Similar, and similar concepts

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Abstract

This paper analyzes English symmetrical predicates such as *collide* and *match*. Its point of departure is an analysis of the concept 'similar' from Tversky (1977) that appears to show that similarity is psychologically asymmetrical. One basis for this claim from Tversky is that the sentences *North Korea is similar to Red China* and *Red China is similar to North Korea* are assessed as differing in meaning by experimental subjects; this seems to imply that the symmetrical entailment (R x, y ↔ R y, x) fails for this concept. Five experiments are presented that show: (1) the apparent asymmetry of *similar* is reproduced for 20 predicates that are intuitively thought to be symmetrical, including *equal* and *identical*; (2) unique linguistic-interpretative properties hold for these symmetrical words, such as reciprocal interpretation when they appear intransitively, for example, *North Korea and Red China are similar*; (3) the asymmetrical interpretation of subject–complement constructions containing the symmetrical words is a consequence of general linguistic-interpretive principles. On the basis of the experimental findings, we offer an analysis of symmetrical predication. One major claim of the analysis is that symmetry is a property of lexical items and has no special syntax, that is, that *John meets* is semantically but not syntactically anomalous. A second claim is that the structural positioning of noun phrases in sentences containing symmetricals – rather than inherent semantic properties of the noun phrases themselves – sets their status as Figure and Ground (as described by Talmy, 1985) or Variant and Referent (as described by Tversky, 1977) in the comparison, even if the nouns are nonsense items. Finally, the behavior of symmetrical predicates is shown to vary as a function of their differing lexical class assignments and collateral semantic designations, such as activity versus state. Most generally, it is claimed that a deeper understanding of symmetrical terms comes from analyzing the semantics of syntactic structures in which they appear.

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PART I: THE LANGUAGE OF SYMMETRY

Our aim in this paper is to contribute to the understanding of symmetrical predicates, including *similar, meet, marry*, and many others. Even so saying seems something of a conundrum because Tversky and his colleagues (Tversky, 1977; Tversky and Gati, 1978; Gati and Tversky, 1984) have provided evidence suggesting that the concept 'similar' isn't symmetrical in the first place. If similarity isn't symmetrical, the English word that expresses this concept shouldn't be expected to be symmetrical either. As one demonstration of the asymmetry, Tversky and Gati asked subjects to "assess the degree to which"

(1) North Korea is similar to Red China.

and other such country comparisons. Other subjects were asked instead to assess the degree to which

(2) Red China is similar to North Korea.

The rating of similarity was higher when the more prominent country (as assessed in a separate experiment) appeared second, as in (1), than when it appeared first, as in (2). It seems incoherent to maintain that similarity is psychologically symmetrical if subjects believe that X can be similar to Y to degree d, while Y is similar to X to degree less than d.

These violations of symmetry predictions are small, as Tversky and Gati pointed out. Still they are reliable and survive many variations in the experimental procedures used to assess them. On such evidence from the behavior of these words, they concluded that 'similar' and 'different' are psychologically asymmetrical concepts:

> . . . symmetry . . . may provide a good first approximation to similarity data . . . At the same time, one should not treat such a representation, useful as it might be, as an adequate psychological theory of similarity . . . An analogy to the measurement of physical distance illustrates the point. The knowledge that the earth is round does not prevent surveyors from using plane geometry to calculate small distances on the surface of the earth. The fact that such measurements often provide excellent approximations to the data, however, should not be taken as evidence for the flat-earth model. (p. 97)

In this paper, we will try to reconstruct the intuition that similarity is a symmetrical concept. Our first step will be to show that a wide variety of concepts thought to be symmetrical show interpretive asymmetries directly analogous to that between sentences (1) and (2); hence that an analysis specific to similarity is not what is required to understand this phenomenon. Second, we will analyze the interpretive distinction between these example sentences as arising from the "regard" in which comparison statements are understood (following Goodman, 1972; Goldstone, 1994; Markman and Gentner, 1991; Barsalou, 1989; Medin, Goldstone, & Gentner, 1990, 1993).

Finally, we will present a linguistic analysis that we believe is responsive to the paradoxical surface facts; namely, that sentences (1) and (2) are different in meaning, yet each is a symmetrical similarity statement. The descriptive problems we try to confront are laid out in the remainder of this introduction. The body of the paper consists of experimental documentation (Parts II and III) and the proposed linguistic analysis (Part IV).

1. The asymmetrical behavior of symmetrical predicates

Let us first inspect the intuition that 'similarity' is symmetrical. What is the source of this intuition if it is flatly false, as a casual reading of Tversky and his colleagues might suggest? Most would probably agree that there are some words that clearly fall into the symmetrical class (e.g., *match*, *near*) while others are undoubtedly asymmetrical (e.g., *drown*, *above*). The *a priori* semantic intuition that lies behind this distinction has to do with the entailments of sentences containing these words; namely,

(i) For all x, y, $R x, y \leftrightarrow R y, x$

Thus if x matches y, then y matches x; but if x drowns y, there is no suggestion that y drowns x; and if x is above y, this is inconsistent with y being above x.

The force of examples (1) and (2) is that this entailment fails for *similar*, suggesting that it is more like *drown* than like *match*. Should we therefore assign *similar* to the asymmetrical class of words (hence, concepts) without further ado? A problem of this coarse partitioning is revealed by inspecting another word that seems symmetrical on first inspection but shares the interpretive complexity revealed by *similar*; namely, *equal*. Orwell aside, *equal* appears to be quintessentially symmetrical, for if one thing is equal to another then so is the latter to the former. Yet the following sentences are not interpreted in the same way:

(3) The humblest citizen is equal to the President.
(4) The President is equal to the humblest citizen.

Example (3) raises the humblest citizen to equality and brings to mind such Presidents as Abraham Lincoln. But (4) raises the President to equality and conjures up the likes of Millard Fillmore or Warren Harding.

A moment's reflection should convince one that a large number of English predicates behave in the same ways. Thus listeners assign somewhat different interpretations to:

(5) Meryl Streep met my sister.
(6) My sister met Meryl Streep.

despite the fact that meeting must be mutual. as Talmy (1978, 1983) has shown, a related distinction crops up for apparently symmetrical spatial terms; for example, (7) seems more natural than (8):

(7) The bicycle is near the garage.
(8) The garage is near the bicycle.

In light of these many curious examples, it would be a distortion to assign the phenomenon isolated by Tversky and Gati to particular aspects of the concept 'similarity'. Following their reasoning, these new instances would suggest that there are no symmetrical concepts at all, that psychologically the symmetrical entailment fails in general. After all, if it fails for *equal*, where could it succeed?

2. What is compared in a similarity comparison?

Now we look a little more closely at Tversky's (1977) analysis of similarity. This analysis assumes that similarity statements (and judgements) compare *objects* (or "stimuli") that belong to some class. Within this class, one comparator is more prototypical (in the sense of Rosch, 1978), that is, has more of the semantic attributes or class features; this "salient" item appears in the second nominal position (as the predicate complement):

> Similarity judgments can be regarded as extensions of similarity statements . . . of the form "a is like b." Such a statement is directional; it has a subject, a, and a referent, b, and is not equivalent in general to the converse similarity statement "b is like a." . . . We tend to select the more salient stimulus, or the prototype, as a referent, and the less salient stimulus, or the variant, as the subject . . . We say "the portrait resembles the person" rather than "the person resembles the portrait," . . . and we say "North Korea is like Red China" rather than "Red China is like North Korea." (p. 328)

Under this description, such similarity statements as (1) are not just different from (2) but better, just because Red China is a more prototypical example of a country, or an Asian power, than is North Korea. Indeed, as we will show (Experiment 4), subjects aver that they "prefer" (1) to (2).

But in other work, Tversky suggests a different and more defensible stance, namely that pairs of objects can be represented in several ways, and that similarity comparisons pertain to these representations rather than to the objects themselves. For example, Tversky (1977) manipulated the choice set over which similarity judgements were to be made. When subjects were asked which of three countries is most similar to Austria, they most often chose Sweden if the choice set was *Sweden, Poland, Hungary*; but they usually chose Hungary if the choice set was *Sweden, Norway, Hungary*. The similarity of Poland to Hungary (both Central European countries) and

the similarity of Sweden to Norway (both Scandinavian countries) affected the perceived similarity of Sweden to Austria. In short, "the similarity of objects is modified by the manner in which they are classified" (1977, p. 344).

If we assume that the same *objects* are compared each time, these context effects seem mysterious. But another way of putting the facts, which seems no more than a friendly amendment, is that subjects did not perform the same similarity comparison (of the object Sweden to the object Austria) in the two conditions, paradoxically getting different answers. Rather, they made two different similarity comparisons in which the relevant representations were cued by the differences in the comparison set. Similarity was in each case "with respect to" something different. Objects compared on one set of properties p, q may be highly similar, but viewed on another set of properties r, s may be less similar.

Surprisingly, this same account may also serve to explain subjects' responses to sentences (1) and (2). On the face of it, Tversky and Gati's results suggest that subjects consider North Korea as more similar to Red China than China is to North Korea in the same regard. After all, no explicit mention of regard or classification appears in either (1) or (2). But there is another possibility. The syntactic positioning of the nominals may accomplish the manner of classification implicitly. If so, again two different similarity comparisons may have been assessed: the first, between countries that are Asian Communist powers, where Red China is the prototype or standard; the second between countries that are alike in a way that makes North Korea the standard (e.g., formal partitioning as the prototypical case of political fragmentation).

A number of commentators cited earlier have made these points concerning the regard or "respect" in which a similarity statement is intended. But in doing so they have usually also assented to the view that *North Korea is similar to Red China* is an asymmetrical similarity comparison. But this is by no means self-evident. To show that this statement is asymmetrical would require spelling out the regard intended in the comparison (i.e., North Korea is similar to Red China *with respect to p*) and showing that listeners will still reject the symmetrical entailment (namely, that Red China is – equally – similar to North Korea *with respect to p*). Put another way, if (1) and (2) are different similarity statements, then the question of whether each such statement is a symmetrical one cannot be resolved by comparing the two of them and judging them different.

3. The symmetrical behavior of symmetrical predicates

So far we have concentrated attention on only one kind of sentence in which the (putatively) symmetrical predicates appear. Yet in reciprocal

constructions (those containing the phrase *each other*), certainly the relation appears to be symmetrical. That is,

(9) North Korea and Red China are similar to each other.

entails that North Korea is similar to China and that China is similar to North Korea in the same regard. But of course no one ever claimed that similarity could not be symmetrical under any circumstances. As Tversky and Gati pointed out, in similarity comparisons like (9), "the task has been formulated in a nondirectional fashion". Accordingly, we should expect use of such sentences (and judgements of symmetry) "whenever the objects are equally salient, or whenever the comparison is nondirectional" (1978, p. 85; see also Talmy, 1978).

This stance on the marginality of reciprocal structures for understanding *similarity* is correct. After all, many obviously nonsymmetrical predicates license the reciprocal construction.[1] Thus if John drowns Bill while Bill drowns John, we can say

(10) John and Bill drown each other.

In (10), these two reprobates have reciprocated the decidedly asymmetric act of drowning someone, but this does not render the concept (or predicate) *drown* symmetrical. So sentence (9) cannot convince us, *mutatis mutandis*, that *similar* is a symmetrical concept.

But there is another kind of sentence, one without the reciprocal pronoun *each other*, that is interpreted reciprocally – but only if it contains a symmetrical predicate. Consider the behavior of *meet*: (11a) is semantically close to (11b) and not to (11c); in fact, (11c) sounds quite awkward. These

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[1] One requirement for the use of this construction is that entities "of the same kind" be described. By "the same kind", we mean, for example, animate versus inanimate, factors that figure in the nominal selections of verbs. Thus *see* can accept animate subject and object (*The monkey saw the cow, The cow saw the monkey*) and therefore reciprocal conjunction (*They saw each other*); in contrast, *frighten* requires an animate object but can take an inanimate subject, so *Sam and the color green frightened each other* is semantically anomalous just because *Sam frightened the color green* is anomalous. As John Kim and Barbara Partee (personal communications) have pointed out to us, actually the need is for at minimum a tripartite division of the predicates in this regard, wherein *match* is symmetrical, *drown* is nonsymmetrical (perhaps "asymmetrical" is the best locution), and *above* is necessarily not symmetrical (or "antisymmetrical"). That is, "Smith and Jones are above each other" appears at first glance to describe a self-contradictory state of affairs. Notice, however, that it is not ungrammatical and might be used to describe some complex political hierarchy in which Smith and Jones are at different levels within each such hierarchy. For this reason, Partee suggests that the antisymmetricals may require an analysis of "regard" similar to the one we present in this paper for the symmetrical predicates. These issues, however, go beyond what we can hope to accomplish here. In subsequent discussion (and except where noted), we simply distinguish between *match*-type predicates, calling these "symmetrical" and *drown*- and *above*-type predicates, calling both these latter types "asymmetrical".

facts are reversed for the asymmetrical word *drown*: (12a) is semantically close to (12c) but not to (12b); and (12c) is not awkward.

(11) (a) John and Bill meet.
      (b) John and Bill meet each other.
      (c) John meets and Bill meets.

(12) (a) John and Bill drown.
      (b) John and Bill drown each other.
      (c) John drowns and Bill drowns.

We will suggest that it is the comparisons in (11) and (12) that are relevant to language users' assessment of the symmetry of predicates. The comparison between (1) and (2) is informative on quite another matter: the semantic interpretation of syntactic structures.

4. The proposed analysis

We will try to defend four specific theses in the experiments and analysis that follow:

A. General properties of sentence interpretation impose a Figure/Ground interpretation on subject–complement constructions.

