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# Synonymity And Concreteness Effects On Free Recall And Free Association: Implications For A Theory Of Semantic Memory

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# SYNONYMITY AND CONCRETENESS EFFECTS ON FREE RECALL AND FREE ASSOCIATION: IMPLICATIONS FOR A THEORY OF SEMANTIC MEMORY


by

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## ABSTRACT

Memory consists of a permanent storage system for retaining context-free semantic information and a more transient system for storing temporally-defined episodes. Considerable controversy exists about the appropriate conceptualization for semantic memory and distinctions can be drawn among three general classes of models. One model hypothesizes that the elementary components of semantic memory are conceptual in nature so that the mind entertains representations that are abstract entities roughly corresponding to ideas. This theory has been endorsed by many psycholinguists and computer scientists concerned with artificial intelligence and computer simulation of human memory. The second hypothesis is that the mind codes information in some verbal form so that the word-like nature of the elements is retained in the representation. The third model assumes, as does the verbal model, that mental representations are experientially based but allows for both verbal and imaginal codes, words and images of the objects to which the words refer.

These three models hypothesize different cognitive structures to represent the meanings of concrete and abstract synonyms. The conceptual model proposes that words with similar meanings converge on a common mental representation while the verbal model argues that such words maintain separate representations in semantic memory. These states exist irrespective of the concreteness of the material. According to the verbal-imaginal model, concrete synonyms converge on a common imaginal representation while abstract synonyms remain "independent" verbal entities.

Experiment 1 examined the effects of literal (presentation of target word twice in list) and semantic (presentation of target word with its synonym) repetitions on the free recall of concrete and abstract words. Semantic repetitions of concrete words resulted in recall levels comparable to those for literal repetitions and both types of repetition were clearly superior to once-presented items. Abstract synonym repetitions produced recall closer to that of once-presented items while the actual repetition of abstract words facilitated recall in comparison to both of these groups. A semantic repetition was as effective at incrementing recall as a literal repetition but only when the materials were concrete. These results are most directly interpreted in terms of the verbal-imaginal model of semantic memory. The other models, per se, predicted either effective semantic repetitions for both concrete and abstract words (conceptual model) or no effect of semantic repetition, whatsoever (verbal model).

Experiments 2 to 4 examined the effects of synonymity and concreteness on the similarity or associative overlap of free associations. The level of associative overlap for synonyms was generally low (always less than 50%) and less than the consistency of responses to the same word presented twice (Experiment 4), although much of the uniqueness of associations to synonyms could be attributed to the general instability of individual free associations. Even though the words were equated for rated synonymity, there was greater overlap for concrete synonyms than for abstract whether different subjects (Experiment 2) or the same subjects (Experiment 3) generated the associations to each member of the pairs. This pattern of results corresponds to that predicted on the basis of the verbal-imaginal model of semantic memory.

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## CHAPTER 1

## ASSOCIATIVE MODELS OF SEMANTIC MEMORY

Many current psychological models conceptualize semantic memory as an associative network that consists of nodes and interconnecting links or arcs (Anderson, 1976; Anderson & Bower, 1973; Collins & Loftus, 1975; Hayes-Roth, 1977; Norman & Rumelhart, 1975). According to such theories, a word initiates activity at a particular node and this activity spreads to other nodes via the associative relationships. These internal responses to the stimulus determine the meaning assigned to that word; or, rather, the aggregate of these responses *is* the meaning of the word.

Initial considerations in the development of an adequate network model of lexical memory are of two sorts. The first concern is the selection of the appropriate form for the atomic representations, engrams, cells, gnostic units, or cogits, to mention a few theoretically neutral terms that have been proposed for the elemental representations in memory. This paper concerns only molar representations, "idea units", but molecular elements such as features are certainly congruent with the very general classes of models under discussion.

A second consideration is the representation of the relationships among these elements. Stimulus-response associations (unlabeled arcs) may be sufficient to account for the basic phenomena of perception, language, and thought; or, it may be necessary to postulate propositional relationships (labeled arcs). The current theoretical bias is towards the latter view of associative relationships and a far greater amount of research has been concerned with this aspect of network models than with the nature of the nodes.

Historical affiliations exist between different modes of item representation and particular sorts of associative structures but these are actually quite independent theoretical issues. I have attempted to adopt an atheoretical view of the association issue and my primary concern is with the selection of appropriate atomic elements. Three types of representation-- verbal, imaginal, and conceptual-- have been selected for consideration. They provide a general taxonomy that is sufficient to classify most current models of semantic memory. These terms are used in this paper to designate particular theoretical constructs and the reader should not confuse words, images, or concepts as constructs with the additional surplus meanings associated with everyday use of the terms. In particular, the term image does not necessarily imply a static, unprocessed, picture-like representation (Pylyshyn, 1973). Neither is the separate class of conceptual representations inconsistent with the view that verbal and imaginal representations are relatively abstract (conceptual in a commonsense way), the position adopted in the present paper.

One additional introductory remark is appropriate. The representations of primary interest are those among which meaningful associative relationships exist, the nodes in semantic memory. Meaning has been characterized as a pattern of activation within a semantic network of verbal, imaginal, and/or conceptual nodes. The hypothesis of a single sort of node in semantic memory does not deny that alternative forms of representation are necessary in other components of the memory system. It is clear, for example, that some form of verbal representation will be necessary in any model of human memory, although some theories would assert that these word-like representations are not directly involved in semantic memory.

The principal question addressed in this thesis can be stated quite simply. Are words, words and images, or concepts the basic elements of permanent memory? The question asks about the number of types of units represented in semantic memory and the level of abstraction of those units. All three alternatives stress the role of some type of associative structure in the determination of word meaning and, for the purposes of this paper, differ exclusively in terms of the elements that are associatively related. The models are introduced in the following section, after which some empirical consequences of the theories are examined.

## An Introduction to the Models

### Verbal Representations

The first hypothesis is that the words themselves function as atomic elements, although a modern proponent of this view was difficult to find until recently. The early behaviourists hypothesized that thought was inner speech and, much later, Archer (1964) still identified concepts as "meaningful words which label classes of otherwise dissimilar stimuli." Neobehaviourists have emphasized the importance of verbal representations and the associations among these elements in thought and language (e.g. Deese, 1965). Permanent memory was viewed by some as mainly a verbal system (Travers, 1970). More recently, the importance of verbal representations *per se* has been explicitly denied (Chase & Clark, 1972; Collins & Quillian, 1972; Rumelhart, Lindsay, & Norman, 1972).

Verbal representations undoubtedly consist, in some form, of the graphemic, phonemic, and/or articulatory features of a word, and these features are stored in permanent memory. Initial analysis of a word activates this mental representation, which is primarily perceptual in nature. The perceptual system may work in a number of different ways. Different physical stimuli may be treated as word tokens (e.g. dog, DOG) which activate some type representation ("dog"). This model corresponds most closely to the word pattern theory of word recognition (Johnson, 1975; Navon, 1977; Terry, Samuels, & LaBerge, 1976). According to a letter integration theory (Sloboda, 1976), the word would be parsed into letter or phoneme tokens which would activate the appropriate generic representations. The verbal unit would then consist of a list of letter types ("'d', 'o', 'g'"). Other authors have argued that an intermediate level of representation such as the syllable (Cole & Scott, 1974) provides the basic unit of speech, or that units of various levels of analysis are required (Mewhart & Campbell, 1977). Atkinson and Juola (1974) presented an extensive listing and discussion of potential verbal codes. It may be that one of these codes plays a dominant role (e.g. Morton, 1970) or that there is a single, still more general, concept of the stimulus (e.g. Wickelgren, 1972).

These issues are not crucial to the current discussion, which is concerned with the semantic role played by a type representation of the word, whatever the form of representation. The verbal representation has a perceptually-based, complex relationship with the stimulus, but the only criteria for membership in the class of events are perceptual ones. A word in such a system could be defined as "a mental representation that is the common denominator of all written and spoken tokens of a given type" (Potter, Valian, & Faulconer, 1977, pp. 1-2).

Clearly, this is not a peripheral theory of the Watsonian type, although evidence for a motor component to thought (McGuigan & Schoonover, 1973) supports the view that mental events of an articulatory or a manual sort may be important in certain cognitive tasks. Furthermore, the presence of verbal codes is certainly not debated. Any model of human memory must incorporate such representations. The issue is whether or not such codes are sufficient to account for cognitive performance or simply represent a preliminary stage of encoding or a terminal stage of decoding linguistic material. Until very recently, words were thought to play only a peripheral part in cognitive functioning. There is, however, growing recognition that the current models do not discriminate between verbal and conceptual representations except in theoretical terms. Potter et al (1977) noted that the conceptual representations of the typical models of semantic memory are functionally indistinguishable from verbal representations and that, in practice, the constituents of such models do correspond to words. Anderson (1976, p. 41) stated that the "more sensory based representations are able to mimic propositional ones."

Hayes-Roth and Hayes-Roth (1977) have argued most strongly for words as the basic units of representation. They pointed out a number of methodological and inferential weaknesses that underly the theory of abstract representations, and argued that the word-based theory was more efficient than the conceptual theory in several ways. A verbal model of semantic memory would account for meaning in terms of the activation of nodes that correspond in one-to-one fashion with words in a given language.

Verbal-Imaginal Representations

The second hypothesis to be considered is that the elements of lexical memory may be of two sorts: verbal and imaginal representations, a proposal championed primarily by Paivio (1971, 1976a, 1976b). All events are represented in terms of the organism's reactions to that event's physical properties. A number of verbal codes for verbal events have been suggested and discussed in the preceding section. Images, schemas, templates, prototypes, ideals, and descriptions are some of the proposed nonverbal codes, but the distinctive features of these concepts have yet to be clarified. Neither has it been determined how abstract imaginal representations should be. Salthouse (1977), with simple dot patterns, found that the initial representation was based on specific instances but later percepts were based on a generic representation. He was not specific about the nature of the generic representation except that it was more similar to old exemplars than to new.

There has been considerable misunderstanding about the relatively abstract nature of imaginal representations. Images do not necessarily imply "some iconic and uninterpreted sensory pattern" (Pylyshyn, 1976), a view which has resulted in considerable criticism of the concept of imagery (Pylyshyn, 1973). Kosslyn and Pomerantz (1977) properly noted that higher-order perceptual processes allowed for imaginal representations of analyzed sensory information. Since the representation is tied to visual experience in a relatively direct fashion, it is appropriate to view the representation as imaginal in nature. It was noted in the previous section that words are also relatively abstract forms of representation. This issue is important enough to receive special consideration in the next section of the paper.

As with verbal representations, there is considerable debate about the relative contribution of holistic and component processing to the recognition of complex, nonverbal patterns. Monahan and Lockhead (1977) argued strongly that integral stimuli are processed holistically and not dimensionally. Goldman and Homa (1977), on the other hand, hypothesized that prototypes are represented by characteristic feature values, and compared feature averaging and feature frequency models of prototype integration. Others have noted the need for both specific and global (holistic) features but, as yet, the paradox of which comes first has not been solved (Turvey, 1973).

A model of semantic memory based on imaginal processes need not wait for the resolution of these issues. Nonverbal events are defined in terms of the appropriate modality, and the imaginal representations may be thought of as unique perceptual features that define classes of objects or events. That is, there exists an initial reaction which maintains a correspondence with the physical, nonverbal stimulus. Imaginal type-representations may consist of typical exemplars (Rosch, 1976), abstract images, lists of perceptual features, or some to-be-determined format that is relatively isomorphic to the input.

The availability of the imaginal component of word meaning is primarily determined by the nature of the word. Some words refer to classes of objects or referents, and the perceptual features of the class are stored as an imaginal representation. Through experience, the word acquires the ability to elicit this mental event as a meaning reaction. Such concrete words have typically been identified using rating scales of concreteness or imagery value (Paivio, Yuille, & Madigan, 1968). Other words in the language do not have any correspondence with specific, nonlinguistic, perceptual events. Such words are abstract in that they do not refer to a definite set of perceptual features. The verbal-imaginal model accounts for abstract word meaning in terms of associative reactions elicited in other words. Concrete words, on the other hand, spread activation, not only to verbal representations associated with the word, but also to imaginal representations that provide an additional dimension to the meaning of such words.

Conceptual Representations

The verbal and verbal-imaginal models assume that the engram is inherently experiential. Some non-trivial aspects of the physical stimulus-- verbal or imaginal-- are maintained in the representations in semantic memory. In contrast with the verbal model, many recent theories of semantic memory have assumed that the stored elements are "concepts or ideas as such, and not the names used in referring to them" (Frijda, 1972). Similarly, arguments have been forwarded that the concreteness of imaginal representations, their "pictureness", makes them unsuitable for a primary form of representation in the mind (Pylyshyn, 1973). The basic elements are hypothesized to be conceptual representations that have been variously characterized as abstract, interlingual, and neutral with regard to mode of input. Meanings represented by such supralinguistic concepts are at a level of abstraction more primitive than the word itself (MacLeod, 1976) and this common conceptual base underlies synonyms, translations, and pictures (Rosenberg & Simon, 1977).

The abstract entities and the relationships hypothesized to exist among these representations have been primarily linguistic in nature since the preponderance of work has been concerned with language, but such models distinguish between the word and the concept underlying the word (Miller, 1972). Name nodes are in a lexical network separate from, but connected to, the concept nodes in the semantic network (Collins & Loftus, 1975). Even when the actual nodes of the graph are words, theorists view these names as mere labels for concepts, the main cognitive structures (Kiss, 1973).

The form of representation has not been settled and the relative importance of holistic and analytic processes is as relevant to the notion of a concept as it was in the previous models. Nelson (1974) has argued that concepts are initially holistic (functional core concepts) based on a process of synthesis (relational theories) but are later analyzed into attributes or features (abstraction theories). Nelson also suggested that representations are abstract at a very early age and at an early stage of development of the concept. Such a view contrasts markedly with verbal and verbal-imaginal theories of representation based on concrete experiences. The major difference among the theories is the amount of abstraction presumed to be necessary to account for human cognitive activity. According to the conceptual model, the meaning of a word depends on activity initiated at a conceptual node and spreading to other conceptual nodes in the associative network. The verbal and imaginal representations play a role in the input and output of the semantic memory but do not participate in the determination of the meaning of a word.

## Levels of Abstraction

Figure 1 attempts to clarify the relationships among the three models of semantic memory. The principal dimension represented in the

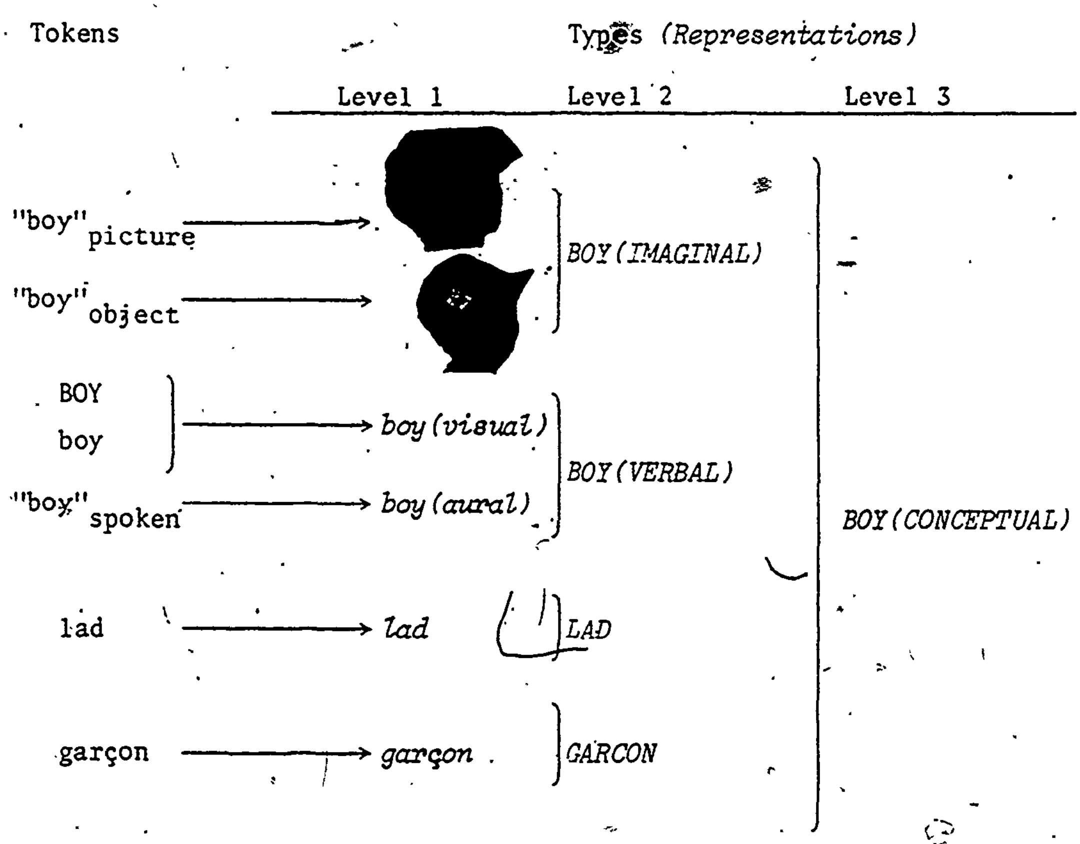


Figure 1: An illustration of the level of abstractness of verbal, imaginal, and conceptual representations. Tokens without subscripts are orthographic.

figure is degree of abstraction which ranges from the concrete stimulus or iconic representation on the left to the most abstract representation, the concept, on the right. Three levels of representation have been included for illustration purposes, although far more stages of processing could have been identified. The process of abstraction is best thought of as a continuum; at each level of representation, a rule exists that defines the set of admissable members. This rule becomes more abstract from level 1 to level 3 and less tied to perceptual considerations.

A number of minor dimensions are represented horizontally. Tokens can be classified as verbal or nonverbal and nested within these categories are a number of other dimensions, the most clearly defined being within the verbal domain. Word tokens may be categorized by language or, within languages, by modality of presentation. The set of modality-specific tokens is very large. For example, the visual stimulus for "boy" could occur in an infinite number of calligraphies (McClelland, 1977).

Level 1 representations require some form of perceptual learning or pattern recognition component to identify tokens that vary greatly in format as exemplars of that category. It is difficult to partition the nonverbal world in as precise and well-defined a fashion as the verbal world. The notion of a continuum of abstraction is most appreciated in the nonverbal domain since the sets of perceptually similar objects are much fuzzier than sets of perceptually similar verbal events. Unique level 1 representations exist for words presented in different modalities, synonyms, translation-equivalents, and images of the relevant object.

Level 2 representations are modality-free (in the case of words, at least) types, although different representations still exist for synonyms, translation-equivalents, and images. The verbal representations and, somewhat arbitrarily, the imaginal representations have been placed at this level so that their relatively abstract nature can be appreciated. Additional degrees of abstraction are, however, possible since the verbal and imaginal representations retain something of their concrete origins.

Representations are clearly more abstract at level 3 than at levels 1 and 2. As conceived in Figure 1, conceptual representations include, as admissable members of the set, items irrespective of intralinguistic differences (synonyms), interlinguistic differences (translation-equivalents), and verbal-nonverbal differences (images). The conceptual representation corresponds to the "idea" of a boy in this particular example.

Each level of representation has a larger set of members than the previous level but, even at level 1, these sets are large (infinite) and the rules which govern inclusion are quite abstract. The imaginal and verbal representations are clearly not simple iconic representations but neither are they as abstract as the conceptual nodes. The primary difference among the models is in terms of the amount of convergence which occurs given semantically-equivalent inputs, a topic discussed in the next two sections of this chapter. The assumption is that the highest (most abstract) order of representation plays the principal role in semantic memory and the concern of this thesis is the moot point about the level of abstraction demanded by the data.

