VERBAL MEDIATION AND EDUCATIONAL POTENTIAL[1]

ARTHUR R. JENSEN

University of California, Berkeley

Can psychologists and educators raise the national IQ? The idea may sound grandiose, but I do not think it is too unrealistic to merit serious consideration. After all, the physical scientists emblazon their public image with spectacular feats that Everyman can understand, such as exploding H-bombs and sending rockets to the moon. In terms of social and economic significance there are possible achievements within the province of psychology and education that can claim at least as great importance to human welfare as the exploration of outer space.

To speak of raising the IQ of the population implies much more, of course, than merely adding a bonus of ten or twenty points to everyone's measured IQ. A boost in IQ implies a boost in all the *correlates* of the IQ as well. If one of the important natural resources of a nation is its intelligence, then a boost of some ten to twenty IQ points among millions of people could have enormous social and economic consequences.

I think this proposal is not so outlandish as to warrant immediate rejection. It deserves further examination. This means making use of all that psychology has learned about the nature of intelligence and learning ability in order to assess the feasibility of boosting the IQ on a large scale. Such an assessment would imply also that we spell out the specific methods and techniques most likely to produce the desired results.

The job is not the concern only of psychologists. Biological scientists could have a big part to play, for we know that intelligence is largely a matter of biology. The genes and the prenatal environment control some 80 per cent of the variance in intelligence. This leaves about 20 per cent of the variance to the environment, which is our particular sphere of manipulation as psychologists. In terms of measured IQ this 20 per cent of the variance represents a range of about 20 IQ points through which the environment can exert its influence. The degree of boost that can be effected in any person will, of course, depend upon the extent to which his usual environment is less than optimal for the full development of his innate intellectual potential. Thus there is reason to believe that children of low socioeconomic status would be the most susceptible to an IQ boost under the influence of a program suitably designed to achieve this end. The largest degree of boost might also be expected in what would ordinarily turn out to be the IQ range from about 70 to 90. Much of the intellectual deficiency below an IQ of 70 is of an organic nature and will not be highly susceptible to purely environmental remediation. And when the IQ is much over 90 it is generally found that the individual's environment is not severely lacking in some of the most important ingredients needed for the growth of intelligence. We can make an analogy with nutrition. If a child is normally robust, the chances are that his diet has been more or less adequate, and the addition of vitamin and mineral capsules will make little difference. A child with rickets or scurvy, however, will greatly benefit from the addition of the necessary vitamins to his diet. Furthermore, if we wish to improve the nutrition of undernourished children, we do not think in terms merely of providing a greater quantity of food. We ask what are the essential ingredients of a healthful diet, and we then see to it that

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the child gets these essential elements in addition to whatever else his parents happen to feed him. We are faced with much the same type of problem in trying to discover how we can boost the IQ through some form of environmental enrichment. One of our jobs as psychologists is to discover the essential ingredients and then to work out methods for providing them efficiently on a wide scale to all who might stand a chance to benefit.

To sum up this picture we can refer to Figure 1.

