4 Relatedness Effects in Word and Picture Naming: Parallels, Differences, and Structural Implications

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INTRODUCTION

Upon presentation of either of the stimuli depicted in Fig. 4.1, subjects will typically have little difficulty answering questions (e.g. What is its name? Is it an animal? Etc.) about the concept they represent. Clearly, both of these stimuli allow access to and retrieval of whatever memorial information we may have about dogs. Nonetheless, there are distinct performance differences between these two stimuli when we ask our subjects to make their responses as rapidly as possible. In particular, while words can always be named more rapidly than pictures (Fraisse, 1968; Potter & Faulconer, 1975), pictures appear to allow more rapid retrieval of most other types of information. For example, relative and absolute size judgments are performed faster for pictures (Paivio, 1977; Pellegrino, Rosinski, Cheisi, & Siegal, 1977), as are shape judgments (Paivio, 1977), as well as decisions about whether two stimuli belong to the same semantic category (Pellegrino et al., 1977; Rosch, 1975). There is also evidence that yes-no categorisation judgments (Hogaboam & Pellegrino, 1978; Potter & Faulconer, 1975; Pellegrino et al., 1977) and tasks requiring the generation of a category name (Smith & Magee, 1980; see also Irwin & Lupker, 1983) can also be performed more rapidly with pictures.

Results such as these have given rise to what appear to be two different types of models. According to one type of model there is a common semantic store accessed by both pictures and words. Pictures are simply assumed to access the store more rapidly (Potter & Faulconer, 1975; Rosch, 1975). Nelson, Reed, and McEvoy's (1977) sensory–semantic model

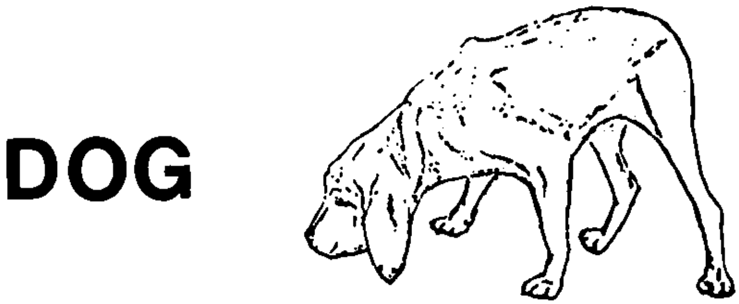

FIG. 4.1. Two different graphic representations of the same concept.

is typical of this approach. In this model, pictures allow direct retrieval of the meaning features of a concept. Words, on the other hand, initially allow the retrieval of name information. Retrieval of semantic information occurs either as a second step or in a direct but slower fashion. Pictures take longer to name because retrieval of name information can only take place after some initial semantic processing.

According to the other type of model, the information initially accessible by words and pictures is quite different. Paivio's (1971) dual-code model typifies this approach. This model proposes two separate knowledge systems, one verbal in nature, one nonverbal or imaginal. Words initially allow access to the verbal system, in which name information is stored. Pictures initially allow access to the nonverbal system, where much of the semantic information is stored. Thus, words would allow retrieval of their name codes more rapidly than pictures while pictures should enjoy an advantage in most tasks requiring the retrieval of semantic information.

Although the Nelson et al. (1977) and Paivio (1971) models appear to be qualitatively different, intermediate positions are also possible. Morton's (1970, 1979) logogen model is a prime example. According to this model, although pictures and words allow very rapid convergence on a common semantic system, their initial memorial analyses are assumed to be different. Thus, it is perhaps best to think of the Nelson et al. and Paivio models as lying at opposite ends of a continuum. This continuum would reflect the degree to which the initial memorial analyses of these stimuli differ. This issue, that is, the extent to which the initial semantic processing of pictures and words differs, is obviously an important one. However, it will not be the main focus of the present chapter. Instead, I would like to begin by considering the one issue on which all of these models are in complete agreement; that the process of naming a picture is not only a longer but a more complex process than naming a word. In particular, retrieval of a picture's name is always assumed to follow the retrieval of at least some semantic information, while retrieval of a word's name is not.

RETRIEVING NAME INFORMATION

Before we begin to consider picture-word differences in naming, one point needs to be clarified. The nature of pictures and words necessitates that the processes by which semantic memory is accessed be different for these two stimulus types. That is, in order for the appropriate memory location to be accessed, any visual stimulus must first undergo a visual analysis. This analysis must lead to the identification of at least some of the stimulus' components, although others may be filled in by redundancy (Massaro, 1979). The information gained through this process then guides the access to the appropriate memory location. Words are made up of letters, pictures are not. Thus, when the components are being identified, different types of memorial contact are being made and different types of intermediate information are becoming available. However, the models under discussion clearly go deeper than simply assuming that there are differences in the memory access process. The statement that pictures receive semantic processing is taken to mean that, after access, semantic information is retrieved from the memory location of the pictured concept before its name can be retrieved. This is the claim to be evaluated.

The Naming Time Advantage for Words

With this access versus retrieval distinction in mind, the first question to ask is: What does the fact that words are named faster than pictures say about differences in name retrieval? I would suggest that the answer is: Not very much. Words have inherently so many advantages for the naming task that it would have been an incredible surprise had the results come out any other way. In order to reinforce this point, let's consider two or three of these advantages. The first would simply be one of familiarity. It has become a fairly reliable finding that more familiar words (i.e. those with a higher frequency of occurrence in English) can be named more rapidly than less familiar words (Cosky, 1976; Forster & Chambers, 1973; Frederiksen & Kroll, 1976; Theios & Muise, 1977). Through repetition alone the processes involved in going from print to sound presumably become more practiced and hence more rapid. Thus, even words that we have seen thousands of times show reliable frequency effects. The same principles would presumably apply to picture naming. As such, the point to realise is that as a normal adult reader, you or I will have processed a graphic representation like the word on the left side of Fig. 4.1 much more often than a graphic representation like the picture on the right side. It would certainly follow that the process of attaching a name to the stimulus on the left would be more practised and hence more rapid than the process of attaching a name to the stimulus on the right. Thus, at least part of the typically observed picture-word naming time difference would be a simple familiarity effect.

A second advantage concerns the lack of ambiguity involved in selecting a word's name in comparison to selecting a picture's name. That is, again considering the stimuli in Fig. 4.1, there is really only one permissible naming response to the stimulus on the left. The stimulus on the right, however, could be correctly labelled *"animal"*, *"dog"*, *"canine"*, *"puppy"*, or perhaps even *"Rover"*. As Rosch (1978) (also Rosch, Mervis, Gray, Johnson & Boyes-Braem, 1976) has argued, only one of these would be the typical, what she calls the basic, level response to any picture. Nonetheless, this is not to say that only one of these responses would ever be considered for any picture. In fact, the task of picture naming may often involve a process in which the subject must select between a number of names which the picture has made available. To the extent that this process is made difficult because of (for example) response competition or simply the observer's inability to determine what an experimenter might want, picture-naming time will suffer. So once again a word would gain an advantage in the naming task which is not a result of differential retrievability of name information.

Finally, a third potential advantage for words over pictures should be mentioned. Many words in English closely follow spelling-to-sound transformation rules. Thus subjects are not, in fact, forced to access memory in order to produce a word's name as they must to produce a picture's name. Evidence that individuals actually do use these rules in naming words can be found in Baron and Strawson (1976). These investigators simply timed subjects while they pronounced a series of words. The important independent variable was whether the words' pronunciations followed the spelling-to-sound rules of English (e.g. glue, fresh, ankle)—these are referred to as regular words—or whether the pronunciations represented exceptions to these rules, and thus had to be retrieved from memory (e.g. tough, beige, cough). These two sets of words were, of course, matched for frequency of occurrence. The basic result, and one that has been replicated a number of times (e.g. Glushko, 1979), is that the regular words produced substantially faster naming times. Thus it does appear that subjects do use spelling-to-sound rules at least some of the time. If so, it would reflect one more advantage that words have over pictures in the naming task that would not be attributable to differences in the memory retrieval process.

