
Culture and Intelligence

Robert J. Sternberg
Yale University

Intelligence cannot be fully or even meaningfully understood outside its cultural context. Work that seeks to study intelligence acontextually risks the imposition of an investigator's view of the world on the rest of the world. Moreover, work on intelligence within a single culture may fail to do justice to the range of skills and knowledge that may constitute intelligence broadly defined and risks drawing false and hasty generalizations. This article considers the relevance of culture to intelligence, as well as its investigation, assessment, and development. Studies that show the importance of understanding intelligence in its cultural context are described; the author concludes that intelligence must be understood in such context.

Behavior that in one cultural context is smart may be, in another cultural context, stupid (Cole, Gay, Glick, & Sharp, 1971). Stating one's political views honestly and openly, for example, may win one the top political job, such as the presidency, in one culture and the gallows in another.

The conceptualization, assessment, and development of intelligence cannot be fully or even meaningfully understood outside their cultural context. Work that seeks to study intelligence acontextually may impose an (often Western) investigator's view of the world on the rest of the world, frequently attempting to show that individuals who are more similar to the investigator are smarter than individuals who are less similar. For example, a test of intelligence developed and validated in one culture may or may not be equally valid, or even valid at all, in another culture.

This article is divided into five parts. First, I define the main concepts of the article, *culture* and *intelligence*. Second, I specify models of the relationship between culture and intelligence. Third, I introduce the article and its main ideas, including a description of how my colleagues and I came to do the work we do. Fourth, I discuss cultural studies relevant to these ideas. Fifth and finally, I draw some conclusions.

What Is Culture and What Is Intelligence?

Because the topic of this article is culture and intelligence, it is necessary to define these constructs. There have been many definitions of culture (e.g., Brislin, Lonner, & Thorndike, 1973; Kroeber & Kluckhohn, 1952). I define

culture here as "the set of attitudes, values, beliefs and behaviors shared by a group of people, communicated from one generation to the next via language or some other means of communication" (Barnouw, as cited in Matsumoto, 1994, p. 4). The term *culture* can be used in many ways and has a long history (Benedict, 1946; Boas, 1911; Mead, 1928; see also Matsumoto, 1996). Berry, Poortinga, Segall, and Dasen (1992) described six uses of the term: descriptively to characterize a culture, historically to describe the traditions of a group, normatively to express rules and norms of a group, psychologically to emphasize how a group learns and solves problems, structurally to emphasize the organizational elements of a culture, and genetically to describe cultural origins.

How is intelligence defined? The theory motivating much of the culturally based work that my colleagues and I have done is the theory of successful intelligence (see Sternberg, 1985, 1997, 1999b, for more details), which proposes its own definition of intelligence. I use the term

Editor's note. Robert J. Sternberg was president of APA in 2003. This article is based on his presidential address, delivered in Toronto, Canada, at APA's 111th Annual Convention on August 8, 2003. Award addresses and other archival materials, including presidential addresses, are peer reviewed but have a higher chance of publication than do unsolicited submissions. Presidential addresses are expected to be expressions of the authors' reflections on the field and on their terms as president. Both this address and that of Philip G. Zimbardo, the 2002 APA president, were presented at this convention to catch up on the year lag that had developed in the last decade of giving presidential addresses.

Author's note. I am grateful to my many collaborators at and affiliates of the PACE Center for their collaborations. My principal collaborator in this work has been Elena L. Grigorenko, who has made invaluable contributions both to our research and to the preparation of the figures for this article. The work in Kenya and Jamaica was supported primarily by the Partnership for Child Development, centered at Imperial College, University of London. The work in Tanzania was supported by the James S. McDonnell Foundation. The work in Alaska was supported by the Institute of Educational Sciences (formerly the Office of Educational Research and Improvement), U.S. Department of Education. The work in Zambia was supported by the U.S. Agency for International Development. The work in Russia was supported by the National Council for Eurasian and East European Studies. The work in Taiwan was supported by the U.S. Office of Educational Research and Improvement. The work in San Jose, California, was supported by the Spencer Foundation.

Correspondence concerning this article should be addressed to Robert J. Sternberg, PACE Center, Yale University, 340 Edwards Street, P.O. Box 208358, New Haven, CT 06520-8358. E-mail: robert.sternberg@yale.edu



Robert J. Sternberg

successful intelligence to underscore the importance of understanding intelligence not just as a predictor of academic performance, in the tradition of Binet and Simon (1916), but also as a predictor of success in life. This theory defines successful intelligence as the skills and knowledge needed for success in life, according to one's own definition of success, within one's sociocultural context. One acquires and utilizes these skills and this knowledge by capitalizing on strengths and by correcting or compensating for weaknesses; by adapting to, shaping, or selecting environments; and through a balance of analytical, creative, and practical abilities.

In solving problems and making decisions, metacomponents, or higher order processes, decide what to do. Performance components actually do it. And knowledge-acquisition components learn how to do it in the first place. Analytical intelligence results when components are applied to fairly abstract but familiar kinds of problems. Creative intelligence results when the components are applied to relatively novel tasks and situations. Practical intelligence results when the components are applied to experience for purposes of adaptation, shaping, and selection (see, e.g., Baltes, Dittmann-Kohli, & Dixon, 1984; Scribner, 1984, 1986; Sternberg et al., 2000).

There are, of course, many alternative theories of intelligence as well (e.g., Carroll, 1993; Cattell, 1971; Ceci, 1996; Gardner, 1983; Spearman, 1927; Thurstone, 1938), many of which are reviewed in Sternberg (1990, 2000). Some of these theories, such as those of Ceci and Gardner, are like the theory of successful intelligence in arguing for a broader conception of intelligence than has typically emerged from psychometric research. I do not claim that these theories are incapable of accounting for any or even many of the results that my colleagues and I have obtained.

I find the theory of successful intelligence particularly useful, however, because of its specification of a universal set of information-processing components complemented by culturally defined contexts in which these components are enacted.

Models of the Relationship of Culture to Intelligence

I have proposed four basic models of the relationship of culture to intelligence (Sternberg, 1988, 1990), which are shown in Figure 1. The models presented here differ in two key respects: whether or not there are cross-cultural differences in the nature of the mental processes and representations involved in adaptation that constitute intelligence and whether there are differences in the instruments needed to measure intelligence (beyond simple translation or adaptation), as a result of cultural differences in the content required for adaptation.

In Model I, the nature of intelligence is the same across cultures, as are the tests used to measure intelligence. Model I comprises such theoretical positions as those of Jensen (1982, 1998) and Eysenck (1986). The argument is that the nature of intelligence is precisely the same cross-culturally and that this nature can be assessed identically (using appropriate translations of text, where necessary) without regard to culture. For example, Jensen (1998) believes that general intelligence, or *g* (Spearman, 1927), is the same across time and place. What varies across time and place are its levels.

Model II represents a difference in the nature of intelligence but no difference in the instruments used to measure it. The measures used to assess intelligence are the same across cultures, but the outcomes obtained from using those measures are structurally different as a function of the culture being investigated. This approach is close to that taken by Nisbett (2003), who found that the same tests given in different cultures suggested that, across cultures, people think about problems in different ways. Thus, Nisbett uses essentially the same tests to elicit different ways of thinking across cultural groups.

In Model III, the dimensions of intelligence are the same, but the instruments of measurement are not. From this point of view, measurement processes for a given attribute must be *emic*, that is, derived from within the

Figure 1
Models of the Relationship of Culture to Intelligence

		Dimensions of Intelligence	
		Same	Different
Tests of Intelligence	Same	Model I	Model II
	Different	Model III	Model IV

context of the culture being studied rather than from outside it. This is not to say that the same instruments cannot be used across cultures; but when they are, the psychological meanings to be assigned to the scores will differ from one culture to another. This is the position taken in this article and in my earlier work (e.g., Sternberg, 1990).

According to the theory of successful intelligence, the components of intelligence and the mental representations on which they act are universal—that is, they are required for mental functioning in all cultures. For example, people in all cultures need to execute the metacomponents to (a) recognize the existence of problems, (b) define what the problems are, (c) mentally represent the problems, (d) formulate one or more strategies for solving the problems, (e) allocate resources to solving the problems, (f) monitor solution of the problems, and (g) evaluate problem solving after it is done. What varies across cultures are the mental contents (i.e., types and items of knowledge) to which processes such as these are applied and the judgments as to what are considered “intelligent” applications of the processes to these contents.

Thus, a wholly relativistic view of intelligence and culture would be inadequate. Some things are constant across cultures (mental representations and processes), whereas others are not (the contents to which they are applied and how their application is judged). Tests must be modified if they are to measure the same basic processes as they apply from one culture to another.

As a result, one can translate a particular test of intelligence, but there is no guarantee it will measure the same thing in one culture as in another (Valsiner, 2000). For example, a test that is highly novel in one culture or subculture may be quite familiar in the next. Even if the components of information processing are the same, the experiential novelty to which they are applied may be different. Moreover, the extent to which the given task is practically relevant to adaptation, shaping, and selection may differ. Hence, the components may be universal, but not necessarily the relative novelty or adaptive practicality of the components as applied to particular contents.

