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Facilitation in Naming and Categorizing Repeated Pictures and Words

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Subjects named or categorized a picture preceded sometime earlier by itself or by its verbal label as well as a word preceded by itself or a pictorial counterpart. The extent to which the second item benefited from prior processing was a function of the mode of the second item, the mode of the previous occurrence of the concept, and the task. The results of the naming task of Experiment 1 suggested that words are more generic, in that they tended to facilitate processing of subsequent occurrences of the concept regardless of the mode of the second occurrence, whereas pictures tended to facilitate only subsequent pictures. In fact, reading a word was not faster after having just named a pictorial representation of that concept. Experiment 2 explored, and ruled out, the possibility that this failure to find facilitation was the result of an inhibitory mechanism. In general, the data are consistent with the idea that pictures and words consult the same semantic system for their interpretation but that words activate a more generic set of semantic information than do pictures.

Possible similarities and differences in the way pictures and words are processed have been of interest to a number of investigators (e.g., Nelson, Reed, & McEvoy, 1977; Paivio, 1971; Pellegrino, Rosinski, Chiesi, & Siegel, 1977). Nelson et al. have recently proposed a model that has two main features: (a) Pictures and words are assumed to differ in the order in which phonemic and meaning codes are activated. Words may activate phonemic features before they activate meaning features (although not necessarily), whereas pictures must always activate meaning features before they activate phonemic features. (b) Pictures and words for the same referent are assumed to have the same semantic representation. Pellegrino et al. have similarly suggested that words and pictures access the same semantic memory system, with pictures doing so more quickly. It is this assumption of a common semantic representation for pictures and their verbal labels that principally distinguishes unitary models (e.g., Nelson et al., 1977; Pellegrino et al., 1977; Potter, Valian, & Faulconer, 1977) and the modified dual code model (Paivio, 1978) from earlier

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versions of the dual code model (Paivio, 1971).

There is some evidence supporting the general proposals of Nelson et al. and Pellegrino et al. Potter and Faulconer (1975), for example, found that pictures required more time to name and less time to categorize than did words. Pellegrino et al. have also found shorter categorization times with pictures. These findings are consistent with the assumption that the phonemic information required in naming is more quickly accessed by words than pictures, and the conceptual information required in categorizing is more quickly accessed by pictures than words.

The present studies attempted to use this basic framework to make predictions about how repeated experience cumulates across pictures and words referring to the same concept. Subjects were presented with pictures and words and were asked either to name the stimulus or to categorize it as natural or artificial (i.e., man-made). A concept such as car could appear twice in the sequence of stimuli. The first occurrence could be either a picture or a word; similarly, the second occurrence could be either a picture or a word. The primary observed variable was the decrease in latency caused by having previously processed the concept. This repetition task was chosen in an effort to maximize sensitivity to facilitation: repetitions have been shown to be sensitive to the influence of earlier exposures in a way that may not be observed with other tasks (cf. Scarborough, Cortese, & Scarborough, 1977). We were primarily interested in the amounts of intramodal and cross-modal facilitation that we would observe as a consequence of the repetition and of the processing task (naming or categorizing).

The Nelson et al. hypothesis would make some specific predictions about the patterns of facilitation produced by prior exposure to the concept. First, for both naming and categorizing, although there should be perhaps greater facilitation from same-mode repetitions as a consequence of experience with the sensory features of the stimulus, there should be substantial cross-modal facilitation based on the assumptions that the same phonemic and/or semantic representations are activated by both pictures and words. Second, the amount of facilitation should depend on the number of stages of processing that are repeated and thus could be facilitated. For example, because naming a picture can theoretically be aided during semantic and phonemic processing, pictures should show more overall benefit from prior processing than words; words are more likely to be helped only during phonemic processing, assuming that semantic information is not required to read a word. Another way of viewing this is that the more difficult the task, the more you would expect to show a benefit from relevant prior experience.

In the category task, both pictures and words should undergo physical and semantic processing. Compared to the naming task, in the category task, pictures and words should benefit more nearly equally from prior relevant processing because the task should tend to equate them on stages necessary to perform the task. In fact, if it is the case that semantic information is initially somewhat less available to words than to pictures, we might even expect words to profit more than pictures from repetitions of the concept.

