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Interpreting Words in Spatial Descriptions

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A word may have the identical conventional meaning in different descriptions and yet be taken as denoting very different things. The proposal we tested is that the denotation of such a word is what the addressee believes it must be in order to contribute to the model of the situation that the speaker intended the addressee to create. We tested this proposal on the verb *approach* in descriptions schematised by "Figure F is just approaching landmark L for reason R." The distance from F to L was judged to be larger, all else being equal, the larger the landmark, the larger the figure, the faster the figure was moving, and the farther away the figure could be and still fulfil his or her purpose. We argued that these and other results about word interpretation are best accounted for by listeners creating the intended situation models.

INTRODUCTION

A word may denote very different things in different descriptions. *Good* can be interpreted as "adept" in *good juggler*, "tasty" in *good sauce*, and "healthy" in *good sleep* (see Katz, 1964). *Red* is generally taken as denoting different hues in *red hair*, *red fire engine*, *red apple*, and *red potato* (Halff, Ortony, & Anderson, 1976), *large* as denoting different sizes in *large dog* and *large elephant* (Rips & Turnbull, 1980), and *eat* as denoting different actions in *eating soup*, *eating a steak*, and *eating corn on the cob* (Weinreich, 1966). The standard assumption is that *good*, *red*, *large*, and *eat* have the same conventional meaning in each of their contexts. What changes from one context to the next are their denotations (Bierwisch, 1981; Lyons, 1977).

How do people determine these changing denotations? Most theories of interpretation account for only narrow ranges of instances. One example is

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the multiplicative model for combining adverbs like *rather* and *very* with adjectives like *evil* and *pleasant* (Cliff, 1959; Howe, 1962; Lilly, 1968). It works for only a few simple modifiers. Another example is the fuzzy set model for adjective–noun nominals, like *tall tree*, and for noun–noun compounds, like *apartment dog* (e.g. Hersh & Caramazza, 1976; Lakoff, 1973). This model fails for a variety of examples, such as *pet fish* (Osherson & Smith, 1981). Yet the alternative models, such as the selective modification model (Smith, Osherson, Rips, and Keane, in press), are also limited in scope and fail to account for a range of common nominals (Clark & Clark, 1979; Clark, 1982; Hampton, 1987; Murphy, in press; Murphy & Medin, 1985). Somehow, all of these approaches are too particular, too closely tied to specialised domains.

We will argue that word denotations are ordinarily determined with respect to a model that represents the situation being described—what we will call a *situation model* (see "situation model" in van Dijk & Kintsch, 1983; "mental model" in Johnson-Laird, 1983; Sanford & Garrod, 1981). These models are distinct from representations of the descriptions themselves, which contain only information about the conventional meanings of words and sentences. We will develop this argument first for spatial situations, where it is easier to see what has to be represented (Clark, 1973a; Clark & Chase, 1972; Morrow, 1985; Morrow, Greenspan, & Bower, 1987). We will then report a study of how people interpret the verb *approach* in various contexts. As a first step, we will characterise some of the properties of models of spatial situations.

MODELS OF SPATIAL SITUATIONS

When people think about a spatial situation, they generally create a situation model S with these properties, among others:

1. S has a three-dimensional Euclidean frame of reference.
2. S is represented from the viewpoint of an observer O at the origin of S.
3. S contains physical entities, which may include animate objects, inanimate objects, single things, groups, collections, masses of stuff, etc.
4. These entities are located with respect to the frame of reference.
5. O attends to some entities (called figures), which he or she sees with respect to other entities (called landmarks).
6. O experiences S as unfolding in time.
7. When entities are agents, O assumes that they may act on the basis of their intentions.

The idea is, roughly, that people think about spatial situations as if they were visually attending to an actual situation from the vantage point of an observer. And they do so whether they are working from a description, from memory of an actual experience, or entirely from imagination. While typical situations have these properties, any particular situation need not have them all. For example, a person's model may be incomplete in various ways.

