

Successful intelligence: finding a balance

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Human intelligence has long been on the borderline between a scientific and a quasi-scientific field within the scope of psychological science. This is partially because its study and measurement have been particularly susceptible to socio-political agendas, but also because empirical tests of theories of intelligence have too often ranged from inadequate to nonexistent. In this article it is argued that two extremes have prevailed in the study of intelligence. At one extreme are general-ability (*g*) theorists, who have collected large amounts of data to test the theory of general intelligence, but often using restricted ranges of participants, materials or situational contexts. They also show a tendency to limit their methods of data analysis (e.g. to exploratory factor analysis). At another extreme are theorists arguing for new, multiple intelligences, whose theories have been subjected to few or no empirical tests. I argue that a middle ground is needed that recognizes the multifarious nature of intelligence and of people's conceptions of it, but that also is subjected to rigorous empirical tests.

The field of human intelligence has long been one of the ugly stepchildren of scientific psychology. Few university psychology departments have even one researcher who identifies his or her primary field of research as human intelligence, and often people who study the phenomenon do so under a more acceptable label, such as 'reasoning' or 'problem solving'. The reason for this state of affairs is, I believe, not hard to find. Nevertheless, my search for a reason represents my own professional point of view, and other scholars hold points of view quite different from my own.

The discussion of this reason will be divided into four parts. The first part will describe one pole of intelligence research, whose proponents claim that what is important about human intelligence can largely (but not exclusively) be understood in terms of a single general (*g*) factor of intelligence. The second part will describe the opposite pole of intelligence research, whose proponents argue that conventional views do not go nearly far enough in characterizing intelligence and that the concept needs to be expanded to include constructs such as multiple intelligences and emotional intelligence. The third part describes a middle-of-the road view according to which intelligence is viewed as multifaceted, and so-called general ability is viewed as part of the array that might require higher cognitive processes. The fourth part will discuss people's conceptions of intelligence and their role in promoting an understanding of the nature of intelligence. A common theme in the ensuing discussion will be that the empirical tests to which theories have been subjected have often ranged from inadequate to nonexistent.

The debate over the *g* factor

The field of human intelligence has long been on the borderline between science and quasi-science. Recognizing this fact, one of the early leaders in the field of human intelligence,

Louis Thurstone, stated that, 'The exploratory nature of factor analysis is often not understood. Factor analysis has its principal usefulness at the borderline of science.'¹

Even Charles Spearman, who single-handedly devised the method of factor analysis for the study of individual differences in intelligence, seems to have recognized the dubious status of reliance on individual differences for identifying the cognitive abilities underlying intelligence. In addition to his factorially based theory of intelligence², Spearman also devised a cognitive theory of intelligence. According to this theory, the three main processes underlying intelligent thought are what we today might call encoding of stimuli, inference of relationships, and application of relationships, but which Spearman referred to as apprehension of experience, education of relationships, and education of correlates³.

The factorial approach to intelligence has continued into modern times, and has formed a major basis even of many recent works on intelligence, whose authors continue to argue for the existence of a general factor of intelligence⁴⁻⁶.

The evidence in favor of the importance of the so-called general factor goes beyond just factor analysis, and is indisputable. For example, scores on tests of *g* predict school performance, professional accomplishments, socio-economic status, and many other things. There also is evidence of heritability of *g* (see Ref. 6). Notwithstanding, the argument here is not that the analytical abilities measured by conventional ability tests do not exist but, rather, that they represent only part of the story. High scores on conventional tests may in themselves open the doors that enable people to attain success in society, for example, by improving chances of admission to gifted programs, universities, professional positions, and so on. Thus, predictions from such tests may be exaggerated because the tests influence the opportunities to achieve that people are given.