Talmy (1978) has proposed that across a wide range of constructional types, objects in subject and complement positions are interpreted respectively as an entity (the Figure) which (physically or conceptually) moves against a Ground, or reference point. This referencing function is in addition to the propositional information that the sentence conveys. If so, it may not be that *similar* in (1) and (2) is asymmetrical; rather, the interpretive difference may arise from general principles of sentence interpretation that apply whatever the predicate content.

B. The referencing function is independent of the choice of nominals

Tversky, Talmy, and other commentators posit that statements like (1) are not only different from (2) but are somehow better because of the way that specific nominal pairs do or do not conform to the mapping of Figure/Ground onto subject/complement positions in a syntactic structure. Taking another example from Talmy (1978), because the real identity of the man from Krypton is Superman, Clark Kent being the disguise, it is "appropriate to treat the former identity as a fixed reference point and the latter identity as displaced therefrom, hence the difference in

acceptability . . ." for *Clark Kent is Superman* versus *Superman is Clark Kent*.

We will defend the reverse causal chain for understanding these preferences: the relevant semantic relations are between representations of objects, not between objects themselves. Whichever entity occurs in the nonsubject position in the sentence "becomes" the prototype or Ground; this is accomplished by changing either the pertinent representation or the valence of the entities within a classification. For example, compare *The horse was tied to a tree* with *A tree was tied to the horse*. In the latter version, the tree gets uprooted or, at minimum, shrinks. From this perspective, the out-of-context preference for (1) over (2) or for (7) over (8) is merely a judgment of which similarity comparison would refer to a more common state of affairs in the world: in the present case, the typical size and mobility of horses and trees.

C. 'Similar' and similar concepts are symmetrical

Language provides specific means by which symmetrical predications can surface absent the referencing function, providing a sentential context for expressing symmetrical relations symmetrically. The chief diagnostic environments were exemplified in (11) and (12); the symmetricals are distinguished by their interpretations in these constructions. This analysis pertains not only to the predicate types we have just discussed (e.g., *similar* and *meet*) but to virtually all symmetrical words including such nouns as *cousin* and *friends*.

D. Symmetrical predicates differ among themselves

As we will show, subjects in certain experimental settings appear to treat symmetry as graded rather than as an all-or-none property of predicates. We will posit that this apparent grading is in reality the collective effect of collateral lexico-syntactic distinctions among the symmetrical predicates that are causally linked to their semantic interpretations. The particular distinction we will investigate, partly correlated with lexical class assignment, is of activity (e.g., *embrace*) versus state (e.g., *similar*) versus location (e.g., *near*).

Speaking more generally, the apparently nonsymmetrical behavior of putatively symmetrical predicates investigated by Tversky and his colleagues points to some very interesting and puzzling phenomena which we pursue further here. We try to show that a deeper understanding can be gained by attending not only to the semantics of the lexical items at issue, but also to the semantics of the syntactic structures in which these predicates occur.

PART II: THE GRAMMATICAL ENCODING OF SYMMETRY

In this section, we report a pretest and two experiments that will show that symmetry is a component of *similar* – and many other words – that is manifest in the mental lexicon of ordinary language users: the generalization from the findings is that predicates for which intransitive sentences containing them are interpreted reciprocally are those that are perceived as symmetrical.

PRETEST: IDENTIFYING SYMMETRICAL PREDICATES

The first step was to determine whether English speakers distinguish between symmetrical and asymmetrical words when provided with no linguistic context beyond the words themselves, and whether there is agreement on this distinction across individuals. The contextless presentation is a first crude procedure for segregating certain lexical-semantic from sentence-semantic issues. The second goal was to extract a set of symmetrical and asymmetrical predicates whose behavior in sentences we could study experimentally.

5. Method

5.1. Materials

With the help of a dictionary, and prior classifications of predicate types studied by L. Gleitman (1965), Atkins, Kegl, and Levin (1986), Talmy (1983), and Dowty (1991), we compiled a list of 40 common English predicates which vary with respect to their symmetry (see Table 1 which shows all 40 words). The list contains a set of symmetrical and asymmetrical terms, further divided into three subgroups: *active terms* (e.g., *meet, choke,* annotated "A" in the table); *stative terms* (e.g., *match, inferior,* annotated "S"); and spatial words (e.g., *far, behind,* annotated "P").[2] Active terms are those that describe something you "do" as opposed to the states of affairs and relations described by statives. There are a number of linguistic diagnostics for this semantic partitioning; for example, actives are more natural in progressive constructions than are statives (compare *John is*

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[2] These are mainly "satellites" in Talmy's (1978) terminology: English generally requires a choice of one of these followed by a preposition to describe a path or location, for example, *"far* from the beach", though not always, for example, *"near* the beach", *"near* to the beach". For expositional clarity, we settle for the phrase "spatial word" to describe all stimuli annotated "P" in the table.

meeting Bill to the unnatural *John is resembling Bill*), in imperative constructions (compare *Kiss Bill tomorrow!* to *Match Bill tomorrow!*), and certain wh-chefts (compare *What John did was meet Bill* to *What the button did was match the shirt*). Included among the stative terms is the only item we knew of where the relation between the syntactic and lexical-semantic factors under investigation do not mesh (*resemble*).[3] The words were arranged in pseudo-random order on a list. Each word was followed by a 5-point scale, the end-points of which were labeled "not at all symmetrical" and "completely symmetrical". The materials were accompanied by a post-test question which asked subjects to "explain symmetry in your own words".[4]

5.2. Subjects

In this and all succeeding experiments, the subjects were students at the University of Pennsylvania. No subject participated in more than one experiment. For this pretest, 20 undergraduates were in the original sample but two were dropped from the study because they failed to understand the instructions, as shown by their responses in the post-test.

5.3. Instructions and procedure

The instructions gave an example of a symmetrical noun (*cousin*) and an asymmetrical noun (*father*), along with a brief explanation of why they were considered symmetrical/asymmetrical. Subjects were instructed to circle 1 on the scale for asymmetrical words, 5 for symmetrical words, and to use the other numbers for intermediate judgements.

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[3] After these experiments were done, we discovered only one more such example among some hundreds we inspected: *encounter*, and there is some evidence (Experiment 2) that subjects may consider *attach* to be another such exception. In assessing the effects of the active/stative distinction here and elsewhere in this paper, we exclude the item *separate*. This is because as an adjective it is stative, as in *Their houses are separate*; but as a verb it is active, as in *She is separating the wheat from the chaff*. When we chose this test item, we failed to notice the ambiguity. At this point in the discussion, some readers may object that there is genuine polysemy for certain further items, and that therefore the contextless presentation is in some ways odd or even misleading; that is, subjects may assign predicates to the symmetry dimension differently, depending on what syntactic frame they bring to bear on the assessment – experimental instructions notwithstanding. We reserve this matter for later discussion, when it becomes central to the understanding of lexical-conceptual symmetry.

[4] In this and in Experiments 1–4, counterpart lists were created so that we could test for effects of the order in which stimuli were presented, and subjects were assigned randomly to these order groups. In no experiment was there an order effect and thus all analyses were conducted by collapsing across these.

6. Results

The predicates arranged in order of their mean symmetry ratings are shown in Table 1. To determine the reliability of the ranking, we divided the subjects into two groups and computed the rank order correlation between the mean rankings of the two groups. The rho for all predicates was 0.93, $p < 0.001$. When the correlation was computed for the symmetrical predicates only (i.e., for the top 20 predicates), the correlation was rho = 0.94, $p < 0.001$. Thus though these out-of-context judgements are in some ways unnatural, subjects were startlingly alike in the way that they performed the task (incidentally mitigating some worries mentioned in footnote 3).

First inspection of the table seems to suggest that symmetry is graded rather than absolute (though there is a relatively large break between the 20th and 21st items). Nevertheless, in the experiments we next report, the higher-ranking 20 predicates are treated as the symmetrical class and the lower-ranking 20 as the asymmetrical class. This categorical treatment of what appear to be continuous data will be defended in Part III of this paper, where we show that it is the subdistinctions among the symmetrical words (active, stative, spatial word) that account for their differential rankings. But as a first indication of the reality of these further distinctions, we note here that within the symmetrical group, overall the stative symmetrical terms were ranked higher than the actives ($t = 2.68$, df = 14, $p < 0.02$).

EXPERIMENT 1: SYMMETRICAL PREDICATES AND PLURAL NOUN PHRASES

We now begin to explore the behavior of symmetrical and asymmetrical predicates in sentences. The symmetrical predicates seem unremarkable in their sentential environments. For instance, both the symmetrical predicate *meet* and the asymmetrical predicate *drown* occur in both transitive and intransitive structures, for example:

(13) (a) John meets Bill.
     (b) John drowns Bill.

(14) (a) John and Bill meet.
     (b) John and Bill drown.

But there is an oddity that pertains to *meet* and not *drown*: as an intransitive, *meet* makes no sense if its subject is singular. That is, 15(a) sounds fine but 15(b) seems wrong or incomplete.

(15) (a) John drowns.
     (b) John meets.

Table 1
Pretest: symmetry ratings of 40 predicates (with 1 = minimum and 5 = maximum symmetry)

Predicate		Symmetry score	Predicate		Symmetry score
equal	S	4.89	love	A	2.44
identical	S	4.89	copy	A/S	2.22
marry	A	4.78	safe	S	2.00
far	P	4.22	see	A	1.89
match	S	4.17	hit	A	1.89
divorce	A	4.11	bounce	A	1.67
resemble	S	4.11	unpleasant	S	1.61
meet	A	4.00	lecture	A	1.56
similar	S	3.94	hurry	A	1.56
across	P	3.94	applaud	A	1.39
near	P	3.94	follow	A	1.33
different	S	3.94	inside	P	1.28
separate	A/S	3.94	eat	A	1.28
combine	A	3.83	drown	A	1.28
collide	A	3.50	choke	A	1.24
attach	A	3.22	inferior	S	1.22
argue	A	3.11	below	P	1.22
embrace	A	3.00	behind	P	1.22
kiss	A	2.89	better	S	1.22
compare	A	2.88	less	S	1.17

S = stative; A = active; P = preposition.

The current experiment will demonstrate that subjects perceive this distinction of naturalness. More interestingly, it will show that sensitivity to the number (singular or plural) of the nominal argument is perceived as characteristic of the predicates rated symmetrical in the pretest – that this property is a linguistic diagnostic for the intuition of symmetry.

7. Method

7.1. Subjects and materials

Twenty-four subjects were tested. The test items were sentences containing the 40 predicates of Table 1. Each item consisted of a pair of sentences. One sentence contained a singular noun phrase (e.g., *The swimmer drowned*) and the other contained a plural noun phrase (e.g., *The swimmer and the lifeguard drowned*). Sample pairs are shown in Table 2. The complete set appears as Appendix 1. Note (see examples B in Table 2) that the hypothesized required plurality of a noun phrase for symmetrical predicates is not always in the subject position. It is in the direct object position for three-argument (*ditransitive*) predicates such as *compare*, *combine*, and *attach*. That is, *The critics compared the singer* is anomalous,

Table 2
Sample sentence pairs for Experiment 1: the effect of plurality with symmetrical and asymmetrical predicates

	Sample sentences
Symmetrical	(A1) North Korea is similar
	(A2) North Korea and China are similar
	(B1) The critic compares the singer
	(B2) The critic compares the singer and Bruce Springsteen
Asymmetrical	(C1) The swimmer drowns
	(C2) The swimmer and the lifeguard drown

but *The critic compared the singer and Bruce Springsteen* is acceptable.[5] In the stimulus sentences, the plural noun phrase was always placed in a grammatically appropriate position for the particular predicate.

The noun phrases in the test sentences were chosen to be plausible for the predicate, and to differ in their prototypicality or salience in much the way described by Tversky. Four lists were constructed, each containing 10 of the test items and 40 filler items. In each list, five test items contained symmetrical predicates and five contained asymmetrical ones. The mean symmetry ratings (from the pretest) of the 10 predicates in each list were approximately equal (for the symmetrical predicates, these were 4.1, 3.7, 3.9, and 3.6 for the four lists, and for the asymmetrical predicates, 1.5, 2.0, 1.7, and 1.9). The first sentence in each pair was labeled **a** and the second was labeled **b**. Each pair was followed by a scale numbered 1–5. Number 1 was labeled "Sentence **a** sounds more acceptable", number 5 was labeled "Sentence **b** sounds more acceptable", and number 3 was labeled "Neither sentence sounds more acceptable."

7.2. Procedure

Subjects were told that for each sentence pair they were to indicate which was more acceptable by circling the appropriate number. An acceptable sentence was defined as "a sentence that seems natural, one that you would not be surprised to hear spoken" and an unacceptable sentence as "one that seems awkward or foreign, that you would not expect to hear spoken".

[5] We will accept throughout this paper Larson's (1988) analysis of such ditransitive sentences which extracts two underlying clauses, the matrix clause pertaining to the agent's activity (e.g., John comparing two things, the preacher marrying two people, etc.) and the embedded clause pertaining to the contained predication, (e.g., the relation of Springsteen to singers in general, the legal attachment between the marrying couple). The symmetry lies in the embedded clause. As the discussion proceeds, we will be able to document, for example, that symmetrical predicates occur intransitively only with a plural argument. We intend these claims to refer also to the embedded clauses of the ditransitives which, as surface sentences, may not occur intransitively at all. For example, "The singer compares with Bruce Springsteen" is anomalous in the authors' dialects.

8. Results

The mean scores for each item are shown in Table 3.[6] The mean score for the symmetrical predicates was 3.75, significantly greater than the midpoint value of 3 ($t = 3.56$, $df = 19$, $p < 0.01$): The plural is preferred to the singular. For asymmetrical predicates the mean score was 2.48, significantly less than the midpoint value ($t = 4.52$, $df = 19$, $p < 0.001$): the singular is preferred to the plural. ANOVAs, one on items and one on subjects, further substantiated the effect of the symmetry variable (min F' (1, 61) = 18.05, $p < 0.001$).

