To the Graduate Council:

I am submitting herewith a dissertation written by Robert G. Malgady entitled "A Feature-Synthesis Model of Metaphor Processing." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Psychology.

Michael G. Johnson, Major Professor

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A FEATURE-SYNTHESIS MODEL OF METAPHOR PROCESSING

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ABSTRACT

Several linguistic and psychological theories of figurative language are reviewed. A model is presented which accounts for the comprehension of metaphorical sentences in terms of a fundamental cognitive process. The basic assumptions of the model are that semantic features represent continuous dimensions of word meaning and that language comprehension is based on the construction of meaning in a linguistic setting. Results of three experiments confirmed a number of predictions stemming from the model. It was shown that the distinction between literal, figurative, and anomalous sentences is best viewed in quantitative, not qualitative, terms. Metaphor was characterized by the "similarity of dissimilars." Predicted effects of meaning uncertainty (ambiguity) and sentence context were supported on several dimensions of metaphor processing—commonality of subjects' interpretations of metaphors, judgments of constituent noun similarity and metaphor interpretability, and ease of recalling a metaphor. Implications of the model for semantic theory and psychological research on language behavior are discussed.

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CHAPTER I

INTRODUCTION

Linguistic Theories of Metaphor

Recent linguistic approaches to the problem of metaphor have been influenced by two philosophical traditions—the Classical view (Aristotleian) and the Romantic view (Platonic). To begin with Aristotle's classical definition in the Poetics: Metaphor is the transfer of the meaning of one object to some other object. Moreover, good metaphor is sustained by the perception of the "similarity of dissimilars." According to Hawkes (1972) the classical view maintains that figures of speech are stylistic ornaments whose primary function is to embellish the commonplace; consequently, metaphor represents a form of speech which is qualitatively different from literal language.

This classical definition has been analyzed by Wheelwright (1960) into three propositions: (a) that a word which is used metaphorically has some usual and familiar meaning, (b) that in a given instance the word is made to stand for some other meaning which is less usual or less familiar, and (c) that the justifying bond between the usual meaning of the word and the metaphorical meaning is some kind of similarity. The process underlying figurative speech is essentially one of substitution; word A does not really mean A, but implies or emphasizes aspects of word B instead. So in the metaphor HERE LIES MY SHIP, for example, LYING substitutes for LYING AT ANCHOR.

In contrast, the Romantic view derives from the dialogues of Plato (Hawkes, 1972). In the Phaedrus, Plato argued that no discourse can be subdivided into its constituent parts, any more than these parts together can simply constitute the whole metaphor. Rather than concentrating on individual words, the unit of analysis in the Romantic tradition is the sentence as a whole. Further, this view does not distinguish metaphor as simply a rhetorical device from literal language, but suggests, instead, that figurative language is an essential aspect of ordinary (literal) language.

Within the Romantic tradition, Richards (1936) identified two structural components of metaphor—tenor and vehicle. The tenor element is the subject or central theme of the metaphor, while the vehicle is the context which embodies (or carries) the tenor. Accordingly, the metaphorical process goes as follows:

> In the simplest formulation, when we use a metaphor we have two thoughts of different things active together . . . whose meaning is a resultant of their interaction [p. 43].

The nature of this interaction is such that:

> . . . the co-presence of the vehicle and tenor results in a meaning (to be clearly distinguished from the tenor) which is not attainable without their interaction [p. 100].

Here, it is important to note that this explanation of metaphor understanding includes the idea of transfer of meaning. Metaphorical transfer, however, is not from vehicle to tenor, or vice versa, but from vehicle and tenor to a separate semantic entity. That is, tenor and vehicle each undergo a mutual change of meaning which results in the synthesis or creation of a new meaning; the similarity of

dissimilars is, therefore, created by the metaphorical juxtaposition, not simply dragged up from a dictionary.

Bridging the gap between philosophies, Wheelwright (1960) has suggested the term "epiphor" to describe the Aristotleian notion that metaphor involves comparison and substitution and "diaphor" to describe the Platonic notion that metaphor involves interaction and the synthesis of novel meaning. Where Wheelwright has distinguished between epiphor and diaphor, Beardsley (1962) has contrasted the object-comparison and verbal-opposition theories of metaphor, respectively. For Beardsley, the object-comparison theory is unacceptable because insofar as metaphorical context stresses properties of a word which are not commonly associated with the object to which the word refers, the object-comparison theory will fail to explicate the metaphor. On the other hand, the verbal-opposition theory proposed by Beardsley holds that the intension of a word (the set of semantic features or attributes associated with the word) may be partitioned into two subsets—those features which are central, literal, and defining, and those features which are marginal, figurative, and connotative. In figurative language there occurs an interplay between words so that central features are blocked or opposed and meaning "twists" toward the periphery. A complex network of oppositions between the features of each word in the metaphor is set up, creating a semantic shift from literal to figurative meaning. Consequently, words

within the sentence (tenor and vehicle) lose their individual integrity to the metaphor as a whole.

In recent semantic theory, the problem of metaphor surfaced in Bolinger's (1965) reply to Katz and Fodor's (1963) attempt to describe the semantic structure of language. Bolinger's first criticism was the "modest" requirement that an adequate semantic theory should relate the several senses of a word in terms of their probable derivation from one another. For example, Bolinger listed the following senses of the word SOUP: Food for human beings, bacterial culture, nitroglycerine, photographic developer, pyroxylin solution, wet cement, thick clouds, power, and predicament. According to Bolinger, the first definition (food for humans) might be taken as literal and the metaphorical basis of each of the remaining senses can be readily demonstrated. Thus, clouds are compared to the thickness of soup; chemicals to its consistency and manner of concoction; bacterial culture to its consistency and edibility; a predicament to the proverbial cartoon of a missionary in a cannibal's cookpot; and power to nitroglycerine, which is in turn compared to food.

One sense of soup which is extremely metaphorical is the reading THICK CLOUDS. For clouds are actually diffuse, not dense as the literal reading of SOUP implies. Given the atomistic nature of semantic features such as DIFFUSE or DENSE, the potential for metaphorical expression is problematic to the lexicographer who attempts to delineate fixed semantic structures. This is especially true in the present example since literal and figurative senses are contradictory (SOUP is literally dense; CLOUDS is literally diffuse, but metaphorically dense).

Secondly, Bolinger states that:

> A dictionary is a frozen pantomine. Our problem is only beginning when we consider the pale flowers of that "nosegay of faded metaphors" that it presses between its pages. A semantic theory must account for the PROCESS of metaphorical invention—all the more so, a theory that stems from generative grammar with its emphasis on creativity. . . . It is characteristic of natural language that no word is ever limited to its enumerable senses, but carries with it the qualification of "something like" [p. 567].

Bolinger's argument addresses metaphorical meanings which have entered into common parlance (or become fixed, as in the derived senses of SOUP), as well as those which are novel and spontaneous in everyday discourse. These concerns are also shared by others; for example, Bickerton (1969; permanent/temporary assignments), Pollio, Barlow, Fine, and Pollio (in press; frozen/novel metaphor), and Wheelwright (1960; block/tensive symbols). To be sure, semantic theory must eventually accommodate both of these points; however, the ontogeny of metaphor (the transition from novel to frozen status) is an interest secondary to understanding the fundamentals of the metaphorical process in everyday discourse.

Weinreich's (1966) outlook on this issue is kindred to Bolinger's as is evidenced by his observation that:

> . . . a semantic theory is of marginal interest if it is incapable of dealing with poetic uses of language, and more generally, with interpretable deviance . . . if KF [Katz & Fodor, 1963] were to be extended to deal more hospitably with anomalies than to merely identify and discard them, a gigantically inflated dictionary would be required, with a relatively small "normal" part and with an indefinitely large "anomalous" part. But this would fail to represent the fact that anomalies arise on the spot in the course of speech [pp. 471-472].

In his version of a semantic theory, Weinreich included a mechanism which permits the assignment of meaning to metaphorical sentences. This endeavor begins by viewing the semantic representation of a word as a set of fundamental features or formatives, each of which is accompanied by a sign factor (+ or -). Weinreich bases his explanation of metaphor on contradiction, which is defined as the co-occurrence within a word of features which dichotomize a dimension of semantic contrast. In the sentence HE TRUES THE THEOREM, the word TRUTH, ordinarily a noun (hence +Noun), is used as a verb (hence +Verb). Since TRUTH is not ordinarily used as a verb it is presumably marked -Verb, and the formatives +Verb and -Verb are simultaneously incompatible and contradictory.

Contradiction may also occur when certain features of one word are marked for privileges of transfer to other words. In the sentence A RED HOUSE OCCURRED TWICE, semantic deviance is noticed in the relationship between HOUSE and OCCURRED; nevertheless, the sentence is interpretable. The word HOUSE is marked with the feature -Time and OCCURRED is marked with the transfer feature +Time. By means of the Transfer Rule, the formative +Time is conveyed from OCCURRED to HOUSE rendering the sentence contradictory or metaphorical since HOUSE contains +Time and -Time.

In the above examples, -Verb and -Time represent features inherent to TRUTH and HOUSE, respectively. The formatives +Verb and +Time are induced into the meaning of these words by sentence context. Here, Weinreich follows Chomsky's (1965) distinction between inherent and contextual features, where transfer features are a subset of the

contextual genre (contextual features loosely correspond to what Chomsky termed selection features). The operation of a Redistribution Rule reorganizes the set of features associated with a word such that contextual features dominate inherent features. Ultimately, a Construal Rule operates to construe a new semantic entity with a more elaborate structure, in which the dominant contextual feature is decisive (more important in determining meaning), but the less salient contradictory feature can be tolerated. The sentence HE TRUES THE THEOREM, for example, is interpreted by construing a new transitive verb, resulting in the reading HE CAUSES THE THEOREM TO BE TRUE.

The Construal Rule is further able to accommodate metaphor of a multifarious nature—separate linguistic rules are formulated for each pair of contradictory features. The degree of semantic deviance is then quantified by a Semantic Evaluator; sentences are normal if the mechanism registers no deviance, or metaphorical, provided that the degree of deviance does not exceed the threshold for nonsense. Weinreich does suggest, however, that although the separation of literal, figurative, and anomalous sentences is based on a competence notion, the application of the Construal Rule is bound by aspects of linguistic performance.

One problem with Weinreich's account accompanies the assumption that semantic features are both discrete and uniformly salient within a dimension. If the dimension of semantic contrast is continuous, words may possess different degrees of a particular attribute. In the metaphor THAT ROBIN IS A BLUEJAY, one might suppose that +Aggressive is

the important feature which is transferred to ROBIN. However, it is difficult to argue that ROBIN is inherently marked -Aggressive—robins are simply less aggressive than bluejays, and the purpose of the metaphor is to communicate that one particular robin is more aggressive than usual. Further, the most outstanding contradiction in this example is the fact that robins are red and bluejays are blue. Although this contradiction facilitates the recognition of the sentence as a metaphor, it does not play an essential part in the construal of a metaphorical meaning. Indeed, Bolinger (1965) cited contradiction as an extreme case of metaphor.

These problems notwithstanding, the Construal Rule represents a noteworthy attempt to provide a formal account of metaphor understanding in linguistic terms. The notion that a new semantic entity is construed from the metaphorical constituents is reminiscent of the Romantic position. Weinreich also concurs with the Romantics on the assumption that metaphor is a quantitative extension (in terms of semantic deviance) of normal discourse. But this assumption implies that separate rules systems cannot be proposed to explain the comprehension of literal and figurative language.

A linguistic theory which is similar to Weinreich's in many respects, albeit more informal, is that proposed by Thomas (1969). In his approach, Thomas makes the assumption that metaphor is a special case of definition, involving logical contradiction. The linguistic structure SUBJECT + TO BE + BE - PREDICATE forms the kernel sentence in the definitional process, and in metaphor "we affirm that A is B

when, in fact, it is not." Relying on a feature representation for word meaning, Thomas makes the added assumption that the semantic features affixed to a word are scalable (orderable) in terms of salience or importance. Thomas' explanation of the interpretation of literal discourse is based on a process very much like verbal-opposition. Sentence context constrains the variety of meanings (or definitions) the subject of the sentence may assume, and usually low level features are blocked (made less salient) if contradictions occur. In literal discourse, the range of attendant features is narrowed by sentence context.

In the case of metaphor, the features of the words which follow the verb TO BE are transferred to the subject of the sentence, and high level features typically need blocking. For example, CHILD and GRANDFATHER display considerable incompatibility in the sentence HIS GRANDFATHER IS A CHILD WHEN IT COMES TO MONEY. The intention here is to transfer the feature +Immature from CHILD to GRANDFATHER, which is marked +Mature. Thomas suggests that linguistic blocking is an inadequate explanation of metaphor resolution since high level features cannot be decreased in salience by sentence context. Rather, these are tolerated so that certain low level features may be attributed to the subject in a specific context. This proposal is related to Weinreich's Construal Rule in a fundamental sense. In both formulations, the features of one word are transferred to another word, contradiction results, and ultimate comprehension depends on the tolerance or de-emphasis of certain highly salient (or inherent) feature oppositions. Thomas also distinguished formal and contextual features as Weinreich

and Chomsky opposed inherent and contextual features. The potential for metaphor derives, in the first case, from the fact that some features cannot co-occur; for example, CHILD cannot be marked +Boy and +Girl. Similarly, the sentence THE PICTURE ADMIRED THE BOY is unacceptable and potentially metaphorical since the verb ADMIRE requires a context in which the subject noun is marked +Animate.