People interpret descriptions of spatial situations in part by creating such situation models. In doing this, they are guided by three assumptions:

1. *Uniqueness assumption.* When speakers describe a spatial situation, they have in mind a particular situation model they believe their addressees can readily create.
2. *Contrastive assumption.* Speakers choose the words they do to distinguish the intended situation from other situations. When told "The cat raced across the floor", listeners feel justified in assuming that the cat is moving faster than it would be for "The cat crept (or moved or walked or went) across the floor", and in a straighter path than it would be for "The cat raced around the floor." Thus, words help specify situations not only through their meanings, but through their contrasts with other word meanings in the language.
3. *Salience assumption.* The model the speaker intended is the most salient one with respect to the current common ground of the speaker and addressees. So when told "The cat is on the sofa", listeners are usually justified in assuming that the cat is sitting on a cushion rather than clinging to the side, because that makes the most sense in terms of the world knowledge they assume they share with the speaker. This assumption is similar to the principle of relevance invoked by conversational theorists to explain how context constrains a listener's interpretation (Grice, 1975; Sperber & Wilson, 1986).

There is already good evidence for the contrastive assumption in interpreting spatial descriptions. Consider how listeners might determine John's location when told "John walked from the kitchen to the bedroom" (Morrow, in press). The preposition *to* marks the bedroom as the goal of John's motion, and *from* marks the kitchen as the source. But where on the path was John? By the contrastive assumption, he had to be already out of the kitchen because *walked* indicates a completed action. If he had still been in the kitchen, the speaker would have chosen *was walking* to indicate an action still in progress. Also, John could not already be in the bedroom, because otherwise the speaker would have chosen *into*. Yet he must have reached the bedroom, because otherwise the speaker would have chosen *toward*. Taken together, these contrasts put John right at the bedroom

door, and that is where listeners judge him to be. Listeners used the same principle in fixing John's location for a variety of locative descriptions (see also Morrow, 1985; 1986).

There is also evidence for the salience assumption. Take the interpretation of demonstrative references like "this man". In one experiment (Clark, Schreuder, and Buttrick, 1983), passers-by were shown a picture of Ronald Reagan (then President) and David Stockman (then Director of the Office of Management and Budget) talking to one another and were asked one of two questions. For the question "You know who this man is, don't you?", 14 out of 15 people chose Reagan as the referent of 'this man". But for "Do you have any idea at all who this man is?", 7 of 15 chose Stockman and only two chose Reagan; the rest asked for clarification, e.g. "Which one?" All 30 people, when questioned afterwards, correctly recognised both men in the picture, but judged Reagan to be more recognisable to the general public. So they chose Reagan as the most salient referent against the presupposition that the referent was known, and Stockman as the most salient against the opposite presupposition. The criterion of salience against common ground was tested and confirmed in other experiments as well (see also Clark & Clark, 1979; Clark, 1983; Clark & Gerrig, 1983).

According to our proposal, then, listeners use these three assumptions to create the intended situation model from the conventional meanings of the elements of the description and from what they know about the world. What a word denotes is simply a product of this process. In the study that follows, we will consider how this works for the verb *approach*.

ON THE DENOTATION OF *APPROACH*

All languages have a wealth of terms for describing space, spatial relations, and spatial direction. In English these include prepositions (e.g. *near, at, from*), verbs (e.g. *come, put, leave*), adjectives (e.g. *far, adjacent, deep*), and nouns (e.g. *top, entrance, floor*). In many uses of these terms, one object is located *with respect to* another, as in *A is beside B*, *A is leaving B*, *A covers B*, *A is the entrance to B* (see Clark, 1973a; Clark & Chase, 1972; Langacker, 1979; Miller & Johnson-Laird, 1976; Talmy, 1975; 1983). Following Langacker, we will call A the *figure* and B the *landmark*. The precise location of A with respect to B depends on the situation that listeners think the speaker intended. Listeners infer this situation from what they know about A and B and from the spatial relations expressed by the prepositions, verb, or noun in the sentence. The same holds for *approach*, as in *A is just approaching B*. Compare the distance from A to B in *We were approaching Chicago* and *We were approaching the door*. Our question is how people determine these locations and distances.

The conventional meaning of *approach* has fundamentally to do with A moving into a *region of interaction* with B. The region of interaction might be characterised as the region in which A is in a position to engage or influence or affect B in some expected way (see Langacker, 1987; Miller & Johnson-Laird, 1976). To approach B is to move from outside to inside such a region. With *A has approached B*, A lies within the region of interaction; with *A is about to approach B*, A lies just outside it; and with *A is just approaching B*, A is roughly on the border. A's precise location depends on the contrasts among these constructions. It also depends on the contrast of *approach* with *reach, go toward, go near*, and other related constructions. Our notions of figure, landmark, and region of interaction for *approach* are depicted in Fig. 1.

