The Cognitive Consequences of Education: Some Empirical Evidence and Theoretical Misgivings

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This report and the research on which it is based were supported by the U.S. Office of Education and the Carnegie Corporation. The ideas contained here were arrived at in close collaboration and discussion with many individuals. The authors thank Sylvia Scribner, Robert Serpell, Charles Super, Sarah Harness, and Jean Lave for their attempts to help them clarify their thinking on the issues discussed here.

For both practical and theoretical reasons, the last decade has seen a renewed academic discussion of the intellectual consequences of formal education. On an international scale, training in basic academic skills was promoted as an essential prerequisite to economic progress (Gray, 1956); nationally, the expenditures for Operation Head Start were often justified as a means of breaking the 'cycle of poverty' by teaching young children the basic intellectual skills that promote learning to read and do arithmetic; following such influential theorists as Hunt (1961), these latter programs assumed that intellectual skills could be taught and that schools were the place where they were most likely to be learned, at least for the poor and 'culturally different.'

More recently, the assumptions that formal education promotes economic development and that intellectual skills are learned in school have come under attack.

At both the national (cf. Greer, 1972) and international levels (Harmon, 1974), evidence has mounted that the development of formal educational facilities follows, rather than leads, development.

In a parallel manner, many social scientists have come to accept the idea that schools do not modify children; rather, they screen children according to previously determined levels of ability. This is by no means a new idea. Many years ago, Pillsbury (1920) actually advocated large-scale intelligence testing precisely because tests could carry out the school's screening function more efficiently. Jencks' (1973) widely cited conclusions concerning the inability of schools to change educational outcomes predicted from home background factors, when combined with popular interpretations of Jensen's (1971) conclusion that 'educability' is inherited, have also contributed substantially to the notion that schools do *not* bring about basic cognitive changes.

These issues are a matter of very broad concern and the controversy surrounding them is easy to understand. Unfortunately, they are also very difficult issues to resolve, scientifically as well as in terms of social policy.

A major impediment to their scientific resolution is the close

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correlations that exist in modern society between contending 'causal' factors associated with test performance, scholastic achievement, and the economic consequences of formal education. In the United States, age and years of education are almost perfectly correlated over the ages of 5-15 years since almost all children start school about age 5 and continue for 10 or more years. Socioeconomic status and years of education are also closely linked, as are socioeconomic status and race, both of which correlate highly with both educational attainment and standardized test performance. A multitude of factors interact to determine the economic effects of education to the individual and society.

Given these complexities, one reasonable strategy is to seek circumstances in which the correlations among socioeconomic conditions, age, and education are either absent or different from those observed in domestic research on this topic.

Cross-cultural psychological research seems to offer one such avenue of approach. While such studies introduce difficulties of their own (cf. Cole and Scribner, 1975), they offer the possibility of breaking up the correlations which bedevil investigations of the causal factors linking education and cognitive performance.

Research by Greenfield carried out more than a decade ago (cf. Greenfield and Bruner, 1966) pointed to schooling as a prerequisite to the development of various logical operations and classificatory skills. Greenfield took advantage of the unequal distribution of educational facilities in Senegal to disentangle age and educational experience. Since that time, many have followed Greenfield's basic strategy. Substantial evidence exists in support of the generalization that schooling teaches a variety of the skills which produce improved performance on psychological tests of intellectual ability (cf. Cole and Scribner, 1974; Serpell, 1976 for reviews).

While there is widespread evidence that formal educational experience does indeed inculcate the skills needed to perform well on psychological tests (our proxy for 'cognitive development'), the data by no means tell an unequivocal story. One problem arises because, for some tasks and some cultural groups, formal schooling makes little difference in test performance.

A second problem results from the same conditions that make cross-cultural research possible. The very recent advent of formal education in many of the societies studied has resulted in limited free variation in age and education. For example, in our research in Liberia (Cole, Gay, Glick and Sharp, 1971), we were unable to find tribal adults with any significant educational experience, and the number of available subjects with secondary school experience was drastically limited. This same difficulty permeates the literature.

A third difficulty concerns selective availability of schooling. Where schools have been located without respect to internal social and economic divisions (as was the case in parts of rural Liberia in the 1960s), we have some justification for assuming more or less random assignment of children to the major contrast groups—schooled and nonschooled—at least at the lower grade levels. However, when we turn to places where mass schooling has been available for some time, or when we become concerned with higher levels of education, we clearly want to evaluate exactly those social factors which are known to influence educational achievement in the United States (e.g., family incomes, home, language), as well as factors specific to the locale of the research, but which may not have exact equivalents here (traditional occupations, availability of schooling).

