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ROLE OF SEMANTICS IN REMEMBERING COMPARATIVE SENTENCES[1]

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It is proposed that comparative sentences are decomposed into independent semantic features for remembering. To test this proposal, 64 *S*s were presented with eight types of comparative sentences and were later required to recall them. The sentences were either comparative (*is better than*) or equative (*is as good as*); they were either positive or negative; and they contained either unmarked adjectives (like *good*) or marked ones (like *bad*). In recalling presented sentences, *S*s made systematic errors mostly predictable from semantic feature theory. The *S*s tended to reconstruct unmarked from marked adjectives, affirmations from denials, and sentences meaning "strictly greater than" from sentences meaning "greater than or equal to." These preferences are each accounted for by the loss of one semantic feature in memory, not by the forgetting of the surface structure or syntactic features of a sentence.

Several recent experiments have shown that people retain very abstract semantic information from sentences they hear. Fillenbaum (1966), e.g., found that his *S*s often confused such pairs as *open* and *not closed* in memory. This indicated to Fillenbaum that his *S*s had stored in memory a single semantic "reading" which could be realized as either *open* or *not closed*. Sachs' (1967) *S*s were likewise unable to recognize the particular surface form of a sentence they had recently heard, but were able to recognize its semantic content. Neither Fillenbaum nor Sachs, however, attempted to define what form this abstract representation takes in memory. To this end, Clark and Clark (1968) and Clark and Stafford (1969) proposed that what *S*s retain from sentences are "semantic features" (Bierwisch, 1967; Katz & Fodor, 1963). In many pairs of constructions, one member differs from the other by having one additional semantic feature. The theory predicts that *S*s will often recall the simpler form in place of the more complex one, because the additional feature is easily lost from memory and this causes *S*s to reconstruct the semantically simpler form from the more complex.

One aim of the present study was to extend the findings about semantic features to common English adjectives. The properties of many antonymous adjective pairs, like *good* and *bad*, and *wide* and *narrow*, indicate that such pairs are not symmetrical: that one adjective (*good* and *wide*) is "unmarked," while its opposite (*bad* and *narrow*) is "marked." The evidence for this is twofold: (*a*) Unmarked adjectives can be used with a neutral meaning. For instance, *How good is the news?* usually indicates that the speaker does not expect the news to be either good or bad, whereas *How bad is the news?* implies that he definitely expects it to be bad. And (*b*) unmarked adjectives refer to both a region on a scale and the name of the scale itself. So the name of the *good-bad* scale is *goodness,* not *badness,* and we say *The board is two feet wide,* but not *The board is two feet narrow.*

In terms of the aforementioned theory, an unmarked adjective has one less semantic feature than its marked counterpart; i.e., *bad* consists of all the features of *good* plus the added feature [−*Polar*]. The theory predicts that in comparative sentences the feature [−*Polar*] should be more easily lost in memory than spontaneously added, so that

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marked adjectives, like *bad,* should be mistakenly recalled as unmarked adjectives, like *good,* more often than the reverse. To test this prediction, the present study required *S*s to recall, after a short period of time, comparative sentences containing marked and unmarked adjectives. (For a more detailed examination and model of marking, see Clark, 1969b; as well as Greenberg, 1966; and Marshall, 1969).

A second aim of the present study was to confirm that *S*s remember comparative sentences generally in terms of semantic components. For this purpose, it is necessary to look closely at comparative (*is better than*) and equative (*is as good as*) constructions. Linguistically, it has been shown (Doherty & Schwartz, 1967; Huddleston, 1967; Lees, 1961; Smith, 1961) that simple comparative and equative sentences are derived from two primitive underlying sentences or base strings. *A is better than B* is derived from *A is good* and *B is good,* two base strings which are conjoined by a series of transformations. *A is better than B* means, literally, that A is good to a greater extent than B is good. It was hypothesized that the component base strings and the relative position of the two terms on a dimension represent semantically distinct components and would therefore be remembered independently of one another; i.e., *S* would remember that A and B are good independently of the fact that A is above B in goodness.

