EVALUATION OF THE KAUFMAN ASSESSMENT BATTERY FOR CHILDREN FROM AN INFORMATION-PROCESSING PERSPECTIVE

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The Kaufman Assessment Battery for Children (K-ABC) has been developed, in part, to incorporate advances in information-processing theory and research into an instrument to be used for intellectual assessment of and educational planning for school children. The K-ABC is evaluated from an information-processing perspective. Four areas are identified in which work in information processing might be reflected: a) theory, b) tests, c) scales and scores, and d) interpretation and educational applications. Each of these aspects of the K-ABC is critically examined. It is concluded that while development of the K-ABC promised a marked improvement in intellectual assessment, this promise went unfulfilled.

The first reviews of the K-ABC are in, but no single evaluation will prove definitive, and the final estimation of the utility of the instrument awaits some years of use, research, and debate. The purpose of this paper is to contribute to that debate by examining the K-ABC in light of information-processing theory and research. Before launching into an evaluation of the K-ABC, however, it is worth pausing to ask "Why the K-ABC?" Why has this test generated the attention and interest reflected in the popular media, scholarly journals, and this special issue of the *Journal of Special Education?* One answer is that the K-ABC has been heralded as a major departure from previous measures of intellectual ability and as an historic synthesis of psychometric and information-processing approaches.

The history of the development of psychology for much of this century is the evolution, along separate and diverging paths, of "two disciplines of scientific psychology" (Cronbach, 1957). Correlational psychologists and experimental psychologists have had little to say to one another and have taken little time to listen to what was being said in the rival camp. Although this situation has been much decried (e.g., Carroll, 1976; Cronbach, 1957; Resnick, 1976), little has been done to remedy the schism. With the emergence of the information-processing perspective within experimental psychology, however, several avenues to rapprochement have been opened. One of the most promising avenues leads along the way of "intelligence."

Correlational psychologists have long held intelligence as their bastion. By relating and contrasting performance across a variety of experimental tasks, they have developed IQ measures that separate individuals along underlying continuous dimensions. While this approach has improved our ability to categorize students into

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groups, it provides little direct information about how to instruct the students once grouping decisions have been made.

Recently, the information-processing researchers have taken up the study of intelligence. Their interest in the area of intelligence derives from work in artificial intelligence using the computer as a model of human cognition. Information-processing researchers have developed detailed models of how people accomplish intelligent acts such as learning from the environment and solving problems posed by the environment. In contrast to the approach of correlational psychologists, information-processing psychologists have stressed the role of assessment in instructional planning and delivery (e.g., Belmont & Butterfield, 1977; Brown, in press; Pellegrino & Glaser, 1979; Ryan, 1981).

Although correlational and information-processing researchers are prominently involved in current investigations of intelligent behavior and have begun to share findings and ideas regarding performance on intelligence-test tasks, this interaction has not been reflected in intelligence tests available for use in the schools. Until very recently, no attempt had been made to integrate the information-processing perspective into standardized measures of intelligence.

The K-ABC was developed to attempt this integration. Kaufman (1983, p. 108) asked, "Shouldn't intelligence tests be based on current theories rather than on arbitrary selections of tasks developed sixty to one hundred years ago?" Kaufman and Kaufman (1983) answered by setting out to measure intelligence "from a strong theoretical and research basis" (p. 5). The success of this venture has great import for educational practice because intelligence tests are critically involved in decisions that determine where students are placed and how they are taught.

In this paper, we will evaluate the K-ABC with respect to four areas in which work in human information processing might inform the development of an intelligence test: a) the theory of intelligence from which the test is developed, b) the tasks included in the test, c) the manner in which information about the examinee's performance is obtained and summarized (i.e., scores and scales), and d) the interpretations placed on and applications drawn from this information.

THEORETICAL UNDERPINNINGS

The theory of intelligence upon which the K-ABC is based is anchored on two major dichotomies: mental processing versus achievement, and simultaneous versus sequential processing.