The way in which the rules may be used is another issue and one which has been the subject of a considerable amount of debate in recent years (Baron, 1977; Forster & Chambers, 1973; Frederiksen & Kroll, 1976; Rubenstein, Lewis, & Rubenstein, 1971). It is also a concern here. If, for example, subjects are simply able to use the results of the spelling-to-sound transformation process to produce a pronunciation, word-naming times would tell us little about how words access memory. However, it seems quite unlikely that subjects could make much use of this strategy since they have no way of knowing that the pronunciation they are about to produce is a correct one unless they also access stored information. A second point of view suggests that the phonetic code is first derived and then it is used to access memory. However, a number of recent studies seem to cast doubt on this interpretation (Hillinger, 1980; Shulman, Hornak, & Sanders, 1978; Tanenhaus, Flanigan, & Seidenberg, 1980). A more viable hypothesis, and one which does not pose a problem for picture-word comparisons in the naming task, would be to localise this effect at the response selection and execution level. For example, the memory-access process and the spelling-to-sound transformation may take place independently, with the results of the spelling-to-sound transformation being loaded into an output buffer. When the name is retrieved from memory it is then compared against the information in the buffer. If a match is found, a rapid response can be executed. If not, a response-competition situation is created and the buffer must be cleared before a correct response can be given. As such, regular words would be named faster than exception words but not as a result of the short-circuiting of the memory-access process.

If words and pictures could be equated along the dimensions just described, the question of whether they produce equivalent naming times would become an empirical one. The fact that they cannot suggests that we will probably learn little about picture-word differences from this comparison of naming times. Instead, a better approach is to ask what factors affect naming times for pictures and words and if those effects are differential. We'll begin by examining the effects of context on word naming.

Naming Words—Semantic Priming

In 1971 Meyer and Schvaneveldt (1971) reported one of the most replicable findings to appear in the psychological literature in the 1970s. Their finding was that subjects could make a correct lexical (word-nonword) decision to a word like *doctor* more rapidly after having just seen a related word like *nurse* than an unrelated word like *butter*. This phenomenon came to be known as semantic priming. These investigators were studying word recognition through the lexical decision task because it was felt to be the best tool for measuring how quickly an individual can access a word's memory representation. The assumption was that a positive lexical decision could be made as soon as a subject could determine that there was a memory representation for that letter string in memory. Any other type of decision, even a name decision, would represent a more complex task since it would require the actual retrieval of information from the memory location. Thus, whatever effects could be produced by an appropriate semantic context in a lexical decision task could most likely be attributed to a speeding or slowing of the memory-access process.

A few years later, Meyer, Schvaneveldt, and Ruddy (1975) expanded on this idea by examining the size of the priming effect as a function of two additional factors, the quality of the stimulus (clear or degraded) and the type of response required (lexical decision or naming). According to additive factors logic (Sternberg, 1969), if priming is a memory access phenomenon, the size of the effect should vary with a factor like stimulus quality, which is also assumed to affect this process. In line with Meyer et al.'s argument, the factors of stimulus quality and semantic relatedness did interact. A second aspect of their argument is that, since the memorial information necessary to make a lexical decision (i.e. the existence of a memorial representation for the word) is available before any other information, all other tasks should show at least the same amount of priming. In fact, the priming effects in the two tasks were quite similar, reinforcing the argument that the priming observed in the lexical decision task is a general access effect. In addition, this equivalence of effects suggests that (at least for the naming task) neither post-access retrieval nor response selection and execution processes are influenced by the semantic context.

Fischler (1977) raised an interesting question with respect to the semantic nature of these effects. He pointed out that the priming studies being reported in the literature were not investigations of the effects of semantic similarity but investigations of the effects of associative relatedness. In particular, the stimulus pairs that were being used were invariably high-frequency associates of one another and in many cases were not at all similar in meaning. Thus, in order to argue that semantics plays a role in word recognition, it would be necessary to demonstrate semantic priming with stimulus pairs having essentially no associative strength. Although Fischler had some difficulty finding a reasonable selection of such stimulus pairs, he did provide such a demonstration using the lexical decision task.

If lexical decisions are, in fact, made in the manner described earlier, an obvious implication of Fischler's results is that word naming would also be primed by purely semantic relationships. That is, if priming is a memory-access phenomenon, since semantic relatedness primes lexical decisions, it should also prime other operations which involve memory access—like naming. Although a number of studies have been reported in which semantically similar pairs were used in a naming task (e.g. Irwin & Lupker, 1983; Massaro, Jones, Lipscomb, & Scholz, 1978; Sperber, McCauley, Ragain, & Weil, 1979), none of these even attempted to control for the effects of association. Thus until recently this implication had never been tested. For future reference it should perhaps be kept in mind that the priming effects observed in these studies were all small, and in many cases, nonsignificant.

Recently Lupker (1984) attempted to determine whether semantic similarity in the absence of associative relatedness can prime word naming. Semantically similar stimulus pairs were created by pairing words from the same semantic category (e.g. *dog—pig, hand—elbow*). The actual stimuli used in these experiments were essentially the same as those used by Irwin and Lupker (1983). They consisted of twelve typical instances from six common categories: Animals, body parts, clothing, furniture, kitchen utensils, and vehicles. This particular definition of semantic similarity was selected because it seemed to fall in line with most of the current models of semantic memory (e.g. Collins & Loftus, 1975; Smith, Shoben, & Rips, 1974). The effects of association were controlled by not pairing stimuli showing any associative strength according to Postman and Keppel's (1970) association norms (e.g. *dog—cat, hand—foot*). This procedure does not, of course, guarantee that none of the stimulus pairs had any associative strength for any of the subjects; however, it is doubtful such a guarantee could ever be given, especially when semantically similar words are being paired.

Three different attempts were made to find priming under these conditions. In Experiment 1 subjects named the first, or "prime" stimulus before naming the "target" word. In the other two experiments subjects had only to look at the prime with stimulus onset asynchronies of 800 msec in Experiment 2 and 250 msec in Experiment 3. The three studies yielded semantic relatedness effects of 7, 7 and 6 msec, respectively. Although these results certainly suggest that semantic similarity does not produce priming, especially given that achieving a total control on associative relatedness may not be possible, the consistency of the results suggested that a closer look was necessary. In a fourth study the effects of association were controlled in a slightly different fashion. Here the category member pairs were selected also to be high-frequency associates of one another (e.g. *cat—dog*), and the size of the priming effect they produced was compared to the size of the priming effect with stimulus pairs which were high frequency associates but were not categorically related (e.g. *hand—*

glove). The results were that while both sets of associated pairs produced priming, the size of the effects were identical. Thus, once again there was no evidence of the influence of semantics on word naming.

The fact that priming was observed in this fourth experiment while at the same time a semantic effect was not is actually quite important. As noted earlier, one could argue that words can be named on the basis of spelling-to-sound transformation rules without memory access being involved. If such were the case, the results of Experiments 1, 2, and 3 would say nothing about the effects of semantics on accessing a word's name in memory. However, the existence of an associative priming effect in Experiment 4 argues that memory access was probably not bypassed in that experiment nor, by extension, in the previous experiments either. Thus, these results taken together (and considered in the context of the earlier results of Irwin & Lupker, 1983; Massaro et al., 1978; and Sperber et al., 1979) argue that it is associative relatedness and not semantic similarity that produces priming when naming words.

This conclusion is, of course, inconsistent with Fischler's (1977) finding that semantic relationships prime lexical decisions, if one holds to the assumption that the process which is primed in lexical decision making is the memory-access process. More recently, however, this assumption has been challenged by a number of investigators (e.g., Forster, 1981; Myers & Lorch, 1980; West & Stanovich, 1982). The basic argument is that making a lexical decision is a much more complicated process than simply finding a memory representation and, in fact, there are a number of primeable post-access operations involved in making lexical decisions. Thus, the effects one observes in lexical decision tasks appear to be somewhat restricted in what they can tell us about how memory is accessed or about the processes involved in naming words.

Phonetic and/or Orthographic Priming

While the amount of research investigating the effect of a semantically appropriate context on word processing is extensive, there has been much less research on the effects of a phonetically or orthographically appropriate context. In addition, what little of this work there is has, unfortunately, been done using the lexical decision task. Nonetheless, we may still wish to examine these results.