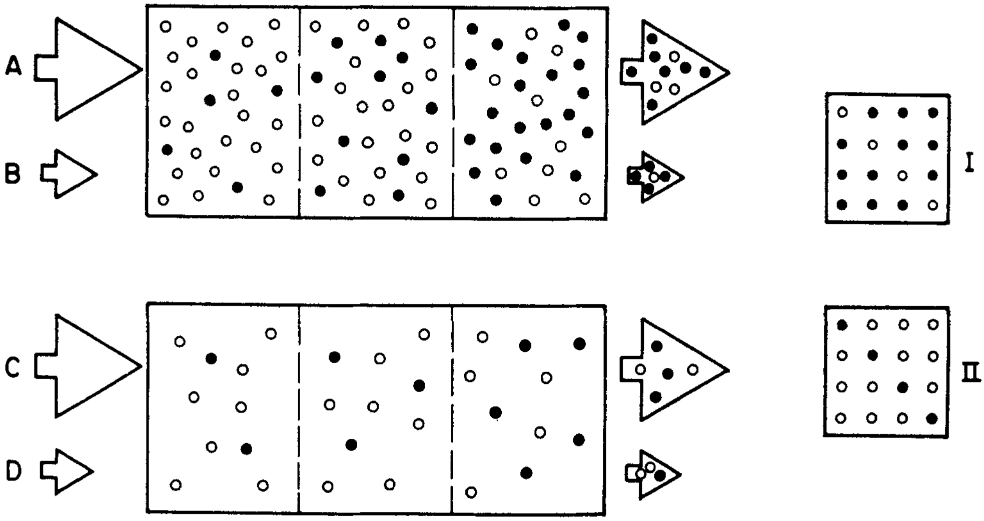

FIG. 1. A "model" of the growth of intelligence. (See text for explanation.)

The arrows represent individuals differing in innate capacity for the development of intelligence. Individuals A and C have greater innate potential than B and D. At this stage we are strictly in the realm of biology. Any influences on capacity at this stage will depend upon biological techniques. But now these individuals pass through an environment, represented by the large rectangles. The dots represent elements of experience—food for learning, so to speak. The upper environment is much richer in these learning opportunities than the lower one. But all of these elements of experience are not equal in their transfer potential. The black dots, in contrast to the white dots, represent elements of learning which greatly facilitate the acquisition of elements encountered later on. These elements with broad transfer to other learning play a large part in determining a person's educational potential. They are the kinds of generalized habits and skills that transfer to, and indeed are prerequisite for, the complex forms of learning the child encounters in his formal education. We know that children from the upper socioeconomic classes have acquired more of these educationally relevant transfer abilities during their preschool years than are acquired by lower-class children. Figure 1 illustrates the results, as the arrows emerge from the environment at any given age. The individual's intelligence can be seen to consist of a combination of his original innate capacity for learning plus what he has actually learned by a certain age. And given a certain capacity, the amount learned is a function of opportunity. But it is important to note that in the years of most rapid development, there is a snowball effect in the growth of intelligence. That is to say, learning grows on learning, and an impoverishment of early learning reduces learning potential at later stages, even though there may be no lack of opportunity for learning at these later stages. A student who has not had algebra will not learn much in a course on calculus. The same principle operates even in the preschool years, though here the elements of learning are so basic that we are apt to take them for granted and forget that a tremendous amount of learning goes on in the first years of life, in fact, the most important learning we ever do. It is during these early years that the individual's entire educational potential is largely determined.

Coming back to Figure 1, the squares on the right represent intelligence and achievement tests. We place the individual in the test situation and his "score" is the number of learned elements in the individual that are congruent with those in the test. Only if the elements in the test are a representative sample of the elements in the individual's environment or sphere of opportunity for learning does the test score give a fair indication of the individual's capacity. The relevance of this model to the problems of assessing abilities across various cultural and socioeconomic groups in our population is quite obvious.

One class of behavior of supreme importance to the development of learning abilities in humans is verbal mediation. Rather rudimentary mediational processes occur in lower animals as well as in humans, but verbal mediation is peculiar to man. Verbal mediation can give man a tremendous advantage as a learner and problem solver. While verbal mediation is dependent upon the possession of language or some symbolic representation of the environment, it is not simply one and the same thing as language. Language may develop without a corresponding development of verbal mediation processes. The reverse, however, seems never to occur.

In brief, verbal mediation consists of "talking" to oneself in relevant ways when confronted with something to be learned, a problem to be solved, or a concept to be attained. In adults the process generally becomes quite automatic and implicit; only when a problem is quite difficult do we begin "thinking out loud." Most mediational processes take place subvocally below our level of awareness. A great deal of experimental evidence, however, leaves little doubt that in adults in most learning and problem solving situations mediational processes play an important role, even when the person is not aware of their operation (Jenkins, 1963). In some learning and problem solving situations many subjects can introspect and tell us a good deal about their own mediational processes.

