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On the Use and Meaning of Prepositions

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This study explored the relationship between the use and meaning of 33 prepositions. The *S*s composed sentences for each preposition and then found sensible substitutes for the prepositions; other *S*s gave free associations to each preposition; and other *S*s grouped the repositions according to their meaning. Patterns of prepositional similarity, derived for the three procedures, showed that prepositions with overlapping substitutes generally had overlapping contexts in sentences, had overlapping free associations, and frequently belonged to the same groups. Free associations were most often the substitutes of a preposition and next most often nominals differing from, but having common properties with, its objects in sentences. The results implied: (a) that a *S* treats two prepositions as being semantically related to the extent that they are interchangeable in sentences; and (b) that a *S* implicitly uses hierarchical phrase structure rules and cognitive categories corresponding to prepositional and noun phrases when he gives free associations and when he makes judgments about meaning.

Clearly, a word's subjective meaning in isolation must be related to its uses in sentences. The present study was designed to explore this relationship for 33 common English prepositions.

Harris (1954) has proposed some general relationships between the possible use of a word within English syntax and its meaning in isolation. He has argued that two words similar in meaning will often fit into nearly identical contexts, but that two dissimilar words will require quite different contexts. His notions lead to the prediction that two nearly synonymous prepositions will often be found, for example, in prepositional phrases with the same object. Compare *to*, *toward*, and *during*. A speaker might say *to the town* or *toward the town*, but rarely *during the town*; similarly, he might say *during the day*, but rarely *to the day* or *toward the day*. Naturally occurring sentences which contain *to*, *toward*, and *during*, therefore, should show the similarity relations among these three words. *To* and *toward*—as compared with *to* and *during*, or *toward* and *during*—should have more sensible substitutes in common, more prepositional objects in common, and more words in common which are modified by their prepositional phrases. In the present study, the necessary sentences were gathered by asking *S*s to compose sentences for each of the 33 prepositions and, later, to find substitutes for the prepositions in their sentences.

Discovering what a word means independently of any linguistic context is difficult. Dictionaries typically define a preposition in terms of other prepositions which can substitute for it in various contexts; dictionaries do not usually indicate what the preposition "denotes". This observation points up the need to treat prepositions and their meanings as a system of relations. *Inside* means something mainly in relation to *outside*, *in*, *into*, *within*, and other prepositions. In the present experiments, the 33 prepositions were studied by examining the similarities in

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meaning among them. The total pattern of similarity gives a comprehensive picture of the semantic relations among all the prepositions.

Two procedures were designed to get *S*s to reveal their knowledge of words outside of linguistic contexts. In the first, *S*s gave free associations to each preposition. Two prepositions similar in meaning will elicit overlapping sets of associations, so the amount of overlap is a convenient measure of the pair's similarity. Deese (1962, 1964, 1966) has used this method of measuring similarity and has successfully derived interpretable meaning relations within various sets of words. In the second procedure, *S*s provided natural groupings of the 33 prepositions, groupings which reflected their meanings. Two prepositions similar in meaning will often be placed in the same group, so a natural measure of their similarity is how often they are grouped together.

It is proposed in the present study that (a) people generate sentences which distinguish among the meanings of prepositions and (b) people give free associations and make direct judgments about prepositional meaning using many of the same mechanisms they used in generating sentences. Stated differently, the semantic distinctions implicit in free associations and direct judgments of meaning must also be apparent in the surface structure of language.

From three independent experimental procedures, five different indices were derived for the similarity of any pair of prepositions. A pair's similarity was measured by: (a) the overlap of the prepositions substitutable for each in sentences; (b) the overlap of their objects in sentences; (c) the overlap of the words modified by their prepositional phrases in sentences; (d) the overlap of their free associations; and (e) the frequency that *S*s placed the pair together in the groups they formed. A multidimensional scaling technique was used to construct an overall pattern of similarity among the prepositions for each criterion separately. The five resulting patterns were then compared for their congruencies.

METHOD

Stimulus Prepositions. Thirty-three prepositions were selected from complete lists of English prepositions, available in any English handbook. The words chosen were among the 500 most common English words (Thorndike and Lorge, 1944) and were prepositions in their principal usage. The 33 prepositions selected for study are listed in Fig. 1a.