## Semantic Equivalence

A word and its meaning have been characterized in terms of verbal, imaginal, and conceptual representations. As depicted in the preceding discussion, the structures inherent in these three models have implications for the representation of synonymity either within or between languages. Table 1 illustrates the types of relationships that hold between two words when the graphemic, phonemic, and semantic dimensions are varied. Some word types defined by these relationships generate little or no ambiguity since the verbal and semantic representations are unique. Other words such as homonyms and, depending upon the modality, homophones and homographs are semantically ambiguous because of possible alternative interpretations. Familiarity or context will generally determine which semantic ensemble is aroused (Begg & Clark, 1975).

A final class of words, synonyms and translation-equivalents, are ambiguous with regard to the verbal representation that initiates the semantic reaction. The present studies are concerned with this class of words and the two other cells underlined in Table 1. Synonyms and translation-equivalents have different verbal representations but share a common semantic representation. Identical words share common verbal and common semantic features while unrelated words share neither. The three models of semantic memory assume that semantic equivalents are represented in distinctive fashions and the structures that correspond to these three views are illustrated in Figure 2.

Synonym relationships are not an integral or structural feature of a verbal system and equivalence must be defined outside of the memory representations in terms of labeled associations or some process

Table 1

Classification of Word

Types by Features

| Feature | | | |
|---|---|---|---|
| Phonemic | Graphemic | Semantic | Word Class and Exemplars |
| Identical | Identical | Identical | Identical Words: river, river |
| Identical | Identical | Different | Homonyms: cross bow, pretty bow |
| Identical | Different | Identical | Orthography: honor, honour |
| Identical | Different | Different | Homophones: boy, buoy |
| Different | Identical | Identical | Articulation: schedule (hard or soft) |
| Different | Identical | Different | Homographs: cross bow, ship's bow |
| Different | Different | Identical | Semantic Equivalents: |
| | | | Synonyms: boy, lad |
| | | | Translations: house, maison |
| Different | Different | Different | Unrelated Words: boy colour |

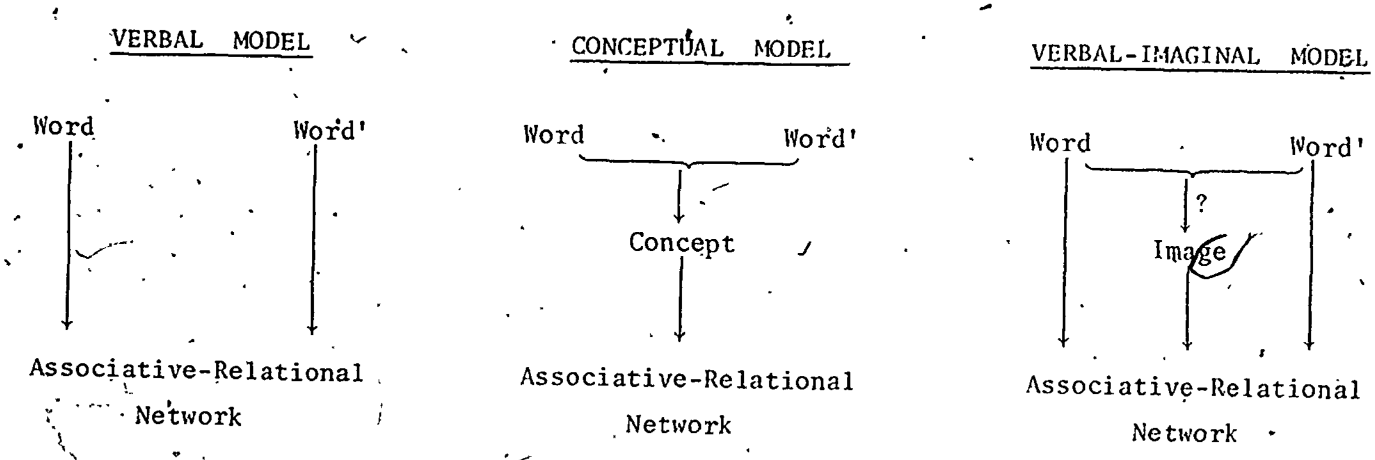


Figure 2. The structure of semantic similarity for three models of semantic memory.

that evaluates the similarity of associative hierarchies for pairs of words. The important aspect of this model is that the words maintain separate identities when input to the associative-relational network of semantic memory.

In contrast, the conceptual model incorporates semantic equivalence into the structure of semantic memory. Words or their verbal representations are equivalent to one another in that such representations enter into token-to-type associations with a common concept. This convergence was illustrated also in Figure 1 and is the defining feature of a conceptual model of semantic memory.

The verbal-imaginal model of the synonym relationship is structurally a combination of the verbal and conceptual hypotheses. All classes of verbal material, concrete and abstract, maintain distinctive verbal representations that do not converge prior to input to the associative-relational network. This verbal format of representation does not bear the entire burden of cognitive representation, however, since concrete synonyms converge on a common referential representation. Imaginal and conceptual views of the convergence operation differ in several ways. The imaginal representation is available primarily for concrete words while the conceptual representation is necessarily available for all words. Secondly, the imaginal representation is not a highly abstract entity as is the conceptual representation. By definition, the image is more closely tied to experience (see Figure 1). According to the verbal-imaginal model, then, synonymity is defined in the structure of concrete words but not abstract.

The models presented in Figures 1 and 2 present views of mental representation that have different empirical consequences. It is apparent that the verbal model does not differentiate the structure of synonyms from the structure of unrelated words since they both contain distinctive features that define the word. The conceptual model views the representation of synonyms as identical to the representation of a single word since synonyms share semantic features that define a single concept. The verbal-imaginal model holds the former view for abstract material and the latter (convergence) for concrete.

There is some debate about the accuracy of the description of the conceptual model that has been presented in this chapter. The predictions to be tested in subsequent sections assume that the structure summarized in Figures 1 and 2 is a faithful outline of the conceptual model's representation of synonymity. Some justification for this representation follows.

## A Valid Interpretation of Conceptual Models?

Three sorts of evidence will be presented to verify the current view of a conceptual model of memory and to assure that several representative theories of semantic memory do correspond to the present description. Three sorts of evidence will be presented: explicit statements about the representation of semantic-equivalents, statements that implicitly agree with a convergence operation, and interpretations of such theories by other authors. In the following discussion, I am not concerned with the format of representation but rather with the nature of the information represented. That is, imaginal, verbal, and conceptual representations may share a common form of representation, such as a propositional one, yet still contain different sorts of information that varies from the very concrete to the very abstract. The current debate about the functional properties of imaginal and conceptual representations is not of interest in the present study.

Several authors have interpreted many of the recent models of semantic memory to imply that the nodes in the networks are extremely abstract and that these theories imply a convergence operation for semantic equivalents. Paivio (1976a) states of conceptual models:

> "The main point in the present context is that verbal and nonverbal perceptual events become amodal or "neutralized" at this representational level. Moreover, these models generally assume that translations between perceptual and linguistic information are mediated by the abstract descriptions. The latter function as a kind of interlingua that permits communication between the two kinds of stimulus events....
>
> (T)he descriptive model allows for modality distinctions at an initial stage..., but conceptual knowledge in long-term memory is amodal. Thus any task that requires a translation of nonverbal to verbal information...would first involve a decomposition of the input information into an abstract description. A picture of a dog and the word dog would be judged as conceptually identical because both access the same description." (Paivio, 1976a, p. 6).

The italics are mine and identify a passage that clearly identifies a convergence operation. Paivio contrasts this common-coding theory with a verbal-imaginal model that maintains separate representations for semantic equivalents, pictures and words, in this case (see Paivio, 1976a, Figure 1).

Hayes-Roth and Hayes-Roth (1977, p. 119) arrive at a similar interpretation of conceptual theories of semantic memory:

> " It is a common assumption among memory researchers that the representation of a linguistic input in memory is more abstract than the words that compose the input. The lexical content of the input is assumed never to enter memory at all or to enter but then to "fade" very rapidly, usually within a matter of seconds. Despite the prevalence of this "abstract" theory,..."

The loss of lexical information mentioned in the quote corresponds to the loss of word information due to convergence on a common semantic representation.

Potter, Valian, and Faulconer (1977, p. 2) arrive at a similar description of a number of current theories of semantic memory:

> " In an abstract conceptual representation of sentence meaning, in contrast, words and images would be replaced by a single underlying code. In this view, the meaning of a given sentence is represented by abstract conceptual elements and their relations. Much the same set of elements would be activated when perceiving the event described by that sentence. No translation from words to images is required; each form of input is translated into a single conceptual format. An abstract conceptual representation is plausible not only on the logical and philosophical grounds put forward by Pylyshyn (1973, 1976) and others, but also because we seem able to mix verbal and perceptual information without difficulty.[2]
>
> [2]A unitary conceptual code is incorporated in computer-based models of human memory such as those of Collins and Quillian (1969), Rumelhart, Lindsay, and Norman (1972), Schank (1972), Anderson and Bower (1973), and Anderson (1976)." (italics mine).

That words and images activate the same set of elements is consistent with the conceptual model depicted in Figure 1. It would appear to be a small step to assume that synonyms would also converge on that common representation.

A final quote should suffice to demonstrate that at least some researchers agree with the interpretation of conceptual theories that is offered in Figures 1 and 2. MacLeod (1976, p. 348) states:

> "... By "supralinguistic concept" is meant an abstraction of meaning at a level more primitive than the word itself. Philosophers have often discussed similar notions of underlying representation (e.g., Langer, 1953, has introduced the idea of a "conception" which is not unlike the idea presented here). Recent computer simulations of sentence memory by psychologists (e.g., Anderson & Bower, 1973; Kintsch, 1974; Rumelhart, Lindsay, & Norman, 1972) have begun using similar constructs in theories of memory representation...."

These quotes indicate that, if the present interpretation is an erroneous one, it is a misconception held by several researchers, at least. More likely, the interpretation has some actual basis in the presentations of the theorists concerned. Two sorts of general statement could have supported the impressions just reviewed. Firstly, theorists have tended to emphasize that mental representations are highly abstract and, secondly, that these representations do not correspond to words in any natural language.

The abstractness of conceptual representations has been attested to by linguists in their attempts to explain the semantic component of language. Many models characterize word meaning in terms of semantic primitives (Fodor, 1977). Miller (1972) has illustrated the decomposition of English verbs of motion into clusters or along dimensions and argued that this abstract approach was necessary. The following passage illustrates the de-emphasis of verbal representations and emphasis on conceptual representations that is characteristic of Miller's (1972, p. 335) and others' view of semantic memory:

> "It is usually not the precise words we happen to use in characterizing an experience that are stored and later recalled. Rather, it is some prelinguistic, conceptual representation that we seem to remember-- something nonverbal, but with an affinity for verbal expression, couched in the dimensions of verbal thought. At the time of recall we are usually able to retrieve the information via various verbal clues and express it in many alternative linguistic forms. Thus we are led to consider the theoretical possibility that what we remember is not the particular words that we used to code our experience, but the concepts underlying those words."

Collins and Loftus (1975) endorse a similar point of view when they distinguish between a semantic network that is responsible for meaningful processing and a lexical network that stores information about words. This duality of representation implies that the word does not play an important role in the semantic processing and the next passage supports this interpretation (Collins & Loftus, 1975, p. 413):

> " The names of concepts are stored in a lexical network (or dictionary) that is organized along lines of phonemic (and to some degree orthographic) similarity. The links from each node in the lexical network are the phonemic properties of the name....Each name node in the lexical network is connected to one or more concept nodes in the semantic network.
>
> ...a person can control whether he primes the lexical network, the semantic network, or both. For example, a person can control whether to prime (a) words in the lexical network that sound like "bird," (b) concepts in the semantic network related to "bird," or (c) words in the lexical network corresponding to the concepts in (b)."

Information about the word and concept is stored in separate systems and option (c), in particular, seems to imply a many-to-one relationship between words and concepts.

The most convincing evidence that semantic-equivalents would converge on a common representation comes from statements by conceptual theorists that directly address this issue. Collins and Quillian (1972, p. 317) clearly endorse the view that semantic nodes are highly abstracted and even suggest a strategy to test their hypothesis:

> " There is another important case where a point-to-point correspondence between words and concepts breaks down. *Often the same concept has more than one name. This is the case with synonyms.* An even more common occurrence is when the two names are not synonyms but map onto the concept in different ways. For example, the words "buy" and "sell,"...can be handled most easily if they refer to the same concept.[4]
>
> [4]The conceptual identity of buying and selling could be tested by a modification of Koler's (1966) technique. He showed that presenting a word and its translation at different places in recall lists given to bilingual subjects improved recall of the word as much as presenting the same word twice. If buy and sell refer to the same concept, they should reinforce each other in a similar way." (italics mine).

The suggested procedure is exactly that used in Experiment 1 which examines the effect of synonym repetitions on free recall. Collins and Quillian state that recall should be as high as an actual repetition, according to a conceptual model such as theirs.

Very similar statements about the representation of synonyms have been made by Anderson and Bower (1973). Not only do Anderson and Bower (1973, pp. 207-208) stress the abstractness of the information stored in semantic memory, they also state that synonyms should produce an identical or common representation:

> "Up until now we have employed the convenient fiction that the name of a node in memory can be the English word for the idea to which that node corresponds. In fact, this is false; the idea nodes are essentially nameless entities that acquire their meaning from the configuration of associations into which they enter with other ideas. Each English word, as a word, is also represented in memory, but by nodes different from the idea nodes that we have discussed so far. The orthographic and articulatory parameters corresponding to the word are accessible from the word node.
>
> ... Because of the existence of synonymous words, any particular idea node can be connected to more than one word node....
>
> ... First, there is the matter of word synonymy which poses no problem at all for the parser. Since synonymous words are connected to the same idea node, synonymous words are represented by the same idea node in the tree that the parser sends to memory. For example, the input trees for the two sentences, "The boy hit the girl" and "The lad hit the girl," would be identical, since "boy" and "lad" reference the same idea node." (italics mine).

This is a very unambiguous statement about the representation of synonyms and corresponds exactly with the theory of conceptual representations that is displayed in Figures 1 and 2.

There is a close correspondence between Anderson and Bower's presentation and that of Norman and Rumelhart (1975). They distinguish between conceptual and verbal information: "Nodes (in semantic memory) are abstract entities.... The...name for a node is contained in a (separate) vocabulary." (Norman & Rumelhart, 1975, p. 39). In addition to these general statements that are consistent with the conceptual representation model, one finds direct indications that Norman and Rumelhart view synonymous expressions as converging on a common level of representation. Firstly, Norman and Rumelhart (1975, p.45) suscribe to the strong assumption of invariance under paraphrase:

> "The semantic representations should be invariant under paraphrases of the same information. No matter how information is received or expressed, expressions that have the same meaning should have the same semantic representation.[2]
>
> [2]The mapping from the formal (verbal) structure to the primitive (semantic) structure is many-to-one. Many formal propositions may have a single common primitive structure."

One's impression is that the Norman and Rumelhart model does not distinguish between the semantic representation whether the input is verbal, irrespective of language, or nonverbal (p. 247). Most importantly for the present studies, semantic overlap must be maintained in the representations (p. 46) and the model clearly predicts that confusions should occur between semantically similar words because of the shared semantic component (pp. 228-231).

Schank (1976, pp. 171-173) has recently described his model in terms that leave little doubt about the abstract nature of the hypothesized representations and the structure maintained to account for synonymity:

> "The first thing to consider is that a proposition cannot be stored in memory in the form of a natural-language sentence. What is far more likely is that people have developed a kind of canonical form for encoding meanings.... (N)o two propositions in memory can have the same meaning unless they are identically represented.
>
> What would such a canonical form look like? First, a canonical representational scheme could not have natural-language words as its elements.... (W)ords can be synonymous and overlap in meaning. By disallowing synonymous canonical forms for propositions, we have also disallowed the use of words in the representations....
>
> (W)ords must be broken down into their conceptual parts....

"Sting still works under these constraints but couldn't we just as well use the word bite? To the average user, these words are synonyms, and we are left with the problem of describing the concept underlying them....

To handle the similarities and overlaps in meaning between words as they are used by the man in the street, I have developed the concept of the primitive action. Primitive actions are intended to be the building blocks out of which verbs and abstract and complex nouns are constructed. The primitive actions are ... elements that can be used in multiple combinations to express the meaning of the concept that underlies a given word."

Words that are synonyms, according to this theory, would have representations that were identical constructions of semantic primitives. This view is consistent with our characterization of conceptual models.

One final theoretical presentation is worth mentioning since it presents, in a single paper, a model of memory that corresponds to the convergence operation presented in Figure 1 for conceptual representations. Figure 1 represents the hypothesis that a common conceptual representation underlies words in different languages and visual representations of the same information. Rosenberg and Simon (1977) addressed the following question: "If related ideas are encountered in French and English, or in pictures and sentences, is the result a single representation in memory, or two modality-dependent ones?" (p. 293). Their answer was an affirmative one and a computer simulation based on a common code for translation-equivalents or pictures and sentences (that expressed the same meaning) was performed. Rosenberg and Simon (1977, p. 294) endorse a view of semantic memory that is equivalent to the conceptual model in Figure 2 except that some modality-specific information may be attached to the conceptual representation:

"We postulate that this conceptual base is relatively independent of the form of the material, as long as the meaning is not changed. Thus information expressed either as a picture or as

> a sentence would be encoded into the same set of relations as long as picture and sentence had the same meaning. Surface structure differences that do not affect meaning would not change the conceptual encoding."

Rosenberg and Simon (1977, p. 307) hypothesize that "a single semantic system provides a common conceptual base for the understanding of pictures as well as French and English."

In summary, there appears to be little doubt that the conceptual model presented in this paper and tested in the subsequent studies is a realistic and accurate description of some, if not all, of the recently presented abstract theories of semantic memory. Figures 1 and 2 are consistent with written impressions of these models, general statements about semantic memory contained within these models, and some quite explicit statements about the representation of semantic-equivalents within such theories. Considerable attention has been devoted to this issue since the predictions about free recall (Experiment 1) and free association (Experiments 2 to 4) tasks are based on the theories as outlined in this Chapter. The recall and association studies are described separately because of the distinct literatures and methodologies involved.

## CHAPTER 2

## LITERAL AND SEMANTIC REPETITION EFFECTS IN FREE RECALL

The three hypotheses about semantic memory lead to different predictions about the relevance of verbal, imaginal, and conceptual features for episodic memory. Episodic memory is that memory which retains information about specific events such as a list of words presented in a particular experimental context (Tulving, 1972). A strictly verbal memory must retain a word in terms of a verbal representation of that event plus any associatively aroused information that was available. The associative information would, of necessity, also be verbal in nature. Verbal-imaginal memories could maintain information in verbal form but could also retain an imaginal representation of the linguistic event. This second mode of representation would only be available for concrete materials. The final model, a conceptual hypothesis, would also allow for two levels of representation. Both verbal and conceptual representations would be available for all linguistic events.

It is possible to evaluate which of these characteristics of a word are important for episodic memory by determining the features which two items must share in order that the later presentation of one will be judged equivalent to the representation of the earlier presentation of the other item. Semantic and representational ambiguity, as defined earlier in the paper, can be used in this way to examine the relevance of different codes to an episodic memory for some linguistic event.

Several paradigms attempt to assess the extent to which different items are treated identically. One class of studies looks at the nature of confusions with or false recognitions of various types of distractors in a recognition memory paradigm (Rosenberg & Simon, 1977). A second class of studies examines the repetition effect or some analogue of it as a function of various relationships among the items presented. The latter approach was adopted in this experiment and a later section reviews the literature within this second paradigm. Firstly, an attempt will be made to give a general description of repetition effects.

The repetition of a particular item results in certain phenomena which vary from task to task. Within- or between-list repetition of an item in a free recall task usually results in better recall for that item than for non-repeated items. However, some other tasks require the retention of order information and within-list repetitions result in order confusions, intralist intrusions. Similarly, within-list repetitions in a paired-associate task typically result in intralist intrusions and more difficult learning. Between-list repetitions for serial and paired-associate tasks result in either positive transfer or interference depending upon the transfer paradigm involved. This rather complex state of affairs requires that the relationship between the repetition studies and the coding issue be stated quite generally. Such a statement follows and represents the rationale for Experiment 1.