Let me over-simplify this explanation at the moment and then proceed to fill in the more essential details and qualifications. The fundamental difference between a nonmediating and a mediating learner is this: the motor responses in the nonmediator are made more or less directly to the sensory input as it is encoded in the sensory areas of the brain; the mediating subject, on the other hand, is a few steps further removed from the sensory input. In the case of mediation, sensory stimulation sets off a chain of verbal or other symbolic associations and it is these to which the subject then responds. This capacity for verbally mediated responding, which is what most distinguishes men from apes, results in a great advantage to the learner in most learning situations because it frees the learner from having his responses bound to specific stimuli and it makes for a degree of generalization and transfer of experience far beyond the narrow limitations of primary stimulus generalization.

TABLE 1. TYPES OF LEARNING PARADIGMS

a.	S - S	*f.*	R_V - R or V - R
b.	S - R	*g.*	S - $\boxed{\text{r - s}}$ - R or
c.	(S) - R - S^+ - R_c		S - V - R
d.	S_V - R	*h.*	S - V - R - V_c
e.	S - R_V	*i.*	S - V - V - R
		j.	V - V V
			V

We can use the symbolism of S-R learning theory to illustrate the relationship of verbal mediation to other forms of learning. Table 1 shows these learning paradigms. They may be described as follows:

a represents perceptual learning, or the connecting, through temporal contiguity, of one sensation with another. Most of this type of perceptual learning takes place during the first year or so of life.

b represents the classical conditioning of skeletal and autonomic responses to stimuli through contiguity of the stimulus and response.

c represents instrumental or operant conditioning, in which a skeletal response is followed by a reinforcing stimulus (S+), which in turn elicits some consumatory or confirmatory response (Rc).

d is the conditioning of a response to an external verbal stimulus. Dogs and even lower animals are quite capable of this kind of learning. But it is interesting to note that in humans, after the age of about six months, verbal stimuli—the sound of the human voice—can be conditioned much more readily than other forms of auditory stimuli.

e is the learning of verbal responses to stimuli. It is the child saying "Mama" when its mother appears, or naming objects placed before him. This tendency to name things is the first real link in the verbal mediational process. Labeling is a learned habit, and the strength of the habit is a function of the amount of reinforcement it receives.

f represents the making of overt responses to one's own verbal responses. If the verbal response is overt it is designated as Rv; if it is covert it is designated as V. For example, the child says to himself "Kick the ball," and then actually kicks the ball. Though it is more difficult and occurs at a slightly later age, the child also learns to *inhibit* responses through his own verbal self-commands. Thus verbal responses gain control over behavior. This is the second important link in verbal mediation. Now if we put the *e* and *f* paradigms together we have paradigm *g*, which is the standard way of representing mediation. The stimulus (S) gives rise to an implicit response (little r), which in turn acts as an internal stimulus (little s) for the overt response (R). The little r—s is enclosed in a box to indicate that this process is not directly observable but is presumed to take place somewhere in the brain. To simplify this expression, I will hereafter refer to the implicit r—s as V, that is, an implicit verbal mediating response. As you might imagine, when the S—V, and the V—R links already exist in the subject's repertoire and the subject is then required to learn the connection S—R, the learning of this connection is greatly facilitated by the the mediating link: thus, S—V—R.

h shows the same chain of connections followed by an implicit verbal confirmatory response, a form of self reinforcement somewhat analogous to the reward in operant conditioning (paradign *c*), except that here the subject provides his own reinforcement. It has been shown, for example, that when a child performs a simple arithmetic problem correctly there often occurs covertly the verbal confirming response "Right!" which can be detected by having previously conditioned the word *right* to an autonomic response that can be picked up with the psychogalvanometer (Razran, 1961). In many learning situations this kind of self-evaluative response is an important part of the facilitative effect of verbal mediation (e.g. Jensen, 1963).

i is merely intended to illustrate the fact that the verbal mediator may consist of more than one link; it can consist of a chain of verbal associations, as was first clearly demonstrated in a now classic experiment by Russell and Storms (1955).

j illustrates the fact that the mediating associations may have a hierarchical structure. That is, certain elements of the associative network will be linked directly, while others will have no direct connections. For example, the words *table* and *chair* are strongly associated, while neither is associated with *bed*; and yet all three are associated with the word *furniture*. The number of elements in the associative network (that is, sheer vocabulary) plus the number and strength of the connections between these elements are important variables in determining the facilitative effects of verbal mediation.

