decomposed to yield their underlying information-processing components. The goal of this research was to understand the information-processing origins of individual differences in (the analytical aspect of) human intelligence. With componential analysis, one could specify sources of individual differences underlying a factor score such as that for "inductive reasoning." For example, response times on analogies (Sternberg, 1977) and linear syllogisms (Sternberg, 1980) were decomposed into their elementary performance components so that it was possible to specify, in the solving of analogies or other kinds of problems, several sources of important individual or developmental differences:

(1) What performance components are used?
(2) How long does it takes to execute each component?
(3) How susceptible is each component to error?
(4) How are the components combined into strategies?
(5) What are the mental representations upon which the components act?

Studies of reasoning need not use artificial formats. In a more recent study, we looked at predictions for everyday kinds of situations, such as when milk will spoil (Sternberg & Kalmar, 1997). In this study, we looked at both predictions and postdictions (hypotheses about the past where information about the past is unknown) and found that postdictions took longer to make than did predictions.

Research on the components of human intelligence yielded some interesting results. For example, in a study of the development of figural analogical reasoning, we found that although children generally became quicker in information processing with age, not all components were executed more rapidly with age (Sternberg & Rifkin, 1979). The encoding component first showed a decrease in component time with age and then an increase. Apparently, older children realized that their best strategy was to spend more time in encoding the terms of a problem so that they would later be able to spend less time in operating on these encodings. A related finding was that better reasoners tend to spend relatively more time than do poorer reasoners in global, up-front metacomponential planning, when they solve difficult reasoning problems. Poorer reasoners, on the other hand, tend to spend relatively more time in local planning (Sternberg, 1981). Presumably, the better reasoners recognize that it is better to invest more time up front so as to be able to process a problem more efficiently later on. We also found in a study of the development of verbal analogical reasoning that, as children grew older, their strategies shifted so that they relied on word association less and abstract relations more (Sternberg & Nigro, 1980).

Some of our studies concentrated on knowledge-acquisition components rather than on performance components or metacomponents. For example, in one set of studies, we were interested in sources of individual differences in vocabulary (Sternberg & Powell, 1982; Sternberg, Powell, & Kaye, 1982; see also Sternberg, 1987b). We were not content just to write these off as individual differences in declarative knowledge, because we wanted to understand why it was that some people acquired this declarative knowledge and others did not. What we found is that there were multiple sources of individual and developmental differences. The three main sources were in knowledge-acquisition components, use of context clues, and use of mediating variables. For example, in the sentence, "The blen rises in the east and sets in the west," the knowledge-acquisition component of selective comparison is used to relate prior knowledge about a known concept, the sun, to the unknown word (neologism) in the sentence, "blen." Several context cues appear in the sentence, such as the fact that a blen rises, the fact that it sets, and the information about where it rises and sets. A mediating variable is that contextual information can occur after the presentation of the unknown word.

We did research such as that described above because we believed that conventional psychometric research sometimes incorrectly attributed individual and developmental differences. For example, a verbal analogies test that might appear on its surface to measure verbal reasoning might in fact primarily measure vocabulary and general information (Sternberg, 1977). In fact, in some populations, reasoning might hardly be a source of individual or developmental differences at all. And if we then look at the sources of the individual differences in vocabulary, we would need to understand that the differences in knowledge did not come from nowhere: Some children had much more frequent and better opportunities to learn word meanings than did others.

The kinds of analytical skills we studied in this research can be taught. For example, in one study, we tested whether it is possible to teach people better to decontextualize meanings of unknown words presented in context (Sternberg, 1987a). In one study, we gave participants a pretest on their ability to decontextualize word meanings. Then the participants were divided into five conditions, two of which were control conditions that lacked formal instruction. In one condition, participants were not given any instructional treatment. They merely were asked later to take a posttest. In a second condition, they were given practice as an instructional condition, but there was no formal instruction, per se. In a third condition, they were taught knowledge-acquisition component processes that could be used to decontextualize word meanings. In a fourth condition, they were taught to use context cues. In a fifth condition, they were taught to use mediating variables. Participants in all three of the theory-based formal-instructional conditions outperformed participants in the two control conditions, whose performance did not differ. In other words, theory-based instruction was better than no instruction at all or just practice without formal instruction.

