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The four experiments of this study represent the first stage on a program of research designed to clarify the nature and development of certain implicit verbal behavior and to move toward application of this knowledge to school learning situations and problems. Specifically, the experiments were created to investigate some aspect of the implicit associative response (IAR). The subjects were presented with one list of words, then were presented with a partially different list, and then were asked to identify those words which also appeared on the first list. On the second list were also new words with and without an associational value to the first-list words. The subjects mistakenly recognized more nonfirst-list associated words than nonfirst-list nonassociated words. Such a mistake is considered to be the effect of IAR. The results of the four experiments indicated that (1) when children were asked to use the strategy of association in learning the first-list words, IAR was facilitated; (2) when children were asked to pronounce each word in the first list as they learned it, the IAR effect was reduced; and (3) the IAR effect was reduced with the age of the child. (WD)

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Evanston, Illinois

August 19, 1968

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U.S. DEPARTMENT OF
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SUMMARY

Internal verbal processes are assumed to play a central role in complex school learning tasks (e.g., reading). The research reported here is concerned with a certain class of internal verbal behavior. The IAR is conceptualized as an internal verbal response that may occur when an individual sees or hears a word. For example, when the word "gallop" is encountered the word "horse" may be produced as an IAR. The IAR is presumed to be involved in verbal mediation, so is important both to the educator and to the theoretical psychologist.

A procedure recently developed for the study of IAR production is as follows: A long list of words is presented, and subjects are asked to indicate whenever a word appears that had occurred earlier in the list. Late in the list, words are inserted that are common associates of earlier appearing words. For example, "gallop" may appear early in the list and "horse" later. Under these conditions subjects are more likely to falsely recognize "horse" as having appeared earlier than they are control words not associated with any earlier appearing word. These errors have been interpreted to mean that when "gallop" was first presented "horse" was elicited as an IAR, resulting in the later confusion. This false recognition effect has been obtained with both adults and children, and the procedure appears to be a promising one for the study of implicit verbal processes.

This report describes the results of four experiments. In three of these a modification of the false recognition procedure just described was employed. This procedure consisted of the successive presentation of two lists of words, a free-learning list and a recognition list. The recognition list (List 2) contained (a) some words that had been presented in List 1, (b) some words that were strong associates of certain words in List 1 but had not themselves appeared in List 1, and (c) words that neither appeared in List 1 nor were associates of any List 1 words. In each case, the task of the subject (S̲) was to identify those words in List 2 that had appeared previously in List 1.

Experiment I examined the effects of variations in rate of presentation during learning and amount of decision-time allowed during recognition on recognition performance by college students. The question of concern was whether the occurrence of words as IARs during learning does in fact set the stage for subsequent false recognition of the words. If so, then presentation of the words at a very fast rate might be expected to reduce IAR occurrence, thus reducing the frequency of subsequent IAR-produced false recognitions. If, however, the relevant processes occur only at the time of recognition, only variations in amount of

recognition decision-time should influence frequency of IAR-produced false recognitions. In fact, in this experiment, neither of these variables affected frequency of IAR-produced false recognitions. Because of certain limitations of the particular experimental procedures employed, the results were considered inconclusive.

The major purpose of Experiment II was similar to that of Experiment I. The procedure, however, was quite different. Children were presented a word list for learning under one of three conditions of learning instructions. One group was told to learn by thinking of words of which the presented words reminded them. These instructions were designed to facilitate IAR occurrence. A second group was told to think over-and-over only the words presented, a strategy designed to reduce IAR occurrence. The third group was told only to remember the words with no special strategy imposed. As predicted, the IAR-produced false recognitions were most frequent for the facilitation group and least frequent for the reduction group. These data suggest that the first step in the processes leading to IAR-produced false recognitions occurs at the time of learning, when IARs are elicited.

In Experiment III the false-recognition procedure was employed with kindergarten and third-grade children. At each age level, half the _S_s pronounced each word after its presentation during learning and half did not. Both variables were reliably related to frequency of IAR-produced false recognitions. Such errors were more frequent for the younger than for the older _S_s and for the nonpronouncing than for the pronouncing condition. It is proposed that the decline with age in frequency of IAR-produced false recognitions is due not to decreased IAR production, but rather to increasing ability to differentiate between words previously presented and words elicited as IARs to the presented words. Further, such differentiation may be facilitated by overt pronunciation of the presented words. Pronouncing also resulted in a higher frequency of correct recognitions of repeated words in the case of the younger _S_s only.

In Experiment IV, first- and fourth-grade _S_s were presented a series of 20 words, and instructed to respond to each presented word (Stimulus word) with the first word that came to mind (Response word). Then, the 20 Stimulus words, the 20 Response words, and 20 New words were presented aurally, one at a time. The task was to correctly classify each of the 60 words. All types of errors were more frequent for younger than for older _S_s. This finding is consistent with the hypothesis that the decrease with age in frequency of IAR-produced false recognitions is due to increased ability with age in differentiating between words presented to them and words elicited by the presented words. A second finding was that more Response words than Stimulus words were incorrectly judged to be New words. Thus, it appears that the Stimulus words were learned better than were the Response words even though only the latter were overtly pronounced by the _S_s. Possible explanations for this finding are discussed.