An item may be followed or preceded by the presentation of the identical item, a related item, or an unrelated item. To the extent that the effects of presenting related items are analogous to those produced by the presentation of the identical item, the relevance of the dimension of similarity has been supported. Phonemic encoding is presumed to be of importance if the effect of a homophone or homonym repetition is similar to that of an identical repetition. Phonemic repetition effects analogous to those produced by the presentation of unrelated items weakens an argument for a contribution of phonemic codes to memory. In a similar fashion, the degree of semantic coding is inferred from the similarity of synonym repetition effects to identical and unrelated item effects. Experiment 1 is concerned with the recall of once-presented items, synonym repetitions, and actual repetitions. One half of the words were concrete and the other half were abstract.

## Experiment 1

The three structures outlined in Chapter 1 and certain assumptions about episodic memory processing generate distinctive predictions for each of the models. These latter assumptions have little justification, however, and the predictions are quite idealistic. One such assumption is that synonyms can enhance recall only by tapping a common representation. An additional possibility that is examined in the discussion is that the associative relationship between synonyms could provide an organizational framework which would facilitate memory.

The second naive assumption is that, if a conceptual or imaginal level of meaning is available, subjects will always process a word to that level and retain in episodic memory that second code. It is quite possible that subjects will only superficially process some of the words in a long list and that these words would be remembered, if at all, at the verbal representation stage.

The predictions of the three models can be derived most clearly from Figure 1. Episodic memory will be based on the representations which enter into the associative-relational network. According to the verbal model, separate representations would be stored for a word and its synonym. Each of these verbal representations would have occurred only once in the list so that recall of synonyms should be equivalent to recall of once-presented items whose synonyms did not occur in the list. An actual repetition would result in the same representation being activated twice so that recall of these items should exceed recall of once-presented items and synonym repetitions. This characterization would be true for both concrete and abstract materials.

The predictions of the conceptual model depicted in Figure 2 are quite different since the presentation of a word and its synonym elicit the same conceptual representation. A conceptual representation would be stimulated twice irrespective of whether the repetition was literal or semantic, according to this theory. Recall of synonym repetitions should, therefore, equal recall of actual repetitions. A once-presented item would be recalled at a lower level since its conceptual representation would have been elicited only once during the presentation of the items. As with the verbal model, these predictions would be made for both concrete and abstract materials.

Only the verbal-imaginal model makes differential predictions about the performance of concrete and abstract words. Abstract words elicit verbal representations and, therefore, abstract synonyms are stored separately. Synonym repetitions should not facilitate abstract word recall relative to once-presented items and both of these types of presentation should result in poorer recall than an actual repetition. Concrete words, on the other hand, are represented imaginally and the same imaginal representation should be activated by both members of a synonym pair.

The model predicts, therefore, that recall of concrete words presented with their synonyms will be as high as recall of actual repetitions and both of these will exceed recall of once-presented items.

In summary, the verbal model predicts a main effect of type of repetition with actual repetition better than both once-presented and synonym repetition items which should produce similar recall levels. The conceptual model predicts a main effect of type of repetition with once-presented items more poorly recalled than synonym or actual repetitions which should not differ in level of recall. In contrast to the verbal-imaginal model, neither of these theories predicts an interaction with concreteness. The interaction predicted by the verbal-imaginal model is that the prediction of the verbal model should be true for abstract words while the prediction of the conceptual model should hold for concrete words. That is, any effect of repetition should be obtained with actual repetitions for abstract materials but with both synonym and actual repetitions for concrete materials. Being conceptual in nature, concrete synonyms should be treated as identical repetitions and not as unrelated items. Abstract synonyms, however, are sounds and should be treated as unrelated events, not as actual repetitions.

These predictions are summarized in Table 2 for the present study. A total of 40 different target words were presented to each subject. Ten words were presented only once in the list and neither were their synonyms presented. Ten words occurred twice in the list without their synonyms. Finally, twenty words (10 synonym pairs) which had synonyms in the list were also presented. Half of each of these sets were concrete words and the other half were abstract. The types referred to in Table 2 are the representations stored in memory, according to the respective

Table 2

Predicted Recall of Concrete
and Abstract Synonyms for
Three Models of Semantic Memory

| Model | | Word Type and Presentation Condition* Abstract T | Abstract ST TS | Abstract TT | Concrete T | Concrete ST TS | Concrete TT |
|---|---|---|---|---|---|---|---|
| Verbal | # Types | 5 | 10 | 5 | 5 | 10 | 5 |
| | # Tokens | {1 | = 1 < | 2} | {1 | = 1 < | 2} |
| Conceptual | # Types | 5 | 5 | 5 | 5 | 5 | 5 |
| | # Tokens | {1 | < 2 = | 2} | {1 | < 2 = | 2} |
| Verbal-Imaginal | # Types | 5 | 10 | 5 | 5 | 5 | 5 |
| | # Tokens | {1 | = 1 < | 2} | {1 | < 2 = | 2} |

* T=Target, S=Synonym of Target

theories. The tokens are the words in the list that would elicit a particular representation (type). All three theories state that the once-presented items (T) consist of one token for each of five concrete and abstract types. According to the verbal model, the five synonym pairs (TS & ST) comprise 10 types (verbal representations) with a single token being presented for each. The conceptual model, however, hypothesizes that these five synonym pairs are only five different types (conceptual representations) with two tokens being presented for each type. These synonym pairs are 10 abstract types or 5 concrete types according to the verbal-imaginal model. Each abstract type has a single token per type while each concrete has two tokens per type. All three models state that the actual repetitions (TT) represent five types and that two tokens of each type are presented. Recall is determined by the number of tokens presented for each type and the predictions of the models are represented by the "less than" and "equals" symbols. These predictions are of the proportion of items of each type that will be recalled.

Semantic Repetition Studies

The literature is quite ambiguous with regard to the effects of semantic repetitions not only on recall but also on recognition memory and semantic priming. It is beyond the scope of the present paper to review the recognition literature but, some authors report dramatic interference effects with semantically similar distractors (e.g. Rosenberg & Simon, 1977) while others report that subjects can be very insensitive to synonym distractors (e.g. Mandler, Pearlstone, & Koopmans, 1969). The current literature on semantic facilitation and interference in priming tasks is discussed briefly in the free association section of the paper. Again, some of the findings are consistent with a semantic level of representation (e.g. Kadesh, Riese, & Anisfield, 1976) while other results are negative (e.g. Hayes-Roth & Hayes-Roth, 1977).

Saltz (1971, chap. 5 and pp. 296-301) reviewed much of the early work on similarity effects on recall in a variety of transfer and interference paired-associate paradigms. These studies generally included an unrelated-item but no identical-item control group which limits the conclusions that can be drawn. Several variables played an important role in determining the magnitude of the semantic similarity effect. Synonyms, in general, produced facilitation but very little interference unless subjects were overwhelmed with relatively large numbers of synonymous items. Secondly, the facilitation effect was greater when a direct association existed between the items than when they were similar in meaning but not directly associated. The nature of the relationship between synonyms is examined in greater detail in subsequent sections of the paper. More recent research indicates that translation-equivalents and synonyms have sometimes resulted in recall levels comparable to those obtained with identical repetitions. At other times, however, performance with semantic repetitions has been found to be no different than recall of once-presented items. The first studies reviewed have found that semantic repetitions are equivalent to identical repetitions.

Kolers (1966) and Glanzer and Duarte (1971) were concerned with interlingual repetitions in free recall lists which contained single words, same language repetitions, and different language repetitions. Kolers (1966) examined recall as a function of type of repetition and number of presentations (0 to 4 in each language). He found that presentation of a word n/2 times in one language and n/2 times in the other language produced the same recall as presentation n times in one language. Recall was a function of the number of presentations of a specific meaning rather than the number of presentations of the nominal items.

Glanzer and Duarte (1971) presented items only twice but varied both type of repetition and lag (0 to 5 intervening items). At very short lags, recall was better for between-language repetitions and at longer lags, recall was still equivalent for the between- and within-repetitions. All repetitions were better recalled than non-repetitions.

Kintsch and Kintsch (1969) compared paired-associate lists composed of four English and four German stimuli which were either unrelated or translations of each other. The response terms were unrelated to these stimulus terms and to each other. There were 16.8 errors made during the learning of the experimental lists but only 11.0 learning the control lists of unrelated words. A shared semantic component was a potent source of interference in that study.

MacLeod (1976) examined semantic facilitation in a savings paradigm introduced by Nelson (1971). Number-noun paired-associates were relearned with identical responses, translation-equivalents, or unrelated words as the new response members. Even when the original response had been forgotten during the five week retention interval, there was no difference in the relearning of the identical or related responses which were both learned more quickly than the unrelated pairs. This same pattern was also found for items which had not been forgotten subsequent to the original learning.

Kintsch and Buschke (1969) presented lists of words with or without a synonym or homophone pair included. A single item from the list was shown following the presentation and subjects had to respond with the item which had followed the probe in the list. If the synonyms were treated identically, order recall should be poorer for lists with synonyms than for lists without synonyms. This effect was obtained but only for the initial items in the lists. There was no semantic interference in probed recall of terminal items. Conversely, homophone pairs resulted in poorer retention of terminal items and had no effect on the initial items.

These five studies are consistent with the hypothesis that subjects store a semantic representation of the to-be-remembered item and this results in a semantic facilitation or interference effect on recall. Whether the relatedness interferes or facilitates depends upon the paradigm. These findings are in agreement with the predictions of the conceptual representation hypothesis. The following studies, however, report that recall of semantically related material is similar to recall of unrelated items which is consistent with a verbal representation hypothesis.

Sampson and Cermak (unpublished) presented subjects with 10 lists of 10 words for free recall and observed the effects of various types of repetition: actual, homophone, synonym, and a no repetition control. Recall of repeated items equalled recall of homophone items and exceeded recall of synonym and control items which did not differ from one another. These findings were independent of the rate of presentation (one-half second or five seconds per word) and lag (one or three intervening items).

Cermak (1970) observed the effect of intertriad similarity by presenting, on successive trials of a Brown-Peterson task, triads which were directly repeated, repeated as synonyms or homophones, or unrelated. The directly repeated and homophone triads did not differ in recall but were remembered better than the synonym triads which did not differ from the unrelated condition. Triads interpolated between the repetitions resulted in the disappearance of the homophone repetition effects.

These studies failed to demonstrate semantic facilitation effects. Others have reported little or no evidence for semantic interference which is consistent with Saltz's (1971) review of the early literature. Gumenik (1969) presented subjects with four word-number pairs in a study-test paired-associate paradigm and compared recall from unique lists to recall from lists with synonym or homophone pairs as stimuli. The number of errors on homophone lists exceeded those on synonym and unique lists which did not differ from one another. Kintsch and Kintsch (1969) used a sequential probe technique with lists of four English and four German words which were or were not translations of each other. Performance on the two types of list was comparable which indicates that translations did not interfere with the storage of order information.

An important study in this debate is one by Nelson (1971) who used a modified paired-associate task in which subjects learned sentences of the type "name VERBED name" with the verb the to-be-recalled item. The subject and object of the sentences were persons' names. This list was learned to a one perfect trial criterion; a delay was introduced, and a retest and a relearning task similar to the original paired-associate task occurred at the end of the delay. The verb in the relearning task was the same as, a synonym of, an antonym of, or unrelated to the item which had originally been learned in that sentence. The proportion of correct responses was examined as a function of the verb type and whether or not the original verb had been correctly recalled on the delayed retest. Some savings occurred for both correctly and incorrectly recalled verbs since the old verb was learned more quickly than an unrelated verb. This savings did not appear to be semantic in nature since the synonym-antonym groups showed evidence of savings only when the original verb had been correctly recalled on the delayed retest. Relearning of synonyms and antonyms was no better than of unrelated words when the original verb was not remembered.

Imagery as a Moderator Variable

Some potent variable or variables must have interacted with semantic similarity to produce the discrepant results just presented. Some investigators report that the inclusion of semantically related words in a list results in facilitation or interference effects indicative of a semantic mode of representation. Others have found that semantic relatedness has little or no effect on recall which is more consistent with verbal modes of representation as the basis of episodic and, presumably, semantic memory.

One possible explanation for these inconsistent results is that long-term episodic memory will demonstrate evidence of semantic coding while short-term episodic memory reflects verbal coding. Studies which involve short lists of words (Kintsch & Kintsch, 1969; Cermak, 1970; Gumenik, 1969) or words presented over terminal serial positions of longer lists (Kintsch & Buschke, 1969; Sampson & Cermak, unpublished) would tap the short-term memory component, a verbal memory system. The results cited in favour of semantic levels of representation were obtained on long-term memory tasks that involved longer lists (Glanzer & Duarte, 1971; Kolers, 1966), initial serial positions (Kintsch & Buschke, 1969), or learning over extended periods of time (Kintsch & Kintsch, 1969; MacLeod, 1976).

The multi-store explanation is not entirely adequate, however, since negative results with regard to semantic codes have been obtained with an apparently long-term memory task. Nelson's (1971) findings cannot readily be accounted for in terms of the distinction between long-term and short-term memory. These findings have been replicated by Nelson in some unpublished research cited by MacLeod (1976). The results cannot be attributed to Nelson's unique paradigm since MacLeod (1976) found evidence for a semantic code with the identical method when the semantically related words were translation-equivalents instead of synonyms. Indeed, MacLeod argued on the basis of these findings that translation-equivalents have a different form of representation than synonyms. The present studies assume that semantic equivalents, either inter- or intra-lingual, have a similar sort of representation in semantic memory.

A more adequate resolution of the empirical inconsistencies may be offered by a levels of meaning or levels of processing explanation (Craik & Lockhart, 1972) which acknowledges that words may be more or less analyzed during the performance of any particular memory task. The nature of the information stored in memory will depend upon the completeness of the analysis-- the deeper the processing, the more likely that the data will support the hypothesis of semantic representations. It is possible to interpret the verbal-imaginal and conceptual models in terms of depth of processing although only two levels of processing rather than a continuum would have to be assumed. The "shallow" level of processing in both models would elicit only verbal representations while "deeper" processing would result in the activation of imaginal or conceptual representations in the verbal-imaginal and conceptual models, respectively.

Evidence for the importance of processing strategies in semantic repetition studies has been obtained by Bower (1972). He compared one-trial learning of a unique list of concrete pairs (unrelated stimuli and responses) to learning of a list that involved half synonym pairs on the stimulus side (with unique responses) and half synonym pairs on the response side (with unique stimulus terms). Half of the subjects were instructed to use visual imagery to learn the pairs and the other half were instructed to use auditory rehearsal. The results of the experiment were quite clear. Semantic interference occurred when subjects were instructed to image the pair as indicated by a 17% difference between the unique and synonym lists. The difference was only 3% when subjects were required to use auditory rehearsal to learn the lists. No evidence for semantic coding was found when subjects attended to the sound of the word while attending to the referent resulted in findings that were consistent with a semantic representation view.

The manipulation is more directly relevant to the imaginal hypothesis than a conceptual one. Bower's results are, however, consistent with both the verbal-imaginal and conceptual views of levels of processing since imagery instructions may function by the production of more effective forms of conceptual coding (Anderson & Bower, 1973). It could also be argued that the potent manipulation in Bower's experiment was the inhibition of conceptual processing in the auditory rehearsal condition.

The conceptual model version of the levels of processing hypothesis does not contain mechanisms for the identification of conditions under which referential coding does or does not occur. That is, there are no operations independent of recall that serve to indicate the level at which the item has been processed. This has also been a major problem with most versions of the levels of processing hypothesis. The model has tended to make only empirically derived predictions or post hoc explanations. An appeal to a levels of processing explanation is gratuitous under these circumstances but the conceptual hypothesis specifies no alternative operations by which the non-semantic nature of the sentences or the "mindless" character of the processing can be identified independently of recall. Some recent efforts have been made to specify more completely what is meant by depth. Rogers, Kuiper, and Kirker (1977), for example, reported that self-reference was an important dimension that determined recall levels for self-descriptive adjectives.

One of the strengths of the research strategy adopted by Paivio and his co-workers has been the emphasis upon the convergent validity of the concept of imagery. Item attributes, instructional sets, and individual differences are some of the independent operations that have served to identify the presence or absence of imaginal processing (Paivio, 1971). That is, the verbal-imaginal model includes additional predictions about the conditions under which referential or imaginal coding will occur. Stimulus attributes as well as processing strategies may be invoked as explanatory and predictive mechanisms. In particular, the sort of evidence for semantic representation that has been discussed in this paper should not be obtained with abstract materials since the referential code is not available. Some support for this hypothesis can be found in the results of Sampson and Cermak (unpublished), Cermak (1970), and Gumenik (1969). The Cermak studies used materials that were generally abstract (e.g. wait, seize, stare; weight, seas, stair; stay, grab, gaze) which would be expected to produce verbal codes and not semantic interference or facilitation effects. Gumenik also failed to find evidence for semantic representations which may have been due to the abstractness of the numbers used in the paired-associate task. More importantly, the failure to find a pure semantic savings in Nelson's (1971) study may have been due to the abstractness of the sentence frames (names) and the relative abstractness of the to-be-recalled items since verbs tend to be much less concrete than nouns (Paivio, 1971, p. 80).

In summary, the inconsistent results may be interpreted in terms of a verbal-imaginal model which assumes that the elicitation of imaginal representations is necessary for semantic interference and facilitation effects to occur. Experiment 1 tested this hypothesis in a free recall task with type of repetition and concreteness manipulated. The interesting predictions concern the synonym repetition condition. A model based on verbal representations asserts that each of ten types were presented once. A conceptual model maintains that each of five types were presented twice. According to the verbal-imaginal model, the ten concrete synonyms represented only five distinct types but the abstract synonyms each represented a separate type. Only the verbal-imaginal model predicted an interaction between concreteness and type of repetition.

Method

Materials. Synonymity ratings were available for 300 synonym pairs, 150 concrete and 150 abstract. Ratings were made on a 7-point scale on which one indicated low synonymity. Sets of 15 concrete and 15 abstract pairs equated for rated synonymity, familiarity, and length were selected (see Table 3) and are presented in Appendix A. The basic lists consisted of 40 words: 10 presented once, 10 presented twice, and 10 synonym pairs. Repeated items were separated by 0, 2, 4, 6, or 8 intervening items and a total of 24 different orders of presentation were used in the counterbalancing.

Table 3

Item Attributes for the Test and Buffer Items (N)

| Rating Scale | | Test Items Concrete | Test Items Abstract | Buffer Items Concrete | Buffer Items Abstract |
|---|---|---|---|---|---|
| Similarity | Mean | 5.64 | 5.63 | -- | -- |
| | St. Dev. | .31 | .43 | | |
| Familiarity | Mean | 5.31(22) | 5.42(17) | 5.42 | 5.39 |
| | St. Dev. | 1.03 | .74 | .70 | .69 |
| Imagery | Mean | 6.16(21) | 3.45(17) | 6.14 | 3.43 |
| | St. Dev. | .50 | .60 | .58 | .54 |
| Length | Mean | 6.00 | 5.80 | 5.40 | 6.60 |
| | St. Dev. | 1.76 | 1.71 | 1.58 | 1.26 |

The first variable considered in the construction of the lists was experimental condition. Three pseudo-random orders of the conditions were generated with the stipulation that all items would appear within 50 serial positions. Nested within this factor was word pair. Three sets of five concrete pairs and three sets of five abstract pairs were randomly selected and each set acted as a single presentation set, an exact repetition set, and a synonym repetition set for one of the three orders.

For each of the three basic orders, eight lists were generated by varying the concreteness of the item (2), the type of repetition (2), and the member of the pair (2) which occurred at a given serial position. The eight lists would involve, for the single presentation condition, two each of a concrete member and of its synonym and two each of an abstract member and of its synonym (cot, bed, act, and deed each in two lists). For the repetition condition, the eight orders would involve actual repetition of a concrete member and of its synonym, actual repetition of an abstract member and of its synonym, synonym repetition of a concrete pair in both orders, and synonym repetition of an abstract pair in both orders (bed-bed, cot-cot, act-act, deed-deed, bed-cot, cot-bed, act-deed, deed-act). Table 4 shows the items from one list in terms of the independent variables.