Thomas' linguistic theory extends the notion of feature construal by addressing the problems noted earlier. One point of dispute, however, regards the claim that blocking is an inadequate explanation of metaphor interpretation. Implicit in Thomas' analysis is the notion that word meaning is probabilistic; that is, semantic features are associated with a word with some prior probability (high level versus low level) and sentence context merely rearranges semantic structures by changing these probabilities (blocking). In the absence of any evidence to the contrary, there is no reason to assume that sentence context can only influence low level (improbable) meanings. Again, there is no reason to postulate two separate theories for explaining the interpretation of literal and figurative discourse.

In his prolegomena to a linguistic theory of metaphor, Bickerton (1969) argued that nonlinguistic approaches, including most Classically-oriented theories, have shared three false assumptions about language: (a) that words have fixed and definite meanings, (b) that the meaning of a sentence is the sum of the meanings of the words that compose it, and (c) that the interpretation of texts is mode-of-discourse free. Alternatively, Bickerton professes a concern for semantic flexibility,

the emergent properties of word complexes, and the context-sensitive nature of semantic interpretation, respectively.

Bickerton demonstrated that by reducing metaphors to their kernel form, one can examine the type of deviance present in terms of the Katz and Fodor (1963) and Katz and Postal (1964) formulations. It should be possible, according to Bickerton, to classify metaphorical deviance as the violation of selection rules (for example, major category violations as in HEARTS THAT SPANIEL'D ME AT HEELS, or subcategory violations as in MISERY LOVES COMPANY), or semantic projection rules (for example, THE FLINTY AND STEEL COUCH OF WAR). But for Bickerton, although all metaphors are rule violations, not all rule violations constitute metaphor. A problem with the Katz-Fodor-Postal formulation, then, is that there is no level at which metaphor and nonsense cannot coexist, and there is no means within their semantic theory of separating the two.

Bickerton proposed that metaphor and nonsense may be disentangled by considering the series of nonorderable binary oppositions set up between the attributes of words. In Figure 1, Male/Female and Married/Single exemplify such oppositions, and the words within the cells illustrate the intersection of these categories. This system is a straight-forward illustration of the course of literal language—in the two dimensional example, the meaning of each word is given by the mutual subdivision of opposed categories. In the lexicon, literal meaning is based on an n-dimensional matrix of binary oppositions.

	Married:	Single:
Male:	(HUSBAND)	(BACHELOR)
Female:	(WIFE)	(SPINSTER)

Figure 1. Intersection of oppositional categories (adapted from Bickerton, 1969).

Given the "heraclitean flux" of everyday language—the three aforementioned properties of language—this system is too rigid to accommodate metaphor. For it is all too apparent that some words are privileged to cross the categories of a dimension. To explain figurative language, Bickerton proposed a second system wherein "marked signs" may cross semantic categories by combining with, or standing for, other signs which share the same attributes. For example, IRON is marked with the feature Hardness relative to its (unmarked) cogeners such as STEEL and DIAMOND. This is true despite the fact that DIAMOND possesses more of the attribute Hardness than does IRON. Thus, IRON WILL may stand for STRONG WILL since both IRON and STRONG share Hardness as a feature, and IRON is specifically marked for metaphorical usage in this context. In contrast, STEEL WILL is unacceptable to Bickerton since STEEL is an unmarked member of the class of metals.

In Figure 1, BACHELOR is marked specifically for Single. By virtue of the second system of language, the marked sign BACHELOR is able to cross the Male/Female boundary and combine with a member of the Female

category. Since the other words in the figure are unmarked, the only acceptable metaphor is something like BACHELOR GIRL.

Integrating these two systems, Bickerton holds that it is possible to construct the following scale of usage: (a) literal expressions (for example, IRON BAR), (b) permanent assignments (for example, IRON WILL), (c) temporary assignments (for example, STEEL COUCH), and (d) meaningless expressions (for example, STEEL MINE), where (c) and (d) are context independent. That is, anomaly is not potential metaphor awaiting validation by appropriate context. Literal expressions derive from the first language system, permanent and temporary assignments from the second system, and meaningless expressions from violations of the second system.

One criticism of Bickerton's account is that he has failed to recognize that metaphor is a phenomenon of language use (Matthews, 1971). Since metaphorical sentences are assumed to be interpretable in ordinary discourse, no distinction between metaphor and nonsense arises in language use. Matthews suggests that the distinction between metaphor and simple deviance is made by the intention of the speaker to be metaphorical, or the perception of metaphorical intent by the hearer. Therefore, Bickerton has confused the performance notion of metaphor with the competence notion of simple deviance by equating the difference between potential metaphor and nonsense with the difference between metaphor and nonmetaphor.

In regard to the notion of marked signs, Matthews notes that it is impossible to separate metaphor from nonsense without first ascertaining

the presence or absence of a marking. The circularity and ad hoc-ness of this principle is apparent as one identifies a marked sign as a word which is permitted metaphorical extension in certain contexts. Further, the category of temporary assignments is difficult to explain in these terms since, by definition, these figures have not previously occurred and could not evolve marking.

Bickerton seems to violate one of his own objections to nonlinguistic theories of metaphor—that semantic interpretation is context-sensitive. Given this property of language, almost any meaningless expression can be rendered metaphorical if an appropriate context is found. For example, Bickerton indicates that the expression GREEN EARS is meaningless. Matthews has countered this example with the sentence THE SAILOR'S PROFANITY CURLED THE SEMINARIAN'S GREEN EARS, which is easily interpretable in a figurative sense. It follows that in proper perspective, nonsense is potential metaphor awaiting contextual validation.

Finally, despite the fact that he explicitly denies any such connection at the outset, Bickerton's theory is most closely associated with the Classical tradition. The idea that marked signs stand for other signs which share the same features implicates a substitution process in metaphor interpretation. In Matthews' words, the strict Aristotelian view fails to realize that it is sentences, and not individual words, which are focal in understanding figurative language. In short, Bickerton and others within this tradition have largely ignored the wholistic properties of sentences—words within a sentence

interact and a single meaning is created by the metaphor. The most obvious link between Bickerton's theory and Classical theory is in his proposal that two language systems are needed to explain all forms of speech.

Matthews' solution is to treat metaphor in terms of the competence distinction between deviant and nondeviant sentences. The violation of a selection restriction is thus a necessary and sufficient condition for deviance. All nonsense is eliminated by our usual assumptions about everyday discourse (an utterance is intended to be meaningful), and the remaining deviance must be metaphor. In accordance with the Romantic view, Matthews proposes an equation between metaphorical and literal comprehension. But even more recently, Price (1974) has added fuel to the competence-performance fire. Price countered that recourse to intention as the divisive element between metaphor and nonsense is equally suspect in a theory which appeals to the native speaker's linguistic competence. According to Price, Matthews confused metaphor with what Chomsky (1965) called the kind of creativity that leaves the language unchanged, as in the comprehension of novel sentences. Alternatively, Price conceives of metaphor as an instance of creativity which changes the rule system. He concludes that if metaphor is to be explained in linguistic terms, it will require nothing less than a separate linguistics of rule changing creativity.

Where linguists are hard pressed to account for the performance phenomenon on a competence level, the task set for psycholinguistic analysis is somewhat different. The psycholinguist's attention is

primarily directed at the cognitive processes of the speaker and hearer involved in the comprehension of figurative language, and to a lesser extent with the formal properties of language itself.

Psychological Theories of Metaphor and Experimental Evidence

A primary concern among linguists has been to generate an adequate semantic theory, one aspect of which is a formal account of a speaker's ability to detect semantic anomalies. As Katz and Fodor (1963) suggest, ". . . a semantic theory will need to mark the distinction between semantically anomalous and semantically regular sentences" [p. 485]. From a psycholinguistic perspective, Pollio and Burns (1974) have noted that if one attends to the examples of anomalous sentences which appear in the linguistic and psycholinguistic literature, it is possible to question the idea of anomaly itself. In two experiments, they showed that anomalous (randomly generated) sentences were interpretable and that the interpretations of such sentences were often metaphorical. A particularly interesting finding from a sentence learning (paired associate) task was that natural sentences were no easier to learn than anomalous sentences when subjects interpreted the latter type prior to learning.

From the standpoint of mediational psychology, Osborn and Ehninger (1962) explain the cognitive effects of metaphor perception as a series of three events: (a) Error, the hearer's initial failing to obtain a literal reading; (b) Puzzlement-Recoil, the subsequent cognitive

difficulty and rejection of literalness; and (c) Resolution, the perception of similarity between the tenor and vehicle. These investigators suggest that the tenor and vehicle are initially disparate, until the Resolution stage when they are associated.

The implications of Osborn and Ehninger's theory have been investigated in a communication setting by Bowers and Osborn (1966) and Reinsch (1971). In both studies it was reasoned that the cognitive effects of persuasive metaphor should enhance perceived source (speaker) credibility and attitude change. Bowers and Osborn reported a significant effect of persuasive metaphor on attitude change, but not on perceived source credibility. Reinsch replicated this study with metaphors and similes, finding that metaphor induced greater attitude change than simile and simile was more persuasive than literal speech. Again, no effect on perceived source credibility was evident.

A different associative theory, which more explicitly reflects a Classical orientation, is Koen's (1965) proposal that metaphor consists of two terms, one used figuratively and one implied in a literal sense. The comprehension of metaphorical sentences involves the recognition of an associative relationship between the figurative usage and the implicit literal concept. Therefore, when metaphor supplants the literal, associations to the former give rise to meaning change in the latter.

In order to test this version of the Classical theory, Koen used the following procedure. First, a group of metaphors were selected from a variety of literary sources and presented to subjects who paraphrased

the metaphors. Subjects replaced figurative words with literal words which preserved the meaning of a metaphor as closely as possible, and word associations to both terms were then obtained. Using a sentence completion task, Koen found that the choice of a figurative or literal target word could be primed as a function of the associative relation between a set of cue words (associations) and the target word. Cue words associated with a metaphorical target prompted figurative completion; cue words associated with a literal target prompted literal completion; and when cue words were associations to both literal and figurative target words, each response was equally likely. These results, however, are probable even without the use of metaphorical sentences. For example, the same pattern of results would be expected if one collected word associations to the different sets of cue words presented alone. Koen's procedure is indeed similar to the paradigm used in attempts to provide evidence for convergent association (cf. Cofer, 1968). These data provide insight into the process of word association, but in the absence of adequate controls nothing specific about metaphor processing is revealed.

In more recent studies of word association and metaphor interpretation, Johnson and Malgady (in press; Malgady and Johnson, in press) investigated the implications of a cognitive feature model for the process underlying meaning change. This model makes the assumption that the unit with which all cognitive activity takes place is not the word, but something more fundamental. It was suggested (Johnson, 1970) that concepts and words have internal representation in terms of

elementary cognitive characteristics (ECCs). Meaning is encoded as the vector or distribution of ECCs associated with a particular concept. Further, ECCs are not redundant—they are nonhierarchical—and ECC patterns are not static either within an individual or over a group of individuals. The act of juxtaposing two words, whether in metaphor or compound word association, results in the summation of constituent ECCs to form a single representation of meaning. Johnson's theory resembles the verbal-opposition hypothesis in that the effective meaning of a metaphor depends on an interaction between the meanings of the constituent words. When two words share ECCs these are raised in salience, prefiguring unique ECCs, and thus become most important in determining metaphorical meaning. In this manner, shared low level features may become the most salient aspects of a metaphor's meaning, while high level features which are unique to the individual words are blocked.

The implications of the cognitive-feature model for metaphor comprehension were first investigated by Johnson and Malgady (in press) in the following manner. A group of metaphors of the sort $NOUN_S$ IS $NOUN_P$ were selected from a variety of published sources of prose and poetry. Ratings of metaphor goodness and constituent noun (S-P) similarity were collected, along with metaphor interpretations and associations restricted to common properties of the constituent nouns. Johnson and Malgady found that all these variables were highly intercorrelated. That is, metaphors which were easy to interpret tended to (a) consist of highly similar constituent nouns, (b) be judged as good figures of speech, and (c) display a high degree of associative

(property) commonality. Another significant result was that the associative properties of each constituent alone were relatively unimportant in determining the meaning of a metaphor. Rather, the properties of the constituent nouns taken together as a whole provided support for Johnson's (1970) model. Metaphor and word association were discussed as "symptoms" of a fundamental cognitive process. By conjoining two words in metaphor or on a word association task, the hearer creates a single representation of meaning with this act of interpretation essentially, a constructive process.