The first study to consider was reported by Meyer, Schvaneveldt and Ruddy (1974). Using a lexical decision task, these investigators reported that word pairs phonetically and orthographically similar (e.g. *bribe—tribe*) could be classified as words more rapidly than unrelated pairs, while decision times for pairs which were only orthographically similar (e.g. *couch—touch*) were actually retarded. The former effect has now been replicated a number of times (Hillinger, 1980; Shulman, Hornak, & Sanders, 1978). Thus, it seems safe to conclude that primes which are both orthographically and phonetically similar to their targets can produce priming in a lexical decision task. The relative contributions of orthographic and phonetic similarity, however, are less clear. Hillinger's (1980) data seem to indicate that phonetic similarity is the whole story, with pairs like *eight—mate* producing as much priming as pairs like *date—mate*. Shulman et al.'s results suggest that although orthographically but not phonetically similar pairs like *couch—touch* in general produce neither facilitation nor inhibition, in certain circumstances they can be made to produce facilitation. Finally, Tanenhaus, Flanigan, and Seidenberg (1980), using a slightly different word recognition task, have produced results suggesting that orthographic similarity may actually be more important than phonetic similarity.

Although the relative contributions of the two factors have yet to be pulled apart, it is clear that they can both influence reaction times in lexical decision and other word-recognition tasks. We have recently carried out a simple study to see whether the same can be said about word naming. Subjects in this experiment were asked to name two stimuli presented sequentially. There were three main factors in this study: prime type (word or picture); target type (word or picture); and similarity of the names of the prime and target. With respect to this final factor, on half the trials the names of the prime and target were both orthographically and phonetically similar (e.g. *king—ring, saw—claw*) and on the other half they were not (e.g. *king—claw, saw—ring*). Concentrating now only on those trials that involved word targets, results indicated that naming latencies were significantly faster following a prime with an orthographically and phonetically similar name. Further, this effect was independent of the nature (word or picture) of the prime stimulus, word primes producing a 24 msec effect, picture primes a 35 msec effect. The priming observed from picture primes clearly shows that phonetic similarity alone can prime word naming. The fact that word primes, which provide orthographic information in their visual representation, produced no more (in fact, slightly less) priming than picture primes, which provide no orthographic information, suggests that the role of orthographic similarity in this process may be minimal at best.

The upshot of this analysis is that there appear to be only two factors which we can confidently conclude speed the naming times for words; associative relatedness, and phonetic similarity. Shortly we will be attempting to determine whether the same can be said for pictures. However, based on these results, I would like first to present a general descriptive model which provides an account of these effects in word naming.

Beginnings of the Model

Attempts to explain priming effects have typically centred on structural properties of memory. The typical assumption is that there is a network-type structure consisting of nodes and the relational links between them. The nodes are typically taken to represent concepts, although they can represent concepts' names, with the links representing relationships between the concepts (or names). Collins and Loftus' (1975) model is typical of this approach. First, they propose that there is a "lexicon" in which each node represents a concept's name. The links between nodes in this network are based on phonetic (and to some extent orthographic) similarity. The name nodes are also linked to their appropriate concept node in a semantic network. In the semantic network links are defined in terms of semantic and, presumably, associative relationships. Priming is a result of activity within these networks. When the prime is processed, its nodes in the networks become active. This activation spreads out along the links of the networks and, presumably, between networks, raising the activation level of neighbouring nodes. If any of these nodes are appropriate to the target which is presented subsequently, its processing is facilitated.

In Collins and Loftus' conceptualisation, phonetic priming can be explained by the spreading of activation along the links of the lexicon. Associative priming cannot, however, because these relationships are only represented in the semantic network which, as discussed previously, has little role in naming tasks. A number of other models run into similar problems. Fodor (1983) has, for example, proposed a lexicon-like structure which is a modular network built on associations between concepts. This model could explain associative priming in a spreading activation fashion. However, phonetic information would not be represented in this network, and thus phonetic priming would have to be explained in another manner.

One potential solution to this problem would be to propose two networks, one based on phonetic relationships (to explain phonetic priming), and one based on associative relationships (to explain associative priming). As an example, consider Morton's (1979) logogen model. According to the model the process of naming a presented word involves a visual input logogen system and a speech output logogen system. Whereas Morton assumes the output system to be phonologically based, phonetic priming may have its locus there. Associative priming could occur in the visual input logogen system itself as a result of a certain type of feedback from semantic memory. (This feedback would have to be based only on associative relationships, of course.) Morton's model is mentioned here solely to indicate one of the possibilities. Others are certainly conceivable. For example, one could propose an input system influenced by phonetic relationships and an output system influenced by associative relationships.

Another possibility would be to expand on the multiple storage system idea. Ellis, Miller, and Sin (1983) have, for example, suggested the existence of as many as four "lexicons," each based on a slightly different type of information.

The framework I prefer to use is one in which the role of structure is much more limited. Memory is viewed simply as a set of storage locations, or files, each corresponding to a concept (Theios & Muise, 1977). Each file contains all the information relevant to the concept; its name, all aspects of is meaning, etc. These files are connected by a network structure based on association. Associative priming is a spreading activation phenomenon in which entire files are activated by the presentation of an associate. Thus, *both* access to a concept's file and retrieval of any task information would be facilitated. Phonetic and any other yet-to-be-discovered priming effects would result not from activation of the files facilitating access but from a speed-up of post-access retrieval operations. That is, searching the file for a word's name would be more rapid when a rhyming cue is presented as a guide. Thus, all but the effects of association would be explained totally in terms of a post-access information-retrieval process.

Semantic priming, in particular, is also viewed as a retrieval phenomenon. As a prime is processed it inevitably allows the retrieval of a certain amount of semantic information. To the extent that target processing requires the retrieval of similar semantic information, that processing will be facilitated. Experimental tasks like categorisation and, as mentioned, lexical decision, are assumed to require the retrieval of semantic information, and thus should be primeable by semantic relationships (Guenther, Klatzky & Putnam (1980), and Irwin & Lupker (1983) for categorisation; Fischler (1977) and Lupker (1984, Experiment 5) for lexical decisions). Naming, which only requires the retrieval of phonetic information, should be (as demonstrated) impervious to the effects of semantics.

Based on the results discussed thus far, it may seem somewhat arbitrary to build the basic memory structure on associations rather than phonetic similarity. Certainly there would be ample precedent for either. The Collins and Loftus (1975) model, discussed above, makes just the opposite assumption. This model contains a phonologically organised lexicon which is the structure initially contacted when a word accesses memory. Only once processing has reached the semantic level would associative relationships have any importance. Morton's (1970, 1979) model, on the other hand, placed the phonological information necessary to name a word (or a picture) in an output lexicon. Stemberger (this volume) proposes a somewhat similar idea on the basis of his analysis of speech-production errors. These two models, of course, do differ from the present conceptualisation in that they propose that a separate memory structure is needed to hold phonetic information. However, they are in agreement with the basic point; that phonetic effects are not memory-access effects but have their locus in post-access retrieval operations.

There are, in fact, three main reasons why our basic network was built on associative rather than phonetic relationships. First, if the phonetic information necessary for pronunciation was contained in a basic network structure, there would seem to be no logical post-access role for association in a naming task. Second, the main source of our information about associations is the free-association task, in which subjects are asked to say the first word that comes to mind in response to a cue word. This task would appear to be ideally suited for determining the nature of the most basic linkages in memory. Finally, using the lexical decision task, Lupker (1984, Experiment 6) has shown that although semantic similarity can prime lexical decisions, semantic similarity on top of an associative relationship provides no additional facilitation. Thus, there seems to be something primary about associative relationships in the sense that they have their full effects before something like semantics can enter the picture.

The same type of model will be used to discuss the processes involved in naming pictures. First, of course, we will need to establish that associative relationships are important in picture naming in order to validate the basic memory structure. We will then consider the effects of semantics and phonetics to determine the similarities and differences in name retrieval between pictures and words. Finally, we'll consider how the model being developed here needs to be extended to account for whatever picture-word differences emerge.