To understand *A is just approaching B*, listeners have to determine the region of interaction as it fits the situation model as a whole. To do this, they rely on the three assumptions described above. Based on the uniqueness assumption, they assume the speaker intended to describe a specific situation they could figure out. By the contrastive assumption, as just noted, they know that *is just approaching* fixes the figure's location at the boundary of the region of interaction rather than inside or outside it. With the salience assumption, they use the properties of the figure, landmark, and other elements of the situation model to determine how large this

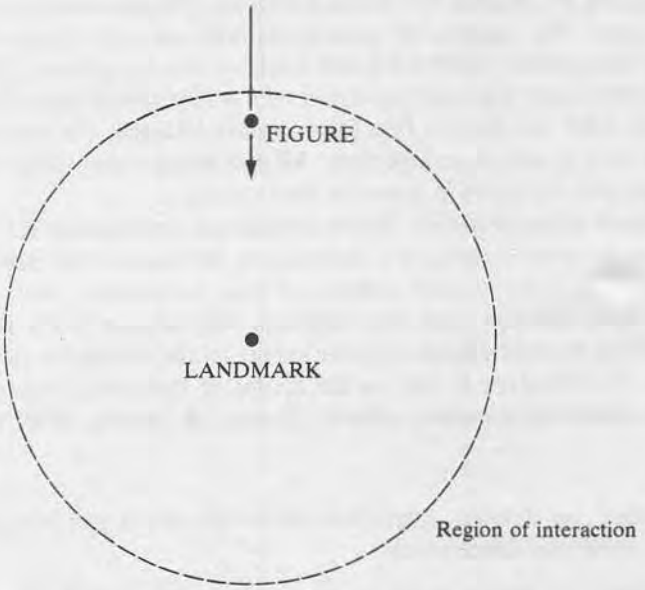

FIG. 1. Meaning of *Approach*. FIGURE moves into region of interaction with LANDMARK.

region is expected to be. Our hypothesis was that the region of interaction should vary with at least five properties of the situation model being created:

1. *Size of figure.* Compare *A tractor is approaching the fence* with *A mouse is approaching the fence.* The tractor, being large, is ready to "interact" with the fence (engage, affect, influence it) from a much larger distance than is the mouse. All else being equal, the larger the figure, the larger the region of interaction.
2. *Size of landmark.* Likewise, compare *A nun is approaching the cathedral* with *A nun is approaching the statue.* A cathedral, being large, has a much larger region of interaction around it than does a smaller statue. You do not have to be so close to the cathedral to be able to inspect it or look at it. All else being equal, the larger the landmark, the larger the region of interaction.
3. *Speed of figure.* Compare *A quarterback has just sprinted onto the field from the goal line* with *walked* in place of *sprinted.* Here the figure (the quarterback) is leaving instead of approaching the landmark (the goal line), but the principle is the same. We suppose that the quarterback engages more of the region of interaction adjacent to the goal line when moving quickly than when moving slowly. All else being equal, the faster the figure is moving, the larger the region of interaction. In order to get the measurements we needed, we found it necessary to use verbs for leaving.
4. *Purpose.* The region of interaction will be very large for some purposes that a figure might have and much smaller for others. Compare *A game warden is just approaching a lion with a rifle* versus *with a hypodermic needle.* One can shoot a lion from a great distance, but one has to be right next to it to give it an injection. All else being equal, some purposes entail a greater region of interaction than others.
5. *Distance of the observer.* Every description presupposes the perspective of the observer creating the description. When we read descriptions, we keep track, more or less closely, of that perspective. For example, observers can explicitly mark their location with respect to the scene they are describing by their choice of *come* versus *go.* In *Richard is coming into the room,* the observer is also in the room; in *Richard is going into the room,* the observer is outside (Black, Turner, & Bower, 1979; Fillmore, 1974).

Perspective, we thought, might help determine the region of interaction. Compare these two descriptions:

> I am sitting in a jeep near (*vs* far down the road from) a bridge across a creek. A canoe is just approaching the bridge.