In Model IV, both the instruments and the ensuing dimensions of intelligence are different as a function of the culture under investigation. This position embraces the radical cultural-relativist position (Berry, 1974) that intelligence can be understood and measured only as an indigenous construct within a given cultural context. It also embraces the position of Sarason and Doris (1979), who view intelligence largely as a cultural invention. In other words, nothing about intelligence is necessarily common across cultures.

Berry and Irvine (1986) have proposed four nested levels of the cultural context (in which intelligence and other hypothetical constructs reside). The broadest, ecological level comprises the permanent or almost permanent characteristics that provide the backdrop for human action. The experiential context refers to the pattern of recurrent experiences within the ecological context that provides a basis for learning and development. The performance context comprises the limited set of environmental circum-

stances that account for particular behaviors at specific points in space and time. The narrowest, experimental context comprises the environmental characteristics manipulated by psychologists and others to elicit particular responses or test scores.

Why Study Culture and Intelligence?

One reason to study culture and intelligence is that they are so inextricably interlinked. Indeed, Tomasello (2001) has argued that culture is what, in large part, separates human from animal intelligence. Humans have evolved as they have, he believes, in part because of their cultural adaptations, which in turn develop from their ability, even in infancy from about nine months onward, to understand others as intentional agents.

I first became interested in empirically exploring the interface between culture and intelligence through the experiences of our teams of researchers in working in other cultures. Three experiences were especially influential.

The first experience evolved from our work in Jamaica. I was sitting in a school listening to a lesson. The school was one big room. Each “classroom” was merely a section of that room with no partitions between classes. I was sitting toward the edge of one class. I realized that I could hardly hear the teacher to whom I was supposed to be listening, and I could better hear the teacher of another class who was proximal to the class I attended. I saw that many of the other children who were not near to the teacher had the same problem. The students, of course, would be tested on the content presented by their own teacher, not by the proximal teacher. How could the children maximally profit from instruction if they could scarcely hear it? How could their achievement equal that of the children who were better placed in the classroom, much less that of Western children?

The second experience was in India (Sternberg & Grigorenko, 1999). We were doing testing in a child-care center. It was 113 degrees in the shade, and the stench of surrounding garbage, excrement, and assorted waste was overwhelming. Elena Grigorenko, my collaborator, was asking a child to solve a linear syllogism. I thought to myself that my collaborator had made a mistake: Certainly, I thought, the problem she had just presented was indeterminate and had no solution. The young child to whom she presented the problem proved me wrong and proceeded successfully to solve it. I realized that the kinds of teaching and testing conditions that apply in most of the developed world, however defective they may be, for the most part scarcely compare to those in the developing world. I could not solve a simple syllogisms problem in the very challenging testing conditions presented to that Indian child. How many Indian children can perform in those conditions in the same way they would if the conditions were less harsh?

The third experience was in our testing in Tanzania. This experience gave new meaning to the concept of bad testing conditions. The school building in which we were

testing collapsed at the time of testing (see Figure 2). How could children possibly perform at a maximal level when they could not even count on the structural integrity of the building in which they were being educated?

These experiences suggested to me that intelligence understood wholly outside its cultural context is a mythological construct. There are some aspects of intelligence that transcend cultures, namely, the mental processes underlying intelligence and the mental representations upon which they act. But these operations play themselves out differently in terms of performance from one culture to another. As soon as one assesses performance, then, one is assessing mental processes and representations in a cultural context (Model III). In this article, I consider how these contexts play out.

Most psychological research is done within a single culture. But I believe that single-culture studies whose results are implicitly or even explicitly generalized across cultures potentially deprive the field in several ways. In particular, they may (a) introduce limited definitions of psychological phenomena and problems, (b) engender risks of unwarranted assumptions about the phenomena under investigation, (c) raise questions about the cultural generalizability of findings, (d) engender risks of cultural imperialism, and (e) represent lost opportunities to collaborate and develop psychology around the world.

Many research programs demonstrate the potential hazards of single-culture research. For example, Greenfield (1997) found that it means a different thing to take a test among Mayan children than it does among most children in the United States. The Mayan expectation is that collaboration is permissible and that it is rather unnatural *not* to collaborate. Such a finding is consistent with the work of

Markus and Kitayama (1991), suggesting different cultural constructions of the self in individualistic as opposed to collectivistic cultures. Indeed, Nisbett (2003) has found that some cultures, especially Asian ones, tend to be more dialectical in their thinking, whereas other cultures, such as European and North American ones, tend to be more linear. And individuals in different cultures may construct concepts in quite different ways, rendering the results of concept-formation or identification studies in a single culture suspect (Atran, 1999; Coley, Medin, Proffitt, Lynch, & Atran, 1999; Medin & Atran, 1999). Thus, groups may think about what appears superficially to be the same phenomenon—whether a concept or the taking of a test—differently. What appear to be differences in general intelligence may in fact be differences in cultural properties (Helms-Lorenz, Van de Vijver, & Poortinga, 2003). Helms-Lorenz et al. have argued that measured differences in intellectual performance may result from differences in cultural complexity; but complexity of a culture is extremely hard to define, and what appears to be simple or complex from the point of view of one culture may appear differently from the point of view of another.

Many investigators have realized the importance of cultural context for the psychology of intelligence and cognition. These realizations have taken diverse forms. Indeed, Berry (1974) reviewed concepts of intelligence across a wide variety of cultural contexts, showing major differences across cultures.

Cole (1998) and Shweder (1991, 2002) have helped define cultural psychology as a field, distinguishing it from cross-cultural psychology (e.g., Irvine, 1979; Irvine & Berry, 1983; Marsella, Tharp, & Ciborowski, 1979), which they believe tends to be somewhat less sensitive to differences among cultures. The studies described in this article represent both approaches, although our own studies are generally more in the “cultural” rather than “cross-cultural” tradition. Cole’s overview of the field builds on his earlier work (Cole et al., 1971; Cole & Means, 1981; Cole & Scribner, 1974; Laboratory of Comparative Human Cognition, 1982), which showed how cognitive performance among populations, such as the Kpelle in Africa, can be qualitatively as well as quantitatively different from that of the North Americans who typically are tested in laboratory experiments on thinking and reasoning. What North Americans might think of as sophisticated thinking—for example, sorting taxonomically (as in a robin being a kind of bird)—might be viewed as unsophisticated by the Kpelle, whose functional performance on sorting tasks corresponded to the demands of their everyday life (as in a robin flying). In a related fashion, Bruner, Olver, and Greenfield (1966) found that among members of the Wolof tribe of Senegal, increasingly greater Western-style schooling was associated with greater use of taxonomic classification.

Cole’s work built, in turn, upon earlier work, such as that of Luria (1931, 1976), which showed that Asian peasants in the Soviet Union might not perform well on cognitive tasks because of their refusal to accept the tasks as they were presented. Indeed, people in diverse cultures are presented with very diverse tasks in their lives. Gladwin

Figure 2
A Building That Collapsed During the Performance of a Study in Rural Tanzania



Note. Copyright 2003 by Matthew Jukes. Reprinted with permission.

(1970), studying the Puluwat who inhabit the Caroline Islands in the South Pacific, found that these individuals are able to master knowledge domains including wind and weather, ocean currents, and movements of the stars. They integrate this knowledge with mental maps of the islands to become navigators who are highly respected in their world.

In related work, Serpell (1979) designed a study to distinguish between a generalized perceptual-deficit hypothesis and a more context-specific hypothesis for why children in certain cultures may show inferior perceptual abilities. He found that English children did better on a drawing task but that Zambian children did better on a wire-shaping task. Thus, children performed better on materials that were more familiar to them from their own environments.

Wagner (1978) had Moroccan and North American individuals remember patterns of Oriental rugs and others remember pictures of everyday objects, such as a rooster and a fish. There was no evidence of a difference in memory structure, but the evidence of a lack of difference depended precisely upon using tests that were appropriate to the cultural content of the individuals being studied. Moroccans who have long experience in the rug trade seemed to remember things in a way that is different from that of participants who did not have their skill in remembering rug patterns. In a related study, Kearns (1981) found that when asked to remember visuospatial displays, Anglo Australians used verbal (school-appropriate) strategies, whereas aborigines used visual (desert-nomad-appropriate) strategies.

Goodnow (1962) found that for tasks using combinations and permutations, Chinese children with English schooling performed as well as or better than Europeans, whereas children with Chinese schooling or of very-low-income families did somewhat worse than did the European children. These results suggest that form of schooling primes children to excel in certain ways and not in others (see also Goodnow, 1969).

Children from non-European or non-North American cultures do not always do worse on tests. Super (1976) found evidence that African infants sit and walk earlier than do their counterparts in the United States and Europe. But Super also found that mothers in the African cultures he studied made a self-conscious effort to teach their babies to sit and walk as early as possible. Stigler, Lee, Lucker, and Stevenson (1982; see also Stevenson & Stigler, 1994) found that at more advanced levels of development, Japanese and Chinese children do better in developed mathematical skills than do North American children.

