BOX 6.1

HOW DO ADULTS VIEW INTELLIGENCE?

We all have our own ideas about what intelligence is. We use particular behaviors to make inferences about our own and others' intellectual ability. What behaviors are these?

Fitzgerald and Mellor (1988) looked at adults' so-called implicit theories about intelligence (Sternberg et al., 1981). In other words, what behaviors do adults usually associate with intelligence? Approximately 100 adults between the ages of 18 and 79 years, when asked about a variety of specific behaviors, were able to separate "unintelligent" behaviors from intelligent ones, as follows:

Unintelligent Behavior	*Intelligent Behavior*
Has a narrow perspective on problems	Is on time for appointments
Refuses to accept the ideas of others	Displays varied interests
Does not communicate effectively	Aware of new problems arising out of solutions to old problems
Does not consider range of options	Identifies connections among ideas
Cannot articulate goals of action	Reasons logically and well
Lacks interest in solving problems	Reads widely
Does not understand other people	Makes fair judgments
Lacks respect for others	Listens well
Does not adapt quickly and well to new situations	Is sensitive to other people's needs and desires
	Able to cope with everyday environment

In a second study, Fitzgerald and Mellor studied whether these conceptions of intelligent behaviors could be meaningfully organized. Again, sampling adults, who represented a somewhat more narrow age range, they concluded that perceptions could be grouped into three highly related clusters of behaviors. Examples of each are:

Cluster 1: Practical Problem-solving Items

Reasons quickly and well

Identifies connections among ideas

Is able to apply knowledge to problems at hand

Sees individual elements in their overall context

Thinks before speaking and doing

Makes good decisions

Aware of new problems arising out of solutions to old problems

Cluster 2: Verbal Learning and Culture Items

Speaks clearly and articulately

Appreciates the arts

Displays good vocabulary

Is verbally fluent

Converses well

Reads with comprehension

Reads widely

Cluster 3: Social Competence and Character

Is sensitive to other people's needs and desires

Able to cope with the everyday environment

Emotions are appropriate to the situation

Displays common sense

Accepts others for what they are

Admits mistakes

Remains calm under pressure

In general, people were more able to clearly separate intelligent from unintelligent behavior than they were able to organize intelligent behaviors into distinct groups. Perhaps we use the more general judgments about intelligent and unintelligent behaviors to evaluate our competence on an everyday basis. In any case, people are "smart" or "dumb" to us, based on our observation of their behavior.

2

TABLE 6.1

WAIS-R SUBTESTS

Scale	Sample Items
Verbal tests	
General information	1. How many wings does a bird have? 2. How many nickels make a dime? 3. What is steam made of? 4. Who wrote "Tom Sawyer"?
General comprehension	1. What should you do if you see someone forget his book when he lea a restaurant? 2. Why is copper often used in electrical wires?
Arithmetic	1. Sam had three pieces of candy and Joe gave him four more. How ma pieces of candy did Sam have altogether? 2. Three women divide eighteen golf balls equally among themselves. How many golf balls did each person receive?
Similarities	1. In what way are a lion and a tiger alike? 2. In what way are a circle and a triangle alike?
Vocabulary	This test consists simply of asking, "What is a _____ ?" or "What does _____ mean?" The words cover a wide range o difficulty.
Performance tests	
In addition to verbal tasks of the kinds illustrated above, there are a number of performance tasks involving the use of blocks, cut-out figures, paper and pencil puzzles, etc.	

Source: Adapted from Wechsler Adult Intelligence Scale—Revised. Copyright 1981, 1955 by The Psychological Corporation. Reproduced by p mission. All rights reserved.

what arbitrary; it depends on the particular courses you have taken, you energy level, state of health, whether you were motivated to do well du ing a particular semester, your family or work responsibilities, an whether the course load itself was a heavy one. Someone with an unde graduate GPA of 3.8 who has few responsibilities, whose academic load i light, and whose course work is composed of beginning-level offering might not be seen as doing as well as someone whose GPA is 3.0 but wh works full-time, who is raising a family, and whose course load is a com paratively heavy one composed of upper-level courses. In this case, wh is the better student?