In a second study, Malgady and Johnson (in press) investigated the effects of adding adjective modifiers to the nouns linked in a metaphor (for example, THE ADJECTIVE-$NOUN_S$ IS ADJECTIVE-$NOUN_p$). They found that adjectives which increased constituent noun similarity, relative to unmodified metaphors, produced better and more interpretable figures of speech. Adjectives which were associatively related to both constituent nouns facilitated metaphor comphrehension in comparison to adjectives which were related to only one constituent noun, and adjectives which were unrelated to either constituent noun most impaired comprehension. These findings suggest that the addition of an adjective modifier to a noun serves to cue, or make more salient, a subset of the potential features which might be appropriate to the unmodified noun. Also, certain contexts may facilitate the assimilation of words, and the extent to which they are assimilated provides a basis for predicting metaphor goodness and interpretability.

For the most part, descriptions of metaphor comprehension in linguistics and psycholinguistics have relied on the simple coupla construction ($NOUN_S$ IS $NOUN_p$) as a paradigm case. This paradigm is also prominent in studies dealing with lexical decision processes and semantic memory. A typical semantic memory experiment employs propositions of the sort: (An S is a P, where the subject decides whether item S (for example, ROBIN) is an exemplar of category P (for example, BIRD). In semantic memory, the primary concern is with an individual's linguistic knowledge and the role this knowledge plays in comprehending semantic relations—what kinds of semantic information is stored in memory, how this information is organized, and how it is retrieved. The rationale for categorization experiments is that an individual's linguistic knowledge reveals something about the processes underlying language comprehension and provides information about the structure of semantic memory (Smith, Shoben, & Rips, 1974). Although metaphor has not yet come to the fore in semantic memory research, some investigators have acknowledged the problem and described its relevance to the mainstream of current psychological theories of language comprehension (Collins & Quillian, 1972; Kintsch, 1972; Smith, Rips, & Shoben, 1974).

Current theories of semantic memory fall into two classes—network models and set-theoretic models. Network models assume that the names of semantic categories are stored as nodes in a complex hierarchy of semantic relations (Collins & Quillian, 1969, 1970; Rummelhart, Lindsay, & Norman, 1972). For example, if one category is a subset of another category, then these two nodes are connected by a subset relation.

Collins and Quillian (1969) found that the time needed to verify a proposition (An S is a P) is a function of the semantic distance between categories S and P. Since A ROBIN IS AN ANIMAL expresses a more distant relation than A ROBIN IS A BIRD, the latency to decide that the former proposition is true is longer. This network model assumes that in order to decide whether a proposition is true or false, one must retrieve the stored relation between S and P and then compare this information to that given in the proposition.

In contrast, set-theoretic models of semantic memory emphasize the role of semantic features in comprehending propositional information. In Meyer's (1970) theory, verification of a proposition is based on a feature comparison process which determines whether the features of S are a subset of the features of P. Meyer explained differences in processing times in terms of category (P) size; that is, A ROBIN IS AN ANIMAL requires more time to process than A ROBIN IS A BIRD because more feature comparisons are involved in the former case (ANIMAL is a larger set than BIRD).

A major criticism which can be leveled at the bulk of the semantic memory literature (this brief review is meant to be illustrative, not exhaustive) is the uniform failure to allow for semantic flexibility. A number of recent papers have emphasized the need to consider the dynamic nature of meaning and flexibility inherent in inter-word relationships (for example, Barclay, Bransford, McCarrell, Franks, & Nitsch, 1974; Johnson, 1972). This is to negate the effect of context on semantic interpretation, and more important the potential for

metaphorical comprehension (Bolinger, 1965; Pollio & Burns, 1974). Most examples of metaphorical propositions would not be verified in a semantic memory experiment, but the ubiquity of such statements in everyday discourse (Pollio et al., in press) implies that individuals may attend to the degree of correctness of a proposed semantic relationship. One study which addresses these criticisms is the final one reviewed in this chapter.

Smith, Shoben, and Rips (1974) recently proposed a model for lexical decisions which is most closely associated with set-theoretic models. They begin with the assumption that semantic features are continuous with respect to "definingness." That is, some features are more defining or essential to word meaning than others which are more accidental or characteristic (cf., Beardsley, 1962; Johnson, 1970; Thomas, 1969). According to their description, a word is represented by a set of features or semantic dimensions, each of which is weighed by its definingness (salience). Thus, a highly salient dimension will be more important in determining word meaning than a characteristic dimension. For each word, there is a distribution of possible values on each dimension. These assumptions admit that word meaning is flexible, and reiterate the problem inherent in previous models of semantic memory. Strict network and strict set-theoretic models encounter difficulty because of their failure to include structural assumptions that would make word membership within a category or feature membership within a word probabilistic.

The feature-comparison model proposed by Smith, Shoben, and Rips depicts a two stage process as follows. The first comparison stage includes three operations: (a) feature lists for S and P are retrieved from memory; (b) these two lists are compared over all features, yielding an overall measure of S-P similarity; and (c) this value is compared to two criterion values of similarity, one high and one low. If S-P similarity exceeds the uppermost criterion, a positive response is made (the proposition is verified). A negative response is made if overall similarity is less than the lower bound criterion. When similarity is between these extremes, a second stage of processing is activated. During this second stage, feature lists are partitioned on the basis of dimensional weights into defining and characteristic feature subsets and the two subsets of defining features are compared. A match results in a positive response, while a mismatch results in a negative response.

Preliminary support for the feature-comparison model was drawn from a study in which typicality (similarity) ratings were obtained for several instances of each of two categories (Rips, Shoben, & Smith, 1973). Since defining features are shared by all instances of a category, typicality ratings reflect the extent to which an exemplar and a category share characteristic features. Multidimensional scaling of the two sets of ratings yielded a Euclidean solution in 2-dimensional semantic space. Evidence that subjects attend to overall similarity, as opposed to one similarity value per dimension, comes from the finding that the Euclidean metric was better fit to the data than a city-block metric. This suggests that individuals process the wholistic properties

of linguistic input, that semantic dimensions are seen as forming a complex unitary whole.

Smith, Shoben, and Rips (1974) also found that positive latencies to verify propositions decreased as a function of typicality; as typicality decreases so does similarity and the probability that overall similarity will exceed the higher criterion. Negative latencies also decreased with typicality; the more dissimilar an S-P pair the easier it is to decide that the proposition is false, since the probability that overall similarity is less than the lower criterion is increased. The usual finding that increased category size increases decision time was explained by the increased likelihood of second stage processing. However, these investigators demonstrated that when increased category size results in higher overall similarity, decision latencies decrease.

In sum, the feature-comparison model accounts for the substance of network and set-theoretic models, previous findings in semantic memory, and addresses several important theoretical issues regarding the representation of meaning in memory. Although they have not dealt specifically with the problem of metaphorical propositions, Smith, Rips, and Shoben (1974) have noted the similarity of their model to Beardsley's (1962) description of verbal-opposition. In the next chapter, a model of metaphor processing is presented which shares a theoretical structure with this model of language comprehension.

Consolidating the rather scant psychological data on metaphor interpretation with linguistic and psychological theory, several preliminary conclusions can be drawn. Research along classical lines has shown

that similarity plays an important role in understanding figurative language. Regardless of the specific type of sentence construction, metaphor serves to assimilate two concepts, either ostensively or implicitly. But what a strong version of associative theory fails to consider is that meaning is flexible, that similarity between words is often unpredictable in some contexts from the semantic properties of each word taken singly. By means of a process such as verbal-opposition, the similarity necessary for an effective metaphor is created in a linguistic setting; and following the romantic penchant for sentence analysis, it is the wholistic properties of linguistic input which are the raw materials for the synthesis of novel meanings. The thrust of this argument is to admit "concept comparison" and "similarity in dissimilarity" as essential components of the verbal-opposition process. Perhaps the most important aspect of this endeavor is to extend a fundamental cognitive process such as verbal-opposition to the range of language. That is, a model of language comprehension should deal with how an individual understands literal, figurative, and anomalous sentences.

CHAPTER II

A FEATURE-SYNTHESIS MODEL FOR METAPHOR PROCESSING

The model developed in this chapter attempts to describe the cognitive processes underlying the comprehension of metaphorical propositions and the relationship between figurative and literal discourse. For the sake of simplicity in what follows, the basic coupla construction ($NOUN_S$ IS $NOUN_P$) serves as a paradigm case. In the first part of this chapter, some assumptions about the representation of semantic information in memory are detailed, along with the mechanisms for processing such information. Following an outline of the feature-synthesis model, specific predictions are generated in association with a series of experiments in the next three chapters. Implications of the model for semantic theory and cognitive psychology are discussed in Chapter VI.

Representation of Meaning

The first assumption, which is not unique, concerns the representation of meaning or the form in which semantic information is encoded in memory: The meaning of a word is represented in long-term memory by a set of semantic features. A semantic feature is defined, in turn, as a dimension along which a series of values are possible. In addition, a salience factor is attached to each dimension weighting a particular value according to its importance in determining the meaning

of a word (cf., Smith, Shoben, & Rips, 1974). In the lexicon, a word has a potential representation in n-dimensional semantic space. In long-term memory, a word has a representation in a space corresponding to the number of dimensions previously encoded and stored by an individual. With repeated presentation of a word, a distribution of weighted values along each dimension is also stored.

In general, the principle of encoding variability governs the nature of such storage (see, for example, Bower, 1972; Martin, 1968; Winograd & Geis, 1974). The encoding variability principle states that individuals make different encodings of the same word on successive occasions, depending on the context in which it occurs; consequently, words have multiple representations in memory and later context merely determines which meaning is accessed in recall (Barclay et al., 1974). Although there is some confusion in the literature as to the nature of each specific encoding of a word, the present model represents competing theories. In a series of papers on the topic, Tulving (1972, 1974; Tulving & Thomson, 1971, 1973) has distinguished between episodic and semantic memory. In contrast to semantic memory, episodic memory refers to the storage and retrieval of spatio-temporal relations among words (Tulving, 1972). Episodic information about a word is information about some event of which the word is the focal element; semantic information about a word is entirely independent of the word's occurrence in a particular situation. The primary finding in support of Tulving's theory is that words which are not physically present with a target word at input (learning) do not serve as effective cues for later recall

(for example, Tulving & Thomson, 1973). Other investigators, however, have found reliable evidence for a semantic interpretation of encoding specificity—effective recall cues must also be congruent with the meaning of a word encoded at input (Light & Carter-Sobell, 1970; Reder, Anderson, & Bjork, 1974; Winograd & Conn, 1971).

The ability of the feature-synthesis model to deal with both points of view (episodic and semantic components in memory) is shown by stating structural assumptions about the representation of meaning in symbolic form. Let the stored meaning of word $\underline{i}$ be represented by the matrix M_i which is of order $J \times K$, where J is the number of different semantic dimensions previously encoded (1, 2, ..., j, ..., J) and K is the number of physical presentations (1, 2, ..., k, ..., K). Each element of the matrix, sf_{jk}, represents the product of the salience and value of the jth dimension (feature) encoded on the kth occasion. Thus, in general, the columns of M_i give the meaning of the word encoded on the kth occasion. To this structure may be added a third dimension—words, so words may share both episodic and semantic characteristics.

Of course M_i will differ across individuals and will be continually changing within an individual over time as a function of everyday linguistic experience, forgetting, and a variety of other factors. Meaning has structure only at a given point in time; it is perhaps more appropriate to think of meaning change as an active, ongoing process. Since the primary purpose of the model is to deal with the representation of meaning and how meaning is comprehended, this discussion

concentrates on the semantic component of memory. Factors affecting the processing of episodic information are beyond the scope of this work.

Processing Stages

A summary version of the feature-synthesis model is presented in Figure 2. Upon presentation of a proposition ($NOUN_S$ IS $NOUN_P$), which may or may not be metaphorical, the momentary structures of S and P are activated during the first stage of the model. Since the order of M_s and M_p is no doubt quite large in long-term memory, it is reasonable to suppose that less than J_s and J_p dimensions are input to a limited-capacity working memory (see Foss & Jenkins, 1973). An added speculation is that multiple feature input is probabilistic. Retrieval of the two feature lists is governed, in part, by the salience factors which derive from the mutual context (opposition) of S and P, and more generally from sentence context. But in the absence of sufficient context, this process is also influenced by prior experience; there is an a priori tendency that certain high level (cf., Thomas, 1969) or familiar features will be input to the working memory (Barclay et al., 1974; Danks & Glucksberg, 1971; Winograd & Conn, 1971). That is, immediate context may not block the input of highly probable features which are not shared by both nouns. For this reason, the sample feature lists of S and P will ordinarily be somewhat different; respective lists are composed of both inherent and contextual features (cf., Chomsky, 1965; Weinreich, 1966), and to the extent that these are not shared, S and P are momentarily dissimilar.