Procedure. Each list plus 20 buffer items (ten at the beginning and ten at the end) were videotaped from the CRT of a PDP-12 at the rate of four seconds per item. Standard free recall instructions were given with the additional admonishment for subjects to recall only those items which they were certain had been presented. Guessing was to be avoided. Immediately after recall, subjects indicated which of the recalled words

Table 4

An Example of the Conditions

Represented in Each List

| | | Repetition Condition | |
|---|---|---|---|
| Attribute | None | Synonym (lag) | Identical (lag) |
| Concrete | revolver | cellar-basement (0) | brook-brook (0) |
| | money | maiden-damsel (2) | photograph-photograph (2) |
| | skull | jewel-gem (4) | prisoner-prisoner (4) |
| | board | bed-cot (6) | tempest-tempest (6) |
| | tavern | street-avenue (8) | judge-judge (8) |
| Abstract | semester | self-ego (0) | consent-consent (0) |
| | comfort | act-deed (2) | magnitude-magnitude (2) |
| | mistake | source-origin (4) | search-search (4) |
| | oath | danger-peril (6) | barter-barter (6) |
| | story | treason-betrayal (8) | freedom-freedom (8) |

had been presented twice.

Subjects. Four subjects studied each list on a television monitor. The 96 subjects worked alone or in small groups and were drawn from the Introductory Psychology population at the University of Western Ontario. These students participated in the research for course credits.

## Results

Figure 3 shows the mean proportion of target words recalled (or the mean proportion of subjects who recalled a word) from each of the three classes of concrete and abstract stimuli: non-repetition items, synonym repetition items, and actual repetition items. It made little difference to the recall of a concrete word whether it was actually shown a second time or its synonym was shown in the list as concrete synonym repetitions were recalled at a level near that achieved by the actual repetition of a concrete word. All repetitions are clearly superior to non-repetition items for concrete materials. Abstract synonym repetitions were recalled at a level closer to that of once-presented items. The actual repetition of abstract words facilitated recall in comparison to both of these groups.

Separate two-way analyses of variance were performed on the proportion of words recalled by each of the 96 subjects and the proportion of subjects who recalled each word for the 15 concrete and 15 abstract pairs. The effects of concreteness, repetition, and the interaction between these two variables were all significant in both analyses. The F ratios for these analyses were combined to produce the minimum value of F' (MIN F') which assesses the reliability

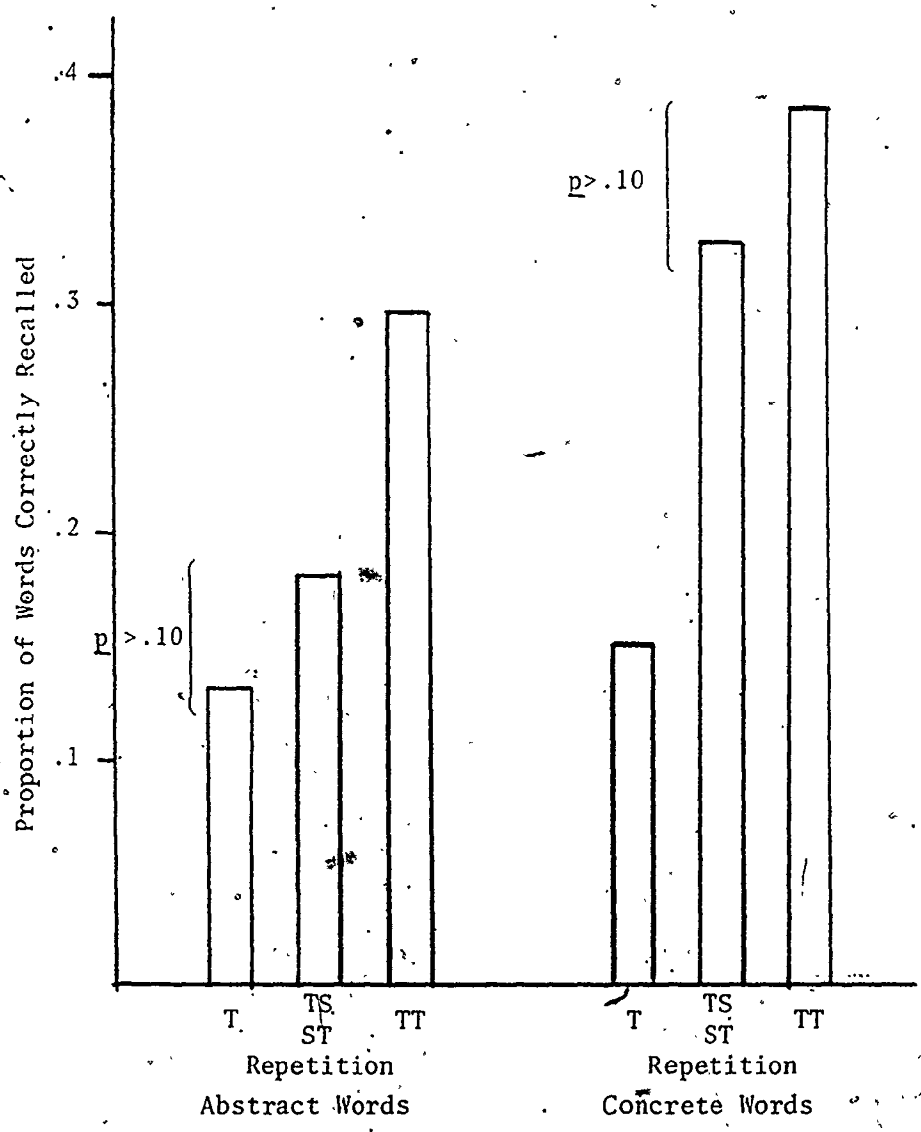


Figure 3. Proportion of words recalled as a function of word type (abstract or concrete) and repetition condition (T=non-repetition; TS & ST=synonym repetition; TT=actual repetition). Non-significant differences are indicated.

of the effects across subjects and items simultaneously (Clark, 1973). A transformed mean square for treatment is divided by the sum of the error terms (corrected) from the subject and item analyses to generate MIN F'. Clark (1973) provides a formula for the calculation of the appropriate degrees of freedom. The test appears to be a conservative one and this fact should be kept in mind as the statistic is interpreted.

The effect of concreteness is reliable across both items and subjects, MIN F' 1, 43 = 4.23, $p<.05$. A significant value of MIN F' is also obtained for the repetition effect, MIN F' 2, 105 = 36.03, $p<.001$. Most importantly, from the point of view of this study, the interaction between concreteness and repetition is significant when both items and subjects are considered as random variables, MIN F' 2, 112 = 3.18, $p<.05$. The specific origin of this interaction was examined in the following analyses.

The repetition effect was highly significant for both concrete (MIN F' 2, 84 = 17.90, $p<.001$) and abstract (MIN F' 2, 93 = 11.13, $p<.001$) materials so that the significant interaction reported in the previous paragraph must have been due to the specific locus of the repetition effect in the different materials. The nature of the interaction is apparent in Figure 3. The proportion of non-repetition abstract words recalled does not differ significantly from the proportion of synonym repetition words recalled (MIN F' 1, 46 = 1.84, $p>.10$). This same comparison results in a highly significant effect with concrete words (MIN F' 1, 42 = 18.38, $p<.001$). In contrast, the proportion of actual repetition concrete words recalled does not differ significantly from the proportion of synonym repetition words recalled (MIN F' 1, 43 = 2.13, $p > .10$). The same effect is highly significant with abstract words (MIN F' 1, 46 = 10.52, $p < .01$). The difference between actual repetitions and non-repetitions is significant for both the concrete (MIN F' 1,42 = 33.02, $p < .001$) and the abstract material (MIN F' 1, 46 = 21.14, $p < .001$).

A succinct summary of these results is possible with concrete materials generating particularly clear results. Over twice as many concrete items were recalled if a repetition occurred whether this repetition was literal or semantic. Fewer than one-fifth additional items were gained by an actual over a synonym repetition. The greatest gains for abstract materials were found when an identical repetition was compared with the other types of repetition, although the results were not as strongly polarized as with concrete words. These are the principal findings of this study but a few supplementary observations are reported in the following section because of their anomolous nature or their relevance to the issue under consideration.

Supplementary Observations. Three findings will be considered in this section: pair recall as a function of lag, item-specific information retained, and the absence of a concreteness effect for once-presented items.

Synonym recall was separated into pair and single-word components since the level of pair recall is especially relevant to the integration or non-integration of synonym pairs. The proportion of pairs from which one or both words were recalled is shown in Figure 4 as a function of concreteness and lag, the number of items that intervened between the presentation of the first and second members of the pair. Pair recall was consistently higher for concrete than abstract words.

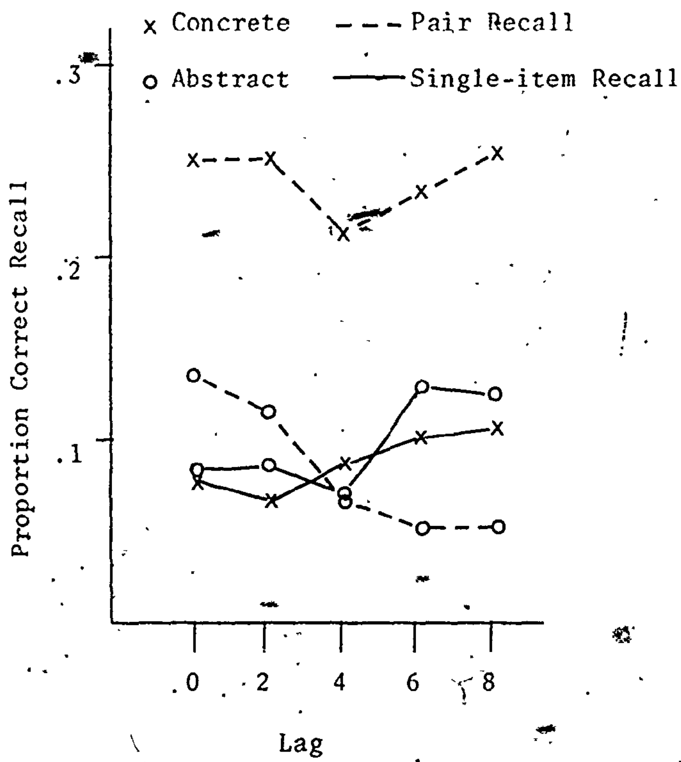


Figure 4. Proportion pair and single-item recall as a function of concreteness and lag.

Lag was unrelated to the recall of concrete synonyms and actual pair recall was consistently greater than chance expectation ($\chi^2$ tests calculated at each lag). Abstract pair recall decreased from lag 0 to lag 8 and was statistically dependent at short but not long lags. Single items accounted for twice as much of the recall of abstract synonyms as of concrete, although the absolute levels of single word recall for the two types of material were quite comparable.

Retention of item specific information is relevant to the issue of verbal versus conceptual coding. Subjects' judgments of the frequency of occurrence of recalled items require a consideration of the role of verbal representations. Two-thirds (67.1%) of the twice-presented items were correctly identified as having been repeated in the list. Interestingly, the false alarm rate did not differ for the non-repetition (6.7%) and the synonym repetition (6.0%) items. Subjects did have a tendency to indicate that an abstract item had occurred twice more than a concrete but this was true for all three types of items.

The main anomaly in the present study is the failure to obtain an effect of concreteness for non-repetition items. The proportion of concrete (.15) and abstract (.13) words recalled in this category is very close. Previous work indicates that once-presented items may be more poorly recalled when they are presented in the context of repeated items than in the context of only once-presented items (Tulving & Hastie, 1972). Differential depression of concrete and abstract materials would be of theoretical interest since the imaginal system would be implicated in the explanation that best accounts for the effects of repeated items on non-repeated items. For example, the repetition of items may prevent the additional processing of non-repetition items which typically results in the activation and integration of imaginal representations. Consistent with this argument, there is some evidence that the depth of processing hypothesis is more relevant to concrete materials than abstract when the traditional depth manipulations are introduced (D'Agostino, O'Neill, & Paivio, 1977). Depression due to repeated items may only occur for concrete words because the effect operates on the basis of mechanisms similar to depth of processing. No attention will be given to this finding in the discussion that follows.

Summary. Concrete synonyms were recalled at a level approximately equivalent to the level for actual repetitions. All repetitions, synonym and identical, were clearly superior to non-repetition items for concrete materials. Abstract synonyms were recalled at a level that approximated the recall level of non-repetition items. The actual repetition of abstract words facilitated recall in comparison to both of these groups. Auxiliary analyses indicated that synonym repetition of abstract words had some effect but only at short lags and that, for both concrete and abstract words, some high-fidelity information about the actual item presented was retained.

Discussion

The results agree remarkably well with the predictions of the verbal-imaginal model. Concrete synonyms behaved as though they converged on a common, referential (Paivio, 1971) representation that was strengthened by the presentation of each member of the synonym pair. The conceptual models reviewed in the introduction anticipated that this sort of facilitation would have occurred for both concrete and abstract materials. Abstract words, however, failed to demonstrate a significant effect of a semantic repetition which serves to disconfirm the conceptual model. A strictly verbal model predicted that neither concrete nor abstract materials should have produced recall levels for synonyms that approximated the performance with actual repetitions. These predictions, however, were based on certain assumptions about episodic memory as well as a theory of the semantic component of memory.

Anderson (1976) has argued very strongly that a theory of the structure of semantic memory can accommodate any data by the concatenation of the structure with appropriate cognitive processes. Norman and Bobrow (1975) have made a similar distinction between data-limited and resource-limited processes. According to this view, no finding necessitates a particular structure since the assumptions about the dynamic features of the system can be modified to account for the results. Anderson noted that it was impossible to examine the nature of semantic representation independent of the processes upon which performance is also contingent. This requires a careful consideration not only of the performance features of the organism but also of the requirements of the particular task under study.

Two assumptions demanded by the predictions of the present study were mentioned briefly in the introduction. One assumption was that semantic similarity would affect recall through a shared underlying representation and not through associative mechanisms. The second assumption was that all items would be processed to the deepest level of representation available. These are assumptions about episodic memory or performance components of free recall and relaxing these assumptions may modify the predictions of the verbal or conceptual models in ways consistent with the present findings.

Verbal Representations and Associative Mechanisms. There is strong evidence in the present study that verbal representations played an important role in the free recall performance of subjects. Subjects discriminated very well between the presentation of the same word twice and the presentation of an item plus its synonym. Indeed, subjects were as likely to think that a word shown only once had actually occurred twice as to think that a word shown with its synonym had occurred twice. These results indicate that, however subjects remembered the materials, they were acutely sensitive to the form of input, to the nominal unit. Other studies have reported that subjects can correctly distinguish between items which had been presented as words or pictures (Potter et al, 1977) and between items which had occurred in different languages (MacLeod, 1976). In the latter study, words were invariably (99%) recalled in the correct language. It may be the case, however, that language tagging is less effective in a multi-list, mixed-item task (Liepmann & Saegert, 1974) or in a recognition memory task (Rosenberg & Simon, 1977).[1] These results argue for a representational level of meaning in this and other memory tasks.

That is, a verbal representation of the item must play some role in episodic memory.

These results cannot, however, be taken as strong evidence for a strictly verbal model, although a high-fidelity representation is necessary to account for subjects' ability to distinguish between once and twice presented items, especially in the synonym condition. A verbal component to episodic memory is compatible with any of the proposed models since verbal representations at least exist, according to all three theories. The assumption that verbal representations are important to recall may also be required for the predicted interaction to occur, since the level of synonym recall required that both members of the synonym pair be retrieved, not just one. It is unlikely that both words would be recalled without some item specific information in memory.

Hayes-Roth and Hayes-Roth (1977) have argued that verbal models can account for the evidence for conceptual representations in terms of associations between related items in semantic memory. A similar mechanism may also explain the effects of synonym repetitions on concrete words and not abstract. The introduction discussed only one mechanism by which subjects could benefit from the shared conceptual information of the synonyms. This mechanism was a common representation activated and strengthened by both words of a synonym pair. Memory could be facilitated, however, by the common associative networks activated by the two words. Presentation of one member of a synonym pair could elicit the other member, and Deese (1965), among others, has found marked facilitation effects of associative relationships that do not share a common underlying representation, a referential level of meaning.

This distinction between referential and associative effects has a definite parallel in the opposing explanations for the effect of categories on free recall. One hypothesis of the facilitatory effect of categories was that each member of the category elicits the category name which is then remembered with a fairly high probability. Retrieval of the category name at recall would mediate the retrieval of the individual members. This position is similar to that adopted in the present paper with regard to the nature of synonym repetition effects on recall. Concrete synonyms tap a common representation which is retrieved and mediates the recall of the individual elements. Abstract synonyms lack this level of representation and should not result in any facilitation, according to the verbal-imaginal model.

Category recall may operate in an entirely different manner, however. Perhaps subjects do not store the category name but instead use associative paths among the members of the category to store and retrieve the elements (Collins & Loftus, 1975). The recall of one member of the category would initiate the retrieval of associatively related words, namely, the other members of the category. Similarily, in the present study, subjects might use a direct path between the synonyms to facilitate recall. Such paths would be available for concrete and abstract words.

A proponent of the verbal representation hypothesis could argue that the associative mechanism just described accounts for any effect of synonym repetition in the present study. Subjects could cluster related words, the synonyms, which would facilitate the storage, retention, and retrieval of specific item information. If organizational factors account for synonymity effects, the interaction with concreteness would be due, not to differential representation in semantic memory, but rather to factors that affect the retrievability of the other member of the pair. The materials used in this study were highly synonymous and equally so for concrete and abstract materials but other factors may have played a role.

Wickens and Engle (1970), for example, have suggested that associative overlap in general is greater for abstract materials and results in greater interference in memory. It could be argued that synonym relationships will be less distinct for abstract materials because of the greater background overlap with the "unrelated" words in the list. It would follow that abstract synonym relationships would require contiguous presentation before they are noticed and used. Concrete synonym relationships, because of their distinctiveness, would be noticed and used at all lags across the limited range included in Experiment 1.

It may be, however, that these lag effects differ because different mechanisms are responsible for the synonym effects with concrete and abstract words. Identical repetitions typically result in a massed-distributed effect with massed items more poorly recalled than distributed items (Underwood, 1969) and an additional effect of distributed lags is sometimes obtained with the longer lags associated with better recall (Glenberg, 1977; Melton, 1970).

Less data are available on the effects of repetitions of related words. Glanzer (1969) presented associatively related words at different lags and found that the probability of recall decreased across lags. This decrease does not appear to occur if the related words tap a common conceptual representation since Glanzer and Duarte (1971) obtained recall levels that did not vary as a function of the lag between the presentation of a word and its translation-equivalent.

However, the research on category recall does not unambiguously support this view. Mathews (1977) found that incidental free recall of category members was identical for members presented contiguously or apart which is consistent with the view that repetition of shared representations does not produce a lag effect. The more typical outcome, however, is that recall decreases with the lag between category members (e.g. Greitzer, 1976).

A definite statement is not possible about the effects of identical and associative repetitions on recall at different lags although associative relationships appear to result in decreases in recall as lag increases while identical repetitions have inconsistent effects. The effects of synonymity may, then, have been mediated by different mechanisms in the case of concrete and abstract words. Concrete synonyms tapped a common, imaginal representation so recall did not vary with lag. Abstract synonyms facilitated recall through associative connections so the synonym repetition effect decreased with lag.

If the verbal model is to account for the effects of synonyms for both concrete and abstract words, the model must, somehow, explain the differential availability of synonyms for concrete words. One of the admirable features of concreteness as an explanatory mechanism is that it serves effectively as an ultimate variable, one that does not require further reduction for completeness. Most alternatives to the imagery explanation, such as associative overlap, do not possess this desireable characteristic. That is, the question remains unanswered as to why concrete and abstract words should differ in associative overlap. Why they differ in concreteness, on the other hand, does not appear to require a psychological answer.