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Recognizing that there is probably more to intelligence than just the general factor, many contemporary psychometric theorists accept some kind of hierarchical theory. Probably the most widely accepted such theory is that of John B. Carroll (see Ref. 4), the 'three-stratum theory'. According to Carroll, intelligence comprises three strata, with general intelligence at the top (Stratum III), followed by seven group factors of intelligence in the middle (Stratum II): fluid intelligence, crystallized intelligence, general memory and learning, broad visual perception, broad retrieval ability, broad cognitive speediness, and processing speed. Still narrower factors comprise the bottom layer of the hierarchy (Stratum I).

Investigators of intelligence have not fully heeded the warning of Thurstone (and later of Lee Cronbach⁷) at their peril. A problem created by such investigators is that they have tended somewhat to restrict the range of participants, tasks and situational contexts in which they have studied intelligence. When the range of such variables is expanded, the claim that a general factor of intelligence characterizes *all* of cognitive functioning becomes more dubious, as shown by recent reviews of more wide-ranging bodies of research^{8–10}.

A fundamental claim underlying the notion of a general factor of intelligence is that tests of intellectual abilities show a positive manifold, meaning that they correlate positively with each other. In a series of studies on practical intelligence, however, such correlations have not always been observed. These studies have looked at children as well as adults in many different occupations. For example, consider research on tests of practical intelligence for managers, sales people and university professors, in which the participants are required to solve problems based on scenarios of the kinds they encounter in the course of their job (see Box 1). Repeated investigations have consistently yielded non-significant or very small correlations between measures of so-called general intelligence (which might better be referred to as measures of 'academic intelligence') and measures of practical intelligence within the ranges of abilities tested^{11,12}. Only with a very wide range of abilities might significant correlations appear. Put another way, people in the very low ranges of IQ might not be effective in high-level studies or jobs, regardless of their practical skills. It is important also to note that such tests of practical intelligence supplement rather than replace conventional tests: both kinds of tests can predict academic and job performance, but relatively independently.

In another recent study, a test of rural Kenyan children's knowledge of natural herbal medicines for combating illnesses was constructed as a measure of practical adaptive intellectual functioning. This knowledge is used by the Kenyan children about once a week, on average, and is useful because almost all of the children are parasitically infected. The research showed significant negative correlations between the measure of practical intelligence and scores on certain conventional Western tests of intelligence as well as with school grades in English¹³. The authors attributed these negative correlations to the fact that local practical knowledge and skills were deemed more useful to the children than the kinds of academic knowledge required by the schools, with the result that time put into the learning of local adaptive knowledge and skills became time taken away from learning of school-related knowledge and skills, and vice versa. Of course, such

Box 1. Tests of practical intelligence

The following are examples of work-related situations and associated response items that have been used in tests of practical intelligence (taken from Ref. a). Items were scored by computing d^2 of the profile of responses for each candidate relative to the mean profile of an expert group (d represents the distance between observations on the test). The value of d^2 for each candidate was the candidate's score.

Academic psychology

It is your second year as an assistant professor in a prestigious psychology department. This past year you published two unrelated empirical articles in established journals. You don't believe, however, that there is a research area that can be identified as your own. You believe yourself to be about as productive as others. The feedback about your first year of teaching has been generally good. You have yet to serve on a university committee. There is one graduate student who has chosen to work with you. You have no external source of funding, nor have you applied for funding.

Your goals are to become one of the top people in your field and to get tenure in your department. The following is a list of things you are considering doing over the next two months. You obviously cannot do them all. Rate the importance of each by its priority as a means of reaching your goals.

- (a) improve the quality of your teaching
- (b) write a grant proposal
- (c) begin long-term research that may lead to a major theoretical article
- (d) concentrate on recruiting more students
- (e) serve on a committee studying university–community relationships
- (f) begin several related short-term research projects, each of which may lead to an empirical article
- ...(g) volunteer to be chairperson of the undergraduate curriculum committee

Business management

It is your second year as a mid-level manager in a company in the communications industry. You head a department of about 30 people. The evaluation of your first year on the job has been generally favorable. Performance ratings for your department are at least as good as they were before you took over, and perhaps even a little better. You have two assistants. One is quite capable. The other just seems to go through the motions but to be of little real help. You believe that although you are well liked, there is little that would distinguish you in the eyes of your superiors from the nine other managers at a comparable level in the company.