Sentence-Composition Task. The *S*s who composed sentences for each preposition were 110 eighth- and ninth-grade public school students and were, by and large, superior students. They were asked to use each preposition in "the first simple but good English sentence that came to mind," but also "to try to write sentences about many different things" for different prepositions. ("Simple" here meant simply uncomplicated.) After writing out each sentence, *S*s circled the preposition they were to have used in the sentence. They were reminded that prepositions had objects and were shown a sample written sentence (using *behind*) with its circled preposition and its object.

After the *S*s had written sentences for all 33 prepositions, they were asked to think of a word that could replace the circled preposition in each sentence and to write it immediately above the circled preposition. They were told that their sentences, after substitution, must still make good sense, but need not keep the same meaning.

To construct the data forms for sentence composition, the 33 prepositions were placed in two random sequences and, for both sequences, were typed along the left-hand margins of three successive mimeographed sheets (11 prepositions per sheet). A given *S* received the three sheets of either sequence in one of the six possible orderings of the three sheets. He wrote his sentences containing a preposition in the space immediately to the right of the word typed on the sheet.

The *S*s worked in groups of 20–30 and were allowed 35 min to complete the task. Twenty-five of them were eliminated from analysis because they did not finish in the time allowed. This left 85 *S*s for use in the analysis.

Three single grammatically defined words were extracted from each of the 33 sentences written by each *S*:

(1) The *Preposition Substituted* was that word each *S* substituted for the given (circled) preposition in the sentences he wrote. Although the *S*s were not specifically asked to do so, they always, with one exception, substituted prepositions or adverb-preposition clusters (e.g., *away from*) in their sentences; the few adverb-preposition clusters were treated as single words.

(2) The *Object of the Preposition* was the head noun or pronoun of the object's noun phrase; for prepositions with two or more objects only the first one was considered. A sentence using the given word as something besides a preposition was deleted from analysis altogether. Preposition-words were not considered prepositions when they were contained in verb-plus-particle constructions (such as *up* in *called up her friend*) or in preposition-with-object-deleted constructions (such as *in* in *let in the dog*). In both constructions, the particle and "adverb", respectively, can be exchanged with their pseudo-object noun phrases (Fraser, 1966).

(3) The *Word Modified* by the prepositional phrase was specified by several rules. In most cases, the Word Modified was unambiguously the noun or verb immediately preceding the prepositional phrase. A prepositional phrase following a copula modified the head noun of the subject's noun phrase. In other cases, adverbial prepositional phrases of time, place, or manner modified the main verb. Where there were two or more modified words in parallel, the first was chosen. If the word modified was properly a relative, then the relative's antecedent was taken as the Word Modified. In all cases, the Word Modified was a single word.

For the three grammatically defined words, obvious spelling errors were corrected, and plurals and their singulars were considered identical. The various inflected forms of a verb were also counted as identical.

For each preposition, then, there were up to 85 single words used as Prepositions Substituted, as Objects of the Preposition, and as Words Modified. These 33 × 3 sets of words constituted the raw data of the sentence-composition task.

Free-Association Task. The *S*s in the free association task were 82 Johns Hopkins University male undergraduates, all enrolled in the introductory psychology course and all fulfilling a course requirement.

Sixty-seven words, chosen from the Thorndike-Lorge (1944) list of the 500 most frequent English words, were added to the list of 33 prepositions to form a grammatically heterogeneous list. The 67 additional words included 15 nouns, 15 adjectives, 10 verbs, and 10 adverbs; the remaining 17 words were conjunctions, pronouns, and articles. The 100 stimulus words were each printed alone in the middle of an IBM data card and were given to each *S* in one of eight different random orders. The *S*s printed their free associations to the right of the printed stimulus word.

The *S*s were told they would be given 100 common English words; they were to write down the first word that came to mind for each, working quickly. They worked on the free-association task in groups of 10–30.

The free-association data, then, consisted of a set of 82 free associations for each preposition. The associations were corrected for obvious spelling errors, and plurals were changed to their singular form.

Grouping Task. The *S*s in the grouping task were 114 Johns Hopkins University male undergraduates, all fulfilling a course requirement for the course in introductory psychology. These 114 *S*s included all 82 *S*s used in the free-association task, which preceded the grouping task.