Naming Pictures—Association and Semantics

The first question would be: Do we find associative priming in picture naming? The answer appears to be yes. There are now a number of studies in the literature (Carr, McCauley, Sperber, & Parmelee, 1982; Huttenlocher & Kubicek, 1983; McCauley, Parmelee, Sperber, & Carr, 1980; Purcell, Stewart, & Stanovich, 1983; Sperber, McCauley, Ragain, & Weil, 1979) showing this type of an effect. However, as in the early word-priming literature, it's somewhat unclear what these researchers are investigating. That is, while their primes and targets are typically selected from the same semantic category, no attempt is ever made to control for the effects of association. In fact, in the Carr et al. study, the only one in which the stimuli were actually reported, it is clear that many of the pairs were strong associates of one another. Thus, although these studies indicate that associative/semantic relationships do produce priming, we are still left with the question of relative contributions.

TABLE 4.1
Summary of a Number of Unpublished Studies Examining Semantic Priming of Picture Naming

Prime Type	*Prime Task*	*ISI*	*Number of Subjects*	*Priming Effect*
pictures[a]	naming	250 msec	16	8 msec
words[a]	naming	250 msec	16	−25 msec
pictures	naming	250 msec	12	6 msec
words	naming	250 msec	12	6 msec
pictures	naming	250 msec	24	7 msec
pictures	look for 550 msec	250 msec	24	4 msec
pictures	look for 200 msec	50 msec	24	−3 msec

[a]These conditions were randomly intermixed in the same experiment. In this experiment the factors of prime type (picture or word) and target type (picture or word) were factorially combined.

One set of studies which provides at least a closer examination of this issue is provided by Irwin and Lupker (1983). As mentioned earlier when considering the word-naming part of these studies, although no real effort was made to control for the effects of association, the stimuli were paired in such a fashion that associated pairings were rare. Three studies were run in which the type of response to the prime was varied (categorisation, naming, or colour report). As with words, there was very little evidence of priming in these situations using either word primes (11 msec average over the 3 experiments) or picture primes (16 msec average over the 3 experiments).

We have now repeated these experiments with a number of different parametric variations and with a better control over associative strength. The results are summarised in Table 4.1. As is obvious, throughout these experiments semantic priming of picture naming was essentially nonexistent, reaching a maximum of 8 msec and a minimum of −25 msec. These results seem to indicate it is not semantic but associative relatedness which is producing the majority of the priming in the studies mentioned previously. The existence of semantic priming in picture-naming tasks can not, of course, as yet be totally ruled out. However, it appears that its role must be quite limited.

Based on the storage models discussed in the beginning of the chapter, one would certainly have anticipated that semantic priming of picture naming would have been found. That is, central to essentially all these models is the assumption that semantic processing precedes picture naming. Thus, there would presumably be a number of operations in picture naming that could be primed (certainly many more than for words, for example). The assumption that semantic processing precedes picture naming appears to be based on three empirical results. First, as indicated above, in a number of memory experiments (Dhawan & Pellegrino, 1977; Nelson & Reed, 1976; Nelson, Reed, & McEvoy, 1977), subjects were much more likely to have a semantic code and much less likely to have a phonetic code for pictures than for words. Second, also as noted previously, subjects tend to make decisions based on the retrieval of semantic information much more rapidly for pictures than for words. Finally, picture naming itself appears to take longer than making certain semantic decisions about the pictured concept (Potter & Faulconer, 1975). Based on these results, in conjunction with the priming results, the question becomes what *can* we and what *must* we say about the role of semantics in the picture-naming process.

Findings in the memory experiments (e.g. Nelson et al., 1977) are clearly supportive of the idea that determining a picture's name is not as automatic a process as determining a word's name. Further, results in these memory tasks, as well as those in speeded semantic decision tasks suggest that access to certain semantic information is more rapid for pictures than for words. However, neither of these conclusions actually has any implications for the basic assumption that semantic processing necessarily precedes picture naming. Retrieving a picture's name may simply be an optional process, one which the subject may wish to bypass when being required to remember a set of pictures. Certainly, this would be a reasonable strategy to use in memory tasks if semantic codes are more viable codes, as they seem to be for words (Craik & Lockhart, 1972; Hyde & Jenkins, 1973). In experiments where subjects are required to make speeded semantic decisions about words and pictures, name retrieval may actually be a harmful strategy. For example, in the Stroop (1935) colour-word interference task, in which subjects are required to say the ink colour of a word, the automatic activation of the word's name appears to retard colour naming. A similar problem may arise when any non-naming response is required to a word stimulus. Thus it would be to the subject's advantage not to retrieve name information when it isn't needed. The fact that this strategy may be a viable one when processing pictures but not when processing words may account for a number of advantages pictures show in semantic decision tasks. In any case, what this argument does make clear is that the picture advantage typically observed in memory and speeded semantic decision tasks does not represent strong evidence for the existence of semantic processing prior to name retrieval.

The third basis for the assumption that semantic processing precedes picture naming, that is, the finding that certain semantic decisions can be made about pictured concepts more rapidly than the concepts can be named (Potter & Faulconer, 1975), actually is relevant to the assumption.

However, while this result, at face value, appears to justify the assumption, there are still at least two interpretation problems. In order to understand the first problem we must make the distinction between semantic decisions made on the visual information and semantic decisions made on the concept's memorial information. To see this distinction best, consider an individual who sees his or her first picture of a kangaroo. What would be immediately obvious is that this is a picture of an animal, since it comes with all the equipment that defines an animal (e.g. head, tail, eyes). As such, a number of "semantic" decisions (such as whether it's an animal or not) could be made quite accurately by this individual although he or she certainly would have no stored information about the concept. What decisions would be obtainable would be an empirical question—would this individual be able accurately to estimate the kangaroo's size, for example, by basing the decision on, say, the size relationship between the eye and head? In any case, the point is that because we don't know the answers to these questions, we do not know the extent to which this information is used and we do not know the extent to which semantic processing at the memorial level can be bypassed.

The second interpretation problem is that these semantic decision tasks, almost by necessity, have different response requirements than naming tasks. While a picture-naming response may be the name of essentially any pictureable concept, these semantic decision tasks inevitably require a binary (e.g. yes/no) decision. This difference should represent an advantage for semantic decision tasks at the response organisation and execution levels, suggesting that a comparison of overall reaction times could be quite misleading. In fact, when the response requirements are more nearly equated, as they were in the Irwin and Lupker (1983) studies, picture-naming times tended to be shorter than times to make semantic (categorisation) decisions. Thus, because of these two problems, even data like that reported by Potter and Faulconer (1975) does not allow us to put forward a strong argument for the assumption that semantic processing precedes picture naming. (In fairness, it should be noted that Potter and Faulconer themselves do not wish to make much of this type of finding, as they are much more interested in making picture-word comparisons in the same task rather than within stimulus comparisons across tasks. They recognise that there are a number of problems inherent in cross-task comparisons, including those mentioned above.)

The thrust of my argument to this point is that there is, at present, little evidence that there are a great many differences at the *memorial* level between retrieving a word's name and retrieving a picture's name. What is not being claimed is that there are no differences in the visual analyses of these stimuli which allow memory access. That is, the analysis of stimulus components which allows memory access must be different because pictures and words are made up of different components. As such, when the components are being identified, different types of memorial contact are being made and different types of intermediate information are becoming available. In the case of words, information is supplied which may be useful in making orthographic decisions, while in the case of pictures the information may be helpful in making some semantic decisions. In the normal course of things this information may be quickly forgotten but, nonetheless, it is crucial to the process and does represent a basic picture-word difference.

While this difference is not central to the present discussion concerning the retrieval of memorial information, its existence means that cross-task comparisons will inevitably be problematic. So, instead, I will once again argue that the assumption under question is best evaluated by considering the effects of a semantic context on picture naming. Thus we'll again return to the issue but in a slightly different situation. As before, the task is picture naming, but this time the pictures will have words superimposed on them (see Fig. 4.2). As one would expect in this type of task, the word's name is retrieved rapidly and automatically and thus is available before the picture's name. This creates a situation where the word's name somehow delays the pronunciation of the picture's name, prolonging response time in comparison to a control condition in which the picture contains no word. This phenomenon is referred to as picture-word interference.