Your goal is rapid promotion to the top of the company. The following is a list of things you are considering doing over the next two months. You obviously cannot do them all. Rate the importance of each by its priority as a means of reaching your goal.

- (a) find a way to get rid of the 'dead wood,' e.g. the less helpful assistant and three or four others
- (b) participate in a series of panel discussions to be shown on the local public television station
- (c) find ways to make sure your superiors are aware of your important accomplishments
- (d) make an effort to match better the work to be done with the strengths and weaknesses of individual employees
- ...(e) write an article on productivity for the company newsletter

a mentality is not necessarily limited to Kenyan children. Children in any country who wish to pursue occupations for which conventional schooling is not key (for example, athletes, musicians, plumbers, carpenters, cooks) might find that the time they put into conventional schooling rather than into specialized training results in time being taken away from their developing their needed expertise.

In another study conducted among Russian adults, academic and practical intelligence correlated only at the 0.1 level with each other; however, practical intelligence was a

better predictor of adaptive functioning in the everyday world (low depression, low anxiety, good physical health) than was academic intelligence¹⁴. In other words, measures of practical intelligence provide a useful complement to measures of academic intelligence.

Other studies that did not explicitly correlate academic and practical intelligence have yielded similar findings. For example, one set of studies found that Brazilian street children who were able to do mathematics effectively on the street were unable to do the same mathematics in a classroom¹⁵. Another set of studies found that housewives able to carry out effective comparison-shopping in a supermarket were unable to do comparable mathematical operations in a classroom¹⁶.

Obviously, no one study on the structure of intelligence is likely to be definitive. But the pattern that emerges from the available data may be interpreted as follows: a general factor of intelligence tends to emerge from a set of tests when the participants, materials and situational contexts are narrowly conceived; a broader view of intelligence, encompassing at minimum a practical aspect and an academic aspect, tends to emerge when the participants, materials and situational contexts are more broadly conceived. Thus, the fact that there are hundreds of studies showing the existence of a general factor might reflect, in part, a confirmation bias in the way in which the studies were designed. They were designed to allow a general factor, and they did just that. I suggest that the factor is broad but not general: it predicts many aspects of human behavior, but not all of them.

The debate over new intelligences

In recent years, another debate has emerged, this time from a different thrust in intelligence research – the debate over the possibility of new, independent intelligences.

Howard Gardner has proposed a theory of multiple intelligences whereby intelligence comprises not just a single entity, but multiple entities^{17,18}. In the most recent version of the theory, Gardner has proposed eight purportedly confirmed independent intelligences and two further candidate intelligences. The eight confirmed intelligences are: (1) linguistic, as used in reading a book or writing a poem; (2) logical–mathematical, as used in deriving a logical proof or solving a mathematical problem; (3) spatial, as used in fitting suitcases into the trunk of a car; (4) musical, as used in singing a song or composing a symphony; (5) bodily–kinesthetic, as used in dancing or playing football; (6) interpersonal, as used in understanding and interacting with other people; (7) intrapersonal, as used in understanding oneself; and (8) naturalist, as used in discerning patterns in nature. The two candidate intelligences are: (9) spiritual, as used in achieving a spiritual understanding of life and aspects of the universe; and (10) existential, as used in understanding the nature and, to some extent, meanings of existence and existential issues.