These results continue to hold up when the active and stative items are examined separately. The mean score for symmetrical statives is 4.0 compared to a mean score of 2.6 for asymmetrical statives. The mean score

Table 3
Experiment 1: mean preference scores for the singular versus plural forms for symmetrical and asymmetrical predicates (1 = maximum preference for singular; 5 = maximum preference for plural)

Symmetrical		Asymmetrical	
Predicate	Preference score	Predicate	Preference score
equal	4.33	love	2.67
identical	4.50	copy	2.00
marry	4.00	safe	3.17
far	3.00	see	3.00
match	4.33	hit	1.67
divorce	2.83	bounce	2.33
resemble	3.17	unpleasant	2.33
meet	4.67	lecture	2.33
similar	4.33	hurry	3.17
across	3.00	applaud	2.83
near	2.33	follow	2.33
different	3.00	inside	2.83
separate	4.17	eat	2.17
combine	4.67	drown	3.17
collide	4.83	choke	2.83
attach	1.33	inferior	1.83
argue	3.67	below	2.67
embrace	4.67	behind	1.83
kiss	3.67	better	1.50
compare	4.50	less	2.83
Means	3.75		2.48

[6] For obvious reasons, half the time the singular sentence was the "a" sentence and half the time it was the "b" sentence. For scoring, a conversion was performed such that the higher values (4 and 5) always represented preference for the plural and the lower values preference for the singular (1 and 2) with 3 representing the "no preference" choice.

for symmetrical actives is 3.7, and for asymmetrical actives it is 2.6.[7] Both these differences are reliable: for the stative terms, the difference between the symmetricals and the asymmetricals is significant (min F' (1, 18) = 10.32, $p < 0.025$); the same holds for the activity terms (min F' (1, 40) = 6.96, $p < 0.025$). However, inspection of Table 3 shows that the spatial words behave differently from the adjectives and verbs. Some of them are ungrammatical as intransitives whether the noun phrase is singular or plural (e.g., *The telephone booth is across*; *The telephone booth and the railroad station are across*). The pattern for these is different in Table 3 to the extent that the means for both symmetrical (2.77) and asymmetrical (2.44) instances are both below the midpoint value of 3. But the difference between the symmetrical and the asymmetrical spatial words is in the same direction as for the adjective and verb items: the conjoined structure is "less unacceptable" (has a higher mean rating) for symmetrical than for asymmetrical items.[8] We reserve until later (Part IV) discussion of the special facts about spatial words.

9. Discussion

For asymmetrical predicates, subjects rated the singular sentences as more acceptable than those with the conjoined noun phrase. This was probably an effect of the choice of nominals: the words in each pair were deliberately made distant from each other along some loosely defined dimension – fleas and frogs, Sam and the Pope, etc. This was so that later (see Experiments 3 and 4) we could test for effects of prototypicality on preferred nominal order. But for this reason their conjunction often seems pragmatically unlikely; for instance, fleas and frogs sitting down to eat together (we thank B. Partee for discussion of this issue). But such plausibility issues were not decisive when it came to the symmetrical predicates that are our main concern here. For these, the clear preference was for the conjoined structure despite the fact that fleas and frogs continued to populate the test sentences.

Why should this be? Presumably, because *meets/collides/is equal/is similar* are hard to interpret at all with just one nominal entity, for they necessarily express a relation between two or more. Therefore, excepting elliptical usages that rarely come to mind when sentences are presented in

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[7] The difference between the mean scores for active and stative symmetricals is not significant ($t = 0.05$).

[8] Omitting the spatial prepositions thus does not alter the findings reported for all items though it strengthens them slightly: the mean for symmetrical items is then 3.92 ($t = 4.19$, $df = 16$, $p < 0.001$) and the mean for asymmetric items is 2.48 ($t = -4.02$, $df = 16$, $p < 0.001$). The mean difference is 1.44 ($t = 5.5$, $df = 32$, $p < 0.001$). Note that here and in the next experiment, the item *attach* is also an outlier.

isolation, both of these nominals must surface in the sentence.[9] We explore the interpretive distinction in the next experiment.

EXPERIMENT 2: SYMMETRICAL PREDICATES AND RECIPROCAL INTERPRETATIONS

We now compare the behavior of symmetrical and asymmetrical predicates in coordinate structures such as

(16) (a) John and Bill meet.
     (b) John and Bill drown.

and in reciprocal structures such as

(17) (a) John and Bill meet each other.
     (b) John and Bill drown each other.

Specifically, we tested the prediction that coordinate structures containing symmetrical predicates (such as 16a) are semantically close to their reciprocals (17a), and that this relation does not hold for asymmetricals (16b, 17b). This would show that the out-of-context intuition of predicate symmetry (from the pretest) is closely associated with the interpretation of sentences.

10. Method

10.1. Materials

The test items were pairs of sentences containing the 40 predicates from the pretest. One sentence in each pair was the conjoined sentence for that predicate in Experiment 1 (e.g., *The scooter and the bus collided*). The

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[9] With sufficient context, the elliptical usages are common. Consider the mini-discourse: "My brother spends most of his time gossiping about the neighbors. My Aunt Fanny is similar." This sounds more or less natural, but *My Aunt Fanny is similar*, inspected alone and without discourse and presuppositional supports, was evidently considered strange or awkward. More generally, many verbs – both symmetrical and asymmetrical – allow suppression of one nominal position at the surface. Thus *John eats* is fully natural. A second argument is implied (i.e., John is assumed to be eating some unmentioned food) but need not be expressed. For discussion of such "open roles" and their psycholinguistic reality, see Carlson and Tanenhaus (1988). Across predicates, there is a range of acceptability for open roles, for example, *John eats* is fine, *John gobbles* is less fine, and *John devours* is awful (for an account of why, see Resnik, 1993). This range occurs for symmetrical verbs as well. *John marries* is fine, *John is similar* is less fine, and *John meets* is awful. But these distinctions are rather exquisite. The overall finding was that the singular forms are dispreferred for symmetrical predicates.

other sentence was formed by adding the reciprocal *each other*, along with any necessary preposition (e.g., *The scooter and the bus collided with each other*). Sample pairs are shown in Table 4. Five lists were constructed, each with eight test items (four symmetrical and four asymmetrical) along with 40 fillers, with items arranged in pseudo-random order.

10.2. Subjects and procedure

Twenty subjects were tested. They were instructed that for each pair of sentences they should indicate how close they were in meaning by circling one number on a scale from 1 to 5 that appeared below each sentence pair. The number 1 was labeled " "**do** mean the same" and 5 was labeled "**do not** mean the same".

11. Results

For each item a mean score was computed, reflecting the degree of perceived meaning change within the pair. These mean scores are shown in Table 5. The judged degree of meaning change for symmetrical and asymmetrical test items was very different. For the symmetrical items the mean score was 2.59, and for the asymmetrical items it was 4.75. Appropriate ANOVAs substantiated the effect of the symmetry variable (min F' $(1, 56) = 41.74$, $p < 0.001$).

This result holds for both actives and statives when these are examined separately. Asymmetrical statives with and without *each other* are more disparate in meaning than symmetrical statives (min F' $(1, 17) = 36.33$, p 0.001); and asymmetrical actives with and without *each other* are more disparate than symmetrical actives (min F' $(1,28)$ $= 30.72$, $p < 0.001$).

Inspection of Table 5 shows that the asymmetrical items behaved uniformly in this regard: each asymmetrical except *hit* changed meaning meaning maximally (score above 4) with the addition of *each other* (see note 18 for the special facts about *hit*). The findings for the symmetricals were more variable: just as in Experiment 1, the spatial items behaved differently from the adjectives and verbs; their interpretation with and without *each*

Table 4
Sample sentence pairs for Experiment 2: the effect of reciprocal "each other"

	Sample sentences
Symmetrical	(A1) The priest and the Pope argue
	(A2) The priest and the Pope argue with each other
Asymmetrical	(C1) The swimmer and the lifeguard drowned
	(C2) The swimmer and the lifeguard drowned each other

Table 5
Mean change-of-meaning scores produced by "each other" for symmetrical and asymmetrical predicates (5 = maximum change of meaning; 1 = minimum change of meaning)

Symmetrical		Asymmetrical	
Predicate	Average meaning change	Predicate	Average meaning change
equal	2.95	love	5.00
identical	1.25	copy	5.00
marry	1.25	safe	5.00
far	4.00	see	4.75
match	2.00	hit	3.00
divorce	3.75	bounce	4.50
resemble	3.50	unpleasant	4.75
meet	1.25	lecture	5.00
similar	2.00	hurry	4.75
across	5.00	applaud	4.75
near	4.25	follow	4.75
different	2.50	inside	5.00
separate	1.50	eat	4.75
combine	1.25	drown	5.00
collide	2.25	choke	4.25
attach	4.25	inferior	5.00
argue	2.75	below	4.75
embrace	1.25	behind	5.00
kiss	2.50	better	4.75
compare	2.50	less	5.00
Means	2.59		4.75

other was close to the maximum value for change. Furthermore, as in Experiment 1, the item *attach* behaved asymmetrically.[10]

12. Discussion

Clearly subjects thought that the meanings of asymmetrical predicates in intransitive structures were nothing like their meanings with reciprocal pronouns (the mean rating was 4.75, just about the ceiling for change). Subjects generally rated the meaning change for symmetrical predicates under these conditions as much smaller (2.59).

That there was some reported meaning change when the predicate was

[10] Two more details are worth noting: rather surprisingly, the item *resemble*, like other symmetricals, is judged not to change interpretation maximally across the two formats even though the form without the reciprocal pronoun is ungrammatical (e.g., *John and Bill resemble*), though its relatively high score (3.50) is probably an effect of this grammatical fact. *Divorce* also scores above the midpoint level (3.75) (see footnote 14).

symmetrical is expectable. As we will discuss later, the relation between symmetrical coordinates and their reciprocals is a (one-way) entailment rather than an identity relation. Also, subjects may have considered alternate readings for some sentences, for example, *John and Bill argue* could mean that each of them is an arguer as well as that they argue with each other (see note 8). Finally, the spatial items behaved differently from the verbs and adjectives, as we saw. Despite the reality of these contaminants, the difference in degree of meaning change with and without *each other* for symmetrical versus asymmetrical predicates is robust. Thus Experiments 1 and 2 documented two interlocked diagnostics for symmetrical predicates:

(ii) Symmetrical predicates can surface with one fewer than their usual number of syntactic positions, provided that one designated position is filled by a plural. *John met Bill* is fine; *John and Bill met* is fine. But *John met* is anomalous (Experiment 1).

(iii) The nouns in the plural argument position, for symmetrical predicates, are interpreted as reciprocally related; this renders the relation between symmetrical coordinates and symmetrical reciprocals a semantically close one. *The shirt and the button match* is more or less equivalent to *The shirt and the button match each other* but *John and Bill choke* means nothing like *John and Bill choke each other* (Experiment 2).

PART III: WHEN SYMMETRICAL PREDICATES SEEM ASYMMETRICAL

The question raised here is whether symmetrical predicates as a group also share the attribute that Tversky and Gati found for *similar* to the considerable astonishment of the psychological community: that they seem to be read asymmetrically in "directional" structures such as

(1) North Korea is similar to Red China.
(2) Red China is similar to North Korea.

Tversky demonstrated this apparent asymmetry in two ways: first, the two orderings were shown to imply different degrees of the relation, with that degree greater for (1) than for (2); that is, the two sentences were construed as nonidentical in meaning. Second, in a preference task, subject affirmed that they would "rather say" (1) than (2). In the next three experiments, we examine the semantic consequences of reversing the nominals.

EXPERIMENT 3: CONSTRUAL CHANGES WITH NOMINAL REORDERING

This experiment examines degree of meaning change as a function of predicate symmetry. As will be documented, the degree of meaning change depends also on whether the predicate is active or stative.

13. Method

We could not conduct an experiment directly equivalent to Tversky and Gati's in which subjects were asked to assess "the degree to which X is similar to Y" for it would have been absurd to ask then to "Assess the degree to which Meryl Streep met my sister." This query makes no sense for many predicates. Though things can match or be similar to varying degrees, one meets (or kisses, etc.) or one does not. Therefore we asked more neutrally whether the construal remained the same when the order of the noun phrases was reversed in directional and nondirectional constructions.

13.1. Subjects and materials

Forty subjects participated. Each of the predicates was embedded in four kinds of sentences: (1) directional constructions, for example, *North Korea is similar to China*; (2) the same directional constructions but with the noun phrases reversed, *China is similar to North Korea*; (3) nondirectional constructions, *North Korea and China are similar*; (4) the same nondirectional constructions but with the noun phrases reversed, *China and North Korea are similar*. Examples are shown in Table 6, the full set in Appendix 2. As there were 40 predicates, there were 160 sentences. Ten lists were constructed, each containing eight different predicates, four of which were symmetrical and four asymmetrical. Two symmetrical and two asymmetrical predicates in each list were rendered in the directional construction with the other four in the nondirectional construction. Each test item on the list consisted of two such sentences, with the second identical to the first but with the order of the noun phrases reversed. The items (along with 40 filler sentence pairs) were arranged in pseudo-random order.

13.2. Instructions and procedure

Each subject received one of the lists. The instructions directed them to rate the sentence pairs according to "how alike they were in meaning" by use of a 5-point scale that appeared below each pair. Number 1 on the scale was labeled "**do** mean the same" and 5 was labeled "**do not** mean the same".