The basic explanation of these types of findings rests on the notion of response competition. The word's name is presumed to occupy a slot in a single-channel output buffer creating a tendency to pronounce it. This tendency must be suppressed before the correct response can be generated, producing the delay in response time. In line with this idea, if it is the word's name that the subject is required to produce, its rapid

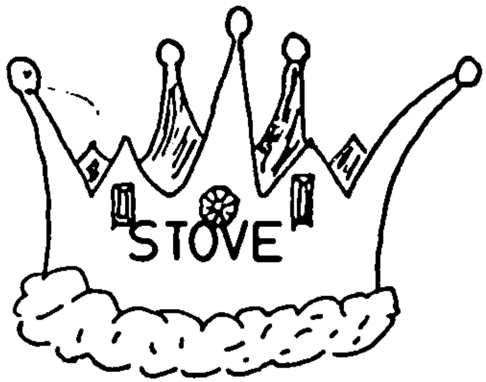

FIG. 4.2. Typical picture-word interference stimulus.

availability and the lack of automaticity in retrieving the picture's name allows it to be produced with no interference (Smith & Magee, 1980).

If this were the whole story, this task would have little to say about the issues being addressed here. However, as Rosinski (1977) has shown, it is not. Rosinski created a picture-word interference experiment with four conditions; a control condition in which the superimposed word was the picture's name, the standard interference condition with unrelated words appearing on the pictures (e.g. CUP on the picture of a pig), a condition in which pronounceable nonwords appeared on the pictures (e.g. BOV on the picture of a pig), and most importantly, a condition in which each superimposed word was related to the pictured concept (LION on the picture of a pig). Rosinski reported that while nonwords produce naming latencies essentially equivalent to those for unrelated words, related words produce substantially longer naming latencies.

In creating his related-word condition, Rosinski had attempted to use simple category relationships. However, as was the case throughout the

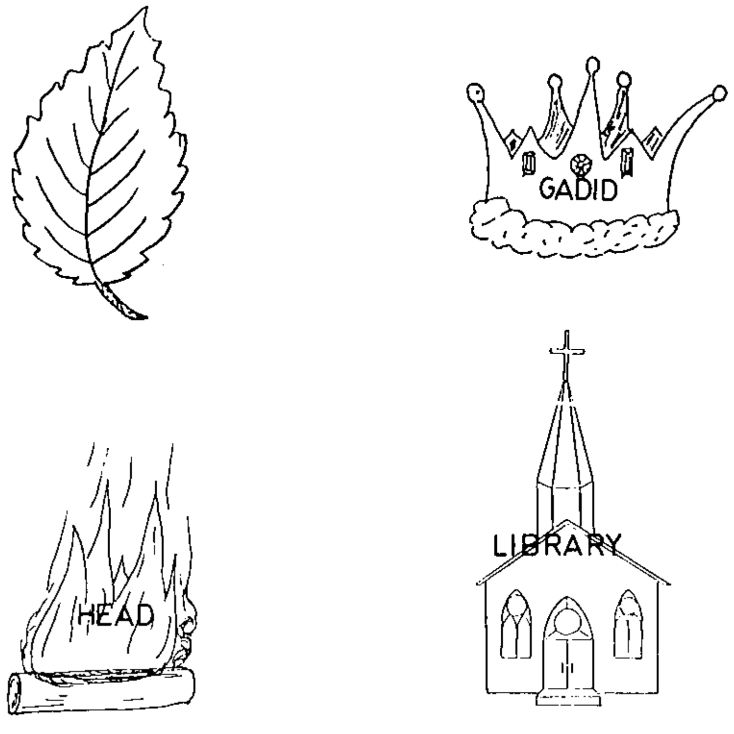

FIG. 4.3 Picture-word conditions included in Experiments 1–3. Clockwise from upper left: Picture alone condition, pronounceable nonword condition, semantic category condition (typical), unrelated word condition (Lupker, 1979).

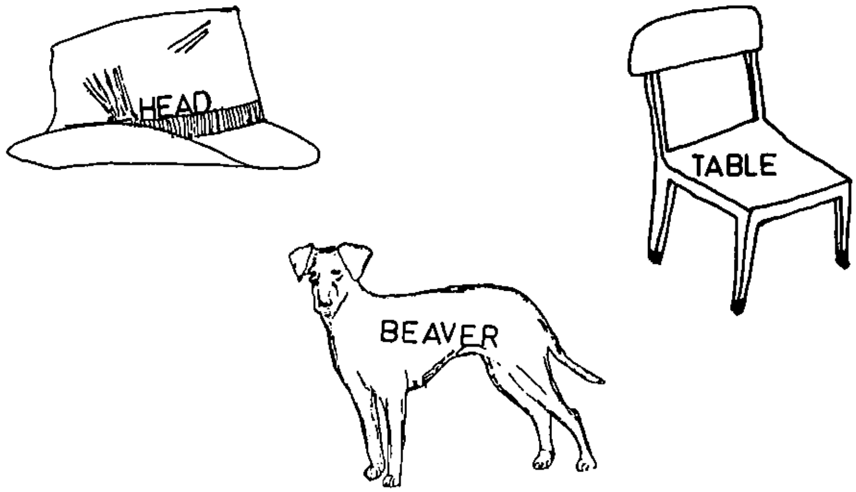

FIG. 4.4. Extra picture-word conditions included in Experiments 1-3. Clockwise from upper left: Noncategorical associate condition—Experiment 1, categorical associate condition—Experiment 2, semantic category condition (atypical)—Experiment 3 (Lupker, 1979).

priming literature, Rosinski made little attempt to determine whether it was the existence of semantic relationships or simply the uncontrolled effects of association which produced his effect. This was the general issue addressed in Lupker (1979).

Included in Experiments 1–3 of Lupker (1979) were always a picture-alone condition, a pronounceable-nonword condition, an unrelated-word condition and a condition in which the pictures and words represented essentially unassociated but highly typical members of the same semantic category (see Fig. 4.3). The basic result, replicated over these three studies, was that the final three conditions all produced interference relative to the picture-alone condition, with unrelated words producing 10–15 msec more interference than pronounceable nonwords, but 30 msec less interference than semantic category words. Superimposed on this basic result it was also shown that: (1) frequent associates not from the same semantic category cause no more interference than unrelated words (Experiment 1); (2) frequent associates from the same semantic category cause exactly the same amount of interference as nonassociates from the same category (Experiment 2); and (3) relatively (although not extremely) atypical category members cause the same amount of interference as typical category members (Experiment 3). (Examples of these stimuli are contained in Fig. 4.4.) Thus, Rosinski's effect seems to be truly a semantic one. Only if pictures and words represent members of the same semantic category and, therefore, share a certain amount of semantic overlap will the extra interference be produced.

Unlike the priming results discussed earlier, this result indicates that under certain circumstances semantic relationships can influence picture naming. The next step would seem to be to determine how this influence is exerted and whether it has any implications for the assumption that semantic processing precedes naming for pictures. As mentioned previously, interference effects have tended to be interpreted in terms of response competition processes (e.g. Dyer, 1973; Klein, 1964; Posner & Snyder, 1975), in which the tendency to say the word's name must be suppressed. Further, it has been suggested in the colour-word interference task that there are factors which affect the difficulty of this suppression process. Klein (1964), for example, has shown that words which are colour names or colour related (e.g.*grass, sky*) produce more interference than unrelated words (e.g. *friend, cup*). Presumably a similar process could be in operation here, with the existence of a semantic relationship somehow making the words harder to suppress. Alternatively, a number of researchers (Hock & Egeth, 1970; Seymour, 1977; Stirling, 1979) have argued for a locus of interference prior to the response level. For example, it could be that the name of a semantically similar concept could delay some aspect of the memory-access process. In Lupker and Katz (1981) we set out to evaluate these possibilities.