The 33 prepositions, each printed in the top middle of an IBM data card, were given to each *S* in one of eight random orders. The *S*s were instructed: "You will be asked to group 33 common English prepositions according to their meaning. That is, some prepositions are more related to each other in meaning than are other prepositions; the prepositions seem to fall into natural groups. First, you are to place all 33 prepositions into anywhere from two to six groups, the groups that seem most natural to you. You can put as many prepositions in each group as you want. Then, once you have formed the main groups, take each main group and divide it into as many subgroups as you think are necessary. You do not necessarily have to subdivide any of your main groups; and again, the subgroups can be any size you wish to make them. It is stressed that you break the prepositions into the groups and subgroups that seem most natural to you."

Individual *S*s, working at their own pace, spread the cards out on their desks, formed the two to six main groups, and separated the main groups with colored IBM cards. Then they took each main group one at a time, formed subgroups, and separated the subgroups with white IBM cards. The *S*s worked on the task in groups of five to 30.

Methods of Analysis

The goal of part of the data analysis was to construct spatial representations of the 33 prepositions. In order to do so, it was necessary to measure the similarity of each pair of prepositions, since each spatial configuration was to reflect the similarities among all possible pairs of prepositions at once. Graphically, prepositions with similar meanings will stand near each other, and prepositions with very different meanings will stand far apart. The analysis of proximities (Shepard, 1962; Kruskal, 1964) is an iterative scaling technique which attempts to do this. It yields the best-fitting monotonically decreasing function between the distances in a spatial representation of few dimensions and the measured similarities of all pairs of objects in the representation. (For a good description of this technique, with examples, see Shepard, 1963.)

The similarity measure used for four of the five similarity criteria was the Intersection Coefficient, a measure of the similarity of two distributions of words (Deese, 1962). Marshall and Cofer (1963) have called the same measure the Measure of Relatedness; McNemar (1962) has called it the common-elements correlation coefficient. For the Intersection Coefficient,

one set of n_1 words (tokens) is compared with a second set of n_2 words to find the number of words n_{12} in the first set which can be uniquely paired with identical words in the second set. Then, $IC = n_{12}/(n_1 n_2)^{1/2}$. This measure represents loosely the proportion of identical words in the two sets and seems to reflect the similarity between the two sets.

The *IC* was used with the addition of "representational responses" in measuring the similarity of Prepositions Substituted and Free Association (see Deese, 1962); for example, the stimulus preposition itself was first added to the set of Prepositions Substituted, once for each *S* still included in the analysis. In a very few instances *S*s gave no responses at all for the Preposition Substituted, Object of Preposition, Word Modified, or Free Association categories. Each blank was treated as if it were a word different from all other actual and blank responses.

For the fifth criterion, the Grouping Task, the similarity measure reflected how often two prepositions were placed in the same groups and subgroups. Any *S* set forth only three levels of judged similarity (relatedness) in his groupings—high similarity within subgroups, medium similarity within main groups but between subgroups, low similarity between main groups. So for a single *S*, two prepositions were given a grouping score of 1.0 if they were both in the same main group and in the same subgroup, a score of .5 if they were in the same main group but in different subgroups, and a score of zero if they were in different main groups. The final grouping measure for two prepositions was the pair's mean grouping score for all 114 *S*s. If many *S*s placed two words in the same group or subgroup—indicating that the two were judged to be closely related in meaning—the two would have a high grouping measure and hence a high similarity.

Thus for each of the five criteria, there was a similarity measure for each of the 528 possible pairings of the 33 prepositions; this is represented by a symmetrical 33×33 matrix of similarity measures. Kruskal's (1964) multidimensional scaling method was performed directly on each of these five matrices. The first three criteria—Prepositions Substituted, Objects of Prepositions, and Words Modified—came from one population of *S*s, and the last two—Free Associations and Grouping Task—came from a different population of *S*s. Because the similarity indices for the first four criteria all utilized the Intersection Coefficient and about the same number of *S*s, they are comparable in sensitivity. The important comparisons do not involve different *S* populations or varying sensitivity.

Results

Figures 1a, b, c, d, and e picture the matrices of similarity measures from the five criteria. Each configuration is the best possible two-dimensional representation according to Kruskal's criterion.