When the observer ("I") is far away, he might take the region of interaction around the bridge to be large, but when he is near, he would take it to be small. The premise is that the observer takes the region of interaction to be a constant fraction of his visual angle on the whole scene. This predicts that the farther the observer is from the figure and landmark, all else being equal, the larger is the inferred region of interaction. Conversely, the farther the *figure* is from the landmark, the farther the observer will place him- or herself from the figure and landmark. Studies of mental imagery show that with larger figures, the observer moves further away in order to keep a constant visual angle on the imagined situation (Kosslyn, 1978). However, this premise could also be wrong. After all, where the observer is does not really influence the *manner* in which a particular figure with a particular purpose engages or influences or affects a particular landmark. If so, it should not affect the region of interaction at all.

The aim of the experiment that follows was to test these five potential factors on the interpretation of *approach* and a few related verbs.

METHOD

A total of 24 Stanford University students each read 30 brief descriptions like the following:

> I am standing on the porch of a farm house looking across the yard at a picket fence. A tractor is just approaching it. How far is the tractor from the fence?

The students estimated the distance between the figure and landmark for each description. Later, they reread the 30 descriptions and estimated the distance between the observer ("I") and landmark.

Descriptions

There were 30 pairs of descriptions in all, and they are listed in Tables 1–5. Each description consisted of two sentences. The first sentence located the speaker ("I"), the observer, with respect to a landmark. The second sentence located a figure with respect to that landmark by describing it as "just approaching" the landmark (or, in a few instances, as just having left it). The two members in each pair differed in just one word or phrase. For the example just cited, there was another description with *mouse* in place of *tractor*. The 30 pairs of descriptions fell into five categories of six pairs each. The two members of each pair differed only in size of figure (Table 1), size of landmark (Table 2), speed of figure (Table 3), purpose (Table 4), or distance of observer (Table 5).

TABLE 1
Size of Figure. Mean Figure–Landmark Distance Judgements in Feet (Observer–Landmark Distance in Parentheses)

Description	*Figure Size*		
	Large	*Small*	*Difference*
I am standing on the porch of a farm house looking across the yard at a picket fence. *A tractor/mouse* is just approaching it.	39.2 (121.3)	2.1 (52.2)	+37.1
I am standing across a yard from a wall. *A gardener/dog* is just approaching it.	7.1 (56.3)	8.0 (74.8)	−0.9
I am standing at a water hole looking across at the other side. *A moose/chipmunk* is just approaching the other side.	10.8 (175.7)	2.9 (33.7)	+7.9
I am standing next to a big pond looking across at the other side. *A cow/raccoon* is just approaching the other side.	12.6 (101.2)	6.5 (106.0)	+6.1
I am standing near the end of a dock in San Francisco bay. *A luxury liner/sailboat* is just approaching the end of the dock.	219.8 (11.0)	38.0 (25.7)	+181.8
I am crouching behind a bush looking across a clearing at the top branches of a small maple tree. *A hawk/hummingbird* is just approaching a branch of it.	9.6 (69.6)	2.3 (48.6)	+7.3
Mean judgements across all items	49.8 (89.2)	10.0 (56.8)	+39.8

The descriptions were assembled in two booklets of 30 descriptions each, one description per page. Each booklet included one member of each pair of descriptions in a counterbalanced design. Each booklet, for example, had three descriptions with a large figure and three with a small one, three descriptions with a large landmark and three with a small one, and so on. Each booklet was given to 12 students; the 30 descriptions were placed in a different random order for each student.

Procedure

The students were told that the study was about how people imagine situations described by an observer. They were asked to read each description and estimate the requested distance in feet and inches (because of Americans' appalling ignorance of metres). On the wall in front of them

TABLE 2
Size of Landmark. Mean Figure–Landmark Distance Judgements in Feet (Observer–Landmark Distance in Parentheses)