With these goals in mind, we undertook a two-part study of education and its cognitive consequences in Yucatan, Mexico. The first part of the research consisted of more than a dozen series of studies of various psychological tasks which previous cross-cultural research had shown to vary with educational experience. The second part of the study consisted of a demographic survey designed to specify the selective factors operating to determine the amount of education obtained by Yucatecans.

Our choice of Yucatan was guided by several factors, paramount among which was the great variability in educational attainment of its heterogeneous population combined with historical circumstances which made at least moderate levels of schooling available to a significant proportion of its rural, adult population.

The essay which follows discusses the results of this work, which are described in full in an unpublished manuscript by the present authors (Sharp, Cole and Lave, 1976, n.d.).

A BRIEF SUMMARY OF MAJOR RESULTS

With respect to the problem of selectivity in the subject populations who obtained different amounts of schooling, we found that the amount of schooling available in one's home town was the major constraint on the amount of education obtained. But schooling available was greater than the amount obtained for most people. Economic and linguistic factors further reduced educational attainment, especially above the third-grade level.

An adapted subscale of the *Wechsler-Adult Intelligence Scale* predicted a small, but statistically significant portion of the variance in the number of grades completed. While this effect could be considered either a cause or a result of educational attainment, its magnitude is reported to be roughly equivalent to the difference obtained between children in a study in Guatemala where testing was carried out prior to exposure to schooling (Irwin, personal communication).

The results of the experimental studies can be summarized by the following nine points:

(1) When categorizing a set of 20 pictures of common objects, all population groups sort taxonomically, but more educated subjects produce tighter, more organized sortings: uneducated adults mix functional and taxonomic organization of the stimuli.

(2) When asked to group artificially constructed stimuli (triangles-squares, red-blue, etc.), subjects' performance is very closely associated with grade (e.g., the highest grade of education completed); age appears irrelevant for the age range studied. Recourse to 'natural' stimuli (red and yellow corn kernels), for which these distinctions are commonly made, but which are without pragmatic significance in the task we presented, leaves the results unchanged.

(3) If subjects are asked to match two items with a target item on the

basis of their unspecified similarity ("choose two that belong with this one"), performance is a function of age (and the nature of the incorrect, distractor items). Correct choices were virtually always justified in terms of the functional relations between items.

(4) If two semantically related items are verbally presented, along with a single distractor, and subjects are required to select the two that belong together, the influence of age and grade varies with the nature of the distractor and the aspect of performance one examines. No differences in response choice appear under the most simple conditions, but both age and grade affect choices when there are two strong and conflicting problem elements. Performance increases with both age and grade when we look at the verbal justification of subjects' choices.

(5) In free association studies, all groups tend to give noun responses to noun stimuli, but only high levels of education produced substantial adjectival responses to adjectives or verbs to verbs. Within-semantic-category responding was also restricted to the most educated groups in these studies.

(6) Free recall performance varied as a function of grade. Especially marked was the fact that high levels of semantically clustered recall were observed only for secondary school students. In paired-associate recall, the grade effect was greater when stimuli and responses were randomly paired with respect to semantic class and less when semantic class and response class corresponded.

(7) Short-term recall of location varied as a function of grade. Fine grain analysis implicated active rehearsal as the behavior which differentiated more and less educated subjects.

(8) Responses to verbal logical problems varied as a function of grade, and perhaps of exposure to modern commerce. The more sophisticated groups were distinguished by their strong tendency to treat the problems as a logical puzzle to be solved on its own terms. Less educated groups were more likely to respond in terms of their knowledge of the world around them.

(9) Total scores on *Thurstone's Primary Mental Abilities* test varied as a function of grade.

We will discuss these results as they affect our interpretation of the effects of education. We will begin by accepting a rather conventional framework for the interpretation of the results of psychological experiments. We will end by questioning that framework and suggesting an alternative.

DISCUSSION

Whatever the shortcomings of individual studies (and there are many) the evidence from the entire series of experiments, combined with our data on the factors limiting years of schooling, make it reasonable to conclude that differences in educational experience make a substantial difference in the cognitive skills that subjects manifest in our studies. Assuming this to be true, two questions arise: (1) How can we best characterize the nature of the differences we observed between schooled and unschooled subjects, keeping in mind that these differences were not uniform across tasks; and (2) What is it about schooling that promotes the development of intellectual skills?

Does education influence stimulus familiarity and lexical organization?

The current literature on education and cognitive development suggests two major lines for the interpretation of these results within a general framework which assumes that test results reflect general cognitive skills; one emphasizes difference in subjects' knowledge about the stimulus materials, the other emphasizes differences in the way stimulus information is processed. We will consider the first hypothesis in this section.