To provide evidence regarding the relative accessibility over time of information generated by pictures and words, an additional variable in these experiments was the number of items intervening between successive presentations of the concept (lag). Insofar as facilitation reflects trace strength or availability, the lag data allow us to look at a "levels of processing" corollary of the Nelson et al. model. At first glance one may assume that since pictures are remembered better than words (Paivio, Rogers, & Smythe, 1968; Shepard, 1967; but see Hasher, Riebman, & Wren, 1976, Experiment 1), they would produce a stronger trace, which would produce more facilitation than would their verbal labels. The model of Nelson et al. suggests, in contrast, that the strength of the trace will be a function of the task. A trace created from processing a picture in a naming task should be stronger than the trace created by a word in a naming task, since it is more likely to have under-

gone semantic processing (e.g., Craik & Lockhart, 1972; Hyde & Jenkins, 1969). In contrast, the traces produced in a category task may be equally strong, or because of the possible additional processing required for words, words may actually produce stronger traces than pictures.

In summary, the purpose of the current research was to explore the extent to which pictures and words contact the same memory representations, to determine whether cross-modal facilitation is a function of the type of processing required to complete the task, and to compare pictures and words with respect to the persistence of the facilitation they produce.

Experiment 1

Method

Design. Three within-subject variables were factorially combined with each other and with one matched-pairs variable. The within factors were mode of the second (or target) occurrence (picture or word), mode of the first occurrence (picture, word, or none), and number of items that occurred between the two occurrences (0, 25, or 50). The matched factor was task (naming or categorizing). Pairs of subjects were randomly assigned to the two tasks and were matched on the stimulus schedule they received.

Materials. The stimuli were 90 low-frequency words (less than 60 parts per million) chosen from the Kucera and Francis (1967) word norms. Of the 90 concepts, 60% occur naturally in the environment (e.g., egg), and 40% are items manufactured or constructed by people (e.g., button). Line drawings were made for each word. Drawings that were not unambiguously named by a group of 20 judges were modified or replaced before the experiment began. Since items were to be repeated, four cards were made for each concept. Two of the cards had only the word in all uppercase letters; two of the cards had only a black ink line drawing of the concept. Each drawing was done separately by the same artist, thus the second drawing of the concept was physically similar though not an exact copy of the first.

Apparatus. The stimuli were presented using a three-field Scientific Prototype tachistoscope adapted to measure latencies from either a vocal or lever press response.

If the subject's task was to name the stimulus, the vocal response was sensed by a voice-actuated relay via a table microphone. If the subject's task was to categorize the stimulus, the response was made using an up–down lever. A response stopped a clock incremented in milliseconds and, in the case of a lever push, turned on a light indicating the direction of the push.

Procedure. The subjects were tested individually. Subjects were seated in front of the tachistoscope and instructed about the use of the start button and appropriate response apparatus. They were then given the appropriate instructions for their task. For the category task, assignment of switch position (up/down) to response (natural/man-made) was counterbalanced. Both groups received instructions to respond quickly and accurately and then began a block of 10 practice trials. The practice was a smaller version of the experimental sequence that immediately followed.

A typical trial involved a signal from the experimenter informing the subject that the trial could be initiated. Five hundred milliseconds after the subject pressed the start button, a stimulus appeared in the viewing field and remained on for 2 sec. At termination of the stimulus, a blank field appeared. Responses after the termination of the stimulus were almost nonexistent. The experimenter recorded latency and response and signaled for a new trial to begin. The average intertrial interval was about 3 sec.

Subjects in the naming group simply named the picture or read the word. Subjects in the categorize group decided whether the stimulus was an object that occurred naturally in the environment or an object made by man.

Each subject saw 160 stimuli. Half of the trials involved pictures, and half involved words. There were 90 critical trials. A critical trial was one during which the subject was responding for the second time to that concept or one during which the subject was responding for the only time to that concept. The critical trials were the only trials that yielded latencies to be used in the analysis. Half of the critical trials consisted of pictures, and half consisted of words. Of the critical trials, 30 were shown earlier as a word, 30 were shown earlier as a picture, and the remaining 30 were not shown before as either a picture or a word nor would the subject encounter them again in the course of the experiment. The manipulation of the mode of the critical trial (picture/word) and mode of the previous exposure (picture/word/neither) yielded six conditions: picture preceded by a picture (PP), by its verbal label (WP), or neither (NP); and word preceded by itself (WW), its pictorial counterpart (PW), or neither (NW).