Mental processing versus achievement

This dichotomy is intended "to separate acquired factual knowledge from the ability to solve unfamiliar problems" (Kaufman and Kaufman, 1983, p. 5). The distinction between mental processing and achievement corresponds to the distinction between fluid and crystallized intelligence or between "a child's current level of intellectual functioning" (Kaufman & Kaufman, 1983, p. 25) and "factual knowledge and skills acquired in a school setting or through alertness to the environment" (Kaufman & Kaufman, 1983, p. 33).

From the information-processing perspective, it appears that the mental processing subtests are intended to tap cognitive processes and strategies while the achievement subtests tap children's knowledge structures. It should be noted, however, that performance on the processing tasks is dependent upon learning and the availability of appropriate knowledge structures. Similarly, a correct response to an achievement item inevitably requires processing of information presented in the item.

Holzman, Pellegrino, and Glaser (1982, 1983) have investigated the nature of differences between adults and children with average and high IQs on numerical analogies and number series problems, tests designed and typically interpreted as indices of rule-induction or abstract reasoning ability. They concluded that while developmental differences resulted from both process-related factors and content-specific knowledge about mathematical operations, only the latter was implicated in ability differences among children. The role of content-specific knowledge in mathematical ability has been stressed by other investigators (e.g., Mayer, Larkin, & Kadane, 1984; Resnick & Neches, 1984). Chi (1978, 1981) has argued that developmental differences in performance on memory tasks are largely due to knowledge structures acquired and refined through experience. Jackson and Butterfield (in press) reviewed this and other research and concluded that superior knowledge structures in part distinguished gifted individuals.

While an attempt has been made to control for the availability of knowledge structures relevant to K-ABC mental processing tasks through the use of stimuli representing familiar objects, it is likely that children differ in their exposure to geometric forms, such as those in the Matrix Analogies and Triangles subtests. Sets of geometrically shaped blocks are available as children's toys, and those children who have spent some time playing with such toys, perhaps even constructing patterns from accompanying illustrations in a manner directly comparable to Triangles, should have a marked advantage. It is also difficult to imagine how a child could successfully complete a Photo Series item without the ready availability of an appropriate schema or script (see, for example, Anderson & Pearson, in press; Rumelhart & Ortony, 1977; Schank & Abelson, 1977). That is, a child's performance on a Photo Series item may be less dependent on mental processing per se than on the ability to discover (recognize, figure out) the event pictured on the basis of prior knowledge and experience.

Simultaneous versus sequential processing

Kaufman and Kaufman (1983, p. 25) point to a convergence of findings from a number of laboratories identifying two basic types of information processing, sequential and simultaneous.

> Diverse avenues of research within cognitive psychology, neuropsychology, and related disciplines have come up with an intriguing variety of labels for the dichotomy between two basic types of information processing: sequential versus parallel or serial versus multiple (Neisser, 1967), successive versus simultaneous (Das, Kirby, & Jarman, 1975; Luria, 1966), analytic versus gestalt/holistic (Levy, 1972), propositional versus appositional (Bogen, 1969), verbal versus imagery or sequential versus synchronous (Paivio, 1975, 1976), controlled versus automatic (Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977), time-ordered versus time-independent (Gordon & Bogen, 1974), and other dichotomous labels associated with individuals such as Freud, Pavlov, Maslow, and James (Bogen, 1969).

Sequential processing refers to the manipulation of stimuli one at a time or feature-by-feature whereas simultaneous processing emphasizes integrated or synthesized input in the form of holistic units.