Description	*Landmark Size*		
	Large	*Small*	*Difference*
I am standing across the street from a post office with a mailbox in front of it. A man crossing the street is just approaching *the post office/mailbox*.	28.3 (43.9)	13.4 (71.0)	+14.9
I am standing on the roof of a building looking down at some vehicles. A man is just approaching *a bus/bicycle*.	10.0 (204.6)	6.3 (88.4)	+3.7
I am sitting at a sidewalk cafe looking across a plaza at a cathedral with a statue in front of it. A nun is just approaching *the cathedral/statue*.	40.3 (145.5)	24.5 (186.8)	+15.8
I am sitting in a helicopter looking down at a warehouse with a phone booth next to it. A soldier is just approaching *the warehouse/phone booth*.	18.1 (281.8)	16.7 (284.5)	+1.4
I am sitting in my car parked across a street from a department store with a flower stand in front of it. A secretary is just approaching *the department store/flower stand*.	18.6 (41.4)	8.2 (95.8)	+10.4
I am standing on the porch of a ranch house looking over at a corral full of horses. A cowboy is just approaching *the corral/horse inside it*.	17.9 (156.7)	9.2 (98.8)	+8.7
Mean judgements across all items	22.2 (145.6)	13.1 (137.5)	+9.1

was a 5-foot tape measure, and for larger distances they were invited to think in terms of a 100-yard long football field (where 1 yard equals 3 feet). These scales were provided to make the task more concrete. Although they might have suggested to participants that we were interested in large variations in distance, they could not influence which distance of each description pair would be judged longer. After finishing their estimates, students were asked to go through their booklets again and draw on the bottom of each page a diagram of the observer, figure, and landmark for the situation described. They were asked to indicate on the diagram both the distance between the figure and landmark (which they had estimated on their first pass through the booklet) and the distance between the observer and landmark. The students who took part did so to fulfil a requirement for a course in introductory psychology.

TABLE 3
Speed of Figure. Mean Figure–Landmark Distance Judgements in Feet (Observer–Landmark Distance in Parentheses)

Description	*Figure Speed*		
	Fast	*Slow*	*Difference*
I am standing at the sidelines of a football field, by the fifty yard line, looking down the field at the goal line. The quarterback has just *sprinted/walked* onto the field from the goal line.	22.8 (142.9)	6.7 (157.9)	+16.1
I am standing by the side of a parking lot, looking at the far side. A woman has just *skated/hobbled* into the lot, from the far side.	11.9 (201.8)	5.0 (146.1)	+6.9
I am sitting in a theatre looking at the stage. An actor has just *dashed/crept* through a door at the right of the stage.	8.6 (76.0)	3.3 (68.9)	+5.3
I am dancing with a friend in a huge ballroom and looking over at the entrance to my right. My wife has just *rushed/limped* into the ballroom.	8.5 (60.8)	5.0 (78.5)	+3.5
I am sitting in the stands next to the finish line of a race course. The contestant has just *run/walked* across the finish line.	12.8 (36.3)	3.4 (37.7)	+9.4
I am sitting in the stands of a racetrack watching the starting gate. A horse has just *galloped/trotted* out of the gate.	17.6 (240.8)	13.0 (153.3)	+4.6
Mean judgements across all items	13.7 (126.4)	6.1 (107.1)	+7.6

RESULTS

Figure–Landmark Distances

The average figure–landmark distance estimate for the 30 pairs of descriptions is shown in Tables 1–5. We have listed for each pair the average distance (in feet) for the two members separately and also the difference between the two. A positive difference confirms our predictions, and a negative difference disconfirms them. As these differences show, the figure–landmark distance varied as predicted with size of figure (Table 1), size of landmark (Table 2), speed of figure (Table 3), and purpose of figure

TABLE 4
Purpose of Figure. Mean Figure–Landmark Distance Judgements in Feet (Observer–Landmark Distance in Parentheses)

Description	*Figure Purpose*		
	Far	*Near*	*Difference*
I am standing by the side of a park looking at a rare lizard on a tree stump. A woman is just approaching it with *binoculars/a sketch pad*.	24.5 (33.3)	11.4 (39.2)	+13.1
I am standing at the entrance to an exhibition hall looking at a slab of marble. A man is just approaching it with *a camera/chisel*.	18.0 (26.1)	4.8 (20.3)	+13.2
I am standing at the entrance to a supermarket, looking out at a car in the parking lot. A policeman is just approaching it with his *gun/keys* out.	12.2 (87.3)	6.2 (55.8)	+6.0
I am sitting in a jeep looking out the window at a lion lying beneath a tree. A game warden is just approaching with a *rifle/hypodermic needle*.	67.5 (162.2)	23.5 (99.2)	+44.0
I am standing in my front yard looking at an oak tree in front of my next door neighbour's house. My neighbour is just approaching it carrying *a palette and easel/chainsaw*.	16.3 (65.8)	9.0 (76.3)	+7.3
I am sitting on top of the fence of a corral watching a horse inside. A cow girl is just approaching it with *a lasso/brush*.	10.1 (31.6)	5.5 (33.5)	+4.6
Mean judgements across all items	24.8 (67.7)	10.1 (54.1)	+14.7

(Table 4). However, it did not vary systematically with distance of observer from the landmark (Table 5).