Research on the componential bases of intelligence was useful in understanding individual differences in performance on conventional tests of intelligence. But it became increasingly clear to me that this research basically served to partition the variation on conventional tests in a different way, rather than serving to uncover previously untapped sources of variation. Children develop intellectually in ways beyond just what conventional psychometric intelligence tests or even Piagetian tests based on the theory of Piaget (1972) measure. So what might be some of these other sources of variation? Creative intelligence seemed to be one such source of variation, a source that is almost wholly untapped by conventional tests.

Creative Intelligence

Intelligence tests contain a range of problems, some of them more novel than others. In some of our work we have shown that when one goes beyond the range of unconventionality of the tests, one starts to tap sources of individual differences measured little or not at all by the tests. According to the theory of successful intelligence, (creative) intelligence is particularly well measured by problems assessing how well an individual can cope with relative novelty. Thus it is important to include in a battery of test problems that are relatively novel in nature. These problems can be either convergent or divergent in nature.

In work with convergent problems, we presented individuals with novel kinds of reasoning problems that had a single best answer. For example, they might be told that some objects are green and others blue; but still other objects might be grue, meaning green until the year 2000 and blue thereafter, or bleen, meaning blue until the year 2000 and green thereafter. Or they might be told of four kinds of people on the planet Kyron: blens, who are born young and die young; kwefs, who are born old and die old; balts, who are born young and die old; and prosses, who are born old and die young (Sternberg, 1982; Tetewsky & Sternberg, 1986). The individuals' task was to predict future states from past states, given incomplete information. In another set of studies, people were given more conventional kinds of inductive reasoning problems, such as analogies, series completions, and classifications, but were told to solve them. But the problems had premises preceding them that were either conventional (dancers wear shoes) or novel (dancers eat shoes). The participants had to solve the problems as though the counterfactuals were true (Sternberg & Gastel, 1989a, 1989b).

In these studies, we found that correlations with conventional kinds of tests depended on how novel or nonentrenched the conventional tests were. The more novel the items, the higher the correlations of our tests with scores on the conventional tests. We also found that when response times on the relatively novel problems were componentially analyzed, some components better measured the creative aspect of intelligence than did others. For example, in the "grue–bleen" task mentioned above, the information-processing component requiring people to switch from conventional green–blue thinking to grue–bleen thinking and then back to green–blue thinking again was a particularly good measure of the ability to cope with novelty.

In work with divergent reasoning problems having no one best answer, we asked people to create various kinds of products (Lubart & Sternberg, 1995; Sternberg & Lubart, 1991, 1995, 1996) where an infinite variety of responses were possible. Individuals were asked to create products in the realms of writing, art, advertising, and science. In writing, they would be asked to write very short stories for which we would give them a choice of titles, such as "Beyond the Edge" or "The Octopus's Sneakers." In art, they were asked to produce art compositions with titles such as "The Beginning of Time" or "Earth From an Insect's Point of View." In advertising, they were asked to produce advertisements for products such as a brand of bow tie or a brand of doorknob. In science, they were asked to solve problems such as one asking them how people might detect extraterrestrial aliens among us who are seeking to escape detection. Participants created two products in each domain.

We found that creativity is relatively, although not wholly, domain specific. Correlations of ratings of the creative quality of the products across domains were lower than correlations of ratings and generally were at about the .4 level. Thus, there was some degree of relation across domains, at the same time that there was plenty of room for someone to be strong in one or more domains but not in others. More importantly, perhaps, we found, as we had for the convergent problems, a range of correlations with conventional tests of abilities. As was the case for the correlations obtained with convergent problems, correlations were higher to the extent that problems on the conventional tests were nonentrenched. For example, correlations were higher with fluid than with crystallized ability tests, and correlations were higher, the more novel the fluid test was. Even the highest correlations, however, were only at the .5 level, suggesting that tests of creative intelligence tap skills beyond those measured even by relatively novel kinds of items on conventional tests of intelligence.

The work we did on creativity raised a number questions about sources of individual and developmental differences:

(1) To what extent was the thinking of the individual novel or nonentrenched?
(2) What was the quality of the individual's thinking?
(3) To what extent did the thinking of the individual meet the demands of the task?

We also found, though, that creativity, broadly defined, extends beyond the intellectual domain. Sources of individual and developmental differences in creative performance include not only process aspects, but also aspects of knowledge, thinking styles, personality, motivation, and the environmental context in which the individual operates (see Sternberg & Lubart, 1995, for details).