The simultaneous/sequential dichotomy on which the construction, interpretation, and educational application of the K-ABC mental processing scales is based, reflects an issue of concern in human information processing. The picture from information-processing theory and research, however, is much messier than a tidy dichotomy implies. Neisser (1967) talked of parallel preattentive processing followed by sequential attentive processing. Schneider and Shiffrin (1977) talked about controlled processes being replaced by automatic processes through extended practice under favorable (i.e., consistent) conditions. Simon and Newell (1971) claimed that *all* human information processing is sequential, and Anderson (1976) argued that the simultaneous/sequential controversy is empirically unresolvable. None of these theorists have considered simultaneous or sequential processing as preferred modes of processing characteristic of and varying between individuals, as in the K-ABC.

Kyllonen, Lohman, and Snow (1984) review several studies published since 1978 and report original research showing that in a variety of spatial tasks: a) different people adopt different strategies given a common task, b) the same person given the same task may change strategies with practice or in response to item characteristics, and c) subjects can be induced to change stragegies for a given task through training or simple instructions to use a given strategy. The fact that the strategies discussed are described as holistic/spatial/visualization or sequential/analytic/verbal would appear to align this research with the simultaneous/sequential distinction of the K-ABC except that: a) the observed differences are characterized as differences in strategies amenable to change through experience rather than as differences in preferred or habitual processing modes, and b) the same task is shown to permit either holistic or sequential strategies, rather than favoring one type of processing over the other as assumed for the subtests of the K-ABC.

For the most part, however, theoretical discussions in information processing have moved beyond the simultaneous/sequential debate. Current analyses focus on the order in which a sequence of processes occurs and whether the processes are exhaustive or self-terminating (see e.g., Goldman & Pellegrino, 1984) and on the development of automaticity (e.g., Fisk & Schneider, 1984; Schneider, Dumais, & Shiffrin, 1984; Schneider & Fisk, 1984; but see also Hirst, Spelke, Reaves, Caharack, & Neisser, 1980; Kahneman & Triesman, 1984; Ryan, 1983). It is clear from the work of Shiffrin and Schneider (1977), and others (e.g., LaBerge & Samuels, 1974) that automatic processes cannot be equated with simultaneous processes as characterized in the simultaneous/sequential dichotomy. For example, in Schneider and Shiffrin's (1977) model, ability to run off in parallel (i.e., simultaneously) with other automatic or controlled (i.e., attention demanding) processes is one of the defining characteristics of automatic processes. On the other hand:

> An automatic process can be defined within this system as a *sequence* of nodes that nearly always become active in response to a particular input configuration . . . where the *sequence* is activated without the necessity of control or attention of the subject. (Shiffrin & Schneider, 1977, pp. 155–156, italics added)

The situation is further complicated by the fact that *both* automatic and controlled processes are required for any complex or "real world" cognitive act (e.g., Schneider & Shiffrin, 1977; Schneider et al., 1984; Shiffrin & Schneider, 1977).

Kaufman and Kaufman (1983) cite factor-analytic support for their simultaneous/sequential constructs (e.g., Kaufman & Kamphaus, 1984), but factor analytic studies of K-ABC subtests do not sample a sufficiently broad range of tasks to promote the likelihood of identifying general factors (c.f., Snow, Kyllonen, & Marshalek, 1984; Snow & Lohman, 1984; Thurstone, 1938; Thurstone & Thurstone, 1941). Further, the pattern of correlations observed can be explained more simply in terms of task demands than in terms of central processing, because all of the sequential subtests and none of the simultaneous subtests require that responses be output in the order presented.

In support of the simultaneous/sequential processing dichotomy, Kaufman and Kaufman (1983) also cite the work of Luria (e.g., 1966, 1973). The K-ABC assumes that when the processing style of the individual does not coincide with the processing demands of the task, resulting mismatches will impact negatively on the quality of performance. In our view, this explanation is at odds with Luria's basic description of brain/behavior relationships on two important counts. First, Luria's use of the terms *simultaneous* and *successive* differs markedly from that of the K-ABC. In Luria's model, information is said to be represented simultaneously in the third functional unit of the brain, but only after extensive processing of successive inputs in the first two units. Second, the notion that individuals have preferred modes of processing is not a theme directly addressed in Luria's theory of how the brain works.