The NP and NW conditions were incorporated as baselines from which to determine the benefits of a prior exposure to a concept. The first occurrence of the concept was not used for this purpose because of the expected decrease in latencies attributable to the fact that the second exposures occurred, on the average, later in the list than the first exposures. In the present design, the NP and NW trials occupied approximately the same position in the stimulus schedule as did the second occurrences of the other concepts.

Table 1
Facilitation (in msec) for the Two Tasks as a Function of the Mode of the Second Occurrence

Task	Picture	Word
Name	142	24
Categorize	39	68

Note. Entries are averages over the mode of the first occurrence and over 0, 25, and 50 intervening items.

The stimuli were presented to subjects according to 1 of 18 different stimulus schedules. In each schedule a concept was randomly assigned a position, with the restriction that it was possible to repeat the concept before the end of the 160 trials. Each stimulus schedule involved a different assignment of concepts to conditions. The assignment was such that no concept appeared in more than one condition, and the concepts were counterbalanced across subjects in such a way that by the end of the experiment each concept had appeared in each condition equally often. The PP, WP, PW, and WW conditions each involved five concepts for each level of lag, whereas the NP and NW conditions, in which a repetition was not possible, involved 15 concepts. The levels of lag for the repeated concepts were either 0, 25, or 50 intervening items. Each schedule involved 60 repeated concepts (120 trials), 30 control concepts (30 trials), and filler items to create the appropriate lags (10 trials). Each subject in the naming task was given a different stimulus schedule and was matched to a subject in the category task who also received that schedule.

Subjects. The subjects were 36 undergraduates from an introductory psychology course who were given extra credit for their participation. Half of the subjects were given intructions to name the stimuli, and half were given instructions to categorize the stimuli.

Results and Discussion

Only concepts that yielded correct responses at each opportunity were considered correct. Errors occurred less than 1% of the time in naming and less than 10% of the time in categorizing for any subject. For each subject mean latencies for correct responses for each condition were computed. For repeated items, only the latency associated with the second presentation entered into the means.

The baseline reaction times for Control Conditions NP and NW for each task were computed. Reading a word (467 msec) was faster than naming a picture (674 msec), but there was a tendency for pictures to be categorized (525 msec) faster than words (582 msec). This pattern essentially replicates the findings of Potter and Faulconer (1975).

The baseline reaction times for the second stimulus of the PP and WP conditions were subtracted from the appropriate NP control for each subject. Similarly, the WW and PW conditions were subtracted from the appropriate NW control for each subject. If the resultant is positive, it indicates that the second response to the concept benefited from the prior processing. Facilitation was also determined by item as well as by subject.

Two repeated measures analyses of variance—one treating subjects as a random factor and one treating items as a random factor—were then carried out on the facilitation scores. The task factor was treated as a matched variable, since subjects were yoked on stimulus schedule, and therefore completely repeated measures analyses were used. For ease of exposition only the F values obtained from the subject analysis are reported unless they conflict with the results of the item analysis. Unless otherwise specified all tests were based on an alpha level of .05.

The analyses of variance were $2 \times 2 \times 2 \times 3$. The factors were task, mode of the first presentation (Mode 1), mode of the second presentation (Mode 2), and lag. Note that there are now only two levels of Mode 1 (picture or word), since we are working with facilitation relative to the controls. Significant sources of variance were provided by the main effect of Mode 2, $F(1, 17) = 9.27$, $MS_e = 20{,}636$, as well as the interactions of task with Mode 2, $F(1, 17) = 22.88$, $MS_e = 27{,}034$, task with Mode 1, $F(1, 17) = 12.88$, $MS_e = 2{,}179$, and Mode 1 with Mode 2, $F(1, 17) = 48.41$, $MS_e = 3{,}390$. The effect of lag is considered later in the article.