Creative-thinking skills can be taught and we have devised a program for teaching them (Sternberg & Williams, 1996). In some of our work, we divided gifted and nongifted fourth-grade children into experimental and control groups. All children took pretests on insightful thinking. Then some of the children received their regular school instruction, whereas others received instruction on insight skills. After the instruction of whichever kind, all children took a posttest on insight skills. We found that children taught how to solve the insight problems using knowledge-acquisition components gained more from pretest to posttest than did students who were not so taught (Davidson & Sternberg, 1984).

Tests of creative intelligence go beyond tests of analytical intelligence in measuring performance on tasks that require individuals to deal with relatively novel situations. But how about situations that are relatively familiar, but in a practical rather than an academic domain? Can one measure intelligence in the practical domain, and, if so, what is its relation to intelligence in more academic kinds of domains?

Practical Intelligence

Practical intelligence involves individuals applying their abilities to the kinds of problems that confront them in daily life, such as on the job or in the home. Practical intelligence involves applying the components of intelligence to experience so as to (a) adapt to, (b) shape, and (c) select environments. Adaptation is involved when one changes oneself to suit the environment. Shaping is involved when one changes the environment to suit oneself. And selection is involved when one decides to seek out another environment that is a better match to one's needs, abilities, and desires. People differ in their balance of adaptation, shaping, and selection, and in the competence with which they balance among the three possible courses of action.

Much of our work on practical intelligence has centered on the concept of tacit knowledge. We define this construct, for our purposes, as what one needs to know in order to work effectively in an environment that one is not explicitly taught and that often is not even verbalized (Sternberg & Wagner, 1993; Sternberg, Wagner, & Okagaki, 1993; Sternberg, Wagner, Williams, & Horvath, 1995; Wagner & Sternberg, 1986). We represent tacit knowledge in the form of production systems, or sequences of "if–then" statements that describe procedures one follows in various kinds of everyday situations.

We typically have measured tacit knowledge using work-related problems that present problems one might encounter on the job. We have measured tacit knowledge for both children and adults, and among adults, for people in various occupations such as management, sales,

academia, and the military. In a typical tacit-knowledge problem, people are asked to read a story about a problem someone faces and to rate, for each statement in a set of statements, how adequate a solution the statement represents. For example, in a paper-and-pencil measure of tacit knowledge for sales, one of the problems deals with sales of photocopy machines. A relatively inexpensive machine is not moving out of the showroom and has become overstocked. The examinee is asked to rate the quality of various solutions for moving the particular model out of the showroom. In a performance-based measure for salespeople, the test-taker makes a phone call to a supposed customer, who is actually the examiner. The test-taker tries to sell advertising space over the phone. The examiner raises various objections to buying the advertising space. The test-taker is evaluated for the quality, rapidity, and fluency of the responses on the telephone.

In our studies, we found that practical intelligence as embodied in tacit knowledge increases with experience, but it is profiting from experience, rather than experience per se, that results in increases in scores. Some people can have been in a job for years and still have acquired relatively little tacit knowledge. We also have found that subscores on tests of tacit knowledge, such as for managing oneself, managing others, and managing tasks, correlate significantly with each other. Moreover, scores on various tests of tacit knowledge, such as for academics and managers, are also correlated fairly substantially (at about the .5 level). However, scores on tacit-knowledge tests do not correlate with scores on conventional tests of intelligence, whether the measures used are single-score measures or multiple-ability batteries. Despite their lack of correlation with conventional measures, the scores on tacit-knowledge tests predict performance on the job as well as or better than do conventional psychometric intelligence tests. In one study done at the Center for Creative Leadership, we further found that scores on our tests of tacit knowledge for management were the best single predictor of performance on a managerial simulation. In a hierarchical regression, scores on conventional tests of intelligence, personality, styles, and interpersonal orientation were entered first, and scores on the test of tacit knowledge were entered last. Scores on the test of tacit knowledge were the single best predictor of managerial simulation score. Moreover, they also contributed significantly to the prediction even after everything else was entered first into the equation. In recent work on military leadership (Hedlund, Sternberg, Horvath, & Dennis, 1998), we found that scores on a test of tacit knowledge for military leadership predicted ratings of leadership effectiveness, whereas scores on a conventional test of intelligence and on our tacit-knowledge test for managers did not significantly predict the ratings of effectiveness.

