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The Zone of Potential Development: Implications for Intelligence Testing in the Year 2000*

ANN L. BROWN
AND
LUCIA A. FRENCH
University of Illinois

The emphasis of this paper is the practice and interpretation of intelligence testing of educable retarded children. The current and future state of intelligence testing are discussed in terms of three criteria: their predictive, diagnostic and remedial functions. In the first section we consider individual testing formats within a framework of Vygotsky's theory of potential development and the underlying assumptions of that theory concerning task analysis and transferring of training. In section two, we consider the social nature of the testing situation and the degree of contextual support provided for the learner. In the final section we consider Neisser's distinction between academic intelligence and everyday thinking with particular reference to the life adjustment of mildly retarded citizens.

This paper forms part of a series concerned with the general topic of the nature of intelligence (IQ) tests, and the purposes they will serve in the year 2000. As there is by no means consensus on the nature and form of IQ tests in the year 1979, such a broad topic invites speculation. We address the topic from the general viewpoint of theories of cognitive development and instruction, and from the particular perspective of the influence of IQ testing on the prediction, diagnosis and remediation of mild mental retardation.

At present, IQ tests serve one function exceptionally well, they predict academic success or failure. As the tests were designed originally to fill the pragmatic need of predicting school success, they are composed of items that are representative of the kinds of problems that traditionally dominate school curricula. Children who perform adequately on school tasks also perform adequately on the very similar IQ test items—a tautology we should not find surprising (Brown & French, 1979; Sharp, Cole, & Lave, 1979).

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Controversy concerning the efficacy of IQ tests arises when they are either overinterpreted or called upon to fulfill functions they were never designed to meet. Overinterpretation commonly takes the form of interpreting IQ measures as indices of "general intelligence," a form of idealized cognitive efficiency that somehow transcends the particular tasks and contexts of schools and other testing environments. Functions frequently demanded of IQ tests, which they were not designed to meet, are that they predict adaptations other than school assimilation, and that they serve an essentially diagnostic function.

Consider first the problem of diagnosis; a major function that we would optimally like any form of intelligence assessment to perform is diagnostic, for the eventual aim of those concerned with instructional psychology is to improve school performance rather than just to predict its course. In the first section of this paper we will consider posible mechanisms for improving the diagnostic functions of testing situations with an eye to possible remediation. We place our discussion of diagnosis and remediation in the framework of Vygotsky's (1978) theory of a zone of potential development. To illustrate the distinction between prediction and diagnosis we compare the basic philosophies underlying Soviet and American testing procedures (Section I). In Section II we consider the social nature of the testing situation and the degree of contextual support provided for the learner. The influence this might have on the prediction and diagnosis of cognitive status is examined.

Next, consider the predictive function of IQ tests from the standpoint of the identification of mildly retarded students. While it is true that current IQ tests serve a useful function in predicting the almost inevitable school failure of this population, there are some severe limitations to the predictive power of existing tests.

The first problem is that given our existing battery of IQ tests, we are generally unable to predict the academic failure of mildly retarded children prior to its occurrence. Roughly speaking, the existing tests provide valid prognostic information at the time when even the least astute teacher or parent will have noted the child's school difficulties. Referral to special education classes is still predominantly based on IQ measures, but referral to the testing situation that reveals the low IQ is usually based on teachers' identification of an existing school learning problem. One obvious need for future test development is that we improve our understanding and measurement of significant early indices of cognitive delay, so that we can identify (and hopefully alleviate) some of the problems of mildly retarded children before they fail in school. We will not address this topic further here, but it is a major concern in our program of research on the diagnosis and remediation of the slow-learning child (Brown & DeLoache, 1978; DeLoache & Brown, work in progress).

The second major limitation to the predictive power of current IQ tests is that within the mildly retarded range of ability (IQ 50–80), IQ does not relate

in significant ways to successful adaptation after the school years. Mild retardation has been designated a school disease, for many who are diagnosed as retarded during the school years lose their school-imposed label and merge into adult society (Edgerton, 1967). In Section III, we will consider the nature of academic intelligence and everyday thinking in terms of the feasibility of designing intelligence tests to predict the real-life adjustment of mildly retarded adults.

I. THE ZONE OF POTENTIAL DEVELOPMENT

A. *Basic description of the Soviet testing philosophy:* For a variety of historical and social reasons standardized intelligence tests have been criticized, and at times officially banned, in the Soviet Union (Brozek, 1972; Wozniak, 1975); at the same time, however, an essential feature of Soviet social policy is a major commitment to special education (Vlasova, 1972). In recent years there has been a growing interest in the development of reliable methods for the differential diagnosis of learning disabilities, or temporary retardation, and more serious and permanent mental impairment (Vlasova & Pevzner, 1971; Zabramna, 1971). Given the unfavorable climate for the establishment of standardized testing, the Soviets have concentrated on the development of clinical batteries of diagnostic tasks to serve the purpose of evaluating differences in learning potential. Perhaps surprisingly, the content of the clinical batteries does not seem to vary greatly from our standardized psychometric tests, but the methods of testing and the data of prime interest reflect the different testing philosophies of the two approaches.