The interaction of task and Mode 2 (Table 1) for facilitation scores is similar to the interaction observed for baseline reaction times. This is support for the general principle that stimuli which require more time to

process will show more facilitation. For example, pictures, which take longer to name than to categorize, benefited more from prior processing (collapsed across the mode of the prior occurrence) in the naming task than from prior processing in the category task, $F(1, 17) = 10.62, MS_e = 9{,}688$; words, which can be read rapidly compared to being categorized, showed more facilitation in the category task, $F(1, 17) = 6.09$, $MS_e = 2{,}578$. Pictures benefited substantially from prior processing if they had to be named compared to the benefit words received in the naming task, $F(1, 17) = 13.63$, $MS_e = 8{,}795$. Though the greater facilitation for words compared to pictures in a category task is suggestive, the difference only approaches significance and only in a subject analysis. For subjects, $F(1, 17) = 3.45$, $MS_e = 2{,}945$, $p < .10$; for items, $F(1, 17) < 1$. In general this pattern is consistent with the assumption that phonemic codes are more available to a verbal input and conceptual information is at least as available to pictures as it is to words.

If it is true as suggested above that for pictures, phonemic information requires more—or "deeper" (Craik & Lockhart, 1972; but see also T. O. Nelson, 1977)—processing than required to name words, we would expect the prior naming of a picture to leave a stronger trace than the prior naming of words. Following the same logic, word traces should produce more facilitation than pictures in a category task. The significant Mode 1 × Task interaction shown in Table 2 is generally consistent with these predictions. However, Table 2 also indicates that having previously named a word subsequently leads to more (rather than, as would be expected, less) facilitation than having previously categorized it. Another note of caution that will be discussed later is that the superiority of picture traces over word traces in the naming task was produced solely by the PP condition.

The interaction of the first mode with the second mode (Figure 1) reflects the fact that more facilitation was observed in the PP condition than in the WP condition, $F(1, 17) = 21.7$, $MS_e = 906$, and more facilitation was observed in the WW condition than in the PW condition, $F(1, 17) = 14.8$, $MS_e = 588$. It is also apparent from Figure 1 that a word trace aided subsequent processing of a picture to the same extent that it aided processing a repetition of itself, whereas a picture trace was more mode specific. If you have processed a picture, a subsequent picture will be facilitated to a greater extent than a subsequent word. On the other hand, a word will facilitate subsequent processing of itself or its pictorial counterpart to the same degree. This pattern of facilitation seems to be independent of the task, since the triple interaction of Mode 1, Mode 2, and task was far from significant, $F(1, 17) < 1$.

Table 2
Facilitation (in msec) for the Two Tasks as a Function of the Mode of the First Occurrence

Task	Picture	Word
Name	95	71
Categorize	48	58

Note. Entries are averages over the mode of the second occurrence and over 0, 25, and 50 intervening items.

The patterns of facilitation discussed thus far were slightly affected by the number of items intervening between the first and second occurrences. In the subject analysis the main effect of lag was significant, $F(2, 34)$

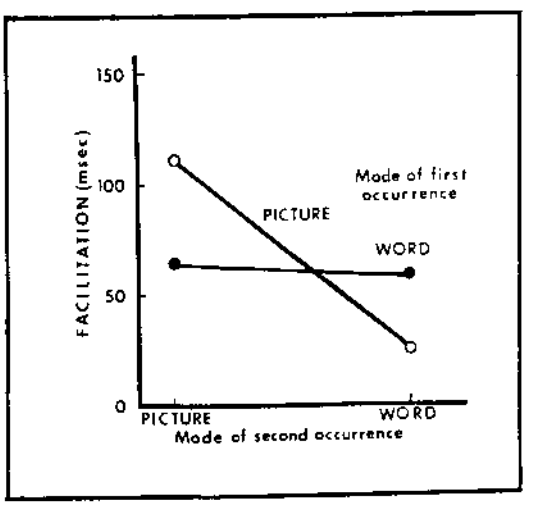

Figure 1. Facilitation as a function of the mode of the first and second occurrence of the concept averaged over 0, 25, and 50 intervening items.