We have also done studies of social intelligence, which is viewed in the theory of successful intelligence as a part of practical intelligence. In these studies, individuals were presented with photos and were asked to make judgments about the photos. In one kind of photo, they were asked to evaluate whether a male–female couple was a genuine couple (i.e., really involved in a romantic relationship) or a phony couple posed by the experimenters. In another kind of photo, they were asked to indicate which of two individuals was the other's supervisor (Barnes & Sternberg, 1989; Sternberg & Smith, 1985). We found females to be superior to males on these tasks. Scores on the two tasks did not correlate with scores on conventional ability tests, nor did they correlate with each other, suggesting a substantial degree of domain specificity in the task.

Practical-intelligence skills can be taught. We have developed a program for teaching practical intellectual skills, aimed at middle-school students, that explicitly teaches students "practical intelligence for school" in the contexts of doing homework, taking tests, reading, and writing (Williams et al., 1996). We have evaluated the program in a variety of settings (Gardner, Krechevsky, Sternberg, & Okagaki, 1994; Sternberg, Okagaki, & Jackson, 1990) and found that students taught via the program outperform students in control groups that did not receive the instruction.

Combining Analytical, Creative, and Practical Intelligence

The studies described above looked at analytical, creative, and practical intelligence separately. But a full validation of the theory of successful intelligence would require research that looks at all three aspects of intelligence in conjunction. To date, we have done two such sets of studies.

In one set of studies, we explored the question of whether conventional education in school systematically discriminates against children with creative and practical strengths (Sternberg & Clinkenbeard, 1995; Sternberg, Ferrari, Clinkenbeard, & Grigorenko, 1996; Sternberg, Grigorenko, Ferrari, & Clinkenbeard, 1999). Motivating this work was the belief that the systems in schools strongly tend to favor children with strengths in memory and analytical abilities.

We devised a test for high-school students of analytical, creative, and practical abilities that consisted of both multiple-choice and essay items. The multiple-choice items required the three kinds of thinking in three content domains: verbal, quantitative, and figural. Thus there were 9 multiple-choice and 3 essay subtests. The test was administered to 324 children around the United States and in some other countries who were identified by their schools as gifted by any standard whatsoever. Children were selected for a summer program in (college-level) psychology if they fell into one of five ability groupings: high analytical, high creative, high practical, high balanced (high in all three abilities), or low balanced (low in all three abilities). Students who came to Yale were then divided into four instructional groups. Students in all four instructional groups used the same introductory psychology textbook (a preliminary version of Sternberg [1995]) and listened to the same psychology lectures. What differed among them was the type of afternoon discussion section to which they were assigned. They were assigned to an instructional condition that emphasized either memory, analytical, creative, or practical instruction. For example, in the memory condition, they might be asked to describe the main tenets of a major theory of depression. In the analytical condition, they might be asked to compare and contrast two theories of depression. In the creative condition, they might be asked to formulate their own theory of depression. In the practical condition, they might be asked how they could use what they had learned about depression to help a friend who was depressed.

Students in all four instructional conditions were evaluated in terms of their performance on homework, a midterm exam, a final exam, and an independent project. Each type of work was evaluated for memory, analytical, creative, and practical quality. Thus, all students were evaluated in exactly the same way.

Our results suggested the utility of the theory of successful intelligence. First, we observed when the students arrived at Yale that the students in the high creative and high practical groups were much more diverse in terms of racial, ethnic, socioeconomic, and educational backgrounds than were the students in the high-analytical group. In other words, just by expanding the range of abilities we measured, we discovered more intellectual strengths than would have been apparent through a conventional test. Moreover, the kinds of students identified as strong differed in terms of populations from which they were drawn in comparison with students identified as strong solely by analytical measures.