INTRODUCTION

It is widely recognized that simple stimulus-response models which have been relatively successful in predicting behavior of lower animals are not adequate in accounting for much complex human behavior such as occurs in school learning situations. This inadequacy has led to increased experimentation and theory development regarding internal processes, especially verbal mediation processes. The work of the Kendlers is of particular interest to Education. They have provided evidence that verbal mediation plays an important role in problem-solving by older school children and adults, and that a shift from nonmediated to mediated behavior occurs, for most normal children, at about five to seven years of age (Kendler, 1963). Apparently younger children are deficient in these processes, as are mental retardates and, perhaps, older children reared in culturally impoverished environments. The nature of this "mediational deficiency" is not clear, and two possibilities have been proposed by Flavell, Beach, and Chinsky (1966). One possibility is that internal or implicit verbal responses are made, but that for some reason they do not function to mediate overt behavior. The second possibility is that the implicit verbal responses are not produced in the first place, i.e., that there is a "production deficiency" (Flavell et al., 1966). In any case, the concept of mediational deficiency has interesting implications for Education. For example, McNeany and Keislar (1966) have reported a recent attempt to teach kindergarten children from relatively impoverished environments increased use of verbal mediation in problem-solving. However, present knowledge regarding these basic processes is so incomplete as to seriously limit effective educational application. It is this state of affairs that provided the background and impetus for the research reported here. These experiments constitute the first stage in a program of research designed to clarify the nature and development of certain implicit verbal behavior, and to move toward application of this knowledge to school learning situations and problems.

There is evidence that when a single, familiar word is presented to an adult or school age child at least two types of implicit or internal responses may occur. One is the response involved in the act of perceiving the word. This implicit response has been called the <u>representational response</u> (RR) by Bousfield, Whitmarsh, and Danick (1958). The second is an <u>implicit associative response</u> (IAR) consisting of a word (or words) previously associated with the word presented and elicited by the stimulus properties of the RR (Wallace and Underwood, 1964). For example, when "high" is presented "low" may be elicited as an implicit associative response (IAR). It appears likely that IARs serve as links in verbal chains assumed to mediate complex human behavior in school learning and problem-solving situations. It seems probable also that the degree to which children habitually produce IARs, and the nature of the IARs produced, are determinants of, or at least lawfully related to, success in school activities which involve reading, originality of productions, and problem-solving.

Recently Underwood (1965) introduced a "false-recognition" procedure in an experiment examining IARs to various classes of stimulus words. A list of 200 words was presented to college students who were asked to report whenever they recognized a word that had appeared earlier in the list. Appearing late in the list were experimental words (E) words which were high frequency associates of certain words (critical stimulus or CS words) which had occurred earlier in the list. It was assumed that if the E words had been elicited previously by CS words as IARs, subjects (Ss) frequently would incorrectly identify the E words as having appeared earlier in the list. This prediction was confirmed by Underwood in that for three of the five classes of words used, false recognition of E words was reliably more frequent than for control (C) words. Although Underwood (1965) suggested that the false recognition of E words was due to their appearance as IARs to CS words early in the list, he acknowledged the possibility that it is due instead (or in addition) to implicit backward associations occurring at the time the E word is present. The first two experiments described in this report bear upon this question.

Assuming that deficiency in verbal mediation processes is involved in mental retardation, and that IARs are critical in such mediation processes, Wallace (1967) predicted fewer false recognitions of associates (compared with nonassociates) of previously appearing words by retardates than by nonretardates. This prediction was confirmed, using a procedure similar to that employed by Underwood.

Extending Wallace's reasoning, the present writer, with an associate, conducted two studies of IAR production by children (Hall and Ware, 1968). The first experiment was designed simply to discover whether or not the basic false recognition phenomenon reported for adults is reproducible with young children. This was accomplished by aural presentations of a free learning word list followed, after an unrelated task by aural presentation, of a recognition list. The free-learning list included several CS words and the recognition list contained both E and C words (*i.e.* new words which were not strong associates of any words in the free learning list). Frequency of false recognitions was reliably greater for E than for C words.

It had been anticipated that IAR-production, and thus frequency of IAR-produced false recognitions, would increase with age. This expectation seemed reasonable in light of evidence suggesting a marked shift in the use of verbal mediators from about four to eight years of age (see, for example, Kendler, 1963), and consistent with the Wallace (1967) results. The second experiment was designed to test the hypothesis that IAR production, as indicated by false recognitions, increases during the early school years. Ss in this experiment were 24 kindergarten and 24 third-grade children enrolled in the same elementary school. A reliable age difference was found, but in exactly the opposite direction to that predicted. False recognition scores (E-C scores) were reliably greater for the younger group, and in fact, no false recognition effect at all was found for the third-graders. These results have forced the investigators to re-examine certain assumptions regarding the processes which contribute to false recognitions and suggest the need for research which will clarify these processes and their development. The results of Wallace (1967) with retardates compared with normals suggested that as MA increases so will the frequency of IAR-produced false recognitions. The results of Hall and Ware suggest that the relation between MA and false recognitions is more complex than that. One possibility is that IAR production does increase as MA increases, but that at the same time the ability to differentiate between IARs and the words actually presented also increases. The last two experiments described in this report (Experiments III and IV) are concerned with this question.

Experiment I

Underwood (1965) proposed that the initial step in the processes leading to the false recognition of an associate of a presented word is the occurrence of that associate as an IAR at the time the presented word is perceived. An alternative possibility suggested by Wang, Powers, Lerner, and Ranken (1966) is that the relevant processes occur exclusively at the time of recognition. In designing Experiment I, it was reasoned that if the Underwood interpretation is correct, false recognition frequency should be sensitive to variations in rate of presentation during learning. A very rapid rate would be expected to reduce the opportunity for the occurrence of IARs, thus reducing the frequency of IAR-produced false recognition. However, if the relevant processes occur exclusively at the time of recognition, then only the rate of presentation during that phase, and not during learning, should affect the frequency with which associates of previous words are falsely recognized.

Method

Two word lists were presented via tape recorder successively to each of 84 Northwestern University students. The word lists and the function of each word are shown in Table 1. The procedure for each S consisted of aural presentation of a 38-item list (List 1a or 1b) with S instructed to try to remember each word. Next, after about 1-min., a 47-item list (List 2) was presented with S instructed to identify those words that had appeared in the first list.

The Ss were assigned randomly to either a fast (.8-sec.) or a slow (2.4-sec.) rate of presentation of List 1. For half of the Ss who received the fast rate during learning, the list was presented three consecutive times equalizing total presentation time with the slow rate group. All other Ss received only a single presentation of List 1. Thus, there were three conditions with respect to List 1 presentation: single presentation - fast (IF), triple presentation - fast (3F), and single presentation - slow (IS).