Gardner's account is based on a set of criteria for defining what an intelligence is and on a review of literature that Gardner interprets as supporting his point of view. The theory has been useful in expanding people's conceptions of the possibilities for domains in which intelligence might apply. At the same time, the literature review was selective and perhaps biased in favor of Gardner's theory, essentially dismissing the many studies reviewed by others that have tended to find

correlations among multiple abilities, such as between logical–mathematical and spatial skills (see Ref. 4). Moreover, 16 years after the theory first was proposed, there still is not a single empirical study providing support for, or even testing, the theory as a whole. Although the theory has been adopted widely in schools, the literature also lacks rigorous empirical tests of the efficacy of educational programs based (sometimes loosely or incorrectly) on the theory. In that scientific theories are most persuasive when they prove to be predictively valid and not just postdictively consistent with selected data, there is a serious need for rigorous empirical tests of this interesting theory.

Another popular construct is that of emotional intelligence, first proposed by Peter Salovey and John Mayer and later expanded and popularized by Daniel Goleman^{19–22}. Emotional intelligence is, roughly speaking, the ability to perceive accurately, appraise, and express emotion; the ability to access and/or generate feelings when they facilitate thought; the ability to understand emotion and emotional knowledge; and the ability to regulate emotions to promote emotional and intellectual growth. The theory of emotional intelligence (unlike that of multiple intelligences) has generated some initial scientific research attempting to construct-validate the notion, in addition to generating a great deal of anecdotal data and many commercialized tests. The scientific data at this point are mixed, however. Two construct validations by the originators of the construct have been purported to show evidence in favor of the overall construct validity of emotional intelligence²³ (see also Ref. 20), whereas another construct validation has been purported to show that the construct fails to hold together as a unified entity or even clearly as a kind of intelligence²⁴.

Finding a middle ground

The triarchic theory

A middle ground between the extreme positions outlined above has been proposed in my own 'triarchic', or three-part theory of intelligence^{10,25}, which has been referred to as a theory of successful intelligence to distinguish the theory from theories of strictly academic intelligence. 'Successful intelligence' is defined as the ability to balance the needs to adapt to, shape and select environments in order to attain success, however one defines it, within one's socio-cultural context. Successfully intelligent people are alleged to discern their patterns of strengths and weaknesses, and to capitalize on their strengths and to compensate for or correct their weaknesses. According to this theory, the processes of human intelligence are universal but their instantiations in behavior are contextually bound. Thus, a behavior that is viewed as intelligent in one culture might be viewed as unintelligent in another culture, although the processes used to arrive at the behavior may be the same. As the name 'triarchic theory' suggests, three aspects of intelligence are involved: analytical, creative and practical.

Analytical abilities are involved in analyzing, evaluating, critiquing, and comparing and contrasting things. Underlying these skills is a set of information-processing components that can be isolated through experimental methods and identified via mathematical models (see Ref. 25). These abilities are the ones measured by conventional tests of academic abilities.

Secondly, creative abilities are involved in creating, exploring, discovering, inventing, imagining and supposing.

These abilities have been identified in various ways, for example, by getting people to: (a) write short stories with unusual titles (such as *'The Octopus's Sneakers'*), (b) draw artwork based on novel topics (such as *'Earth from an Insect's Point of View'*), (c) create advertisements for dull products (such as a new brand of door knob), and (d) solve quasi-scientific problems (such as how one could tell whether someone had been on the Moon in the last two months). Performance on these tasks is evaluated for novelty, quality and task-appropriateness. (A more creative and a less creative real example of *'Earth from an Insect's Point of View'* are shown in Fig. 1.) Investigations of responses to these kinds of tasks found them to be relatively domain-specific and to show only modest correlations with analytical measures²⁶.

Thirdly, practical abilities are involved in applying, using, implementing and putting into practice. They are measured by the kinds of tasks described in the first section of this article (solving problems in job-related scenarios) as well as by other kinds of tasks. These include tasks such as practical-reasoning problems of the kinds one encounters in everyday life (e.g. figuring out how to make friends), solving practical mathematics problems, or planning routes using maps (see Box 2). These abilities, as mentioned earlier, tend not to be correlated with analytical abilities and can even be negatively correlated with them.