Table 6
Sample sentence pairs for Experiment 3: the effect of the order of the nominals with symmetrical and asymmetrical predicates

Symmetrical	Directional: Order 1: The button matches the shirt Order 2: The shirt matches the button
	Nondirectional: Order 1: The button and the shirt match Order 2: The shirt and the button match
Asymmetrical	Directional: Order 1: The swimmer drowns the lifeguard Order 2: The lifeguard drowns the swimmer
	Nondirectional: Order 1: The swimmer and the lifeguard drown Order 2: The lifeguard and the swimmer drown

14. Results

The mean score for each predicate is shown in Table 7. As the table shows, subjects as a group were never willing to say that the two sentences in a pair meant precisely the same thing (for all four cells, the differences from the no-change score of 1 on the scale provided are significant). However, for all nondirectional constructions, the absolute reported change in construal is close to the minimum value of 1 (1.5 for the symmetricals and 1.4 for the asymmetricals). For the directional constructions, the change in construal for the symmetricals was much larger (3.0) and for the asymmetricals it was larger still (4.8, close to the maximum value of 5).

Appropriate ANOVAs yielded significant main effects of symmetry (min F' $(1, 73) = 15.48$ $p < 0.001$) and directionality (min F' $(1,72) = 158.5$, $p < 0.001$). There was a significant interaction between the symmetry and directional factors (min F' $(1, 68) = 24.88$, $p < 0.001$). This interaction is graphically presented in Fig. 1, which shows that asymmetrical and symmetrical verbs behave the same way in nondirectional constructions: the interpretation changes to the same (minimal) degree as a function of the ordering of conjuncts. But there is a very large change of construal in the directional constructions. Moreover, now there is a great difference between the symmetrical and asymmetrical items. The change in meaning for the former type is much smaller than for the latter type.[11]

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[11] Notice also that the item *divorce* is an outlier in this manipulation, with maximum (4.50) construal change in the present manipulation even though it is high in symmetry in the pretest. We remarked on a similar quirk for *divorce* in Experiment 2. Evidently, these undergraduate subjects don't believe in no-fault divorces.

Table 7
Average meaning change as a function of order of nominals with symmetrical and asymmetrical predicates (5 = maximum meaning change; 1 = minimum meaning change)

Symmetrical

Predicate	Nominals[a]	Average meaning change	
		Directional	Nondirectional
equal	humblest citizen President	2.75	2.25
identical	copy painting	3.00	1.25
marry	peasant movie star	2.50	1.00
far	Anchorage Paris	1.00	2.00
match	button shirt	1.50	1.25
divorce	waitress senator	4.50	1.25
resemble	photo landscape	3.25	2.50
meet	my sister Meryl Streep	2.75	1.00
similar	North Korea China	1.75	1.00

Asymmetrical

Predicate	Nominals[a]	Average meaning change	
		Directional	Nondirectional
love	teenager Jon Bon Jovi	5.00	3.25
copy	apprentice master	4.75	1.75
safe	soldier tank	4.50	1.00
see	Sue Madonna	5.00	1.00
hit	comet planet	4.50	1.25
bounce	weightlifter pebble	5.00	1.25
unpleasant	baron serf	4.50	1.00
lecture	professor teaching assistant	4.00	1.50
hurry	police chief patrolman	4.25	1.00

across	telephone booth	2.00	1.25	applaud	fan	5.00	1.00
	railroad station				Oscar-winner		
near	bicycle	3.25	1.00	follow	pupil	5.00	1.25
	building				principal		
different	Ecuador	1.50	1.50	inside	shoe	5.00	1.25
	United States				box		
separate	wheel	2.00	1.00	eat	frog	5.00	1.00
	car				fly		
combine	salt	2.00	1.50	drown	swimmer	5.00	1.00
	batter				lifeguard		
collide	scooter	4.25	1.25	choke	psychopath	5.00	1.50
	bus				young woman		
attach	leaflet	4.25	2.00	inferior	sargeant	5.00	1.50
	Empire State Building				general		
argue	priest	5.00	1.75	below	picture	5.00	1.50
	Pope				window		
embrace	mother	4.75	2.00	behind	horse	4.50	2.00
	infant				track		
kiss	Princess Diana	4.50	1.25	better	high school player	5.00	1.00
	sick child				little leaguer		
compare	singer	3.25	1.25	less	pint	5.00	1.75
	Bruce Sringsteen				quart		
Means		2.99	1.46	Means		4.78	1.39

[a] In each cell, the second nominal is the "canonically more salient" as determined by pilot inverviews.
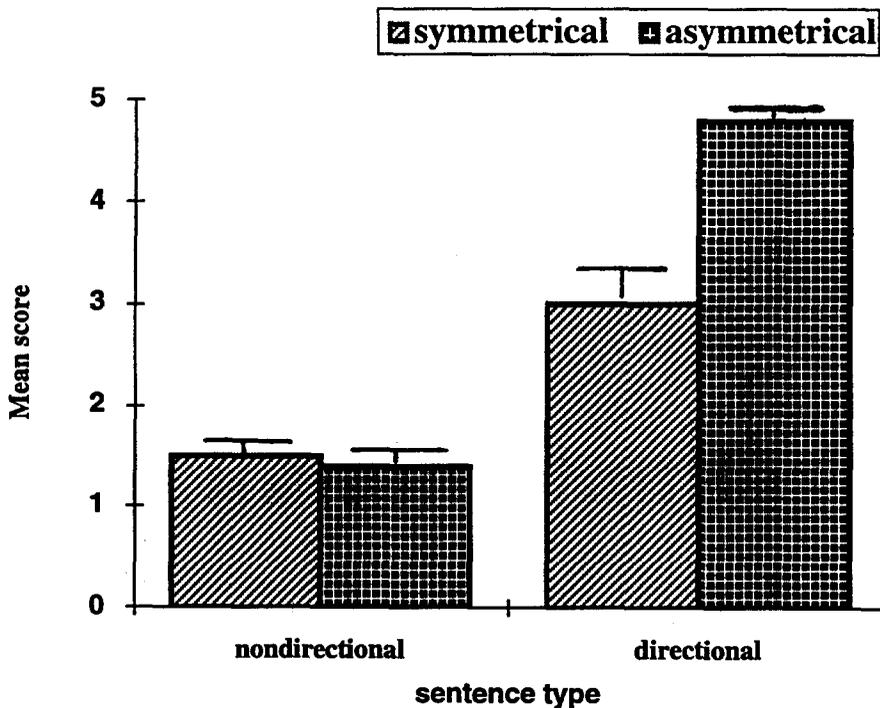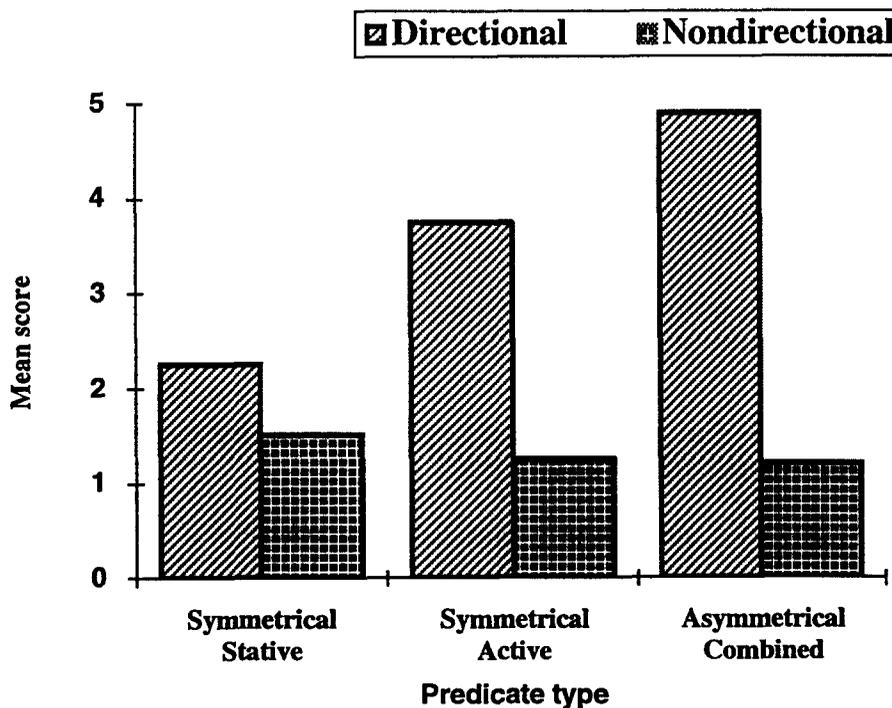
Fig. 1. Mean change of construal of symmetrical and asymmetrical predicates in directional and nondirectional constructions under noun phrase reversal.

Most centrally, we can ask how closely the results of this experiment dovetail with the pretest result, in which the items were ranked according to "degree of symmetry", with *identical* rated higher than, say, *kiss*, and *kiss* higher than *drown*. Is the rated degree of meaning change with nominals reversed (in directional constructions) inversely correlated with height on the symmetry scale as derived from the pretest? To find out, we first calculated the correlation between mean symmetry rating on the pretest and mean meaning change in the current experiment. For all items, the correlation is of course quite large (rho $= -0.75$, $p < 0.001$). More interesting is that these relationships continue to hold when symmetrical verbs only go into the correlation, though these correlations are necessarily smaller because the range of variation is restricted (rho $= -0.53$, $p < 0.05$).

The relationship between height on the symmetry scale and degree of meaning change with noun phrase reversal reflects the influence of the active/stative distinction within the symmetrical group. The role of this factor is illustrated in Fig. 2, which presents mean construal changes for

stative and active symmetricals and for asymmetricals.[12] As the figure shows, in all predicate groups directional constructions led to greater meaning change than nondirectional constructions, with mean differences of 0.68, 2.38, and 3.48 for stative symmetrical, active symmetrical, and asymmetrical predicates respectively (the corresponding t-values are $t(5) = 2.70$, $p < 0.05$, $t(9) = 7.99$, $p < 0.001$, and $t(15) = 23.71$, $p < 0.001$, respectively). But as the figure also shows, this difference was less for the stative than for the active symmetricals, $t(14) = 4.39$, $p < 0.001$; and less for the active symmetricals than for the asymmetricals, $t(24) = 3.31$, $p < 0.005$.

15. Discussion

Reversing the order of conjoined nominals effects little meaning change. That there was any change at all deserves some comment. There is a

Fig. 2. Mean change of construal of active and stative predicates in directional and nondirectional constructions under noun phrase reversal.

[12] The difference between the average meaning change for directional and nondirectional asymmetrical constructions was virtually zero – and near ceiling – for both active and stative terms, so these were combined for analysis. (While the analyses reported here were conducted with predicates as the random variable, similar analyses conducted over subjects gave essentially the same results).

tendency for the prototypical element to appear first, all else being equal, in a conjoined phrase (Kelly, Bock & Keil, 1986), just as this item appears second in a similarity comparison. For completeness, we reproduced this effect with our materials, asking a new group of subjects to state their preference as between the phrases *the Pope and Sam*, *Sam and the Pope*, etc., for all the noun phrase pairs; we found an effect of prototypicality (though it was statistically marginal). Thus the minimal effect of conjunct order on interpretation has nothing to do with the predicate content.

The much larger effect is that when the compared nominals appeared in two different phrasal positions in the sentence, the perceived meaning of the sentence was heavily affected. How this semantic distinction is achieved is a matter we begin to take up in the next experiment. But it is important to note that the symmetry of symmetrical predicates was not obliterated in directional sentences.The meaning change of symmetrical predicates with nominals reversed was significantly smaller than that meaning change for asymmetrical predicates (Fig. 1), with the magnitude of the difference larger for actives than for statives (Fig. 2).

In sum, this experiment tells us three things about the construal of symmetrical predicates in directional structures. First, the positioning of nominals affects the meaning of the sentence as a whole, just as it does for all predicates. Second, the lexical symmetry of the predicate acts as a limiting factor on the degree of that change. Third, the active/stative distinction exerts an independent influence: with stative symmetricals, the meaning change effected by noun phrase reversal is small in magnitude (just as Tversky and Gati found for *similar* and *different* in particular), but it is larger for active symmetricals.

EXPERIMENT 4: INTERPRETING THE ASYMMETRY IN DIRECTIONAL CONSTRUCTIONS

Exactly what comparison is intended when symmetrical predicates are used in directional sentences? Recall that, in Tversky's feature-matching approach, it is the perceived relations between the objects compared that predicts their syntactic positioning: the relation is of a comparison stimulus which appears as sentence subject to a standard which appears as predicate complement.

We demonstrated this effect for the full set of symmetrical predicates in individual interviews with 16 subjects.[13] They were asked to state their preference as between the "a" and "b" forms of all 20 sentences (see Appendix 2 for the complete list of "a" and "b" sentences), which had been

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[13] We also conducted a paper-and-pencil preference study for all these predicates that was closer in method to Tversky and Gati's original study which asked "which [similarity statement] would you prefer to say?" The results were the same as for the present experiment.

constructed to embody such a salience difference. For example, they had to state their preference between *North Korea is similar to China* (the "a" or standard order) and its reverse, *China is similar to North Korea* (the "b" or nonstandard order). For 18 of 20 predicates, subjects agreed on a preferred order, namely the "a" forms of Appendix 2 (Table 8, columns 2 and 3).

To see if this effect was independent of the predicate choice, we next randomly scrambled the noun phrase pairs across the symmetrical predicates and offered these to eight new subjects. As can be imagined, the new sentences were often quite odd, for example, *The wheel argued with the car*. Table 9 shows sample pairs generated by this procedure. The full list appears as Appendix 3. These subjects had the same task: to choose their preference within each pair. For all 20 of the predicates, subjects agreed on a preferred noun phrase order (columns 4 and 5, Table 8). The question of interest is whether the preferences were for the same noun phrase ordering for both the original and scrambled versions. The answer is yes, for 15 of 20 predicates ($p = 0.02$, by a sign test) – not surprising since such preferences can be discerned even in conjoined phrases (e.g., *China and North Korea*) with no predicate at all (Kelly et al., 1986).