Within each of the above conditions, half the Ss received the recognition list at a fast pace and half at a slow pace. This was done by instructing Ss to respond with a judgment of "old" or "new" as soon as the word "mark" occurred. For the fast-pace condition "mark" occurred immediately (about .3-sec.) after each presentation, whereas a 2.5-sec. interval obtained for the slow-pace condition. The result of these manipulations was six conditions each containing 14 Ss: IF-F, 3F-F, 1S-F, 1F-S, 3F-S, and 1S-S.

List 1 contained twenty-one words which also occurred in List 2 and were termed Repeated or R words. The nine Critical Stimulus or CS words were those for which strong associates existed which presumably were likely to occur as IARs, leading to their subsequent false recognition.

Table 1

Word Lists Used in Experiment I

Learning

List 1a		List 1b	
begin	R	begin	R
window	R	window	R
baby	F	baby	F
listen	R	listen	R
tobacco	R	tobacco	R
hard	CS_1	long	CS_2
love	F	love	F
face	R	face	R
slide	R	slide	R
angry	R	angry	R
book	F	book	F
rich	R	rich	R
high	CS_1	black	CS_2
shoes	R	shoes	R
birthday	F	birthday	F
rock	R	rock	R
dogs	CS_1	ice	CS_2
blossom	CS_1	bed	CS_2
near	F	near	F
dirty	R	dirty	R
table	CS_1	saddle	CS_2
basket	R	basket	R
star	F	star	F
scissors	CS_1	lamp	CS_2
good	R	good	R
slow	CS_1	queen	CS_2
train	R	train	R
deaf	R	deaf	R
house	F	house	F
number	R	number	R
fun	R	fun	R
hammer	CS_1	bitter	CS_2
street	R	street	R
eagle	CS_1	carpet	CS_2
judge	R	judge	R
bridge	F	bridge	F
water	R	water	R
large	R	large	R

List 2 (recognition)

tobacco	R	short	E_2 C_1
pencil	F	king	E_2 C_1
window	R	light	E_2 C_1
begin	R	flower	E_1 C_2
street	R	low	E_1 C_2
listen	R	dirty	R
stove	F	nail	E_1 C_2
music	F	white	E_2 C_1
angry	R	soft	E_1 C_2
face	R	fun	R
preacher	F	fast	E_1 C_2
apple	F	cats	E_1 C_2
basket	R	bird	E_1 C_2
judge	R	large	R
good	R	sweet	E_2 C_1
number	R	rock	R
change	F	cold	E_2 C_1
deaf	R	horse	E_2 C_1
pretty	F	rug	E_2 C_1
water	R	slide	R
rich	R	ring	F
chair	E_1 C_2	shoes	R
sleep	E_2 C_1	train	R
cut	E_1 C_2		

Table 2

Recognition Performance in Exp. I: Mean Numbers of "Old" Judgments per Subject

Learning Condition		Recognition Condition F: R words	F: E words	F: C words	S: R words	S: E words	S: C words
1F	$\bar{X}$	5.28	3.07	3.07	4.28	3.57	1.43
3F	$\bar{X}$	6.28	2.14	0.78	6.42	2.99	1.85
1S	$\bar{X}$	5.93	2.28	1.50	5.71	2.28	1.92

The remaining words in List 1 (Filler or F words) were inserted only to increase task difficulty. In addition to twenty-one R words, List 2 contained nine Experimental (E) words (the strong associate of the CS words in List 1), and nine Control (C) words (nonassociates of List 1 words). The CS-E pairs were selected on the basis of published word association data (Palermo and Jenkins, 1964).

Half of the Ss in each of the six conditions received List 1a and half received List 1b. As shown in Table 1, the E words in List 2 for Ss who received List 1a functioned as C words for those who received List 1b. Similarly, the E words for Ss who received List 1b functioned as C words for Ss who received List 1a. For example, CHAIR functioned as an E word for Ss who received List 1a and a C word for those who received List 1b, while the reverse was true for SLEEP.

Results

Since the performance of Ss did not differ reliably as a function of the particular list employed during learning (List 1a or 1b), the data for these two conditions were combined for all subsequent analyses.

The mean numbers of responses of "old" to the R, E, and C words are shown in Table 1. The means for the R words are based on responses to only the last nine R words that appear in List 2. An overall t test showed that the E words were falsely recognized with greater frequency than were the C words, $t\ (83) = 3.84$, $p < .001$. Analysis of variance applied to the E-C scores indicated no significant effects of presentation condition either during learning or recognition, nor was there a significant interaction between these two variables.

In the case of correct recognitions of R words, the only reliable effect was that of presentation condition during learning, $F(2,78) = 6.61$, $p < .01$. The highest frequency of correct recognitions occurred in the 3F condition and the lowest in the 1F condition. This reflects the fact that the 1F Ss were markedly poorer in performance than those in conditions 3F and 1S, whereas the latter two conditions were highly similar.

Discussion

The data of this experiment provide no evidence that the frequency of IAR-produced false recognitions is affected either by rate of presentations of words during learning or by amount of decision-time available during recognition. Procedural factors may have accounted for these negative findings. The overall difference between E and C words in frequency of false recognitions, although highly reliable, was rather small. This may have resulted from the fact that the rate of presentation during learning in the so-called slow condition was considerably faster than rates in previous studies in which relatively large differences between E and C words have been found. At any rate, it appears that the specific experimental materials and procedures employed were such that the effects of only relatively powerful variables were likely to be evident. One index of this problem is the frequency of false recognitions of C words, which, in this experiment, is considerably higher than has been usual in previous studies. Also, the frequency of correct recognitions of R words is considerably lower than in past studies.