The distances were analysed as follows. The distances for each pair of descriptions were normalised separately to give them a mean of 0 and a standard deviation of 1 (i.e. they were z-scores). These z-scores were then submitted to analyses of variance. The five factors were analysed separately, with both subjects and description pairs treated as random effects (Clark, 1973b).

For our sample of descriptions, the distance from figure to landmark averaged about 40 feet longer for the large than for the small figures [$F'(1,12) = 9.84$, $P < 0.01$]; about 9 feet longer for the large than for the small landmarks [$F'(1,26) = 4.77$, $P < 0.05$]; about 8 feet longer for the

TABLE 5
Distance of Observer. Mean Figure–Landmark Distance Judgements in Feet (Observer–Landmark Distance in Parentheses)

Description	*Observer Distance*		
	Far	*Near*	*Difference*
I am standing *one block from/next door to* a new house being constructed. A carpenter is just approaching it.	18.4 (216.4)	11.2 (77.9)	+7.2
I am sitting in a jeep *far down the road from/near to* a bridge across a creek. A canoe is just approaching it.	30.9 (306.6)	34.6 (26.4)	−3.7
I am sitting *at the back of/in the front row of* an opera house watching the tenor at the centre of the stage. A singer is just approaching him.	9.8 (165.0)	7.1 (41.3)	+2.7
I am standing *a block from/at* an intersection looking at the red light. A car is just approaching the light.	22.6 (216.7)	35.0 (32.3)	−12.4
I am standing *on the roof of/on the sidewalk in front of* a skyscraper looking at a car parked across the street. A boy is just approaching it.	11.2 (382.9)	8.7 (69.4)	+2.5
I am watching a basketball game *from high up in the stands/from the bench* A player is just approaching the centre line.	6.0 (185.4)	3.9 (18.0)	+2.1
Mean judgements across all items	16.5 (245.5)	16.7 (44.2)	−0.2

fast than for the slow figures [$F'(1,24) = 14.07$, $P < 0.001$]; and about 15 feet longer for purposes that could be accomplished at a distance than for purposes that could be done up close [$F'(1,7) = 19.50$, $P < 0.01$]. As for the final factor, the distance of observer led to a tiny 0.2-foot difference in figure–landmark distance, and this was not significant [$F'(1,9) = 1.30$, *n.s.*].

Observer–Landmark Distance

The judged distance of observer to landmark did *not* vary systematically with size of figure or landmark, or with speed or purpose of figure. Tables 1–5 list (in parentheses) the average estimate of these distances for each description—distances that students indicated on their diagrams on their

second time through their booklets. As before, we normalised the distances for each pair before submitting them to analyses of variance. The average distances were not reliably different for large and small figures, for large and small landmarks, for fast and slow figures, or for distant and close purposes (all F's < 1). But of course the distance *was* longer, by about 201 feet, when the observer was explicitly described as far from rather than near to the landmark [$F'(1,26) = 119.46$, $P < 0.001$]. This demonstrates only that the students had understood the first sentence of each description and were reflecting the observer–landmark distance appropriately.

DISCUSSION

The interpretation of *approach*, like those for most words, changes with the context. Listeners infer strikingly different actions for *The stalking cat is approaching the insect*, *The spaceship is approaching Mars*, and *The sprinter is approaching the finish line*. We studied only one aspect of these interpretations—the distance of the figure from the landmark. We found that this distance is judged to be larger, all else being equal, the larger the landmark, the larger the figure, the faster the figure is moving with respect to the landmark, and the farther the figure can be from the landmark and accomplish his or her purposes.