Carraher, Carraher, and Schliemann (1985) 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 are suspected of resorting to robbing stores). Hence, if they are not intelligent in the sense of adapting to their environment,

they risk death. The investigators found that the same children who are able to do the mathematics needed to run their street businesses are often little able or unable to do school mathematics. In fact, the more abstracted and removed from real-world contexts the problems are in their form of presentation, the worse the children typically do on the problems. For children in school, the street context would be more removed from their lives. These results suggest that differences in context can have a powerful effect on performance (see also Ceci & Roazzi, 1994, Nuñez, 1994, and Saxe, 1990, for related work).

Such differences are not limited to Brazilian street children. Lave (1988) showed that housewives in Berkeley, California, who could successfully 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.

In sum, a variety of researchers have conducted studies suggesting that how one tests abilities, competencies, and expertise can have a major effect on how "intelligent" students appear to be. Street children in Brazil, for example, need the same mathematical skills to solve problems involving discounts as do children in the United States about to take a high-stakes paper-and-pencil test of mathematical achievement. But the contexts in which they express these skills, and hence the contexts in which they can best display their knowledge on tests, are different (as in Model III described previously). My colleagues and I have also done research suggesting that cultural context needs to be taken into account in testing for intelligence and its outcomes.

Our Cultural Studies

In cultural studies, investigators seek to understand the extent to which the way intelligence is conceptualized in one culture is more or less useful in another culture. In several studies, my collaborators and I have examined some implications of the notion that tasks that require and therefore measure intelligence may be, in part, culturally defined (Sternberg, 1990).

All of the cultural studies we have done have been collaborations. They generally involve people indigenous to the culture being studied, collaborators from the Center for the Psychology of Abilities, Competencies, and Expertise at Yale, and other collaborators (often from abroad) as well.

In our cultural studies, we often use tests of developing competencies as tests of intellectual skills. This use reflects our view of the measurement of intelligence as occurring on a continuum from abilities to competencies to expertise (Sternberg, 1999a, 2003a, 2003b). All tests of intelligence, even ones once believed to be culture-free, such as tests of abstract reasoning, measure skills that are, at least in part, acquired through the covariance and interaction of genes with the environment. For example, a test of vocabulary, found on intelligence tests, is clearly a test

of achievement. But so is a test of abstract reasoning, as shown by the Flynn effect, by which abstract-reasoning skills showed substantial secular increases over the 20th century in diverse cultures around the world (Flynn, 1984, 1987). Hence, we test knowledge as part of intelligence, but all tests of intelligence require knowledge, even if it is only in how to take the tests and maximize one's score on them.

Children May Develop Contextually Important Skills at the Expense of Academic Ones

Many times, investigations of intelligence conducted in settings outside the developed world can yield a picture of intelligence that is quite at variance with the picture one would obtain from studies conducted only in the developed world. 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. We devised a test of practical intelligence for adaptation to the environment (see Sternberg & Grigorenko, 1997; Sternberg et al., 2001). The test of practical intelligence measured children's informal tacit knowledge of natural herbal medicines that the villagers believe can be used to fight various types of infections. Tacit knowledge is, roughly speaking, what one needs to know to succeed in an environment; it is usually not explicitly taught and often is not even verbalized (Sternberg et al., 2000). Children in the villages use their tacit knowledge of these medicines an average of once a week in medicating themselves and others. More than 95% of the children suffer from parasitic illnesses. Thus, tests of how to use these medicines constitute effective measures of one aspect of practical intelligence as defined by the villagers as well as their life circumstances in their environmental contexts. Note that the processes of intelligence are not different in Kenya. Children must still recognize the existence of an illness, define what it is, devise a strategy to combat it, and so forth. But the content to which the processes are applied, and hence appropriate ways of testing these processes, may be quite different (as per Model III, described earlier).

Middle-class Westerners might find it quite a challenge to thrive or even survive in these contexts, or, for that matter, in the contexts of urban ghettos often not distant from their comfortable homes. For example, they would know how to use none of the natural herbal medicines to combat the diverse and abundant parasitic illnesses they might acquire in rural Kenya.

We measured the Kenyan children's ability to identify the medicines, where they come from, what they are used for, and how they are dosed. On the basis of 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 85 children of the study the Raven Coloured Progressive Matrices Test (Raven, Court, & Raven, 1992), which is a measure of fluid or abstract-reasoning-based abilities, as well as the Mill Hill Vocabulary Scale (Raven et al., 1992), 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 Dholuo language. The Dholuo language is spoken in the home, whereas English is spoken in the schools.

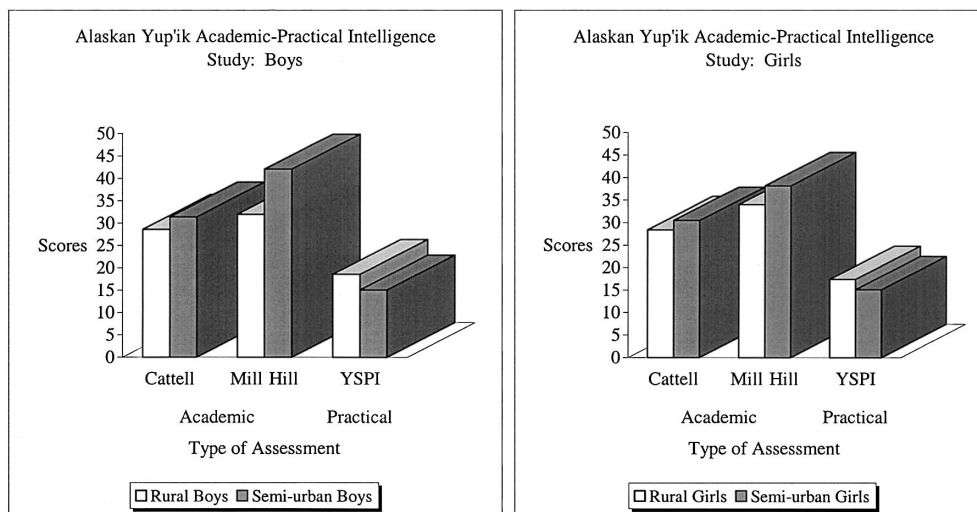
To our surprise, all correlations between the test of indigenous tacit knowledge and scores on fluid-ability and crystallized-ability tests were negative. The correlations with the tests of crystallized abilities were significantly so. For example, the correlation of tacit knowledge with vocabulary (English and Dholuo combined) was $-.31$ ($p < .01$). 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 (vocabulary).

This surprising result can be interpreted in various ways, but on the basis of the ethnographic observations of the anthropologists on the team, Prince and Geissler (see Prince & Geissler, 2001), we concluded that a plausible scenario takes into account the expectations of families for their children. Many children drop out of school before graduation, for financial or other reasons, and many families in the village do not particularly see the advantages of formal Western schooling. There is no reason they should, as the children of many families will for the most part spend their lives farming or engaged in other occupations that make little apparent 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. Children who spend their time learning the indigenous practical knowledge of the community may not always invest themselves heavily in doing well in school, whereas children who do well in school generally may invest themselves less heavily in learning the indigenous knowledge—hence the negative correlations.

The study conducted in Kenya suggests that the identification of a general factor of human intelligence may reveal more about how abilities interact with cultural patterns of schooling and society, especially with Western patterns of schooling and society, than it does about any structure of intrinsic abilities. In Western schooling, children typically study a variety of subject matters from an early age and thus develop skills in a variety of 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, 2003) 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.

Figure 3

Performance of Rural and Semiurban Eskimo Children on Academically and Practically Oriented Tests



Note. Rural Alaskan Eskimo children did better on practical-intelligence tests, whereas semiurban Alaskan children performed better on academic-intelligence tests. Cattell = Cattell Culture-Fair Test of *g*; Mill Hill = Mill Hill Vocabulary Scale; YSPI = Yup'ik Scale of Practical Intelligence.

What does a general factor mean anyway? 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 is 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.

Just as we have argued that the so-called *g* factor may partly reflect human interactions with cultural patterns, so has Tomasello (2001) argued that so-called modularity of mind may reflect, in part, human interactions with cultural patterns. We are not dismissing the importance of biology. Rather, we are emphasizing its importance as it interacts with culture rather than simply viewing it as some kind of immutable effect that operates independently and outside of a cultural context.

The partial context-specificity of intellectual performance does not apply only to countries far removed from North America or Europe. One can find the same on these continents as we did in our studies of Yup'ik Eskimo children in southwestern Alaska.