Conceptual Representations and Depth of Processing. The problem for the verbal representation model was to account for the effect of synonym repetition on concrete words. The difficulty for the conceptual representation theory is to explain the non-effect of synonym repetition on abstract words. The present study supports the hypothesis that the referential representations correspond to relatively concrete images rather than supralinguistic concepts or ideas because the latter form of representation fails to predict the weak or nonexistant effects of synonym repetitions on abstract materials.

Previously, it was assumed that subjects would process words to a conceptual level fairly automatically. It may be the case, however, that a conceptual episodic memory representation requires an active process of encoding which does not always occur and some items will be retained at a more superficial verbal level or not at all. The argument could be made, somewhat after the fact, that concrete words are more likely to result in conceptual representations while abstract words are more likely to remain in a verbal form. This position would explain the main effect of concreteness as well as the interaction with type of repetition since synonyms would enhance recall only when conceptual coding took place.

The problem, of course, is to specify an independent operation that would allow one to identify those circumstances under which conceptual codes will or will not occur. Kintsch (1972) suggested that abstract words were more lexically complex than concrete and, it could be argued, subjects may elect not to perform the extra processing required because of self-imposed or experimenter-imposed constraints. This failure to completely process abstract materials would result in better overall recall of concrete words as well as the interaction with type of repetition. These explanations do admit the possibility of abstract materials being encoded at a conceptual level which suggests that situations can be conceived in which abstract words will be remembered as well as concrete.

A more plausible modification would incorporate some structural difference between concrete and abstract words such that episodic memory would necessarily be better for concrete. Kintsch's hypothesis that abstract representations are more complex could imply a greater memory load for such materials and poorer memory. The recall differences would be attributed to representational differences rather than depth of processing. It is important to note, however, that this complexity hypothesis does not simultaneously account for the concreteness effect and the interaction with repetition while the depth of processing hypothesis accounts for both effects. An additional concern is that the origin of the differences in complexity of concrete and abstract materials remains unaccounted for.

It should be noted that a mechanism similar to unspecified depth of processing could have operated against the verbal-imaginal model in the present study. Imaginal processing is not as automatic as suggested in the introduction. Subjects instructed to use imaginal strategies will demonstrate greater concrete-abstract word differences than subjects instructed to use other modes of learning (Paivio & Foth, 1970). Mixed lists of concrete and abstract materials, as use in the present experiment, generally result in greater concreteness effects than homogeneous lists (Postman & Burns, 1974). This evidence that concreteness effects can be enhanced suggests that subjects voluntarily control access to the imaginal system or control strategies of learning that are only available in the imaginal system (e.g. integrative imagery). These options available to the subject make the agreement of the results with the verbal-imaginal model the more impressive.

Two plausible but theoretically uninteresting explanations for the present results can be discounted. One possibility is that the synonymity ratings were not adequate controls for similarity of meaning because of polysemy. Many words in the English language are homonyms and have alternative meanings. Perhaps one of these alternative interpretations was accessed when the word was presented alone in the free recall task. If this occurred more frequently with abstract materials, the failure to obtain a synonym repetition effect could be explained. The first argument against this explanation is the observation, based on unpublished data, that homonyms tend to be concrete rather than abstract, contrary to this hypothesis. A more specific rebuttal is possible. In an unpublished study, 48 subjects were asked to produce synonyms to one member or the other of each of the 50 concrete and abstract pairs used in Experiments 2 to 4. All of the responses were consistent with the desired interpretation for approximately 80% of the words and no differences were found between concrete and abstract words. There were only a few extremely deviant pairs such as act/deed and branch/limb that had substantial numbers of responses consistent with alternative readings of the words. These few discrepant words cannot account for the present results which generalize across abstract and concrete materials, according to the item analysis.

A second explanation is that the scoring procedure for synonyms was inappropriate to test the predictions of the conceptual model. Word recall is not the only measure of recall available in the case of synonyms. The alternative system, type scoring, measures the number of concepts retrieved (rather than words) by computing the proportion of pairs from which one or both members was recalled. This revised measure primarily affects abstract synonym recall, since relatively few pairs were recalled in this condition. The proportion of pairs from which one or both abstract synonyms was recalled was .28. This score is still below the comparable value for concrete synonyms, .41. This modification does affect some of the comparisons but at times in rather dubious ways. The comparisons with non-repeated items do not lead to different conclusions since the proportion of unrelated word pairs from which one or both were recalled did not differ from the type scoring for abstract words (.24 vs. .28) but did for concrete (.28 vs. .41). Although the type score for abstract synonyms is now as high as recall in the literal repetition condition (.29), so is the comparable score for unrelated abstract items. This suggests that the type measure may be inappropriate or, at least, insensitive to the sorts of effects that are of interest in the present study. The frequency judgments are also inconsistent with the hypothesis that subjects were recalling only one word from a conceptual representation that was accessed twice during presentation. If subjects did perform in this fashion for abstract words, frequency judgments should have been similar to those for identical repetitions rather than non-repeated items. In conclusion, the most satisfying approach is that taken in the present study, one that assumes that a conceptual repetition should have affected word recall, as occurred with concrete materials.

## Summary and Conclusions

The results are most consistent with Paivio's verbal-imaginal model of memory. Concrete words were stored imaginally and, therefore, recall of synonyms was equivalent to recall of twice-presented words. Abstract words were stored verbally and, therefore, recall of abstract synonyms should have behaved as once-presented words. Presentation of abstract synonyms only facilitated recall if the pairs were displayed contiguously or nearly so and this facilitation possibly resulted from associative mechanisms rather than a shared semantic representation. Verbal representations also play an important role in episodic memory and any adequate model must preserve the integrity of the word in a verbal representation.

Both the verbal and conceptual hypotheses can be modified to account for the interaction between concreteness and type of repetition. The modifications involve additional assumptions about the episodic memory processes involved in the performance of the free recall task (Anderson, 1976). A strictly verbal model would predict that synonyms should behave as once-presented words irrespective of concreteness unless some associative or organizational factor enhanced recall. The synonym may be more available for concrete material. A model based on conceptual representations would predict that synonyms should behave as identical repetitions unless items are only superficially processed. It could be argued that abstract materials are less likely to be processed to a conceptual level given the constraints of the free recall task.

In either case, some embellishment is required to account for the differences between concrete and abstract materials in the availability of associative connections or deeper levels of meaning.

# CHAPTER 3

## CONCRETENESS EFFECTS ON FREE ASSOCIATIONS TO SYNONYMS

Conclusions made on the basis of Experiment 1 were stated in a weak form because of the possibility that performance factors contaminated what was intended as a test of semantic representation or structure (Anderson, 1976; Norman & Bobrow, 1975). The free recall task is a complex one and the verbal or conceptual models may hypothesize strategies, such as the use of associative mediators, in order to mimic the predictions of the verbal-imaginal model. A word association task would appear to be freer of the sorts of memory processing routines that might serve to confound the predictions made on the basis of structural format (Friendly, 1977).

The free association task offers a purer test of the nature of semantic representation. This does not mean that tasks of this sort are strategy-free and, indeed, strategically and structurally determined effects on priming tasks (e.g. Underwood, 1977) receive considerable attention in Chapter 4. However, such paradigms, and especially the free association task, do present fewer opportunities for irrelevant processes to confound the outcome than do more elaborate procedures, such as those with substantial memory requirements of an episodic sort. Word associations will tap semantic memory more directly than did the free recall task. The free association task is particularly relevant since associative mechanisms offered a major alternative explanation for the results of Experiment 1.

Although the word association task may involve more automatic processing requirements than were involved in the free recall study, an important assumption of the next series of studies is that free association data have particular relevance to the study of semantic memory (Clark, 1970; Glucksberg & Danks, 1975; Nelson, 1977). Early attempts to classify associations acknowledged the meaningful nature of the relationships between the stimulus and response terms (Miller, 1951), and unidentifiable or superficial relationships (e.g. meaningless, clang associations) were the exception rather than the rule. The types of connections emphasized in recent models of lexical memory have been demonstrated in the word association task, with hierarchical or categorical associations (subordinates, superordinates, and hyponyms) having received considerable attention in both areas. Kiss (1973, 1975) has emphasized the fundamental nature of associative relations and interprets word associations as "extremely important indicators of the structure of the organization in our minds" (1973, p. 8).

## Semantic Models and the Free Association Task

Figure 2 represented the essential differences among the three models contrasted in this paper while Figures 5 to 7 present a more formal description of each model so that predictions for the free association task can be derived. The models remain faithful to the description presented in Chapter 1 with some elaboration of the nature of the nodes in the associative-relational network and a consideration of the input of stimuli and the output of responses, both components necessary in the free association task.

Verbal Representations

The generation of a word association is quite straight forward, according to the verbal model presented in Figure 5. A stimulus word is presented and activates the representation appropriate to that particular word. The verbal representations are represented in Figure 5 as lower-case letters with a subscript. A common lower-case identifier indicates that the words belong to a class of semantically-equivalent stimuli. The subscript serves to distinguish different words; that is, "a(1)" is a synonym of "a(2)" and so on.

The semantic network is presented in propositional form for convenience since associative networks become unwieldy. These propositions state that "a(j)" is associated with "i(k)" or, that a word belonging to a particular set is associated with other words in semantic memory. Some of these words will belong to the same set of meaning-equivalents while others will belong to other sets. Each verbal representation is associated with a large number of other verbal units in the associative-relational network, and the original verbal representation activates another element that is semantically or experientially related to the first. This verbal representation elicited by the stimulus becomes the response.

Only verbal representations (lower-case letters) exist in semantic memory, according to the verbal model. There is very little difference between the overt task and the covert mental operations assumed to determine the response. Multiple and relatively separate associative paths connect different words whether these words are synonyms or unrelated words. Semantic-equivalents, whether concrete or abstract, do not converge prior to the associative process because

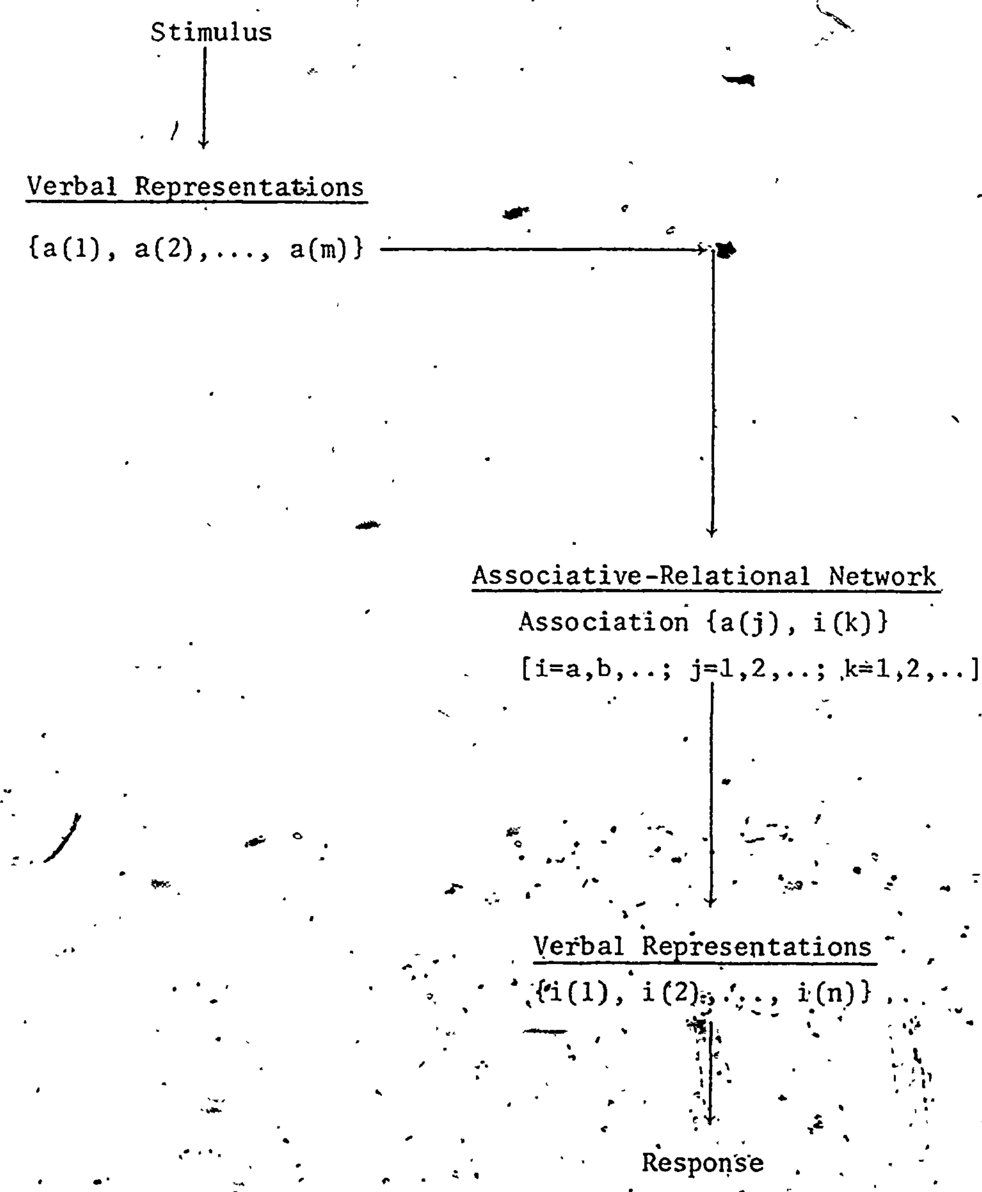


Figure 5. A verbal model of the free association task.

of the absence of a referential level of meaning within this model.

Associations to one member of a synonym pair will, then, be determined by a different associative network than an association to the other member of the pair. This leads to the prediction of a relatively low level of associative overlap for both concrete and abstract words. Synonyms should not elicit one another often, nor should they elicit a common, shared response frequently.

Conceptual Representations

The conceptual representation model described in Figure 6 derives a quite different prediction about associative overlap to concrete and abstract synonyms. Typically, the free association task would proceed as follows. A stimulus word elicits a verbal representation in much the same manner as in the verbal model. This verbal representation, however, arouses some concept via the appropriate token-to-type association which should be read as follows: "a(j) is a token or instance of Concept(A)." The result of this sequence is the activation of a conceptual representation.

Each concept has two sorts of outpath which correspond to associations with other concepts (the Associative-Relational Network) and type-to-token relationships with verbal representations that also label the concept. The conceptual representation for the stimulus may elicit another member of the equivalent-stimuli set through these latter relationships or another concept that is semantically or experientially related to the first may be activated. One of the set of tokens appropriate to this subsequent concept could then be given as a response. The logic of the arguments to be made is the same

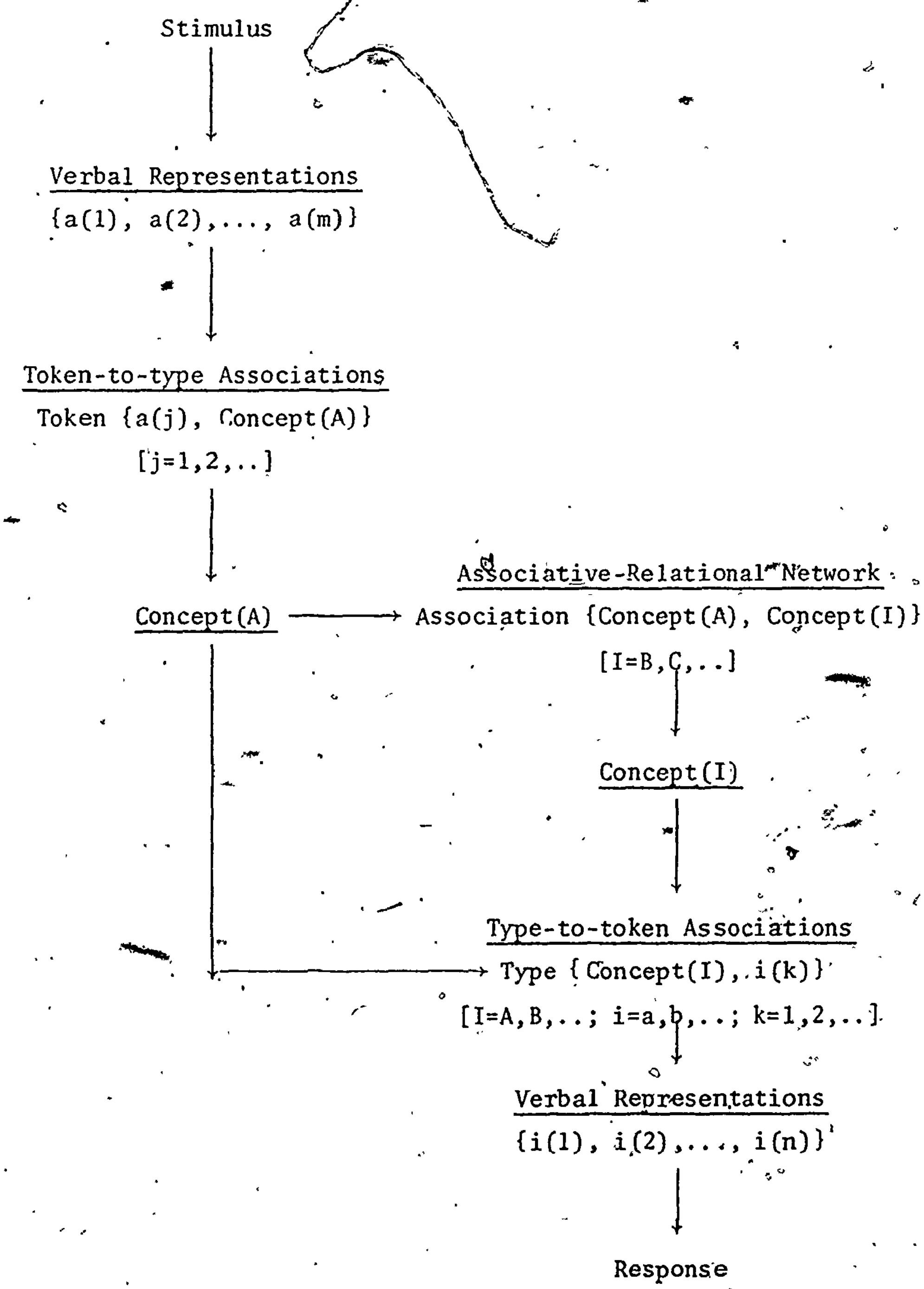


Figure 6. A conceptual model of the free association task.

whether one or n associations (recursion) intervene between the initial and final concept, the latter being the to-be-verbalized concept that determines the ultimate response.

All semantic equivalents converge on a common concept before the associative process is initiated and it is this convergence that leads to the prediction of high associative overlap for synonym pairs and translations. Subjects should emit either shared responses common to both stimuli or synonym responses, the other member of the synonym pairs. These predictions should hold for both concrete and abstract materials since the underlying structure is similar, conceptual, for both types of word.

According to the conceptual model, semantic equivalents enter into token-to-type associations with a common concept (upper-case letters) that was not available in the strictly verbal theory. Each concept has a set of type-to-token associations with a number of words. The type and token associations correspond to Anderson and Bower's (1973) word and idea associations, respectively. The present terminology is preferred because of its greater generality and because of the ambiguity of "word association" in the present context.