On the face of it, these outcomes appear to document Tversky's claim that the choice of nominal order depends on the relative salience of the objects. But the results are much better understood when we take into account not just the objects but the classification under which subjects understood them to be compared. This is tested in the next experiment.

EXPERIMENT 5: THE SENTENCE STRUCTURE DETERMINES THE NOMINAL CLASSIFICATIONS

As part of the interview studies of Experiment 4, we also asked the subjects to tell us if and when they might prefer the nonchosen order: "You said you would prefer to say 'North Korea is similar to China.' Can you think of any occasion in which you might prefer to say 'China is similar to North Korea?' " If the chosen order is a fixed function of the nominals, our subjects should have declined this invitation. But they readily came up with scenarios in which they would prefer the reversed orderings. This was so both for the original stimulus set and for the versions which scrambled the nominals across predicates.

Subjects took one of two approaches to rendering an interpretation for the dispreferred ordering. The first was to alter the very basis of comparison. For example, according to our subjects, if the President under discussion is physically short and the comparison is on stature, it becomes natural to say "The President is equal to the humblest citizen". A more common method was to hold the dimension of comparison constant but to change the valence of the nouns, for example, "If you had this humungous bicycle statue in the town square and a tiny building on wheels going around

Table 8
Preference ratings for the order of nominals for directional sentences with symmetrical predicates (3-point scale, where +1 equals preference for the "canonical" order, −1 preference for the opposite)

Original sentences			Scrambled sentences	
Predicate	Nominals	Preference rating	Nominals	Preference rating
equal	humblest citizen President	+0.25	my sister Meryl Streep	+1.00
identical	copy painting	+0.88	Anchorage Paris	+0.38
marry	peasant movie star	0	salt batter	−0.12
far	Anchorage Paris	+0.19	Princess Diana sick child	−0.50
match	button shirt	+1.00	telephone booth railroad station	+0.88
divorce	waitress senator	+0.56	mother infant	+1.00
resemble	photo landscape	+0.62	waitress senator	−0.62
meet	my sister Meryl Streep	+1.00	humblest citizen President	+0.50
similar	North Korea China	+0.75	scooter bus	+0.62
across	telephone booth railroad station	+1.00	singer Bruce Springsteen	+0.62
near	bicycle building	+1.00	button shirt	+0.50
different	Eucador United States	+0.75	peasant movie star	+0.12
separate	wheel car	+0.75	photo landscape	+0.25
combine	salt batter	+1.00	leaflet Empire State Building	+0.50
collide	scooter bus	−0.06	bicycle building	+1.00
attach	leaflet Empire State Building	+1.00	priest Pope	+0.75
argue	priest Pope	+0.94	wheel car	+0.25
embrace	mother infant	+0.88	North Korea China	−1.00
kiss	Princess Diana sick child	+1.00	copy painting	+0.50
compare	singer Bruce Springsteen	+0.94	Ecuador USA	+0.62
Mean		+0.72		+0.36

Table 9
Sample sentences generated by the scrambling procedure (see Appendix III for the complete list)

Original sentences	Scrambled sentences
My sister met Meryl Streep	My sister is equal to Meryl Streep
The baker combines the salt with the batter	The salt married the batter
The scooter collides with the bus	The scooter is similar to the bus
The worker attaches the leaflet to the Empire State Building	The baker combines the leaflet with the Empire State Building
Princess Diana kisses the sick child	The copy kisses the painting
The critic compares the singer with Bruce Springsteen	The singer is across from Bruce Springsteen

it, then you would say 'The building is near the bicycle.' " In both kinds of response, the subject conjured up an unlikely situational context, and then the anomaly of the reversed-order sentence vanished. Just as Tversky proposed, the variant (Figure) rather than the prototype (Ground) always occupies the subject position. But the important implication is that *the sentence structure – rather than the lexical content of the compared nominals – legislates which compared entity is that prototype.* Thus these interview studies suggest that there is no principled answer to which is the Ground in symmetrical comparisons of Sam and the Pope, of bicycles and buildings, etc. Rather, whichever of the two appears in nonsubject position becomes the Ground. To test this supposition more formally, we performed a further experiment.

16. Method

Twenty-six undergraduate and graduate students served as subjects. They were presented with 20 directional sentences, each containing one of the symmetrical predicates, but the nouns were replaced with nonsense syllables, for example, "The ZUM met the GAX." For each pair of nonsense syllables (arbitrarily designated **a** and **b**), **a** came first for half the sentences and **b** for the other half. In half the sentences, the nonsense words were preceded by the definite article, and in half not. These control factors were counterbalanced across lists, yielding four lists in all. Following each sentence were five phrases: "more famous", "older", "bigger", "more mobile", and "more important". These represented the typical bases on which subjects in the interviews had justified their ordering preferences when the nominals were real words rather than nonsense. The subjects' task was to decide for each phrase, by means of a check list, whether it best described the first nonsense word, the second nonsense word, described both of them equally well, or was irrelevant. Subjects were encouraged to

Table 10
Sample item for Experiment 5

	ZUM	GAX	Equal	Irrelevant
The ZUM is identical to the GAX				
More famous:	_____	_____	_____	_____
Older	_____	_____	_____	_____
Bigger	_____	_____	_____	_____
More mobile	_____	_____	_____	_____
More important	_____	_____	_____	_____

use the sentence context to help them in this admittedly strange task. A sample item is shown in Table 10.

17. Scoring

For the first four adjectives (*more important, more famous, older and bigger*), if a subject judged the *first* word in the sentence to be better described by a particular adjective, a −1 was scored, and if the *second* word was judged better, a +1 was scored. For the fifth adjective (*more mobile*), this scoring was reversed.[14] For all adjectives, if the subject checked "equal", the score was 0. Trials checked "irrelevant" were discarded.

18. Results

The prediction was that the directional structure would accord Ground status to the nonsense syllable in nonsubject position. For the various predicates, the local interpretation of Ground would be "bigger", "more famous", etc., just as it had been in the interview study with real nouns. Thus given "The ZUM is identical to the GAX", the gax would be judged to be more famous, and so on. If this pattern holds throughout, this would yield a positive mean score for each adjective. These means are shown in Table 11(across subjects), and Table 12 (across predicates).

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[14] This oddity requires explanation. Subjects in the interview study (and see Talmy, 1983) averred that entities that were unmoveable (like buildings) should occupy the second, or referent, position in directional comparisons. But the adjective phrase "more immobile" or "more permanent" (matching the other adjectives by being positive comparative phrases) seemed clumsy and hard to understand. Therefore we used the phrase "more mobile" instead. Another advantage of this is that subjects could not see their task as checking the same column in response to every question; that is, in a sentence like *The zup is near the riff*, the subject is likely to be rated "more mobile" (column 1) and the complement as "more famous" (column 2). For the sake of uniformity, we here present the results as if the subjects had been shown "more immobile", by coding "more mobile" in reverse.

Table 11
Means across subjects in Experiment 5

Adjective	Mean	$t(df = 19)$
important	0.45	7.3***
famous	0.38	5.1***
old	0.41	6.2***
big	0.38	5.8***
immobile	0.15	2.6**

*** $p < 0.01$; ** $p < 0.02$.

As the tables show, there were reliable effects of nonsense word positioning for each adjective in the predicted direction: every adjective had a positive mean score. That is, every adjective was judged as being more descriptive of the second nonsense word than of the first (correcting for the reversed scoring of "immobile"). Since the nonsense words have no intrinsic meaning, this systematic choice as to which of them is "more famous", etc., must be attributable to the sentence structure.

Tversky (1977) suggested that the reason subjects show preferences for one word order over the other in similarity statements is that the prototype (reference object) takes nonsubject position; Talmy (1983) suggested a physical distinction (size and mobility) underlying the Figure/Ground distinction for the case of spatial words. While the question of what makes one entity more prototypical or "Groundlike" than another is a difficult one, the interview findings led us to expect that the adjective phrases we used would form one or more groups corresponding to such distinctions. To study this prediction, we tested for correlations among the responses to the five adjectives, and also performed a factor analysis. The obtained correlation matrix is shown as Table 13.

An orthogonal factor analysis extracted two factors. The adjectives *important*, *old*, *famous*, and *big* loaded heavily on Factor 1. *Immobile* loaded heavily on Factor 2, and *big* loaded moderately on Factor 2. Factor 1 might be described as representing social prominence (as in the examples studied by Tversky, including country comparisons), while Factor 2 represents physical prominence (as in Talmy's investigation of spatial terms).

Table 12
Means across predicates in Experiment 5

Adjective	Mean	$t(df = 25)$
important	0.45	9.0***
famous	0.36	7.6***
old	0.40	8.6***
big	0.37	7.4***
immobile	0.20	2.1*

*** $p < 0.01$; * $p < 0.05$.

Table 13
Correlations among adjective scores in Experiment 5

	Important	Big	Old	Famous	Immobile
Important	1				
Big	0.59***	1			
Old	0.75***	0.72***	1		
Famous	0.67**	0.58**	0.63**	1	
Immobile	0.18	0.46*	0.16	0.21	1

*** $p < 0.001$; ** $p < 0.005$; * $p < 0.025$.

19. Discussion

The nonsense nouns are semantically inert; neither is inherently prototype to the other. Yet subjects had a strong intuition as to which of them is more famous, larger, etc., in a symmetrical comparison; namely, the one in lower position (second serial order) in the structure. The structure determined the classification subsuming the two nonsense items: Whatever that classification may be, it must be one that renders the second nonsense the Ground object for the class. This outcome raises doubt about prior approaches which assumed the reverse; namely, that the semantics of the compared nominals determine their position in the directional structure.

Of course one could object that only when subjects have no guidance from the nominals do they reverse the causal chain and let the structure decide. But the interview studies weaken the force of this new claim, for there the subjects evaluated the prototypical status of real compared nominals (such as North Korea and China) differently when their position in directional sentences was reversed. It is the results of the two manipulations taken together that support the claim:

(iv) The placement of nominals in the subject and complement positions in a syntactic structure containing a symmetrical predicate causes these to be assigned Figure (variant) and Ground (referent) status respectively.

PART IV: UNDERSTANDING SYMMETRY

20. The lexical representation of symmetry

The first aims of this work were to demonstrate that speakers partition the lexical stock along the symmetry dimension, and that a large number of predicates, including *similar*, fall into the symmetrical class. Accordingly, in Part II we documented that subjects share an intuition about which items are symmetrical (Pretest), that their judgement of the acceptability of sentences containing symmetrical predicates is sensitive to the number of a

designated argument (Experiment 1), and that they judge the relation between nominals in coordinate structures to be (roughly) reciprocal for the symmetricals only (Experiment 2).

We now ask how the symmetry of predicates is mentally represented. The choice turns on the requirement to account for their defining peculiarity: symmetrical predicates can surface in the same structures as do asymmetrical predicates, as shown in Fig. 3, but with a systematically different interpretation.

One way of describing these facts is to suppose that structures a and b in Fig. 3 are different, despite appearances. This could be done by claiming that symmetrical predications require two underlying argument positions; and that symmetrical intransitives are derived from reciprocals (*John and Bill meet each other*) by pruning the node dominating the reciprocal pronoun, leaving a trace. The appeal of this proposal (for which see Gleitman, 1965) is that it seems to account both for the anomaly of singular symmetrical intransitives (*He met*) and for the semantic closeness of symmetrical intransitives to their reciprocals.

This analysis cannot be correct. For one thing, it does no real work for it does not obviate the necessity to stipulate (at the lexical entry) just which predicates allow the deletion of the reciprocal pronoun; namely, the symmetrical ones! Even so, one might argue that the derivational solution has the virtue of explaining the semantic identity of intransitive symmetricals to reciprocals. But this potential gain too is illusory for our subjects consistently declared that while these sentence types were closely related, they did not quite mean the same thing. An important semantic distinction between the reciprocal and intransitive structures is revealed by such activity predicates as *kiss*. Not all kissing is reciprocal (the flag never kisses one back) and reciprocal kissing is not always symmetrical kissing:

(18) *John and Mary kiss each other.*
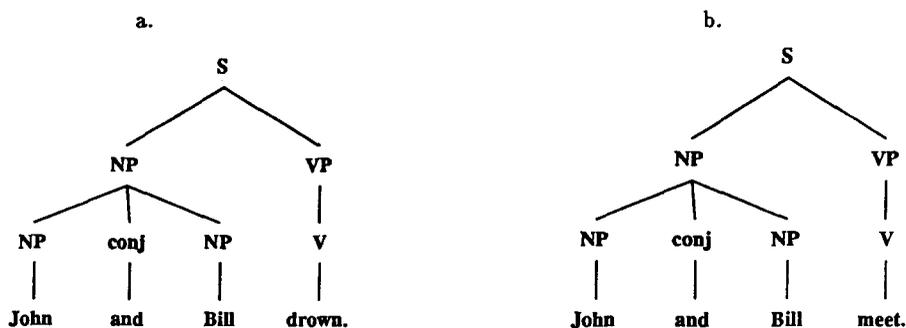(19) *John and Mary kiss.*

Fig. 3. Simplified phrase structure representations of the intransitive use of an asymmetrical and a symmetrical predicate.

Example (18) but not (19) can be uttered in case John kisses Mary's hand while (or even before or after) Mary kisses John's hand. They are then kissing each other, but they are not kissing: the relation between symmetrical and reciprocal structures is a one-way entailment (19 entails 18) rather than an identity of logical form (for 18 does not entail 19).[15] (It becomes progressively harder to find such distinguishing events and states as we ascend the symmetry ladder represented by subjects' responses in the pretest: how could two things be identical to each other but not be identical?)