The fact that the 3F and 1S conditions did not differ in performance on R words is of some interest in light of the total-time hypothesis and the question of massed vs. distributed practice. Spaced presentation (the 3F condition) did not result in a higher level of learning than did massed presentation (the 1S condition). This is consistent with total-time hypothesis, which states that degree of learning is a function of amount of study time (see, for example, Cooper and Pantle, 1967).

Experiment II

As in the previous experiment, Experiment II was concerned with the hypothesis that the occurrence of a word as an IAR during learning sets the stage for the subsequent false recognition of that word. If this interpretation is correct, then one would expect that experimental manipulations which increase IAR-production during learning would increase the frequency of false recognitions of associates in a subsequent recognition test. Similarly, manipulations that decrease IAR-production should decrease the frequency of such false recognitions. Accordingly, _Ss_ in the present experiment were presented a list of words to be learned under one of three conditions presumed to affect IAR-production. In one condition, IAR-production was facilitated by instructing the _Ss_ to think of words of which the to-be-learned words reminded them. In a second condition _Ss_ were cautioned to think of nothing but the presented words, thus presumably restricting IAR-production. _Ss_ in the third condition were allowed to select their own learning strategy.

METHOD

Subjects

The _Ss_ were 45 first-grade children (six- and seven-year olds) and 45 third-grade children (eight- and nine-year olds) enrolled in a summer session program in public elementary schools in a predominantly middle-class community.

Design and procedure

The words in the two lists may be divided into five types according to their functions. Table 3 shows the order in which the words were presented and the function of each word. Five of the words in List 1 were repeated in List 2 and were termed R words. The ten critical stimulus or CS words in List 1 were those assumed to elicit the ten experimental or E words placed in List 2. Each R word and each CS word occurred twice in List 1. Along with the ten E words in List 2 were ten words not associated with any List 1 words. These functioned as control or C words. Finally, each list contained several words inserted to increase task difficulty, termed filler or F words. The particular CS and E words employed were chosen on the basis of word association data provided by Entwisle (1966) and Palermo and Jenkins (1966).

_S_'s task for List 2 was to judge each word as either "old" (on List 1) or "new" (not on List 1). Both lists were presented to each _S_ individually by a tape recorder at approximately a 5-sec. rate with about 1-min. between lists. The experimental variation

Table 3

Word Lists Used in Exp. II

List 1

at	F	salt	CS
chair	F	eagle	R
money	F	girl	R
slide	F	gallop	CS
king	F	bed	CS
salt	CS	baby	R
eagle	R	thirsty	CS
gallop	CS	eating	CS
thirsty	CS	clear	R
girl	R	scissors	CS
scissors	CS	spider	CS
bed	CS	fingers	CS
baby	R	pretty	R
eating	CS	blossom	CS
pretty	R	lamp	CS
spider	CS	mouth	F
lamp	CS	pencil	F
clear	R	look	F
fingers	CS	window	F
blossom	CS	coat	F

List 2

girl	R	house	F
needle	F	sleep	E
train	F	ball	C
pepper	E	gold	C
coffee	C	food	E
lion	C	clear	R
horse	E	web	E
eagle	R	run	C
hair	F	baby	R
lazy	F	church	C
tall	C	hand	E
cut	E	flower	E
water	E	south	C
car	C	light	E
pretty	R	receive	C
read	F		

Table 4

Exp. II: Percent of "Old" Judgments for Each Type of Word at Each Age Level Under Each Type of Learning Instructions

Grade level	Facilitative instructions			Neutral instructions			Reduction instructions		
	R words	E words	C words	R words	E words	C words	R words	E words	C words
1st	72.9	14.3	2.9	74.3	13.6	3.6	84.3	11.4	2.9
3rd	90.0	28.6	6.4	88.6	16.4	5.7	88.6	10.7	6.4

in learning strategies was introduced in the learning instructions for List 1, and resulted in 3 conditions. Subjects in condition N were given instructions that were neutral in regard to their learning strategy. That is, they simply were asked to listen to the words and try to remember them. In condition F, the *Ss* were given instructions designed to facilitate IAR occurrence during List 1 learning. They were instructed that, to aid in their remembering the words, they should think of words of which the presented word reminded them. The remaining *Ss* received instructions designed to reduce IAR occurrence (condition R). These *Ss* were told that to help them remember they should repeat each presented word over and over to themselves and not think of anything else.

At each age level *Ss* were assigned randomly to the 3 conditions resulting in a total of six groups. Because of the continued absence of three *Ss*, three of the groups contained only 14 *Ss*. One *S* was then removed randomly from each of the other 3 groups, equalizing the groups at 14 *Ss* each.

RESULTS

The per cents of E and C words incorrectly judged "old" are shown in Table 4. A 3x2x2 analysis of variance was applied to evaluate the main effects of, and interactions among type of instructions (F vs. N vs. R), type of words (E vs. C), and age. False recognitions were reliably more frequent for E than for C words, F (1, 78) = 45.30, $p < .001$. No other main effects approached significance. Only one interaction was reliable, that between type of instructions and type of word, $F(1,78) = 3.30$, $p < .05$, the E-C difference being greatest under cond. F and least under cond. R. Even in condition R, however, false recognitions occurred more frequently for the E than for the C words. The direction of the E-C differences was positive for 12 *Ss* and negative for only 2 *Ss*, a reliable difference ($p < .05$, sign test). A closer examination of the data reveals that in terms of these E-C scores, condition F differs substantially from conditions N and R, while the latter two differ relatively slightly.

The per cents of R words correctly recognized within each condition and at each age level also are shown in Table 4. Analysis of variance indicated reliably more accurate performance by the older *Ss*, F (1, 78) = 9.54, $p < .01$, with no other differences approaching significance. However, although the younger *Ss* produced fewer "true positives," inspection of the C word data shows that they also produced fewer "false positives."