Children May Have Substantial Practical Skills That Go Unrecognized in Academic Tests

We have found related, although certainly not identical, results in a study we conducted among Yup'ik Eskimo children in southwestern Alaska (Grigorenko et al., in press). We assessed the importance of academic and practical intelligence in rural and semiurban Alaskan commu-

nities.¹ A total of 261 children were rated for practical skills by adults or peers in the study: 69 in Grade 9, 69 in Grade 10, 45 in Grade 11, 37 in Grade 12, and 41 were "other" or unidentified. Of these children, 145 were females (74 from the rural and 71 from the semiurban communities), and 116 were males (62 were from the rural and 54 were from the semiurban communities). We measured academic intelligence with conventional measures of fluid intelligence (the Cattell Culture Fair Test of *g*; Cattell & Cattell, 1973) and crystallized intelligence (the Mill Hill Vocabulary Scale; Raven et al., 1992). We measured practical intelligence with a test of tacit knowledge of skills (hunting, fishing, dealing with weather conditions, picking and preserving plants, etc.) as acquired in rural Alaskan Yup'ik communities (the Yup'ik Scale of Practical Intelligence [YSPI]; Grigorenko et al., in press). The semiurban children statistically significantly outperformed the rural children on the measure of crystallized intelligence, but the rural children statistically significantly outperformed the semiurban children on the measure of the YSPI. The test of tacit knowledge skills was superior to the tests of academic intelligence in predicting practical skills as evaluated by adults and peers of the rural children (for whom the test was created), but not of the semiurban ones. Figure 3 shows a sampling of our data.

¹ We use the term *semiurban* because the city in which we tested, Dillingham, Alaska, population 2,500, would only barely qualify as urban by traditional U.S. standards. Nevertheless, by Alaskan standards, Dillingham, which is 55.8% Alaskan Native in its population, is an urban hub. It is the economic, transportation, and public-service center for western Bristol Bay.

This study, like the study in Kenya, suggests the importance of practical intellectual skills for predicting adaptation to everyday environments. Here, as in Kenya, the processes of intelligence do not differ from those in the environments in which most readers of this article live. The Eskimo children need, for example, to plan trips, just as you or I do. But the constraints of planning these trips, often by dogsled in environments with no landmarks you or I would recognize, are very different, and hence different tests are needed (Model III). Can one find similar results in cultures that are urban and somewhat less remote from the kinds of cultures familiar to many readers?

Practical Intellectual Skills May Be Better Predictors of Health Than Academic Ones

We were interested in studying Russian citizens because Russia is a country that has recently undergone very rapid change. Indeed, for many people, their economic conditions have changed dramatically compared with those under the old governmental system. The new capitalist system has introduced dramatic variations in incomes; many who were once near the top of the socioeconomic spectrum are now near the bottom, and vice versa. In this study (Grigorenko & Sternberg, 2001), 490 mothers and 328 fathers of children were recruited through 511 schoolchildren (ranging in age from 8 to 17 years). We used entirely distinct measures of analytical, creative, and practical intelligence (for details, see Grigorenko & Sternberg, 2001), with at least two summative indicators for each construct. The exploratory principal-component analysis, with both varimax and oblimin rotations, yielded clear-cut analytical, creative, and practical factors for the tests. Thus, the results supported the theory of successful intelligence.

The main objective of this study was to predict, using the analytical, creative, and practical tests, mental and physical health among the Russian adults. Mental health was measured by widely used paper-and-pencil tests of depression and anxiety, and physical health was measured by self-report. The best predictor of mental and physical health was the practical-intelligence measure for mental health ($r = .17, p < .001$, for anxiety and $.23, p < .001$, for depression) and physical health ($r = .12, p < .01$), respectively. (Or, because the data are correlational, it may be that health predicts practical intelligence, although the connection here is less clear.) Analytical intelligence came second, and creative intelligence came third. All three contributed to prediction; however, the correlations with academic intelligence were $.01$ (ns) for self-reported physical health, $.07$ ($p < .05$) for anxiety, and $.09$ ($p < .05$) for depression. The correlations with creative intelligence were $.07$ ($p < .05$) for self-reported physical health; they were nonsignificant for mental health. Thus, we again concluded that a theory of intelligence encompassing all three elements provides better prediction of success in life than does a theory comprising just the analytical element. Moreover, although the three abilities were the same (analytical, creative, practical), measuring them—especially the practical ones—required cultural adaptation that was appropriate for the Russian adults being tested (Model III).

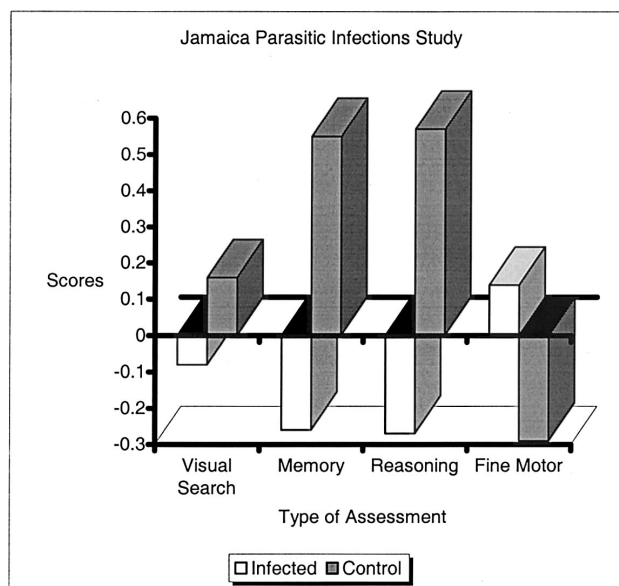
The results in Russia emphasized the importance of studying health-related outcomes as one measure of successful adaptation to the environment. Health-related variables can affect one's ability to achieve one's goals in life, or even to perform well on tests, as we found in Jamaica.

Physical Health May Moderate Performance on Assessments

It is always important when interpreting results, whether from developed or developing cultures, to take into account the physical health of the participants one is testing. In a study we did in Jamaica (Sternberg, Powell, McGrane, & McGregor, 1997), we found that Jamaican schoolchildren who suffered from parasitic illnesses (for the most part, whipworm or *Ascaris*) did more poorly on higher level cognitive tests (such as of working memory and reasoning) than did children who did not suffer from these illnesses, even after controlling for socioeconomic status. The children with parasitic illnesses did nonsignificantly better on fine-motor tasks, for reasons unknown to us. Figure 4 shows relevant data from this study.

Thus, many children were poor achievers not because they innately lacked abilities but rather because they lacked the good health necessary to develop and display such abilities. If you are moderately to seriously ill, you probably find it more difficult to concentrate on what you read or

Figure 4
Performance of Jamaican Children on Cognitive Tests as a Function of Health Status



Note. Infected children in Jamaica performed more poorly on tests of cognitive functioning, even after controlling for socioeconomic status, than did uninfected control children. The infected children did nonsignificantly better on fine-motor tests, however. The figure shows combined standard scores of the infected and uninfected comparison groups at the time of enrollment in the study; the statistically significant group differences are those for memory and reasoning tasks.

what you hear than if you are well. Children in developing countries are ill much—perhaps even most—of the time. They simply cannot devote the same attentional and learning resources to schoolwork that well children can devote. Here, as in Kenya, their health knowledge would be crucial for their adaptation to the environment. Testing that does not take into account health status is likely to give false impressions.

Do conventional tests, such as of working memory or of reasoning, measure all the skills that children in developing countries can bring to the table? Work we have done in Tanzania suggests they do not.

Dynamic Testing May Reveal Cognitive Skills Not Revealed by Static Testing

A study done in Tanzania (see Sternberg & Grigorenko, 1997, 2002; Sternberg et al., 2002) points out the risks of giving tests, scoring them, and interpreting the results as measures of some latent intellectual ability or abilities. Near Bagamoyo, Tanzania, we administered to 358 school-children between the ages of 11 and 13 years tests that included a form-board classification test (a sorting task), a linear syllogisms test, and a Twenty Questions Test (“Find a Figure”), 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 (Brown & Ferrara, 1985; Feuerstein, 1979; Grigorenko & Sternberg, 1998; Guthke, 1993; Haywood & Tzuriel, 1992; Lidz, 1991; Sternberg & Grigorenko, 2002; Tzuriel, 1995; Vygotsky, 1978).

Dynamic testing is like conventional static testing in that individuals are tested and inferences about their abilities are made. But dynamic tests differ in that children are given some kind of feedback in order to help them improve their performance. 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, 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. This integration makes sense in terms of traditional definitions of intelligence as the ability to learn (“Intelligence and its measurement,” 1921; Sternberg & Detterman, 1986). What a dynamic test does is directly measure processes of learning in the context of testing rather than measuring these processes indirectly as the product of past learning. Such measurement is especially important when not all children have had equal opportunities to learn in the past.