Correlates of Verbal Mediation Tendency

From all the things that have been said and can be said about verbal mediation, I wish to point out just a few of the generalizations and hypotheses that seem most relevant to our present discussion.

1. Verbal mediation is not an all-or-none process. The tendency for verbal mediation to occur is related to a number of other variables. First, it is helpful to consider two aspects of verbal mediation: (a) the state of availability of the elements of the mediational system, i.e. labels, vocabulary, the associative network, and an established syntax; and (b) the threshold of arousal of verbal mediational processes. Different learning and problem-solving situations differ in their tendency to elicit mediational processes; and individuals differ in their threshold of arousability of mediational activity.

2. High availability of mediational elements is a function of innate capacity and the opportunity for learning provided by a verbally rich environment. Both the availability and threshold aspects of mediation are generally directly related to mental age and IQ. Both primary intellectual retardation and retardation due to so-called cultural deprivation have similar outward effects on verbal mediation. The essential difference between primary retardates and cultural retardates will show up to the greatest extent in learning tasks that depend relatively little upon verbal mediation. In such learning tasks primary retardates are inferior to cultural retardates, who may perform at a normal level. The culturally handicapped will be *most* handicapped in learning or problem solving situations which depend to a large degree upon verbal mediation but which are ostensibly "nonverbal." This may sound paradoxical. But a learning or problem-solving task which on the face of it is

nonverbal does not tend to arouse mediational activity in most preschool children or in many older children whose environment has been deficient in fostering mediation tendencies. For example, it usually comes as a surprise to most of us to find that children from a lower-class background actually perform more poorly on nonverbal tests of intelligence than on highly verbal tests (Fowler, 1957). This is especially true of Negro children. It is generally found, for example, that lower-class children, especially among the Negroes, perform better on a highly verbal test such as the Stanford-Binet than on an ostensibly nonverbal or so-called "culture-fair" test such as the Raven Progressive Matrices (Higgins & Silvers, 1958). Such facts seem puzzling until one notes the amount of verbal behavior needed to solve many of the Progressive Matrices. This type of "nonverbal" test is even more verbal in a really important sense than many tests of vocabulary or verbal analogies. Obviously verbal tests more easily arouse and elicit verbal responsiveness. A test like the Progressive Matrices, which does not pose problems in the form of verbal stimuli, has less tendency to arouse verbal mediation in subjects who for some reason have a high threshold of arousal. When verbal behavior is not aroused by the task, the subject tries to solve the problem on the perceptual level, and for more difficult problems this approach is totally ineffective. I once had the interesting experience of observing some so-called culturally deprived children taking the Progressive Matrices test alongside some upper middle-class children of the same age, but of higher IQ. Lip movements and even muttering were clearly noticeable in the upper middle-class children and conspicuously lacking in the culturally deprived, who tried to fathom these problems simply by staring at them, with no evidence of the arousal of verbal associations.

3. The third main point I wish to make is related to the so-called "spew hypothesis" of Underwood and Schulz (1960). This hypothesis states, in effect, that given a certain innate capacity, the availability of verbal responses, associations, and mediators, is directly related to the frequency with which these verbal elements have been previously encountered in the environment. There is a great deal of impressive evidence for this generalization, which it is impossible to go into in the present discussion. I will add to this proposition what seems to me a reasonable corollary: the threshold of verbal responsiveness is directly related to the amount of practice in, and reinforcement of, verbal labeling behavior and other forms of verbal coping with the environment.

Examples of Verbal Mediation

Mediational processes have been demonstrated by experimental psychologists in a great variety of learning situations. Only a few typical prototypes can be described here for the purpose of illustrating some of the general principles I have just outlined.