Three validations of the theory as a whole have been carried out, in addition to numerous studies testing specific predictions of the theory. In one validation study, 326 high-school students were given a test that measured their analytical, creative and practical abilities using multiple-choice verbal, quantitative and figural items, as well as essay problems²⁷. Sample items from this test are shown in Box 2. Confirmatory factor analysis revealed no general factor underlying the test. Correlations across analytical, creative and practical abilities were trivial after controlling for mode of testing (multiple-choice versus essay).

In the study, 199 of the participants were selected according to their triarchic patterns of ability; that is, they were assessed as relatively high in (1) analytical abilities only, (2) creative abilities only, (3) practical abilities only, (4) all three kinds of abilities, or (5) none of the three kinds of abilities. The participants then were taught a four-week, college-level introductory psychology course in a way that emphasized either memory (e.g. 'What are the basic ideas in the cognitive theory of depression?'), analytical thinking (e.g. 'Compare and contrast the cognitive theory to the behavioral theory of depression'), creative thinking (e.g. 'Propose your own theory of depression that builds upon but goes beyond previous theories of depression'), or practical thinking (e.g. 'How might you use what you have learned about theories of depression to help a friend who is depressed?'). Participants were placed in an instructional condition that either well matched or more poorly matched their triarchic pattern of intellectual abilities. All participants' achievement throughout the course was evaluated for memory, analytical, creative and practical accomplishments through homework, tests (multiple-choice and essay), and an independent project. It was found that participants who had been better matched to their triarchic pattern of abilities when taught outperformed participants who were largely mismatched.

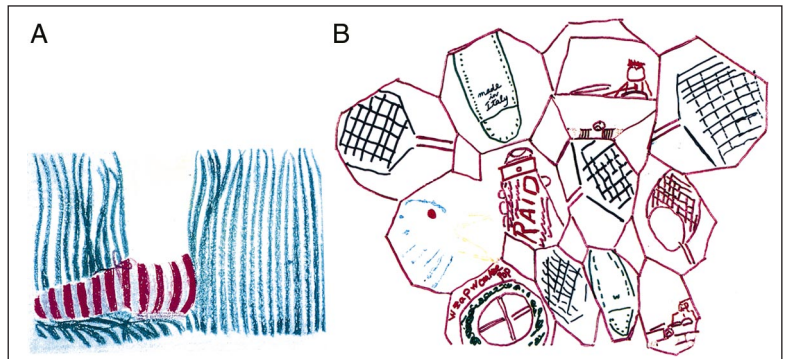


Fig. 1. Testing creative ability. The drawings are actual examples in response to the instruction to draw a picture based on the topic *'Earth from an Insect's Point of View'*. **(A)** Less creative response: this drawing of a foot stepping into the grass is representative of many that simply depicted the insect as seeing everything in the world as very large. **(B)** More creative response: the drawing uses the idea that insects have multifaceted eyes. Through its representation of objects hazardous to insects (a can of Raid™, an Italian shoe, a bird, a fly swatter, an electric 'bug zapper', and an oncoming truck) the drawing suggests that insects have a rather anxious view of their world. (Drawings supplied anonymously to the author by participants in the study of Ref. 26.)

A second study examined 225 third-graders who were taught social studies and 142 eighth-graders who were taught psychology in one of three ways: with emphasis on memory; with emphasis on analytical (critical) thinking; or with equal, triarchic emphasis on analytical, creative and practical thinking. Time on task was the same for all conditions²⁸. In both grade levels, participants who were taught triarchically outperformed students who were taught in the other two conditions, even when achievement was measured via multiple-choice memory test items. Thus, triarchic teaching appears to be more effective than conventional teaching even if the goal is merely to produce factual recall.