The method of clinical assessment is based on Vygotsky's theory of a zone of proximal (Vygotsky, 1978) or potential development (Luria, 1961). The distinction is made between a child's actual developmental level, i.e., his completed development as might be measured on a standardized test, and his level of potential development, the degree of competence he can achieve with aid. Both measures are seen as essential for the diagnosis of learning disabilities and the concomitant design of remedial programs (Egorova, 1973; Pevzner, 1972).

A child's standardized test performance is regarded as providing at best a quantitative index of current developmental status, or actual developmental level. Although informative concerning what the child knows now, it provides only indirect evidence about how he arrived at this state. Vygotsky claims that such measures also fail to provide any information about:

> those functions that have not yet matured but are in the process of maturation, functions that will mature tomorrow but are in the embryonic state. These functions could be termed the 'buds' or 'flowers' rather than the 'fruits' of development. The actual developmental level characterizes mental development retrospectively, while the zone of proximal development characterizes mental development prospectively. (Vygotsky, 1978, pp. 86–87)

The zone of proximal development is used as an indication of learning potential; children with the same current status on an IQ test item may vary quite widely in terms of their cognitive potential. It is claimed that a major difference between learning disabled and truly retarded children lies in the width of their potential zone. Given the central place of this concept in both clinical diagnosis and remedial training (Egorova, 1973), it is informative to consider exactly what the Soviets mean by the notion of proximal development and how they set about measuring its width.

A typical testing session consists of the initial presentation of a test item exactly as it would occur in an American IQ test with the child being asked to solve the problem independently. If the child fails to reach the correct solution, the adult progressively adds clues for solution and assesses how much additional information the child needs in order to solve the problem. The child's initial performance, when asked to solve the test item independently, provides information comparable to that gained with standardized American IQ testing procedures. The degree of aid needed before a child reaches solution is taken as an indication of the width of his potential zone. Once solution on a particular test item is reached another version of the original task is presented and transfer to the novel item is considered by calculating if the child requires fewer cues in order to reach solution.

The following is a concrete example of the testing materials and procedures. The problem presented to the child is a common IQ test item, usually referred to as pattern matching or geometric design. Such items occur on many standard tests, including the Binet, the WIPPSI, and the WISC. The child is given a model (picture) of a silhouette shape and he must copy this model by combining a subset of wooden geometric forms. In the Soviet version of this task, however, there is an interesting trick; some of the requisite shapes are not included in the set of available wooden pieces but must be constructed by joining two wooden pieces together.

The first step in the testing procedure is to present a small model picture and ask the child to copy it with his wooden shapes; if he fails, he is given a life-size representation of the to-be-copied shape. There are a series of additional prompts, including a model that has one composite geometric shape (corresponding to one of the wooden pieces) clearly delineated in the picture. If this does not lead to solution the child is given a further detailed model that clearly shows the join (trick) necessary to create the missing form. If all else fails the tester constructs the figure and then encourages the child to go through the construction with him.

Of particular interest to us were the "transfer" tests. Following solution of Problem 1 (provided by the tester if all else failed), the second problem is immediately presented, with the same series of aids if so needed. Problem 2 is a new picture problem where it is necessary to construct (by joining) two of

the composite forms. One of the required joined shapes is identical to that required in Problem 1, the other is a new construction. It seemed to us that these features of Problem 2 tapped two kinds of transfer. Specific transfer would be measured by the recognition that the subpart constructed to solve Problem 1 was again required for Problem 2 solution. More general transfer would be the knowledge that joining shapes in general would be a requirement of the pattern-copying task, and this knowledge should be reflected in the facility with which the child attempts to construct the new joined subpart. We would like to emphasize that this is our assessment of the transfer tests, and is not necessarily shared by our Soviet colleagues.

The Soviet diagnostic testing method provides invaluable information concerning the child's starting level of competence and an estimate of the width of his zone of potential development, the level of competence he can reach with aid. In addition we gain information of the child's ability to profit from adult assistance, his speed of learning, and the facility with which he transfers the new skill across tasks. Of prime importance for the diagnosis of the cause of school failure is the Soviet claim that whereas learning disabled (developmental backward) and mildly retarded children tend not to differ greatly in terms of their starting competence on a variety of cognitive tasks, the two groups differ dramatically in terms of their ability to benefit from the additional cues provided by the tester. Learning disabled children need fewer prompts than retarded children before they arrive at a satisfactory solution. They are also more proficient at transferring the result of their brief learning experience to new variations of the task within the testing situation and in subsequent independent class performance. In studies where comparisons with normal children were included, the average children were even more effective at initial learning and subsequent transfer than were the two clinical populations (Egorova, 1973; Lubovsky, personal communication).