Lupker and Katz (1981) attempted to create a task in which the ability of the word's name to produce response competition was essentially eliminated, so that the early processes in picture naming could be examined. The task selected was one in which subjects were required to respond to picture presentations by deciding whether they were pictures of dogs or not. One group responded manually, the other verbally. What we presumed would happen was that subjects would establish, in working memory, a general set of features that could characterise the visual appearance of a dog. Those features could then be compared against the incoming visual information. When a criterion of certainty had been reached, a response (yes or no) would be selected and executed. It was hoped that by keeping the response set small (two possible responses) and using responses that are quite different from the word's name (even in the vocal condition where the responses were yes and no), the word's name would not evoke any response tendencies. An examination of our results suggests that we were successful on all counts. Subjects did appear to be handling this task at a visual level as indicated by the fact that animal pictures were harder to reject than nonanimal pictures on negative trials. Our success at controlling the response process is indicated by the fact that neither unrelated words nor pronounceable nonwords produced any significant interference for either manual or vocal responders. Nonetheless, the same semantic category-unrelated word difference on positive trials (i.e. dog pictures) emerged nearly full-blown for both types of responders.

This result indicates that this semantic category effect is not a result of differential suppression difficulties at the response level. Instead, it appears that the locus of the effect is an input process which is common to the naming task and this identification task. The argument is that the process which is common to both tasks is the evaluation of the visual information. In the naming task this information is evaluated for the purpose of determining what concept is being represented. In the identification task a similar process takes place but here the end product is to determine whether this information characterises a dog. Apparently, while this evaluation is going on, the word is being processed automatically. This processing appears to produce not only the word's name but also a certain amount of semantic information. The semantic category effect arises because the information from a semantically similar word matches reasonably well with that provided by the picture, suggesting that the word's name may be an appropriate label for the picture. Determining that the label is inappropriate takes extra time, providing extra interference in the same semantic category condition in comparison to when the word and picture are unrelated.

If our analysis of how subjects handle this task is correct, this study suggests that the effects of semantics in picture-word interference involve the visual analysis of pictorial information and not information retrieved from the picture's memory location. We have now considered five empirical findings which could be and have been used to argue for the assumption that semantic processing precedes picture naming: (1) the picture advantage in memory tasks (e.g. Nelson et al., 1977); (2) the picture advantage in speeded semantic decision tasks (e.g., Paivio, 1977); (3) Potter and Faulconer's (1975) result that semantic decisions about pictured concepts can be made more rapidly than those pictures can be named; (4) "semantic" priming of picture naming (e.g. Carr et al., 1982); and (5) the semantic category effect in picture-word interference. The first two of these, in fact, appear to have nothing to do with the assumption. "Semantic" priming of picture naming seems to disappear when the effects of association are controlled. The third finding may be a function of response requirements or, as with the final result, more likely a function of the way in which the visual analysis of pictures is carried out rather than a function of post-access semantic processing. Thus, at this point, we are still left with the conclusion that there is little evidence that pictures must be processed semantically at the memorial level before they can be named.

Naming Pictures—Phonetics and Orthography

In the subsection on phonetic and orthographic priming of words we discussed a study demonstrating that word naming could be primed

TABLE 4.2
Mean Reaction Times (in msec) in the Key Conditions (from Lupker, 1982)

EXPERIMENT 1	
Nature of superimposed letter string	*RT*
Orthographically but not phonetically similar word	698
Unrelated word	754
Orthographically similar X string	665
Unrelated X string	690
EXPERIMENT 2	
Nature of superimposed letter string	*RT*
Phonetically and orthographically similar word	646
Phonetically but not orthographically similar word	678
Unrelated word	701

phonetically, though perhaps not orthographically. The obvious question is: Can the same be said for pictures? In the same study we also included picture targets and discovered that, in fact, the parallels are strong. Pictures were primeable by either word or picture primes whose names rhyme, and as with words, the magnitude of this effect does not vary as a function of prime type (78 msec priming effect for picture primes, 70 msec effect for word primes).

The finding that words and pictures provide equivalent priming suggests that the effect is phonetic but not orthographic in origin. However, some previously published results (Lupker, 1982; see also Underwood & Briggs, 1984) suggest that this conclusion is a bit too simple. In Lupker (1982) the task was a straightforward picture-word interference task. In Experiment 1 a condition was created in which the superimposed word was orthographically quite similar to the picture's name but phonetically quite different (BOOT on the picture of a foot). In comparison to an unrelated-word condition (BAR on the picture of a foot), this condition produced substantially shorter naming times, suggesting that the orthographic similarity of a superimposed word to a picture's written name can have an effect on picture naming (see Table 4.2).

The argument could, of course, be made that this effect is a result of the fact that there still is a bit of phonetic similarity between the word's name and the picture's name (i.e. the final phoneme). In an effort to counter this objection, two additional manipulations were introduced. First, another set of conditions was introduced into Experiment 1. In one of these conditions the pictures contained letter strings similar to their names except that Xs replaced all the letters up to and including the final vocalised vowel (XXXT was on the picture of a foot, XXR was on the picture of an oar). These letter strings should supply a certain amount of accurate orthographic information but the derivation of a phonetic code would be essentially impossible. In the other condition the same letter strings appeared on different pictures (e.g. XXXT appeared on the picture of an oar). The results were that letter strings containing accurate orthographic information produced picture-naming latencies 25 msec faster than the same letter strings on different pictures, reinforcing the notion that orthography influences picture naming (see Table 4.2).

The second result pointing to this same conclusion comes from Experiment 2. Here pictures contained either unrelated words, rhyming words which were not orthographically similar to the picture's name (BEAR on the picture of a chair), or rhyming words that were orthographically similar (AIR on the picture of a chair). The result was that the phonetic similarity without orthographic similarity condition produced only a small, although significant, advantage over the unrelated-word condition while orthographic and phonetic similarity together produced a much larger advantage (see Table 4.2). The small phonetic similarity-unrelated word condition difference indicates that the phonetic similarity does not play a large enough role that it could explain the effects attributed to orthographic similarity in Experiment 1. Finally, the fact that there was a significant difference between the phonetically and orthographically similar condition and the only phonetically similar condition provides one more piece of evidence for the importance of orthographic similarity in this type of task.

Although the variety of orthographic-similarity conditions never did produce picture-naming latencies more rapid than the picture-alone control, these results are still most reasonably explained in terms of priming. The reason the picture-alone control is generally faster is that the word, even when it primes picture naming, still occupies the output buffer and has to be suppressed before the picture's name can be produced. However, the orthographic information, and to some extent the phonetic information from the word, does appear to aid retrieval of the picture's name and, thus, the suppression process can begin sooner.

If this conclusion is correct, however, it raises an interesting question. Why do word primes produce no more priming than picture primes in the rhyme-priming study reported earlier? The answer to this question focuses on the memory-access process and the information used to accomplish it. Although we need to identify letters in order to identify words, as readers we have little recognition of this process. It seems simply to produce its results and (fortunately) leave behind little memory trace. Thus, it's perhaps not surprising that there would be little or no orthographic priming from a word which had been processed to the point that its name had been produced. However, in the picture-word interference task, the picture-naming process is ongoing at the time this orthographic information is becoming available. Thus, the circumstances are optimal for discovering effects of orthography, allowing orthographic priming to emerge. This reasoning does, of course, suggest that with more appropriate timing manipulations orthographic priming of word naming could emerge. That, however, remains an empirical question.

Extending the Model

Earlier, based on a review of a number of word priming studies, I proposed a general model of memory. Memory was viewed as a set of files of information, each file representing a single concept. These files were connected by a network structure based on association. Associative priming arose through a spreading activation process wherein entire files are activated by the presentation of an associate. Thus, both access to these files and retrieval of any information required by the task would be facilitated. Other types of priming (e.g. phonetic, semantic) result not from activation of files but solely from a speed-up of post-access retrieval operations.

We have now examined a number of similar studies using pictures. The main conclusions to emerge are that, as with words: (1) semantic relationships do not prime picture naming; (2) phonetic relationships do prime picture naming; and (3) there is no strong evidence that name retrieval for pictures must be preceded by semantic processing at the memorial level. Based on these results the model for word processing presented earlier appears to be a reasonable one for picture processing as well. Two additional issues do, however, need to be discussed. The first is how phonetic and orthographic similarity produce priming. The second is the one clear difference between word and picture processing, the memory-access process.