When one does principal-components or principal-factor analysis, one always obtains a general factor if one leaves the solution unrotated. Such a factor is a mathematical property of the algorithm used. But we found the general factor to be very weak, suggesting that the general factor of intelligence is probably relevant only when a fairly narrow range of abilities is measured, as is typically the case with conventional tests. We found that testing format had a large effect on results: Multiple-choice tests tend to correlate with other multiple-choice tests, almost without regard to what they measure. Essay tests show only weak correlations with multiple choice, however. We further found that after we controlled for modality of testing (multiple choice versus essay), the correlations between the analytical, creative, and practical sections were very weak and generally nonsignificant, supporting the relative independence of the various abilities. We found that all three ability tests—analytical, creative, and practical—significantly predicted course performance. When multiple-regression analysis was used, at least two of these ability measures contributed significantly to the prediction of each of the measures of achievement. Perhaps as a reflection of the difficulty of deemphasizing the analytical way of teaching, one of the significant predictors was always the analytical score. (However, in a replication of our study with low-income African-American students from New York, Deborah Coates of the City University of New York found a different pattern of results. Her data indicated that the practical tests were better predictors of course performance than were the analytical measures, suggesting that what ability tests predict depends on population as well as mode of teaching.) Most importantly, there was an aptitude-treatment interaction whereby students who were placed in instructional conditions that better matched their pattern of abilities outperformed students who were mismatched. In other words, when students are taught in a way that fits how they think, they do better in school. Children with creative and practical abilities, who are almost never taught or assessed in a way that matches their pattern of abilities, may be at a disadvantage in course after course, year after year.

In a follow-up study (Sternberg, Torff, & Grigorenko, 1998a, 1998b), we looked at learning of social studies and science by third graders and eighth graders. The third graders were students in a very low income neighborhood in Raleigh, North Carolina. The eighth graders were students who were largely middle to upper-middle class studying in Baltimore, Maryland, and Fresno, California. In this study, students were assigned to one of three instructional conditions. In the first condition, they were taught the course that basically they would have learned had we not intervened. The emphasis in the course was on memory. In a second condition, they were taught in a way that emphasized critical (analytical) thinking. In the third condition, they were taught in a way that emphasized analytical, creative, and practical thinking. All students' performance was assessed for memory learning (through multiple-choice assessments) as well as for analytical, creative, and practical learning (through performance assessments).

As expected, we found that students in the successful-intelligence (analytical, creative, practical) condition outperformed the other students in terms of the performance assessments. One could argue that this result merely reflected the way they were taught. Nevertheless, the result suggested that teaching for these kinds of thinking succeeded. More important, however, was the result that children in the successful–intelligence condition outperformed the other children even on the multiple-choice memory tests. In other words, to the extent that one's goal is just to maximize children's memory for information, teaching for successful intelligence is still superior. It enables children to capitalize on their strengths and to correct or to compensate for their weaknesses, and it allows children to encode material in a variety of interesting ways.

Thus the results of two sets of studies suggest that the theory of successful intelligence is valid not just in its parts but as a whole. Moreover, the results suggest that the theory can make a difference not only in laboratory tests, but in school classrooms as well.

☐ Conclusion

The time has come to move beyond conventional theories of intelligence and its development. In this essay I have provided data suggesting that conventional theories and tests of intelligence are incomplete. The general factor is an artifact of limitations in populations of individuals tested, types of materials with which they are tested, and types of methods used in testing. Indeed, our studies show that even when one wants to predict school performance, the conventional tests are fairly limited in their predictive validity (Sternberg & Williams, 1997). I have proposed a theory of successful intelligence and its development that fares well in construct validations, whether one tests in the laboratory, in schools, or in the workplace. The greatest obstacle to our moving on is in vested interests, both in academia and in the world of tests, where testing companies are doing well financially with existing tests. We now have ways to move beyond conventional notions of intelligence; we need only the will.

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17
CHAPTER

James V. Wertsch

Cognitive Development

☐ Introduction

Reflecting on the study of cognitive development as we near the end of this century naturally leads to questions about how far we have come since 1900. The short answer is that although progress has been uneven and halting it has nevertheless been very impressive. Theoretical and empirical findings from the past one hundred years, especially since World War II, provide us with a much more informed picture of human cognition and its development than was ever before imaginable. (See Case, this volume, for a comprehensive overiew.)

This progress has been possible because scholars have focused on certain issues and pursued them in detail. Although this strategy has been entirely reasonable and quite productive, it has also involved certain costs in terms of what has been left out of the picture. A useful way to formulate these costs can be found in Kenneth Burke's (1966) account of "terministic screens." In contrast to approaches that focus on the power of insight that theoretical terms bring to an analysis, Burke was often concerned with the limitations and blinders they introduce. He emphasized that: "even if any given terminology is a *reflection* of reality, by its very nature as a terminology it must be a *selection* of reality; and to this extent it must function also as a *deflection* of reality" (1966, p. 45).

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