In common with many second-hand reports of Soviet psychology, this description is notable for its lack of specificity. Although some examples of the specific test batteries are available to American readers (Wozniak, 1975), these examples must be only fragmentary illustrations of the type of test battery needed to fulfill the functions claimed for it, i.e., the differential diagnosis of fine degrees of retardation based on estimations of cognitive potential.

B. *Task analysis and transfer of training:* Quite explicit in the Soviet description of their testing program is the role of Vygotsky's theory of a proximal zone of development; the Soviets emphasize the place of graduated aids in uncovering the "readiness" of children to perform competently in any task domain. Also entailed by this position, and at least as important to contemporary theories of cognition, is an implicit theory of task analysis and transfer of training. Although the sample of tests we viewed clearly showed an

implicit dependence on task analysis, our Soviet colleagues appeared to regard this aspect of their work as secondary, indeed almost as a serendipitous outcome of their considerable experience in devising clinically sensitive tasks.

We would like to argue that testing the zone of potential development as a means of diagnosis requires a detailed task analysis of a suitable set of cognitive tasks and detailed task analysis of possible transfer probes (Brown, 1978; Campione & Brown, 1978). Without this information it would be difficult to select either the series of graduated aids for the original learning task, or suitable methods for assessing the speed and efficiency of transfer. The importance of this point should not be lost in the rhetoric surrounding Vygotsky's theory of cognitive potential. In the diagnostic sessions, what is being measured, or at least the factor the Soviets claim is essential for differential diagnosis, is the efficiency of learning within any one task domain. The assessment of the width of a child's zone of potential development actually translates into the assessment of how many prompts he needs to solve Problem 1, versus Problem 2, versus Problem 3, etc. A child judged to have a wide zone of potential development is one who reduces the number of prompts needed from trial to trial, i.e., who shows effective transfer of a new solution across similar problems. As one of the traditional definitions of intelligence is the ability to learn then "estimates of it (intelligence) are, or at least should be, estimates of the ability to learn. To be able to learn harder things, or to be able to learn the same things more quickly, would then be the single basis of evaluation (Thorndike, 1926, pp. 17–18)." The Soviet attempt to measure directly the ability to learn is of more than casual interest.

We hope that even this informal look at the Soviet testing method makes obvious how great a reliance on careful task analysis and transfer measurement such a testing procedure would demand. It is in these domains that contemporary American instructional psychologists have devoted a great deal of attention and expertise (Glaser, 1978). Research programs based on anything from enlightened intuition to detailed computer simulations have formed the base of a growing interest in providing rigorous task analyses of basic cognitive skills. Of particular interest in this paper is the extensive work that has been conducted with facsimiles of IQ test items (Estes, 1974), e.g., the series completion task (Holzman, Glaser, & Pellegrino, 1976; Kotovsky & Simon, 1973; Simon & Kotovsky, 1963), geometric and verbal analogies (Mulholland, Pellegrino, & Glaser, 1977; Pellegrino & Glaser, 1978; Sternberg, 1977; Pellegrino & Glaser, this volume) and the Raven's (1938) progressive matrices items (Hunt, 1974; Jacobs & Vandeventer, 1971, 1972; Linn, 1973).

The aim of detailed task analyses is very similar to that of the Soviet testing program. Feasible rules for solution are specified explicitly and the tasks engineered in such a way that the particular rules used by a child can be detected. When this is done well, errors produced by the novice can be just as

informative as correct responses produced by the proficient. With a well-designed task analysis it is often possible to detect not only the presence or absence of a desired piece of knowledge or skill but intermediate stages of understanding as well. Such a program of task analysis provides optimal information for those who would attempt any form of instructional intervention and the Soviet testing method is in many ways a mini-instructional format.