Using this same analogy, we could also ask whether grades give u reliable information about who will ultimately be the most successful i real life, or who will even be the better graduate student. For exampl scoring high on certain scales of the WAIS-R, such as Vocabulary, Compre hension, or Information (see Table 6.1), may reflect one's formal educa tional background or simply be a function of an avid interest in readin and acquiring diverse facts. Being intelligent, in this sense, may predi success in fields such as Library Science or English but do little to predi

classic Aging pattern

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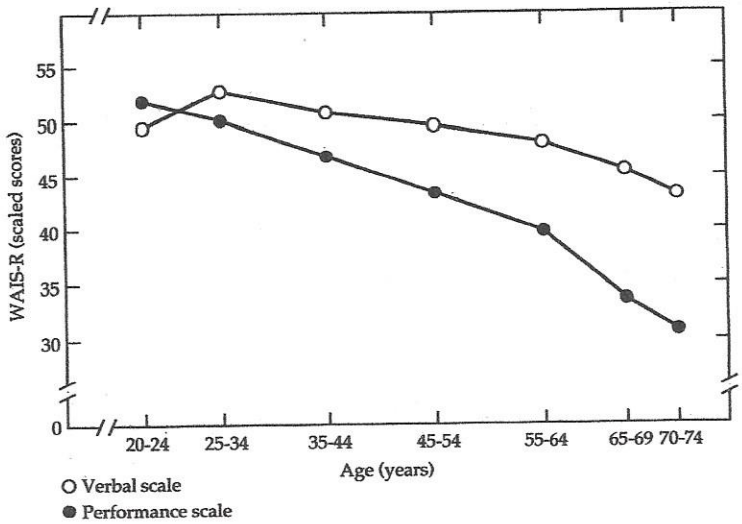


Figure 6.5 WAIS-R Verbal and Performance scores as a function of age. Data were obtained from Table 20 of the WAIS-R Manual (Wechsler, 1981, pp. 97–109) by culling sum of scaled scores of IQs of 100. (The Verbal scaled scores were multiplied by 5/6 to develop a common base with the Performance scaled scores.)

Schaie's PMA Research

As noted above, developmental research on intelligence has, to this point, been dominated by the psychometric tradition. Schaie's work on intelligence and aging best exemplifies the work done in this area.

In a comprehensive account of his research program, Schaie (1979) described a series of cross-sectional and longitudinal studies that began in 1956. Initially, he carried out a cross-sectional comparison of over 500 adults, ranging in age from 20 to 70 years and spanning seven different cohorts. In 1963, a new cross-sectional sample was drawn. In addition, a seven-year longitudinal follow-up of the subjects tested in 1956 was begun, using a battery of scales based on Thurstone's Primary Mental Abilities theory of intelligence. In 1970, a new random sampling of subjects was taken, and follow-ups of subjects originally interviewed in 1956 and 1963 were conducted. Also in 1970, new random samples from those originally tested in 1956 and 1963 were drawn. In 1977, this process was essentially repeated, so that Schaie now had independent samples from each of seven cohorts at 1956, 1963, 1970, and 1977, and longitudinal follow-ups (dependent samples) involving people of seven age ranges who had been originally interviewed at each of the four measurement points (Schaie & Hertzog, 1983).

By amassing data collected in this fashion, Schaie was able to examine the relative impact of age, cohort membership, and time of measurement on different aspects of intelligence in adulthood using a combination of cross-sectional and longitudinal analyses (see Chapter 2). These

Gc. Gf is thought to increase and then decline over the life span, whereas Gc should generally increase or remain stable over the adult years (Horn & Cattell, 1966, 1967; Horn, 1970, 1978).