Moreover, the relative position of A and B was itself expected to be remembered as a composite of semantic features. First, both the positive sentence, *A is better than B,* and the negative sentence, *B isn't as good as A,* mean "A is greater than B in goodness." However, both *A is as good as B* and *B isn't better than A* mean "A is greater than *or equal to* B in goodness." (As a shorthand for these two meanings, "greater than" and "greater or equal," respectively, are used even where "less than" and "less than or equal to," respectively, would be appropriate.) Note that the second type of comparison contains all the relational notions of the first type (greater than) plus an additional notion (equal to). It was expected that the additional feature of "equal to" would be easily lost so that "greater or equal" sentences would be reconstructed as their corresponding "greater than" sentences more often than the reverse. Second, it was proposed that positive and negative constructions differ by a single semantic feature. Negative sentences are related to their positive counterparts in that the former deny what the latter affirm. It was hypothesized, therefore, that a denial would be stored in memory as an affirmation plus a feature indicating the sentence was a denial. Since the denial feature should often be lost in memory, negative sentences should be reconstructed as positive more often than the reverse.

Methods

Materials.—Eight pairs of unmarked-marked antonymous adjectives were selected: *happy-sad, hot-cold, clean-dirty, old-new, pretty-ugly, fast-slow, wide-narrow,* and *good-bad.* Seventy-two triples of nouns, nine triples for each adjective pair, were then composed. Two triples for the adjectives *good* and *bad,* e.g., were *desserts, pie, cake* and *snack, hamburger, hotdog.* The first noun was used as a recall cue and the second two nouns as the two terms in a comparative sentence. For example, some *S*s studied the following noun cue and sentence:

The desserts. The pie isn't as bad as the cake.

Later, presented with only the noun cue, *The desserts,* these *S*s attempted to recall the sentence.

Each triple was used to construct eight comparison sentences. For the adjective pair *good-bad* and the triple (*desserts, pie, cake*), e.g., there were the following eight sentences:

1. The pie is better than the cake.
2. The pie is as good as the cake.
3. The cake isn't better than the pie.
4. The cake isn't as good as the pie.
5. The cake is worse than the pie.
6. The cake is as bad as the pie.
7. The pie isn't worse than the cake.
8. The pie isn't as bad as the cake.

These sentences are distinguished by the following three properties: (*a*) They are either comparative (1, 3, 5, 7) or equative (2, 4, 6, 8); (*b*) they are either positive (1, 2, 5, 6) or negative (3, 4, 7, 8); and (*c*) they contain either unmarked adjectives (1, 2, 3, 4) or marked adjectives (5, 6, 7, 8). The order of *pie* and *cake* was determined at random for the first sentence, but fixed by that decision for the remaining seven sentences. One important property of these eight sentences is that they are

all at least partially synonymous. Another is that interchanging the order of the two nouns produces sentences nearly antonymous in meaning to the original eight sentences. There were 72 octuples of sentences altogether.

Procedure.—Every *S* received a study deck and a recall deck. The study deck consisted of the 72 sentences he was to study, 1 from each octuple. Each was printed on a separate IBM card together with its noun cue. The sentences were separated by blank cards into nine blocks of 8 sentences each. The recall deck was precisely identical to the study deck in form and in order except that the sentences to be recalled were omitted.

An *S* studied each sentence in his study deck for 7½ sec., one after another in blocks of 8 sentences. Beginning with the first block, he heard a signal every 7½ sec. to turn from one card to the next. On encountering the blank ninth card, he turned to the recall deck and, working at his own pace, attempted to recall the 8 sentences in order to the appropriate noun cues. Once he had tried 1 sentence and had turned to the next noun cue, he was not allowed to go back. The entire procedure was repeated for the next eight blocks of sentences. The first block was included for practice only and was discarded before analysis, leaving 64 sentences.

The *S*s were 64 introductory psychology students from Carnegie-Mellon University fulfilling a course requirement. They were randomly assigned to eight equal groups, each group receiving one of eight different study decks. The *S*s were run in groups of 8–16 in sessions lasting about 45 min. The *S*s were urged by the instructions to recall the sentences verbatim. When they could not recall a sentence completely, they were to write down what they could remember, even if they could only remember parts of the sentence.