In order to assess how well the child has benefited from instructional aids it is necessary that we have a battery of appropriate transfer tests. This again demands careful attention to the underlying processes being tapped by any one task so that suitable varieties of surface formats can be selected that tap the same underlying rules (Brown & Campione, 1978). In the process of constructing batteries of suitable task domains that permit transfer, careful attention will have to be paid to the difficulty of "problem isomorphs" (Simon & Hayes, 1976), but hopefully tasks can be adapted or constructed that vary in surface structure, but at the same time demand identical processes for their solution. On initial inspection, tasks such as series completion, geometric analogies, and matrices problems all seem ideally suited to provide near and far transfer tests (Brown, 1978). For example, near transfer items might consist of a set of distinct problems demanding the same rules of solution (e.g., movement in a matrices problem). Intermediate transfer items might be those that demand the same rule in two tasks differing somewhat in their surface format, e.g., movement in a matrices problem and in a geometric analogy problem (Hunt, 1974; Sternberg, 1977), or the backward next rule in series completion items (Simon & Kotovsky, 1963) and in the Binet Letter-number decoding task (Stanford-Binet revised version 1964, Superior Adult II). Even farther transfer, between quite disparate tasks, might be implicated if Greeno (1978, p. 243) is correct in asserting the generality of the "psychological process of solving any analogy or series extrapolation problem involving identifying relations among components and fitting the relations together in a pattern."

Ideally what would be required for a systematic consideration of zones of potential development would be a series of well-analyzed task domains with near, intermediate, and far transfer items well defined. In addition one would need a series of relatively unrelated constellations of tasks where direct transfer from one to the other would not be expected. This would enable us to consider whether a child is adept at benefitting from graduated learning aids in one domain or in almost all domains. If there appears to be consistency in the width of an individual's zone in a variety of disparate domains, one might use the width as an index of his general "learning to learn" effectiveness, a measure of his "speed and efficiency" of new learning (Estes, 1974; Thorndike, 1926). If, on the other hand, the child's zone width varies as a function of the specific task constellation, this might indicate specific areas of

learning disability. We realize that this must sound rather reminiscent of the age-old search for a separation of *g* and *s* factors (Spearman, 1927), and we will not reiterate the pitfalls of such a search here (Sternberg, 1977; Tuddenham, 1966). We would like to emphasize, however, that our approach would be based on process theories of learning rather than on a factor analytic determination of task clusters. We would also like to emphasize that the field of instructional psychology is still a long way from completing the theoretical work and empirical verification necessary for devising such transfer domains (Brown & Campione, 1978). Considerable advances have been made in recent years, however, and by the year 2000 perhaps such a technology shall be within the grasp of cognitive process theories of academic intelligence.

The development of a systematic battery of well-analyzed learning and transfer domains would be particularly useful for improving our diagnostic procedures for detecting and remediating the learning problems of academically marginal children. The current picture we have of such children can be summarized briefly. They perform poorly on a variety of problems that demand the use and control of strategies for adequate solution. With intensive, well-designed training they improve their performance dramatically, particularly when such training concentrates on both inculcating the specific strategies and providing detailed instructions concerning self-regulation (Brown, 1978). Such children experience difficulty primarily in transferring the results of any training to new situations, and this diagnostic transfer failure is particularly likely to occur if explicit instruction in self-regulatory mechanisms is not provided (Brown & Campione, 1978; Brown, Campione, & Barclay, 1979; Meichenbaum, 1977—see also Section II this paper). Because the Soviet method of testing the zone of potential development consists of a mini-training series, followed by well-designed probes, it should be particularly sensitive to the characteristic learning problems of educable retarded children. We are currently examining the transfer efficiency of retarded children, using a format similar to that used by the Soviets to uncover the zone of potential development. We hope that such a research program will provide guidelines for the development of tests of cognitive efficiency with greater diagnostic power than current standardized testing procedures.

II. INTERPERSONAL AND INTRAPERSONAL THINKING

A. *Vygotsky's theory of internalization:* In the preceding section we were primarily concerned with the problems associated with the selection of a suitable battery of tasks with which to test the width of a child's zone of potential development. Here we will consider another direction for research implied by the theory. Vygotsky's (1978, p. 86) definition of the zone of

proximal development is "the distance between the actual developmental level as determined by individual problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers." To put this statement into historical perspective it is necessary to consider briefly the concept of internalization, so important to Vygotsky's thinking (Vygotsky, 1978; Wertsch, 1979). Vygotsky argues that all psychological processes are initially social, shared between people, particularly between child and adult, and that the basic interpersonal nature of thought is tranformed through experience to an intrapersonal process. Thus, for Vygotsky, the fundamental process of development is the gradual internalization and personalization of what was originally a social activity.

> We propose that an essential feature of learning is that it creates the zone of proximal development; that is, learning awakens a variety of developmental processes that are able to operate only when the child is interacting with people in his environment and in cooperation with his peers. Once these processes are internalized, they become part of the child's independent developmental achievement. (Vygotsky, 1978, p. 90)

From Vygotsky's viewpoint it is essential to consider a child's problem solving abilities in situations other than traditional testing milieux, situations such as mother–child dyads (Wertsch, 1978), children tutoring children (Allen, 1976), and group problem-solving situations (Kelley & Thibaut, 1954). In the basic clinical testing situation described previously, it is a supportive adult who leads and guides the child to the limits of his current ability. But other social settings could also serve the function of uncovering the uppermost level a child can reach with aid. In that the use of a social setting to uncover learning potential mimics the normal process of development—i.e., the social becoming internalized as the individual progresses—interpersonal situations might prove especially effective at revealing previously untapped learning potential.