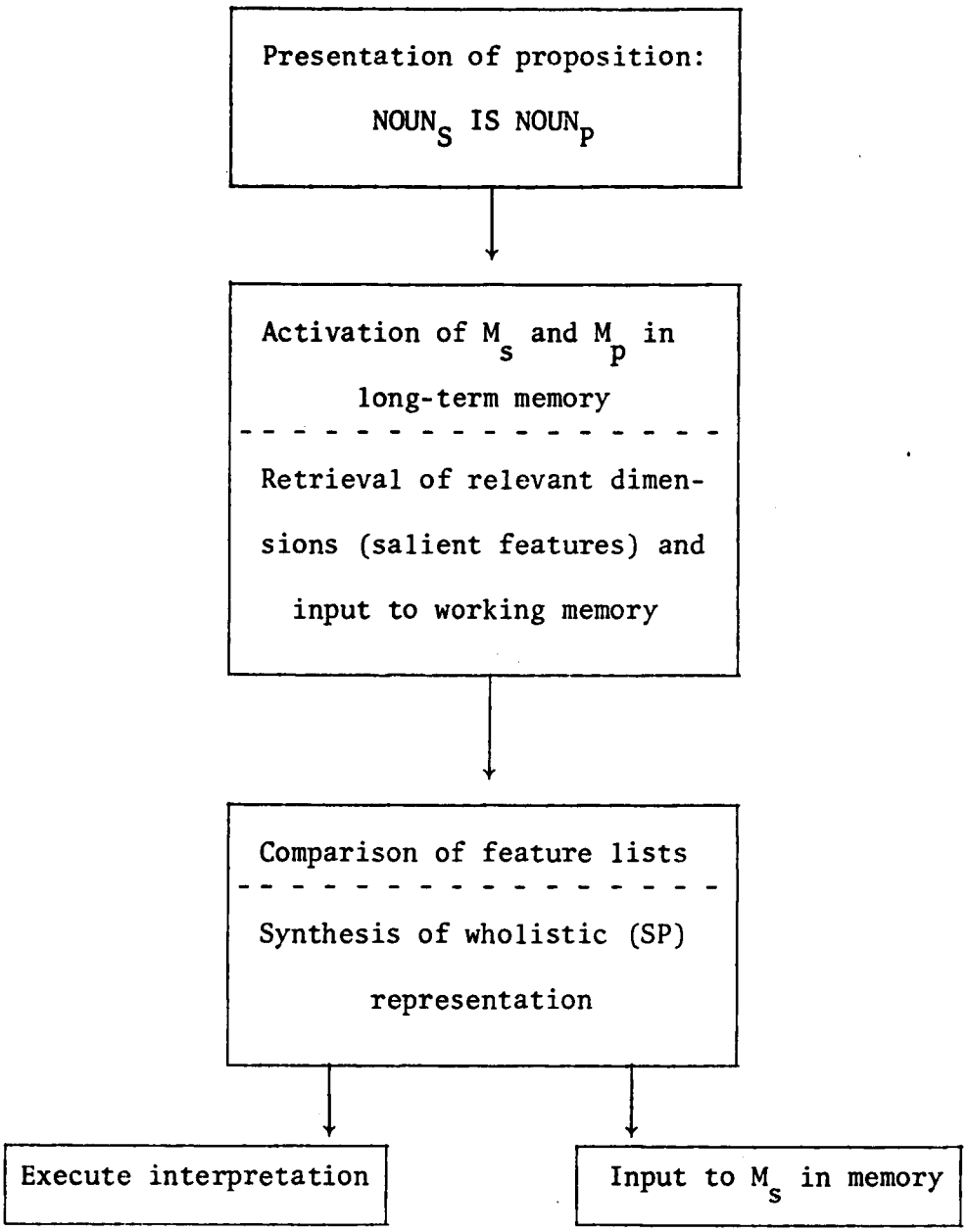


Figure 2. Summary of the two-stage, feature-synthesis model for the comprehension of propositional information.

During the second stage of processing (feature-synthesis), feature lists are compared and integrated to form a single, wholistic representation in working memory. From the sample feature lists associated with S and P, a new semantic entity is construed (SP). Finally, the newly encoded representation of S, the subject of the proposition, may be input to long-term memory as part of M_s. Johnson's (1970) research on compound word association suggests that during the feature-comparison operation, features shared by S and P are raised in salience relative to unitary features, regardless of prior probability. Given S as the subject of a proposition, it seems reasonable to assume that those features unique to S dominate those features unique to P. Thus, in a manner similar to Weinreich's (1966) Redistribution Rule, the total set of features input to the working memory is partitioned into three subsets, ordered in salience: Shared features (F_{sp}), features unique to the subject noun (F_s), and features unique to the predicate noun (F_p). For this reason, the propositions $NOUN_A$ IS $NOUN_B$ and $NOUN_B$ IS $NOUN_A$ generate distinct representations as is shown in Figure 3, where S_h, S_m, and S_l denote high, moderate, and low levels of salience.

From this linguistic perspective, this illustrates how high level features may be blocked, or de-emphasized. Shared low level features are able to override unique high level features by virtue of their combinatorial power or ease of integration, and contradictions are possible only within the lower level F_s and F_p subsets. Contradictions are resolved by comparing the weighted values along each dimension of semantic contrast. In the psycholinguistic terminology of Smith,

$NOUN_A$ IS $NOUN_B$:

$$\begin{matrix} S_h \\ \\ S_m \\ \\ S_l \end{matrix} \begin{bmatrix} F_{sp} = F_{ab} \\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot \\ F_s = F_a \\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot \\ F_p = F_b \end{bmatrix}$$

$NOUN_B$ IS $NOUN_A$:

$$\begin{matrix} S_h \\ \\ S_m \\ \\ S_l \end{matrix} \begin{bmatrix} F_{sp} = F_{ba} \\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot \\ F_s = F_b \\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot \\ F_p = F_a \end{bmatrix}$$

Figure 3. Representation of two propositions after feature synthesis.

Shoben, and Rips (1974), the set difference between the representations AB and BA reflects a difference only in the characteristic features of the compounds; defining feature subsets (F_{ab} and F_{ba}) are equivalent.

Before proceeding to the specific predictions about metaphor processing which stem from the model, a brief comment is in order regarding construct validity. The substance of the first chapter has illustrated the continuity of several research topics in linguistics and psychology. Theoretical accounts of metaphor, semantic theory, and memory share many fundamental concepts. One source of weakness in any model is its task specificity. In order to broaden the perspective of the feature-synthesis model with some degree of confidence, the strategy used in the following experiments was to converge upon a prediction by cumulating evidence from multiple measures obtained in different experimental tasks.

CHAPTER III

EXPERIMENT I: SOME RELATIONSHIPS BETWEEN LITERAL, FIGURATIVE, AND ANOMALOUS SENTENCES

Consider the predictions which arise from the model when three different propositions, which vary in constituent (S-P) similarity, are processed. The first proposition is a literal statement of fact (for example, ROBES ARE GARMENTS); the second represents what most researchers would call anomaly (for example, ROBES ARE TRUCKS); and the third, which might be dubbed metaphorical (for example, ROBES ARE SHADOWS), lies somewhere between the first two.

In the first proposition, ROBES and GARMENTS share many high level features, so mutual context has little influence on the prior probability that these will be retrieved from long-term memory. These words should be judged similar and easily synthesized into a well-formed wholistic representation. Since most of the features associated with ROBES are extant in the stored representation of GARMENTS, the encoded meaning of the proposition consists, for the most part, of shared features. In other words, the subset F_{sp} is largely relative to the subsets F_s and F_p. Thus, an interpretation will be readily assigned to the resultant feature representation in working memory. In this case, meaning change is not novel. Certain dimensions within the internal representation of ROBES are given added salience, but few novel dimensions (F_p) are

input to long-term memory. Therefore, the proposition should be interpreted and remembered with little or no difficulty.

In the second proposition, ROBES and TRUCKS are markedly dissimilar and their juxtaposition is a deviant one in the sense that the proposition is false. Mutual context is perhaps insufficient to cue many common contextual features, and more high level inherent features are again input to working memory—but few of these are shared by the constituent nouns. Since these high level features are not blocked or de-emphasized, a disintegrated representation is the result. The encoded representation of the proposition consists, for the most part, of features unique to the subject noun (F_s) and features unique to the predicate noun (F_p). In this case, it should be more difficult to assign a meaning to the proposition. With such dissimilar constituents, many novel dimensions are attributed to ROBES, but it is unlikely that these will be stored in long-term memory. Consequently, a proposition that is difficult to interpret should be very difficult to remember.

In the third proposition, ROBES AND SHADOWS form a linguistically deviant juxtaposition, yet they do appear similar in some respects. High level features which are incompatible may be retrieved from memory, but a sufficient number of common contextual features are input to the working memory such that these prefigure unique features. ROBES and SHADOWS should be judged moderately similar, and a well formed representation should be created. The proposition should therefore be amenable to figurative interpretation. Also important is the hypothesis that this proposition is most likely to create novel

meaning change in the individual's internal lexicon—interpretable dimensions are added to the meaning of ROBES in long-term memory. However, the effects of similarity, feature commonality, interpretability, and remembering should be of an intermediate level with respect to the first two propositions.

The specific predictions made from the feature-synthesis model in comparing literal, figurative, and anomalous propositions are as follows. First, constituent similarity, truth value, interpretability, feature commonality, and level of correct recognition of propositions should all be positively correlated. Second, the figurativeness of propositions should be a curvilinear (quadratic) function of each of these variables—metaphors should display intermediate values on each of these dimensions, relative to literal and anomalous sentences. Finally, propositions should be distinguishable as either literal, figurative, or anomalous simply on the basis of truth value and constituent similarity—metaphors should reflect the similarity of dissimilars.

Method

Subjects

One hundred and eleven undergraduate students enrolled in introductory psychology at The University of Tennessee served as subjects in the experiment. All subjects received course credit for voluntary participation.

Design and Materials

This experiment was designed to investigate the interrelationships among constituent similarity, truth value, interpretability, feature commonality, recognition memory, and figurativeness within each of three replications. Three high frequency nouns were selected from the list of 56 nouns used by Johnson and Malgady (in press) to collect word association norms. These nouns (BLOSSOMS, DEW, and ROBES) were arbitrarily designated as the subject nouns to be used in the construction of all propositions. For each subject noun (replication), a set of 40 propositions were generated in the following manner. Each subject noun was paired with a number of (a) synonyms used to define the subject noun in several standard English dictionaries, (b) noun associations collected by Johnson and Malgady which seemed intuitively to form metaphorical juxtapositions with a particular subject noun, and (c) nouns selected at random from the Thorndike-Lorge (1944) word count which seemed intuitively to form anomalous juxtapositions with a particular subject noun. These materials were then used to generate 40 propositions of the form $NOUN_S$ IS/ARE $NOUN_P$ for each subject noun replication. Propositions appeared to represent about an equal number of literal, figurative, and anomalous sentences. Some examples of the propositions constructed for the experiment are presented in Table 1; they are classified according to subjects' decisions which were obtained in the first part of the experiment.

Table 1

Some Examples of Propositions from Each Subject Noun Replication Used in Experiment I[a]

Literal	Figurative	Anomalous
ROBES ARE CLOTHING	ROBES ARE SHADOWS	ROBES ARE TRUCKS
ROBES ARE GARMENTS	ROBES ARE WISDOM	ROBES ARE FISH
ROBES ARE CLOAKS	ROBES ARE SECURITY	ROBES ARE KITES
DEW IS WATER	DEW IS YOUTH	DEW IS TEETH
DEW IS A COVERING	DEW IS A VEIL	DEW IS PAPER
DEW IS A MIST	DEW IS TEARS	DEW IS A RADIO
BLOSSOMS ARE PETALS	BLOSSOMS ARE CHILDREN	BLOSSOMS ARE LAWS
BLOSSOMS ARE ROSES	BLOSSOMS ARE SILK	BLOSSOMS ARE HORSES
BLOSSOMS ARE DAISIES	BLOSSOMS ARE FACES	BLOSSOMS ARE DAGGARS

[a]Classification is based on the model response (literal, figurative, or nonsense) given by subjects in the first part of the experiment.

Procedure

General procedure. In each part of the experiment, subjects were tested in small groups of one to six subjects each. At the beginning of each experimental session, subjects were given written instructions, which were also read aloud by the experimenter, explaining the nature of their task. Except for the recognition study, no time limits were imposed upon the tasks.

Classification of propositions. Twenty-one subjects were given booklets containing the 120 propositions constructed for the experiment. Booklets consisted of 12 pages of propositions, with 10 propositions involving the same subject noun listed on each page. Within subject noun replications, propositions were randomly assigned to pages and a different page order was randomly determined for each subject. The order of subject noun replications (blocks of four pages) was completely counterbalanced across subjects. Subjects were instructed to read a given proposition, determine the relationship between the two key nouns, and then decide whether the proposition represented a literal statement, a figure of speech, or just nonsense. Subjects indicated their judgments by circling one of the three categories, which appeared next to each proposition.