## Verbal-Imaginal Representations

The verbal-imaginal model of the word association task presented in Figure 7 is more complex as it combines structural elements of both the verbal and conceptual theories. A stimulus initiates activity in a verbal representation that may directly elicit a verbal response in the verbal component of the associative-relational network. The probability that this occurs is high for abstract words and somewhat

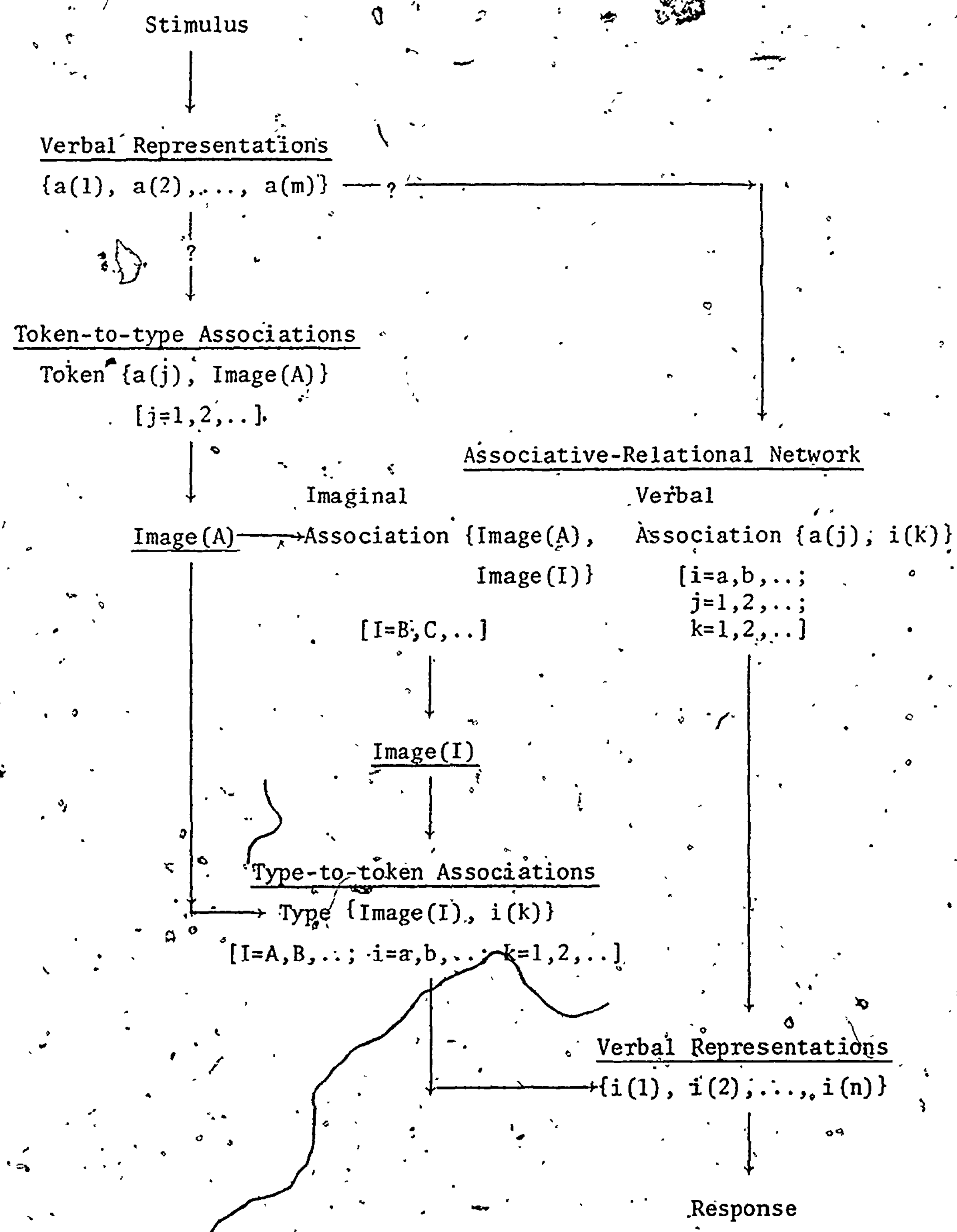


Figure 7. A verbal-imaginal model of the free-association task.

lower for concrete.

Concrete words, on certain occasions, activate the appropriate token-to-type association and arouse an imaginal representation in a fashion that is analogous to the arousal of a conceptual representation in the conceptual model. The image may directly elicit a verbal response through the type-to-token associative relationships or a response mediated by imaginal-imaginal associations may occur. This structure predicts higher associative overlap for concrete stimuli than abstract because concrete words and their semantic equivalents share a common referential reaction that can mediate the verbal response.

As in a purely verbal model, abstract words are only directly related or associated to one another and each of the semantic equivalents has an independent set of associations into which it enters. Some of the response members in the sets will be shared, but the sets are separate in the sense that different paths with different strengths exist for each of the abstract stimuli. Because abstract words elicit multiple associative reactions according to the verbal-imaginal model, lower associative overlap would be expected than for concrete words. Concrete synonyms should elicit more shared responses than should abstract synonyms, and concrete synonyms should elicit each other more frequently than should abstract. The level of overlap expected for concrete words, however, should be less than that based on the conceptual model since the verbal-imaginal model allows for direct word-word associations as well as associations mediated by the common, underlying representation.

This is a strong test of the hypothesis and the theory that generated it since the typical result is that abstract words display greater associative overlap than concrete (Paivio & Begg, 1971). The free association task, at least superficially, is highly verbal so that evidence for an imaginal component would be quite compelling. Finally, it is not immediately apparent how performance or strategy processes could account for such an effect in that subjects are simply asked to respond with the first word that comes to mind.

The predictions of the three models are summarized in Figure 8 although discussion of what constitutes high and low overlap will be deferred for the moment. In summary, the availability of a referential level of meaning (concepts or images) leads to the prediction of high associative overlap while the absence of such a level (only verbal representations) leads to the prediction of low associative overlap. A single study by Kolers (1963) presents evidence relevant to these predictions and motivated the current experiments. Kolers compared several hypotheses about bilingual representation and the rationale for his research is worth mention.

One hypothesis examined by Kolers (1963) was that bilinguals have a shared semantic store tapped by separate linguistic systems. The second hypothesis was that both the semantic and linguistic systems were separate. Separate conceptual systems would represent the experiences that correspond to the different languages in the latter model. Kolers examined the word associations of bilingual subjects to English words and their translation-equivalents. He reasoned that the shared hypothesis would predict a high proportion of similar responses to stimuli in the two languages. The separate hypothesis would predict different responses to stimuli presented in

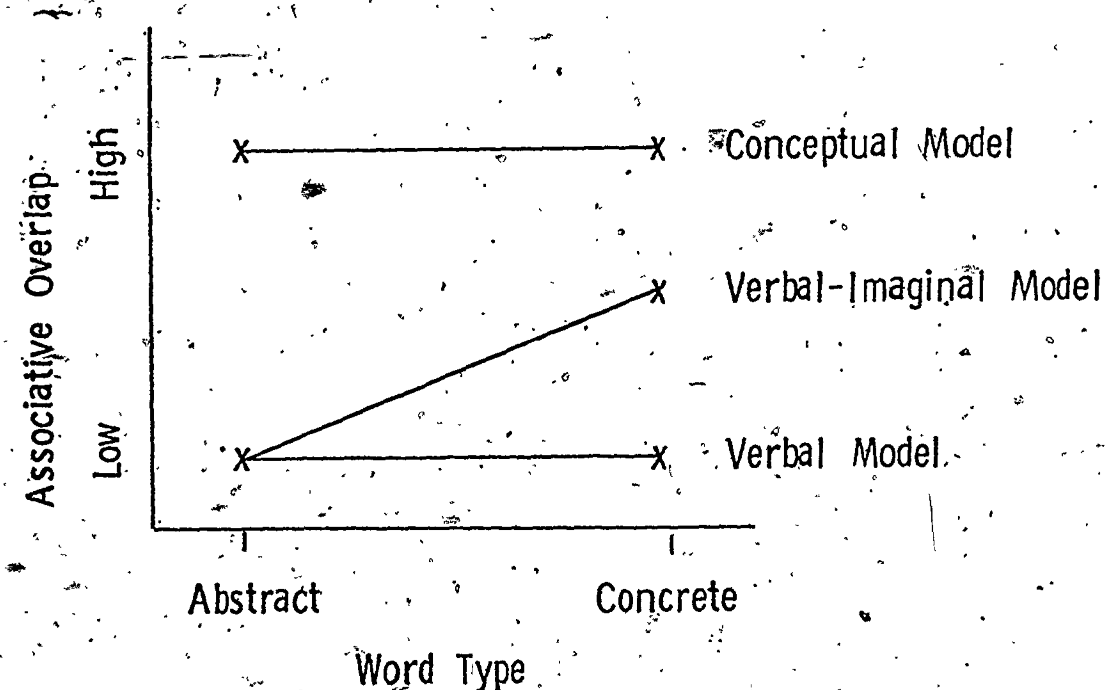


Figure 8. Levels of associative overlap predicted by the three models of semantic memory.

different languages. Only one-third of the associations could be considered shared and Kolers concluded that bilinguals have separate semantic and linguistic systems.

The hypotheses of separate or shared systems can be interpreted in terms of the verbal and conceptual models of semantic memory. The conceptual view maintains that verbal representations converge on a common concept irrespective of language and this view corresponds to the notion of shared semantic systems. The verbal hypothesis has certain similarities with the separate hypothesis but the former argues that the redundancy of representation at the verbal and conceptual levels is unnecessary. Kolers attempted to maintain the basic spirit of conceptual representation even in the separate hypothesis. According to the verbal model, Kolers's low levels of associative overlap are evidence for the absence of conceptual levels of representation in semantic memory rather than for separate conceptual levels in both languages.

Experiment 2 evaluated these two accounts in terms of a unilingual analogue of Kolers's task and constituted a stronger test of the conceptual and verbal hypotheses. Subjects were asked to free associate to English words or their synonyms. The assumption of separate semantic systems is reasonable given the bilingual nature of Kolers's procedure, since it is plausible that separate conceptual systems would represent experiences in different languages and cultures. The assumption of different conceptual representations is untenable when the task materials are drawn from the same language. The hypothesis of a conceptual level of representation predicts high overlap between synonym pairs while the hypothesis of verbal representations predicts a low level of overlap. The rationale for these predictions was presented earlier.

In addition, Kolers found higher associative overlap when the stimuli were concrete words (e.g. lamp, tree) than when the stimuli were more abstract (e.g. freedom, wisdom) or referred to feelings (e.g. hate, love). Kolers argued that concrete words were more likely to occur in similar situational contexts and to be operationally defined in terms of the objects to which they referred. Abstract and emotive words were more likely to occur in different contexts, to be subjectively defined, and to mean different things in the different languages. That is, concrete words and their translations are more nearly synonymous, more similar in meaning, than are abstract and emotive translation-equivalents. Cofer(1957) has demonstrated that associative overlap between pairs of words decreases as their rated synonymity decreases which would account for Kolers's findings.

These findings are also consistent with the predictions of the verbal-imaginal model presented in Figure 8. According to the model, concrete stimuli generate more shared responses because of the common image that may mediate performance on the word association task. This explanation for the concreteness effect departs from Kolers's account in at least one important respect. The primary reason for higher associative overlap with concrete materials is not the higher synonymity but rather the nature of the representation of concrete and abstract materials in semantic memory. The verbal-imaginal model (but not the explanation given by Kolers) predicts that concrete and abstract synonym pairs rated as being equally synonymous will still produce differential overlap in favor of the concrete words. Concrete synonyms should elicit more related responses than abstract as predicted in Figure 8. Experiments 2 and 3 examine the predictions of the three models.

## Experiment 2

An additional explanation of the concreteness difference may be direct or indirect priming of common responses (Cramer, 1968) since Kolers's subjects responded to both the English stimuli and their translations. Concrete words are more memorable than abstract words so that priming may have facilitated the generation of common responses more for concrete words than abstract. The differences in associative overlap would be accounted for in terms of the different episodic memorability of the event traces and it would not be necessary to hypothesize a structural difference in semantic memory.

In order to test this hypothesis, subjects in Experiment 2 responded to only one member of each synonym pair and different subjects' responses were compared so that differential priming could not account for any associative overlap differences between concrete and abstract words. This modification is quite valid since the concern is with the nature of semantic memory rather than individual associative hierarchies. The procedure is commonly used in free association studies when the unit of interest is the word, which it typically is (e.g. Kiss, 1973). Subjects in Experiment 3 will respond to both members of the pair so that the effect of this modification will be determined.

### Method

Subjects. The 48 Introductory Psychology students were tested in groups of one to six.

Materials. From the norms described in Experiment 1, 50 concrete pairs with a mean synonymity rating of 5.57 (s=.38) and 50 abstract pairs with a mean of 5.50 (s=.42) were selected. Some of the 200 words, which are presented in Appendix B, were listed in the Paivio, Yuille, & Madigan (1968) norms. The 64 concrete words with imagery values had a mean rating of 6.40 (s=.24) and the mean familiarity of 63 items was 5.55 (s=.72). The respective means were 3.30 (s=.57) and 5.56 (s=69) for the 62 abstract words for which ratings were available.

Procedure. A PDP-12 performed the randomizations and printed the lists on a line-printer. The 100 synonym pairs were randomized to generate 24 different orders. One member of each pair was randomly selected for each list which resulted in 48 yoked lists. Each word appeared in the same ordinal position as its synonym in another list. All subjects were given standard word-association instructions to write the first word, other than the stimulus word, which came to mind.

## Results and Discussion

Traditionally, associative overlap consists of two components: the number of times that a word elicits its synonym as a response and the number of times that a shared response is given to both synonyms (Cofer, 1971). The total overlap can be determined by the addition of the number of synonym responses to the number of shared responses.

For example, if the responses to pail were: bucket (frequency of 5), water (3), garbage (1), and diaper (1); and the responses of ten different subjects to bucket were: pail (4), water (4), well (1), and kick (1), the overlap would be computed in the following manner. The number of synonym responses would be 9, 5 plus 4 for, respectively, bucket and pail as responses. The maximum number of synonym responses is 20, the number of associations obtained. When different subjects respond to each member, the number of associations will equal the total number of subjects. The number of shared responses is awkward to arrive at because water was given 4 times to bucket but only 3 to pail. The traditional approach is to select the lower value if the shared response is given a different number of times to the synonyms. This would be 3 in the present case and the total overlap would equal 12. The maximum score for the shared responses would be equal to the number of pairs of associations, 10 in this case.

This procedure is adequate if one is concerned only with the relative amounts of overlap. The present study attempts to make some strong statements about the absolute amount of overlap obtained and it is not clear how the total overlap measure just described is to be treated in any absolute sense. The maximum value in the hypothetical example is 20 and the relative overlap is 60%. This percentage is difficult to interpret in any way other than as a restatement of the operational procedures by which it was determined. This problem arises because of the different ceilings for shared and synonym responses.

Associative overlap components in the present study were defined as above but shared responses were doubled which generated a measure that was allowed to reach 100% and that was readily translated into a statement about the proportion of responses accounted for in terms of the relatedness measure. The example would obtain a revised overlap score of 15 or 75% which accurately reflects the fact that 15 of the responses contributed to the associative overlap, the odd response still being ignored. This measure is more meaningful, in an absolute sense, than that traditionally used.

The revised measure is also more liberal than the older procedure since considerably more weight is given to shared responses. This bias is in the proper direction as the major conclusions will depend upon the extent to which associative overlap fails to achieve sufficiently high levels to indicate a common underlying structure to synonyms. An alternative and more direct measure is introduced in Experiment 3 when the same subjects respond to both members of the synonym pairs.

The associative overlap data are shown in Table 5. Overall, only 29.4% of the responses were shared or synonym associates. Concreteness was an important determinant of total overlap, t 98 = 4.71, $p<.01$, as only 23% of the abstract responses were synonyms or shared words while 35% of the concrete responses were so classified. Synonym pairs served as experimental units in the statistical analyses. The total overlap reflected equal contributions of direct (synonym) and indirect (shared) relationships. The superiority of concrete words was not qualified by a consideration of the synonym and shared components.

These results are similar to Kolers's findings and associative overlap appears to be lower than expected on the basis of a conceptual model of memory. More than two-thirds of the responses indicated that the subjects had treated the synonyms as different semantic entities. The verbal model predicted the low level of associative relatedness but did not anticipate the concrete-abstract difference in overlap.

Table 5

Synonym, Shared, and Total Related Responses:

Different Subjects Responded to Each Member of

a Synonym Pair

| | Attribute | | |
|---|---|---|---|
| | Concrete | Abstract | Combined |
| Synonym | | | |
| Mean | 8.08 | 5.56 | 6.82 |
| Standard Deviation | 5.05 | 4.99 | 5.13 |
| Proportion | .17 | .12 | .14 |
| Shared | | | |
| Mean | 8.88 | 5.68 | 7.28 |
| Standard Deviation | 7.44 | 5.13 | 6.56 |
| Proportion | .19 | .12 | .15 |
| Total | | | |
| Mean | 16.96 | 11.24 | 14.10 |
| Standard Deviation | 6.37 | 5.75 | 6.69 |
| Proportion | .35 | .23 | .29 |

Several conclusions appear to be warranted by these findings. The phenomena observed by Kolers have considerable generality since the effects have generalized to a larger pool of words, to a unilingual task, and to a more general population of subjects. Kolers incorrectly assumed that separate abstract levels of representation were necessary to account for his data. Subjects in the present experiment performed at a comparable level on a unilingual task with English words that had been rated as highly synonymous. This suggests that low similarity of translations was not a necessary cause of the generally low overlap observed by Kolers. To say that subjects have different conceptual representations for synonyms would strip the notion of concept of its generality and equate it with a verbal representation. The more parsimonious explanation is that subjects based their free associations on paths which connect, not abstract elements, but representations of the words themselves. Some consideration of the integrity of the word unit seems to be necessary in semantic memory.

Verbally based associations appear to be less characteristic of concrete words than of abstract. The overall level of relatedness was higher for concrete words which suggests that a shared semantic component exists for these materials but not for abstract ones. Such a difference was not expected on the basis of a verbal system and the general pattern of results is most consistent with a verbal-imaginal model of semantic memory.

The effect of concreteness on associative overlap was not due to any differential synonymity of concrete and abstract words in the present study or, presumably, in Kolers's experiment. The rating scale assured that the concrete and abstract synonym pairs did not differ in similarity of meaning. Subjects rated a mixture of concrete and abstract pairs so that it is unlikely that the norms would be insensitive to any differences in the equivalence of terms.

Neither can the effect of concreteness be attributed to an episodic memory factor such as priming since subjects responded to only a single member of each pair. This procedure, however, presents certain problems that are considered in Experiment 3.

## Experiment 3

The effect of concreteness and the low level of associative overlap are consistent with the predictions of the verbal-imaginal model. Associative overlap accounted for a small percentage of word associations to synonyms and this finding is at variance with the predictions of the conceptual model. Experiment 3 is concerned with an alternative explanation for the low level of shared and synonym responses. In particular, it may be argued that considerable diversity exists among individuals in their associative-relational networks. Experiment 2 compared the responses of different people to each of the synonym pairs and the idiosyncrasy of semantic memory probably served to decrease the commonality of responses. Subjects in Experiment 3 free associated to concrete and abstract words and their synonyms. The conceptual model states that the responses of the same individual to synonyms should show the high level of associative overlap predicted by the theory. This statement should be especially true for shared responses since synonym responses count as related even if only one member of the pair produces the synonym. A shared response, however, must be given twice and would be more affected by idiosyncrasy.

Method

Subjects. Twenty-four Introductory Psychology students were tested in small groups that varied in size from one to six.

Procedure. The materials were those used in Experiment 2. Four random orders of the entire set of 200 words were generated. The average lag between the presentation of the first and second members of a pair was approximately 60 items for both the concrete and abstract pairs. Each order was given to six different subjects who were given standard word association instructions to write the first word, other than the stimulus word, that came to mind.

Results and Discussion

Associative overlap components were defined initially as in Experiment 2 and these results are presented in Table 6. Shared and synonym responses accounted for 38% of the associations with concrete words again producing a higher level of overlap (45%) than abstract (32%). This difference was significant, $t_{98} = 4.81$, $p < .01$.

The increment in overlap responses from Experiment 2 to 3 is relatively small (9%) but significant, $t_{99} = 8.64$, $p < .01$, and was restricted to the production of synonym responses. There was little, if any, difference between the shared responses in the two experiments. The general level of relatedness is still quite low when one considers that the same person generated both responses within a relatively short period of time. A less biased measure of the overlap is possible in Experiment 3.