Traditional theories of group problem solving are especially interesting in this context because they often parallel Vygotsky's thinking. For example, Bales (1950) contends that individual problem solving and group problem solving are necessarily similar, as the one (individual) is born of the other (social).

> Individual problem solving is essentially in form and in genesis a social process: thinking is a re-enactment by the individual of the problem-solving process as he went through it with other individuals. (Bales, 1950, p. 62)

Similarly, Kelley and Thibaut also put forward a theory of interalization similar to Vygotsky's when they suggest that an individual:

> ...acquires his thought and judgmental habits largely through interaction with other persons. It is by no means entirely fanciful to suppose that he 'internalizes' certain problem-solving functions that are originally performed for him by others. For example he may internalize a 'critic' role in the sense of learning to apply to himself the same standards and rules of critical evaluation that another person has previously manifested in interaction with him. (p. 738)

Whether the "critical other" is the mother, the teacher, a peer or an older child, a consideration of the effects of dyadic/group problem-solving in children would seem to have great potential for: (1) assessing the effects of situational variables on task performance, (2) uncovering a child's zone of potential development, and (3) acting as a learning vehicle for improving a child's performance.

Firm evidence to support this suggestion is, unfortunately, not yet available. Although there exists a considerable literature concerning such relevant areas as group problem solving (Davis, Laughlin, & Komorita, 1976; Kelley & Thibaut, 1954), and cross-age tutoring (Allen, 1976), the emphasis of prior research has been somewhat different from the one we would like to see, i.e., a concentration on group influences on individual learning. For example, in cross-age tutoring programs we know that the tutor tends to be the major beneficiary of the tutoring process (Allen & Feldman, 1974), but even when the tutees do show noticeable gains, improvement is measured against vague, global criteria, such as teacher ratings of general reading or arithmetic improvement (Horan, DeGirolomo, Hill, & Shute, 1974), rather than on the specific material that was the subject of tutoring. Similarly, the main concern in studies of group problem solving has been group effectiveness compared with individual performance (Kelley & Thibaut, 1954) rather than the influence of group activity on the learning of the individual child (Bos, 1937; Klugman, 1944).

B. *Other-regulation and self-regulation:* What kinds of influence would we expect social interactions to have on the child's learning ability? While it must be true that task-specific strategies can be demonstrated by the expert and imitated by the novice within a social medium, this would not necessarily lead to the durable and generalized learning gains that Vygotsky's theory would demand and that current Soviet psychologists claim they achieve. A consideration of the little data we have concerning the dynamics of group/dyadic problem-solving situations suggests that one of the major classes of cognitive activies that the group assumes initially (which may then be interalized by the child) are varieties of self-regulation skills (Brown & DeLoache, 1978; Meichenbaum, 1977).

Consider first a social psychologist's description of the major function of a problem-solving group.

> Qualitatively group discussions seemed to be adequately characterized by the traditional analyses of individual thinking, e.g., stated by Dewey as: 1) motivation by some felt difficulty, 2) analysis and diagnosis, 3) suggestion of possible solution or hypothesis, 4) the critical tracing out of their implications and consequences, and perhaps 5) an experimental trying out, before 6) accepting or rejecting the suggestion. (Dashiell, 1935, p. 1131)

Most of these activities seem to be variants of the basic transsituational regulatory skills of predicting, checking, monitoring, and reality testing (Brown, 1978; Brown & DeLoache, 1978). Similarly, Bales (1950) describes the early stages of group interaction as being concerned with a variety of regulatory activities including: asking for, giving, repeating, and clarifying information, asking for and giving directions, and asking for and suggesting ideas or plans for possible lines of action. Shaw (1932) also noted that one major function of the group was that it acts as a form of executive to its individual members. For example, the initiator of a suggestion will reject his own plan only one-third as often as will other members of the group. The group members function together to reject inadequate plans that escape the notice of individuals working alone. Thus a major function of the group is that it makes overt many of the executive functions that are usually hidden when an individual works alone on a problem. Kelley and Thibaut (1954) suggest this essential role of critic and evaluator, first learned in interpersonal setting, becomes internalized as self-regulatory skills.