DISCUSSION

As has been the case in several previous studies (e.g. Hall and Ware, 1968; Hall, in press), associates of previously appearing words were falsely recognized much more frequently than were nonassociates. This has been interpreted to mean that the E words occurred earlier as IARs when their corresponding CS words were presented for learning. This interpretation seems particularly reasonable in light of the effects of the instructional variations employed in the present experiment. As predicted, instructions that facilitated production of IARs during learning resulted in a higher frequency of false recognitions of E relative to C words in comparison to the IAR-restricting instructions. This suggests that even for very simple learning tasks recognition performance can be altered by instructor-imposed learning strategies. Note, however, that this alteration is not reflected either in per cent of repeated words that were correctly recognized or in per cent of C words (the nonassociates of List 1 words) falsely recognized. Only when errors on E words (the associates of List 1 words) are examined is the effect of differential learning strategies apparent. It is interesting that, despite the restricting instruction, IAR-produced false recognitions did occur among the _S_s in cond. R. This fact raises several questions. Does the presence of IAR-produced false recognitions for cond. R mean that, try as they might, _S_s were unable to inhibit IAR-production? Or did some _S_s simply ignore or not understand the learning instructions? A third possibility is that such false recognitions, while facilitated by the occurrence of the E words as IARs during learning, do not depend entirely on such occurrence.

Also of interest is the fact that the frequency of IAR-produced false recognitions was only slightly lower for cond. R than for cond. N. Further experimentation will be necessary to determine whether, when left to themselves, _S_s select strategies that are as effective in minimizing IAR-produced false recognitions as any instructor-imposed strategies would be. It appears likely that the effectiveness in self-selected strategies will be found to increase with age and with amount of prior task information, and that the latter two variables may interact. That is, as children grow older, their ability to effectively utilize preliminary task information in order to adopt optimal learning strategies will increase. These possibilities will be examined in future experiments.

When one examines age differences in correct recognitions of R words, it is tempting to conclude that recognition accurracy improves markedly across the age range sampled, particularly since a substantial ceiling effect may be operating in respect to the older _S_s. However, this age difference is somewhat misleading, since fewer "false positives" as well as fewer "true positives" occurred for the younger _S_s. That is, the younger _S_s appear to have employed a more stringent criterion for their judgments of "old."

The lack of age differences in frequency of IAR-produced false recognitions (i.e. the mean E-C scores) deserves comment, in light of two previous studies (Hall and Ware, 1968; Hall, in press) that have found a decline with age in this respect. In these previous studies, Ss in the youngest groups (i.e. the groups in which a higher frequency of IAR-produced false recognitions have been found) have been, on the average, one year or more younger than the younger group in the present experiment. It may well be that it is between 5½ and 6½ that the developments occur which account for the age differences reported in the earlier studies.

Experiment III[1]

One purpose of Experiment III was simply to replicate the age difference finding of the Hall and Ware (1968) study described earlier. A second major purpose was related to a hypothesis regarding this age difference. More specifically, it was proposed that the older children make fewer IAR-produced false recognitions than do the younger ones, not because the older children produce fewer IARs, but because their ability to discriminate between RRs and IARs is greater than that of the younger children. If this is the case, then anything that affects discriminability of RRs and IARs should influence frequency of IAR-produced false recognition. One such variable may be the overt pronunciation of the presented word. Thus, in this experiment approximately half of the Ss at each level were required to say aloud each word presented to them, and the remainder were given no instructions regarding pronunciation of the words.

Method

Subjects

Ss were 40 kindergarten children (17 boys and 23 girls) with mean CA = 5-10 and 40 third-graders (20 boys and 20 girls) with mean CA = 8-11, enrolled in a public elementary school in Winnetka, Illinois.

Design

The design called for the presentation of one word list under free learning (FL) instructions, followed by a second list under recognition instructions. Both word lists are shown in Table 5. The words are listed in the order in which they were presented, with the function of each word indicated beside it. Included in List 1 were 10 words (critical stimulus or CS words), each of which has been shown to elicit a particular response with relatively high frequency when standard word-association procedures are used. These high frequency responses to the CS words, presumed likely to occur as IARs, were placed in List 2 as experimental (E) words. In recent word association data (Palermo and Jenkins, 1966; Entwisle, 1966), the mean frequency with which the 10 E words used here were elicited by their respective CS words was 43.7 percent for kindergartners[2] and 45.4 per cent for third-graders.

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1. A report of this experiment has been accepted for publication in the Journal of Educational Psychology under the title "Word Recognition by Children of Two Age Levels."

2. Because the Palermo and Jenkins norms do not include data on kindergartners, frequency estimates for seven of the ten CS-E pairs were based on first-grade data.

Table 5

Exp. III: Words Used and Their Functions

List 1 (Free Learning)

at		salt	CS
chair		eagle	R
money		girl	R
slide		gallop	CS
king		bed	CS
salt	CS	baby	R
eagle	R	thirsty	CS
gallop	CS	eating	CS
thirsty	CS	clear	R
girl	R	scissors	CS
scissors	CS	spider	CS
bed	CS	fingers	CS
baby	R	pretty	R
eating	CS	blossom	CS
pretty	R	lamp	CS
spider	CS	mouth	
lamp	CS	pencil	
clear	R	look	
fingers	CS	window	
blossom	CS	coat	

List 2 (Recognition)

girl	R	house	
needle		sleep	E
train		ball	C
pepper	E	gold	C
coffee	C	food	E
lion	C	clear	R
horse	E	web	E
eagle	R	run	C
hair		baby	R
lazy		church	C
tall	C	hand	E
cut	E	flower	E
water	E	south	C
car	C	light	E
pretty	R	receive	C
read			

Table 6

Exp. III: False Recognitions of E and C Words and Correct Recognitions of R Words

Instructions	Kindergarten			Third Grade		
	E words	C words	R words	E words	C words	R words
Overt Pron.						
$\bar{X}$ per S	0.95	0.35	4.60	0.50	0.35	4.60
SD	0.76	1.37	0.75	1.05	0.59	0.60
No Overt Pron.						
$\bar{X}$ per S	2.00	0.25	3.65	1.25	0.50	4.35
SD	1.69	0.55	0.74	1.57	1.09	0.84

Also included in List 1 were five repeated (R) words, so termed because they also appeared in List 2. To reduce learning differences within List 1 due to serial position 10 filler words occupied the first and last five positions in List 1. Each CS word and each R word appeared twice within List 1.