Hall (1972) obtained results very similar to those reported here in a study conducted among Colombian children of different ages and levels of educational attainment; he interpreted his data as a reflection of differences in the attributes of stimuli to which his two populations attended. In a paired-associate study, a recognition memory, and a free association study, he observed substantial differences associated with education. Like us, he found that his more educated subjects gave superordinate responses in free associating to nouns, and more adjectival responses to adjectives. He also observed that his more educated subjects were likely to err in their recognition memory by falsely asserting that they had previously seen items that were likely associates of items that had really been presented. The only task for which education-related differences were small required the subjects to learn a set of verbal discriminations.

Hall concluded that sensitivity to the "verbal associative and acoustic attributes" of stimuli by educated subjects is the source of differences between them and their less educated counterparts. Something about formal education induces the educated subjects to attend to stimulus attributes which are more effective instruments of remembering (Hall mentions "the emphasis during the early school years on conceptual and associative relationships among words" as a likely causal variable).

We, too, have been impressed with the possibility that differences in the content and structure of people's knowledge about our experimental materials and tasks might underlie the performance differences we have reported. It is for this reason that we took pains to use culturally familiar materials so that differential knowledge of test *content* would be minimal in our categorizing and memory studies.

The results of these efforts, as reflected in our data summary, do not build a very strong case for interpreting the pattern of education-related performance differences in terms of differential familiarity with the task stimuli, or any of their associated attributes.

Consider the data from the free association studies, where our results and Hall's are in close agreement. A central index in these studies was the probability that people would respond to each stimulus with a response from the same grammatical class (termed paradigmatic responding, e.g., red-green or house-tree). When nouns were the stimuli, all groups tended to give noun (paradigmatic) responses. But for adjectives in Hall's study, and adjectives and verbs in our work, the more highly educated subjects responded paradigmatically more often than uneducated subjects. What theory of differential-stimulus encoding can encompass differences in responding conditional on grammatical word class?

The results of our study in which people had to form categories of geometric figures or pieces of maize must also appear puzzling from this perspective. The color and size of corn kernels are both salient attributes of these objects for Mayan farmers, attributes which they readily use in describing individual stimuli, just as students are 'used to' describing geometric figures. But farmers were no more successful at forming groups with maize than they were with geometric figures, nor did the students deal more successfully with the geometric stimuli.

It is findings such as these that have made us skeptical about the importance of differences in lexical structure or stimulus familiarity as a general explanation for the education-related differences observed in our studies.

Is it what you do with what you have that counts?

At the risk of drastically oversimplifying a very complicated set of relations, we would like to suggest that one way to characterize the major results of our research is to suggest that, in contrast to uneducated subjects, more highly educated subjects engage in intellectual activities which are not rigidly predetermined by the structure of the task and which promote efficient cognitive performance. Phrased differently, it is not differences in the information about the stimuli *per se,* but differences in what people do with commonly available information that is critical to performance on a wide range of cognitive tasks. If this position is correct, differences between educated and noneducated subjects will depend on the extent to which the task permits or requires such activities and the difficulty of the required behaviors. If the task itself organizes subjects' responses so that it can be solved without recourse to special intellectual work, or if the task's demands are beyond the reach of the educated subjects, little or no education-related differences in performance are to be expected.

In various guises, this line of thought can be found in a great variety of current cognitive theorizing (c.f. Brown, 1975a, b; Flavell and Wellman, 1976). As a rule, it has been used to explain age-related differences in the performance of children, but it has been applied in comparisons of retarded and normal children (Brown, 1975a) and children from different social class or ethnic groups (Jensen, 1969). Earlier applications to education-related differences can be found in Cole, Gay, Glick and Sharp (1971), Cole and Scribner (1974), Scribner and Cole (1973), while a more sophisticated recent discussion is presented by Brown (1976).

The nine-item summary of results with which we began this section is a useful reference point against which to evaluate the usefulness of our loosely formulated "cognitive processing" interpretation. The following conditions failed to produce marked education-related differences in performance:

(1) the sorting studies where subjects were asked to group items from distinct semantic categories on the basis of their similarity, or when functional sorting produced performance that was indistinguishable from semantic sorting;

(2) when a paired-associate list was constructed using highly associated items from the same semantic category;

(3) in a short-term memory study, when the location presented just prior to recall was the probed-for item.

All these tasks (or parts of tasks) share the characteristic that the basis of solution is made obvious by the lack of competing alternatives or that little processing is required to produce a response (as in the short-term recall study where the last-presented item is often said to reside in 'echoic' memory).

Marked education-related differences appeared in several different contexts; they were apparent in categorization tasks containing several competing sorting principles, especially when semantic and functional classification were pitted against each other. This result appeared very clearly when similarity had to be judged via the difference between the two semantically related items and a distractor.