The distinction between fluid and crystallized intelligence (Horn, 1978, 1982) reinforces the complex picture of intelligence and aging painted thus far. In this case, the curves of stability and growth for Gc and decline for Gf suggest intelligence to be both multidirectional and multidimensional in nature. In this case, too, it would be inappropriate to compare older and younger adults in terms of IQ, since the scales measuring IQ are partially crystallized and partially fluid in nature.

You can see in Figure 6.4 that the two abilities exhibit a different path of development, and also vary greatly from a global index of intelligence, or general IQ (Horn, 1970). Global tests fail to separate crystallized and fluid intelligences.

Horn (1982) points out that apparently simple distinctions such as learned/unlearned and verbal/performance are in fact complex and are not equivalent to the Gc-Gf distinction. He underscores the unique nature of Gf and Gc in terms of the kinds of learning experiences that underlie each. Gc is determined by purposeful, acculturational learning provided by societal institutions, such as the home environment, the school, and by implication, the work environment. Gf is, on the other hand, determined by idiosyncratic, largely self-determined casual learning influences. Horn also maintains that Gc and Gf are each, to a certain extent, a function of neurological factors, such as the number of active brain cells or the effects of stroke damage. However, the evidence for the differential relationship be-

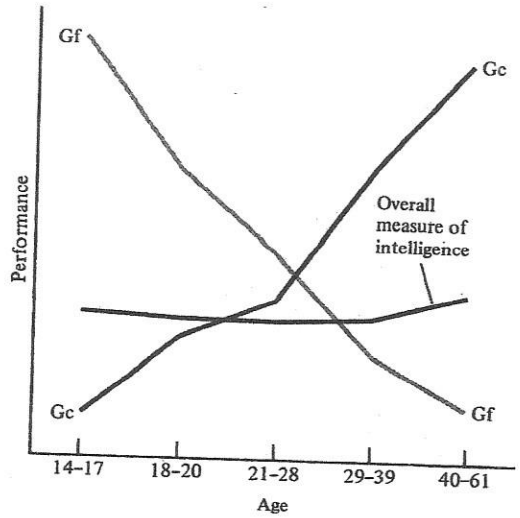


Figure 6.4 Age curves for Gc and Gf versus overall intelligence. *Source:* J. Horn. (1970). Organization of data on life-span development of human abilities. In L. Goulet and P. Baltes (Eds.), *Life-span developmental psychology: Research and theory* (p. 463). New York: Academic Press. Reprinted by permission of the author.

crystallized & fluid abilities

4

Aa

measuring fluid ability

Induction (Letter Series)

In these questions, write the letter that comes next in a series of letters.

Example:

A B C D E F G ____NA

The next letter in this series is H. Try another example.

Example:

A B B C C C D D D D E E E E ____NA

This time the next letter is E. You can see that A occurs once, B twice, C three times, D four times, and so E should occur five times. But there are only four E's listed. Therefore, the next letter in the series should be E.

Here are some examples with the right answer given. Study these examples to make sure you understand this kind of question.

Example:

G F E D C B A Z ___Y___NA

In this series the alphabet is written backwards. When the series comes to A, it goes to the end of the alphabet to the letter Z, and continues on backwards, so Y is next in the series.

Example:

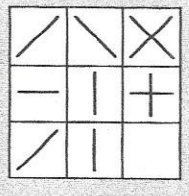
R S R T R U R V R ___W___NA

Here the letters in the series S T U V are separated by an R. The last letter to appear is one of these R's, so the next letter is W.

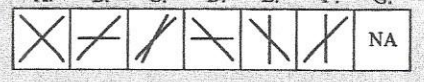
Figural Relations (Matrices)

Find the picture on the right that should be in the empty square on the left. Write the letter that corresponds with the correct answer in the space to the far right next to the problem number.