In addition, each configuration has been supplemented by a clustering solution (Johnson, 1967), which shows groups of similar prepositions enclosed in solid or dashed lines. The clustering method itself, Johnson's "maximum method," forms sets of successively larger and larger clusters of similar prepositions, although only two kinds of clusters have been drawn in each figure. Loose clusters have been enclosed by dashed lines, and tight clusters by solid lines. The loose clusters in Fig. 1a have been constructed (a) by taking the 115 largest of the 528 possible similarity measures, (b) by forming the best set of mutually exclusive clusters in which the similarity between each pair of prepositions within a cluster is among these 115 measures, and (c) by enclosing all such clusters in dashed lines. The tight clusters enclosed in solid lines are formed similarly, but only the 35 largest similarities are used; consequently, all tight clusters are included within loose clusters. The loose and tight clusters shown in the five figures are each formed at natural breaking points in the clustering solutions, points which are approximately equivalent for the five different figures.

The two-dimensional spatial configuration and the clusters in each figure are meant to complement each other, since the true configuration is of many more dimensions. The clusters bring out the relations among highly similar prepositions more clearly than the configuration does, while the configuration shows the gross relations among the clusters of prepositions. The clustering of *up* and *down* in Fig. 1a, for example, corrects the impression, because of their distance, that they are fairly dissimilar. Small local parts of the representation are not always properly formed; in Fig. 1a *within* is nearer to *outside* than to *inside*, although their three pair-similarity measures show the reverse to be true. In general, however, the configurations

plus the clusters represent the data quite well.

To make comparisons among Figs. 1a through e easier, the latter four have been rotated about their centroids so that they are each as congruent with Fig. 1a as possible.[2]

The five pictorial representations, except for Words Modified, easily satisfy one's intuition about prepositional meaning. In the Prepositions Substituted representation (Fig. 1a), the groups formed are of highly related words: *inside*, *outside*, and *within* form one closely knit group; *on*, *off*, and *upon* form another; *between* and *among* form another; and so on. At a grosser level, each cluster seems to neighbor on other clusters similar to it: *up-down* is near *above-across-over*, which in turn is near *under-along-off-on-upon*; *between-among* is near *at-by-near;* and so on. *During-after* is quite distant from other prepositions, since no others are very similar to the cluster at all. The other four representations detail the prepositional relations in much the same way.

Some of the five configurations appear to be more related than others. These relations are indicated more directly in Table 1, which

TABLE 1

RANK-ORDER CORRELATIONS OF THE 528 SIMILARITY MEASURES ACCORDING TO THE FIVE MAIN CRITERIA

	2	3	4	5
1. Prepositions Substituted	.58	.11	.47	.50
2. Objects of Prepositions		.12	.24	.38
3. Words Modified			−.02	.20
4. Free Associations				.30
5. Grouping Task				