Experimental design.—The study decks were put together according to a carefully counterbalanced design. The goals of the design were to have each *S* encounter one of each adjective pair in each block, each construction in each block, and each adjective pair in each construction. These three specifications were to be uncorrelated with each other as well as with the positions of the sentences within each block. To meet these constraints, eight different study decks were prepared in an 8 × 8 Graeco-Latin square design. First, one order of the 72 noun cues was made for the eight decks; the cues were to be for a different construction type in each deck. The Graeco-Latin square, then, consisted of four orthogonal variables: (*a*) the eight decks, (*b*) the eight adjective pairs, (*c*) the last eight blocks, and (*d*) the eight positions within each block. The practice block in each deck was identical to the very last block, except, of course, that different noun triples had been used. This elaborate counterbalancing was used so that any serial recall strategies or learning-to-learn phenomena would affect all the conditions equally.

Results

In recalling presented sentences, *S*s made many errors. These errors are displayed in Table 1 in a tally of sentence forms *S*s recalled for each presented form; the head of each column lists the form presented, and the head of each row the form recalled. The only responses tallied are those that contained (*a*) either the correct underlying adjective or its opposite, (*b*) a recognizable comparison construction, and (*c*) at least one of the appropriate two nouns. Of the 27% of the responses not tallied, 41% were failures to respond, 25% consisted of nouns with no relational term, and the rest consisted of only an inappropriate relational adjective. In the upper 8 × 8 matrix are tallied the recalled sentences which are partially or wholly synonymous with the presented sentence; in the lower 8 × 8 matrix are those which are partially or wholly antonymous with the presented sentence. In Table 1 and elsewhere, *good* and *bad* represent all unmarked and marked adjectives, respectively.

The errors were statistically analyzed primarily by three-way analyses of variance, with one fixed treatment factor (e.g., the eight construction types) and two random factors (the eight adjective pairs and the 64 *S*s) (Winer, 1962). Adjectives were considered a random factor in order to be able to generalize across adjectives as well as across *S*s (Coleman, 1964). The appropriate error term for testing the fixed factor in such a design is a combination of two-way and three-way interactions, depending on the size of the former. But because calculation of the three-way interactions would have to be carried out on dichotomous values only and because various interaction terms had been systematically confounded, the usual error term could not be used. Instead, the fixed effects were tested against the two random effects separately (adjectives and *S*s), with the reasonable assumption that the Treatment × Adjectives and the Treatment × *S*s interaction variances are zero and their estimates consist solely of error variance.

Parametric F tests were used where possible; nonparametric tests were used for response bias where the scores, though not independent, contained order information appropriate for nonparametric tests.

First, some overall properties of the matrix are discussed, and then two specific properties are dealt with in detail—the effects of the marking of the adjectives and the effects of the type of comparison construction.

Overall results.—The *S*s' preference in recall for certain constructions over others can be seen in the row totals in Table 1. A measure of overall bias towards, say, the form, *X is better than Y,* is obtained by adding the total number of responses listed for Sentence 1 in the top part of the matrix to the total for 1′ in the bottom part. The resulting eight totals differ significantly from each other, χ^2 (7) = 105, $p < .001$, Friedman's one-way analysis of variance by *S*s, and χ^2 (7) = 34.20, $p < .001$, by adjectives. Among the possible orthogonal comparisons within the eight constructions (an unmarked-marked × positive-negative × comparative-equative design), there were only three significant effects. First, constructions with unmarked adjectives were preferred over those with marked adjectives, 1,635 to 1,347, normal $z = 4.47$, $p < .001$, sign test by *S*s, and $p < .025$, Wilcoxon test by adjectives. Second, positive constructions were preferred over negative, 1,828 to 1,154, normal $z = 6.70$, $p < .001$, sign test by *S*s, and $p < .005$, Wilcoxon test by adjectives. Finally, there was an important interaction between positive-negative and comparative-equative: the positive comparative and negative equative constructions were strongly preferred over the negative comparative and positive equative, 1,726 to 1,256, normal $z = 4.75$, $p < .001$, sign test by *S*s, and $p < .005$, Wilcoxon test by adjectives. This indicates that the constructions meaning "greater than" (like *is better than* and *isn't as good as*) were preferred over those meaning "greater or equal" (like *is as good as* and *isn't better than*). Notice that this occurs without a significant