Truth value judgments. Eighteen subjects were given booklets constructed in the same manner as those used in the first part of the experiment. However, in this part of the experiment, each proposition

was preceded by the hedge TECHNICALLY SPEAKING (for example, TECHNICALLY SPEAKING, ROBES ARE GARMENTS). Subjects were instructed to read a given proposition, determine the relationship between the two key nouns, and then decide whether the proposition was true or false. Subjects indicated their judgments by circling one of the two categories, which appeared next to each proposition.

Property associations. Twenty-four subjects were given booklets constructed in the same manner as previously described. Subjects were instructed to read a given proposition, determine its meaning, and then list up to four properties (in the form of adjectives) to convey the meaning they had in mind. Instructions further stressed that subjects should list only those adjectives which were necessary to describe the meaning of a particular proposition; this served to minimize intra-subject redundancy.

Interpretability judgments. Eighteen subjects were given booklets constructed in the same manner as previously described. Subjects were instructed to read a given proposition, determine its meaning, and then rate how interpretable or comprehensible the proposition was on a five point scale (1 = uninterpretable or very difficult to comprehend; 5 = highly interpretable or very easy to comprehend). Subjects were told to glance over the propositions, first, to get a feel for the range of interpretability present.

Constituent similarity judgments. Eighteen subjects were given booklets which contained each subject noun and the 120 words used as predicate nouns in the propositions. Booklets consisted of three pages of experimental materials, with each subject noun and its 40 predicate nouns listed on a different page. A subject noun was presented at the top of each page, followed by the 40 predicate nouns listed in random order. Page order was completely counterbalanced across subjects. Subjects were instructed to compare the meaning of each of the 40 listed nouns with the meaning of the subject noun given at the top of a page, and then to rate their similarity in meaning on a five-point scale (1 = very dissimilar or not related in meaning; 5 = very similar or highly related in meaning). Subjects were told to glance over each page, first, to get a feel for the range of similarity present.

Recognition memory. Twelve subjects studied a sample of the 120 propositions used in earlier parts of the experiment and were later tested for recognition. Based on the model classification of each proposition in the first part of the experiment, all propositions were categorized as either literal, figurative, or anomalous. Ten propositions from each category were randomly selected from the larger set in each replication. Half were used as an acquisition list and half as distractors in the recognition phase. The 45 propositions on the acquisition list were typed on 3 × 5 index cards and presented to subjects in decks. In order to eliminate the effects of serial position and short-term memory, three filler propositions, involving one subject

noun from each replication, preceded and followed the presentation of the target propositions in acquisition. Each subject studied the propositions in a different random order.

In the acquisition phase of the study, subjects were given standard recognition memory instructions. They were told to study each proposition for the time allotted and that later they would be asked some questions about the propositions. Propositions were exposed for five seconds each, and subjects proceeded through the decks in response to a verbal signal given by the experimenter. A two minute rest period separated the acquisition and recognition phases of the study.

In the recognition phase, subjects were given booklets containing the 90 propositions (45 acquisition propositions and 45 distractors) sampled from the larger set of 120. Booklets consisted of 10 pages of propositions, with three propositions from each replication on each page (one from each category). About an equal number of acquisition and distractor propositions were included on each page. Apart from these considerations, all propositions were randomly assigned to pages. For each subject, a different random order of pages was determined. Subjects were instructed to read a given proposition and then decide whether it was included in the deck that they had just studied. Subjects indicated their judgments by circling one of the following categories which appeared next to each proposition: Sure Yes, Probable Yes, Probable No, or Sure No. No time limit was imposed during the recognition phase.

Results and Discussion

The first step in the statistical analysis was to reduce the data to quantitative form. In the case where subjects classified propositions as either literal, figurative, or anomalous, an index of the figurativeness of a proposition was taken as the percentage of subjects choosing the "figurative" category. Similarly, the percentage of subjects choosing the "true" category in the second part of the experiment was used as an index of the truth value of a proposition. Rating scale data (interpretability and constituent similarity judgments) were tabulated by averaging the individual subject's ratings. This provided a mean interpretability and a mean constituent similarity rating for each proposition.

Property association data from the third part of the experiment were first tabulated in the form of distributions of adjective responses to each proposition. An index of feature commonality was derived from the variability within an adjective distribution, as measured by Garner's (1962) average uncertainty coefficient ($\underline{U}$). The degree of feature commonality was defined for each proposition by the index: $1 - \underline{U}/\underline{U}_{max}$, where $\underline{U}$ is the actual uncertainty or variability of a distribution of property association and $\underline{U}_{max}$ is the maximum variability possible. This index ranges from 0 (low commonality), when each subject lists different adjectives, through 1 (high commonality), when each subject lists the same adjectives.

Finally, recognition scores were tabulated for both acquisition and distractor propositions by considering the confidence of subjects in their decisions as well as the correctness of their decisions. A proposition which was correctly recognized with a "Sure" rating was scored +2; a correct recognition with a "Probable" rating was scored +1; a false recognition with a "Probable" rating was scored -1; and a false recognition with a "Sure" rating was scored -2. A proposition on the acquisition list was scored as follows: Sure Yes (+2), Probable Yes (+1), Probable No (-1), and Sure No (-2). However, the direction of the scale was reversed for propositions used as distractors: Sure No (+2), Probable No (+1), Probable Yes (-1), Sure Yes (-2). A mean recognition score for both types of propositions was calculated by averaging individual subject's scores.

Since the first hypothesis in this experiment concerned the form of the interrelationships among the six variables, all measures were intercorrelated over propositions within each replication. Except for those correlations with recognition scores (N = 30), all remaining correlations were based on 40 observations. The equivalence of the three correlation matrices was then tested by applying the Box test of the homogenity of covariance matrices (see Winer, 1971). Results of this preliminary test indicated that the pattern of intercorrelations was not significantly different across replications, $\underline{X}^2$ (42) = 16.85, $\underline{p} > .95$. Since intercorrelations were stable across replications, corresponding correlations in each replication were averaged by means of Fisher's $\underline{r}$ to $\underline{z}$ transformation. The average correlation matrix is

shown in Table 2; significance tests were based on the average transformed correlation. Correlations with recognition scores were based on 81 degrees of freedom and the remaining correlations were based on 101 degrees of freedom (see McNemar, 1969).

Inspection of Table 2 shows that the predicted positive relationships between truth value, constituent similarity, feature commonality, interpretability, and recognition memory were confirmed. Although the correlations in this subset are "statistically significant," it is important to note that the process of averaging correlations resulted in a small standard error, and also that the number of tests conducted precludes a straight-forward interpretation of significance levels. Far more interesting is the direction and magnitude of each correlation. Taken together, these intercorrelations were in the predicted direction (positive). The intercorrelations among truth value, constituent similarity, feature commonality, and interpretability were high, ranging from .611 to .913. However, the correlations involving recognition scores were of a much lower magnitude, ranging from .256 to .367. Reanalyzing these correlations for acquisition and distractor propositions separately, correlations with recognition memory were somewhat higher for acquisition propositions (.462 to .488) and negligible for distractor propositions (.069 to .128). Overall, the first hypothesis was supported by the pattern of intercorrelations which emerged from the data, but to a less extent by the results of the recognition study.

Table 2

Intercorrelations Among the Variables Examined in Experiment I
Averaged Across Replications

	Figurativeness	Truth Value	Similarity	Feature Commonality	Interpretability	Recognition
Figurativeness	(1.000)					
Truth value	.016	(1.000)				
Similarity	.004	.886***	(1.000)			
Feature Commonality	-.134	.611***	.641***	(1.000)		
Interpretability	.280**	.869***	.913***	.701***	(1.000)	
Recognition	-.279**	.288**	.256*	.281**	.367***	(1.000)

***$p < .001$

**$p < .01$

*$p < .05$

The second hypothesis was that the degree of figurativeness of propositions should be curvilinearly related to all other variables. Specifically, U-shaped functions were expected which would reflect significant quadratic regression. Table 2 shows that the correlations with figurativeness were both low and inconsistent in direction. This implies that a linear function does not adequately represent the underlying relationships with figurativeness.

In order to examine the hypothesis that a higher-order polynomial (quadratic) would fit the data better than a linear function, the following procedure was used. Separate univariate tests were conducted for each variable to ensure that respective means and variances within each replication were not significantly different. In each univariate analysis of variance, the F test was less than unity, indicating that the means were not reliably different. Results of a series of F_{max} tests, used to test the difference between variances, revealed that all variances were homogeneous across replications. These results suggested that pooling replications would yield the best estimate of the mean and variance on each dimension. In order to illustrate the graphic relationships with figurativeness, all variables were standardized on the pooled estimates of the means and variances so that they could be represented together on a unitless scale. Propositions were then divided into five groups on the basis of their standardized scores on each variable (low to high) such that each group contained at least 10 propositions. In addition, following the recommendation of Winer (1971)

for trend analysis, groups were formed to represent equal standard score intervals.

The mean figurativeness scores for each variable (subdivided into group intervals) are plotted in Figure 4 to illustrate the general relationships between figurativeness and the other variables. In each case, the variables appear to relate to figurativeness by a curvilinear function—high figurativeness is associated with moderate values on each variable. The significance of quadratic regression was tested by conducting five trend analyses, one for each variable. The results of these analyses are also presented in Figure 4. Clearly, the correlation associated with the quadratic component was highly significant in each case. No other trends (for example, linear or cubic) accounted for a substantial portion of the variance in any analysis. These results tend to confirm the second hypothesis; however, truth value, constituent similarity, and interpretability again provide the strongest support.

One unexpected finding in the experiment was the difference between the relationships with acquisition and distractor propositions used in the recognition study. Whereas recognition scores for acquisition propositions were linearly related to truth value, constituent similarity, feature commonality, and interpretability and nonlinearly related to figurativeness (see Figure 4), recognition of distractor propositions was negatively correlated with figurativeness (r = -.545) and uncorrelated with the other variables. Subjects tended to falsely recognize highly figurative propositions (mean = .983) more often than literal (mean = 1.306) and anomalous propositions (mean = 1.703),

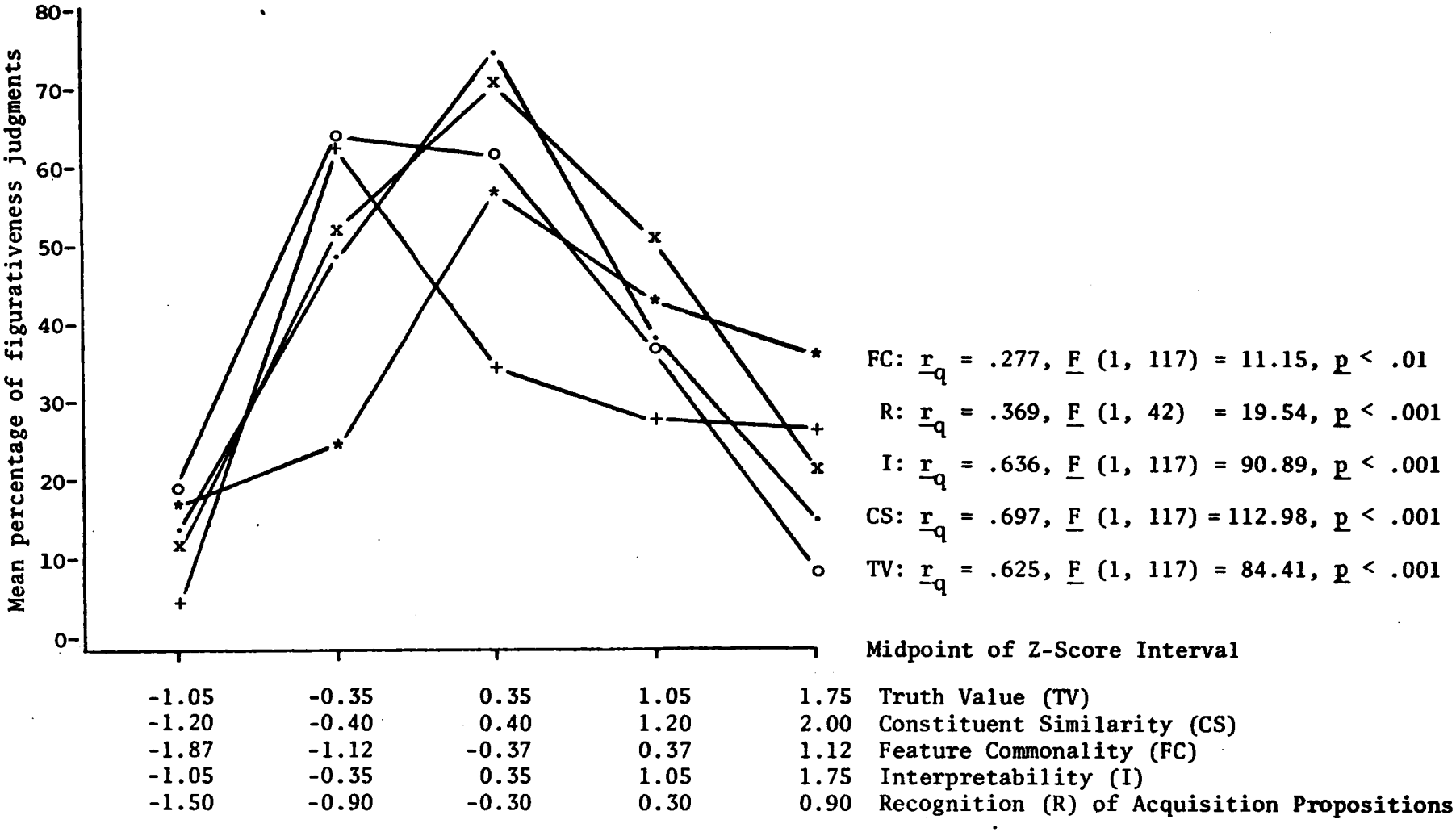


Figure 4. Plot of figurativeness as a function of standardized score intervals on truth value, constituent similarity, feature commonality, interpretability, and recognition of acquisition propositions; correlations associated with quadratic regression components (r_q); and significance of quadratic regression.