Education-related differences in memory tasks occurred in close association with those aspects of performance widely accepted as evidence of 'strategic' activity (Brown, 1975, a, b). In the free recall task, the effect of education was most strongly manifested in reordering of the to-be-recalled list to conform with its latent taxonomic categories. In the paired-associate study, the superiority of the educated subjects was greatest for the more *difficult* list, consistent with Rohwer's (1973) repeated observation that group differences appear under circumstances where subjects must 'elaborate' the list items to facilitate their association. In the short-term location recall study, education effects occurred for early and middle items in the list—that part of the task where spontaneous, cumulative rehearsal has been demonstrated to be an essential accompaniment of enhanced performance in older children (Hagen and Hale, 1973). All of these results are consistent with the generalization that the more highly educated subjects are engaged in deliberate remembering activities which successfully augment their performance.

In the verbal problem-solving task, the evidence clearly points to an education-related difference which hinges on the evidence subjects deem necessary to make a judgment; a few years of educational experience appears sufficient to induce people to treat these questions as a problem in reasoning from the given premises to a conclusion, while uneducated subjects seek empirical support for their evaluations.

The *Primary Mental Abilities Test* is an amalgam of tasks like those we have just discussed, and the effects of education are very clear.

This 'information transforming' hypothesis appears to be much more attractive than a differential familiarity hypothesis that operates at the level of individual stimuli. It may well be correct. Our doubts about its validity and the steps we think need to be taken for its proper evaluation will be discussed in a later section, after we have had an opportunity to present a different framework for the interpretation of the cognitive consequences of schooling.

Does education promote cognitive development?

So far we have been extremely careful in the language we have used to characterize the performance differences between educated and noneducated subjects. Even in the preceding section, where we urged differences in cognitive operations as the locus of education effects, not differences in stimulus familiarity, stimulus attributes, or lexical organization (all versions of the position that the content of the tasks are not equivalent across groups), we were circumspect in our claims for the generality of the results we were reporting. Here we want to address directly the issue of generality; are we observing and reporting phenomena that are characteristic of the thinking of educated and noneducated Yucatecans, or are we dealing with a circumscribed set of tasks which have little significance outside of experiments (and possibly schools)?

For most researchers who have considered the problem of the effects of education on cognitive development, the conclusion to be reached from this kind of research is clear. Hall, for example, concluded that formal education is responsible for producing differences in what he terms "verbal development" (1972, p. 287). Wagner, in his summary of the short-term memory experiment described earlier concluded that "Higher mnemonic strategies in memory may do more than 'lag' by several years [without education] — the present data indicate that without formal schooling, such skills may not develop at all" (Wagner, 1974, p. 395). Ann Brown (1976) generalizes this conclusion in a way that is compatible with the results of our research: "Even this brief consideration of cognitive development in cultural perspective suggests that much of what we regard as the 'normal' course of development is, if not actually an outcome of formal schooling, at least greatly influenced by the process." (p.13)

Our doubts about this kind of conclusion come from two sources, one largely empirical, the other speculative (theoretical would be too respectable a word).

EMPIRICAL INCONSISTENCIES

On the empirical side, we have to consider apparent contradictions to our generalization based on experimental, psychological research; it is not the case that we can account for all of the results in this monograph, or all of the results in the literature with a 'cognitive processing interpretation' of the effects of education.

Within the set of studies reported here, several discordant results need further study. We have already had occasion to note that there is no ready explanation for the absence of population differences in free associative responding to nouns, while differences appear in response to verb and adjectives. We have faulted 'differential encoding' and 'familiarity' explanations of these results with good cause. But we have no convincing explanation for them.

We were surprised by the lack of education-related differences in the replication of Birch and Bortner's (1966) attribute matching study, especially when the matching set contained competing bases for a reasonable response. We strongly suspect that the failure to obtain differences by educational level resulted because, even when there were competing bases of solution (which should have produced an advantage for educated subjects according to the line of reasoning being discussed here), an answer that was scored as correct could be obtained by functional means, which the Mayan farmers were experts in producing.

The results of the study in which subjects had to choose two similar names or reject a dissimilar name are also difficult to explain. We initially included 'similar' and 'different' procedures for reasons of experimental symmetry. Clearly, more than a matter of experimental elegance was involved in this procedural change, but we have no theory to guide us in an attempt to interpret the complex set of results we obtained.

Turning to the broader literature on education and cognitive development, we see two sets of results which we must consider. First, there are the studies by Kagan and his associates in neighboring Guatemala (Kagan and Klein, 1973; Kagan, Klein, Finley, and Rogoff, 1976). Although concerned with broader cultural comparisons, the Guatemalan studies (which include free recall and recognition memory among other tasks) have been interpreted as evidence that cultural differences in basic cognitive processes are minimal by the time children have reached puberty, although substantial differences may exist in infancy.