TABLE 1

MATRIX OF CONFUSIONS FOR EIGHT LINGUISTIC FORMS

Recalled form	Presented form								Totals
	1	2	3	4	5	6	7	8	
1. A is better than B.	275	46	21	21	4	4	22	34	427
2. A is as good as B.	28	224	5	9	2	4	18	2	292
3. B isn't better than A.	1	4	140	40	7	9	3	1	205
4. B isn't as good as A.	4	3	78	166	21	5	4	5	286
5. B is worse than A.	1	1	13	27	242	45	5	10	344
6. B is as bad as A.	0	0	10	3	13	212	11	6	255
7. A isn't worse than B.	4	3	4	1	2	0	132	36	182
8. A isn't as bad as B.	6	3	0	0	5	4	57	159	234
Subtotals	319	284	271	267	296	283	252	253	2225
1′. B is better than A.	14	7	56	56	15	10	0	1	159
2′. B is as good as A.	4	26	33	32	6	12	2	1	116
3′. A isn't better than B.	17	13	11	1	1	1	14	13	71
4′. A isn't as good as B.	21	17	6	15	0	0	11	9	79
5′. A is worse than B.	6	6	3	4	23	7	51	43	143
6′. A is as bad as B.	1	4	0	0	3	23	24	37	92
7′. B isn't worse than A.	0	1	7	1	10	16	5	3	43
8′. B isn't as bad as A.	2	0	6	7	11	16	5	7	54
Subtotals	65	74	122	116	69	85	112	114	757
Totals	384	358	393	383	365	368	364	367	2982

Note.—*Good* and *bad* are only exemplary adjectives, standing for unmarked and marked adjectives, respectively.

preference for either the comparative or equative syntactic forms themselves.

In parallel with recall bias was *S*s' ability to recall a presented sentence verbatim. Verbatim recall is tallied in the eight main diagonal cells of the upper 8×8 matrix. These eight numbers exhibited the same significant effects that recall bias did. First, constructions with unmarked adjectives were recalled verbatim more often than those with marked adjectives, 805 to 745, F (1, 63) = 4.93, $p < .05$, by *S*s, and F (1, 7) = 2.00, $p > .05$, by adjectives. (The latter is not significant presumably because of the insensitivity of the error term with 7 *df*.). Second, positive constructions were recalled more often than negative ones, 953 to 596, F (1, 63) = 91.12, $p < .001$, by *S*s, and F (1, 7) = 225.6, $p < .001$, by adjectives. And finally, the constructions meaning "greater than" were better recalled than those meaning "greater or equal," 842 to 708, F (1, 63) = 14.07, $p < .001$, by *S*s, and F (1, 7) = 23.25, $p < .001$, by adjectives. There was again no better recall of comparative than of equative constructions.

It might be proposed, however, that the response bias considered previously was an artifact of the better verbatim recall of some constructions over others. This proposition can be tested by considering response bias in Table 1 once verbatim recall, the main diagonal cells of the upper matrix, has been eliminated. Indeed, the "corrected" bias towards the eight constructions shows the same differences as before, since it correlates .85 with verbatim recall. Moreover, the variance of the proportions of the verbatim recall of the eight constructions is only about one-fifth the size of the variance of the proportions of the incorrect recall of those constructions relative to the opportunity for these erorrs. Hence, there is a sizable response bias that is independent of the level of verbatim recall.

Lastly, there appear to be only small differences in *S*s' abilities to recall at least some partly correct sentence for each of the presented sentences. The column totals in Table 1 showed no significant differences by *S*s, although by adjectives there were significant interactions between the markedness of adjectives and positivity, F (1, 7) = 6.63, $p < .05$, and between markedness and comparative-equative sentence type, F (1, 7) = 6.64, $p < .05$. It is important that these column totals are approximately equal; otherwise, *S*s might be trying to remember only the easy constructions, and this possibility would considerably complicate the interpretations of response bias and verbatim recall.