It was noted previously that the shared component of associative overlap was somewhat inflated. A stricter procedure can be adopted

Table 6

Synonym, Shared, and Total Related Responses: The Same Subject Responded to Both Members of a Synonym Pair

| | Attribute | | |
|---|---|---|---|
| | Concrete | Abstract | Combined |
| Synonym | | | |
| Mean | 12.64 | 8.94 | 10.79 |
| Standard Deviation | 6.30 | 5.79 | 6.33 |
| Proportion | .26 | .19 | .23 |
| Shared | | | |
| Mean | 8.96 | 6.24 | 7.60 |
| Standard Deviation | 7.46 | 5.64 | 6.72 |
| Proportion | .19 | .13 | .16 |
| Total | | | |
| Mean | 21.60 | 15.18 | 18.39 |
| Standard Deviation | 6.82 | 6.51 | 7.38 |
| Proportion | .45 | .32 | .38 |

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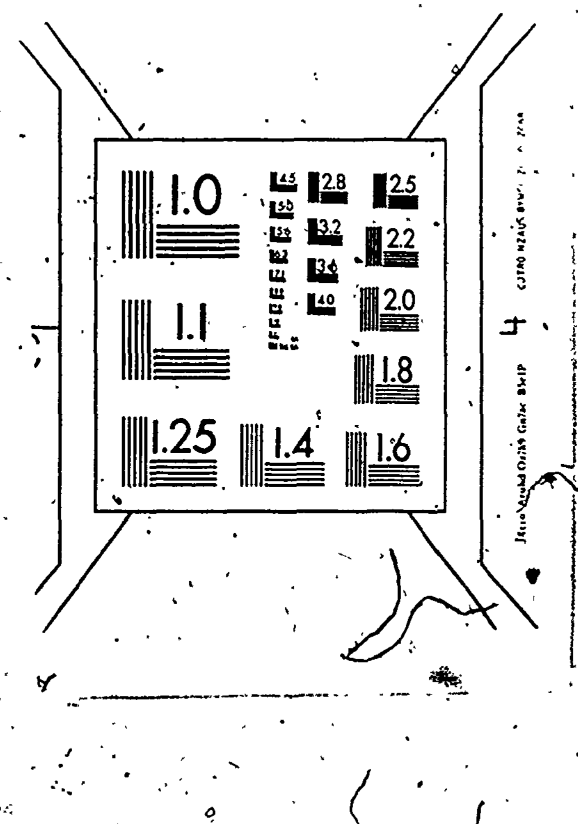


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with shared responses in Experiment 3 since subjects free associated to both members of a pair. Responses can be scored as shared only if the same subject gives the same response on both occasions. The shared or repeated component of overlap was less with this criterion and accounted for much less of the total overlap (9%). The mean number of shared responses for concrete synonyms was 5.16 (s=5.86) and for abstract synonyms was 2.96 (s=3.82). The total overlap for concrete material (m=17.80, s=6.09) was still significantly higher than that for abstract material (m=11.90, s=5.65), t 98 = 5.02, p<.01. The effect of this adjustment is to reduce the total overlap to less than one-third of the responses, a level similar to that obtained by Kolers and one inconsistent with a conceptual model of memory.

The increment from Experiment 2 to 3 was similar for both concrete (9.7%) and abstract materials (8.2%) which discounts the differential priming hypothesis of the concreteness effects in Kolers's original study. It is somewhat tangential to the current purpose but interesting to note that the increase in synonym responses was due to different mechanisms in the case of concrete and abstract words.

Concrete words produced more synonym responses in Experiment 3 largely because of a general set to respond with a synonym. Even when subjects had not previously seen the other member of the synonym pair, concrete stimuli produced more synonym responses than had occurred in Experiment 2. This effect is illustrated in Figure 9. The proportion of synonym responses to the first member of a synonym pair in Experiment 3 should be equal to the proportion of synonym responses in Experiment 2 where synonyms were always presented alone. Such is the case for abstract stimuli throughout Experiment 3. Concrete synonyms, however, begin at a level comparable to Experiment 2 but rapidly rise to a much

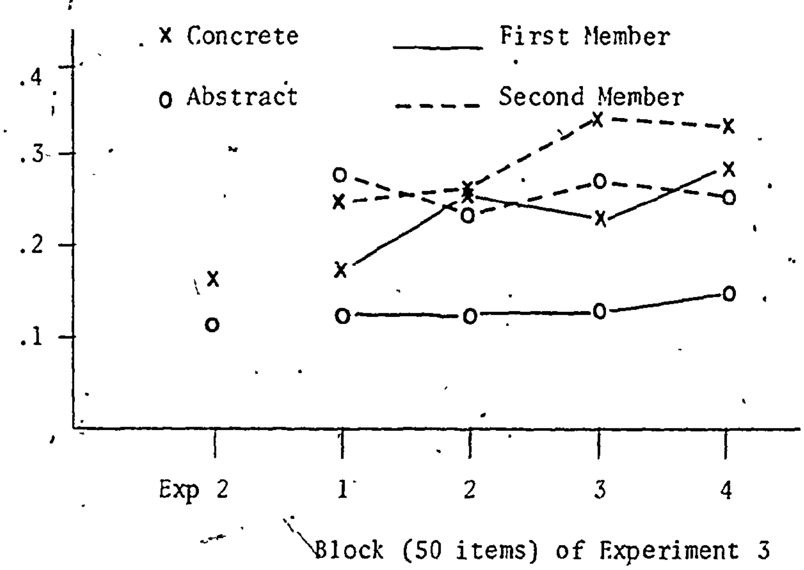


Figure 9. The proportion of synonym responses given in Experiment 3 as a function of block and order of presentation. The values for once-presented items in Experiment 2 are also shown.

higher level which indicates that a general response set is operating to increase the proportion of synonym responses.

Abstract synonyms, on the other hand, were facilitated primarily by the direct presentation of one member of the pair which served to stimulate a synonym response when the second member of the pair was presented later in the list. Figure 9 illustrates that the difference between the first and second presentation of a synonym pair was more marked for abstract materials than for concrete. This result is somewhat paradoxical since concrete words are more memorable than abstract; however, direct priming may be especially beneficial when associative networks are relatively undifferentiated (no very strong response) which may be more likely with abstract words.

In summary, relatively low levels of associative overlap occurred to synonyms even when the same subjects responded to both members of a pair. Concrete words did produce a higher level of overlap than abstract as anticipated by the verbal-imaginal model of memory. There was no increase in the number of shared responses from Experiment 2 to 3 which indicates that associative networks may not be particularly idiosyncratic. The increase in overlap was restricted to synonym responses and the gains were comparable for both concrete and abstract words. Despite the similarity in the magnitude of the effect, the mechanisms by which the increase occurred differed for the two types of material. Concrete synonyms increased primarily because of a mental set to respond with synonyms while abstract synonyms increased largely because of the direct priming due to the earlier presentation of one member of the synonym pairs.

# CHAPTER 4

## THE STABILITY OF ASSOCIATIVE NETWORKS

Experiments 2 and 3 demonstrated that relatively low levels of associative overlap occurred whether different or the same subjects responded to each member of a synonym pair. The argument was made that the different responses were due to the presentation of different tokens (words) of a particular type (equivalent meaning set) and that these results were inconsistent with a conceptual model of semantic memory. This reasoning implies that the presentation of the same token of a particular type would have resulted in many more identical responses. It is time to examine the notion of an associative network in more detail and carefully evaluate the expectation that semantic equivalents would result in a common output.

Upon closer analysis, there appear to be several reasons why synonym pairs might not produce high associative overlap even if semantic memory corresponded to a conceptual structure. A number of variables might affect the probability of a common response given a shared concept is available and activated. These sources of uncertainty center around the selection of the associated concept from the associative-relational set and the selection of a verbal representation from the type-to-token associative sets.

One factor that affects the elicitation of these particular elements is the size of the set under consideration since, the larger the set, the lower the probability that one particular outcome occurs. The type-to-token set should be relatively small but the associative-relational set would be extremely large. Most common words have an extremely rich and varied associative structure (Kiss, 1973). Size is important only to the extent that the effect of the second factor, relative differentiation of associations, is minimal. Differentiation incorporates the important associative ideas of strength and hierarchy in that a value or strength can be assigned to each of the paths in the network. This value reflects the probability that the response will be emitted, since associations which are stronger will be more likely to lead to responses than will weaker relationships even if the size of the total network is extremely large. The independence of number and strength of associations can best be appreciated by the fact that concrete stimuli produce fewer different responses in the discrete word association task and more responses in the continuous task than do abstract stimuli (Cramer, 1968).

The final factor to be considered is the stability of the associative sets which is affected by two influences. The passage of time may be sufficient to produce important changes in the associative structure if any significant amount of "spontaneous activity" occurs in the system. A related and possibly more important influence is the effect of context which produces temporary changes in the associative structure. The effect of priming on word associations was considered in the previous study and this is one way that the importance of situational context on associative structure has been demonstrated.

If the influence of these factors is at all substantial, any associative model would predict different responses to synonyms if the stimuli were presented in different contexts, at different points in time, and the responses came from large sets of concepts or words which were relatively undifferentiated with regards to associative strength. These types of mechanism are more characteristic of the verbal learning tradition than of the more deterministic information-processing or computer simulation approaches but probabilistic associative mechanisms have been given greater importance in recent formulations of semantic memory (e.g. Collins & Loftus, 1975; Hayes-Roth, 1977; Hopf-Weichel, 1977). These sources of variability may account for the results of Experiments 2 and 3.

## Experiment 4

A strong test of the contribution of these factors to the associative task is possible since subjects should generally give different responses to the same stimulus when it is administered at different points in time. The sources of uncertainty just described should adversely affect both an actual repetition of the stimulus and a synonym repetition of the stimulus concept. Subjects in Experiment 4 free-associated to a single member of each synonym pair and each member occurred twice in the list of words. If the level of identical responses is similar to the level of identical or synonym responses in Experiment 3, the interpretation of the latter results would change dramatically. The results of Experiments 2 and 3 could be accounted for by a conceptual model which allowed for the sources of fluctuation outlined in this section of the paper. The conceptual model would be threatened if the stability of responses to the same word was substantially above the overlap level of Experiment 3.

The sources of indeterminacy outlined for associative models in general, would also apply to the verbal and verbal-imaginal models. The selection of a particular response from the network would depend upon the size of the set, the relative differentiation of associations within the set, and the stability of the associative hierarchy. Since fewer representations would exist in a conceptual system than in a verbal one, the size of a purely verbal set would be substantially larger than that hypothesized by the conceptual model.

Differential predictions arise because the verbal and verbal-imaginal models hypothesize an additional cause of uncertainty in the synonym task that is not present in the actual repetition task. The presentation of the same word twice generates responses from the same associative network on both occasions while the presentation of synonyms generates responses from different, although closely related, associative systems. This difference between identical and synonym repetitions should result in more consistent responding to separate presentations of the same word than to the presentation of semantic equivalents.

A similar prediction follows from the verbal-imaginal model because of the role of verbal representations but the difference between overlap and reliability should be greater for abstract materials than for concrete. Indeed, there is no a priori reason that any of the theories would anticipate a difference between the stabilities of concrete and abstract associations.

Some data are available with regard to the general issue of associative stability although relatively little work has been done on the reliability of individual word associations (MacKenzie, 1972) since almost all association measures are pooled across subjects. Hall (1966) evaluated the stability of free associations over intervals of 7 or 21 days and subjects generated identical associations only 45% of the time. This value was not affected by the interval of time between sessions, the Thorndike-Lorge frequency value of the stimuli, or the number of common responses obtained on the original testing. Even lower values have been reported by other authors. Brotsky and Linton (1967) found only 32% identical associations to the Kent-Rosanoff list over a 10-week interval and, on a similar task, Gegoski and Riegel (1967) obtained only 28% identical responses. MacKenzie (1972) obtained a similar value (33%) with a larger pool of words and a longer, 2 week, interval between the tests. In this last study, the scale reliability (collapsed across subjects) was very high but correlated only moderately with the stability of individual response patterns.

The issues raised in the present experiment appear to be justified since associative responses are very unstable, at least over the intervals studied in these experiments. It remains to be seen if responses within a single session are as variable. No data have been reported over such short intervals.

## Method

Subjects. Forty-eight summer school students were group tested.

Procedure. The materials were those used in the previous experiments and four random orders of the entire set of 200 words were generated. These orders were used to produce separate lists of the two members of the synonym pairs. The average lag between the first and second occurrence of a word was approximately 60 items for both concrete and abstract materials. Each of the eight lists was given to six different subjects who were given standard word association instructions to write the first word, other than the stimulus word, that came to mind. In addition, subjects were told that some of the words would be repeated in the list and that they should not consciously search out or repress earlier associations but simply respond with the first word that comes to mind, whether or not it was the earlier response.

Results

Only 48% of the responses to concrete words and 41% of the responses to abstract words were identical on both presentations. The difference between concrete and abstract words was significant when words were considered as the replication factor, $t(98)=3.58$, $p<.01$, or when subjects were considered replications, $t(47)=3.71$, $p<.01$. The percentage of responses which were identical was the same as that obtained by Hall over much longer time intervals, although it was not as low as some of the other results reported.

Since synonym responses were of particular interest in the present study, associations were classified as synonym and non-synonym on the first presentation. The proportion of these associations which were repeated on the second presentation was calculated. Synonym responses were more stable than non-synonym, 67% and 41%, respectively. This separation into synonym and non-synonym components helps to explain some of the difference in apparent stability of concrete and abstract associations.

Consistent with the results of Experiments 2 and 3, subjects generated more synonym responses (20%) to concrete stimuli than to abstract (14%). The stability of these synonym responses did not differ significantly although abstract associations were repeated slightly more often (67%) than concrete (66%), $t(47)<1$. The greater occurrence of synonyms to concrete stimuli, however, contributed to the overall difference between concrete and abstract words. The percentage of non-synonym responses which were repeated was greater for concrete materials (44%) than for abstract (37%), $t(47)=3.17$, $p<.01$.

Discussion

As measured by the free association task, associative networks would appear to be extremely unstable. The majority of responses in Experiment 4 were unique even though the interval between successive presentations of the same word was on the order of minutes. The immediate discussion will focus on this relative unreliability or instability of free associations. Chapter 5 will examine in greater detail the relationship between these findings and the results of Experiment 3. This comparison will be more meaningful after the following discussion which identifies several potential sources of variation in semantic tasks that might account for the association results just reported.

The introduction to this experiment stated that different paths in the associative network may be activated on different occasions that the same word or concept is presented. The following discussion outlines, at an operational level, seven sources of variation that may operate in the free association task to instigate this sort of variability. The potency of each of these factors presumably depends upon the structure of semantic memory, so their effects will provide important evidence about the nature of our cognitive systems. The general thesis is that, in the free association task, a particular item is responded to by a particular individual in a particular setting. Differences among items, individuals, and settings will affect the similarity of responses to different or the same stimuli.

Individual variability. One source of variability between individuals may simply be individual differences in the associative hierarchies of different persons, person variability. Person X and

Person Y may tend to respond differently to nominally identical events because of differences in the individuals' experiences. Associative networks, according to this view, are somewhat idiosyncratic and influenced by a variety of differences among subjects. There are potential dangers if subject differences are not taken into consideration in the interpretation of experimental data. Association norms, for example, are quite stable but the individual responses are very unreliable. A model of semantic memory based only upon the former would err in some very basic ways and, indeed, would attempt to mimic stable representations or processes that were only a figment of an imaginary average subject. An examination of the free associations of individual subjects would make it more likely that the basic assumptions of the researcher were veridical with the cognitive life of some actual organism. Friendly (1977) found that multidimensional scaling solutions contained as much or more information about the subjects as about the words. The solution offered by the analysis was a two-dimensional one but individual subjects used only a single dimension, with different subjects using different dimensions.

A comparison of Experiments 2 and 3 indicated that such idiosyncratic factors contributed little to associative overlap in the present study. It is possible, however, that personal effects may have been overshadowed by priming effects of one sort or another. Only Experiment 2 was directly affected by person variability since the subjects in Experiments 3 and 4 responded to both members of a synonym pair or both presentations of the same word, respectively. Individual differences cannot account for any of the uniqueness of the responses in Experiment 4. Another sort of individual variability may have operated.

The second type of individual variability derives from the tendencies of subjects to adopt particular strategies, intentional variability, in the free association and related tasks. A wide variety of effects may be included under the rubric of intentional factors but the common concern is that a subject or subjects may differ in the consistency with which they respond under mental Set X and mental Set Y. It may be that a subject's orientation or set would change as the task progresses, for example, from a deeper to a shallower level of processing. Any change of this sort could have contributed to the newness of second responses in Experiment 4 or Experiment 3.

Such sets can be manipulated in a systematic fashion and some research is available which indicates that the performance of subjects who have a set to generate a particular type of response differs from the usual free association performance. Subjects in Experiment 3 adopted a mental set to respond with synonyms but this set operated only on concrete materials. Subjects' strategies have been considered a source of variability associated with the individual but such factors may also be considered related to the setting. The presence of synonyms in the lists of Experiment 3 produced the set to respond with synonyms.

Setting variability. One dimension of setting variability is contextual variability which refers to two sources of variation. These can be viewed as discrete sources or as points along a continuum and, although the latter view may be more accurate, I shall assume that some temporal criterion can be established to separate contemporary from historical contextual effects. Contemporary effects refer to the influence of the immediate environment which includes the verbal stimuli. It is typically assumed that free associations to a word will differ if it is presented in Context X as opposed to Context Y. Although the same word was presented twice in Experiment 4, the immediate context was randomly determined and undoubtedly varied from the first to the second presentation. Such unmonitored contingencies could have a substantial effect on the stability of free associations. This factor may also have affected the associative overlap data in Experiment 3 since the synonyms occurred amidst different items in each of the lists. This immediate environment may be particularly important as several studies have indicated that associative reactions are rapidly decaying. The typical procedure involves the measurement of naming or recognition latency given various cues presented prior to or simultaneous with the target word. Such priming research indicates that the effects of primes are relatively immediate (Collins & Loftus, 1975; Swinney & Hakes, 1976) although some authors have argued that structural modifications to the associative network are also involved (Hopf-Weichel, 1977).

Such latency studies would be of interest in the free association task as one means of assessing the dynamic properties of the associative network. More remote priming effects have been clearly demonstrated in the free association task and correspond to the second sort of contextual variability. Each list provides a unique History X that differs from another History Y although, in most cases, the functional history to which the subject reacts is not determined. This factor could have been an important source of variability in Experiments 3 and 4 as subjects' experiences differed when they responded on the separate presentations of synonyms or the same word. Experiment 3 examined an experimenter-defined history in the priming effect of synonyms. Subjects were more likely to free-associate synonyms on the second presentation than on the first. This effect is of a much more remote sort than that typically reported in the priming literature. There is, however, other evidence that remote contextual effects occur for semantic memory tasks. Caramezza, Hersh, & Torgerson (1976) described what they referred to as the context-sensitivity of multi-dimensional scaling. The particular solution to a scaling problem depends very much on the other words in the list, even if the other words are not to be plotted.

Setting variability may be affected not only by systematic effects of context but also by spontaneous changes that are best attributed to _temporal variability_. Consistency across time is measured by the similarity of responses at Time X and Time Y, Unfortunately, this source is inexorably confounded with one or more of the other dimensions of variation since the effects of context or intention may affect subjects' responses to the same word presented at two points in time. The same word may occur in the context of different list materials or subjects may adopt different tendencies. There is something theoretically unsatisfying about an appeal to spontaneous variation but it is unlikely that all, or even many, of the specifiable sources of variation will be identifiable for any occasion on which a free association is emitted. This leaves, as the only operationally specifiable variable, time. In terms of Experiments 3 and 4, the only observable or measured difference between one occurrance of an item and the later occurrance of the same item or its synonym is that one item did, indeed, occur at a different point in time. Although it is possible to hypothesize that contextual factors were actually responsible for the novelty of the responses, there is little basis in fact for such assertions. Spontaneity may be an attribute of the human mind.