List 2 contained the 10 E words, 10 Control (C) words, the five R words, and six "new" filler words. The C words were similar to the E words in general frequency of occurrence (Thorndike and Lorge, 1944) but were not strong associates of any List 1 words. Thus, if false recognitions were more frequent for E than for C words, it would be inferred that this difference was due to the previous occurrence of E words as IARs.

Procedure

The procedure for each S (run individually) consisted of aural presentation of List 1 at a 5-sec. rate followed, after 7-min., by presentation of List 2 at a 4-sec. rate with S instructed to respond "yes" if a word had occurred on List 1 and "no" if it had not. The 7-min. delay between learning and recognition was used to increase the difficulty of the recognition task. To prevent rehearsal during that interval Ss were occupied with jigsaw puzzle tasks. All instructions and words were presented by use of a tape recorder.

During FL an experimental variation in instructions was introduced. Twenty-four of the younger and 23 of the older Ss, selected randomly, were instructed to pronounce each word aloud after it had been presented, and to attempt to remember the word. The remaining 20 younger Ss and 23 older Ss were instructed identically except that no request for pronunciation was made. All Ss followed these instructions properly. For purposes of analyses, random procedures were used to exclude 4 Ss from one group and 3 from each of two others, equalizing the Ss at 20 per group.

Results

False recognitions

In table 6 the mean numbers of false recognitions per S of the E and C words are shown separately for each age level and each pronunciation condition. Using a difference score (E - C) for each S, a t test for correlated data showed the overall mean of the differences (X = .81, S.D = 1.30) to be highly reliable, $t(79) = 5.56$, p .001. This is interpreted as confirming earlier results by Underwood (1965), Davis (1967) and others in showing that E words frequently are elicited as IARs during learning, resulting in their subsequent false recognition.

The E - C difference scores then were used to examine the effects of age and pronunciation instructions on frequency of IAR-produced false recognitions. Analysis of variance showed the main effect of age to be highly reliable, $F(1,76) = 7.48$, $p < .01$. That is, the frequency of IAR-produced false recognitions was higher for the younger than for the older Ss. The main effect of instructions to pronounce also was highly reliable, $F(1,76) = 10.89$, $p < .01$, indicating that overt pronunciation reduced the frequency of IAR-produced false recognitions. The interaction between these variables was not significant.

Correct recognitions

The mean numbers of correct recognitions per S of the R words also are shown in Table 6. Since the data were characterized by marked skewness and nonhomogeneity, nonparametric analyses were performed in which groups were compared in terms of the number of Ss who correctly recognized all five R words. On this basis, the two third-grade groups and the kindergarten Ss under overt pronouncing instructions were quite similar. The mean numbers of perfect scores in these three groups were 13, 11, and 15 respectively. Of the nonpronouncing kindergarten Ss, however, only three of the 20 correctly recognized all five R words. For the kindergarten Ss the difference in this respect between the two pronouncing conditions was highly reliable, X^2 (1) = 12.22, $p < .001$, while the corresponding difference between the two third-grade groups did not approach significance. Clearly, the instructions to pronounce did increase the frequency of correct recognitions of R words by the younger Ss. Although no similar effect was found for the third-graders, it should be noted that the performance level of the nonpronouncing third-graders was so close to maximum that the possibility of a ceiling effect must be considered.

Discussion

False recognitions

The fact that IAR-produced false recognitions were more frequent for the younger than for the older children simply replicates the earlier findings of Hall and Ware (1968). The question, then, is whether the older children simply produce fewer IARs under these experimental conditions or whether some other process is accounting for the differences found. The first alternative seems unlikely in view of evidence from other lines of research and common conceptions of verbal development in children. It is generally believed that implicit verbal behavior increases markedly from about three to eight years of age. The Kendlers, in particular, have provided considerable experimental evidence that verbal mediation increases substantially during this period (e.g., Kendler, 1963). Presumably IARs are frequently involved in such mediation, so that one would expect their occurrence to be <u>more</u> frequent in the older children, not less frequent. Of course, one might speculate that there is something about the particular experimental situation that inhibits the production of IARs by the older children, and that under other circumstances false recognitions would be greater for the older children. However, there is another alternative that appears more plausible, at least as a working hypothesis.

Perhaps as a child grows older (from five to eight, say) he does become more productive of IARs, but, at the same time, he also becomes better able to discriminate between words that were presented and words that he was reminded of. The basis for discrimination is not clear. One possibility involves the frequency hypothesis proposed by Ekstrand, Wallace, and Underwood (1966). The notion here is that the RR occurs with greater frequency than does the IAR. That is, the <u>S</u> probably says the presented word silently several times while an IAR is unlikely to be rehearsed. This frequency difference then may be the basis for the <u>S</u>'s ability to respond correctly during recognition, i.e., to successfully distinguish between the IAR and the RR. Possibly the older <u>S</u>s rehearse the presented words more than do the younger <u>S</u>s, so that the frequency discrepancy on which discrimination is based increases with age.

As predicted, pronunciation of the words during FL reduced false recognitions that were attributable to IAR occurrence. The interpretation favored by the author is that pronunciation of the words increased discriminability of those words from the IARs which they elicited, although the basis for increased discriminability is unclear. Again, frequency may be involved if we assume that the speaking of a word, at least for some <u>S</u>s, adds to the number of implicit rehearsals that the word receives, producing a higher frequency of occurrence than if the word had not been spoken. It also could be argued that the time taken to pronounce the word left less time for IAR production than was available for <u>S</u>s who did not pronounce the word. Thus, it simply may be that fewer IARs were made by <u>S</u>s who pronounced. These, as well as other possibilities cannot be evaluated at present.