F (2, 42) = 7.32, $p < .01$. This finding is consistent with the results of a study by Harris (1975), who found that subjects falsely recognized metaphors more often than nonmetaphors (literal paraphrases). One explanation offered by Harris was that subjects might be biased toward choosing metaphors because they are more difficult to comprehend than literal sentences. This speculation is unlikely, however, since in the present experiment, the response bias to metaphors was greater than that for anomalous sentences. An alternative explanation suggested by Harris is more consistent with the proposed model and the data.

The tendency to falsely recognize metaphors may reflect the fact that metaphors involve an "additional semantic domain" and therefore more semantic information to falsely associate with. The integrated meaning of a literal proposition is less uncertain (or ambiguous) than the integrated meaning of a metaphorical proposition, and therefore the probability of confusion with meanings encoded during acquisition is greater in the case of metaphor. On the other hand, anomalous propositions are so uncertain that their meanings are disintegrated. The two "semantic domains" brought together in anomalous propositions are not easily synthesized into a wholistic representation, hence the probability of confusion is, again, less than that in the case of metaphor. The fact that fewer false recognitions occurred for anomalous propositions than for literal propositions might reflect the lower probability of confusing two distinct meanings (two disintegrate constituent nouns) than confusing one meaning (an integrated proposition).

A final analysis was conducted to investigate the notion that metaphor involves the perception of the "similarity of dissimilars" or moderate similarity given a logically false proposition. In this regard, propositions within each replication were classified as either literal, figurative, or anomalous, according to the model response given by subjects in the first part of the experiment. Using discriminant analysis procedures, propositions were then reclassified solely on the basis of their truth value and constituent similarity scores. The point of interest in these analyses was the "hit rate" or percentage of correct reclassifications. In each replication, the percentage of correct reclassifications exceeded chance: In the first replication (BLOSSOMS) the hit rate was 87.5%; in the second replication (DEW) the hit rate was 85%; and in the third replication the hit rate was 87.5%. However, defined in terms of constituent similarity and truth value, metaphor was somewhat more elusive than literal and anomalous sentences. Overall, 75% of the figurative propositions were correctly reclassified in terms of constituent similarity and truth value, while the hit rates for literal and anomalous propositions were 91.3% and 98%, respectively. Literal propositions were characterized by high constituent similarity and truth value; anomalous propositions were characteristically associated with low constituent similarity and truth value. Of those metaphors which were incorrectly classified, 77% were confused with anomalous propositions.

In sum, the results of the first experiment substantiated the hypotheses about interrelationships among the six properties of

propositions. The high positive correlations between truth value, constituent similarity, feature commonality, and interpretability also corroborate previous findings (Johnson & Malgady, in press; Malgady & Johnson, in press). Recognition data supported the predicted relationship when propositions studied during acquisition and those used as distractors were analyzed independently. Recognition of acquisition propositions was moderately correlated with truth value, constituent similarity, feature commonality, and interpretability.

The present data clearly demonstrate that figurative propositions lie on a continuum, midway between tautology and nonsense. Results of the discriminant analyses supported the definition of metaphor in terms of moderate similarity given a deviant (false) juxtaposition of two words. Taken together, these findings support the notion that metaphor is not qualitatively different from literal language. Rather, Bickerton's scale of usage (meaningless expressions, novel metaphor, frozen metaphor, literal expressions) can now be described purely in quantitative terms. Perhaps the most important aspect of the feature-synthesis model is that it accounts for the comprehension of literal, figurative, and anomalous propositions on the basis of a single, fundamental cognitive process.

CHAPTER IV

EXPERIMENT II: EFFECTS OF MEANING UNCERTAINTY ON METAPHOR PROCESSING

Since the semantic distance from S to P must be equivalent to the distance from P to S, similarity cannot explain the difference between processing ROBES ARE GARMENTS and GARMENTS ARE ROBES, for example. With nested categories such as these—ROBES is a subset of GARMENTS—category size is often implicated in an explanation of differential verification time (for example, Meyer, 1970; Smith, Shoben, & Rips, 1974). Meyer (1970) suggests that the features of the predicate (category) noun are matched against those of the subject noun; large categories result in more feature comparisons and longer processing times. Although it is debatable whether processing differences are a result of nesting or of category size (see Collins & Quillian, 1970), the use of nested categories and subset relations is only a special case of the more general situation in which the constituents in a proposition have different feature structures. For example, in the proposition ROBES ARE SHADOWS, set relations are ill defined—ROBES and SHADOWS are not subsets of each other or of any ostensible larger category.

A more general description of a word's feature structure is given by Garner's (1962) concept of information uncertainty (U). The

uncertainty measure of a word's meaning is sensitive to two parameters—the number of different features associated with the word and the commonality structure of the same. High uncertainty, which is analogous to large category size, results from a large number of equiprobable features. In contrast, low uncertainty reflects little ambiguity in a word's representation. Indeed, the factor structure of the Battig and Montague (1969) category norms consists primarily of two dimensions—number and relative probability of category exemplars (Herrmann, Chaffin, & Corbett, 1973).

Based on assumption that figurative propositions are not qualitatively different from literal propositions, the familiar category size effect (restated in terms of uncertainty) should generalize to subjects' comprehension of metaphors. In the more general case, manipulating uncertainty by reversing constituent noun order in a metaphor should produce an effect analogous to the effect of category size on time to verify propositional information. High uncertainty in the predicate position should impair metaphor processing relative to low uncertainty in the predicate position. The feature-synthesis model explains this effect in terms of the feature structure of the wholistic representation of a metaphor. An uncertain predicate noun is more likely to input a large number of unique (incompatible) features to the working memory. Since the number of common features is held constant by reversing the order of constituent nouns (see Figure 2, p. 31), it is more difficult to integrate the two feature sets when the predicate noun is highly uncertain in meaning.

The present hypothesis also follows the philosophical notion that metaphor serves to make the "strange familiar" or the "familiar strange" (Cassirer, 1953; cited in Pollio et al., in press). Making an abstract or unfamiliar concept more concrete or more familiar should produce a more comprehensible metaphor than its converse. The specific predictions made in this experiment were that predicate noun uncertainty should be inversely related to (a) the feature commonality of metaphorical propositions, (b) metaphor interpretability or the ease of assigning a meaning to a proposition, and (c) the ease of recalling a metaphor.

Method

Subjects

Eighty-eight undergraduate students enrolled in introductory psychology at The University of Tennessee served as subjects in this experiment. All subjects received course credit for voluntary participation.

Design and Materials

Twelve noun pairs were selected from among those representing the key nominal comparisons in the 28 literary metaphors used by Johnson and Malgady (in press). The original 28 metaphors were drawn from a variety of sources of prose and poetry judged to be rich in figurativeness (for example, from works by Shakespeare, Wordsworth, Frost, and McKuen). Metaphors were originally selected with the constraint that

they consist of two key nouns which could be specified as standing in a figurative relation to each other. Noun pairs were selected for the present experiment on the following basis. The 56 nouns involved in the original metaphors were rank ordered in terms of the uncertainty of their property association distributions. Twelve noun pairs were then selected which contained one high and one low uncertainty noun. Nouns classified as highly uncertain in meaning ranged from .639 to .878 (mean = .734) on a normalized index, while nouns classified into the low uncertainty group ranged from .419 to .577 (mean = .491). Thus, there was no overlap between the two groups of nouns in terms of uncertainty. Two sets of metaphors of the form $NOUN_S$ IS/ARE $NOUN_P$ were then constructed. In Condition A, noun pairs were arranged so that the subject noun was highly uncertain in meaning and the predicate noun was of low uncertainty. Noun pair order was reversed in Condition B. The noun pairs used to construct metaphors for the experiment are presented in Table 3 in their respective groups.

The basic structure of the experiment was a treatment × noun pairs design involving three dependent variables: Feature commonality, interpretability, and level of free recall. Each of the 12 noun pairs was measured on three dimensions within the two uncertainty conditions.

Procedure

General procedure. In each part of the experiment, subjects were tested in small groups of one to five subjects each. At the beginning of each experimental session, subjects were given written instructions,

Table 3

Noun Pairs Used to Construct Metaphors for Experiment II

High uncertainty	Low uncertainty
FROST	CLOAK
LOVE	SEASON
LIVING	FEVER
MEMORIES	GARMENTS
HOLIDAYS	SIGNPOSTS
MOONS	KITES
SMILES	WALLS
MOUNTAINS	KINGS
SNOW	CONFETTI
NECK	TOWER
VOICES	WAVES
RAIN	TEARS

which were also read aloud by the experimenter, explaining the nature of their task. Except for the free recall study, no time limits were imposed on the tasks.

Property associations. Forty-eight subjects were randomly assigned to one of two groups of 24 subjects each. Subjects in each group were given booklets containing metaphors with 12 different noun pairs. Booklets consisted of four pages of metaphors, with three metaphors per page. Six metaphors from each condition were randomly assigned to pages and a different random page order was used for each subject in each group. Subjects were instructed to read a given metaphor, determine its meaning, and then list up to four properties (in the form of adjectives) to convey the meaning they had in mind. Instructions further stressed that subjects should only list those adjectives which were necessary to describe the meaning of a metaphor.

Interpretability judgments. Twenty subjects were randomly assigned to one of two groups of 10 subjects each. Subjects were given both sets (12 pairs) of metaphors in a one-page list. On one form of this list, noun pair order and condition order within noun pairs was randomly determined. A second form of the list was used to counterbalance condition order within noun pairs (AB, BA). Instructions directed subjects to read each pair of metaphors, determine their meanings, and then decide which metaphor in a pair was the most interpretable or easiest to

comprehend. Subjects indicated their judgments by circling the most interpretable metaphor in each pair.

Free recall. Twenty subjects were randomly assigned to one of two groups of 10 subjects each. Subjects in each group studied one of two lists of metaphors and were later asked to recall these items. Six metaphors from each condition, each involving a different noun pair, were randomly assigned to lists. Metaphors were typed on 3 × 5 index cards and presented to subjects in decks. In order to eliminate the effects of serial position and short-term memory, three filler metaphors were included at the beginning and end of each deck. Each subject studied the metaphors in a different random order.

In the acquisition phase of the study, subjects were instructed to memorize the metaphors and also that they would be later asked to recall them. Metaphors were exposed for five seconds each, and subjects proceeded through the decks in response to a verbal signal given by the experimenter. A two minute rest period separated the acquisition and recall phases of the study.

In the recall phase, subjects were given a one-page sheet containing 18 blank lines and were asked to write down as many metaphors, or as many parts of metaphors, as they could remember. No time limit was imposed upon the free recall task.

Results and Discussion

In the case where subjects judged interpretability, the quantitative index used was the proportion of subjects choosing one metaphor in a pair over its counterpart. Since these data represent binomial proportions, an arcsine transformation of all proportions was made to stabilize the variances in the statistical analysis.

Property association data were tabulated in the form of distributions of adjective responses. After calculating an uncertainty coefficient for each distribution, feature commonality was defined for each metaphor by the index: $1 - \underline{U}/\underline{U}_{max}$ (see Experiment I).

Free recall scores were calculated as the proportion of subjects in a group correctly recalling the nouns in a metaphor. Individual subject's responses were scored as 2, if both nouns in a metaphor were recalled in their correct syntactic position (the order of presentation in acquisition); 1, if only one noun in a metaphor was recalled; otherwise, responses were scored as 0. There was an insufficient number of noun pairs recalled in a syntactic position opposite that studied during acquisition to justify a more complex scoring system. Each metaphor contained two nouns and 10 subjects studied each metaphor, so cumulative recall scores ranged from 0 to 20. Free recall scores in proportions were thus calculated by dividing the cumulative score for each metaphor by 20.

These data were used as the dependent variables in a repeated measures, multivariate analysis of variance. The 12 noun pairs were

measured on each variable within the two uncertainty conditions (A, High-Low; B, Low-High). There was no significant difference between the two forms used to counterbalance condition order in the second part of the experiment (interpretability judgments), so these two sets of data were pooled.