Speaking to the free recall results, variables which differ between Kagan and Klein's study and our own may explain the apparent discrepancies: we presented materials for several trials (instead of a single presentation) and the range of educational experience of our subjects was far greater than in the study reported by Kagan and Klein. It should not be overlooked that we observed group differences only at the higher levels of education (primarily secondary school) and that with respect to category-based reorganization of the list during recall, group differences appeared only after repeated experience with the list. For comparable education levels and amount of exposure to the experimental materials, our results are compatible with Kagan and Klein.

A potentially more serious difficulty arises if we consider the extensive literature on education and the developmental course of responses to Piagetian tasks. Here the picture is very unclear: education or special familiarity with the requirements of the task have often made a substantial difference in various Piagetian tasks, but often they have not. Since there is no agreed-upon interpretation of these results from those who conducted the research, and since we did not include such tasks in our set of studies, we can do no more than point out the omission. Well-considered discussions of the interpretive problems in this research can be found in Dasen (1977) and Greenfield (1973).

There are other contradictory studies in the literature (for example, the recent studies by Strauss, Ankkri, Orpaz, and Stavy, 1976), but with the major exceptions noted, the data are consistent with, if not confirmatory, of the notion that formal education somehow promotes cognitive development.

SPECULATIVE UNCERTAINTIES

Our 'speculative' doubts arise not so much from unexplained experimental results as from very general doubts about the logic of the entire enterprise represented by our experiments and survey. Although our concerns with generalization from experimental data have been voiced previously (cf. Cole and Scribner, 1974, 1975), they bear repeating in the face of seemingly massive confirmatory evidence that education fosters general cognitive development.

This conclusion rests upon the assumption that our experimental tasks are representative samples of cognitive problems people normally encounter and the processes which they apply to such problems. The problem of 'representative design' is an old issue in psychology (cf. Brunswik, 1955). It can be pushed into the background if our sole concern is with accounting for behavior in the situations we have chosen to observe, but it cannot be ignored when we want to assert that the behavior manifested in our experiments represents a general characteristic of the way people process information about the world.

It is perhaps easier to see how strong our assumptions about test performance and cognitive development really are if we consider some examples from very different domains of behavior. Suppose, for example, that we wanted to assess the consequences of learning to be a carpenter. Sawing and hammering are instances of sensorimotor coordination. Learning to measure, to mitre corners, and to build vertical walls requires mastery of a host of intellectual skills which must be coordinated with each other and with sensorimotor skills to produce a useful product (we are sensitive to this example owing to our own lack of success as carpenters!). To be sure, we would be willing to certify a master carpenter as someone who had mastered carpentering skills, but how strong would be our claim for the generality of this outcome? Would we want to predict that the measurement and motor skills learned by the carpenter make him a skilled electrician or a ballet dancer, let alone a person with 'more highly developed' sensorimotor and measurement skills?

Lest it be thought that the example is too absurd to merit juxtaposition with the outcome of schooling, consider psychological experiments in light of the contexts from which their procedures have been derived and the domains in which they are routinely applied.

Some version of virtually every experimental task reported in this monograph can be found in Alfred Binet's early work on the development of behavior samples which would predict children's success in school. The inspiration for their content came from an examination of the school curriculum, combined with Binet's sage guesses about the fundamental principles that underlie success in mastering that curriculum. The correlation between successful performance on Binet's tasks and success in school was a tautology; the items were picked because they discriminated between children at various levels of academic achievement. Might we not be witnessing the converse of that process when we observe people with educational experience excelling in experimental tasks whose form and content are like those they have learned to master in school? Is there any difference in principle between their excellence in recalling word lists, and the master carpenter's ability to drive in nails quickly? After all, practice makes perfect; if we test people on problems for which they have lots of practice, why should we be surprised when they demonstrate their competence? Conversely, what leads us to conclude that they will be equivalently good at solving problems for which they have no specific practice?

The answer to this latter question, of course, is that we expect practice to be more than locally specific in its effects, because we expect it to transfer. In an earlier discussion of the cognitive consequences of schooling (Scribner and Cole, 1973), we found that differences in transfer between problems was one of the distinguishing features of educated and noneducated adults. Unschooled populations tended to treat learning and memory problems as if they were discrete experiences, each constituting a new problem; there was a lack of learning to learn across problems which we are used to think of as examples of the same kind (even a lack of improvement from trial to trial within the same experiment). Schooled groups, by contrast, show marked learning across trials in free recall studies, learning to learn, and a general tendency to treat classes of problems as instances of the same type, applying common operations in appropriate ways. This is just the kind of result we would expect if an outcome of formal education was the development of flexible problem-solving routines and rules for their application.

The weakness in this argument brings us right back to the problem of representative design. Perhaps the impression of educated subjects as general problem-solvers is an illusion, produced by the narrow range of tasks, all of them derived from school contexts, which we selected to represent the domain, 'cognitive development'. The fact of the matter is that we have no direct evidence that educated subjects differ identifiably from their uneducated counterparts in the way they transfer their learning in any contexts other than our tests. Just as important, we have no idea of how often the intellectual demands represented by our experimental tasks are ever encountered outside of the educational context from which they were derived.