Labeling

Labeling is perhaps the simplest form of verbal facilitation of learning and retention. Very young children generally do not attempt to label the stimuli with which they are confronted in, say, a discrimination learning task. As they advance in age, however, there is an increasing tendency spontaneously to label stimulus objects, with a corresponding facilitation of learning. An experiment by Pyles (1932) illustrates this kind of facilitation through verbal labeling. Children between two and seven years of age were presented with a set of five papier-mâché nonsense shapes, one of which concealed a small toy. The task was to learn which of the five shapes had the toy reward. The set of five shapes was presented repeatedly until the child picked up the baited shape on four successive trials. A matched group of children was given the same task, but with one difference. The examiner told the child that the shapes had names and proceeded to point them out. They all were nonsense names: Mobie, Kolo, Tito, Gamie, and Bokie. The child was encouraged to say the name of the object that concealed the reward. A third group of children was given a similar task, but the shapes were of familiar animals whose names the children already knew. The median number of trials needed to attain the criterion of learning for the three conditions were:

Nonsense shapes unnamed:	69 trials
Nonsense shapes named:	37 trials
Animal shapes:	5 trials

It is clear that labeling had a powerful facilitating effect. The much greater speed of learning the animal forms was due to the fact that these forms had already been well differentiated in the children's experience and their names had already been very much over-learned. It is also interesting to note that some of the fastest learners in the no-label condition had actually made up names spontaneously in order to facilitate their discrimination and retention. Little facilitative effect of the experimenter's naming would be found in an older group of children, since the majority would spontaneously make some facilitating verbal associations to the nonsense shapes.

Transposition

The phenomenon of transposition under certain conditions demonstrates the operation of verbal mediation. For example, subjects learn through trial and error to find a reward under one of three boxes, *a*, *b*, or *c*. In our example, based on an experiment by Stevenson and Iscoe (1954), the reward is always under box *c*. On each trial, of course, the boxes are placed in a different order, so that the subject must learn to associate the reward with the size of the box rather than with its position. After the task has been mastered, box *a* is eliminated and box *d* is added, so that the subject is now presented with boxes *b*, *c* and *d*. Which box will the subject now pick up with the expectation of finding the reward? Animals and young children, in whom verbal mediational processes either do not exist or have a very high threshold for evocation, will generally choose box *c*, for that is the box under which the reward had been previously associated. Older children and adults generally pick box *d*. The tendency to select *d* is associated with the subject's ability to verbalize what he has learned. And what the verbal mediating subject has learned is that the reward is under the *largest* of the three boxes. The nonmediating subject learned that the reward was under box *c*; for the idea of "largest" was not aroused by the task. A few years ago I tried a variation on this that clearly demonstrated mediation. After the three boxes had been learned with the largest box always rewarded, I presented subjects with three boxes all of exactly the same size, one bearing a picture of a mouse, one of a horse, and one of an elephant. Furthermore, the animals were all pictured as the same size. Most younger children, those in the kindergarten and first grade, were puzzled by the problem and selected one of the picture boxes more or less at random. Most of the children in the third and fourth grades, however, unhesitatingly selected the box with the elephant picture. Clearly these children had made the mediating response "largest" in the process of learning which of the three boxes contained the reward.

Reversal and Nonreversal Shift

The reversal-nonreversal shift problem has been used to great advantage by the Kendlers in their extensive research on mediational processes (Kendler & Kendler, 1962). Figure 2 shows the problem. The subject first learns the discrimination