Example:

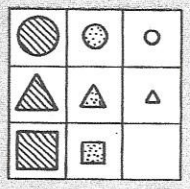


___F___1.



The correct answer –F.–has been written in the answer space. Make sure you understand why this is the correct answer. Here is another example for you to try:

Example:



___C___2.

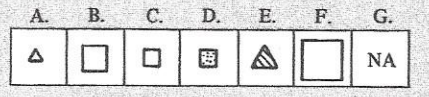


Figure 6.4 Induction (letter series). Measures of Gf-typical induction and figural relation items. *Source:* Adapted from J. Horn (1975). Gf-Gc Sampler. University of Denver Mimeo. Reprinted by permission of the author.

5

Primary mental abilities

A. Verbal Meaning (V)

This is the ability to understand ideas expressed in words. It is used in activities where information is obtained by reading or listening to words. The task requires verbal recognition via a multiple-choice format. In the following example the subject must select that alternative which is the best analog of the capitalized stimulus word:

BIG A. ILL B. LARGE C. DOWN D. SOUR

The test contains 50 items in increasing order of difficulty with a time limit of 4 min.

B. Space (S)

Measured here is the ability to think about objects in two or three dimensions. It may be described as the ability to imagine how an object of figure would look when it is rotated, to visualize objects in two or three dimensions, and to see the relations of an arrangement of objects in space. The more recent technical definition of this ability is *spatial orientation.* Space is measured by 20 test items, with a time limit of 5 min. In the example given below every lettered figure that is the same as the stimulus figure, even though it is rotated, is to be marked. Figures that are mirror images of the first figure are not to be marked.

A B C D E F

C. Reasoning (R)

The ability, which in current factor taxonomies is often more specifically identified as *inductive reasoning,* involves the solution of logical problems--to foresee and plan. The Thurstones (1949) propose that persons with good reasoning ability can solve problems, foresee consequences, analyze a situation on the basis of past experience, and make and carry out plans according to recognized facts. Reasoning is measured by such items as the following:

a b x c d x e f x g h x h i j k x y

The letters in the row form a series based on a rule. The problem is to discover the rule and mark the letter which should come next in the series. In this case the rule is that the normal alphabetic progression is interrupted with an x after every second letter. The solutions therefore would be the letter i. There are 30 test items with a time limit of 6 min.

D. Number (N)

This is the ability to work with figures and to handle simple quantitative problems rapidly and accurately. It is measured by test with items of the following kind:

$$\begin{array}{r} 17 \\ 84 \\ \underline{29} \\ 140 \end{array} \qquad \boxed{R} \qquad \boxed{W}$$

The sum of each column of figures is given. However, some of the solutions given are right and others are wrong. Sixty test items are given with a time limit of 6 min.

E. Word Fluency (W)

This ability is concerned with verbal recall involved in writing and talking easily. It differs from verbal meaning further in that it concerns the speed and ease with which words are used, rather than the degree of understanding of verbal concepts. The measurement task requires the subject to write as many words as possible beginning with the letter S during a 5-min. period.

Figure 6.2 Thurstone's Primary Mental Ability (PMA). *Source:* Reprinted by permission of the publisher from *SRA Primary Mental Abilities, Ages 11–17, Form AM* by L. L. Thurstone & T. G. Thurstone. Chicago, IL: Science Research Associates, Inc. Copyright 1948 by Science Research Associates, Inc.

analyses also permitted an assessment of mortality effects (see Chapter 2) on intelligence in adulthood.

Schaie's results yielded a picture of intelligence that is somewhat complex and consistent with the multidimensional, multidirectional nature of development discussed in Chapter 1. Although Schaie's work is quite comprehensive, we will focus on only the most relevant findings bearing on the question of intelligence and age.

Data from the first cross-sectional study, conducted in 1956, suggested that different types of abilities demonstrated diverse age-related peaks of functioning (see Figure 6.6). Schaie found PMA reasoning to peak earliest, and space, verbal fluency, word fluency, and number abilities to peak later. Moreover, younger people had strengths in different areas than did those who were older.