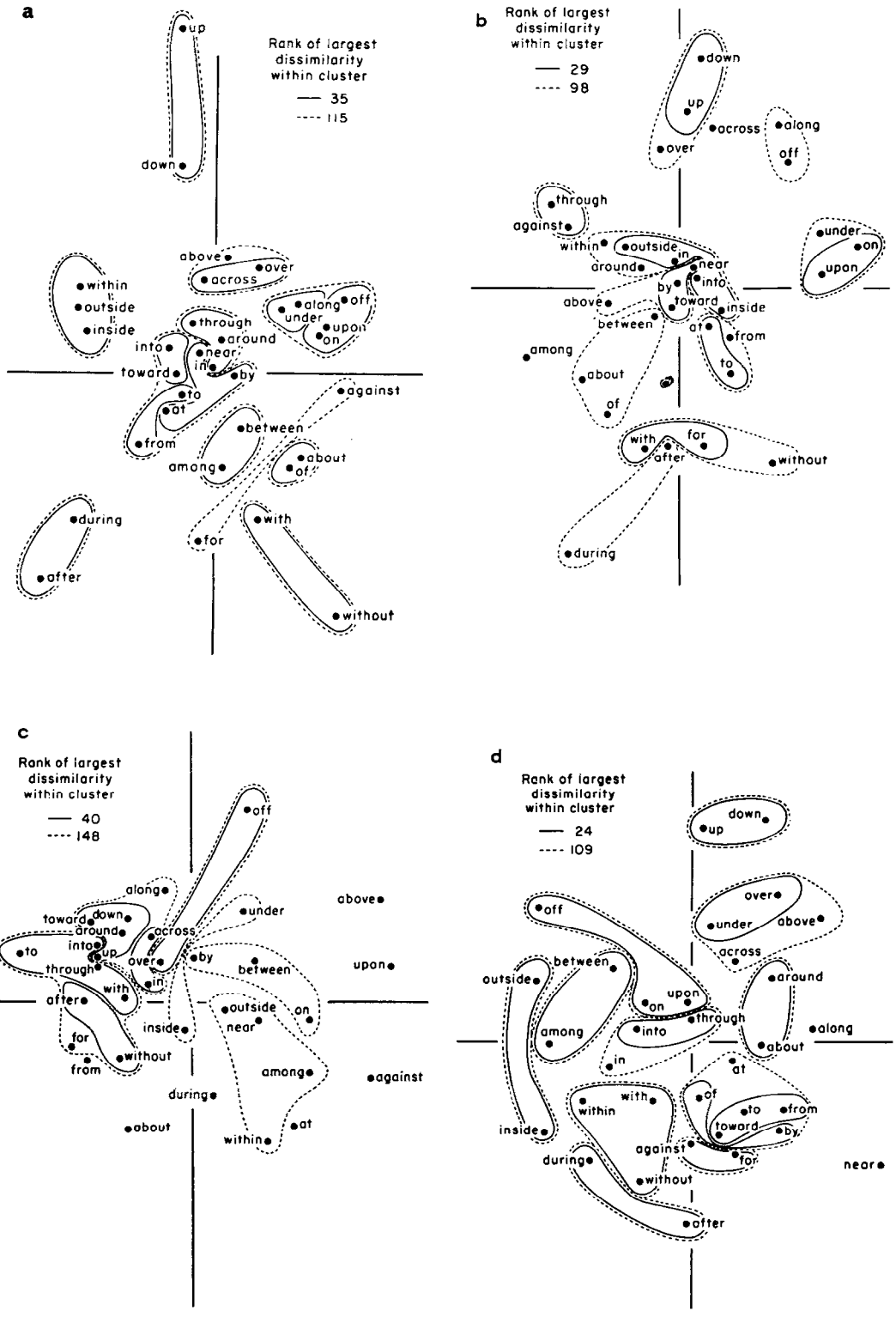
shows the Spearman rank-order correlations among the 528 similarity measures gained from the five criteria. Prepositions Substituted, Objects of Prepositions, Free Associations, and the Grouping Task were all moderately interrelated. The highest correlations occurred between Prepositions Substituted, and Objects of Prepositions, Free Associations, and the Grouping Task; on the opposite end, the lowest correlations occurred between Words Modified and all other criteria.

A property evident in Figs. 1a, b, d, and e, is that the largest differences in meaning among the prepositions can be attributed to what might be called a movement-implied dimension, roughly corresponding with the vertical axis. At the top are prepositions implying much movement (*up*, *down*, *above*, *across*, *over*, *off*, etc.), but at the bottom are prepositions devoid of movement connotations (*without*, *with*, *during*, *for*, *among*, etc.). These semantic distinctions must be built into a preposition's context, for the Prepositions Substituted and Objects of Prepositions reflect the movement property quite naturally. The same distinctions are implicit in *S*s' free associations and in their judgments of the relatedness of two prepositions. The movement-implied dimension suggests the traditional distinctions among kinds of prepositional phrases. Moving down the graph, one finds generally prepositions with meanings of direction, of position, of manner, and of time (*during* and *after*); more generally, prepositions seem to cluster according to these distinctions.

In Fig. 1b, the movement-implied dimension can be given an alternative description in terms of the kinds of Objects each preposition allowed. The Objects to each preposition were first classified as animate, inanimate, or abstract. With Objects classified in this way, it was found that the raw percentages of inanimate Objects correlated .93 with the projections of all prepositions on a line through the centroid of the figure and 19 degrees clockwise from vertical.[3] *Up* and *down*, for example, had nothing but inanimate Objects; on the opposite end, *during* had no such Objects, and *after* had only 5%. This

[2] The rotation was performed using an unpublished computer program written by G. M. Schulman and W. S. Torgerson.

[3] The orientation of this line, rotated so that it correlated maximally with the percentage criterion, was determined by Schulman and Torgerson's unpublished computer program.


a
Rank of largest dissimilarity within cluster
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Rank of largest dissimilarity within cluster
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inanimate dimension is almost identical to the subjectively defined movement-implied dimension, which shows up in all but the Words Modified configuration. The relationship between the two is semantically interpretable: movement is experienced with respect to objects, not abstractions, and with respect to inanimate fixed objects more often than to animate ones.