TABLE 2

MATRIX OF CONFUSIONS BETWEEN MARKED AND UNMARKED ADJECTIVES

Recalled adjective	Presented adjective		Totals
	Unmarked	Marked	
Unmarked	1394	241	1635
Marked	124	1223	1347
Totals	1518	1464	2982

The lexical marking of adjectives.—A marked adjective like *bad*, we have proposed, should be mistakenly recalled as its unmarked partner *good* more often than the reverse. These two kinds of errors are shown in Table 2, a collapsed version of Table 1 with only two presentation and recall categories remaining. There were 241 errors from *bad* to *good*, but only 124 errors from *good* to *bad*. This difference is consistent across *S*s, normal $z = 4.27$, $p < .001$, sign test, as well as across adjective pairs, $p < .05$, Wilcoxon test. Thus it does appear that adjectives tend to be changed from marked to unmarked over time in memory.

The eight pairs of adjectives, however, were not all alike in their error results. Overall, 66% of the antonym errors were in the predicted direction, but this percentage varied considerably: *pretty-ugly* showed 87%, *happy-sad*, 86%; *old-new*, 80%; *good-bad*, 78%; *fast-slow*, 74%; *hot-cold*, 60%; *wide-narrow*, 54%; and *clean-dirty*, 22%. *Clean-dirty* was the only pair which elicited more errors in the unpredicted than predicted direction.

The adjective pairs also differed considerably in simply how often a presented adjective was mistakenly recalled as its antonym. The overall percentage was 12%, but indi-

vidual percentages ranged from 19% to 3%: *fast-slow* had 19%, *wide-narrow*, 17%; *clean-dirty*, 15%; *happy-sad*, 13%; *old-new*, 13%; *good-bad*, 13%; *pretty-ugly*, 6%; and *hot-cold*, 3%. An explanation is proposed later to account for the differences in directional antonym errors, as well as for the low percentage of absolute antonym errors for *pretty-ugly* and *hot-cold*.

The four comparative constructions.— There were four types of syntactic constructions in the present study: positive and negative comparative and positive and negative equative. To show the errors among them independent of the adjectives they contained, Table 3 tallies only those responses which preserve the underlying adjective of the presented sentence; it is derived from Table 1 by collapsing across marked and unmarked adjectives. The exemplary adjective throughout this discussion is *good*.

As noted previously, *S*s preferred in recall to give positive over negative constructions and constructions meaning "greater than" over those meaning "greater or equal." These preferences, it is claimed, result from specific errors away from the nonpreferred "greater or equal" and negative constructions.

Consider the positive-negative attribute first. There were 420 negative to positive errors, but only 144 positive to negative ones. That is, 74% of the errors on this dimension were towards the positive.

As for the second kind of errors, there were 424 errors towards "greater than" constructions, but only 242 errors towards "greater or equal" constructions; 65% of the errors were in the predicted direction. These errors, furthermore, were relatively independent of comparative and equative constructions as syntactic forms. When both presented and recalled sentences were positive, 69% of the errors interchanging comparative and equative were towards the comparative, the construction meaning "greater than." But when both were negative, 65% of these errors were towards the *equative*, the construction meaning "greater than." Overall, there were about as many errors towards the comparative as towards the equative, 348 to 308. The *S*s, then, were not making errors based on the syntactic properties of the sentences. Rather, they made errors on a semantic property, recalling "greater than" constructions in place of "greater or equal" ones.