Table 3
Facilitation (in msec) as a Function of the Number of Items Intervening Between Occurrences for Each Combination of Modes for the Two Tasks

Task	Lag 0	Lag 25	Lag 50	*M*
Naming				
PP	200	165	159	175
WP	118	121	89	109
PW	3	19	24	15
WW	28	37	32	32
M	87	86	76	
Categorizing				
PP	77	56	20	51
WP	44	24	12	27
PW	74	46	16	45
WW	118	81	70	90
M	78	52	30	

Note. PP = picture followed by picture; WP = word followed by picture; PW = picture followed by word; WW = word followed by word.

= 9.37, $MS_e = 3.391$; lag interacted with task, $F(2, 34) = 3.57$, $MS_e = 3.857$; and the Lag × Task × Mode 2 interaction was significant, $F(2, 34) = 3.82$, $MS_e = 1.812$. The only comparison approaching significance in the item analysis was the Task × Lag interaction, $F(2, 34) = 2.14$, $MS_e = 6.706$, $p < .13$.

Table 3 shows the effect of lag on the four conditions for naming (top) and for categorizing (bottom). The analyses suggest that facilitation in the category task decreased as lag increased and that the rate of decrease was approximately equal for each of the four conditions; facilitation in the naming task did not decrease as rapidly, and this was primarily a consequence of the case in which the second occurrence was a word.

It is interesting to note that there was no influence of the mode of the first stimulus on the endurance of the traces. Though some traces were stronger than others, they tended to maintain their relative superiority as lag increased. It is also of note that even after 50 intervening items, there was still significant facilitation in some conditions.

Though we would expect facilitation to decrease with increasing lag, we expected to observe facilitation in all conditions when the repetition was immediate. At zero lag, significant facilitation was present for each of the eight conditions except when words were read. For the WW condition, facilitation was detected by the subject analysis, $t(17) = 2.54$, but not by the item analysis, $t(17) = 1.04$, $p > .10$. For the PW condition, neither analysis revealed reliable facilitation. As predicted, reading words showed the smallest benefit from prior processing. However, observing *no* facilitation for reading a word preceded by its pictorial counterpart was unexpected. Meyer, Schvaneveldt, and Ruddy (1975) demonstrated that reading a word such as *nurse* can be aided by having read an associated word such as *doctor*. In the present experiment, reading a word was not aided by having named a picture of the same concept. If pictures and words have identical semantic codes and facilitation is observed from reading verbal associates, then reading a word should certainly be facilitated by naming a picture of the concept. However, it appears that reading the word *nurse* can be aided by having read the word *doctor* or the word *nurse* but not by having said "nurse" to a picture.

Following the logic that facilitation in tasks such as the present one reflects relatedness, we would have to conclude that the word *nurse* is more related to the word *doctor* than it is to a picture of a nurse. The present results also suggest that pictures and words receive different semantic processing—at least in a naming task. If semantic processing were the same, we would expect at least some facilitation just by virtue of sharing the same semantic code.

One could argue that we did not observe facilitation from pictures to words in the naming task because words are read so rapidly that any additional decrease in reading latency would be difficult to observe under any but the most optimal facilitation conditions (WW). This would, however, lead to the conclusion that the facilitation observed in the WW condition was due entirely to previous experience with the physical features of the word, and that this physical information persists for at least 50 intervening items (see Table 3). Typically,

the advantage of a physical match (Posner, 1973) is presumed to be much more short-lived.

Though at this point a unitary semantic code model does not fare well against this finding, we should mention that a dual-code model does no better. Paivio (1971) suggests that there is a high probability of pictures being dually coded; if so, then some facilitation from pictures to words should be observed from activation of the verbal code during the earlier processing of the picture.

An alternative explanation for the lack of facilitation from pictures to words that would enable us to maintain the notion of identical semantic codes is that an inhibitory mechanism is operating to mask the facilitating effects of prior semantic processing. It is theoretically possible that producing the same response—first to a picture and then a word—causes some type of interference or inhibition. This seems especially feasible when the task requires a vocal response (cf. Neill, 1977) as the naming task obviously did. This explanation was suggested in part by the hint of an *increase* in facilitation for the PW condition as lag increased. As Table 3 indicates, the PW condition shows only 3 msec facilitation with no intervening items and 24 msec with a lag of 50.