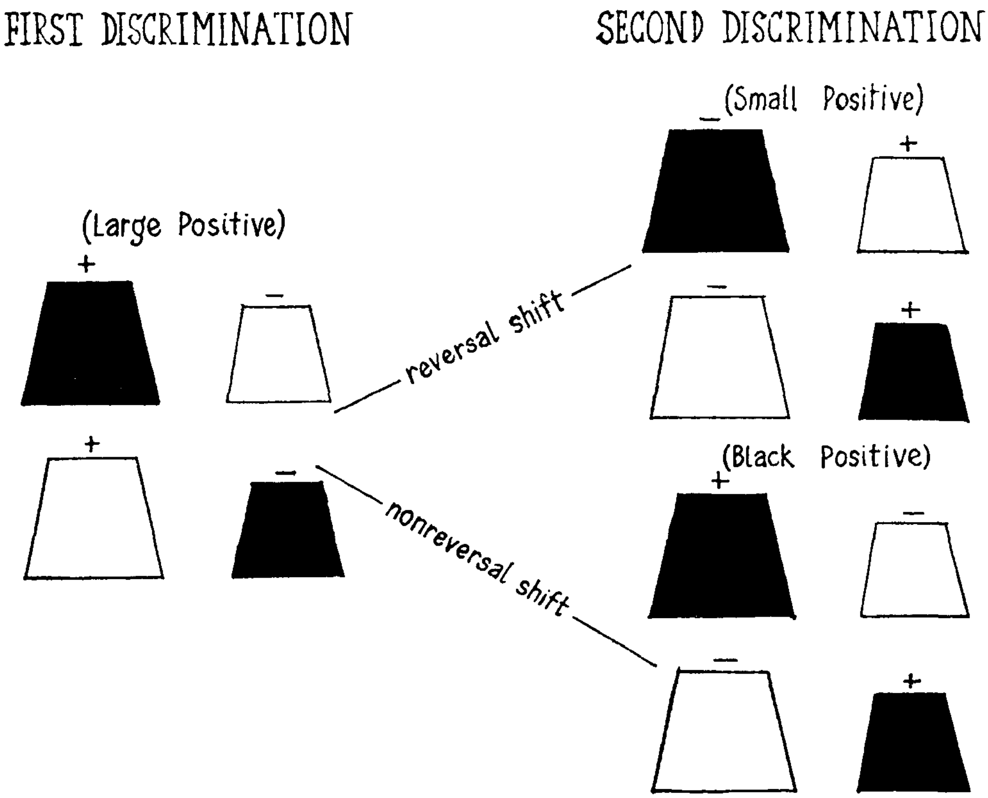

FIG. 2. Illustration of the reversal and nonreversal shift discrimination problem.

on the left, in which the large figure is always rewarded and the brightness of the figure is irrelevant. After this discrimination has been mastered the subject is switched to either the reversal or the nonreversal shift discrimination. Note that in the reversal shift the subject now has to learn that the reward is to be found under the small figure; the dimension along which the discrimination is made—size—is still the same, but is reversed. In the nonreversal shift, the basis for the discrimination is on a different dimension than that of the first problem; in the nonreversal shift the subject must learn that the reward is now to be found under the *black* figure and size is now the irrelevant dimension. The interesting thing about this problem is that nonmediating subjects such as animals and young children (preschoolers) find the nonreversal shift easier than the reversal, while just the opposite is true of older children whose learning is verbally mediated. If four-year-old children, however, are told to say the words large and small while learning the first discrimination, the reversal shift is then made easier for them than the nonreversal. The same sort of instruction to seven year olds has relatively little effect; since most of them verbalize the solution spontaneously, telling them to do so makes little difference. On the other hand, instructing the seven year olds to verbalize the irrelevant dimension—black and white—greatly delays their learning of the reversal shift (Kendler & Kendler, 1961).

One of my graduate students, Miss Jacqueline Rapier, has used this task in the study of children from a culturally and verbally impoverished background (see Jensen, in press). The subjects were fourth-grade Mexican-American children in the lower half of the IQ distribution. They were compared with Anglo-American children of the same age and IQ. The Anglo-American children showed the expected difference between the reversal and nonreversal shift; the reversal was easier than the nonreversal shift, indicating that most of the subjects were verbally mediating. The Mexican-Americans, on the other hand, showed no difference in performance on the reversal and nonreversal shift. This outcome is typical of the performance of middle-class, Anglo-American children of kindergarten age. This task thus seems quite sensitive in detecting the presence or absence of verbal mediation in the subject's learning. Interestingly enough, these Mexican-American children perform completely up to their age level on tasks which either do not depend to any appreciable extent upon mediation or in which the mediators are made explicit by the experimenter. Evidently there is something in the background of these Mexican-American children that causes them to have a high threshold for the elicitation of verbal mediation. This is especially true in an ostensibly nonverbal learning task.

Syntactical Mediation

Syntactical mediation refers to the interesting phenomenon that the grammatical structure of the language greatly facilitates some forms of learning. The effect is often dramatic, but the mechanism of its operation is not yet understood.

Here is an example. A list of, say, a dozen paired-associates made up of familiar nouns, such as the following, is given to a subject to learn.