Finally, *S*s preserved the order of the two nouns of the presented sentence in 89% of the recalled sentences. That is, for the presented sentence, *The girl isn't as bad as the boy*, *S*s almost always constructed a sentence with *the girl* and *the boy* placed in the original left-to-right order. Furthermore, they recalled the first noun (the subject of the sentence) better than the second. Of the sentences tallied in Table 1, there were 396 in which either the subject or predi-

TABLE 3

MATRIX OF CONFUSIONS FOR FOUR COMPARISON CONSTRUCTIONS

Recalled form	Presented form				Totals
	I	II	III	IV	
I. A is better than B.	517	91	26	31	665
II. A is as good as B.	41	436	16	15	508
III. B isn't better than A.	3	4	272	76	355
IV. B isn't as good as A.	9	7	135	325	476
Subtotals	570	538	449	447	2004
I′. B is better than A.	37	14	107	99	257
II′. B is as good as A.	7	49	57	69	182
III′. A isn't better than B.	27	29	16	4	76
IV′. A isn't as good as B.	32	33	11	22	98
Subtotals	103	125	191	194	613

cate noun of the presented sentence was missing or wrong. Of these, 63% had the correct subject, and only 37% had correct predicate nouns, a difference significant at $p < .001$, sign test. This percentage was the same whether the noun order had been preserved in recall (63%) or not (62%). That is, it was the subject of the *presented* sentence, not of the *recalled* sentence, that was well remembered.

The recall of noun order appears to be relatively independent of the memory errors towards positive sentences and towards "greater than" sentences. Errors towards the positive occurred 73% of the time when noun order was preserved and 79% of the time when it was not preserved. Similarly, errors towards "greater than" sentences occurred 59% of the time when noun order was preserved and 67% of the time when it was not preserved.

Discussion

It has been argued throughout that remembering sentences is a reconstructive process. A person retains only bits and pieces of what was presented to him and later uses them to reconstruct what he thought was presented. The present proposal is that he retains semantic information. Evidence for this argument shows up on two levels—on the lexical level in the remembering of an unmarked adjective for its opposite and on the syntactic level in the remembering of one comparative construction for another.

Memory for polar adjectives.—In the introduction, comparative sentences like *A is better than B* were shown to consist linguistically of the conjoining, by various transformations, of two base strings, *A is good* and *B is good*. The present *S*s clearly tried to preserve the sense of these primitive constituent sentences, not the meaning of the relation described, for they often recalled *A is better than B* as *A is as good as B*, or as *A isn't as good as B*, or as *B is better than A*. In these instances, *S*s have preserved the underlying base strings while making gross errors in the relation described. At the same time, *S*s almost never recalled *A is better than B* as *B is worse than A* or as *A isn't as bad as B*, two sentences which express the same relation as the presented one, but which contain different base strings. The conclusion is that *S*s stored the base strings—*A is good* and *B is good*—separately from the relation between A and B—that A is higher on the goodness scale than B.

When *S*s did forget the base strings underlying the comparative sentence, they often replaced one adjective by its opposite. These errors were predominantly towards the unmarked adjective, supporting the theory that marked adjectives are stored with one semantic feature in addition to those of its correlative unmarked adjective, and that this feature is sometimes lost in memory. This finding is consonant with several previous studies on free associations (Greenberg, 1966; Marshall, 1968) and on speed of comprehension (Clark, 1969a, 1969b).

The base strings underlying a comparative sentence can be viewed more generally as the *syntactic* presuppositions of that sentence. Underlying *John is sadder than Mary* are the presuppositions that John is sad and Mary is sad. Not all nouns that enter into comparative sentences, however, are neutral vis-à-vis syntactic presuppositions. For example, the sentence. *This genius is stupider than that genius*, sounds highly incongruous, clearly because its presuppositions sound incongruous: *This genius is stupid* and *That genius is stupid*. The word *genius* has its own *lexical* presuppositions—that geniuses are inherently intelligent.

The results show the influence of both syntactic and lexical presuppositions. Syntactic presuppositions, as noted earlier, were well remembered, but lexical presuppositions appeared to have an additional influence on the reconstruction of a sentence at recall. Take, e.g., *clean-dirty*, the one adjective pair which did not show the tendency for errors to go in the direction of the unmarked adjective. Several of the nouns used with *clean* and *dirty* might be more commonly described as dirty than clean: *carpenter, plumber, Ford, Chevy, hand,* or *foot*. For these nouns, an *S* who had forgotten the syntactic presuppositions would reconstruct a sentence having base strings congruent with its lexical presuppositions, i.e., base strings containing *dirty*. This would account for the bias towards *dirty*, the marked form. (Additional evidence for the interaction of lexical and syntactic presuppositions appears in the data of Wallis & Audley, 1964; and Audley & Wallis, 1964.) The question remains whether lexical presuppositions might not account for the more general bias towards the unmarked adjective. The answer appears