Experiment 2

This rise for the PW condition suggested that at zero lag we might have been observing the competition between a facilitating mechanism and an inhibitory mechanism. Perhaps at zero lag, inhibition prevented us from observing the benefits of prior processing. Somewhere between 0 and 25 intervening items, the inhibition could weaken, allowing facilitation to be observed. Therefore, an early rise in facilitation would suggest that the lack of facilitation at zero lag in Experiment 1 was produced by an inhibition or suppression of the prior response and not necessarily by an absence of overlap in semantic codes for successive experiences with the same concept. Alternatively, if pictures never facilitate words in a naming task, then it seems safe to conclude that pictures and words received different semantic processing in this task.

To replicate the findings of the first experiment and to conduct a more detailed analysis on the course of facilitation between lags of 0 and 25, Experiment 2 utilized the same procedure as before but with more and shorter lags: 0, 1, 8, and 20 intervening items.

Method

Materials and design. Because of the incorporation of four rather than three lags, it was necessary to add additional concepts to counterbalance the stimuli. To keep the number of trials at a manageable number and still use four levels of lag, the number of concepts that occurred for any one subject in any one condition was reduced. Subjects now saw four concepts for each lag of the PP, WW, WP, and PW conditions (128 trials), 16 concepts for each of the control conditions, NP and NW (32 trials) and fillers (10 trials), for a total of 170 trials.

The design was the same as the first experiment except for the addition of another level of lag.

Subjects. Subjects were 48 undergraduates from an introductory psychology course who were given credit for their participation. Again, half of the subjects were given instructions to categorize the stimuli, and half were given instructions to name the stimuli. None of the subjects had participated in Experiment 1.

There were no apparatus or procedural changes.

Results and Discussion

Again, only concepts that yielded correct responses at each exposure were considered in the analysis. Errors were almost nonexistent for the naming group and were less than 10% for any subject in the category group. As in the first experiment, mean latencies were computed for each condition. Average vocal response time for initially

Table 4
Facilitation (in msec) for the Two Tasks as a Function of the Mode of the Second Occurrence

Task	Picture	Word
Name	111	14
Categorize	86	97

Note. Entries are averages over the mode of the first occurrence and over 0, 1, 8, and 20 intervening items.

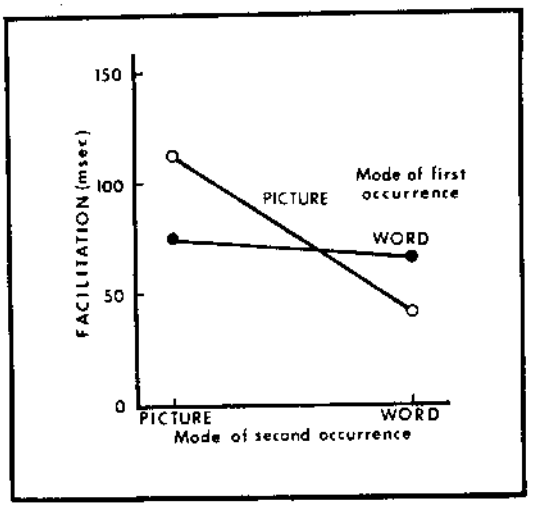

Figure 2. Facilitation as a function of the mode of the first and second occurrence of the concept averaged over 0, 1, 8, and 20 intervening items.

naming a picture was 700 msec and for initially reading a word was 520 msec. For categorizing, words required slightly more time (676 msec) than did pictures (656 msec) to be processed. In general this pattern was similar to that observed in the first experiment. However, here the subjects were slower overall, and this was especially true for the categorize group.

These control conditions were again used as a basis for determining facilitation. Pictures were facilitated more than words in a naming task, whereas the opposite trend was suggested in the category task, $F(1, 23) = 19.18$, $MS_e = 25{,}088$. This Task × Mode 2 interaction (Table 4) replicates the first experiment, though the category group showed more facilitation relative to the naming group than was the case in Experiment 1. The main effect of Mode 2, $F(1, 23) = 16.43$, $MS_e = 25{,}654$; for items, $F(1, 23) = 3.26$, $MS_e = 122{,}371$, $p < .10$, and the interaction of the first and second mode, $F(1, 23) = 12.92$, $MS_e = 8{,}546$, are similar to the findings of the first experiment (see Figure 2). Here again, words facilitated subsequent occurrences of the concept regardless of mode, whereas pictures were more mode specific. In contrast to Experiment 1, the Task × Mode 1 interaction failed to reach significance, $F(1, 23) < 1$. Furthermore, the interpretation of the interaction in Experiment 1 was somewhat equivocal as previously discussed. Therefore, in these two experiments, the notion of depth of processing as characterized in the Nelson et al. model does not apply to the traces of prior processing as well as it applies to the current processing.