These findings can be accounted for in a situational approach to word denotations (see Bierwisch, 1981; Johnson-Laird, 1983). The idea is that listeners keep track of a model of the situation in which the figure is moving in relation to the landmark. *Approach* means "to move into a region of interaction with", and what changes with context is the size of the region that listeners infer. Regions of interaction tend to be larger for larger landmarks, for larger figures, for speedier figures, and for figures whose purposes can be achieved at larger distances. At the same time, we found no evidence that these regions vary directly with the observer's distance from the figure or the landmark. For our descriptions, the observer's distance bears no relation to the interpretation of *approach*. Of course, it is possible that observer distance will depend on figure–landmark distance for certain kinds of situations. In fact, some of our description pairs did produce large differences in observer distances.

The situational account is consistent with findings about many types of terms. Take verbs. It explains why "Bill was sitting in the living room reading the paper, when John *came* into the living room" is judged to be more comprehensible than "Bill was sitting in the living room reading the paper, when John *went* into the living room" (Black, Turner, & Bower, 1979). In the first description, the observer has a spatially consistent point of view from the first to the second clause; in the second, he or she does not. We have already noted how the same framework accounts for John's

judged location in such descriptions as "John walked (*vs* was walking) from the kitchen to the bedroom" (Morrow, in press). These are just a few obvious examples.

Another class of terms that fit this account are prepositions. Suppose *on* means, as Miller and Johnson-Laird (1976) argued, "included in a region of the surface of and supported by". What we take it to denote on any occasion, then, should depend on the available regions and surfaces of the landmark and how the figure might be supported. "On the sofa", for example, limits the denotation of *on* to various surface regions of the sofa—cushions, arms, back, top, side, bottom, etc. It is further narrowed by what is claimed to be "on the sofa"—a visiting aunt, two lovers, an 8-year-old boy, a book, a cat, an ant, the manufacturer's label, some mud. It is narrowed still further by other elements, as in "The cat climbed *vs* sat on the sofa." In each case we try to create that situational model, consistent with the meaning of *on*, that we believe the speaker intended us to create, and that fixes the denotation of *on* for that occasion. Other prepositions presumably show analogous changes in denotation (Herskovitz, 1985).

Many adjectives and adverbs appear to work this way too. How large is a "large snowman"? That may depend on whether it was built by a child or a college fraternity. How quickly did the man move in "George crossed the road quickly"? That may depend on whether Geroge is known to be sprinting, walking, or on crutches. How long ago did something "just" happen? That has been shown to depend on what that something is, as in "Connie just ate a sandwich" *vs* "Connie just got married" (van Jaarsveld & Schreuder, 1986). These are just a few selected examples.

A more extensive demonstration can be found in Hörmann's (1983) study of the quantifiers *some*, *several*, and *a few*—or rather their German counterparts *einige*, *mehrere*, and *ein paar*. When people were asked to say how many objects were denoted by phrases like "several crumbs", their median estimates changed dramatically with context. For "several crumbs" it was 9.69, for "several paperclips" 8.15, and for "several pills" 7.27. But for "several children" it was 5.75, for "several cars" 5.50, and for "several mountains" 5.27. The median estimate also decreased from "several small cars" to "several cars" to "several large cars". Very generally, as Hörmann noted, the larger the object, the smaller the number inferred.

A natural account for these results is that listeners create situation models of crumbs or mountains. The models are constructed to reflect the maximum possible number of crumbs or mountains one would ordinarily imagine filling the observer's field of view. "Several" is taken to denote a number relative to this maximum number because, by the contrastive assumption, it contrasts with such terms as "many", "lots", and "great many". It also is taken to contrast with "few", "some", "one", "two", "three", and so on. Because the maximum number is larger for crumbs

than for mountains, "several" is interpreted as denoting a larger number for crumbs than for mountains.

When the maximum number possible is varied by other aspects of the described situation, the number denoted by "a few" follows suit. Consider these two sentences and their median estimates:

In front of the hut are standing a few people: 4.55
In front of the building are standing a few people: 6.69

The larger the space, the more people there could be, hence the larger number "a few" denotes. Or consider this contrast:

Through the window one can see a few people: 5.86
Through the peephole one can see a few people: 4.76

The maximum number of people visible through a window is much larger than through a peephole, hence "a few" denotes proportionately more through the window than through the peephole. Hörmann provides many more examples as well.

Our conclusion, then, is simple: The denotation of a word is what the listener infers it has to be in order to fit the situational model that the speaker intended the listener to create.

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