To summarize, our analysis of the information-processing literature has revealed no support for the simultaneous/sequential processing dichotomy on which the K-ABC is based. This does not negate the possibility that individuals might have processing preferences that could be characterized as sequential or simultaneous. However, from the information-processing perspective, there is at present no theoretical basis for the simultaneous/sequential analysis of intellectual or academic ability.

TYPES OF TASKS

The K-ABC consists of 16 subtests divided into mental processing and achievement scales. The 10 mental processing subtests are subdivided into simultaneous (7 subtests) and sequential (3 subtests) processing scales. These subtests, for the most part, have been collected and adapted from a variety of psychometric and clinical batteries, notably those of Wechsler.

In terms of the mental processing subtests included in the K-ABC, an information-processing analysis based on current theory and research techniques would differ markedly from simple classification as sequential or simultaneous. Our analysis will focus on the simultaneous processing subtests. The sequential processing subtests are all variations on the standard memory span task, for which the information-processing literature is too extensive to permit a review in this space. Two simultaneous subtests have been selected for examination: Matrix Analogies, a task that resembles the geometric analogy problems studied by Mulholland, Pellegrino, and Glaser (1980), and Spatial Memory, for which a test of an information-processing analysis is provided. In both cases, the information-processing analysis stands in stark contrast to that provided for the K-ABC (Kaufman & Kaufman, 1983).

Mulholland, Pellegrino, and Glaser (1980) provide a state-of-the-art information-processing account of geometric analogy solution. Based upon a rational analysis of the task, they constructed problems by systematically varying two task dimensions expected to contribute to task difficulty: number of elements (e.g., circles, rectangles, or crosses) and number of transformations (e.g., increase size, rotate 45° to the right, reflect on *x* axis). Twenty-eight adult subjects each answered 460 true or false analogy problems. Reaction time data were collected along with the response data. For the true items, reaction time was a linear function of the number of elements, the number of transformations, and the interaction of elements and transformations, which accounted for more than 95% of the variance in reaction-time means for 11 problem types. Error data for true items showed a strong effect for number of transformations, and supported a model positing a fixed-capacity working memory that was taxed on the more complex problems. The data from the false problems were used to refine the process model. The final model was organized into three processing stages with recursive sequential processing in each. This research clearly implicates the sequential nature of processing in the task and the effect of limited working memory capacity on performance.

Our own examination of Matrix Analogies (Subtest 8) of the K-ABC revealed several similarities to the Mulholland et al. (1980) analogy problems. For items 5 through 20, the stimuli used are primarily geometric forms similar to those of Mulholland et al. An informal analysis of the items suggests that the number of elements and the number of transformations could be reliably determined for all or most items. However, we also noted a potentially crucial difference between the two tasks. Whereas with the Mulholland et al. problems, subjects only had to process complete four-picture analogy problems and respond true or false, in Matrix Analogies, subjects must process a three-picture incomplete analogy (presumably in a fashion similar to that posited by Mulholland et al.), scan a set of seven cards for the correct form, determine the proper orientation of the form on the card, and place the card on the board. This task would seem to put a tremendous load on working memory. Given the extensive literature showing that children have smaller working memory capacities or are less effective at using their capacity than adults (e.g., Ornstein, 1978), we suspect that performance differences on Matrix Analogies are primarily determined by factors related to limited working memory capacity. Coding strategies and the availability of knowledge structures related to the figures may well be involved. Although Matrix Analogies is on the Simultaneous Processing Scale, we suspect that the processing is largely sequential.

Spatial Memory (Subtest 9) is also an interesting test from the information-processing perspective. In Spatial Memory, the examinee is presented with a stimulus page upon which pictures of several (2 to 7) familiar objects (e.g., apples, birds) are arrayed. After 5 seconds, the stimulus page is removed and a test grid exposed. The examinee's task is to point to the squares on the 3 × 3 or 3 × 4 grid that correspond to the locations of the objects on the stimulus page.