This genesis from other-regulation to self-regulation is the major focus of Wertsch's (1979) research with mother–child dyads. The basic situation is that mothers and their young children are given the task of copying a wooden puzzle (a truck) with a set of identical composite pieces. The mother is encouraged to help the child if necessary. The following is a sample of a videotaped interaction between a mother and her 2½-year-old daughter:

(1) C: Oh (glances at model, then looks at pieces pile). Oh, now where's this one go? (picks up black cargo square, looks at copy, then at pieces pile)

(2) M: Where does it go in this other one (the model)? (child puts black cargo square back down in pieces pile, looks at pieces pile)

(3) M: Look at the other truck (model) and then you can tell. (child looks at model, then glances at pieces pile)

(4) C: Well (looks at copy then at model)

(5) C: I look at it.

(6) C: Um, this other puzzle has a black one over there. (child points to black cargo square in model)

(7) M: Um-hm.

(8) C: A black one (looks at pieces pile)

(9) M: So where do you want to put the black one on this (your) puzzle? (child picks up black cargo square from pieces pile and looks at copy)

(10) C: Well, where do you put it there? Over there? (inserts black cargo square correctly in copy)

(11) M: That looks good.

Here we can see the mother serving a vital regulatory function, guiding the problem-solving activity of her child. Good examples of the mother assuming the regulatory role are statements 2, 3, and 9 where she functions to keep the child on task and to foster goal relevant search and comparison activities. This protocol represents a mid-point between early stages, where the mother and child speak to each other, but the mother's utterances do not seem to be interpreted by the child as task relevant, and later stages, where the child assumes the regulatory functions herself, with the mother functioning as a sympathetic audience.

We would like to argue that social interactions between supportive "experts," such as mothers in Wertsch's example, master craftsmen in apprenticeship systems (Brown & French, 1979), and more experienced peers in tutoring studies (Allen, 1976) serve a major function of initially adopting the regulatory role of the group's activities. These regulatory roles are thereby made overt and explicit. This serves the diagnostic role of drawing out the novice's full capabilities, thus mapping his zone of potential development. It also serves a learning function that proceeds via the mechanism of internalization from other-regulation to self-regulation (Vygotsky, 1978).

In summary, in order to improve the predictive and diagnostic power of our tests by the year 2000 we will be forced to consider both the child's initial ability and learning potential in a variety of testing formats quite unfamiliar to today's standardized procedures. For example, a child's ability in any one task domain could be considered first in an individual problem-solving format and then in a supportive social setting. This should provide valuable information concerning the situational specificity of cognitive abilities. Michael Cole and his colleagues (personal communication) have already made some headway with this approach. They videotaped a group of children solving traditional IQ-like items in a a one-to-one formal testing setting and the same children solving the same items in a competitive social situation, i.e., a group IQ bee that involved animated discussion of the correct solutions. Another potentially illuminating testing procedure would be to consider individual performance before and after experiences intended to uncover zones of potential development, experiences that could include supportive adult/child cooperation, and group activities. We are currently initiating a program of research to examine the feasibility of such an approach. By the year 2000, we may have a battery of techniques for considering the situational specificity of cognitive competences and the learning potential of individual

children. Armed with such information we should be able to form a far more balanced picture of the child's capabilities than can be revealed by his score on standardized tests.

III. ACADEMIC INTELLIGENCE AND EVERYDAY THINKING

In several recent papers (Brown, 1978; Brown & Campione, 1978), we have considered the problems of intelligence and school performance from the particular perspective of the mildly retarded citizen, or "nonacademic" members of our society. Although we have covered quite different topics in these papers, the basic organizational format is constant. In the first half of each paper we deal with methods of improving the diagnosis and remediation of the academic problems of slow-learning children and then, in the remainder of the paper, we raise doubts concerning the utility of the whole enterprise. This format is repeated here. The basic dilemma concerns the predictive and diagnostic functions of our current tests. As regards school success, we are quite confident that extant IQ tests do an adequate job of predicting the performance of slow-learning children. The problem is that this prediction is essentially negative; we can predict school failure. A concern for the general welfare of this group of students leads us to call for the development of tests that do more than predict, tests that diagnose more sensitively and suggest areas where remediation is both necessary and possible. Thus, in the preceding section of the paper we have been concerned with methods of improving the diagnosis and remediation of academic problems.