When we step back from our close-up look at experimental results and take a more commonsense approach to our topic, it is easy to generate doubts on both scores.

Consider first the occasions upon which one is likely to meet demands such as those set up by our various tasks outside of an educational setting. How often is one asked to recall a set of 20 discrete items following a single exposure lasting only a second or two in duration for each item (the conditions obtaining in our free recall procedure)? Not only are such instances rare ("Hey, Charlie, name all the major league baseball teams," or "Who came to the club meeting last week?"), they are also treated in a more "negotiable" fashion. If the question is genuine (someone really wants to know who attended the meeting), the person required to recall would undoubtedly be able to jot down names if he could write, or ask his interlocutor for help ("Did I name Jones?"). We may try to rehearse an unfamiliar phone number, but it is more likely that we will jot it down, look it up in the phone book (if we can read and write) or call information. We often entertain the hypothetical ("What would have happened if I dropped a rock on your tow?"), but encountering a syllogism where the conclusion follows only according to logical rules contained within the problem seems a very rare event indeed; talk devoid of empirical content is something we are more likely to complain about than engage in.

There is virtually no evidence concerning the way educated and non-educated people respond to mundane intellectual demands of the sort we have just been imagining. One problem with gathering such evidence is that we would want to be certain that our observations were not contaminated by such factors as differential familiarity with the materials, amount of practice, and other factors which would influence our interpretation of the outcome. In other words, we would be tempted to set up an *experiment.* In so doing, we would, of course, undo the enterprise.

THE PROBLEM OF FAMILIARITY AGAIN

In an earlier section, we rejected the notion that the pattern of results obtained in our research could be accounted for by differential familiarity with the stimulus materials used for eliciting classification, remembering, or problem-solving behaviors. Instead, we offered the idea that the educated subjects *did* more with the information they were given. We pointed out the implication of this view that group differences related to education would appear only to the extent that the task permitted or required active transformation of task information.

Our speculations about the special nature and restricted generality of cognitive tests suggest that we adopt a more complicated view of the ways in which the same cognitive task can differ in unfamiliarity for educated and noneducated people. At a minimum, we would want to suggest that familiarity with the activities (or operations) required by the task can differ across groups. But this obvious addition will not suffice: we have repeatedly seen instances where two groups manifest what appear to be the same operations (classifying, free associating) when responding to one set of stimuli, but different operations when responding to a different set of (presumably equivalent) stimuli *in the same task.*

What the data seem to require is an explanation which treats performance as an *interaction* between familiarity of content (in the sense used in our initial discussion) and familiarity of *operations.* In addition, it seems likely in some cases that familiarity with content and operations must be supplemented by knowledge of what constitutes adequate performance (e.g., the right answer) in order for the behavior to be optimally organized.

Again, we can illustrate our point with examples from the domain of carpentering. In order to make a table, one must be able to measure, cut and nail accurately. Depending on conditions, one may have to take into consideration the properties of one's materials (mahogany will require different treatment than pine). One must also understand a good deal more about a table than that it has a flat surface and four legs; in particular, one will need to know how to assemble a table top and legs in a manner that will keep the table from collapsing when one sits down to eat at it.

What would we want to claim if an apprentice and novice carpenter both succeeded in making equivalently sturdy tables? Whatever the answer, I think it is rather probable that we would want to make differential predictions about how well our two carpenters would make a bureau. Exactly the same operations are involved, but we would expect the more practiced carpenter to have mastered the additional skills necessary for assembling them to make a bureau. To emphasize that the particulars of the assembly process matter, we should add that it would be foolhardy to ask the man who was successful at making a bureau to build us a house; a different way of assembling carpentering skills is necessary for this task, and we want to be certain that the carpenter knows what the correct assemblage is, in addition to knowing each step.

Again, we urge serious consideration of the applicability of this far-fetched analogue to the cognitive tasks we use to assess the consequences of educational experience. In particular, we want to take seriously the notion that subjects who fail to produce what we consider a good performance may do so because they are unfamiliar with the required assemblage of sub-skills: *at least* three sources of unfamiliarity must be seriously considered when failures of performance occurs—at the level of stimuli, operations, and their assemblage, which is organized by knowledge of what constitutes adequate performance.

The results of our studies appear to be as neatly summarized by this idea as the "difference in information processing skills" explanation offered earlier. Earlier, we characterized the conditions which produced education-related differences as those which require or permit the subject to impose structure on the task and to engage in activities that promote efficient cognitive performance. These are exactly the conditions where the requirements for good performance are obscure, or where the required activities are sufficiently specialized, so that it is reasonable to assume that opportunities to learn and apply them may be entirely school-specific. In either event, we would not want to attribute the relatively poor performance of noneducated subjects to a *generalized* lack of ability.