In the third validation study, 240 Spanish high-school students were administered a Spanish translation of the multiple-choice sections of the triarchic abilities test described above²⁹. Structural-equation modeling (equivalent to confirmatory factor analysis) was then used to compare alternative models of the data. These models included one simply with a general factor, as well as one with analytical, creative and practical factors, and one with content (verbal, quantitative, figural) factors. The model that best fit the data was the one most closely based on the triarchic theory – that with correlated analytical, creative and practical factors. The correlation between factors was probably increased by the fact that only multiple-choice items were used so that it was not possible to separate modality of testing from the processes that were tested.

The role of implicit theories

Another way of investigating intelligence is to look at people's conceptions (implicit theories) of intelligence³⁰. These conceptions tend to support the newer and less traditional kinds of theories. Data from studies of implicit theories are no better a match for the theory of the *g* factor of intelligence than are performance-based data.

For example, one study examined laypersons' notions of intelligence and found that their notions could be characterized in terms of (1) practical problem-solving ability, (2) verbal ability, and (3) social competence³¹. In a study conducted among Taiwanese Chinese people, notions of intelligence could be characterized in terms of: (1) a general cognitive

Box 2. Tests of the triarchic theory of intelligence

Sample questions from a study that aimed to validate the triarchic theory of intelligence (Ref. a).

(1) The following question gives you information about a situation involving a high-school student. Read the question carefully. Choose the answer that provides the *best* solution, given the specific situation and desired outcome.

Circle the letter next to the answer you choose.

John's family moved to Iowa from Arizona during his junior year in high school. He enrolled as a new student in the local high school two months ago but still has not made friends and feels bored and lonely. One of his favorite activities is writing stories. What is likely to be the most effective solution to this problem?

- A. volunteer to work on the school newspaper staff
- B. spend more time at home writing columns for the school newsletter
- C. try to convince his parents to move back to Arizona
- D. invite a friend from Arizona to visit during Christmas break

(2) In the question below, there are three underlined words. The first two underlined words go together in a certain way. Choose the word that goes with the third underlined word in the same way that the first two go together.

The question has a 'pretend' statement. You must suppose that this statement is true. Sometimes the statement will be important in helping you choose the correct answer and sometimes it will not. Think of the statement, and then decide which word goes with the third underlined word in the same way that the first two underlined words go together.

Circle the letter next to the answer you choose.

Statement: Money falls off trees.

Snow is to shovel as dollar is to:

- A. bill
- B. rake
- C. bank
- D. green

(3) The following question asks you to find routes on a map of an entertainment park and to choose the best route to take (see Fig.). To go from one place to

another you must use the streets (shaded black). Read the question carefully and choose the best answer.

Circle the letter next to the answer you choose.

(a) You are at the Burger Stand. You want to go to the front of Ticket Sales to meet some friends. If you walk the shortest way, you will pass the entrance to the:

- A. Lemonade Stand and Computer Games Arcade
- B. Music Hall and Wild Animal Show
- C. Music Hall and Soft Drink Stand
- D. Monkey Show and Wild Animal Show