Discussion

English speakers daily compose sentences with prepositions relying on their knowledge of language. When asked, they can also give free associations and make judgments of prepositional relatedness, both somehow by virtue of this knowledge. Sentence composition, free associations, and semantic judgments were expected to be closely related, and they were found to be so; the five configurations derived were, in the main, very congruent. But how is this congruence to be interpreted in terms of a speaker's linguistic knowledge?

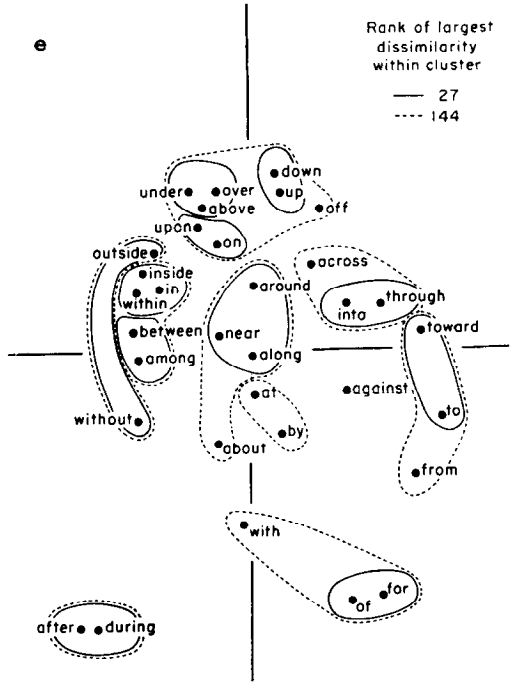

Fig. 1. The two-dimensional configuration and clusters for the five criteria. For Fig. 1a, within the tight clusters (enclosed by solid lines) the least similar pair of prepositions ranked among the 35 largest similarities; within the loose clusters (enclosed by dashed lines) it ranked among the 115 largest similarities. The clusters of Figs. 1b, c, d, and e, have analogous properties. 1a. Prepositions Substituted; 1b. Objects of Prepositions; 1c. Words Modified; 1d. Free Associations; 1e. Grouping Task.

Currently, most linguists distinguish the grammatical from the semantic components in a linguistic description of sentences (Katz and Fodor, 1964). The grammatical component describes sentences in terms of grammatical categories, like nouns, adjectives, and determiners; the semantic component describes the selection of words in sentences once the grammatical component has been determined. Grammatical variation has been excluded in the present study since only prepositions have been examined. What remains is the semantic component. (Strictly speaking, a few grammatical distinctions can be made among prepositions, but for the present these distinctions will be called semantic.)

In this light, the main finding is that two prepositions are treated as semantically related when they are interchangeable in discourse. On the grammatical level, two nouns will be judged to be more closely related than will a noun and an adverb. This judgment is based on the knowledge that the two nouns, when substituted for each other in discourse, are more likely to form sensible sentences. The present results show the same to be true on the semantic level. Free Associations and the Grouping Task—both assumed to reflect meaning relations—were most closely related to Prepositions Subsituted, a criterion reflecting mainly how interchangeable two prepositions were in meaningful sentences. Taken alone, however, this main result glosses over the more detailed linguistic knowledge *Ss* relied on in the present study.

First, it is clear that the *Ss* reflected an implicit knowledge of English syntax in all three tasks. According to phrase-structure

analyses (Gleason, 1961), a sentence such as *The boy went to the store* contains the prepositional phrase *to the store* as a constituent at one level of analysis, and the word modified *went* plus the prepositional phrase as a constituent at another level, (*went* (*to the store*)). By this analysis, a preposition and its object are more closely related than either element is to the word modified. The correlations among the similarity measures of the three sentence-composition criteria (Table 1) bear out phrase-structure analysis: within the prepositional phrase boundaries, the correlation was .58; across its boundaries, the correlations were .11 and .12.