At the present time, we have no adequate data with which to differentiate the idea that the "school teaches specialized information processing skills" and the more complex versions of a differential familiarity hypothesis. It is entirely possible, as our discussion suggests, that both factors are operating in our tasks. New kinds of observation will be necessary to disambiguate our current position.

An ingenuous attempt to overcome the dilemmas we have raised here has recently been completed by Lave (1976). Working with tribal tailors in Monrovia, the capitol city of Liberia, Lave constructed various tests of tailoring arithmetic skills built around the actual activities of tailors (problems concerning measurement of waist circumference, fly length, etc.). One test contained two kinds of items; those where the numbers were realistic examples of actual pairs of pants and those where the numbers were of the same order of magnitude, but unrealistic or taken from a wholly different domain (e.g., money). She gave her tests to a sample of tailors varying in the length of time they had spent at their craft and the number of years of formal education they had completed.

Using multiple regression techniques to partial out the effects of work experience and education, Lave found out that conclusions about the influence of tailoring and school experience differed according to the content of the task *and* the operations required for successful performance. If the task was one that tailors perform (or similar to ones that tailors perform), years of tailoring experience was the major predictor of performance. If the task was like the arithmetic problems encountered in school and *not* used in tailoring, years of schooling was the major predictor of performance. Neither years of schooling nor tailoring experience predicted performance for arithmetic problems which had no close analogues in either domain of activity, even though the stimulus materials were familiar (in the sense of being often encountered), and the operations were the same across tasks. This is exactly the pattern of results we would expect to find if the skills produced by tailoring and schooling were applied only where the rules for proper assembly of those skills were also known.

Lave's work (see also the study by Greenfield and Childs, 1971) is only a small, albeit very useful, step away from evaluating the consequences of education via a psychological test; she was, after all, giving a test, albeit one that fit with her subject's everyday work. But she picked her tests in such a way that she could build a plausible, if crude, scale of similarity-relating activities in different domains.

SOME CONSEQUENCES OF A 'SKILLS' APPROACH TO THE EFFECTS OF SCHOOLING

The connection between identifiable work tasks and the consequences of education strikes us as a useful road to follow. When psychologists move from experimental data to assessment of policy questions, their claims for educational consequences (and the hoped-for changes by educational planners) are unlikely to depend upon proving that education produces intellectual development (although this belief crops up in a substantial portion of the literature linking literacy to economic development, c.f. Gray, 1956). Rather, education is advocated as a means of instilling skills needed by a technological society, along with the values and aspirations needed to induce people to apply those skills. While we have to remain agnostic on the question of education's influence on helping someone to remember who attended a recent meeting, there are plausible grounds for believing that the information processing skills which school attendance seems to foster could be useful in a variety of the tasks demanded by modern states, including clerical and management skills in bureaucratic enterprises, or the lower-level skills of record-keeping in an agricultural cooperative or a well-baby clinic. These activities may well be facilitated by skills currently transmitted in schools.

If this is the case (as we believe it to be), the skills transmitted in schools do have applications in the important nonschool settings. But until there is stronger evidence to the contrary, we advocate adoption of the rather restricted view of the consequences of education which we are adopting here. Like carpentry for a carpenter, it provides children with instruments that may be useful to them in specific work contexts. This perspective urges on us a reexamination of the *cognitive* basis for a relation between education and later income in terms of the respective skills required by the two settings.

Evidence about the determinants of people's current occupations gathered as part of our demographic survey emphasizes that in the Yucatan, like the United States, education is important for job selection. A series of regression equations showed two variables to be key determinants of informants' current occupational status (and, hence, income): highest grade and sex. Other demographic factors (e.g., town modernity, family size, and languages spoken) had a lesser influence, though in all the expected directions. The impressive fact about the determinants of occupation is that with the exception of highest grade, they all constitute accidents of birth from the informants' point of view. The importance of education as a source of social mobility among Yucatecans is a social fact.

But what is the basis of this fact? Are we observing a repetition of our experience in the United States, where educational requirements for jobs have increased to meet the current (increasing) level of educational attainment, irrespective of the relation between the skills transmitted in school and job-related skills (Berg, 1971)? Or are we observing evidence that skills transmitted in schools do transfer to work domains? Until there is a substantial body of evidence demonstrating the generality of tested skills beyond school-like circumstances, and until their utility has been demonstrated through detailed studies of the similarity between the activities demanded in tests and various occupations, we must conclude that educational attainment cannot be legitimately used as a blanket prerequisite for employment in modern economic enterprises. Each job must be evaluated for the extent to which particular skills transmitted in school are necessary prerequisites.