The remaining viable solution is that 'symmetry' is a lexical-semantic property of certain predicates. This symmetrical content imposes the reciprocal interpretation on the sentence in Fig. 3(b) but not on the one in Fig. 3(a): *meet*, just like *drown*, is grammatical in intransitive sentences, but owing to its classification as a symmetrical word, it requires a reciprocal interpretation of its nominals. Therefore, if the argument position is occupied by a nominal describing a single entity, there can be no nonanomalous reading of the sentence because reciprocality is a relation between two or more things. On this account, it is the semantic entailment of symmetry ($Rx, y \leftrightarrow Ry, x$) which must be satisfied in the sentence, not a syntactic (verb subcategorization) requirement. Consistent with this approach, symmetrical predicates in intransitive structures are acceptable with singular subjects if these are conceptually plural (*The group/class/senate meets*). We conclude that *John meets* is not ungrammatical; rather, it is semantically ill formed.[16]

This position is solidified by considering such predicates as *scatter*, which for reasons of conceptual coherence requires not only plurality but "more than two". Surely the varying numerical requirements of *drown*, *meet*, and *scatter* (not to speak of *duo*, *trio*, etc.) are unlike what have traditionally been regarded as verb-subcategorizing information. Grammatically speaking, *scatter* (like *meet* or *similar*) occurs intransitively and transitively (*John*

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[15] A related case that we discussed earlier (footnote 10) is *divorce*. If John divorces Mary and Mary divorces John, then *John and Mary divorce each other*. But at least according to our subjects' responses to this item, it is apparently possible to deny with regard to this scenario that *John and Mary divorce*; hence subjects said the two expressions meant very different things in Experiment 2. The intuition that lies behind this judgement appears to be that the directional forms (and by inheritance their reciprocal) describe the outcome of hostile legal procedures instigated by one or both of the agents, while the state of affairs described in *John and Mary divorce* is nonagentive and perhaps pacific. We will return to this issue.

[16] This analysis does not deny that there may be genuinely polysemous items among the symmetricals. In fact, *meet* is a likely candidate. *John meets Mary at the airport* appears to have two distinct interpretations: one where John runs into Mary at the airport (symmetrical *meet* in its transitive Figure/Ground guise), the other where John goes out to the airport to pick up Mary, that is, where she is not a co-actor in the interaction. The first of the *meet*s is symmetrical and for semantic coherence requires a plural subject when intransitive; the second has no intransitive at all.

scatters the leaves, The leaves scatter). The oddity of *The leaf scatters, John scatters the leaf*, and *The two leaves scatter* is semantic.[17]

Relatedly, consider conceptually symmetrical nouns. *John and Bill are fathers* cannot be interpreted reciprocally (as meaning that they are fathers of each other) while *John and Bill are cousins* is usually so interpreted. For such pairs, it is hopeless to maintain that a syntactic distinction underlies the interpretive difference. It is the fact that *cousin* is lexically designated symmetrical that triggers the reciprocal reading of sentences in which it appears. If this account is correct, it follows that symmetry is a lexical-semantic attribute of *cousin* – and of *match, similar*, and all other predicates that can be read reciprocally in the structure of Fig. 3(b).

It was just asserted that a variety of words including such semantically disparate items as *identical* and *collide* behave alike in certain ways because they share the semantic property of symmetry. Bolstering this account, there are also some pairs among our materials that demonstrate the converse effect: two words that are very close semantically but pattern differently because they differ on the symmetry dimension. Consider *hit* and *collide* which are so close in meaning that many dictionaries give one as a synonym for the other: both refer to sharp contacts. Despite this semantic closeness, *hit* is ranked by subjects among the asymmetrical items while *collide* is ranked among the symmetrical items (Table 1). This ranking is associated with the linguistic patterning: *Hit* behaves asymmetrically in Experiment 1; that is, its acceptability is not improved with a plural argument while that of *collide* is so improved (Table 3).[18] Another example in our materials is the pair *kiss/love*. Although they are not as closely related to each other as are *hit* and *collide*, they do share many relevant aspects of their interpretations. Yet *kiss* is rated higher than *love* on the symmetry scale and is preferred in the plural. That is, *kiss* behaves symmetrically in English; therefore it is

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[17] These sentences might be interpreted by analogy to *fragment*, however, by assuming that each leaf goes to bits. Such rare but nonanomalous interpretations are another reason for not considering the selection for number to be a grammatical property (in a related regard, see Grimshaw, 1993). More generally, sentences like *N's scatter*, where "N" is any noun, sound fine or not fine simply as a matter of the presumed pragmatics of their use: fine if there are more than two leaves under discussion, otherwise not fine.

[18] Actually, there is yet another complication here. If (like our subjects) one is confronted by the sentence *John and Bill hit*, how is one to interpret it? If *hit* is necessarily transitive, it is hard to interpret as a coordination; and if it is asymmetrical, it is hard to interpret as the reciprocal, without *each other*. When subjects are posed the problem of interpreting sentences that seem ungrammatical, they have several repair options. One is compliance with the verb semantics, in this case asymmetrical semantics; if so, the primary reading of the sentence is as a generic statement (e.g., an indictment of a pair of nursery-school bullies, who characteristically hit). The other stretches the semantics, assigning *hit* to the symmetrical class by analogy to *collide*, that is, as meaning *John and Bill hit each other*. Notice (Table 5) that subjects in Experiment 2 sometimes adopted this second option. Hence *hit* was the only verb classified as asymmetrical by the pretest and by Experiment 1 that did not show maximum construal change between *The planet and the comet hit* and *The planet and the comet hit each other*.

more likely to be perceived as expressing a symmetrical relation than is *love*, whose linguistic behavior is asymmetrical. This is so despite the fact that, in real life, both loving and kissing are often unrequited.

21. Alternate constructional devices

The linked diagnostics for lexical symmetry (reduction in number of required argument positions with plural nominals, reciprocal interpretation) failed for the spatial terms, for example, *far*: their singular was preferred to the plural in Experiment 1 and their construal with and without *each other* was nonequivalent in Experiment 2. As the subjects realized, *Anchorage and Paris are far* does not imply that they are far from each other; rather, far from the speaker. On the criteria we have accepted, then, these spatial terms do not fall into the symmetrical class.

One explanation for this finding is that spatial relations may be construed as necessarily asymmetrical. A number of commentators have indeed proposed that space is not treated metrically in language for conceptual reasons. Notably, Talmy's (1978) proposal asserts that we *necessarily* conceive of entities in space in terms of a Figure moving or located on a Ground defined by a reference frame. Thus garages and bicycles being what they are, we say *The bicycle is near the garage*, not *The garage is near the bicycle*; moreover, the reciprocal structure *The bicycle and the garage are near each other* is odd just because it inherits the oddity of one of its sentential conjuncts. So Talmy posits that the syntactic constraints on spatial predicates derive quite straightforwardly from psychological facts about spatial representation. In short, farness is described by Talmy as inherently asymmetrical just as, in Tversky's writings, similarity is described as asymmetrical. Such a solution would fit well with findings on subjective maps (Borroughs and Sadalla, 1979) in which subjects reliably report that the distance from a well-known landmark to an arbitrary point is larger than the distance from that point to the landmark (see also Rosch, 1975, for an important related discussion of perceptual and cognitive reference points).

Yet subjects in the pretest asserted that *far* was symmetrical and that *behind* was not; that is, they could conceive of the former term as – at least sometimes – expressing a symmetrical relation. If so, it would be surprising if there were no convenient linguistic device for expressing this perceived symmetry. In fact, there is one but this time it is a different one. We can say (20) but not (21):

(20) *Sam and the Pope are far apart/close together*
(21) *Sam and the Pope are above apart/behind together*.

That is, *apart/together* are reserved to the words that can encode symmetrical spatial relations, and imply a reciprocal reading in the absence

of *each other*. This peculiarity in the treatment of prepositions and satellites is not unexpected. Syntactic form is sensitive to lexical class. The structures licensed for symmetrical verbs and adjectives are not licensed for words in these classes, but they accept a semantically equivalent structure.[19]

There is some quirkiness in the surface manifestation of symmetry beyond the spatial words. The symmetrical adjectival predicates *kin* and *like* are prefixed with *a* in their nondirectional usages (*John and Bill are akin/alike*) though in all other regards they are linguistically well behaved as symmetrical predicates.[20] Moreover, we found genuine counterexamples to the predicted linguistic diagnostics for *resemble* and *attach*. Subjects take these words to be conceptually symmetrical but there is no sentence *John and Bill resemble* (or *Jane resembles John and/to Bill* with the reading "Jane causes there to be a resemblance between John and Bill"). Another offending case that we did not study experimentally is *encounter*.[21]

The overall conclusion is that *only predicates held to be symmetrical out of context* (as in the Pretest) *require a plural in one argument position and accept reciprocal readings of their plural nominals* in intransitive constructions. Though a few symmetrical predicates do not show this pattern, the most important facts are that the overwhelming majority of them do, and that *no* asymmetrical predicate does. This linguistic pattern is a derivative of the conceptual facts: a symmetrical relation must hold between at least two things, and it must hold reciprocally. Because *similar* is a predicate that conforms to this linguistic-conceptual generalization, observers are surprised at the results of experiments such as Tversky's that seem to show that similarity is asymmetrical.

22. The inherent asymmetry of subject–complement constructions

We now turn to the apparent failures of the symmetrical entailment in so-called directional sentences; that is, why *The button matches the shirt* and *The shirt matches the button* are interpreted differently as shown in

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[19] We thank Noam Chomsky for a discussion of these points. Notice that *apart* can occur also for specific measure nominals, for example, *two inches apart*. We should acknowledge that there is at least one symmetrical preposition that resists this analysis and has to be treated as a true counterexample: *across*. *They are across* is simply ungrammatical. If interpretable at all, it does not mean that they are across from each other. And one can't say *across together/apart* instead.

[20] That is, they are unintelligible with singular nominals (*John is like/alike*), and they yield nonequivalent interpretations in directional constructions (compare *A man is like a tree* and *A tree is like a man*; see Tversky, 1977), of which more later in this discussion. The prefix *a-* in these words (as well as *across, asleep, astir*, and many others) apparently derives from the OE preposition *on* (Jespersen, 1956) and seems to impart a stative flavor to the interpretation.

[21] Such semantically related expressions as *bear a resemblance* and *have an encounter* do behave symmetrically.

Experiments 3, 4, and 5. In particular, we will try to understand why in general there is not only a difference but a preference for one version (Experiments 4 and 5). Finally, we will consider why the effect of nominal reordering is stronger for active symmetricals (*My sister met Meryl Streep* vs. *Meryl Streep met my sister*) than for such statives as *match* (Experiment 3).

One appealing explanation of all these effects is that predicates like *kiss* and *match* and even *equal* are polysemous: there is a symmetrical predicate *kiss* that occurs in intransitive sentences with plural subjects and an asymmetrical predicate *kiss* that occurs in transitive sentences; and in all aspects save the symmetry, the two *kiss*'es "mean the same". Not only would this solution be adequate for many of the phenomena we demonstrated but it would account as well for selectional differences associated with the transitive and intransitive forms: we hear *John kissed the flag* but not *The flag kissed John* or *John and the flag kissed*. However, this approach implies a large and not so plausible coincidence in the design of lexicons: that for each intransitive symmetrical predicate – and only these – there happens to be another item that sounds the same but is asymmetrical, transitive, and semantically identical to the first except for the symmetry itself. In the following discussion we assume instead that there is but one *kiss*, and that the semantics of syntactic structures (general principles of sentence interpretation that apply well beyond the symmetrical case) account for the differences in interpretation.

23. Figure/Ground in sentence interpretation

All of the results we have reported suggest the psychological potency of Talmy's (1978) distinction between the Figure and Ground entities in a predication

(v) *Figure:* a moving or conceptually moveable object whose site, path, or orientation is conceived as a variable the particular value of which is the salient issue.

(vi) *Ground:* a reference object – itself having a stationary setting within a reference frame – with respect to which the Figure's site, path, or orientation is characterized.

and their association with the (deep) subject and complement positions respectively. Accepting this analysis, we first ask how the Figure and Ground assignment is made to entities in a symmetrical predication.

23.1. Default relations between nominals

For many pairs of nouns, some particular classification subsuming them will suggest itself by default, at least when they are presented out of

conversational context. For instance, we usually have in mind different senses of *equal* if we say *A peasant is equal to a king, Margarine is equal to butter*, or *Dollars are equal to pounds*; this is the sense in which real-world knowledge is brought to bear to understand a particular comparison. Rarely are noun pairs so disparate as to suggest no such relation. hence the whimsicality of *cabbages and kings* as a topic of conversation. For North Korea/Red China and my sister/Meryl Streep the default basis for classification is fame or prominence, for bicycle/building it is size and mobility as physical objects, and so forth.

For each such pair, a distinction in their position within the classification usually exists. Kelly et al. (1986) showed that these differences account for preferences of nominal ordering in conjoined structures (*Red China and North Korea* vs. *North Korea and Red China*), and we replicated this effect on conjunct ordering for the noun pairs used in our experiments (Experiment 4). The same effect was shown in Experiment 4 for directional symmetrical constructions, replicating Tversky and Gati's original findings for *similar* and *different* and generalizing them to a larger set of symmetrical predicates.[22] That the preference in nominal ordering is independent of the specific choice of symmetrical predicate was also shown in the "scrambling" variant of Experiment 4, where noun pairs were assigned at random to the 20 symmetrical predicates, yet the preferred order for the two nominals remained the same.