With respect to the first of these issues, I would argue that the requirement to name a picture creates an artificial situation. Under normal circumstances one would not want to generate a name to a picture. The preferred behaviour is to attempt to retrieve the semantic information necessary for understanding the picture as rapidly as possible. Naming would follow only if necessary. However, as the set of results presented here shows, when required to name pictures, subjects can handle their information store for the pictured concept in a different fashion. To do this it would seem that they simply search the file for any information they can find to aid in picture naming. It would not be unreasonable to assume that this information is not stored in a unitary fashion. In fact, research on the tip-of-the-tongue phenomenon (e.g. Brown & McNeill, 1966) suggests that people do find themselves with partial phonetic or orthographic information about a concept (e.g. its first letter or a word that sounds like it). If retrieval is conceptualised as a hunt for various pieces of information, then it would make sense that any of these pieces the word could supply (orthographic or phonetic) would help in the search and retrieval, speeding picture naming.

A similar suggestion would be made for word naming, although it may seem hard to believe that words' names are not retrieved in an all-or-none manner. However, there is no real reason to believe that this retrieval must be holistic. It is certainly a very rapid and essentially automatic process but this simply reflects years of practice. In normal individuals, it is unlikely that tip-of-the-tongue partial information states would ever be created by word stimuli. However, this may simply reflect the fact that any failure of retrieval can be corrected by using spelling-to-sound transformation rules on the visual stimulus. In fact, Ellis, Miller, and Sin (1938) have documented word-generated tip-of-the-tongue partial information states in an individual with Wernicke's aphasia, giving credence to the idea of piece-by-piece retrieval of phonetic information with words. Thus, although there undoubtedly are differences in speed of retrieval, the ways in which name information is read out of memory for words and pictures (when required) do not appear to be substantially different.

With respect to the issue of the memory-access process, pictures and words appear to be substantially different. Words, being made up of letters, must first undergo some sort of graphemic analysis. Orthographic and phonetic codes must be activated and synthesised in order to direct the process to the appropriate memory location. Whether these codes correspond to letters (e.g., Massaro, 1975), syllable-like units (e.g., Smith & Spoehr, 1974) or words (e.g., Johnson, 1979) is irrelevant to the discussion here. What is important is that the information which is analysed is graphemic and this type of information is not contained in pictures.

Pictures, due to their nature, must activate a set of "semantic" codes. The nature of these codes is, at present, even more ambiguous than those for words. Sperber et al. (1979) have put forth an argument that the codes would correspond to what we would consciously call the "features" of the object. However, Warren and Morton (1982) failed to find any evidence to back this up. Thus, they appear to suggest that the codes are a bit more abstract. Our use of the word "semantic" stems from the fact that in Lupker and Katz (1981, Experiment 1) what we have been calling semantic relationships (e.g., horse—dog) influenced this process. In any case, whatever the nature of the codes, they are not graphemic, thus requiring that pictures access memory in a different way than do words.

SEMANTIC PROCESSING

Our model to this point is a set of memory locations, each corresponding to a particular concept and linked together in an associative network. Pictures access this structure from one direction, words from another. Name information is stored at these locations in a piece-by-piece fashion. While retrieval of this information can be aided by relevant (i.e. phonetic and, presumably, orthographic) information, semantic information has little, if any, effect on this process. An appropriate semantic context can, however, aid in the subsequent search and retrieval of semantic information about a target concept. Thus, tasks which require the retrieval of semantic information would presumably be influenced by semantically appropriate contexts. Further, the fact that pictures and words do access memory from different directions may have implications for how semantic information is retrieved and how these context effects are manifest. It is to these issues we now turn.

Semantic Priming as a Retrieval Phenomenon

The first type of task which seems to involve the retrieval of semantic information is the lexical decision task. As discussed earlier, the initial conceptualisation of the semantic priming in this task regarded it as strictly an access phenomenon. However, more recently a number of investigators have argued for a second, post-access locus. There now appears to be a substantial amount of evidence supporting this view. Forster (1981) and West and Stanovich (1982) have demonstrated that priming effects are typically larger when subjects are required to make a lexical decision than when they are required to name the same stimuli. If priming were purely an access phenomenon, the two tasks, since they both require memory access, should benefit equally. Shulman and Davison (1977) have shown that the type of nonword used affects the amount of priming observed and the reaction times on positive trials. Word-like nonwords led to more priming than consonant strings and longer response times to words. The type of nonword used should not affect how long it takes to access memory; thus these differences should not have arisen. Finally, Fischler (1977) and our own results (Lupker, 1984, Experiment 5), showing that purely semantic relationships influence lexical decisions, suggests that if an access explanation is appropriate, semantics should also prime naming. As we have discussed earlier, this does not seem to be the case.

Forster (1981) has proposed that the post-access process which can be primed by semantic relationships is one in which the subjects make an attempt to integrate the word into the context that has been created. Semantically related words fit well, allowing a decision to be made easily.

Unrelated words do not, necessitating further processing before a correct decision can be made. While this explanation may account for the lexical decision results, it does not appear to have enough flexibility to account for semantic priming in other tasks.

The explanation I am proposing for post-access priming in the lexical decision task is based on retrieval operations. Although nonwords do not have memory representations, some, particularly those which are word-like, do cause memory locations to be accessed. Thus, the fact that a memory location has been accessed is not sufficient evidence for a positive decision. Additional processing is necessary. This additional processing would presumably involve the retrieval of memorial (e.g. semantic, phonetic) information. Supposedly, words allow retrieval from the memory location to occur more easily than nonwords. Essentially, the subject would be sitting in judgment of how easy or difficult these retrieval operations seemed until eventually a correct decision could be made on an ease-of-retrieval index. Thus it follows that lexical decisions could be primed by semantic relatedness as they were in Fischler (1977) and in Experiment 5 of Lupker (1984), using the same stimuli that had failed to produce priming in the naming task.

Other examples of situations where the retrieval of semantic information can be primed by semantic relationships can be found in Irwin and Lupker (1983) and Guenther, Klatzky, and Putnam (1980). In the Irwin and Lupker studies, as described earlier, subjects were required to categorise, name, or report the colour of the prime. In the target task of interest here, subjects were required to produce one of six possible category names. The use of so many categories was designed to prevent responses from being made on the basis of visual analysis. Priming was found in all instances with the largest amount of priming in the prime categorisation task and the smallest amount in the prime colour report task. The interpretation of these results was couched in a depth of processing framework. The prime categorisation task required the deepest level of processing, and thus activated the most semantic information. In retrieving the category of related targets, since considerable amounts of similar information had already been activated, the process was speeded considerably. When the prime was named, less semantic information was retrieved. In fact, as argued earlier, none is required for either pictures or words, and thus less priming was observed. Similarly, in colour report, memory access was not even required, thus the semantic information retrieved should be limited to what is available automatically. Here even less priming was observed.

Implications of Different Access Routes

The other interesting aspect of the Irwin and Lupker data is that the pattern of priming was essentially independent of the nature of the prime and target stimuli. With respect to the lack of a prime type difference across these three studies, perhaps this result is not really surprising. The nature of the tasks would seem to direct prime processing to the retrieval of a particular type of semantic information which would seem to be the same for both stimulus types. The colour report task could conceivably be an exception. Here only automatically activated information should be available. Thus, according to the idea that pictures and words initially access memory from different directions, differential priming might have been expected. The equivalence, however, may be due to the long (> 1500 msec) prime-target onset asychrony allowing subjects to retrieve enough information to prepare equally for a picture or a word. What is more surprising is that there were no differential effects of target type in any of the tasks. As discussed previously, words should have slower access to categorical information. In fact, averaged over these three experiments, the picture advantage in categorising unrelated targets was 60 msec. Thus, there would seem to have been more opportunity for words to show priming.