to be no, for the bias showed up for a sizable cross section of nouns and adjective pairs, and particularly for pairs like *happy-sad, old-new,* and *good-bad* which do not describe lasting or characteristic attributes of objects. The bias towards the unmarked adjective is best accounted for by a simplification of the feature composition of the adjectives.

Actually there is some doubt about whether *hot* of *hot-cold* and *pretty* of *pretty-ugly* are truly unmarked. The dimension for *hot-cold* is really *warmth,* and for *pretty-ugly* it is *beauty;* on the neutrality criterion, too, *hot* and *pretty* appear to be usually nonneutral or marked. These facts are reflected in the number of errors *S*s made on these dimensions. The *S*s interchanged *hot* and *cold* in only 3% of their recalled sentences, and *pretty* and *ugly* in only 6%; these errors were remarkably low compared to the 13–19% range for the other six pairs. Thus in pairs with a clearly unmarked member, antonym errors occurred often, because the two adjectives differ in one feature only and confuse easily. *Hot* and *cold,* and *pretty* and *ugly,* on the other hand, differ in a more complex way, so they did not confuse so easily.

Memory for comparative constructions.—It has been shown that a sentence like *A is worse than B,* when recalled, is reconstructed from two independently retained memories: first, its syntactic presuppositions, that A and B are bad; and second, the comparison of A and B. The comparison relation itself, however, can also be shown to consist of independently remembered features: (*a*) the theme of the sentence, (*b*) whether the sentence was an affirmation or a denial, and (*c*) whether the relation meant "greater than" or "greater or equal."

First, *S*s remembered the surface subject or theme of comparative sentences better than the term in the predicate. Although the theme might be remembered well because it occurs first in these sentences, there is an excellent alternative explanation. Semantically, the theme is the focus of attention in the sentence —what the sentence is about—whereas the other term is not. In remembering sentences, therefore, *S*s could be remembering the term on which the attention of the utterance was focused. There is other evidence which supports this account. For active and passive sentences which differ in thematic emphasis, but not in "cognitive" meaning, the theme is better recalled (Anderson, 1963; Coleman, 1965; Prentice, 1966; Turner & Rommetveit, 1968); theme also has important consequences on the course of problem solving (Duncker, 1945, p. 24), in the generation of sentences (Clark, 1965; Prentice, 1967; Tannenbaum & Williams, 1968), and in the interpretation of sentences (Clark & Begun, 1968; Johnson, 1967; Johnson-Laird, 1968a, 1968b).

Next, *S*s often changed denials into affirmations, and hence remembered affirmations better than denials. This finding supports the hypothesis that the denial feature which marked a sentence as a negative was dropped from memory between study and recall. Such an interpretation is consonant with several previous studies (Gough, 1965, 1966; Wason, 1961; Wason & Jones, 1963).

Finally, *S*s often reconstructed sentences meaning "greater or equal" as ones meaning simply "greater than." This, too, can be viewed as semantic simplification. It occurs because the additional "equal to" feature of "greater or equal" sentences is lost between the presentation of a sentence and its reconstruction.

One last point of interest is a traditional question in memory: How well were the different sentences remembered? The answer, as the present results have shown, depends on the criterion for memory. For the loose criterion of correct recall of one noun and the underlying adjective or its opposite, the eight sentences of the present experiment were about equal. For the stricter criterion of whole or partial synonymy, sentences that were positive or that contained unmarked adjectives were better recalled. For the tightest criterion, that of verbatim recall, sentences that were positive, that contained unmarked adjectives, or that meant "greater than" were better recalled. Each of these levels is accounted for by the simplification of semantic features. Thus, the strength of the present theory is that it accounts for memory at many levels—from remembering the gist of a sentence to recalling the sentence verbatim.

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