The 1963 data found evidence for a time-of-measurement effect; those tested in 1963 were superior to those tested in 1956 at comparable ages. Moreover, longitudinal (1956–1963) findings suggested that age-related changes in intelligence were minimal until subjects reached their sixties.

Recall from Chapter 2 that sequential analyses can pit longitudinal time-of-measurement changes against age-cohort differences. Schaie's sequential data suggested that cohort differences were more important than chronological age in explaining the sectional or longitudinal age effects found for many abilities. These sequential analyses, however, also implied that, in early adulthood and very late adulthood, age effects on abilities within cohorts might also be substantial.

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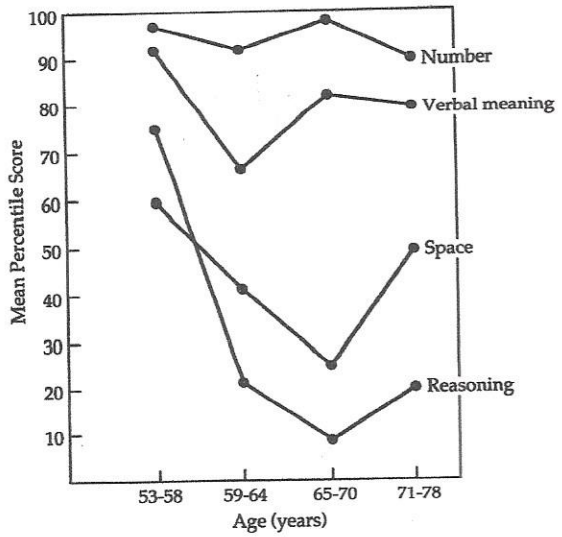

Figure 6.6 Age differences in scores on the factor components of the Primary Mental Abilities (PMA) Test. (Adapted from Schaie, Rosenthal, & Perlman, 1953, Figure 2. Copyright © 1953 by the Gerontological Society of America. Adapted by permission.)

Primary Mental abilities

age differences

The 1963 data collection yielded evidence for a *time of measurement* effect, where those in 1963 at comparable ages were superior (except for word fluency) to those in 1956. In this case, Schaie utilized data from *two* cross-sectional studies; subjects of the same age are compared at two occasions—a *time sequential* analysis. Moreover, longitudinal (1956–1963) findings suggested (again, except for word fluency) that age-related changes in intelligence were minimal until subjects reached their sixties.

Recall from Chapter 3 that *cross sequential* analysis pits longitudinal (*within* cohort) time of measurement changes (where age and time of measurement are confounded) against cohort differences (where age and cohort are confounded), involving comparisons of *different* cohorts at *similar* times of measurement. Schaie's cross sequential data suggested that *cohort* differences were *more* important in explaining the cross-sectional or longitudinal age effects found for many abilities than was chronological age. These cross sequential analyses, however, also implied that in early adulthood *and* in very late adulthood, age effects on abilities within cohorts might also be substantial. Schaie's 1956 to 1963 analyses illustrated the marked time of measurement, between cohort and within cohort aging effects (applying to the youngest and oldest cohorts especially) on aspects of intelligence (PMA) in adulthood (see K.W. Schaie, 1979; K.W. Schaie & Strother, 1968a, 1968b).

Additional cross sequential and time sequential analyses (see Chapter 3) of these data suggested positive cohort effects (more favorable performance with successively younger cohort membership) for verbal meaning, space, reasoning, and number. For word fluency, both age and time of measurement effects were found.