Although the phrase structure itself does not contain meaning, it does indicate where meaning relations should be located. Harris (1954) conjectured that similarity in meaning should be correlated with the distributional properties of words within sentences, just those properties formally described by phrase structure. He would predict, then, that if the Free Association and Grouping Tasks were really measuring similarity in meaning—as it was assumed—their similarity measures should agree very closely with those of the Prepositions Substituted, somewhat less with those of the Objects, and even less with those of the Words Modified. The correlations of Table 1 confirm these predictions: the similarity measures from Free Associations correlated .47, .24, and −.02, respectively, with those from the sentence-composition task; the similarity measures from the Grouping Task correlated .50, .38, and .20, respectively.

A more detailed look at the *Ss*' Free Associations showed that they reflected a phrase-structure analysis of the prepositional phrase quite directly. The Free Associations to each preposition were classified into three categories: (a) words able to be used as prepositions; (b) nouns or pronouns judged able to serve as objects of the preposition; and (c) other associations. The first category, the preposition-associations, made up 45% of the associations; the second category, the object-associations, 29%; and the other associations, 26%. Fillenbaum and Jones (1965) classified the associations to 15 prepositions by grammatical class and found, similarly, that prepositions made up 42% of the associations, nouns and pronouns together, 24%, and other words, 34%. The present percentages again reflect the relative importance to the meaning of a preposition, of other prepositions, its objects, and the words modified (which fall into the other-association category).

According to further analysis, however, preposition- and object-associations apparently contain different kinds of information: one relates mainly to Prepositions Substituted, and the other to Objects of Prepositions. Two matrices of similarity measures—Intersection Coefficients—were computed separately for the preposition- and object-associations, exactly as the measures had been computed for all Free Associations. The similarity measures from the preposition-associations correlated .51 with those of Prepositions Substituted and .19 with those of Objects of Prepositions; the respective correlations for the object-associations were .24 and .28. Prepositions Substituted and Objects were also more closely related to preposition- and object-associations, respectively, than to the full set of Free Associations. This last finding is surprising, since the preposition- and object-association similarity measures, each based on fewer responses, might be expected to be less reliable than the Free Associations measures. These comparisons, along with direct support from the associations, indicate that: (a) the paradigmatic preposition-associations reflect how prepositions are substitutable for each other; and (b) the syntagmatic object-associations reflect the properties of the Objects of Prepositions used in sentences.

The Objects of a Preposition and its object-associations differed in one important respect. The Objects were rarely pronouns (4%), but object-associations were often pronouns (48%). Fillenbaum and Jones (1965) similarly found that 50% of the nominal associations to

prepositions were pronouns. Despite this difference, prepositions demanding mostly animate objects in the composed sentences also elicited mostly animate object-associations; the rank correlation between the percentage of animate Objects and of animate object-associations was .73 ($p < .001$). It is important to note that it was *not* the identity of the specific Objects and object-associations that determined the correlation between the two. It was their underlying properties that were similar—properties such as animateness, concreteness, and so forth. Stated differently, the object-associations are not necessarily the objects *S*s would use in sentences, but they have important properties in common with those objects.

From this evidence, one can attempt to characterize the knowledge—both grammatical and semantic—that a *S* brings to bear in free association. An important property of phrase structure rules is their hierarchical character (Chomsky, 1965). By such rules, for example, *under* directly belongs to the category named Preposition; the Preposition, along with a Noun Phrase, in turn belongs to a Prepositional Phrase; the Prepositional Phrase might in turn belong to a Verb Phrase and follow a Verb. These hierarchical rules can be incorporated into a model of free association. This model assumes that the stimulus *under* suggests each of the higher categories in turn with decreasing probabilities. *Under* most often suggests Preposition, next Prepositional Phrase, and least often Verb Phrase. If *under* suggests the category Preposition, *S*s must give other members of the category—other prepositions—as free associations. If *under* suggests Prepositional Phrase, *S*s must choose whether to give a Preposition or Noun Phrase and, if they choose Noun Phrase, whether to give a noun or pronoun. If *under* suggests Verb Phrase, *S*s must choose whether to give a Verb (the word modified in the present study) or a part of the Prepositional Phrase. Thus the present model accounts for the relative frequency of preposition-, object-, and other associations.