When one considers the success of IQ tests for predicting adaptation outside of school settings, however, one must be less sanguine that existing tests provide any useful information concerning critical life experiences of the nonacademically inclined citizens. In order to enhance our ability to predict and diagnose everyday cognitive efficiency, we must consider the limitations of the types of tasks that traditionally constitute our tests and curricula. In the preceding sections we have been concerned with academic intelligence, i.e., performance on closed system (Bartlett, 1958; Cole, Hood, & McDermott, 1978), typical academic problems that have fixed goals, fixed structures and known elements. In consequence, we have neglected the importance of the contrastive class of open system problems that predominate everyday thinking. In a recent monograph, Cole, Hood, and McDermott (1978) have considered this distinction at length, and Neisser (1976, and this volume) has also contrasted academic intelligence with general intelligence, so we will make the point only briefly here. Academic intelligence is the type of thinking that is fostered by the schools and measured by IQ tests. It is characterized by attitudes toward information, problems, and problem solving peculiar to the

school experience. There is an emphasis on abstractness and speed of solution, an overriding goal of reaching the correct solution, and an attitude that there is one best answer that can be reached through rational processes based just on the information given in the problem. Contrast this description with everyday reasoning. Speed is often irrelevant and a concrete solution is more appropriate than a general abstract rule. Also in contrast to academic problem solving, where there is little emotional commitment to any one answer, in everyday thinking there is a considerable investment in a particular answer, so much so that facts are often manipulated to support a desired conclusion. Everyday problems are open in the sense that one seldom has all the necessary information for solution and one does not weigh the available information rationally and evenly. Personal motivation is clearly involved in the selection and weighing of pertinent facts.

Traditionally the main concern of cognitive psychology has been the problems of academic intelligence. Similarly, it is understandable that intelligence tests, which were developed to predict the ability of students to profit from school experience, measure primarily academic intelligence. For the mildly retarded, however, problems that tap academic intelligence are the primary source of intellective difficulties, failure to perform effectively in an academic setting is, of course, the reason they were diagnosed as retarded. But a case could be made that in many "everyday life" contexts, academic intelligence is either inappropriate or irrelevant for successful adaptation. Consider in this light epidemological surveys of the prevalence of mental retardation; prevalence increases from birth until 16 years and then declines. In addition, when one considers the rate of successful adaptation to adult life of those in the mildly retarded range (IQ range 50–80), IQ level does not predict successful adaptation (Edgerton, 1967).

The implication of the age dependence of prevalence rates, and the lack of relationship between IQ and social adaptation, is that the environment partially determines when or whether an individual can be judged as mentally deficient. In some sense, schools "create" a class of retarded citizens because of the reliance on academic intelligence which is beyond the capabilities of many. Once outside the academic setting, many of those who as children were diagnosed as retarded lead successful, productive lives as adults. They are not considered retarded by their peers, or by authorities concerned with labeling retardation, hence the dramatic decline of the prevalence of retardation after the school years.

Reacting to the prevalence figures, Berkson (1978) called for an analysis not only of the abilities of the individual, but also of the environments to which he must adjust. While it is clearly reasonable to advocate measuring competence in relation to the demands of an individual's environment, so that we can either predict successful adaptation to adult life or diagnose areas

where problems in adaptation may occur, there is a definite problem in carrying this out. Both cognitive and developmental psychologists have concentrated on academic intelligence, on the cognitive capabilities of the college sophomore. Most of our theories of adult cognition are notable for this bias. We have almost totally ignored the blue collar worker, both in terms of estimating his abilities on academic closed-system tasks, and in terms of defining the cognitive demands of various vocational occupations in which he might engage. There are, therefore, some fundamental questions that remain unanswered (or unasked!), e.g., what are the average capabilities of successful blue collar workers? what are the minimum demands of their everyday life? and therefore, for what end should education be preparing the children who must eventually join their ranks? In order to answer such questions we need to develop an understanding of the cognitive demands of everyday life based on a theory of cognition that includes a consideration of more than academic intelligence.

Tests of functional literacy and minimum competence are being developed nationally in response to a demand that schools foster skills of everyday cognition. But these tests, as currently constituted, are unlikely to help with the prediction and diagnosis of everyday thinking problems. One reflection of the weakness of existing tests of functional literacy is the wide disparity in the prevalency rates reported, a finding that suggests that there is no agreed upon criterion of just what functional literacy might be (Fisher, 1978). Far from being based on a coherent theory of everyday cognition, the test items are selected on the basis of two intuitive criteria. First, the skills are said to reflect the competency expected from "normal eighth graders." Second, the items are derived from a "common sense" approach to defining the composite skills that will be needed in adult life. Not only is there no theory of nonacademic adult intelligence to guide the selection of items, but there is also an absence of the fundamental ethnographic analysis that would describe the types of competencies necessary for success in everyday life and in various blue collar occupations. Some of the items selected for inclusion on tests of functional literacy may indeed turn out to be excellent examples of the minimum skills needed for survival but in the absence of a theory of nonacademic adult cognition, and/or ethnographic observations concerning basic skills, we do not know what cognitive competences are needed for everyday life success. As a result we are basically ignorant concerning what type of intelligent activities we should foster in our schools, and tap in our tests of "functional" literacy.