The 1970 follow-up analyses clearly suggested what Schaie's earlier data had pointed to: what had initially appeared as a decrement associated with age was, upon examination, attributable to cohort differences. Furthermore, as revealed by a cohort sequential analysis of the data, the extent to

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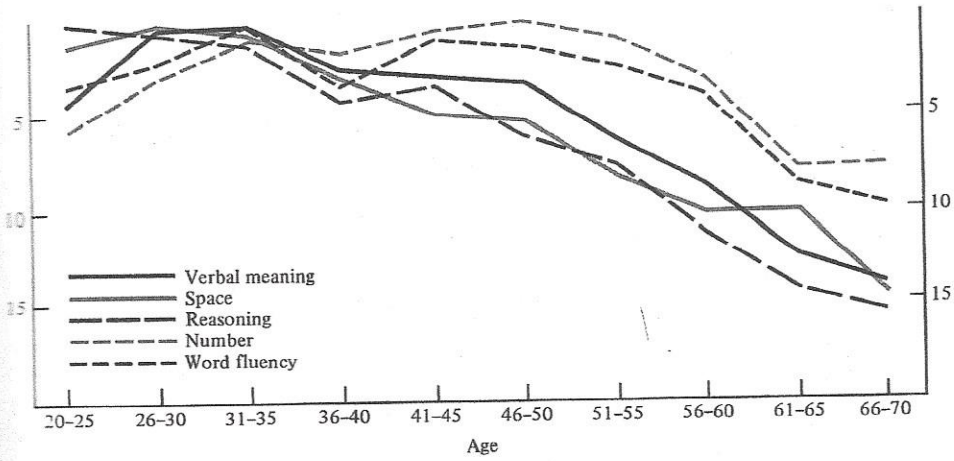

Primary mental abilities

age changes

Figure 6.6 PMA curves across age: mean decrement in the primary mental abilities from mean peak levels in standard scores. *Source:* Adapted from K.W. Schaie. (1958). Rigidity-flexibility and intelligence: A cross-sectional study of the adult life span from 20–70. *Psychological Monographs, 72,* No. 9 (Whole No. 462), 15.

Additional analyses of these data suggested positive cohort effects, that is, more favorable performance in successively younger cohorts, for verbal meaning, space, and reasoning. For number abilities, cohort effects were minimal, while for word fluency, cohort effects were slightly negative—younger cohorts scored more poorly (see Figure 6.7).

The 1970 follow-up analyses clearly suggested what Schaie's earlier data had pointed to: what had initially appeared as a decrement associated with age was attributable to cohort differences. Furthermore, the extent to which age decrements were found varied with both (1) the type of ability examined and (2) cohort membership (see Schaie, 1990).

Cross-sectional and longitudinal replications of seven-year follow-up analyses (1956 vs. 1963; and 1963 vs. 1970) to a large extent yielded similar findings. Clearly, the extent of age decrement in abilities varied with cohort membership. Moreover, for most abilities, a decline was apparent only relatively late in life, at age 67.

The third cross-sectional study in 1970 yielded substantial time-of-measurement effects, with advantages to those tested in 1970 for all PMA factors except word fluency. When the data were rearranged by cohort (see Schaie, 1979), dramatic cohort-specific patterns, again varying by PMA ability, emerged. Cohort sequential analyses (in 1970 and 1977), which allowed Schaie to measure age changes over seven-year intervals from 25 to 81 years and cohort differences for cohorts 1889 to 1938, again clearly indicated that cohort membership was more important in explaining these data than was age per se (Schaie & Hertzog, 1983). Schaie and Hertzog (1983) also found clear declines in most PMA factors after age 60, with