Correct recognitions

In the correct-recognition data one finding stands out - the striking effect of instructions to pronounce on the performance of the younger children. The importance of pronouncing responses in a learning task of this type is well documented (e.g. Mechanic and D'Andrea, 1965). The present data suggest that with the younger children explicit instructions to pronounce markedly increase pronouncing and thus learning. It is not clear whether the pronunciation would need to be overt, as it was in the present instance, rather than covert in order to obtain this effect.

The fact that for the older <u>S</u>s only a slight difference occurred between the pronouncing and nonpronouncing groups may have been due simply to a ceiling effect. However, an alternative worth examining further is that by the age of eight or nine normal learning instructions produce covert pronouncing responses so regularly that explicit pronouncing instructions are superfluous.

Experiment IV [3]

In two recent studies (Hall, in press; Hall and Ware, 1968), IAR-produced false recognitions were found to occur with greater frequency by five- and six-year old children than by eight- and nine-year olds. It appears unlikely that this age difference is due to a decline with age in the frequency with which IARs occur. A more plausible hypothesis is that the older subjects (Ss) were better able than the younger ones to discriminate between words that had been presented to them and those that had occurred only as IARs.

The experiment reported here was designed to test a prediction based on the above discrimination hypothesis. The test consisted of obtaining associative responses of children to a set of stimulus words, then requiring the children to differentiate among three types of words: the words previously presented to them, their responses to the presented words, and a set of "new" words. It was anticipated that differentiation would become increasingly accurate with age.

Method

Subjects

Ss were 27 first-grade (mean CA = 6-11) and 27 fourth-grade (mean CA = 9-11) children selected randomly from these grade levels in a public elementary school in Winnetka, Illinois. There were 14 boys and 13 girls at each age level.

Design and procedure

The experiment consisted of two phases. First, a list of 20 common words, ordered randomly, was read to each S, with the S instructed to say the first "real word" that came to his mind. S's responses were recorded by E. Next, beginning immediately, 60 words were read to S. Twenty of these were the words that had been presented to the S in phase 1 (Stimulus words), twenty were S'S responses (Response words) from phase 1, and 20 were "New words" of high frequency but not strongly associated with any of the stimulus words. The Stimulus words and the New words are shown in Table 7. Of course, the Response words cannot be shown since they differed from S to S. These 60 words were presented in a predetermined random order, with S instructed to tell whether "this is a word that I said to you, a word that you said back to me, or a brand new word." In both phases, the interval between and S's response and E's presentation of the next word ranged from 4 to 6 sec.

3. A report of this experiment has been accepted for publication in the Journal of Educational Psychology under the title "Errors in Word Recognition and Discrimination by Children of Two Age Levels."

Table 7

Stimulus Words and New Words

Stimulus Words		New Words	
salt	table	gold	running
gallop	mountain	pencil	picture
thirsty	sweet	jump	train
scissors	needle	pretty	church
bed	eagle	tiger	dog
eating	king	house	ball
spider	cry	bridge	curtain
lamp	shoot	hair	stove
fingers	rocket	car	friend
blossom	jacket	cold	slide

Table 8

Mean Numbers of Each Response for Each Type of Word
(with Standard Deviations in Parenthesis)

Type of response given

Type of word presented	First grade Stimulus word	Response word	New word	Fourth grade Stimulus word	Response word	New word
Stim. word						
$\bar{X}$	17.11	1.56	1.33	18.44	0.82	0.74
S.D.	(4.22)	(1.27)	(1.18)	(4.38)	(0.92)	(0.88)
Resp. word						
$\bar{X}$	3.22	12.33	4.44	1.41	16.37	2.15
S.D.	(1.83)	(3.58)	(2.15)	(1.21)	(4.12)	(1.49)
New word						
$\bar{X}$	0.48	0.07	19.44	0.18	0.00	19.81
S.D.	(0.70)	(0.87)	(4.49)	(0.44)	(1.09)	(4.54)

Results and Discussion

Responses of Ss at each age level to each of the three types of words are summarized in Table 8. The means shown in Table 8 represent the mean numbers of Stimulus, Response, and New words that were judged to be in each of these three categories. Thus, for example, the mean number of Stimulus words correctly categorized as Stimulus words was 17.11 (S.D. = 4.22) of a possible 20, and the mean number of Stimulus words incorrectly judged as Response words was 1.56 (S.D. = 1.27).

First to be considered are errors in which words that had occurred in phase 1 (i.e., the Stimulus words and the Response words) were not recognized as having occurred. These will be termed recognition errors, and were indicated whenever a Stimulus word or a Response word was incorrectly categorized as a New word. Errors in which Stimulus and Response words were interchanged will be termed discrimination errors, and are considered later.

Analysis of variance applied to the recognition error data for Stimulus and Response words showed that the main effects of both age and type of word were significant, F (1,52) = 15.05 and 75.76, $p < .01$ as was the interaction, F (1,52) = 10.77, $p < .01$. As would be expected, the older Ss were much better able than the younger Ss to recognize that the Stimulus and Response words had appeared earlier. Quite unexpected was the fact that recognition errors were made three times as frequently for Response words than for Stimulus words, by the Ss. There are at least two explanations for this striking difference that deserve consideration. One is that in order for a S to produce a response, the stimulus word must be pronounced covertly, and that in many cases multiple covert pronouncing of the stimulus occurs before the overt response is elicited. That is, for example, when SWEET is presented, the S "thinks" SWEET, SWEET, SWEET, -- CANDY, so that the stimulus word is rehearsed more, and thus learned better, than is the response word. A second possibility is that children are more likely to intentionally attempt to learn words presented by a teacher or experimenter (or possibly by any adult to whom they are attending) than words which they, themselves, emit. Thus, although the task was considered to be an incidental learning task in that no mention of a subsequent test was made, it may not have been equally incidental for the two types of words. This explanation might also account for the fact that the difference in error frequency between stimulus and response words was greater for the younger than for the older Ss (i.e., the significant age x word-type interaction). That is, the social stimulus value of the E may have been greater for the younger than for the older Ss.