HAT - TABLE
TREE - HOUSE
CAT - BED
etc.

College students in learning such a list of paired associates report that they make up verbal mediators to link the paired items. And we know that the easier it is for the subject to make other verbal associations to the paired items, the faster the list is learned. If such a list is given to subjects who do not spontaneously mediate, such as young children or the mentally retarded, a great many repetitions will be needed to learn the list of paired-associates. If, on the other hand, we present these same pairs imbedded in sentences just on the first trial, and then present subsequent trials in the same manner as shown above, the learning is almost immediate, even in the mentally retarded or in children.

Thus:

The HAT fell off the TABLE.
The TREE stands beside the HOUSE.
The CAT ran under the BED.
etc.

In an experiment in which severely retarded adults learned six paired-associates with and without mediators of the type shown above, the mediators were provided by the experimenter on the first trial only (Jensen & Rohwer, 1963b). Actual familiar objects were used rather than words, and the experimenter put the names of the objects into a sentence on first presenting them to the subjects. This resulted in learning the pairs about five times as fast as when they were presented without any mediating sentences but were only named by the experimenter. Practically all the effect occurred in the original learning. The relearning a week later, used as a measure of retention, did not show a statistically significant difference between the Mediation and Nonmediation conditions.

This type of mediation does not facilitate the learning of a serial list, strangely enough, even when the mediators between the items in the list are the same as those which so effectively link the paired-associates (Jensen & Rohwer, 1963a). In an experiment on four matched groups of mentally retarded adults the paired-associate learning was greatly facilitated by providing mediators on the first trial, while the same treatment had no effect whatever on serial learning.

Subjects do not always have to be given the mediators by the experimenter. They can be told to make up mediators of their own. William Rohwer and I did this with groups of children from the kindergarten to the 12th grade, matched for IQ at each grade level (Jensen & Rohwer, in press). Half the children only had to say the names of the picture pairs on the first trial and half were told to put the names of the pictured objects into sentences. The same procedure was followed for both serial and paired-associate learning. The Naming and Sentence conditions do not differ significantly for serial learning, while they produce a large difference in learning speed on the paired-associate task. With sentential mediation, second-graders learn paired-associates as fast as twelfth graders. The kindergartners, however, do not benefit from the mediation instructions, probably because their mediators were syntactically inadequate—a point we shall take up shortly. Also note that with increasing grade level the lack of instructions to mediate makes less difference. This is because older children mediate spontaneously and instructing them to do so does not appreciably improve their performance.

My co-worker on this research, William Rohwer, and Robert Davidson, a graduate student, have been investigating the effective properties of the syntactical mediators (Davidson, 1964; Rohwer, 1964). Rohwer has found that mediators made up to be nonsyntactic, that is, not in normal English word order have no facilitating effect; in fact, they tend to produce interference. Nonsense paralogs which sound like words and give the impression of normal word order also have no facilitating effect. When paired-associates are linked by different parts of speech and by phrases differing in verbal complexity it is found that different parts of speech differ in their facilitating power and that complete sentences are more effective than phrases. And imbedding the paired items in verbally rich sentences seems to be more facilitating than simple sentences. For example, Rohwer compared the facilitating effects of such phrases and sentences as:

a. The HAT and the COW.

b. The dirty HAT on the sleeping COW.

c. The dirty HAT rested quietly on the sleeping COW.

The effectiveness of the mediation increases in the order *a*, *b*, *c*. With a complete sentence, more than four times as many items were correct on the first test trial than in the control condition. Davidson (1964) has shown a similar effect in second-graders.

Conclusion

The tendency to verbally mediate in learning and problem-solving situations appears to be one of the main ingredients of intelligence and hence of educability. Furthermore, it is an aspect of intelligence and learning ability which is relatively susceptible to environmental influence. Though spontaneous mediation will be deficient when innate capacity is poor, it will also be deficient when innate capacity is good but the social environment is impoverished in the kind of verbal interactions which inculcate mediational habits. The psychology of verbal mediation should be regarded by educational psychologists and school psychologists as one of the major areas for further research and development in connection with the goal of increasing the intellectual and educational potential of large segments of our population.

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