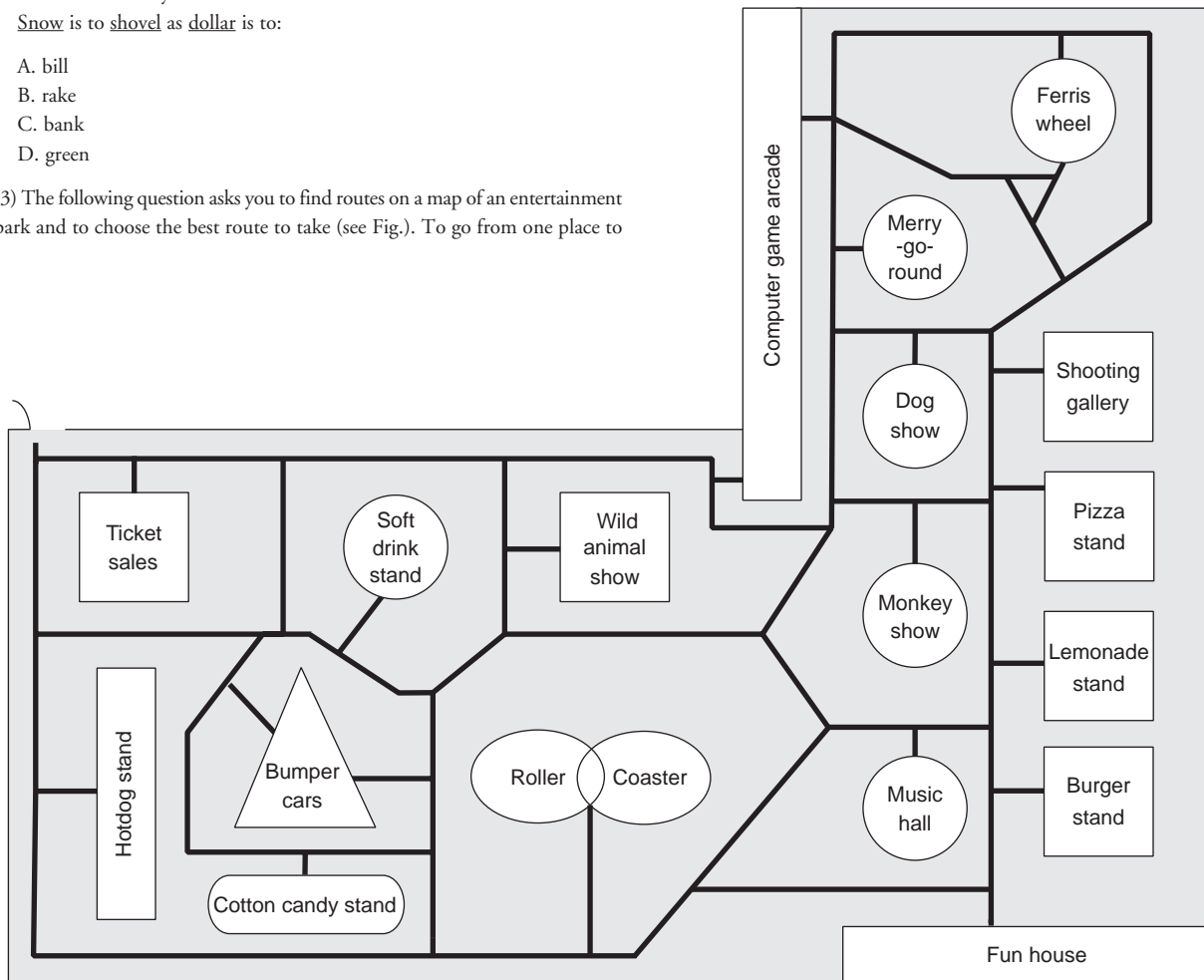
(b) You walk from the Lemonade Stand to the Computer Games Arcade. Your friend walks from the Shooting Gallery to the Roller Coaster. Which of these will both of you most likely pass?

- A. Merry-Go-Round
- B. Music Hall
- C. Pizza Stand
- D. Dog Show

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[Answers: (1) A; (2) B; (3) B; (4) C]



trends in Cognitive Sciences

Online: Fig. 1

factor, much like the *g* factor in conventional tests of intelligence; (2) interpersonal intelligence; (3) intrapersonal intelligence; (4) intellectual self-assertion; and (5) intellectual self-effacement³².

Comparative studies reveal differences in conceptions of intelligence among different groups. For example, a study among university students in Australia found that the Australian students valued academic skills and the ability to adapt to new events as critical to intelligence whereas the Malay students there placed higher value on practical and creative skills³³. A related study found that Malay students emphasize both social and cognitive attributes in their conceptions of intelligence³⁴.

In Africa, conceptions of intelligence seem to revolve largely around skills that help to facilitate and maintain harmonious and stable intergroup relationships; nevertheless, intragroup relationships are probably equally important and at times more important³⁵. Consistent with this view is the finding that Chewa adults in Zambia emphasize social responsibilities, cooperativeness and obedience as important to intelligence³⁶. Kenyan parents also emphasize responsible participation in family and social life as important aspects of intelligence³⁷.