23.2. Changing the defaults

Context can affect the classification perceived to be pertinent to the relation implied between two entities. Thus in a conversation about places to go on one's vacation, the relative political prominence of China and North Korea may not matter as much as the weather. The interviews of Experiment 4 were a way of getting subjects to mentally generate several such real-world scenarios in which the reversed nominal orderings would be nonanomalously interpretable. This was an easy task for subjects even in the scrambled condition. Such contextual effects were also shown in Tversky's choice-set experiment where the presence of additional exemplars changed subjects' perception of the intended similarity comparison – the classification within which countries are judged similar to Austria. In sum, despite the potency of default classifications, nouns can be compared to each other on any of several dimensions. Which is then Figure to the other's Ground will change accordingly.

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[22] Notice that in conjoined phrases the Figure takes second serial position while in subject/complement structures it takes first serial position. Thus no structural explanation like "put most important things first" (or last!) will do.

23.3. Syntactic cueing of the classification

As Experiments 4 and 5 showed, syntactic form is a powerful determinant of the classification under which entities are perceived to be related by the predicate, and their status in this classification. Whichever nominal occupies the subject position is interpreted as the Figure to the Ground provided by the nominal in complement position. With nothing else to go on in an experimental setting, subjects prefer a symmetrical comparison in which the nominals are compared under the default classification that subsumes the two of them (Experiment 4). This is what accounts for subjects' apparent preferences ("Which would you rather say?") in directional symmetrical comparisons despite the symmetry of the predicate itself. Asked to judge sentences out of context, the subject conjures up a minimally presuppositional environment in which the utterance of a sentence would "make sense".

But when the syntactic positions change, either the pertinent classification or the item's position in the classification will then have to change too. The syntactic structure literally imposes this requirement: the lower noun in the syntactic configuration must be the Ground.[23] To be sure, it often requires a stretch for listeners to overcome allegiance to the default classification (or likely valence) when sentences are presented in isolation. Yet in the interviews, subjects showed themselves quite capable of coping when these default classifications failed to accord with the interpretation imposed by the structure. The most striking finding in this regard is that in the absence of *any* semantics in the compared nominals (when they are nonsense, Experiment 5), the structure assigns the Figure and Ground roles to gaxes and yigs. We hold, then, contra Tversky and Talmy, that position in a syntactic structure – not default relations among nouns or among real-world objects – imposes the Figure/Ground distinction on the compared items.

To sum up, part of the genius of the language is to exploit the configural structure of sentences as a cue to the category within which entities are symmetrically compared; that is, the structure limits the basis for comparison. Subjects disprefer certain arrangements of the nominals just because of the implausibility of the propositions that they express. To say *The building is near the bicycle*, you would have to believe, to quote our subjects: "It is a very famous bicycle." Or "If someone knew the location of the bicycle but not the building." Or "If you parked your bike there and

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[23] A good question is why this structural positioning – rather than its reverse – should be the one that language chooses. Why is the Figure the subject rather than the complement? It goes beyond our knowledge to answer this question. But it can be noted that, universally across languages, topics tend to surface foregrounded as the subjects of predication: taking as given the status of China (an Asian power so famous as to be, presumably, priorly known to the listener), a similar status *in some regard* is predicted of the less familar North Korea. On the other hand, in most formulations of the Given/New distinction it is asserted that the Given surfaces as subject.

somebody built a building next to it." But such violations of default assumptions are understood by revising the representation under which the symmetrical relation is asserted to hold.

From this perspective, *The bicycle is near the building* is just a more plausible thing to say than its reverse, given the standard size/mobility (and thus, known locations) of the two. And *The humblest citizen is equal to the President* is merely a more plausible equation than its reverse, given what Presidents are (or what we wish they were). But language design must be served. If the order of the nominals is reversed, the regard in which the nouns are being considered must be some unusual one.

The details of this regard are left for the listener to puzzle out on the basis of real-world knowledge and Gricean principles of cooperative interpretation. Absent conversational context, the listener's only recourse is inference about plausible situations, of which there are many. The probabilistic nature of subjects' solutions are clear from the extensive inquiries of Tversky and his collaborators.[24] While the speaker's intended representation cannot be fully and unerringly culled from the form of the sentence itself, the syntax of directional sentences serves the communicatively important function of narrowing the interpretive options.

It is important to emphasize here that in directional sentences the predications have not "become asymmetrical". To so say would violate the experimental findings (e.g., Figs. 1 and 2 which show that the symmetricals are less affected semantically than asymmetricals by reversal of noun phrase position) which reflect our subjects' implicit semantic analysis: the predication in a directional sentence (e.g., *The button matches the shirt*) is symmetrical (the button and the shirt are asserted to match) but, over and above this, the shirt is predicated to be dominant (Ground) in some classification into which the button (Figure) also fits (presumably, *articles of clothing*).

24. The major distinctions among symmetrical predicates

We now turn to the final surprising outcome of our experimental review of symmetry. In the Pretest and in Experiment 3, we found distinct *differences*

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[24] For instance, in the choice-set experiment from Tversky, the percentage choice of Sweden as "the most similar to Austria" is 49% (to Hungary's 36%) when the third member is Poland, but Sweden falls to 14% and Hungary rises to 50% of responses when the third member is Norway. This is not a categorical change, rather a probabilistic shift in the inference to a classification. The problem set to the subject, after all, is quite unconstrained. Similarly, while the nominal order and the choice of nominals and predicates has discernible effects on subjects' inference to the classification, many options as to what this classification is are available, and were offered by subjects in the interview sessions. In contrast, that *some* difference in classification is intended as a function of structural position is crystal clear to subjects, who therefore agree that meaning has changed when the nominal order changes (Table 7) and that one meaning is more plausible than the other (Table 8).

in behavior within the symmetrical class that had been picked out by their *same* behavior in Experiments 1 and 2. Specifically, subjects ranked predicates on a symmetry scale in the Pretest, and – within the symmetrical class – this ranking predicted the degree of perceived meaning change when the nominals were reversed in Experiment 3.

Consider first the subset of symmetrical terms including *identical, similar, compare*, and *match*, which express a conceptual comparison. These differ among themselves in the scope of nominal classifications for which the symmetrical entailment holds – that is, in how hard it is to think up examples for which the order of nouns in the directional sentences would matter semantically. Thus *identical* pertains to the compared entities in every regard (barring their space–time positioning) but *similar* pertains only to some of these. Apart from their symmetrical content and scope over the category set, these comparison predicates are semantically quite empty, the particular nature of the comparison being supplied inferentially by examining the positioning (Experiment 5) and the semantics (Experiment 4) of the nominals. As Medin et al. (1990) put this, one must ask "How are X and Y similar?" when assessing "How similar are X and Y?" The inferential clue as to the intended regard is supplied by the Figure/Ground relations in directional constructions, at least partly rescuing the concept 'similarity' from the charge of emptiness laid upon it by Goodman (1972).

Most of the comparison predicates conform to the linguistic diagnostics of stativity such as oddity in the progressive form (e.g., *The button is matching the shirt*), in imperatives (Command to a button: *Match that shirt!*), and so forth.[25] By and large, this stative-symmetrical group of predicates is ranked *highest* on the symmetry scale and yielded the *least* perceived meaning change with nominals reversed in directional constructions (Fig. 2). In contrast, active symmetricals such as *meet, kiss*, and *collide* were as a group ranked *lower* on the symmetry scale, and showed the *strongest* Figure/Ground effect – that is, the greater change of meaning (among symmetricals) consequent on nominal position in directional sentences.

Despite first appearances, we do not believe that this is because *collide* or *embrace* is perceived as "less symmetrical" than *equal* or *similar*. Rather,

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[25] One might well wonder why the comparison terms are not *all* statives; notably, it is a potential embarrassment for the analysis we here present that *compare* (a comparison term, if anything is) is active, for example, appears in progressive sentences like *John is comparing horses to/with/and cows*. However, the activity (and agentivity) does not concern the entities compared (the horses and the cows); rather, it pertains to John as the active instigator of the comparison; the relation between the horse and cow is itself static. The distinction shows up even more clearly in *John equates horses to/with/and cows*, where again John's role is active, but the relation (of equality) is stative. Particularly informative for explaining the semantic-syntactic relations here is Larson's (1988) analysis of such ditransitive sentences, as described in footnote 5. In assigning predicates to the active/stative subclasses (Table 1), we ignored this plausible analysis: any predicate that naturally appeared in progressive sentences was automatically assigned to the activity category. The effect of this mechanical coding decision was to weaken (but not obliterate) the findings pertinent to the present discussion.

the difference lies in the local interpretation of Figure/Ground as causal agent/patient of the action. The agent of a physical action (symmetrical or not) must surface as subject of a transitive predication (Fillmore, 1968; Dowty, 1991). In contrast, the statives do not describe relations of an agent to a patient. It is absurd to conceive North Korea as the agent or experiencer of Red China's similarity or the button as the agent of the shirt's matching. For the statives there is no doing, hence no agent, in the first place. In principle, then, reversal of noun position for active symmetricals changes the perceived meaning more just because such a switch necessarily reassigns the cause and effect relations that are psychologically prepotent.

To see this point, consider the nouns *bus* and *scooter*. They differ in their prototypicality for the class *vehicle*, and in which of the two is ordinarily larger. For both these reasons (and as Experiment 4 showed), with no other contextual cue, the bus is assumed to be Ground and is preferred in the complement position. For example, *The scooter is near/similar to the bus* seem the more natural locutions: nearness and similarity are modulated by the mobility/size factors. But when the predicate describes a physical activity, the local interpretation of Figure is as causal agent of the action; for example:

(22) (a) The bus collides with the scooter.
     (b) The scooter collides with the bus.
     (c) The scooter and the bus collide.

In (22a), the bus's insurance company pays; in (22b), the scooter's company pays; and in (22c) the case goes to the jury. The relative status of *bus* and *scooter* as members of the class *vehicle* and their relative size or mobility predict their syntactic positions only in the sterilized environment of the sentence-judging laboratory in which no contextual cue is available. Ordinarily, the choice is imposed by their causal roles in the transaction.

This analysis applies as well to examples in which the conceptual relationship appears asymmetrical in the extreme:

(23) Columbus kissed the earth of the New World.
     The drunk collided with a lamppost.

Reversing the nominals in these cases seems to yield an anomaly. But this is *only* because in the everyday world the Earth doesn't kiss, lampposts don't move, and so forth. It is the extreme implausibility of these entities as agents (hence Figures) in the actions that is at fault, and that vanishes if we conjure up visions of welcoming Earths and flying lampposts. As Dowty (1991) has discussed, the property *animate agent* has pride of place in the definition of "good Figure". The Earth is therefore semantically grotesque as the Figure, hence agent, in a kissing act.

More generally, any striking difference between the nominals in their status as good Figures predicts a strong intuition as to which will occupy subject position: the predicate need not be active, and the local interpretation of Figure/Ground need not be of agency. Thus both metaphorical statements (which seem to gain some of their flavor by symmetrically comparing sharply different nominal types), and even equations (again see Talmy) show strong Figure/Ground effects despite the indisputable symmetry of their predicates, as in the oddity of:

(24) Limpid pools are like your eyes.
     $15 = 12 + 3$.

Finally, consider reciprocal sentences which, like symmetrical comparisons, require for felicity a sameness of nominal type apart from any question of symmetry of their predicates (see footnote 1). Asymmetrical *hit* and symmetrical *collide* sound equally dismal in *The drunk and the lamppost hit/collided with/each other* because in this construction both inherit the Figure/Ground (pragmatic) violation of one of their sentential conjuncts: *The lamppost hit/collided with the drunk.*

In sum, in respect to the switch in causal agency, switching nominal order for both active asymmetricals (*John drowns Bill* vs. *Bill drowns John*) and symmetricals (*John meets Bill* vs. *Bill meets John*) reverses who-did-what-to-whom, yielding a judgement of significant meaning change. At the same time, the symmetry factor continues to exert its influence so the meaning change is smaller for the symmetrical actives than for the asymmetrical terms. Meetings, in the end, must be mutual regardless of the instigating agent, but thankfully this is not so for drownings.

25. Interacting factors in symmetrical predication

We have asserted overall that the analysis of lexical symmetry is a complex matter, interacting as it does with several other factors such as part-of-speech assignment, syntactic structure, the collateral semantic content of predicates for which this semantic feature is defined, the plausible classification of nominal pairs, and conversational context. These and a variety of subsidiary factors account for the corresponding complexity of subjects' response characteristics in the experiments we have presented. All the same, the speaker/listener's understanding of interpretive principles for the symmetrical terms shines through all these cross-cutting complexities.

V. SUMMARY AND CONCLUSIONS

Humans can conceive of symmetrical and asymmetrical relations. This conceptual distinction is closely mirrored in the lexicon of English (and all

languages we know of). The subtle linguistic distinctions that our subjects reliably made were used here to document the conceptual distinction itself. Overwhelmingly often, symmetrical concepts are expressed by predicates marked with a special lexical feature. This lexical feature licenses a reading of noun phrase conjunction to express reciprocality of the relation between the nominal conjuncts. No asymmetrical concepts have this feature, that is, license this reading of noun phrase conjunction. Subjects' manifest ability to honor this interpretive distinction leads us to suggest that *similar*, and similar concepts, are symmetrical after all.

At the same time, symmetrical relations are conceived as applying to entities under a classification, as Tversky showed for the predicate *similar*. The intended classification can be deduced by the listener from context in many instances. Even in the absence of contextual clues, particular pairs of nouns taken together with the predicate choice will often suggest some default classification, accounting for subjects' preferred similarity statements. But language also exploits the structural organization of the clause to cue the intended property set for a symmetrical comparison by varying the structural positions in which the nominals occur. The subject–complement asymmetry, as Talmy has discussed, serves as the linguistic vehicle for the spatial–conceptual distinction between Figure and Ground object. Therefore, as we showed in Experiment 5, Figure and Ground interpretations will be assigned even to nominals which have no semantic content. Subject–complement syntax does not nullify the symmetry of symmetrical comparisons, but rather establishes what they are comparisons of.