The mean value on each variable for metaphors in both conditions is presented in Table 4. The multivariate significance test was based on Bartlett's approximation to Wilks' likelihood-ratio criterion (see Tatsuoka, 1971). The analysis of variance revealed a highly significant main effect due to conditions, $\underline{X}^2$ (3) = 13.28, $\underline{p} < .005$. Examination of the direction of the differences in Table 4 clearly shows that for each pair of means, Condition A exceeded Condition B. Metaphor processing was impaired when the predicate noun was highly uncertain in meaning. In other words, predicate noun (category) uncertainty is inversely related to the integrity of the entire metaphor, the ease of assigning a meaning to the metaphor, and the ease of recalling a metaphor.

Table 4 also shows the percentage of variance accounted for by differences between conditions. Simultaneous confidence intervals were applied at the level of each univariate difference to evaluate the independent contribution of each variable to the overall difference. Follow-up tests revealed that each difference accounted for a significant proportion of variance; each variable contributed independently to the rejection of the overall null hypothesis ($\underline{p} < .01$).

Table 4

Mean Value and Percentage of Total Variance on Each Variable of Metaphor Processing for Uncertainty Conditions

Variable	Uncertainty Condition A (High-Low)	Uncertainty Condition B (Low-High)	% Variance
Interpretability	.702	.298	48.31
Feature commonality	.317	.271	91.02
Free recall	.392	.241	71.06

The results of Experiment II provide unequivocal support for the hypothesis that predicate noun uncertainty is inversely related to metaphor comprehension. Particularly important was the high predictability (91%) of the structural aspects of metaphor meaning (that is, feature commonality). By reversing the syntactic position of the constituent nouns in a metaphor the number of semantic features common to both nouns was held constant over the two conditions. Differences in feature commonality between the two conditions must therefore reflect differences only in the structure of unique feature subsets. In Condition A, the subject of a metaphor was highly uncertain in meaning and the input of relatively few predicate-unique features reduced uncertainty about the meaning of the entire metaphor relative to its counterpart in Condition B. In contrast, although the subject of a Condition B metaphor was initially of low uncertainty, a highly uncertain predicate noun created a more disintegrated meaning of the whole metaphor. This was also evidenced by the fact that Condition B

metaphors were more difficult to recall and interpret. In Cassirer's (1953; cited in Pollio et al., in press) terms, it would seem, not surprisingly, that metaphors which make the strange familiar are more easily understood than those which make the familiar strange.

Results of this experiment attest to the generalizability of the category size effect found in semantic memory studies. More important though, these results provide insight into the processes underlying the comprehension of semantic relations which are independent of constituent similarity—reversing the syntactic position of the constituent nouns in a metaphor precluded differences in similarity over conditions. Despite the fact that the feature comparison model proposed by Smith et al. (Smith, Shoben, & Rips, 1974; Smith, Rips, & Shoben, 1974) is based on structural assumptions related to those in the present model, these investigators explain language processing at the "level" of similarity. Since results analogous to the category size effect were obtained in this experiment in the absence of similarity differences, this implies that similarity alone cannot account for the comprehension of semantic relations. Rather, a concept such as meaning uncertainty (or feature commonality), which is highly correlated with similarity, seems to deal more hospitably with the present data.

CHAPTER V

EXPERIMENT III: SENTENCE CONTEXT AND METAPHOR PROCESSING

Up to now the model has dealt with propositions involving two nouns linked by a copula. The purpose of the third experiment is to examine some hypotheses about processing metaphors with more complex sentence structure. The Malgady and Johnson (in press) study showed that adding adjective modifiers to the nouns linked in a metaphor influenced constituent similarity and metaphor interpretability. They concluded that the extent to which adjectives are semantically congruent with the meanings of both nouns in a metaphor determines the integrity of the wholistic representation.

The feature-synthesis model explains the effects of complex sentence context in the same manner as the simple S-P context. The presence of an adjective, for example, serves to cue certain features of the noun which it modifies. An adjective increases the salience of a set of features in the internal representation of the noun, and therefore the probability that these will be input to the working memory. If an adjective is semantically congruent with both nouns in a metaphor, more shared features are aroused as a function of sentence context and there is a greater suppression of incompatible features which are unique to the individual constituent nouns. If an adjective cues features of one noun which are not shared by the other noun, this increases the salience of unique features and it is more difficult to

integrate the two feature lists into a single representation in working memory.

On the basis of such considerations, the first prediction made in Experiment III was that the effects of modifying a noun in a metaphor will depend on whether the adjective increases the salience of shared features or features which are unique to the individual constituent nouns. Three types of adjectives were used in the experiment: Adjectives which cued features (a) shared by both nouns, (b) unique to the subject noun, and (c) unique to the predicate noun. With respect to constituent similarity, metaphor interpretability, and ease of recall, it was predicted that (a) would show most facilitation, (b) next most, and that (c) would impair metaphor processing.

A second factor is the syntactic position of an adjective in a metaphor. The effects of modifying the predicate noun should depend on whether its uncertainty is increased or decreased (see Experiment II). Modifying the predicate noun by an adjective which cues shared features or features unique to that noun should decrease uncertainty because these adjectives constrain the potential semantic representation of the predicate noun. Since a subject-unique adjective (b) is, by definition, incongruent with the usual meaning of the predicate noun, it should increase predicate noun uncertainty. Modifying the predicate noun by an adjective which relates to the subject noun should introduce more variability into the feature set which is input to the working memory. For the subject noun, this prediction is reversed—modifying the subject noun by a subject-unique adjective should decrease its uncertainty,

while modifying it by a predicate-unique adjective should increase its uncertainty. Thus, the model predicts a main effect of adjective position (subject or predicate phrase) only for adjectives which cue features shared by the constituent nouns. An adjective type × adjective position interaction was predicted for subject-unique (b) and predicate-unique (c) adjectives.

For the verb form class, predictions were parallel to those for the adjective type factor. Three types of verbs were used in the experiment, verbs describing an event associated with (a) both constituent nouns, (b) the subject noun alone, and (c) the predicate noun alone. With respect to constituent similarity, metaphor interpretability, and ease of recalling a metaphor, it was predicted that (a) would show most facilitation, (b) next most, and that (c) would impair metaphor processing.

Method

Subjects

Seventy-four undergraduate students enrolled in introductory psychology at The University of Tennessee served as subjects in the experiment. All subjects received course credit for voluntary participation.

Design and Materials

Five noun pairs were selected at random from the same source as in Experiment II. For each noun pair, three different types of adjectives

were selected from distributions of property associations collected from independent groups of subjects. The first adjective type, defined as a common property, was selected from adjective distributions obtained when subjects (N = 50) were presented each noun pair as a compound stimulus and asked to list properties common to both members of a noun pair. Since adjectives selected in this manner relate to both nouns in a pair, it was assumed that these adjectives would increase the salience of features shared by both constituent nouns in a metaphor. The second and third adjective types were selected from adjective distributions obtained by presenting subjects (N = 45) with each noun as an individual stimulus and asking them to list properties of the isolated words. The second adjective type was defined as a subject-unique property, and the third adjective type was defined as a predicate-unique property. A subject-unique adjective should increase the salience of features unique to the subject noun in a metaphor, while a predicate-unique adjective should increase the salience of features in the predicate noun. The uniqueness of these adjectives was ensured by comparing the three property lists and discarding any adjectives classified as unique which (a) appeared on more than one list, or (b) seemed intuitively related to both nouns in a pair. Apart from the foregoing considerations, all adjectives selected were among the five most commonly occurring responses in each distribution.

Three different types of verbs were also selected for each noun pair. The first verb type, defined as a common event, was selected from distributions of verb associations collected on the following basis. A

group of subjects (N = 47) were presented with the five noun pairs in a sentence frame of the sort: $NOUN_S$_____LIKE $NOUN_P$. Subjects were then asked to fill in each blank with a verb describing an event commonly associated with both nouns in a metaphor. Similarly, the second and third verb types were selected from distributions obtained by presenting an independent group of subjects (N = 43) with each noun as an individual stimulus and asking them to list events associated with the isolated nouns. The second verb type was defined as a subject-unique event, and the third verb type was defined as a predicate-unique event. Thus, a subject-unique verb should describe an event ordinarily associated only with the subject noun in a metaphor, while a predicate-unique verb should describe an event associated only with the predicate noun. The uniqueness of these verbs was ensured by comparing the three lists of verb associations and discarding any verbs classified as unique which (a) appeared on more than one list, or (b) seemed intuitively related to both nouns in a pair. Apart from the foregoing considerations, all verbs selected were among the five most commonly occurring responses in each distribution.

The noun pairs, adjectives, and verbs used in the experiment are presented in Table 5. These materials were used in a 3 × 2 × 3 design to generate 18 metaphorical propositions for each noun pair. The first factor, adjective type, consisted of common, subject-unique, and predicate-unique properties. The second factor, adjective position, varied the syntactic position of the adjective in the subject phrase or the predicate phrase of a metaphor. The third factor, verb type,

Table 5

Materials Used to Construct Metaphors in Experiment III

Noun Pair		Adjective Type			Verb Type		
Subject	Predicate	Common	Subject-Unique	Predicate-Unique	Common	Subject-Unique	Predicate-Unique
HAIR	SILK	SOFT	LONG	RICH	FLOWS	CURLS	WEARS
FACES	ROSES	RED	HAPPY	SWEET	SHINE	SMILE	BLOOM
RAIN	TEARS	WET	COLD	SAD	FALLS	DRIZZLES	WEEPS
MEMORIES	GARMENTS	OLD	PLEASANT	WOOLEN	FADE	REVIVE	COVER
SUNSHINE	FRIEND	WARM	BRIGHT	CLOSE	GLOWS	RADIATES	HELPS

consisted of common, subject-unique, and predicate-unique events. In all, 90 metaphors were constructed according to this procedure. Because of the verb factor, the qualifier LIKE was inserted in all metaphors (for example, SOFT HAIR FLOWS LIKE SILK).

Procedure

General procedure. In each part of the experiment, subjects were tested in small groups of two to eight subjects each. At the beginning of each experimental session, subjects were given written instructions, which were also read aloud by the experimenter, describing the nature of their task.

Constituent similarity and interpretability judgments. Fifty subjects were randomly assigned to one of two groups of 25 subjects each. One group of subjects was asked to judge constituent similarity and the other metaphor interpretability. Metaphors were typed on 3 × 5 index cards and presented to subjects in decks. The procedure used was the same in these two parts of the experiment.

A rank order task was used within noun pairs (replications); that is, subjects ranked the 18 metaphorical versions of a given noun pair along one of the two dimensions. Each subject was exposed to all 90 metaphors, with replications presented sequentially. Metaphor order within replications was randomized for each subject and the presentation order of noun pair replications was balanced using one standard form of a 5 × 5 latin square. Each presentation order was used with five subjects.

The instructions were designed to mimic a paired comparison task as closely as possible. Subjects were told to take the first two cards in a deck, read the metaphors printed on the cards, and then make a comparative judgment by ordering the two metaphors along one of the two dimensions. Next they were told to read the third card and position the metaphor appropriately with respect to the first two, and so on, until all 18 metaphors in a replication were rank ordered. After subjects completed this procedure, they were instructed to go back and check their order by comparing adjacent metaphors to be sure that all were ranked appropriately. No ties were permitted. Finally, subjects transcribed their rank orders onto data sheets. In each session, subjects were allowed 10 minutes to complete each replication, and a two minute rest period was interposed between successive replications.

Cued recall. Twenty-four subjects were randomly assigned to one of two groups of 12 subjects each. Subjects in each group studied the same list of metaphors and were later asked to recall them with different sets of cues. The five noun pairs were typed on 3 × 5 index cards in the form $NOUN_S$ IS/ARE $NOUN_P$ and were presented to subjects in decks. Since there were only five target pairs, 12 filler metaphors preceded and followed the target metaphors in each deck. The order of target metaphors within the decks was randomized for each subject.

In the acquisition phase of the study, subjects were instructed to memorize the metaphors and also that they would be later asked to recall them. Metaphors were exposed for seven seconds each, and the

subjects proceeded through the decks in response to a verbal signal given by the experimenter. A two minute rest period separated the acquisition and cued recall phases of the study.

In the recall phase, subjects in each group were given one of two booklets of recall cues. All cues were in the form of an incomplete metaphor; an adjective, a verb, and the qualifier LIKE were provided, but the two key nouns were left blank. The first booklet (S) differed from the second booklet (P) only in terms of the syntactic position of the adjectives given. In Booklet S, adjectives always appeared in the subject phrase of an incomplete metaphor (for example, SOFT_____ FLOWS LIKE_____), while in Booklet P, adjectives always appeared in the predicate phrase (for example, _____ FLOWS LIKE SOFT_____). Otherwise, the procedures used to construct both booklets were identical.