One implication of this work for psychological theory seems clear, although it will be important primarily to those who are actively engaged in the research: developmental, cognitive research in the United States and other industrialized countries, where years of education and age go hand in glove, has been studying the consequences of education rather than culture-free developmental laws. A great deal remains to be done to disentangle the various knots which currently bind this line of inquiry.

REFERENCES

Berg, I. *Education and Jobs.* New York: Bekin Press, 1971.

Birch, H.G. and Bortner, N. "Stimulus competition and category usage in normal children." *Journal of Genetic Psychology,* 1966, *109*, 195-204.

Brown, A.L. The role of strategic behavior in retardate memory." In N.R. Ellis (Ed.), *International Review of Research in Mental Retardation,* Vol. VII. New York: Academic Press, 1975. (a)

Brown, A.L. The development of memory: "Knowing, knowing you don't know and knowing how to know." In H. Reese (Ed.), *Advances in Child Development and Behavior,* Vol. X. New York: Academic Press, 1975. (b)

Brown, A.L. "Development, schooling, and the acquisition of knowledge about knowledge." In R.C. Anderson, R.J. Spiro, and W.E. Montague (Eds.), *Schooling and the Acquisition of Knowledge.* Hillsdale, New Jersey: Lawrence Erlbaum Associates, 1976.

Brunswik, E. "The conceptual framework of psychology." *International Encylopedia of Unified Science.* Vol. I, Part 2. Chicago: University of Chicago Press, 1955, 656-750.

Cole, M., Gay, J., Glick, J.A., and Sharp, D.W. *The cultural context of learning and thinking.* New York: Basic Books, 1971.

Cole, M. and Scribner, S. *Culture and thought.* New York: John Wiley & Sons, Inc., 1974.

Cole, M. and Scribner, S. "Theorizing about socialization of cognition." *Ethos,* 1975, *3*, 250-268.

Dasen, P.R. *Introduction in Piagetian psychology: Cross-cultural contributions,* P.R. Dasen (Ed.). New York: Gardner Press, 1977.

Flavell, J.H. and Wellman, H.M. "Metamemory." In R.V. Kail, Jr. and J.W. Hagen (Eds.), *Perspectives on the development of memory and cognition.* Hillsdale, New Jersey: Lawrence Erlbaum Associates, 1976.

Gray, W.S. *The teaching of reading and writing.* UNESCO Monographs on Fundamental Educaton No. X, Paris, 1956.

Greenfield, P.M. and Bruner, J.S. "Culture and cognitive growth." *International Journal of Psychology,* 1966, *1*, 89-107.

Greer, Colin. *The great school legend.* New York: Basic Books, 1972.

Hagen, J.W. and Hale, G.A. "The development of attention in children." In A.D. Pick (Ed.), *Minnesota Symposium on Child Psychology,* Vol. VII. Minneapolis: University of Minnesota Press, 1973.

Hall, J.W. "Verbal behavior as a function of amount of schooling." *American Journal of Psychology,* 1972, *85*, 277-289.

Harmon, D. Community fundamental education. Lexington, Massachusetts: Lexington Books, 1974.

Hunt, J. McV. *Intelligence and experience.* New York: Ronald Press, 1961.

Jencks, C. *Inequality.* New York: Basic Books, 1973.

Jensen, A.R. "How much can we boost IQ and scholastic achievement?" *Harvard Educational Review,* 1969, *39*, 1-123.

Jensen, A.R. "The role of verbal mediation in mental development." *The Journal of Genetic Psychology,* 1971, *118,* 39-70.
Kagan, J. and Klein, R.E. "Cross-cultural perspectives on early development." *American Psychologist,* 1973, *11,* 947-961.
Kagan, J., Klein, R.E., Finley, G.E. and Rogoff, B. "A study in cognitive development." *Annals of the New York Academy of Science.* 1976, in press.
Lave, J. "Cognitive consequences of traditional appreticeship in West Africa." Unpublished manuscript. University of California at Irvine, 1976.
Pillsbury, W.B. "Selection: An unnoticed function of education." *The Scientific Monthly,* 1920, XII, 62-74.
Rowher, W.D., Jr. "Elaboration and learning in childhood and adolescence." In H.W. Reese (Ed.), *Advances in child development and behavior,* Vol. VIII. New York: Academic Press, 1973, pp. 1-57.
Serpell, R. *Culture's Influence on Behavior.* London: Methuen, 1976.
Sharp, D., Cole, M. and Lave, C. *Education and Cognitive Development: The Evidence from Experimental Research,* in press.
Strauss, S., Ankkri, M., Orpaz, N., and Stavy, R. "Schooling effects on the development of proportional reasoning." Manuscript, Tel Aviv University, 1976.
Wagner, D.A. "The development of short-term and incidental memory: A cross-cultural study." *Child Development,* 1974, *45,* 389-396.