A preliminary rational analysis (cf., Mulholland, et al., 1980) suggests that during presentation of the initial stimulus, the examinee: 1) scans the visual field to find an object to encode, and 2) encodes the location of the object in a mental representation. These operations are repeated until all objects are encoded or until the 5-second time limit is exhausted. During the response phase of the task, the examinee: 3) accesses the mental representation of the stimulus constructed during the study phase of the task, 4) retrieves information specifying the location of an object from the representation, 5) scans the test grid for the location corresponding to the object location just retrieved, and 6) points to the appropriate location on the test grid. Steps 3 through 6 are repeated until all of the stored object locations have been pointed to. Although the particular operations and sequence outlined above may need revision (e.g., subjects may scan the test grid and then access their mental representation to test for the presence of an object, reversing Steps 4 and 5), it seems likely that detailed investigation, such as that by Mulholland et al. (1980), would reveal sequential processing components at both the storage and retrieval stages of the task.

If the processing of this task is indeed sequential and analytic, item difficulty should be dependent on the number of objects in the stimulus and the number of squares in the test grid. It was noted during informal observation of about a dozen children that while they frequently looked away from the stimulus or said, "I'm ready" or "Let's go" on early items, they almost never did on later items. As Table 1 shows, complexity of items in terms of number of objects and grid squares increases throughout the test. Thus, our informal observations support the sequential, information-processing analysis.

The items on Spatial Memory, as on other K-ABC subtests, have been ordered in terms of increasing item difficulty in the standardization sample, therefore, a zero-order test of this analysis is possible through examination of the complexity of the items and their relative difficulties. Table 1 shows the number of objects pictured in the stimulus and the number of squares in the test grid. The sequential, information-processing analysis can be tested by examining the order of items to determine if they become increasingly more difficult (and are therefore presented later) as information load increases. The simultaneous-processing hypothesis makes no such prediction. An effect of matrix complexity is apparent in Table 1: all 12-square grid items are more difficult than (i.e., follow) all 9-square grid problems. Within problems of a given grid size, Kendall's K statistic (Hollander & Wolfe, 1973) was computed to test the effect of number of objects. For the 9-square grid problems, later items contained more objects than did earlier items in 33 of 45 comparisons. Later items contained the same number or fewer objects in 4 and 8 comparisons, respectively. Thus, the effect of information load as indexed by number of objects was significant, $p < .05$. For 12-square problems, items contained more, the same number, and fewer objects than preceding items in 45, 9 and 1 comparisons, respectively, $p < .001$.

It might be argued that the initial encoding and central processing of Spatial Memory stimuli are indeed simultaneous, and that the observed effects are due

TABLE 1
INFORMATION LOAD OF MATRIX ANALOGIES ITEMS

Item Number	Number of Objects	Number of Grid Squares
1	2	9
2	3	9
3	2	9
4	2	9
5	4	9
6	4	9
7	3	9
8	5	9
9	5	9
10	5	9
11	2	12
12	4	12
13	4	12
14	3	12
15	5	12
16	6	12
17	6	12
18	7	12
19	7	12
20	7	12
21	7	12

solely to difficulties that arise at output, because the child cannot point to all the marked squares at once. Such an argument, however, would seem to suggest that performance on the task is determined primarily by the ability to efficiently output information, rather than facility at processing material simultaneously, as assumed in the K-ABC. It should also be noted that the task analysis sketched above is an admitted oversimplification. It does not adequately represent the contribution of strategies and executive functions to performance on the task. Coding strategies that aid retrieval, such as coding objects by rows or recoding objects into chunks (e.g., triangles, squares) should improve performance. Executive functions seem essential to knowing when you have encoded or pointed to all of the objects in an item. The important point, however, is that simple classification of a test as simultaneous (or sequential) is not reflective of the current sophistication of work in human information processing and does little to explain why children perform as well (or as poorly) as they do on the test.