Booklets consisted of nine pages of cues, with five cues per page. Each page corresponded to the adjectives and verbs from one cell of the 3 × 2 × 3 design previously described. Pages were arranged into three blocks such that no adjectives or verbs were repeated within a block. Thus, each block of three pages contained completely different cues to the five target noun pairs. Page order within blocks was balanced so that each set of adjective and verb repetitions appeared in each position (page one through three) once and only once across blocks. Block order was completely counterbalanced across subjects.

Pages in the recall booklets were collated with a blank sheet separating blocks. Subjects were instructed to read each incomplete metaphor and to fill in the blanks with the noun pairs from the

metaphors they had studied earlier which made the most sense in the contexts given. Further, subjects were told that although the same noun pairs could be repeated on different pages, they should not use the same noun pair to complete more than one metaphor on a single page. Subjects were encouraged to give partial responses if they could not remember both nouns in a metaphor. Subjects were given 30 seconds to complete each metaphor within a block, and a one minute lag was interposed between blocks to minimize the effects of repeated exposure to the adjectives and verbs.

Results and Discussion

The transivity (internal consistency) of subjects' judgments on the two rank order tasks was assessed by calculating a coefficient of concordance for each replication. In each of the 10 cases, differences between metaphors were highly reliable over subjects (all $p < .001$). Averaging across replications, the mean coefficients of concordance for constituent similarity and interpretability judgments were .286 and .402, respectively. Thus, subjects were moderately consistent in their judgments and metaphors within replications were reliably scaled on both dimensions. Paired comparison data were then deduced from the results of the two rank order tasks. Rank order judgments were converted into all possible pairwise comparisons between metaphors in each replication. Constituent similarity and metaphor interpretability indices were derived as the percentage of observations in which one metaphor was judged greater than all other metaphors on a particular

dimension. In the data analysis, an arcsine transformation of these percentages was made to stabilize the variances.

Cued recall scores were calculated for each metaphor in the same manner as in Experiment II. Individual subject's responses were scored as 2, if both nouns in a metaphor were correctly recalled; 1, if only one noun was correctly recalled; otherwise, responses were scored 0. Cued recall scores were calculated as the percentage of subjects correctly recalling the nouns in a metaphor (cumulative score divided by 24).

Constituent similarity, interpretability, and cued recall scores served as the dependent variables in a four-factor, multivariate analysis of variance. Adjective type, adjective position, and verb type were treated as fixed effects, and the noun pairs factor (replications) was treated as a random effect. Significance tests in this analysis were based on Bartlett's approximation to Wilks' likelihood-ratio criterion. Overall tests in the analysis of variance revealed significant main effects of adjective type, $\underline{X}^2$ (6) = 12.65, $\underline{p} < .05$; adjective position, $\underline{X}^2$ (3) = 12.89, $\underline{p} < .005$; verb type, $\underline{X}^2$ (6) = 39.41, $\underline{p} < .001$; and the adjective type × adjective positive interaction, $\underline{X}^2$ (6) = 41.68, $\underline{p} < .001$. No other interactions approached significance (all $\underline{p} > .20$). The mean score vectors which differed significantly are shown in Tables 6 and 7.

Since the adjective type × adjective position interaction was significant, simultaneous confidence intervals were applied to the univariate differences associated with this effect and to the verb type

Table 6

Mean Scores on Constituent Similarity (CS), Metaphor Interpretability (MI), and Cued Recall (CR) Variables for Adjective Type as a Function of Adjective Position

Adjective Position	Variable	Adjective Type		
		Common	Subject-Unique	Predicate-Unique
Subject Phrase	CS	53.81	58.79	41.55
	MI	56.72	62.34	33.78
	CR	25.00	29.46	8.87
Predicate Phrase	CS	53.83	40.28	51.72
	MI	56.86	35.89	54.41
	CR	32.50	18.63	36.67
Total:	CS	53.82	49.53	46.63
	MI	56.79	49.11	44.09
	CR	28.75	24.04	22.77

Table 7

Mean Scores on Constituent Similarity (CS), Metaphor Interpretability (MI), and Cued Recall (CR) Variables for Verb Type

Variable	Verb Type		
	Common	Subject-Unique	Predicate-Unique
CS	55.90	46.52	47.58
MI	61.95	44.40	43.65
CR	23.04	29.58	22.92

factor. These tests revealed that all variables contributed independently to the overall significance of the interaction ($p < .01$) as well as the main effect of verb type ($p < .05$). The main effect of adjective type was consistent with the hypothesized order; Common > subject-unique > predicate-unique. But in order to interpret this effect in light of the interaction with adjective position, orthogonal contrasts were made within each level of the latter factor using Hotelling's T^2 to identify the source of nonadditivity (Winer, 1971).

Within the subject phrase position, subject-unique adjectives led to higher constituent similarity, interpretability, and recall than predicate-unique adjectives, $T^2 = 82.74$, $p < .001$. Common property adjectives led to consistent facilitation across all three measures relative to unique adjectives, $T^2 = 17.28$, $p < .05$. But within the predicate position, predicate-unique adjectives facilitated metaphor processing relative to subject-unique adjectives, $T^2 = 20.54$, $p < .05$. Although common property adjectives exceeded the average of both unique adjective types, this result was not significant within the predicate phrase position, $T^2 = 9.18$, $p > .10$.

In general, adjectives which relate to both nouns in a metaphor increase their similarity and produce more interpretable metaphors than unique adjectives. This is further supported by the results of the cued recall study. Adjectives which are semantically congruent with the wholistic representation of the unmodified metaphor serve as better cues for recall than adjectives which emphasize properties of the individual constituent nouns (cf. Reder et al., 1974). The

facilitation effects of common property adjectives implies that by increasing the salience of features shared by the constituent nouns, the uncertainty (or ambiguity) of the resulting semantic representation of the metaphor is reduced. Sentence context serves to make certain features of the constituent nouns more salient and the extent to which the two feature sets are compatible determines the course of ultimate comprehension. When the features emphasized by adjectives are unique to either constituent noun, it is more difficult to integrate them into a single meaning. However, the difference between adjectives positioned in the subject phrase versus the predicate phrase indicates that the syntactic structure of a metaphorical proposition is also an important consideration.

The influence of adjective position on metaphor comprehension is analogous to the effect of category size on lexical decisions (see Experiment II). Common property adjectives were most effective when positioned in the predicate phrase (see the first column of Table 6, p. 76). The effects of unique adjectives are position specific, and yet intuitively reasonable. Modifying the subject noun by a subject-unique adjective resulted in better metaphor comprehension than modifying it by a predicate-unique adjective, while the reverse was true for the predicate noun. If the present argument is correct, modifying the predicate noun by a common property or predicate-unique adjective decreases the uncertainty of that noun's feature distribution, whereas modifying the predicate noun by a subject-unique adjective increases its uncertainty. This is a reasonable explanation since an

unlikely juxtaposition of an adjective and a noun induces more features into the noun's internal representation than if the noun is unmodified. On the other hand, an appropriate juxtaposition constrains the potential feature representation of the unmodified noun. In terms of the feature-synthesis model, appropriate modification reduces the semantic input to the working memory, while inappropriate modification increases the amount of semantic information to be processed.

Table 7 (p. 76) shows that the predicted order for the three verb type conditions resulted on only one variable—metaphor interpretability. With respect to constituent similarity and metaphor interpretability, it is clear from Table 7 (p. 76) that the common event verb differed significantly from the unique verb types, but the latter was not appreciably different. Cued recall data, however, complicate the verb picture considerably. Here, the subject-unique verb type cued recall most effectively and the common event and predicate-unique verb types were not reliably different.

One possible explanation for the enhancement effect of the subject-unique verb type is that this may be an artifact of the scoring procedure. Reexamination of partial recall data revealed that subject nouns were more often recalled (64% of the time) than predicate nouns. This finding is in agreement with the results of other memory studies (see, for example, Clark & Card, 1969). A bias to recall subject nouns was also supported by the observation that the number of syntactic reversals—recalling the subject noun in the predicate position, and vice versa—was lowest when the subject-unique verb type was used as

a recall cue. It is not surprising, then, that a verb which describes an event associated with the subject noun of a metaphor should appear to be the most effective recall cue when partially correct responses are considered. Unfortunately, there was insufficient variance in verbatim recall to permit additional analyses of the effects of the verb factor. To be sure, the effects of verbs on language comprehension are about as clear in this experiment as in previous research on the topic. Yuille (1973), for example, provides a summary of numerous studies in which an adequate explanation of the facilitation effects of various verb forms on noun pair learning has proven elusive.

The final point of interest in this experiment is the lack of an adjective type × adjective position interaction on any variable. These nonsignificant results provide insight into the cognitive operations underlying the second stage of the proposed feature-synthesis model. The fact that adjective type did not interact with verb type suggests that adjective-noun pairs are synthesized prior to subject-predicate combination (see Sternberg's, 1969, explanation of processing stages). If adjective-noun pairs are combined during an initial stage of feature synthesis, an additional stage may be operative in which the verb influences the synthesis of the two constituent phrases.

The results of the third experiment support the primary hypotheses about processing metaphors with complex sentence structures. Evidence for a feature-synthesis process was found on three response measures. However, the model has failed to explain how verb forms other than the copula influence the recall of metaphors.

CHAPTER VI

IMPLICATIONS

The feature-synthesis model is based upon the assumptions that semantic features represent continuous dimensions of word meaning and that depending on the particular contextual circumstances, certain features may become more or less important to the situational meaning of a word or sentence. The model also serves to emphasize the dynamic nature of language comprehension; individuals create a meaning from word complexes. In the first experiment, it was shown that the model predicted the form of several relationships between literal, figurative, and anomalous sentences. Although this experiment did not address the contention that so-called anomalous sentences are often amenable to figurative interpretation (see Pollio & Burns, 1974), this is not problematic for the feature synthesis model. It was suggested in the Introduction that a rigid distinction between figurative and anomalous sentences is, at best, tenuous—the model explains that anomalous sentences are simply less comprehensible than figurative sentences. The second and third experiments dealt only with the comprehension of metaphorical propositions. The effects of sentence context and meaning uncertainty on metaphor processing provided strong support for the proposed model as well as for feature theories in general.

Consider a recent criticism of Kintsch's (1972) explanation of metaphor comprehension by the special application of "compression" and

"analogy" rules (p. 280-286). As Collins and Quillian (1972) suggest, there is no line on one side of which is semantic acceptability and on the other side of which is metaphor. In Kintsch's system and others like it (for example, Weinreich, 1966; Bickerton, 1969) provision is made for two distinct processes or rule systems where only one is necessary. Perhaps the recognition that metaphor, especially in poetic usage, testifies on behalf of the flexible nature of meaning and the constructive processes in language comprehension has led to the mistaken suspicion that understanding figurative speech requires linguistic abilities (or competence) above and beyond those exercised in understanding more ordinary discourse. Comparison of the nature of metaphor with the nature or literal language is instructive because it stresses that all language comprehension relies on the same active, constructive process.

A proposal such as feature synthesis, however, cannot rescue a semantic theory formally entangled in the structure of meaning, for synthesis clearly implies a concern for process and therefore momentary structures. As Johnson (1972) concluded, language is figurative to the extent that the meaning of a word depends on its use in a given context, rather than some dictionary reading. This seems to offer two possibilities for the future course of semantic theory. First, a complete semantic theory would need to include a system of rule-changing rules (Price, 1974). For example, Katx (1964) proposed a type of projection rule, distinct from the Katz and Fodor (1963) type, which changes the internal structure of semantic markers (features). Combinatorial rules

permit different readings of the same word over a variety of linguistic contexts without the need to enumerate an infinite variety of possible selection restrictions on acceptable usage (for a review of this formulation, see Savin, 1972). But any such endeavor to formalize special linguistic rules is, again, inconsistent with the nature of language use. Alternatively, following the lead of Katz and Fodor (1963), one can arbitrarily mark the domain of semantic theory to eliminate more troublesome nuances of language behavior such as metaphor. In this case, one can adopt a set of conventions which distinguish admissible competence criteria from inadmissible performance criteria. This reduces to an exercise in lexicography, or establishing what Weinreich (1966) termed the structure of lexical entries in a "normal" dictionary.

Metaphor is somewhat less enigmatic in psychological theory—feature synthesis is a notion consistent with current thinking about information processing and remembering. A major advantage of the model is its generality, particularly where many language processing models are narrow in scope and rather task specific. Through converging operations, the proposed model illustrates the continuity of extant theories and lends support to the construct validity of a single process in the encoding, organization, retrieval, and ultimate comprehension of semantic information.

Finally, several implications for psychological research are worthy of mention. As Barclay et al. (1974) noted, attention to semantic flexibility prompts an evaluation of the role of normative

techniques in psycholinguistic research. Given the assumption that meaning is created in a particular linguistic setting, normative references will fail to disclose the unique contribution of each and every distinct context to semantic interpretation. This is not to dismiss the value of normative data, indeed these provide perhaps the only starting point for constructing an experiment on language behavior. Put simply, psychologists must begin to sample contexts as well as word units and subjects (Johnson, 1972).

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