Performance on the New words was nearly perfect for the fourth-graders (99% of the New words were judged to be new) and only slightly lower (97%) for the first-graders. Since the prior analysis of recognition errors indicated a higher level of learning for the Stimulus than for the Response words, one might anticipate that when New words were falsely recognized, they would be confused with the Response words more often than with the Stimulus words. However, at both age levels New words were more often erroneously judged to be Stimulus rather than Response words. Combining age levels, 14 Ss judged one or more New words to be a Stimulus word while only two Ss judged a New word to be a Response word, a statistically significant difference, X^2 (1) = 10.75, $p < .01$. Evidently Ss tended to set a less stringent criterion for a Stimulus-word judgment than for a Response-word judgment. Why such a response bias should exist is unclear.

As may be seen in Table 8, discrimination errors (i.e., the tendency to classify a Stimulus word as a Response word or vice versa) were more frequent for the younger than for the older Ss. At both age levels classification of Response words as Stimulus words was more frequent than the reverse. Analysis of variance applied to these discrimination-error data showed both these main effects (age and type of word) to be significant, F (1,52) = 16.81 and 22.56, $p < .01$, as was the interaction between them, F (1,52) = 5.28, $p < .05$.

Both the main effect of age and the age x word-type interaction appear consistent with the discrimination hypothesis proposed to account for previously observed decreases with age in the frequency of IAR-produced false recognitions (Hall and Ware, 1968). Not only did discrimination errors generally decrease with age, but the decrease was particularly great in the case of Response words. It is precisely this type of error (i.e., classification of a word that has occurred only as a response as actually having been presented) that is assumed to occur in the case of IAR-produced false recognitions.

The fact that at both age levels Response words were more frequently classified as Stimulus words than the reverse may be due, at least in part, to the response bias suggested earlier by the error data for the New words. That is, for some reason the Ss set more stringent criteria for judging a word as their own response than for judging it to have been a presented word.

An interesting question not answered by the present data is whether the factors that underlie the observed decline with age in recognition errors also underlie the decline in discrimination errors. It may be that the experimental task involved two decision stages rather than a single stage, and that the most relevant cues for these two judgments differ substantially. In stage 1 the S must decide whether the presented word is "new" or "old." If the decision is "new," the process stops; if "old," however, a second decision is required, namely, whether the item is a Stimulus or a Response word. Assuming the general validity of this analysis, what are the cues involved at each step? One possibility is that the "old-new" decision involves matching the perceived situational frequency of a word with some subjective situational frequency criterion set by the S for a judgment of "old." That is, if the perceived situational frequency of the word exceeds the criterion, the word is judged "old," and the S goes on to the Stimulus word-Response word judgment for which some other kinds of cues may be utilized. Although highly speculative, the possibility that perceived frequency is involved in such judgments may merit consideration in view of recent experimental evidence that perceived frequency is an important cue in verbal discrimination learning (Ekstrand, Wallace, and Underwood, 1966).

CONCLUSIONS

Experiments I and II both had as major purposes clarification of thr role of IAR occurrence during learning on the nature and frequency of subsequent recognition errors. In this respect Experiment I was inconclusive, since frequency of IAR-produced false recognitions was unaffected by variations in rate of presentation during learning and by amount of decision-time allowed during recognition. Experiment II yielded more positive results. Frequency of IAR-produced false recognitions varied reliably as a function of learning instructions. Ss who were instructed to think of words of which the presented word reminded them were highest, and Ss told to think over-and-over of only the presented words were lowest in frequency of IAR-produced false recognitions. Those given no specific learning strategy to follow were intermediate. Frequency of correct recognitions of repeated words was unaffected by these experimental variations. These results are interpreted as supporting the notion that the initial step leading to IAR-produced false recognition occurs during learning when the words subsequently falsely recognized occur as IARs to the words actually presented. Evidently even for very simple learning tasks recognition performance can be altered by instructor-imposed learning strategies. A question that remains unanswered concerns the degree to which children can themselves devise learning strategies that minimize these kinds of errors, once the children are given advance information regarding the nature of the forthcoming recognition task. This question will be the subject of an experiment to be conducted shortly.

In Experiment III the age differences in frequency of IAR-produced false recognitions reported in a previous study (Hall and Ware, 1968) were replicated. Such errors were reliably more frequent among kindergarten as compared to third-grade children. In addition, the frequency of these errors was less under learning instructions that forced the children to overtly pronounce each presented word. It was suggested that increased ability to discriminate between RRs and IARs accounts for this age difference, and that such discriminations are facilitated by the overt pronunciation of the to-be-learned word. Also of interest was the fact that overt pronunciation led to a higher frequency of correct recognitions of repeated words by kindergarten Ss. The absence of such an effect for third-graders may be due to their already pronouncing covertly, making specific instructions to pronounce superfluous.

Experiment IV further explored developmental changes in the nature of word recognition errors. The task of the Ss (first- and fourth-grade children) was to differentiate among (a) words previously presented to them in a word association task (Stimulus words), (b) their overt responses during that task (Response words), and (c) words that had not occurred at all during the experiment (New words). Errors of all types were more frequent by the younger Ss. In particular, the younger Ss were more likely than were the older Ss to misclassify Response words as having been Stimulus words. This appears to be analagous to the classification of words occurring only as IARs as actually having been presented. Thus, the discrimination hypothesis proposed earlier to account for a decrease with age in the frequency of IAR-produced false recognitions appears to have received support. Also of interest, was the fact that more Response words than Stimulus words were misclassified as New words. That is, Ss evidently learned the words presented to them better than they learned the words that they "constructed" themselves in response.

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