The emphasis on social intelligence is not limited to Africa. Certain Asian cultures also emphasize the social aspect of intelligence as do northern North Americans³⁸. However, in a study of Asian-Americans, Anglo-Americans and Latino-Americans, the Latino-Americans were found to emphasize social-competence skills in their conceptions of intelligence more than either the Asian-Americans or the Anglo-Americans³⁹. It also was found that the closer the match between the conceptions of the parents of school children and the teachers of these school children, the better the children tended to do in school.

One might dismiss studies of implicit theories as dealing only with conceptions of intelligence rather than with intelligence itself. At the same time, most if not all so-called explicit theories of intelligence started with experts' conceptions of what intelligence is, and sometimes were followed up with little empirical data. Although the mental processes underlying intelligence might be universal, how these processes translate into labeled skills and behavior almost certainly are not.

Conclusion

The field of intelligence is haunted by a history of verging on the quasi-scientific. This history is buttressed by the obvious political and sociocultural agendas of many of those who have specialized in this field⁴⁰.

On one side of the debate are those researchers who have done hard-core empirical studies, but studies that, at times, seem to have limited their choice of participants, instrumentation and situational contexts to ones that are narrower than might be ideal for optimal understanding and prediction of human performance. Of course, those who take this position would disagree strongly, arguing in favor of conventional conceptions, and that modern conceptions of intelligence really go beyond the boundaries that should be respected for the concept of intelligence⁴¹.

On the other side are those who have collected much less rigorous empirical data (sometimes none) but who have ar-

Outstanding questions

- Is the so-called general factor of intelligence truly general?
- Can prediction of a wide variety of real-world skilled performances be improved by replacing, or at least supplementing, traditional notions of intelligence with new notions?
- Can scientific research on intelligence and other phenomena find ways to minimize the effects of confirmation bias with respect to previous beliefs?
- Might more extensive research in a variety of cultures show further limitations of conventional notions of intelligence or new limitations of the more recent notions of intelligence?

gued, many believe convincingly, that conventional conceptions of intelligence are too narrow⁴². Because the field has no consensually agreed guidelines for the criteria for specifying the boundaries (or any prototype) for intelligence, it is perhaps difficult to say how these arguments could be resolved. Probably the best resolution is what has always been the case: a combination of rigorous internal validation of the structure of a theory combined with rigorous external validation of the predictive value of that theory. The newer views do not yet have the extensive data base of the older views, and only time will tell whether they will be able to garner continued support. Of course, there are many approaches to understanding human intelligence, only a small proportion of which could be reviewed in this article but which are described elsewhere⁴³⁻⁴⁵.

The need for a resolution is shown by the somewhat contradictory situation where two major theorists, John Carroll (see Ref. 4) and Howard Gardner (see Ref. 17) can claim to review the literature on intelligence and come to opposite conclusions, that there is a general factor (Carroll) or that there is not (Gardner). In fact, their reviews are selective, with Carroll reviewing primarily factor-analytic studies, which tend to support a general factor (and mathematically are compelled to, if factors are unrotated), and Gardner dismissing such studies and reviewing others instead. Such research makes restricted assumptions that might lead to confirmation bias with respect to the investigators' opening positions.

The field of human intelligence needs to remain on a firm footing with respect to the scientific basis of intelligence. There are different views on how such a footing should be maintained, and the one represented in this article places more emphasis on creative and practical abilities than might others in the field⁴⁶. Nevertheless, most scholars would agree that practitioners in intelligence research need to be much more respectful of the limitations of their theorizing with respect to applications of their theories to society that have high stakes, such as psychological assessment⁴⁷. With such respect, perhaps the field of human intelligence will remain a stepchild, but will not continue to be an ugly one.

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