SCALES AND SCORES

A child's performance on the K-ABC is characterized in a set of raw scores (ceiling item minus errors) for each of the subtests. Raw scores are converted to standard scores and then are added up and converted to the various standardized global scales (i.e., sequential processing, simultaneous processing, mental processing composite, achievement, and nonverbal). The standard scores are used to depict the child's normative standing (i.e., percentile rank, age, and grade equivalents) and to identify the child's relative strengths and weaknesses by comparing differences between standardized scores (i.e., mental processing vs. achievement, simultaneous vs. sequential, single subtests vs. subtest mean).

From the information-processing perspective, the information provided by the K-ABC is deficient on three counts. First, the scores and scales that depict a child's performance represent an impoverished data set; only the level of correct performance is considered. As Simon (1975) noted, even for relatively simple tasks, different strategies are possible and can produce the same level of performance. Information-processing researchers avail themselves of a richer data base, often looking at the time required for a response and at the nature of the errors a child produces. Examination of error patterns can be especially instructive for the educator, often indicating that a child's errors are not random. The development of an information-processing model of a child's attempts to perform a cognitive task based on error analysis often reveals that the child's approach to the task is not totally unreasonable, but rather, incomplete or flawed (e.g., Case, 1978; Brown & Burton, 1978).

Second, K-ABC scores and scales depict children's normative standing. Even the procedure for identifying a preference for simultaneous or sequential processing is essentially normative. In contrast, the information-processing approach would stress the development of a detailed procedural model of a child's performance. For the student having difficulties on some academic task, the educator operating from the information-processing perspective would investigate precisely how the student was performing the task. Brown and Burton's (Brown & Burton, 1978; Burton, 1982) BUGGY system represents a sophisticated version of such analysis for simple arithmetic problems. A procedural network realized as a computer program simulates children's correct performance on the problem, and also the performance of a child with one or more procedural flaws or "bugs." The system can be used to diagnose the cause of a child's difficulties with arithmetic problems through the identification of that child's bug or bugs.

Third, the K-ABC is used to determine a child's relative strength at simultaneous and sequential processing in the belief that a preferred processing mode will generalize over a variety of intellectual and academic tasks. The information-processing perspective would emphasize direct measurement of a child's cognitive activities on the specific task of interest. Direct measurement requires that the logical distance of the inferential chain between the behavior measured and inferred cognitive processes or strategies be minimized (Belmont and Butterfield, 1977). For example, the amount of time spent on an item during initial study has been used as a measure of input activity. On the other hand, certainly the inferential chain from a child's performance on K-ABC subtests to simultaneous and sequential processing scales to an understanding of the child's difficulties in reading or math is less than optimal.

To summarize, from the information-processing perspective, it is of little interest to know that a child has accomplished a scaled score of 10 on some task, or that performance on several tasks places the child at the thirty-fifth percentile on a mental processing scale. It may be of great interest to know in detail how the child performed some task, particularly if the task is one of direct instructional significance.

INTERPRETATIONS AND APPLICATIONS

The ultimate goal of the assessment process is instructional application of findings; that is, translating assessment information into educational interventions. Strengths and weaknesses in processing new information, identified through analysis of children's protocols, are used to define parameters related to the structure, substance, and focus of educational programs based on the K-ABC. In contrast to interventions developed from general process training models (e.g., psycholinguistic, auditory-perceptual, visual-perceptual, or visual-motor skill training programs), programs based on the sequential/simultaneous model of processing are not deficit based. Academic interventions based on analysis of K-ABC profiles are designed to tap into the individual child's preferred mode of achieving, retaining, transforming, and organizing information.