This analysis of semantic memory accounts for the results of Experiment 4. Subjects tend to produce different associations on successive presentations of the same word because intentional, contextual, and temporal factors modify the associative structures from the first presentation to the second. A person responding to a particular item taps a uniquely determined associative network that changes over relatively short periods of time.

In Experiment 4, the same nominal item was presented to subjects on both occasions. Such was not the case in Experiment 3 where subjects were asked to free associate to both members of a synonym pair. This procedure allows an additional source of variability to affect the stability of associations. Two sorts of item variability can be identified, conceptual and representational variation, and these will be considered in some detail in Chapter 5 which compares the associative overlap and associative stability studies. In brief, conceptual variation taps a dimension of semantic similarity while representational variation assesses the contribution of different tokens of a particular concept to associative variability.

The present results are particularly relevant to a number of issues current in the memory area and the next section digresses for a moment to relate the present findings to the issue of encoding variability.

Encoding variability. Semantic memory should not be viewed as a static network of associations (see, for example, Kiss, 1973) since the primacy of a particular associative response will vary as a function of many factors. The discussion of sources of variation in the free association task provides a more specific description of the sorts of mechanisms emphasized in encoding variability theory (Martin, 1975). Similar views of memory have been presented as theories of encoding specificity (Tulving & Thomson, 1973) or of an instantiation process (e.g. Anderson, Pichert, Goetz, Schallert, Stevens, & Trollip, 1977). The gist of such theories is that words have a family of meanings rather than a fixed meaning and words are instantiated with different senses depending upon the context. Bregman (1977) attributes the variability in experience to the instantiation process and the consistency to ideals.

The present study identified a number of factors which affect the variability of encoding of an item: contextual, intentional, and temporal factors. According to the present view, the code for an item corresponds to a pattern of mental events which vary from time to time as a function of these sources of variability. Some of this variation appears to be spontaneous so that a word does not "mean" exactly the same thing each time that it is presented. There is some constant core which corresponds to the crucial aspect of the meaning. What is most revealing about the present studies is that variation in the reactions to words is quite extensive even over short periods of time.

Some authors have argued that the major source of encoding variability with words is their polysemous nature (Martin, 1975). Research has examined the way in which particular senses are instantiated although there is some disagreement as to the manner in which an ambiguous word is interpreted. Begg and Clark (1975) presented indirect evidence that a single interpretation of the ambiguous stimulus was made on the basis of familiarity in a situation in which no context was provided. Conrad (1974), on the other hand, argued that instantiation was a late process and that both readings of a word were accessed. This view was not supported by Swinney and Hakes (1976) who found that a prior context restricted the interpretations which were made for an ambiguous item. The actual process by which instantiation occurs remains to be described in detail but there is considerable evidence that subjects do interpret polysemous terms in different ways depending upon the context. A much broader view of encoding variability is possible, however.

A number of authors have argued that no words have a "transsituational identity" and that memory for a word involves "information about the specific encoding of that word in that context in that situation" (Tulving & Thomson, 1973, p. 359). There is some evidence that even unambiguous words are instantiated with different senses depending upon the context (Anderson et al, 1977; Till, 1977) and that memory storage involves a configuration which includes aspects of the item as encoded and the contextual information.

The present model allows for these types of encoding variability but suggests that variability of associative reactions is even more basic than that effected by the manipulation of context. Words have an inherent and dynamic variety to them such that even the presentation of the word without a context results in some unique aspects to the code or meaning aroused.

One final aspect of the encoding variability issue should be considered. Anderson, Goetz, Pichert, and Halff (1977) argued that concrete terms had a more stable encoding than abstract and, cited as evidence, the fact that subjects failed to recognize abstract stimuli in a paired associate task. The difference was small and the majority of the concreteness effect was due to the integration of the stimulus and response terms. However, Anderson et al concluded that some of the concreteness effect could be attributed to encoding variability differences between concrete and abstract stimuli. This conclusion would appear to be supported by the free association research since abstract words generate more different responses than do concrete (Cramer, 1968), a result that was also obtained in the present series of studies. Uncertainty in the free associations of groups of subjects, however, should not be used to infer individual responses. The evidence in Experiment 4 is of a very modest effect of concreteness on the stability of associations and, even this difference, was largely due to the types of responses that abstract words elicited rather than stability, per se. For a particular individual, the encoding of an abstract word is as stable as the encoding of a concrete word, or nearly so. The greater number of different responses reflects the greater contribution of individual differences to abstract hierarchies. The taxonomy presented in the earlier discussion readily identifies such alternative sources of variability in associative events.

# CHAPTER 5

## AN EXAMINATION OF THE ASSOCIATION RESULTS

The present chapter will examine the free association studies to determine which of the predictions made in Chapter 3 are best supported by the combined results of Experiments 3 and 4. These findings have turned out to be somewhat ambiguous so that an unqualified statement about the three models simply cannot be made. In addition, an attempt will be made to briefly summarize the view of meaning and semantic memory that has evolved during the course of this research. First, some sources of variation in the free association task have not received enough consideration.

Item variability. One source of item variability in free associations is conceptual variation, that is, differences in the similarity of meaning of different ideas, concepts, or types. It would be possible to assess the semantic similarity of Type X and Type Y and, on this basis anticipate the degree of similarity in free associations to tokens of these types. The discussion is at a level of discourse that does not equate an operational notion of concept or idea with the underlying structure of memory and no causal relationship is implied. In particular, it would be as meaningful (perhaps more) to infer that associative variability determined similarity of meaning as that similarity determined variability.

Conceptual variation should not have affected the similarity of free associations in either Experiment 3 or Experiment 4 since the items presented twice accessed the same conceptual representation.

An assumption made in the following analysis of the results is that this factor affected both synonym and identical repetitions to the same degree. That is, the probability of giving the same response on both occurrences of the same word should equal the probability of giving the same response when synonyms are presented (compensating for synonym responses), if conceptual variation was the sole factor that influenced the stability of responses. According to a conceptual model of memory, much of the variation in free associations should be attributable to differences in the meanings of the stimulus words so there should be little difference in the consistency of responses generated to synonym pairs and the stability of associations to the same word.

The second source of item variation is a within-type difference in the words presented as instances of a particular concept, representational variability. The present studies were primarily concerned with the extent to which subjects gave identical associations to Token X versus Token Y. Models of semantic memory that do not postulate a distinct conceptual level of representation attribute considerable variability to representational differences. This factor could not have affected the stability of associations in Experiment 4 since the same word was presented on both occasions. In contrast, the synonyms of Experiment 3 represent distinctive tokens so that representational variability should have contributed to the associative overlap and not the associative stability.

A superficial consideration of the results of Experiments 2 and 3 would have led to the rejection of the conceptual model because the apparent contribution of representational variability to associative overlap was so substantial. Indeed, this data corresponds exactly with the results that led Kolers to reject the hypothesis of a shared semantic system for bilinguals. Such a conclusion is not immediately warranted given the very potent sources of variation that affect even the presentation of the same word. Associations are very unreliable, presumably for the sorts of reasons outlined in Chapter 4. Had these associations to actual repetitions been very stable, the rejection of the conceptual model would be more justified.

The present results indicate that many of the unique responses made to synonyms should be considered as characteristic of associative responses, in general, and not due to the representation of synonyms in semantic memory. The reliability data place a ceiling on the level of associative overlap that can be expected with synonyms in the free association task. A weaker conclusion can, however, be made on the basis of the difference between the overlap levels in Experiment 3 and the stability levels in Experiment 4.

Overlap versus Stability. A number of comparisons may be made between the results of Experiments 3 and 4. It is possible to compare the probability of an actual repetition in 4 (.45) with the probability of a shared response (actual repetition) in 3 (.09) but this comparison is biased in favour of the same word condition since synonym responses cannot be repeated in the synonym association study. The deletion of synonym repetitions from Experiment 4 resulted in a proportion (.33) that was still considerably greater than the probability of a repeated response to synonyms. However, synonyms may have served to depress shared responses in Experiment 3 because of the direct priming effect.

The most appropriate procedure is to allow both synonym and shared responses to count as repetitions and to compare the probability of a synonym or a shared response to synonyms in Experiment 3 with the probability of an exact repetition to the same word in Experiment 4. On these measures, both concrete and abstract materials demonstrated greater reliability than total overlap ($t$'s (49)= 5.22 and 9.28, respectively, $p<.01$) but the difference was greater for abstract words than for concrete, $t$ (98)=2.14, $p<.05$. The difference between the concrete and abstract words would be even more marked if the effect of the different numbers of synonym responses in the reliability data was corrected for in the scoring procedure.

This pattern of results is most consistent with the verbal-imaginal model of semantic memory. Synonyms resulted in a lower likelihood of a related response than did identical presentations which was not expected from the conceptual class of models, since the model predicted equal reliability and overlap. The difference between identical and synonym repetitions was greater for the abstract words than the concrete which was not anticipated from a verbal model of semantic memory. Concrete synonyms tended to be more reliable than abstract in Experiment 4 but this was not a consequence of greater variability in abstract associations *per se*. The differences in reliability between concrete and abstract materials appear to be due, not to differences in stability, but to differences in the types of associations emitted, and it is unlikely that the concreteness effect on associative overlap to synonyms can be explained in terms of differential reliability. As in Experiment 1, it is the interaction between type of repetition and concreteness that poses such a problem for both the conceptual and verbal models. These results are more consistent with the predictions of the verbal-imaginal model than with the predictions of either the conceptual or verbal models.

There is at least one other explanation for the finding that the probability of an identical response to the same word in Experiment 4 is greater than the probability of an identical or synonym response to synonyms in Experiment 3. The alternative is that the conceptual representation was not aroused by synonyms despite its presence in semantic memory. This might have occurred if different stimuli were not semantically equivalent to one another. If ratings are accepted as a sensitive index of synonymity, this factor should not have been a potent one in this series of studies. The polysemy of language poses a second problem since many words have more than one meaning and must enter into token-to-type associations with several different concepts. These two factors would affect the probability that a common conceptual representation was consistently activated by two members of the equivalence set. No estimation of the effect of these variables on the present free association studies was made. For this reason, as well as others, the appropriate interpretation of the comparison between overlap and stability is ambiguous as the conceptual model could appeal to mechanisms based on similarity of meaning and/or polysemy to account for the combined free association results.

These qualifications notwithstanding, the most parsimonious explanation of the present results is that semantic memory consists of verbal and imaginal representations as basic elements. Subjects consistently gave more similar responses to concrete synonyms than to abstract. This could not be accounted for in terms of the different reliabilities of concrete and abstract materials, and it represents a reversal of the typical results with unrelated words. Some additional properties of semantic memory and meaning have surfaced during this research. Most of these are concerned with the general theme of semantic equivalence.

Equivalence relationships. Unlike other associations, synonym responses demonstrated substantial stability in the reliability study. This finding suggests that the sorts of equivalence relationships emphasized in the present paper play a very important role in semantic memory. Semantic similarity has received less empirical and theoretical consideration than other formal relationships such as hierarchical inclusion relations. Even when semantic distance or relatedness has been considered, it has sometimes been given a role in memory subservient to hierarchical relations (Collins & Loftus, 1975), at least with regard to the nature of representation.

The importance of semantic equivalence has been demonstrated in a number of areas and, even within categories, similarity plays an important role in the performance of certain cognitive tasks (Caramezza et al, 1976). Several authors have reported that the effects of synonyms in priming tasks are different from the effects of other associates. Kadesh, Riese, & Anisfeld (1976) found that synonyms facilitated word identification in both a simultaneous and a successive condition while other relations were effective only in the successive condition. Warren (1977) found that the time course of synonym priming differed from other associative relationships in that the synonym prime had its greatest effect at the shortest durations. In the Warren study, however, the synonym primes were not as effective as identical primes, and Hayes-Roth and Hayes-Roth (1977) reported that synonym verbs did not interfere with verification latencies whereas shared verbs did. These latter findings emphasize the need for the proposed distinction between representational and conceptual identity as well as the possibility that concreteness effects may play a role in such tasks. According to the present model, abstract synonyms should behave as any other association would while concrete synonyms demonstrate effects characteristic only of representations that share a common underlying code.

Similarity is also emphasized in the theory of word meaning that has evolved. An adequate model of semantic memory must be able to account for the ways in which an "idea-unit" is similar to and different from other such units. A token of a particular meaning initiates a mental event that is extremely complex and contains all or some of representational, associative, and referential reactions (Paivio, 1971). Some aspects of this arousal pattern will be shared by different meanings but some core elements must exist that distinguish a particular idea-unit from all others. If there are no aspects of the mental events that differentiate between them, then the instances must be identical in meaning. Any discrimination that can be made between the meanings of two instances must have some correspondence with differences at the representational level. Similarity, then, is a central concept in the representation of different meanings.

The second requirement of a mental representation is that some aspects of the activity must remain constant each time that a particular meaning reaction occurs. Some essential features of the mental event are similar given that a specific instance occurs on different occasions. This requirement is necessary if there is to be consistency to our cognitive world. Some variability in the consequences of a particular stimulus is necessary but there must be some elements that remain constant or similar across time and settings. Chapter 4 outlined some of the major factors that induce variability into the associative network.

The meaning of a word must be represented in a fashion that reflects the distinctive and the constant elements of that idea unit. These two aspects of mental representation, distinctiveness and consistency, are logically necessary properties of word meaning, are necessary features of an adequate model of meaning, and can be accounted for in terms of the single dimension of similarity. Bregman (1977) has presented similar notions but with greater emphasis on the consistency dimension than on discrimination. He argued that cognitive events could be partitioned into constant components (ideals) and variable transformations applied to these ideals. The unique encoding that results from the ideal by transformation product has been termed an instantiation by several authors. The present view would emphasize, as well as consistency, that the ideals must contain elements that differentiate the constructed representations from constructions based on other ideals.

It is just this sort of flexible, infinite world that a network model which is not fixed or static can account for best. The free association task is particularly well suited to assess the dynamic properties of this unique cognitive system. Although only words are emitted, inferences about representations at other levels are possible. The current results imply that the nodes of the network are relatively concrete words and images. A complete model will probably include other types of information as well (e.g. emotional and motoric nodes). It does not seem to be necessary at the present time to hypothesize an abstract, conceptual level of representation; the "idea" is the pattern of verbal, imaginal, and other representations elicited by a particular word.

Are words, words and images, or concepts the "stuff" of which semantic memory is made? A definite answer is, of course, not possible. Many of the results reported in this study are consistent with the hypothesis that meaning is based on relatively concrete representations of words and the objects to which these words refer. Few individuals would feel compelled by these studies to adopt a verbal-imaginal model of memory. It is hoped that future research will help to identify the weaknesses of the approach endorsed in this thesis.

## Appendix A

### Free Recall Materials: Experiment 1

| A | B | Familiarity A | Familiarity B | Imagery A | Imagery B | Similarity |
|---|---|---|---|---|---|---|
| Plank | Board | 5.23 | 6.06 | 6.30 | 6.07 | 5.29 |
| Money | Cash | 6.89 | 6.32 | 6.43 | 6.17 | 5.21 |
| Saloon | Tavern | 4.21 | - | 6.43 | - | 5.46 |
| Cellar | Basement | 4.98 | 5.81 | 6.27 | 6.03 | 5.68 |
| Cranium | Skull | 3.53 | 5.31 | 4.53 | 6.47 | 5.22 |
| Stream | Brook | - | - | - | - | 5.79 |
| Tempest | Storm | 4.08 | 5.83 | 5.63 | 6.43 | 5.79 |
| Magistrate | Judge | - | 5.60 | - | 6.27 | 5.82 |
| Snapshot | Photograph | - | 5.85 | - | 6.43 | 5.86 |
| Captive | Prisoner | 4.55 | 5.29 | 5.27 | 6.23 | 5.75 |
| Bed | Cot | 6.84 | 4.31 | 6.63 | - | 5.04 |
| Jewel | Gem | - | 4.88 | - | 6.40 | 5.93 |
| Damsel | Maiden | 3.13 | - | 6.03 | - | 5.93 |
| Avenue | Street | 6.11 | 6.70 | 6.07 | 6.57 | 5.79 |
| Pistol | Revolver | - | 5.26 | - | 6.70 | 6.04 |
| | | | | | | |
| Pledge | Oath | 4.35 | - | 3.63 | - | 5.79 |
| Story | Tale | 6.55 | 5.33 | 4.66 | 3.50 | 5.43 |
| Solace | Comfort | - | 6.20 | - | 3.34 | 5.11 |
| Mistake | Error | 6.24 | - | 3.50 | - | 6.32 |
| Semester | Term | 5.44 | - | 3.53 | - | 6.46 |
| Search | Quest | 5.98 | 4.53 | 3.47 | 4.53 | 5.86 |
| Barter | Trade | - | 5.77 | - | 3.63 | 5.33 |
| Magnitude | Size | 4.71 | - | 2.50 | - | 5.32 |
| Consent | Permission | - | 5.73 | - | 2.87 | 5.32 |
| Freedom | Liberty | 6.31 | - | 3.83 | - | 5.89 |
| Act | Deed | - | 5.15 | - | 3.63 | 5.29 |
| Ego | Self | 5.37 | - | 2.90 | - | 5.54 |
| Peril | Danger | - | - | - | - | 5.68 |
| Origin | Source | 5.67 | - | 2.30 | - | 6.14 |
| Treason | Betrayal | 4.36 | 4.38 | 3.28 | 3.57 | 5.04 |

## Appendix B

## Free Association Stimulus Materials

### Concrete Pairs

| | | |
|---|---|---|
| Avenue.......Street | Baby.........Infant | Bible........Scriptures |
| Blossom......Flower | Bosom........Breast | Branch.......Limb |
| Bucket.......Pail | Bunny........Rabbit | Car..........Automobile |
| Cash.........Money | Cellar.......Basement | Child........Youngster |
| Church.......Chapel | Claw.........Talon | Clock........Timepiece |
| Corridor.....Hall | Dawn.........Daybreak | Dog..........Canine |
| Firearm......Gun | Fisherman....Angler | Forehead.....Brow |
| Grime........Dirt | Harbour......Port | Hearth.......Fireplace |
| Inn..........Hotel | Insect.......Bug | Jail.........Prison |
| Jewel........Gem | Marsh........Swamp | Mallet.......Hammer |
| Magistrate...Judge | Mortuary.....Morgue | Nightfall....Dusk |
| Nook.........Corner | Palace.......Castle | Photograph...Snapshot |
| Physician....Doctor | Plank........Board | Policeman....Patrolman |
| Revolver.....Pistol | Saloon.......Tavern | Scissors.....Shears |
| Serpent......Snake | Shotgun......Rifle | Steed........Horse |
| Tomahawk.....Hatchet | Tweezers.....Pincers | Umbrella.....Parasol |
| Vocalist.....Singer | Waistcoat....Vest | |

### Abstract Pairs

| | | |
|---|---|---|
| Act..........Deed | Amount.......Quantity | Assumption...Premise |
| Attribute....Characteristic | | Avarice......Greed |
| Barter.......Trade | Contribution.Donation | Conviction...Belief |
| Decree.......Edict | Difficulty...Trouble | Disgrace.....Shame |
| Duty.........Obligation | Evidence.....Proof | Expense......Cost |
| Extremist....Radical | Fate.........Destiny | Feeling......Sensation |
| Freedom......Liberty | Illusion.....Hallucination | Inside.....Interior |
| Issue........Edition | Memory.......Recollection | Mistake......Error |
| Option.......Alternative | Origin.......Source | Outcome......Result |
| Ownership....Possession | Pledge.......Promise | Predicament..Dilemma |
| Quiet........Silence | Reply........Answer | Repose.......Rest |
| Search.......Quest | Size.........Magnitude | Solace.......Comfort |
| Statute......Law | Story........Tale | Style........Fashion |
| Subject......Topic | Surplus......Excess | Temperament..Mood |
| Term.........Semester | Thought......Idea | Treason......Betrayal |
| Trickery.....Deceit | Truth........Veracity | Upkeep.......Maintenance |
| Vanity.......Conceit | Velocity.....Speed | Vocation.....Occupation |

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