The total independence of the amount of priming and prime-target type strongly supports the notion of a common semantic store. However, the processing involved in these tasks was so directed, in the sense of what retrieval operations were required, that the chances of finding picture-word differences were far from maximal. What is perhaps a better task was employed by Guenther, Klatzky, and Putnam (1980). Their task required subjects to determine whether stimuli were living or nonliving, making the decision about both prime and target. This type of information would probably not be stored holistically in memory but would certainly be derivable from other pieces of information about the concept. Further, this task is much less directed in that many different types of information could be used to make the judgments. As such, if pictures and words initially access different semantic information, we may find much more intramodal (picture—picture or word—word) than crossmodal priming. This is essentially the result Guenther, Klatzky, and Putnam report, with semantically related pairs producing an intramodal priming effect of 80 msec and a crossmodal priming effect of only 25 msec.

This result and others which show larger intramodal than crossmodal priming effects (e.g. Durso & Johnson, 1979) suggest that the different access routes to memory taken by pictures and words have implications for semantic processing. In particular, there appears to be a difference in the semantic information initially available from pictures and words. A potential next step would be to ask how this information may differ. For what must be regarded as preliminary evidence concerning this issue we turn again to interference paradigms, which allow a better examination of the type of information automatically available.

The task to be considered involves a category decision about a word. In order to make a decision of this sort, memory access is essential since visual information from a word contains no clue to category membership. In Lupker and Katz (1982), typical picture-word interference stimuli were used. The task was to decide whether the word named a member of the animal category. The question was: How is this process influenced by the presence of the background picture? In Shaffer and LaBerge (1979), a stimulus consisted of a word presented centrally with a second word displayed directly above it and below it on the screen. The subject's task was to determine which of four categories the concept represented by the central words belonged to. The question here was how this process is influenced by the presence of the background words. In both experiments an identity relationship (either the word named the pictured concept or the two flanking words were the same as the central word) facilitated responding in comparison to the control condition. The key difference occurred when the background stimulus represented a member of the same category as the central stimulus. In the Shaffer and LaBerge study, same-category words facilitated word decisions, while in the Lupker and Katz study same-category pictures did not (in fact, they produced slightly longer reaction times than in the control condition).

The conclusion that these results seem to suggest is that same-category words make available some information which is helpful in making category decisions about words while same-category pictures do not. First of all, this conclusion backs up the idea that the initial semantic information available from pictures and words is somewhat different. In addition, it suggests that the semantic information initially and automatically retrieved via pictures is more concept specific while that retrieved via words is more category based. A very similar suggestion has recently been offered by Durso and Johnson (1979) based on their results in a repetition priming task. In addition, this idea blends well with the description of the semantic category effect in the standard picture-word interference paradigm. In that task the additional semantic interference observed seemed to occur only when the word and picture represented concepts from the same semantic category, essentially independent of typicality. Thus, the suggestion offered was that the semantic information that the word makes available automatically must be somewhat categorically based.

This last conclusion about the nature of automatically available information is, of course, an extremely tentative one. However, the conclusion that this information is not identical for pictures and words has a much firmer base. In fact, it seems quite likely that for every different access route into a concept's information store, the information which can be retrieved most readily would be different. Thus, the understanding one would gain from listening to a speech would be slightly different from that gained from reading the text of a speech. Similarly, looking at a line drawing of a pictureable concept would provide slightly different information than would looking at the physical object itself. The first point to be argued, then, is that different types of stimuli provide different entry points to a concept's memorial representation.

The other point, however, is that there are many more parallels between word and picture processing at the memorial level than there are differences. If a subject is required to retrieve a specific piece of information about a concept (for example, its name or its category), the retrieval processes appear to merge quite quickly. Overall time differences may be observed. However, many of these can probably be removed with practice or explained in terms of the use of visual information. What cannot be removed would need to be explained in terms of the points of entry for one type of stimulus being closer to the relevant retrieval routes.

FINAL THOUGHTS

Additional Structure

The model as proposed consists of a single structure. There is no entry structure, what is commonly thought of as a lexicon (e.g. Collins & Loftus, 1975), nor an exit structure for pronunciation such as that proposed by Stemberger (this volume). Failure to include a lexicon was quite deliberate. Previous theorising has often relied on the notion of a lexicon to explain priming effects, particularly in the lexical decision task. As the argument went, accessing an item in the lexicon was thought to be sufficient to make a positive lexical decision. As I have argued here, this type of description of the processes involved in the lexical decision task is woefully inadequate. In the present conceptualisation, the lexical decision task is viewed as just another task requiring the retrieval of information from memory. Priming of all sorts is seen as occurring in the basic memory structure and, in general, as resulting from a facilitation of retrieval operations. As such, there appears to be no compelling reason for including a lexicon-like structure in the present framework.

The failure to include an output structure may be a bit more problematic. I have concentrated in the present chapter on the processes involved in naming simple concepts. The model assumption is that the phonetic information necessary to say the concept's name is stored with all the other information about the concept. The subject need only retrieve the information to produce the name. However, in normal speech the issues become much more complicated. The speaker must deal with such problems as when to pluralise, how to pluralise, how to create noun-verb agreement, and how to sequence. Although some of this information would be stored in a concept's file (e.g. how to pluralise the word "woman"), some of it would not. Thus, as a complete model of speech production, the present framework would be inadequate. However, extending it to create a reasonable model of speech production would not be an unwieldy task. When that has been successfully accomplished the issue of whether another structure is needed could be addressed.

The Nature of Association

One additional direction that needs to be explored concerns the definition of an associative relationship. For my purposes I was using the fact that a particular response tends to occur frequently to a particular stimulus in a free association task. However, we were clearly not born with these associative links already in place. Rather, they have developed through years of experience with the world and with the language, and in many cases in an idiosyncratic fashion. Further, with sufficient practice, it would undoubtedly be possible to create any given degree of associative strength between two previously unrelated concepts. Presumably, there would be some factor or factors underlying the creation of these relationships that make it easier or harder for two words to become frequent associates; this would presumably interact with frequency of co-occurrence. Understanding these factors would be helpful in creating future versions of the model.

What also needs to be considered is how concepts that cannot be represented in any simple way are linked into the network. For example, in recent years a more complicated type of priming has been reported (Fischler & Bloom, 1979; Kleiman, 1980; West & Stanovich, 1982). Subjects are presented with incomplete sentence contexts as primes: "The carpenter used the hammer to drive the ______." and then presented either a congruous (*nail*) or incongruous (*donkey*) target word. Typically, both naming and lexical decision making are faster for congruous sentence completions. Further, West and Stanovich (1982) have produced a reasonably strong argument that this effect in the naming task results from a facilitation in the congruous word condition. At present it isn't totally clear that the effect is not actually due to associative relationships between the target word and earlier words in the sentence. However, it may reflect some spreading of activation from a memory location for the concept of a carpenter hammering to that for the concept for a nail. Unfortunately, the number of concepts of this type would appear to be virtually limitless. Nonetheless, they may be more important than single word concepts to our ability to comprehend written language. Thus, an understanding of their relationship to this system would be crucial.

Finally, in spite of this potential proliferation of concept locations, it should be pointed out that the guiding philosophy behind the construction of the present model was to get by with as few structural assumptions as possible. Hopefully, this has been accomplished. The starting point was the simple file model of Theios and Muise (1977), and the only structural assumption added, the associative links, was added because the data appear to compel it. Rather than attributing the other context effects to the structure of memory, an attempt was made to explain them in terms of a processing assumption; that the recent activation of certain types of memorial information aids in a retrieval process. Further, the argument was presented that most picture-word differences do not arise because of the structure of memory but because of how individuals use the visual information to reach memory. While this emphasis on process rather than structure represents a bit of a departure from more established ways of thinking about these issues (e.g., Collins & Loftus, 1975; Paivio, 1971), I think it is important. It seems clear that humans have an incredible flexibility in manipulating language; an incredible number of processing options open to them. In any circumstance, an individual would presumably choose the option which makes performance, at least subjectively, easiest. Thus, understanding any psycholinguistic phenomenon like those addressed in the present chapter would seem to require a more thorough evaluation of the ways in which information can be processed before falling back on structural assumptions.

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