Once the child's preferred mode of processing has been identified, the educator reviews potential instructional materials for a means of presentation in the appropriate format (i.e., sequential or simultaneous). Importantly, Kaufman and Kaufman (1983) note that the successful development of most, if not all, academic skill areas depends on the child's "processing integrity," thus, combined tasks (sequential and simultaneous focus) "more closely parallel the learning process" (p. 236). While new information should be introduced in ways consistent with students' processing strengths, their educational programs should also include procedures for developing essential academic skills associated with area(s) of weakness.

The recommended interpretation and application of the K-ABC should be considered in the context of work in the area of cognitive psychology over the past decade. This work demonstrates a growing concern over how individual differences should be assessed and interpreted for purposes of educational intervention (Glaser, 1981). Traditionally, the goals of mental testing have been to predict intellectual achievement. Individuals who performed relatively less well on intelligence tests were then certified as being eligible for "special" instructional programs. In addition to eligibility decisions, these tests, via interpretation of validity and factor analytic studies of the subtests, were generally thought to differentiate individuals on the basis of underlying constructs purportedly measured by small groups of subtests (e.g., Verbal-Comprehension, Perceptual Organization, and Freedom from Distractibility factors on the WISC-R or the Sequential/Simultaneous processing dichotomy represented on the K-ABC). This general approach to assessment of intelligence has been referred to as the *cognitive correlates approach.* As described by Pellegrino and Glaser (1979), "The cognitive correlates approach seeks to specify the information processing abilities that are differentially related to high and low levels of aptitude" (p. 188). A contrasting approach used to study intelligent behavior is the *cognitive components approach.* "The cognitive components approach is task analytic and attempts to directly identify the information processing components of performance on tasks that have been generally used to assess mental abilities" (Pellegrino & Glaser, 1979, p. 188). Hall (1984) summarized the practical value of this approach for classroom teachers relative to the task of spelling.

> Knowing, then, something about the developmental sequence that describes how children acquire skill and having the ability to assess the level or stage of representation at which a child currently functions, we can predict the next plateau of a child's knowledge representation. That is, we know where the child has been (i.e., aspects of the skilled behavior that already are accomplished), where the child is (i.e., the level of problem solving that currently is difficult but solvable for the learner), and where the child is likely to go (i.e., skills the child will need to accomplish) relative to the componential demands of the spelling task. (p. 72)

It should be noted that the authors of the K-ABC have carefully outlined a broad interpretive package to accompany their test. This makes it difficult to pigeonhole the K-ABC into one of the two major camps, cognitive correlates or cognitive components. While the tasks selected and factor analytic work used to construct the test appear to align this instrument as representing the traditional cognitive correlates approach, the authors' theoretical rationale and advocacy for analyzing task performance and searching for corroborative evidence suggest the cognitive components approach. All this is to say that the authors have done an admirable job of specifying a systematic method for interpreting performance characteristics on the K-ABC or on any other test, for that matter.

Lest the reader be lulled into thinking, however, that the K-ABC offers the interpretive power of both competing approaches—the reality is that business is conducted as usual. As noted above, scales and scores for the K-ABC are based on correct response data only, performance comparisons are essentially normative, and educators are asked to funnel their interpretations through the sequential/simultaneous dichotomy before deciding on a plan for educational intervention. The instructional approach outlined by Belmont and Butterfield (1977) and further articulated by Butterfield and Belmont (1977); Brown and Campione (1978); Borkowski and Cavanaugh (1979); Brown, Campione, and Day (1981); Ryan (1981); and Brown, Bransford, Ferrara, and Campione (1982) represents an attempt by information-processing researchers to translate empirical findings from learning and memory research into a model for delivering and evaluating academic instruction. Two methodological principles of the instructional approach (Belmont & Butterfield, 1977) relevant to the current discussion are direct measurement and task analysis. As stated previously, direct measurement requires that cognitive operations be assessed as closely and straightforwardly as possible. Task analysis describes, as accurately as possible, the sequence of cognitive steps necessary for attaining an efficient solution for some problem. Knowing how instructions relate to task requirements or how the method of instructing individuals to use devices such as labeling, rehearsal, chunking, elaboration, and imagery can affect comprehension and memory is essential to the instructional approach and serves to keynote the principle of task analysis.