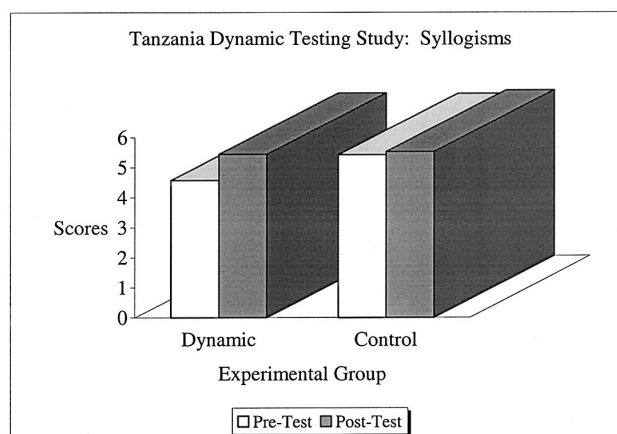
In the assessments, children were first given the ability tests. Experimental-group children were then given an intervention; control-group children were not. The intervention consisted of a brief period of instruction in which children were able to learn skills that would potentially enable them to improve their scores. For example, in the Twenty Questions tasks, children would be taught how a

single true–false question could cut the space of possible correct solutions by half. Then all children—experimental and control—were tested again. Because the total time for instruction was less than an hour, one would not expect dramatic gains. Yet, on average, the gains from pretest to posttest in the experimental group were statistically significant and significantly greater than those in the control group.

In the control group, the correlations between pretest and posttest scores were generally at the .8 level. One would expect a high correlation because there was no intervention and hence the retesting was largely a measure of alternate-forms reliability. More important, scores on the pretest in the experimental group showed only weak although significant correlations with scores on the posttest. These correlations, at about the .3 level (which were significantly less than those in the control group), 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 could be that the children are not accustomed to taking Western-style tests, and so they quickly profit from even 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 performances on tests of working memory, the pretest score or the posttest score? We found the posttest score to be the better predictor of working memory in the experimental group. Figure 5 shows our results with respect to pretest-to-posttest performance: Children in the dynamic-testing group improved significantly more than

Figure 5
Improvement of Tanzanian Children From Pretest to Posttest as a Function of Group Membership



Note. Dynamically tested children in Tanzania improved more from pretest to posttest than did control-group children, who did not receive dynamic instruction between pretest and posttest ($p < .001$). Results for tests other than syllogisms were similar.

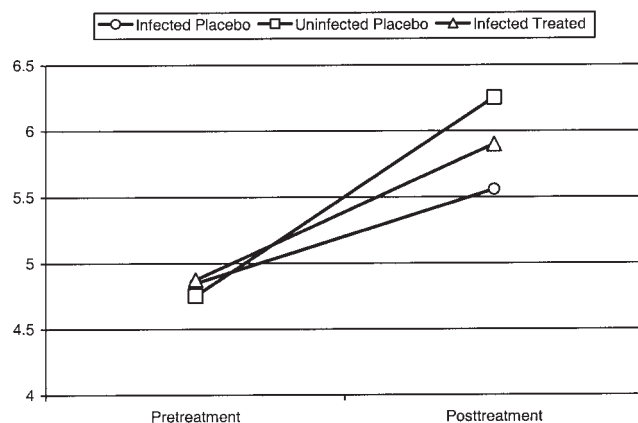
those in the control group (who did not receive intervening dynamic instruction between pre- and posttests).

In the Jamaica study, described earlier, we had failed to find effects of an antiparasitic medication, albendazole, on cognitive functioning. Might this have been because the testing was static rather than dynamic? Static testing tends to emphasize skills developed in the past. Children who suffer from parasitic illnesses often do not have the same opportunities to profit from instruction and acquire skills that well children do. Dynamic testing emphasizes skills developed at the time of the test. Indeed, the skills or knowledge are specifically taught at the time of the test. Would dynamic testing show effects of medication (in this case, albendazole for hookworm and praziquantel for schistosomiasis) not shown by static testing?

The answer was yes. Over time, treated children showed an advantage over children who did not receive treatment and were closer after time had passed to the control (uninfected) group than were the untreated children (as shown in Figure 6 for syllogisms, one of the three tests we used; Grigorenko et al., 2004). In other words, conventional static tests of intelligence may fail to fully reveal children's intellectual potentials. Thus, when tests are modified in different environments (as per Model III), one may wish to modify not only their content but also the form in which they are administered, as we did in our dynamic testing.

Dynamic testing is very labor intensive. Might there be a less labor-intensive way of showing the same effects? And might the effect be shown through tests that are closer to what students actually need to do in school?

Figure 6
Improvement of Tanzanian Children as a Function of Group Treatment Status



Note. Although all children we tested in Tanzania benefited from pedagogical intervention as a part of dynamic testing, medically treated infected children benefited more than did infected children treated with placebo. (Placebo-group children were given medication immediately after the termination of the study.)

New "Intermediate Tests" of Cognitive Skills Reveal New Aspects of Cognitive Performance

Those conducting cultural research may want to assess school-related skills that are intermediate between abilities and achievement. Traditional tests of cognitive abilities are quite far removed from school performance. Achievement tests *are* school performance. Is there something in-between that can be tested in a way that is relatively non-labor-intensive?

In our work in Zambia (Grigorenko et al., 2003), we devised such an intermediate test. Children in school and outside it continually need to be able to follow instructions. Often they are not successful in their endeavors because they do not follow instructions as to how to realize these endeavors. Following complex instructions is thus important for the children's success. A test of following instructions has dynamic elements, in that one learns the instructions at the time of test. Yet it is not a complex instructional intervention. Indeed, all tests require test takers to follow instructions.

The Zambia Cognitive Assessment Instrument (Z-CAI; Kwiatkowski et al., 2004) was designed to measure children's ability to follow oral, written, and pictorial instructions that become increasingly complex. It was also designed to be simple to implement, so that teachers can easily be trained to administer the instrument. We further created a test that would be sensitive specifically to any improvement in cognitive functioning that was a result of improved health status. And finally, we needed the test to be psychometrically sound (valid and reliable) in Zambia.

The Z-CAI measures working memory, reasoning, and comprehension skills in the oral, written, and pictorial domains. We found that among children tested on the Z-CAI, those who were treated for parasitic illnesses ($n = 1,000$) outperformed children who were not treated ($n = 1,000$) relative to baseline performance, as shown in Figure 7.

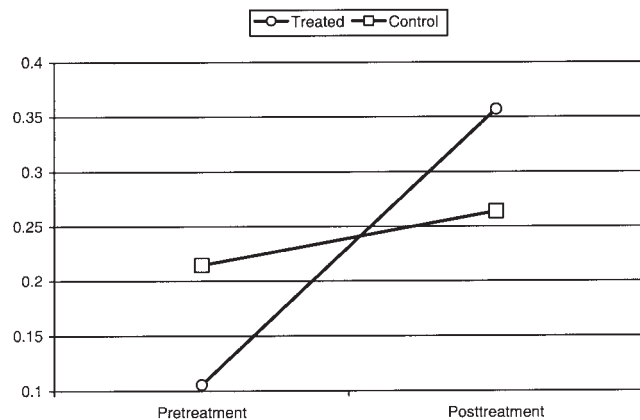
Intelligence May Be Different Things in Different Cultures

Intelligence may be conceived in different ways in different cultures (see reviews in Berry, 1984; Serpell, 2000, 2002; Sternberg & Kaufman, 1998; and Wober, 1974). Such differences are important, because cultures evaluate their members, as well as members of others cultures, in terms of their own conceptions of intelligence.

Yang and Sternberg (1997a) reviewed Chinese philosophical conceptions of intelligence. The Confucian perspective emphasizes the characteristic of benevolence and of doing what is right. As in the Western notion, the intelligent person spends a great deal of effort in learning, enjoys learning, and persists in life-long learning with a great deal of enthusiasm. The Taoist tradition, in contrast, emphasizes the importance of humility, freedom from conventional standards of judgment, and full knowledge of oneself as well as of external conditions.

Figure 7

Improvement of Zambian Children From Pretest to Posttest as a Function of Medical Treatment for Parasites



Note. Intervention-group children in Zambia improved more from pretreatment to posttreatment than did control children who were not medically treated.

The difference between Eastern and Western conceptions of intelligence may persist even in the present day. Yang and Sternberg (1997b) studied contemporary Taiwanese Chinese conceptions of intelligence and found five factors underlying these conceptions: (a) a general cognitive factor, much like the *g* factor in conventional Western tests; (b) interpersonal intelligence (i.e., social competence); (c) intrapersonal intelligence; (d) intellectual self-assertion; and (d) intellectual self-effacement. In a related study but with different results, Chen (1994) found three factors underlying Chinese conceptualizations of intelligence: nonverbal reasoning ability, verbal reasoning ability, and rote memory. The difference may be due to different subpopulations of Chinese, differences in methodology, or differences in when the studies were done.

The factors uncovered in Taiwan differ substantially from those identified in the United States by Sternberg, Conway, Ketron, and Bernstein (1981) regarding people's conceptions of intelligence—(a) practical problem solving, (b) verbal ability, and (c) social competence—although in both cases, people's implicit theories of intelligence seem to go quite far beyond what conventional psychometric intelligence tests measure. Of course, comparing the Chen (1994) study to the Sternberg et al. (1981) study simultaneously varies both language and culture.