Since the primary purpose of Experiment 2 was to determine the shape of the functions between lags of 0 and 20, we looked at the linear and quadratic components of lag for each of the conditions. Inspection of Table 5 reveals that the zero-lag condition often yielded less facilitation than did longer lags. Statistically, however, this nonlinearity in the functions relating facilitation to lag was not reliable. Only the subject analysis revealed reliable effects of lag, and none of these involved the quadratic component. The linear component in the naming task was significantly different from the linear component in the category task, for subjects, $F(1, 23) = 5.38$, $MS_e = 11{,}246$; for items, $F(1, 23) = 2.21$, $MS_e = 24{,}345$, $p > .10$. No other linear or quadratic component was reliable, though the residual of the Mode 1 × Lag interaction reached significance, for

Table 5
Facilitation (in msec) as a Function of the Number of Items Intervening Between Occurrences for Each Combination of Modes for the Two Tasks

Task	Lag 0	Lag 1	Lag 8	Lag 20	*M*
Naming					
PP	109	126	131	116	120
WP	95	105	127	78	101
PW	−37	27	8	3	0
WW	26	8	35	43	28
M	48	66	75	60	
Categorizing					
PP	95	131	129	95	112
WP	83	74	61	23	60
PW	110	88	53	83	83
WW	131	112	110	92	111
M	105	101	88	73	

Note. PP = picture followed by picture; WP = word followed by picture; PW = picture followed by word; WW = word followed by word.

subjects, $F(1, 23) = 5.61$, $MS_e = 4{,}604$; for items, $F(1, 23) = 1.82$, $MS_e = 12{,}875$, $p > .10$. It appears that the average function of the naming task declined less rapidly than the average function of the category task.

Though statistically insignificant, visual inspection of Table 5 suggests that our consideration of an interfering mechanism was not unfounded. However, whether or not the quadratic function is actually present, the PW condition never showed significant facilitation either in a subject or an item analysis. In addition, collapsed across lag, the PW condition produced significantly less facilitation than the WW condition, for subjects, $t(23) = 2.50$, for items, $t(23) = 1.75$, $p < .10$. So, though an interference mechanism may be operating, it does not expain why words were never facilitated by prior naming of a picture.[1] We seem to be left with the conclusion that despite possible initial inhibition in a naming task, pictures and words differ to some extent in the semantic processing they receive.

In summary, the two experiments suggest that pictures are facilitated more from previous experience with the concept in a naming task than are words. Words, on the other hand, are facilitated slightly more in a category task than are pictures. The facilitation *produced* by words does not seem to be a function of the task in either experiment; the facilitation *produced* by pictures may have been more prominent when the task was naming, but this task difference did not manifest itself in Experiment 2 and showed up largely only in the picture–picture condition of Experiment 1.

More interestingly, the data suggested that a word trace contains information capable of aiding subsequent processing of both pictures and words, whereas picture traces are more specific in that they aid the processing of pictures to a large extent while aiding the processing of subsequent words to a small extent. Experiment 1 suggested that the semantic code of a picture and its label are not identical, since prior naming of a picture did not aid subsequent reading of its label. The hypothesis that the lack of facilitation was due to an inhibitory mechanism that operates at short lags was tested in Experiment 2 but did not account for the lack of facilitation from pictures to words.

General Discussion

One major finding of the present experiments is that whether pictures or words benefited more from prior exposure to the concept depended on the task requirements. Pictures clearly profited more when the task was naming, whereas words tended to profit more when subjects performed a categorization task. These findings extend those reported previously (e.g., Potter & Faulconer, 1975), suggesting that words have easier initial access to phonemic information, whereas pictures may have easier access to information about meaning, and the results are in general agreement with the discussion of Nelson et al. and Pellegrino et al.