We would like to argue that it is imperative for us to determine the types of everyday reasoning engaged in by the average "man in the street," not just to advance our knowledge of the kinds of capabilities the mildly retarded must possess to "pass" in the adult world (Edgerton, 1967) but also to expand our basic theories of psychology so that they can go beyond the cognitive

capabilities of the academic elite. As we develop a psychology of mundane cognition, focusing on how ordinary people cope with the demands for reasoning in everyday life, we will be better prepared to predict the ability of the mildly retarded to adapt to everyday life in accord with their performance on "tests of mundane cognition."

If we are to predict, diagnose, and maximize the learning potential and life success of mildly retarded persons, both the approaches described in this paper will be necessary. We need to refine and extend the diagnostic procedures we use to estimate academic intelligence so that we may alleviate school problems for as many as possible. In addition, we must also consider the "end point" of cognitive development for those not academically inclined. We need to know what the minimum cognitive competencies demanded by everyday life situations are, so that we can predict who will fail, diagnose the source of failure, and attempt to prepare the less able child to meet the demands of everyday life more adequately.

IV. CONCLUSION

We have discussed the current and future state of intelligence testing in the light of three criteria: the predictive, diagnostic, and remedial functions they perform. Existing IQ tests perform the function they were designed to fulfill; that is, they predict academic success. By the year 2000 we would like to see an extension of the predictive power of intelligence tests so that we are able to (a) predict school failure prior to its occurrence and (b) predict potential adult competence by a consideration of performance on tests of everyday reasoning. To achieve these ends we will need to invest considerable energy in ethnographic surveys and experimental testing programs directed at improving our scanty knowledge in two main areas. First we need sensitive indices of early cognitive (in)competence that are related to subsequent academic intelligence. Secondly we need theories and measures of functional literacy, minimal competence, and mundane cognition, so that we can begin to predict life adaptation as well as academic success.

We would also like to see an increased emphasis on the diagnosis and remediation of cognitive deficits, of both the academic and everyday variety. We argue that Soviet theory and practice regarding the clinical diagnosis of learning disabilities provide a useful framework in which to examine the child's learning potential. In addition, a variety of interpersonal testing formats should be employed to examine the situational specificity of any cognitive ability, as well as the child's potential for benefiting from expert aid. Considering the current limited service to the identification and treatment of the retarded provided by IQ tests in the year 1979, any evidence of improvement by the year 2000 would be welcomed.

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REFERENCES

Allen, V. L. *Children as teachers: Theory and research on tutoring.* New York: Academic Press, 1976.

Allen, V. L., & Feldman, R. S. Learning through tutoring: Low-achieving children as tutors. *Journal of Experimental Education*, 1974, *42*, 1–5.

Bales, R. F. *Interaction process analysis: A method for the study of small groups.* Cambridge, Mass.: Addison-Wesley, 1950.

Bartlett, F. C. *Thinking: An experimental and social study.* New York: Basic Book, 1958.

Berkson, G. Social ecology and ethology of mental retardation. In Gene P. Sackett (Ed.), *Observing behavior: Theory and application in mental retardation.* Baltimore: University Park Press, 1978.

Bos, M. C. Experimental study of productive collaboration. *Acta Psychologica*, 1937, *3*, 315–426.

Brown, A. L. Knowing when, where, and how to remember: A problem of metacognition. In R. Glaser (Ed.), *Advances in instructional psychology.* Hillsdale, N.J.: Lawrence Erlbaum Associates, 1978.

Brown, A. L., & Campione, J. C. Permissible inferences from the outcome of training studies in cognitive development research. *Quarterly Newsletter of the Institute for Comparative Human Development*, 1978, *2*, 46–53.

Brown, A. L., Campione, J. C., & Barclay, C. R. Training self-checking routines for estimating test readiness: Generalization from list learning to prose recall. *Child Development*, 1979, in press.

Brown, A. L., & DeLoache, J. S. Skills, plans and self-regulation. In R. Siegler (Ed.), *Children's thinking: What develops?* Hillsdale, N.J.: Lawrence Erlbaum Associates, 1978.

Brown, A. L., & French, L. A. The cognitive consequences of education: School experts or general problem solvers. Commentary on "Education and cognitive Development: The Evidence from Experimental Research" by Sharp, Cole, and Lave. *SCRD Monographs*, 1979, in press.

Brozek, J. To test or not to test: Trends in the Soviet views. *Journal of the History of the Behavioral Sciences*, 1972, *8*, 243–248.

Campione, J. C., & Brown, A. L. Toward a theory of intelligence: Contributions from research with retarded childen. *Intelligence*, 1978, *2*, 279–304.