A *S*'s semantic knowledge might also be characterized within this grammatical framework. *Under*, it was said, could suggest the category Preposition and elicit as free associations other members of that category. *Under*, however, would not elicit all prepositions, but only a restricted subset of them—those prepositions which could sensibly replace *under* in sentences (like *under* itself, *over*, and *below*). This restriction would account for the preposition-associations being almost identical to the Prepositions Substituted of the sentence composition task. Likewise, *under* would not elicit all members of the Prepositional Phrase category, but only phrases which could sensibly replace *under*-phrases in sentences (including the *under*-phrase itself). This restriction would account for the object-associations to *under* having the same underlying properties as the Objects of *under* in the sentence composition task. Similarly, *under* would not elicit all members of the Verb Phrase category, but only substitutable members of the category. This restriction would help account for the other associations *S*s gave to *under*. These linguistic categories, restricted by semantic considerations, will be called cognitive units, since they have no linguistic definitions.

Such cognitive units are needed to explain the differences between Objects and object-associations. Earlier accounts of free association, such as Saporta's (1955), assumed that in generating object associations *S*s simply gave nouns or pronouns which often follow *under* in sentences. With this assumption, the object-associations and the Objects for *under* should be the same distribution of words. But they are not. To explain the difference, *under* must be assumed to elicit a cognitive unit corresponding to a prepositional phrase, from which a noun phrase is derived. This procedure does not specify whether the noun phrase is to be a noun or pronoun. It does specify that the noun phrase contain the semantic properties of the higher cognitive

unit. As a consequence, the procedure allows Objects and object-associations to differ in how often they will be pronouns, yet it requires them to be similar in all other underlying properties.

The semantic relations of antonymy and synonymy were clearly implicit in the *S*s' treatment of prepositions. In Figs. 1a, b, d, and e, opposites formed some of the tightest groups. Consider seven pairs of opposites present: *up-down*, *inside-outside*, *on-off*, *over-under*, *to-from*, *with-without*, *for-against*. All their similarity measures were above the median for Prepositions Substituted, for Free Associations, and for the Grouping Task ($p < .008$, for each set, by a sign test); all but one ranked above the median for Objects of Prepositions ($p < .062$). The reasons for this tight clustering are seen in the data. With few exceptions, a preposition's most frequent substitute in sentence composition was its opposite, if it had one; its most frequent association was also its opposite. In both tasks, antonyms usually took precedence over synonyms; for example, *inside's* most frequent substitute and association was *outside*, not *in* or *within*.

Similarity, as measured by the five criteria, is not synonymous with synonymy, since opposites (like *up* and *down*), as well as near synonyms (like *on* and *upon*), were very similar on each of the indices. This observation contradicts Harris (1954), who has implied that similarity in use should correlate with synonymy. The present results suggest, on the contrary, that antonymy might be a more central semantic relation for prepositions than synonymy.

Some of what *S*s do in free association seems to have little relation to the linguistic knowledge they need for composing sentences. *Within* often elicited *without* in free association, probably because of the strong *in-out* association; and in the Grouping Task *without* was grouped as often with *within* as it was with *with*. The *S*s composing sentences, however, used the two words in quite different ways (compare Figs. 1d and e with Fig. 1a).

There is also reason to believe that *S*s in free association did not always react to the 33 stimulus words as prepositions. For example, *near's* most frequent association was *far*, an adjective or adverb. Fraser (1966), however, has pointed out that many other adverbial uses of preposition-words can be derived (in a generative grammar) from prepositional phrases by deleting the object. The command *wait inside* is related to *wait inside the house* in which *the house* has been left unspecified; in this example, *inside's* most sensible replacement is *outside*, the same as if the object were present. In many cases, then, it does not matter whether *S*s treated the stimuli as prepositions or as abverbs, because their associations would reflect the same underlying process.

In summary, an English speaker uses specifiable linguistic knowledge in composing sentences, giving free associations, and judging the relatedness of prepositions. In the most general terms, he treats two prepositions as semantically related if they are mutually interchangeable in meaningful sentences. He will often give one interchangeable word as an association to the other and will judge the two to be related. Opposites, for him, are among the most closely related pairs of words. In associating and judging, he tacitly acknowledges phrase-structure rules. He treats prepositions as if their meaning were correlated most highly with the distributional properties of the prepositions themselves, next with the linguistically proximal objects of prepositions, and least with the more distant words modified. His free associations to prepositions reflect the hierarchical character of phrase-structure rules. He first emits other members of the Preposition category, then other parts of the Prepositional-Phrase category, and then other parts of still higher-order categories. This process implies that free associations originate in underlying cognitive units and not directly in sentences that he might produce.

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