However, the findings that (a) a word trace produces comparable facilitation for both words and pictures and (b) pictures failed to facilitate words in a naming task suggest an important limitation of the Nelson et al. model. In contrast to the idea of separate storage systems for pictures and words, unitary models tend to assert that both pictures and words activate exactly the *same* semantic "code" or features. In fact, it seems much more reasonable to think of pictures as something like words in context —they generate some specific representation (usually a novel one) that could be characterized by some but not all of the semantic components of the concept it represents. The corresponding word, on the other hand, (which is not a novel stimulus and which has been dealt with many times before) may be more likely to activate a large and less specific set of semantic features. Johnson, Raye, Wang, and Taylor (1979) have

[1] Subsequent to the completion of the present studies, Scarborough, Gerard, and Cortese (1979) reported that the time to make a lexical decision on a verbal label was not reduced by having earlier named the picture, thus providing some additional support for the null result reported here. However, their lags were quite long on the average, and facilitation would perhaps be less expected there than in the present studies.

used similar reasoning to suggest that any particular repetition of the same conceptual event involving some deviation from a prior trace would have more chance of overlapping with features of the original experience in the case of words than in the case of pictures. This would in fact predict our obtained greater facilitation from words to pictures than from pictures to words in the naming task.

Rosch (1975, Experiment 7) provides data that can be taken as support that words activate a set of semantic features that are mode independent. In her task, subjects determined whether a pair of pictures or a pair of words belonged to the same category. The effect of saying a prime (category name or the word "blank") 2 sec prior to the pair affected picture and word pairs similarly. Rosch argued that

> the representation (of the category name) is not entirely specific to either a pictorial or verbal mode but is some set of abstract probabilities of items that can represent the meaning of the category in either mode. (p. 219)

We would extend this line of thinking to all words, not only labels of natural categories. More importantly, the present results suggest that the representation activated by a picture cannot be characterized by this ability to represent the meaning in either mode.

A number of investigators have found it useful to make a distinction between core and peripheral aspects of meaning (Hasher, Griffin, & Johnson, 1977; Hasher & Johnson, 1975; Hashtroudi, 1977; Hashtroudi & Johnson, 1976; Miller & Johnson-Laird, 1976; Smith, Shoben, & Rips, 1974; Johnson, Hasher, & Hashtroudi, Note 1). For example, Johnson et al. (Note 1) have emphasized the importance for memory of the way specific interpretations capitalize on aspects of the meaning of concepts that vary in semantic distance from the core. As proposed above, simpy reading a word out of context is likely to activate the most general, or least situation-specific, aspects of meaning or those closest to the core, whereas a picture is more likely to activate more peripheral aspects of the concept. When subjects are asked to perform the categorization task, however, pictures and words are forced to consult similar semantic information. The semantic processing involved in categorizing items as natural or man-made, incidentally, is probably more likely to involve peripheral as opposed to core features of most of the items. Thus, in general, the overlap between pictures and words in activated semantic information should be more similar in going from pictures to words and words to pictures when semantic information has been controlled than when it has not. If the core meaning hypothesis as applied to the present data is correct, then, it ought to be possible to increase facilitation from pictures to words by creating pictures that yield more generic interpretations or by providing a word with a context that increases the specificity of its interpretation while bringing it in line with the specific interpretation of the earlier picture.

A second limitation with the Nelson et al. model is suggested by the lag data in the current experiments. The depth of processing corollary of the model would predict "slower rates of forgetting for deeper levels" (Craik & Lockhart, 1972). In neither experiment did we observe a differential decay of traces as a function of the mode of the first item. For pictures, whereas the "deeper" phonemic trace decayed less rapidly than the "shallower" semantic trace as a levels-of-processing analysis would predict, the same pattern of decay was observed for words, where presumably the phonemic level is not deeper than the semantic level.

In conclusion we feel that the processing differences between pictures and words are best viewed as differences in the nature of and the specificity of the activation within a single system. Out of context, words are more likely to activate a set of "abstract probabilities" capable of aiding the processing of incoming information equally, independent of the mode in which the information is presented.

Reference Note

1. Johnson, M. K., Hasher, L., & Hashtroudi, S. *The core-meaning hypothesis and long-term retention.* Manuscript in preparation, 1979.

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