The analysis we have provided is mute on a number of issues that will doubtless be found pertinent. For one thing, while we have used the idea "nominals of different types" as an explanation for the perceived oddity of the sentences in (23) and (24), we have offered no definition of "different types" and thus are in the position of explaining one unknown with another one. An additional open question concerns just how the notion of "regard" or "respects" enters into the interpretation of sentences. It may well be an instance of the application of Gricean maxims of interpretation and cooperative reconstrual, a fact about the pragmatics of conversation rather than a lexical or sentence-level specification, and may be relevant well beyond the case of the symmetricals. Thus, as Kamp and Partee (1995) have pointed out, apparent contradictions such as "Bob is a man and not a man" are interpretable by reconstruing the sentence in terms of respects: Bob is a man (with respect to such-and-such, say, his age) and not a man (with respect to such-and-such, say, his independence), just as North Korea is highly similar to Red China (with respect to being an Asian Communist country) but not so similar in several other respects.

Perhaps the least problematical results of our studies have been those which exposed the special linguistic-interpretive properties of a variety of symmetrical words (Experiments 1 and 2). In light of the generality of these findings, we have disagreed with Tversky in his claim that preferences between directional similarity statements call for an asymmetrical analysis of

similarity, or that the appropriate analysis will refer to similarity in particular. Rather, the use and interpretation of *similar* has to be understood in the context of a general theory of symmetrical predication that applies to hundreds of words and phrases. In other regards, we consider the findings and analyses we have presented to be much in the spirit of Tversky, Talmy, Medin et al., and other investigators we have cited – only turning the generalization on its head. Tversky claimed that 'similarity', an asymmetrical concept, can be rendered symmetrical in certain nondirectional linguistic contexts such as reciprocal conjunction. We have claimed that *similar*, a symmetrical predicate, can by force of general linguistic principles be applied symmetrically to a pair of nominals that are classified as unequal.

Acknowledgements

Appendix 1. Test sentence sets for Experiments 1 and 2

Below, we designate the singular sentence as **a** and the plural sentence as **b**. The presentation of these pairs was counterbalanced across lists such that an individual subject would see the **a** version above the **b** version for half the items, the **b** member above the **a** member for the other half. All these pairs were the stimuli for Experiment 1. In Experiment 2, the sentence pairs consisted of the **b** versions of the sentences below, paired with that same sentence to which the phrase each other (along with any necessary preposition) was added, for example, *The scooter and the bus collide* and *The scooter and the bus collide with each other*. The counterbalancing of order of sentences within each pair was done in the same way as for Experiment 1. In both experiments, filler pairs were interspersed among the test pairs.

a. The humblest citizen is equal.
b. The humblest citizen and the President are equal.

a. The copy is identical.
b. The copy and the painting are identical.

a. The peasant married.
b. The peasant and the movie star married.

a. Anchorage is far.
b. Anchorage and Paris are far.

a. The button matches.
b. The button and the shirt match.

a. The waitress divorces.
b. The waitress and the senator divorce.

a. The photograph resembles.
b. The photograph and the landscape resemble.

a. My sister met.
b. My sister and Meryl Streep met.

a. North Korea is similar.
b. North Korea and China are similar.

a. The telephone booth is across.
b. The telephone booth and the railroad station are across.

a. The bicycle is near.
b. The bicycle and the building are near.

a. Ecuador is different.
b. Ecuador and the United States are different.

a. The wheel is separate.
b. The wheel and the car are separate.

a. John combines the salt.
b. John combines the salt and the batter.

a. The scooter collides.
b. The scooter and the bus collide.

a. The worker attaches the leaflet.
b. The worker attaches the leaflet and the Empire State Building.

a. The priest argues.
b. The priest and the Pope argue.

a. The mother embraces.
b. The mother and the infant embrace.

a. Princess Diana kisses.
b. Princess Diana and the sick child kiss.

a. The critic compares the singer.
b. The critic compares the singer and Bruce Springsteen.

a. The teenager loves.
b. The teenager and Jon Bon Jovi love.

a. The apprentice copies.
b. The apprentice and the master copy.

a. The soldier is safe.
b. The soldier and the tank are safe.

a. Sue sees.
b. Sue and Madonna see.

a. The comet hits.
b. The comet and the planet hit.

a. The pebble bounces.
b. The pebble and the boulder bounce.

a. The baron is unpleasant.
b. The baron and the serf are unpleasant.

a. The professor lectures.
b. The professor and the teaching assistant lecture.

a. The police chief hurries.
b. The police chief and the patrolman hurry.

a. The fan applauds.
b. The fan and the Oscar-winner applaud.

a. The pupil follows.
b. The pupil and the principal follow.

a. The shoe is inside.
b. The shoe and the box are inside.

a. The frog eats.
b. The frog and the fly eat.

a. The swimmer drowns.
b. The swimmer and the lifeguard drown.

a. The psychopath chokes.
b. The psychopath and the young woman choke.

a. The sergeant is inferior.
b. The sergeant and the general are inferior.

a. The picture is below.
b. The picture and the window are below.

a. The horse is behind.
b. The horse and the track are behind.

a. The high school player is better.
b. The high school player and the Little Leaguer are better.

a. A pint is less.
b. A pint and a quart are less.

Appendix 2. Test sentence sets for Experiments 3 and 4

An individual subject in Experiment 3 would see four symmetric and four asymmetric pairs. Two of the symmetrical ones would be in directional syntactic contexts (column 1, below) and two in nondirectional syntactic contexts (column 2, below); and the same for the asymmetrical pairs. Half the time, the a sentence preceded the b sentence within the pair, and half the time this order was reversed. The sentences designated a below are those which, based on pilot work, were the "preferred" or more plausible forms. The same directional pairs (but for the symmetrical predicates only) were used for Experiment 4. Experiment 4 (Table 9) shows that the a forms were indeed the versions that subjects prefer. In Experiment 3, filler pairs were interspersed among the test pairs. In Experiment 4, fillers were omitted so as to create a preference situation comparable to that used by Tversky and Gati (1978).

Directional	*Nondirectional*
a. The humblest citizen is equal to the President.	a. The humblest citizen and the President are equal.
b. The President is equal to the humblest citizen.	b. The President and the humblest citizen are equal.
a. The copy is identical to the painting.	a. The copy and the painting are identical.
b. The painting is identical to the copy.	b. The painting and the copy are identical.
a. The peasant married the movie star.	a. The peasant and the movie star married.
b. The movie star married the peasant.	b. The movie star and the peasant married.
a. Anchorage is far from Paris.	a. Anchorage and Paris are far.
b. Paris is far from Anchorage.	b. Paris and Anchorage are far.
a. The button matches the shirt.	a. The button and the shirt match.
b. The shirt matches the button.	b. The shirt and the button match.
a. The waitress divorces the senator	a. The waitress and the senator divorce.
b. The senator divorces the waitress.	b. The senator and the waitress divorce.
a. The photo resembles the landscape.	a. The photo and the landscape resemble.
b. The landscape resembles the photo.	b. The landscape and the photo resemble.
a. My sister met Meryl Streep.	a. My sister and Meryl Streep met.
b. Meryl Streep met my sister.	b. Meryl Streep and my sister met.
a. North Korea is similar to China.	a. North Korea and China are similar.
b. China is similar to North Korea.	b. China and North Korea are similar.
a. The telephone booth is across from the railroad station.	a. The telephone booth and the railroad station are across.
b. The railroad station is across from the telephone booth.	b. The railroad station and the telephone booth are across.

a. The bicycle is near the building.

b. The building is near the bicycle.

a. Ecuador is different from the United States.

b. The United States is different from Ecuador.

a. The wheel is separate from the car.

b. The car is separate from the wheel.

a. The baker combines the salt with the batter.

b. The baker combines the batter with the salt.

a. The scooter collides with the bus.

b. The bus collides with the scooter.

a. The worker attaches the leaflet to the Empire State Building.

b. The worker attaches the Empire State Building to the leaflet.

a. The priest argues with the Pope.

b. The Pope argues with the priest.

a. The mother embraces the infant.

b. The infant embraces the mother.

a. Princess Diana kisses the sick child.

b. The sick child kisses Princess Diana.

a. The critic compares the singer with Bruce Springsteen.

b. The critic compares Bruce Springsteen with the singer.

a. The bicycle and the building are near.

b. The building and the bicycle are near.

a. Ecuador and the United States are different.

b. The United States and Ecuador are different.

a. The wheel and the car are separate.

b. The car and the wheel are separate.

a. The baker combines the salt and the batter.

b. The baker combines the batter and the salt.

a. The scooter and the bus collide.

b. The bus and the scooter collide.

a. The worker attaches the leaflet and the Empire State Building.

b. The worker attaches the Empire State Building and the leaflet.

a. The priest and the Pope argue.

b. The Pope and the priest argue.

a. The mother and the infant embrace.

b. The infant and the mother embrace.

a. Princess Diana and the sick child kiss.

b. The sick child and Princess Diana kiss.

a. The critic compares the singer and Bruce Springsteen.

b. The critic compares Bruce Springsteen and the singer.

a. The teenager loves Jon Bon Jovi.

b. Jon Bon Jovi loves the teenager.

a. The teenager and Jon Bon Jovi love.

b. Jon Bon Jovi and the teenager love.

a. The apprentice copies the master.

b. The master copies the apprentice.

a. The apprentice and the master copy.

b. The master and the apprentice copy.

a. The soldier is safe from the tank.

b. The tank is safe from the soldier.

a. The soldier and the tank are safe.

b. The tank and the soldier are safe.

a. Sue sees Madonna.

b. Madonna sees Sue.

a. Sue and Madonna see.

b. Madonna and Sue see.

a. The comet hits the planet.

b. The planet hits the comet.

a. The comet and the planet hit.

b. The planet and the comet hit.

a. The weightlifter bounces the pebble.

b. The pebble bounces the weightlifter.

a. The weightlifter and the pebble bounce.

b. The pebble and the weightlifter bounce.

a. The baron is unpleasant to the serf.

b. The serf is unpleasant to the baron.

a. The baron and the serf are unpleasant.

b. The serf and the baron are unpleasant.

a. The professor lectures the teaching assistant.

b. The teaching assistant lectures the professor.

a. The professor and the teaching assistant lecture.

b. The teaching assistant and the professor lecture.

a. The police chief hurries the patrolman.

b. The patrolman hurries the police chief.

a. The police chief and the patrolman hurry.

b. The patrolman and the police chief hurry.

a. The fan applauds the Oscar-winner.

b. The Oscar-winner applauds the fan.

a. The fan and the Oscar-winner applaud.

b. The Oscar-winner and fan applaud.

a. The pupil follows the principal.

b. The principal follows the pupil.

a. The pupil and the principal follow.

b. The principal and the pupil follow.

a. The shoe is inside the box.   a. The shoe and the box are inside.
b. The box is inside the shoe.   b. The box and the shoe are inside.

a. The frog eats the fly.   a. The frog and the fly eat.
b. The fly eats the frog.   b. The fly and the frog eat.

a. The swimmer drowns the lifeguard.   a. The swimmer and the lifeguard frown.
b. The lifeguard drowns the swimmer.   b. The lifeguard and the swimmer drown.

a. The psychopath chokes the young woman.   a. The psychopath and the young woman choke.
b. The young woman chokes the psychopath.   b. The young woman and the psychopath choke.

a. The sergeant is inferior to the general.   a. The sergeant and the general are inferior.
b. The general is inferior to the sergeant.   b. The general and the sergeant are inferior.

a. The picture is below the window.   a. The picture and the window are below.
b. The window is below the picture.   b. The window and the picture are below.

a. The horse is behind the track.   a. The horse and the track are behind.
b. The track is behind the horse.   b. The track and the horse are behind.

a. The high school player is better than the Little Leaguer.   a. The high school player and the Little Leaguer are better.
b. The Little Leaguer is better than the high school player.   b. The Little Leaguer and the high school player are better.

a. A pint is less than a quart.   a. A pint and a quart are less.
b. A quart is less than a pint.   b. A quart and a pint are less.

Appendix 3. Test sentence sets for scrambled version of Experiment 4

Here again, the order of sentences within pairs was counterbalanced.

a. My sister is equal to Meryl Streep.
b. Meryl Streep is equal to my sister.

a. Anchorage is identical to Paris.
b. Paris is identical to Anchorage.

a. The salt married the batter.
b. The batter married the salt.

a. Princess Diana is far from the sick child.
b. The sick child is far from Princess Diana.

a. The telephone booth matches the railroad station.
b. The railroad station matches the telephone booth.

a. The mother divorces the infant.
b. The infant divorces the mother.

a. The waitress resembles the senator.
b. The senator resembles the waitress.

a. The humblest citizen met the President.
b. The President met the humblest citizen.

a. The scooter is similar to the bus.
b. The bus is similar to the scooter.

a. The singer is across from Bruce Springsteen.
b. Bruce Springsteen is across from the singer.

a. The button is near the shirt.
b. The shirt is near the button.

a. The peasant is different from the movie star.
b. The movie star is different from the peasant.

a. The photo is separate from the landscape.
b. The landscape is separate from the photo.

a. The baker combines the leaflet with the Empire State Building.
b. The baker combines the Empire State Building with the leaflet.

a. The bicycle collides with the building.
b. The building collides with the bicycle.

a. The worker attaches the priest to the Pope.
b. The worker attaches the Pope to the priest.

a. The wheel argues with the car.
b. The car argues with the wheel.

a. North Korea embraces China.
b. China embraces North Korea.

a. The copy kisses the painting.
b. The painting kisses the copy.

a. The critic compares Ecuador with the United States.
b. The critic compares the United States with Ecuador.

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