8

cohort effects

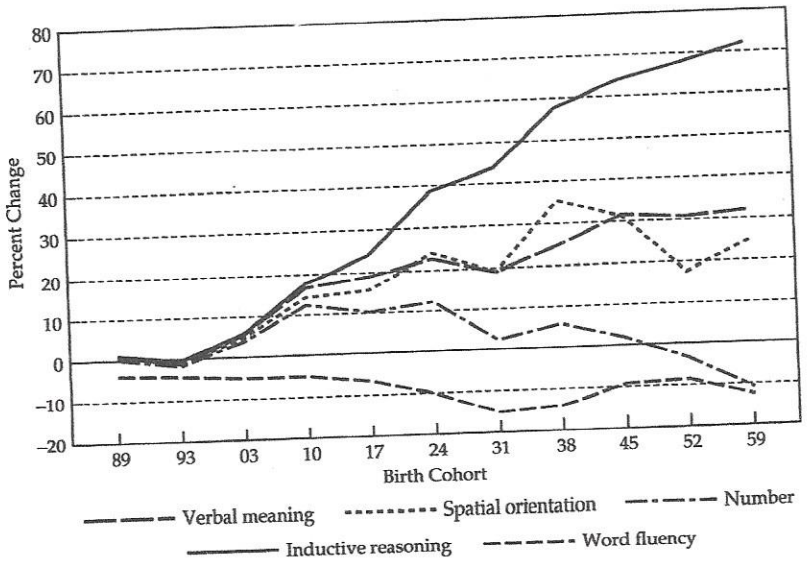

Figure 6.7 Cumulative cohort differences from 1889 base cohort for the mental abilities. *Source:* Schaie (1990). Cohort differences in mental abilities. *Late life potential* (p. 48). Gerontological Society of America.

consistent with each person's interests, interpersonal/financial resources, educational background, health, and current environment. In contrast to Schaie's approach emphasizing structural change (i.e., stages), P.B. Baltes et al. (1984) advocate a more functional (adaptive) approach to intelligence in adulthood.

The "dual process" approach of Baltes can be compared to Denny's (1982) distinction between **unexercised** ability and *optimally* **exercised** (improved via use or training) ability. In contrast to Baltes, Denny maintains that both unexercised and optimally exercised abilities will decline with increased age during adulthood (see Figure 6.9). Furthermore, due to biological and environmental factors (poor health, isolation from others), the differences between the levels of unexercised and optimally exercised abilities will be least for a given person during childhood and old age versus during adolescence and adulthood. It is important to see that Denny's distinction is a quantitative one (unexercised/optimally exercised ability), while Baltes's is a qualitative one (mechanics vs. pragmatics of intelligence).

GETTING AN ACCURATE PICTURE: INFLUENCES ON INTELLIGENCE TEST PERFORMANCE

In interpreting any test finding, or more generally data on intelligence and age, we need to be aware of the fact that other factors contribute to the measured performance on our test(s) of intelligence (recall our discussion at this chapter's outset). We *assume* that whatever index or score we obtain from an individual accurately reflects that quality or qualities we term intelligence, but does it? What Botwinick (1970a) and Furry and P.B. Baltes (1973) have

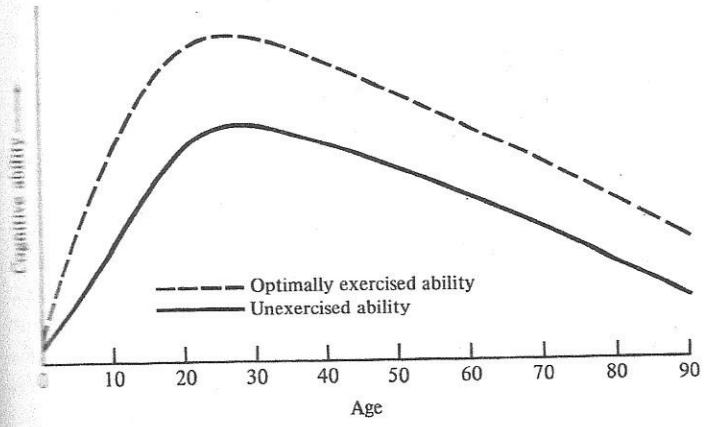

Figure 6.9 Denney's curves for unexercised and exercised abilities. Developmental functions of unexercised and optimally exercised cognitive abilities. *Source:* Nancy Wadsworth Denney, "Aging and Cognitive changes," in *Handbook of developmental psychology*, B. Wolman, ed., © 1982, p. 819. Reprinted by permission of Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

(9)

exercised skills fare better with Age