Studies in Africa provide yet another window on the substantial differences in conceptions of intelligence across cultures. Ruzgis and Grigorenko (1994) argued that, in Africa, conceptions of intelligence revolve largely around skills that help to facilitate and maintain harmonious and stable intergroup relations; intragroup relations are probably equally important and at times are more important. For example, Serpell (1974, 1996) found that Chewa adults in Zambia emphasize social responsibilities, cooperativeness,

and obedience as being important to intelligence; intelligent children are expected to be respectful of adults. Kenyan parents also emphasize responsible participation in family and social life as important aspects of intelligence (Super & Harkness, Super & Harkness, 1982, 1986, 1993). In Zimbabwe, the word for intelligence, *ngware*, actually means to be prudent and cautious, particularly in social relationships. Among the Baoule, service to the family and community and politeness toward and respect for elders are seen as key to intelligence (Dasen, 1984).

It is difficult to separate linguistic differences from conceptual differences in cross-cultural notions of intelligence. In our own research, we use converging operations in order to achieve some separation. That is, we use different and diverse empirical operations in order to ascertain notions of intelligence. So we may ask in one study that people identify aspects of competence; in another study, that they identify competent people; in a third study, that they characterize the meaning of "intelligence"; and so forth.

The emphasis on the social aspects of intelligence is not limited to African cultures. Notions of intelligence in many Asian cultures also emphasize the social aspect of intelligence more than does the conventional Western or IQ-based notion (Azuma & Kashiwagi, 1987; Lutz, 1985; Poole, 1985; White, 1985).

It should be noted that neither African nor Asian notions emphasize exclusively social notions of intelligence. These conceptions of intelligence emphasize social skills much more than do conventional U.S. conceptions of intelligence while also recognizing the importance of cognitive aspects of intelligence. In a study of Kenyan conceptions of intelligence, Grigorenko et al. (2001) found that there are four distinct terms constituting conceptions of intelligence among rural Kenyans—*rieko* (knowledge and skills), *luoro* (respect), *winjo* (comprehension of how to handle real-life problems), *paro* (initiative)—with only the first directly referring to knowledge-based skills (including but not limited to the academic).

Once again, it is important to realize that there is no one overall U.S. conception of intelligence. Indeed, Okagaki and Sternberg (1993) found that different ethnic groups in San Jose, California, had rather different conceptions of what it means to be intelligent. For example, Latino parents of schoolchildren tended to emphasize the importance of social-competence skills in their conceptions of intelligence, whereas Asian parents tended rather heavily to emphasize the importance of cognitive skills. Anglo parents also gave more emphasis to cognitive skills. Teachers, representing the dominant culture, gave more emphasis to cognitive skills than to social-competence skills. The rank order of the various groups (including subgroups within the Latino and Asian groups) in terms of the performance of the children could be perfectly predicted by the extent to which their parents shared the teachers' conception of intelligence. In other words, teachers tended to reward those children who were socialized into a view of intelligence that happened to correspond to the teachers' own.

In sum, people have different conceptions, or implicit theories, of intelligence across cultures. From a practical point of view, in Model III one may still try to draw restricted comparisons of scores on given tests across cultures. For example, Western tests may still be predictive in other cultures (Vernon, 1969), even if their appropriateness varies according to the culture and the use to which they are put. Comparisons need, however, to be conditional ones that take into account the context of the individuals' development (Laboratory of Comparative Human Cognition, 1982; Sternberg, 1990). The scores may not mean the same thing across the cultures.

Conclusion

When cultural context is taken into account, (a) individuals are better recognized for and are better able to make use of their talents, (b) schools teach and assess children better, and (c) society utilizes rather than wastes the talents of its members. One can pretend to measure intelligence across cultures simply by translating Western tests and giving them to individuals in a variety of cultures. But such measurement is only pretense. Care must be taken even when attempting to measure the intelligence of various cultural groups *within* a society.

A study by Sarason and Doris (1979) provides a close-to-home example of the effects of cultural differences on intelligence, particularly on intelligence tests. These researchers tracked the IQ scores of immigrant Italian Americans. Roughly a century ago, first-generation Italian American children had a median IQ of 87, which is in the low-average range. Some social commentators and intelligence researchers of the day pointed to heredity and other nonenvironmental factors as the basis for the low IQs. A leading researcher, Henry Goddard, pronounced that 79% of immigrant Italians were "feeble-minded"; he also asserted that about 80% of immigrant Hungarians and Russians similarly lacked intelligence (Eysenck & Kamin, 1981). Goddard (1917) associated moral decadence with this deficit in intelligence. He recommended that the intelligence tests he used be administered to all immigrants. And he declared that all potential immigrants with low scores should be selectively excluded from entering the United States.

Today, Italian American students who take IQ tests show slightly above-average IQs; other immigrant groups that Goddard (1917) denigrated have shown similar "amazing" increases (Ceci, 1996). Even the most fervent hereditarians would be unlikely to attribute such remarkable gains in so few generations to heredity. Cultural assimilation, including integrated education and adoption of American definitions of intelligence, seems a much more plausible explanation.

Psychologists must be cautious in making comparisons that some are currently willing and even eager to make, such as between alleged "racial" groups. For example, some investigators have attempted to compare genetic versus environmental factors as bases for racial differences in intelligence (e.g., Herrnstein & Murray, 1994; Lynn, 1994). But if intelligence itself needs to be understood and

measured in a cultural context, it is not clear just how meaningful such comparisons can be or whether they really have any implications for social policy at all. At the very least, one must deal with the issue of whether scores on a given test mean the same thing for members of the various groups being assessed. One must also deal with moderator variables that may be confounded with culture, such as socioeconomic status, which may influence measurements of intelligence and its heritability (Turkheimer, Haley, Waldron, D'Onofrio, & Gottesman, 2003).

In the proposed model of culture and intelligence, Model III, tests are adapted in form and content to take into account the differences in adaptive tasks that individuals confront in diverse cultures, within and across countries. Individuals in other cultures often do not do well on our tests, nor would we always do well on theirs. The processes of intelligence are universal, but their manifestations are not. If we want best to understand, assess, and develop intelligence, we need to take into account the cultural contexts in which it operates. We cannot now create culture-free or culture-fair tests, given our present state of knowledge. But we can create *culture-relevant tests*, and that should be our goal.

REFERENCES

- Atran, S. (1999). Itzaj Maya folkbiological taxonomy: Cognitive universals and cultural particulars. In D. L. Medin & S. Atran (Eds.), *Folkbiology* (pp. 119–213). Cambridge, MA: MIT Press.
- Azuma, H., & Kashiwagi, K. (1987). Descriptions for an intelligent person: A Japanese study. *Japanese Psychological Research*, 29, 17–26.
- Baltes, P. B., Dittmann-Kohli, F., & Dixon, R. A. (1984). New perspectives on the development of intelligence in adulthood: Toward a dual-process conception and a model of selective optimization with compensation. In P. B. Baltes & O. G. Brim (Eds.), *Life-span development and behavior* (Vol. 6, pp. 33–76). New York: Academic Press.
- Benedict, R. (1946). *The chrysanthemum and the sword*. Boston: Houghton Mifflin.
- Berry, J. W. (1974). Radical cultural relativism and the concept of intelligence. In J. W. Berry & P. R. Dasen (Eds.), *Culture and cognition: Readings in cross-cultural psychology* (pp. 225–229). London: Methuen.
- Berry, J. W. (1984). Towards a universal psychology of cognitive competence. In P. S. Fry (Ed.), *Changing conceptions of intelligence and intellectual functioning* (pp. 35–61). Amsterdam: North-Holland.
- Berry, J. W., & Irvine, S. H. (1986). Bricolage: Savages do it daily. In R. J. Sternberg & R. K. Wagner (Eds.), *Practical intelligence: Nature and origins of competence in the everyday world* (pp. 271–306). New York: Cambridge University Press.
- Berry, J. W., Poortinga, Y. H., Segall, M. H., & Dasen, P. R. (1992). *Cross-cultural psychology: Research and applications*. New York: Cambridge University Press.
- Binet, A., & Simon, T. (1916). *The development of intelligence in children* (E. S. Kite, Trans.). Baltimore: Williams & Wilkins.
- Boas, F. (1911). *The mind of primitive man*. New York: Macmillan.
- Brislin, R. W., Lonner, W. J., & Thorndike, R. M. (Eds.). (1973). *Cross-cultural research methods*. New York: Wiley.
- Brown, A. L., & Ferrara, R. A. (1985). Diagnosing zones of proximal development. In J. V. Wertsch (Ed.), *Culture, communication, and cognition: Vygotskian perspectives* (pp. 273–305). New York: Cambridge University Press.
- Bruner, J. S., Olver, R. R., & Greenfield, P. M. (1966). *Studies in cognitive growth*. New York: Wiley.
- Carraher, T. N., Carraher, D., & Schliemann, A. D. (1985). Mathematics in the streets and in schools. *British Journal of Developmental Psychology*, 3, 21–29.

- Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies*. New York: Cambridge University Press.
- Cattell, R. B. (1971). *Abilities: Their structure, growth, and action*. Boston: Houghton Mifflin.
- Cattell, R. B., & Cattell, A. K. S. (1973). *Measuring intelligence with the Culture Fair Tests*. Champaign, IL: Institute for Personality and Ability Testing.
- Ceci, S. J. (1996). *On intelligence* (Expanded ed.). Cambridge, MA: Harvard University Press.
- Ceci, S. J., & Roazzi, A. (1994). The effects of context on cognition: Postcards from Brazil. In R. J. Sternberg & R. K. Wagner (Eds.), *Mind in context: Interactionist perspectives on human intelligence* (pp. 74–101). New York: Cambridge University Press.
- Chen, M. J. (1994). Chinese and Australian concepts of intelligence. *Psychology and Developing Societies*, 6, 101–117.
- Cole, M. (1998). *Cultural psychology: A once and future discipline*. Cambridge, MA: Belknap.
- Cole, M., Gay, J., Glick, J., & Sharp, D. W. (1971). *The cultural context of learning and thinking*. New York: Basic Books.
- Cole, M., & Means, B. (1981). *Comparative studies of how people think*. Cambridge, MA: Harvard University Press.
- Cole, M., & Scribner, S. (1974). *Culture and thought*. New York: Wiley.
- Coley, J. D., Medin, D. L., Proffitt, J. B., Lynch, E., & Atran, S. (1999). Inductive reasoning in folkbiological thought. In D. L. Medin & S. Atran (Eds.), *Folkbiology* (pp. 205–232). Cambridge, MA: MIT Press.
- Dasen, P. (1984). The cross-cultural study of intelligence: Piaget and the Baoule. *International Journal of Psychology*, 19, 407–434.
- Eysenck, H. J. (1986). A theory of intelligence and the psychophysiology of cognition. In R. J. Sternberg (Ed.), *Advances in the psychology of human intelligence* (Vol. 3, pp. 1–34). Hillsdale, NJ: Erlbaum.
- Eysenck, H. J., & Kamin, L. (1981). *The intelligence controversy: H. J. Eysenck vs. Leon Kamin*. New York: Wiley.
- Feuerstein, R. (1979). *The dynamic assessment of retarded performers: The Learning Potential Assessment Device theory, instruments, and techniques*. Baltimore: University Park Press.
- Flynn, J. R. (1984). The mean IQ of Americans: Massive gains 1932 to 1978. *Psychological Bulletin*, 95, 29–51.
- Flynn, J. R. (1987). Massive IQ gains in 14 nations. *Psychological Bulletin*, 101, 171–191.
- Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. New York: Basic Books.
- Gladwin, T. (1970). *East is a big bird*. Cambridge, MA: Harvard University Press.
- Goddard, H. H. (1917). Mental tests and immigrants. *Journal of Delinquency*, 2, 243–277.
- Goodnow, J. J. (1962). A test of milieu effects with some of Piaget's tasks. *Psychological Monographs*, 76(Whole No. 555).
- Goodnow, J. J. (1969). Cultural variations in cognition skills. In D. R. Price-Williams (Ed.), *Cross-cultural studies* (pp. 246–264). Harmondsworth, England: Penguin.
- Greenfield, P. M. (1997). You can't take it with you: Why abilities assessments don't cross cultures. *American Psychologist*, 52, 1115–1124.
- Grigorenko, E. L., Geissler, P. W., Prince, R., Okatcha, F., Nokes, C., Kenny, et al. (2001). The organization of Luo conceptions of intelligence: A study of implicit theories in a Kenyan village. *International Journal of Behavior Development*, 25, 367–378.
- Grigorenko, E. L., Jarvin, L., Kaani, B., Kapungulya, P. P., Kwiatkowski, J., & Sternberg, R. J. (2003). *Effects of interventions against parasitic illnesses on a test of cognitive skills administered in Zambia*. Unpublished manuscript.
- Grigorenko, E. L., Meier, E., Lipka, J., Mohatt, G., Yanez, E., & Sternberg, R. J. (in press). The relationship between academic and practical intelligence: A case study of the tacit knowledge of Native American Yup'ik people in Alaska. *Learning and Individual Differences*.
- Grigorenko, E. L., & Sternberg, R. J. (1998). Dynamic testing. *Psychological Bulletin*, 124, 75–111.
- Grigorenko, E. L., & Sternberg, R. J. (2001). Analytical, creative, and practical intelligence as predictors of self-reported adaptive functioning: A case study in Russia. *Intelligence*, 29, 57–73.
- Grigorenko, E. L., Sternberg, R. J., Jukes, M., Alcock, K., Lambo, J., Ngorosho, D., et al. (2004). *Effects of antiparasitic treatment on dynamically and statically tested cognitive skills over time*. Manuscript submitted for publication.
- Guthke, J. (1993). Current trends in theories and assessment of intelligence. In J. H. M. Hamers, K. Sijtsma, & A. J. J. M. Ruijsenaars (Eds.), *Learning potential assessment* (pp. 13–20). Amsterdam: Swets & Zeitlinger.
- Haywood, H. C., & Tzuriel, D. (Eds.). (1992). *Interactive assessment*. New York: Springer-Verlag.
- Helms-Lorenz, M., Van de Vijver, F. J. R., & Poortinga, Y. H. (2003). Cross-cultural differences in cognitive performance and Spearman's hypothesis: g or c? *Intelligence*, 31, 9–29.
- Herrnstein, R., & Murray, C. (1994). *The bell curve*. New York: Free Press.
- "Intelligence and its measurement": A symposium. (1921). *Journal of Educational Psychology*, 12, 123–147, 195–216, 271–275.
- Irvine, S. H. (1979). The place of factor analysis in cross-cultural methodology and its contribution to cognitive theory. In L. Eckensberger, W. Lonner, & Y. Poortinga (Eds.), *Cross-cultural contributions to psychology*. Amsterdam: Swets & Zeitlinger.
- Irvine, S. H., & Berry, J. W. (Eds.). (1983). *Human abilities in cultural context*. New York: Cambridge University Press.
- Jensen, A. R. (1982). The chronometry of intelligence. In R. J. Sternberg (Ed.), *Advances in the psychology of human intelligence* (Vol. 1, pp. 255–310). Hillsdale, NJ: Erlbaum.
- Jensen, A. R. (1998). *The g factor*. Westport, CT: Praeger-Greenwood.
- Kearins, J. M. (1981). Visual spatial memory in Australian aboriginal children of desert regions. *Cognitive Psychology*, 13, 434–460.
- Kroeber, A. L., & Kluckhohn, C. (1952). *Culture: A critical review of concepts and definitions*. Cambridge, MA: Peabody Museum.
- Kwiatkowski, J., Jarvin, L., Kapungulya, P., Kaani, B., Sternberg, R. J., & Grigorenko, E. L. (2004). *Zambia Cognitive Assessment Instrument*. Unpublished test.
- Laboratory of Comparative Human Cognition. (1982). Culture and intelligence. In R. J. Sternberg (Ed.), *Handbook of human intelligence* (pp. 642–719). New York: Cambridge University Press.
- Lave, J. (1988). *Cognition in practice*. New York: Cambridge University Press.
- Lidz, C. S. (1991). *Practitioner's guide to dynamic assessment*. New York: Guilford Press.
- Luria, A. R. (1931). Psychological expedition to central Asia. *Science*, 74, 383–384.
- Luria, A. R. (1976). *Cognitive development: Its cultural and social foundations*. Cambridge, MA: Harvard University Press.
- Lutz, C. (1985). Ethnopsychology compared to what? Explaining behaviour and consciousness among the Ifaluk. In G. M. White & J. Kirkpatrick (Eds.), *Person, self, and experience: Exploring Pacific ethnopsychologies* (pp. 35–79). Berkeley: University of California Press.
- Lynn, R. (1994). Some reinterpretations of the Minnesota Transracial Adoption Study. *Intelligence*, 19, 21–27.
- Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review*, 98, 224–253.
- Marsella, A. J., Tharp, R. G., & Ciborowski, T. J. (Eds.). (1979). *Perspectives on cross-cultural psychology*. New York: Academic Press.
- Matsumoto, D. (1994). *People: Psychology from a cultural perspective*. Pacific Grove, CA: Brooks-Cole.
- Matsumoto, D. (1996). *Culture and psychology*. Pacific Grove, CA: Brooks-Cole.
- Mead, M. (1928). *Coming of age in Samoa*. New York: Morrow.
- Medin, D. L., & Atran, S. (Eds.). (1999). *Folkbiology*. Cambridge, MA: MIT Press.
- Nisbett, R. E. (2003). *The geography of thought: Why we think the way we do*. New York: Free Press.
- Núñez, T. (1994). Street intelligence. In R. J. Sternberg (Ed.), *Encyclopedia of human intelligence* (Vol. 2, pp. 1045–1049). New York: Macmillan.
- Okagaki, L., & Sternberg, R. J. (1993). Parental beliefs and children's school performance. *Child Development*, 64, 36–56.
- Poole, F. J. P. (1985). Coming into social being: Cultural images of infants in Bimin-Kuskusmin folk psychology. In G. M. White & J. Kirkpatrick (Eds.), *Person, self, and experience: Exploring Pacific ethnopsychologies* (pp. 183–244). Berkeley: University of California Press.