Relative to the instructional model, the sequential/simultaneous processing model lacks specificity. Measurement is not direct; the K-ABC, like other standardized intelligence tests, samples a narrow range of behaviors on tasks far removed from those encountered by children in classrooms. Moreover, measurement of underlying constructs is imprecise, rendering judgments that are arbitrary and relative. Rather than providing a detailed task analysis as a basis for understanding, interventions developed from the K-ABC are based upon the simultaneous/ sequential dichotomy and designed to focus instruction on the general mode of presentation. Thus, the K-ABC leaves those responsible for providing instruction without the information and instructional framework they need to best serve their students. From the information-processing perspective, the time and money devoted to assessment with the K-ABC, or other intelligence tests, might, in most instances, be better spent directly observing, analyzing, and teaching the cognitive operations entailed in the academic tasks with which children are experiencing difficulty.

SUMMARY

We have provided an evaluation of the K-ABC from an information-processing perspective. Because the incorporation of findings from current information-processing theory and research was a major goal of the development of the instrument, it is important and timely to view the K-ABC from this perspective to examine how well it accomplishes its objective. Based on our review of work in information processing, we identified four areas of potential input on this instrument: theory, tasks, scores and scales, and educational applications. Briefly, we will summarize our conclusions.

Two major theoretical dichotomies underlie the K-ABC; mental processing versus achievement and simultaneous versus sequential processing. Information-processing research may be interpreted to suggest that knowledge structures (i.e., the products of achievement) are inextricably interwoven with mental processing in any cognitive task. Thus, the separation of processing and achievement measures is suspect from the information-processing perspective. With regard to the sequential/simultaneous processing dichotomy, work in information processing has produced no consensus such as that upon which the K-ABC was ostensibly based. Thus, the tidy bisection of cognitive processing provided by the K-ABC may be illusory.

Tasks comprising the K-ABC were chosen to reflect the relative efficiency of simultaneous and sequential processing. An information-processing analysis of the tasks, however, suggests that even the nominally simultaneous tasks may have important sequential components. Further, performance on both simultaneous and sequential tasks is likely dependent upon cognitive structures, strategies, and executive functions not adequately characterized or taken into account in the K-ABC.

Information derived from K-ABC tasks (i.e., scores, scales) is: a) organized around the simultaneous/sequential processing dichotomy, b) based primarily on quantification of correct responses, and c) related to performance norms. Work in the area of information processing has emphasized the construction of detailed models of cognitive functioning through examination of a rich data base (i.e., time and error data). The intent of this work has been to understand the nature of skilled performance and to identify an individual's weaknesses in context. From the information-processing perspective, information provided by the K-ABC is not sufficient to permit adequate understanding of the causes of an individual's performance on the tasks that comprise the instrument, or to illuminate the nature of the individual's cognitive capabilities in other contexts.

Finally, when applying information derived from the K-ABC, educators are encouraged to formulate instructional plans on the basis of the student's relative strengths at simultaneous and sequential processing. Information-processing researchers concerned with effective instructional planning and delivery have emphasized the importance of documenting, for a given child: a) the skills possessed versus the skills that need to be attained, b) the nature of the specific difficulties encountered by the child on a task, and c) the specific content and sequence of instruction based on analysis of task and child characteristics. Instructional applications based on presenting the child with information either simultaneously or sequentially to match the child's assessed strength seem an inadequate response to the task at hand.

To conclude, attempts to revise intelligence testing in light of work in information processing are to be applauded; information-processing theory and research hold great promise for improving educational practice associated with intellectual assessment. In our view, however, development of the K-ABC has left this promise largely unfulfilled.

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