- Prince, R. J., & Geissler, P. W. (2001). Becoming "one who treats": A case study of a Luo healer and her grandson in western Kenya. *Educational Anthropology Quarterly*, 32, 447-471.
- Raven, J. C., Court, J. H., & Raven, J. (1992). *Manual for Raven's Progressive Matrices and Mill Hill Vocabulary Scales*. Oxford, England: Oxford Psychologists Press.
- Rogoff, B. (1990). *Apprenticeship in thinking: Cognitive development in social context*. New York: Oxford University Press.
- Rogoff, B. (2003). *The cultural nature of human development*. London: Oxford University Press.
- Ruzgis, P. M., & Grigorenko, E. L. (1994). Cultural meaning systems, intelligence and personality. In R. J. Sternberg & P. Ruzgis (Eds.), *Personality and intelligence* (pp. 248-270). New York: Cambridge.
- Sarason, S. B., & Doris, J. (1979). *Educational handicap, public policy, and social history*. New York: Free Press.
- Saxe, G. B. (1990). *Culture and cognitive development: Studies in mathematical understanding*. Mahwah, NJ: Erlbaum.
- Scribner, S. (1984). Studying working intelligence. In B. Rogoff & J. Lave (Eds.), *Everyday cognition: Its development in social context* (pp. 9-40). Cambridge, MA: Harvard University Press.
- Scribner, S. (1986). Thinking in action: Some characteristics of practical thought. In R. J. Sternberg & R. K. Wagner (Eds.), *Practical intelligence: Nature and origins of competence in the everyday world* (pp. 13-30). New York: Cambridge University Press.
- Serpell, R. (1974). Aspects of intelligence in a developing country. *African Social Research* (No. 17), 576-596.
- Serpell, R. (1979). How specific are perceptual skills? A cross-cultural study of pattern reproduction. *British Journal of Psychology*, 70, 365-380.
- Serpell, R. (1996). Cultural models of childhood in indigenous socialization and formal schooling in Zambia. In C. P. Hwang & M. E. Lamb (Eds.), *Images of childhood* (pp. 129-142). Mahwah, NJ: Erlbaum.
- Serpell, R. (2000). Intelligence and culture. In R. J. Sternberg (Ed.), *Handbook of intelligence* (pp. 549-577). New York: Cambridge University Press.
- Serpell, R. (2002). The embeddedness of human development within sociocultural context: Pedagogical and political implications. *Social Development*, 11, 290-295.
- Shweder, R. A. (1991). *Thinking through cultures: Multicultural expeditions in cultural psychology*. Cambridge, MA: Harvard University Press.
- Shweder, R. A. (2002). *Engaging cultural differences: The multicultural challenge in liberal democracies*. New York: Russell Sage Foundation.
- Spearman, C. (1927). *The abilities of man*. London: Macmillan.
- Sternberg, R. J. (1985). *Beyond IQ: A triarchic theory of human intelligence*. New York: Cambridge University Press.
- Sternberg, R. J. (1988). A triarchic view of intelligence in cross-cultural perspective. In S. H. Irvine & J. W. Berry (Eds.), *Human abilities in cultural context* (pp. 60-85). New York: Cambridge University Press.
- Sternberg, R. J. (1990). *Metaphors of mind*. New York: Cambridge University Press.
- Sternberg, R. J. (1997). *Successful intelligence*. New York: Plume.
- Sternberg, R. J. (1999a). Intelligence as developing expertise. *Contemporary Educational Psychology*, 24, 359-375.
- Sternberg, R. J. (1999b). The theory of successful intelligence. *Review of General Psychology*, 3, 292-316.
- Sternberg, R. J. (Ed.). (2000). *Handbook of intelligence*. New York: Cambridge University Press.
- Sternberg, R. J. (2003a). What is an expert student? *Educational Researcher*, 32(8), 5-9.
- Sternberg, R. J. (2003b). *Wisdom, intelligence, and creativity, synthesized*. New York: Cambridge University Press.
- Sternberg, R. J. (in press). There are no public-policy implications: A Reply to Rushton and Jensen. *Psychology, Public Policy, and Law*.
- Sternberg, R. J., Conway, B. E., Ketron, J. L., & Bernstein, M. (1981). People's conceptions of intelligence. *Journal of Personality and Social Psychology*, 41, 37-55.
- Sternberg, R. J., & Detterman, D. K. (1986). *What is intelligence?* Norwood, NJ: Ablex.
- Sternberg, R. J., Forsythe, G. B., Hedlund, J., Horvath, J., Snook, S., Williams, W. M., et al. (2000). *Practical intelligence in everyday life*. New York: Cambridge University Press.
- Sternberg, R. J., & Grigorenko, E. L. (1997, Fall). The cognitive costs of physical and mental ill health: Applying the psychology of the developed world to the problems of the developing world. *Eye on Psi Chi*, 2(1), 20-27.
- Sternberg, R. J., & Grigorenko, E. L. (1999). A smelly 113° in the shade, or, why we do field research. *APS Observer*, 12, 1, 10-11, 20-21.
- Sternberg, R. J., & Grigorenko, E. L. (2002). Just because we "know" it's true doesn't mean it's really true: A case study in Kenya. *Psychological Science Agenda*, 15(2), 8-10.
- Sternberg, R. J., Grigorenko, E. L., Ngrosho, D., Tantufuye, E., Mbise, A., Nokes, C., et al. (2002). Assessing intellectual potential in rural Tanzanian school children. *Intelligence*, 30, 141-162.
- Sternberg, R. J., & Kaufman, J. C. (1998). Human abilities. *Annual Review of Psychology*, 49, 479-502.
- Sternberg, R. J., Nokes, K., Geissler, P. W., Prince, R., Okatcha, F., Bundy, D. A., & Grigorenko, E. L. (2001). The relationship between academic and practical intelligence: A case study in Kenya. *Intelligence*, 29, 401-418.
- Sternberg, R. J., Powell, C., McGrane, P. A., & McGregor, S. (1997). Effects of a parasitic infection on cognitive functioning. *Journal of Experimental Psychology: Applied*, 3, 67-76.
- Stevenson, H. W., & Stigler, J. W. (1994). *The learning gap: Why our schools are failing and what we can learn from Japanese and Chinese education*. New York: Simon & Schuster.
- Stigler, J. W., Lee, S., Lucker, G. W., & Stevenson, H. W. (1982). Curriculum and achievement in mathematics: A study of elementary school children in Japan, Taiwan, and the United States. *Journal of Educational Psychology*, 74, 315-322.
- Super, C. M. (1976). Environmental effects on motor development: The case of African infant precocity. *Developmental Medicine and Child Neurology*, 18, 561-567.
- Super, C. M., & Harkness, S. (1982). The development of affect in infancy and early childhood. In D. Wagnert & H. Stevenson (Eds.), *Cultural perspectives on child development* (pp. 1-19). San Francisco: Freeman.
- Super, C. M., & Harkness, S. (1986). The developmental niche: A conceptualization at the interface of child and culture. *International Journal of Behavioral Development*, 9, 545-569.
- Super, C. M., & Harkness, S. (1993). The developmental niche: A conceptualization at the interface of child and culture. In R. A. Pierce & M. A. Black (Eds.), *Life-span development: A diversity reader* (pp. 61-77). Dubuque, IA: Kendall/Hunt.
- Thurstone, L. L. (1938). *Primary mental abilities*. Chicago: University of Chicago Press.
- Tomasello, M. (2001). *The cultural origins of human cognition*. Cambridge, MA: Harvard University Press.
- Turkheimer, E., Haley, A., Waldron, M., D'Onofrio, B., & Gottesman, I. I. (2003). Socioeconomic status modifies heritability of IQ in young children. *Psychological Science*, 6, 623-628.
- Tzuriel, D. (1995). *Dynamic-interactive assessment: The legacy of L. S. Vygotsky and current developments*. Unpublished manuscript.
- Valsiner, J. (2000). *Culture and human development*. Thousand Oaks, CA: Sage.
- Vernon, P. E. (1969). *Intelligence and cultural environment*. London: Methuen.
- Vernon, P. E. (1971). *The structure of human abilities*. London: Methuen.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Wagner, D. A. (1978). Memories of Morocco: The influence of age, schooling, and environment on memory. *Cognitive Psychology*, 10, 1-28.
- White, G. M. (1985). Premises and purposes in a Solomon Islands ethnopsychology. In G. M. White & J. Kirkpatrick (Eds.), *Person, self, and experience: Exploring Pacific ethnopsychologies* (pp. 328-366). Berkeley: University of California Press.
- Wober, M. (1974). Towards an understanding of the Kiganda concept of intelligence. In J. W. Berry & P. R. Dasen (Eds.), *Culture and cognition: Readings in cross-cultural psychology* (pp. 261-280). London: Methuen.
- Yang, S., & Sternberg, R. J. (1997a). Conceptions of intelligence in ancient Chinese philosophy. *Journal of Theoretical and Philosophical Psychology*, 17, 101-119.
- Yang, S., & Sternberg, R. J. (1997b). Taiwanese Chinese people's conceptions of intelligence. *Intelligence*, 25, 21-36.