Reference-point Reasoning and Comparison Asymmetries

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Abstract

Comparison asymmetries are most often explained in terms of underlying asymmetries in the perceived similarity of the comparison items, which in turn are seen as arising from the differential weighting of distinctive features of the target and base representations. In two experiments, we fail to confirm the predictions of the standard account. Rather, comparison asymmetries seem to follow from two general principles. First, certain items act as cognitive reference points that other, less prominent category members are located in terms of or assimilated to. And second, the target and base terms of a comparison play different semantic roles, with the target acting as the figure and the base acting as the ground.

Introduction

The notion that similarity is a symmetric relation is highly intuitive. After all, if one claims that limes are similar to lemons, this would seem to entail that lemons are also similar to limes. This notion is further supported by the observation that many comparisons can be stated either directionally, as in *Limes are similar to lemons*, or non-directionally and reciprocally, as in *Lemons and limes are similar to each other*. Nevertheless, comparisons often behave asymmetrically. For example, Tversky (1977) showed that people frequently prefer one direction of comparison (e.g., *North Korea is similar to China*) over the other (e.g., *China is similar to North Korea*). Such asymmetries are even more pronounced in metaphors and similes, for which only one direction of comparison may be meaningful. For example, whereas *Time is like a river* is an informative statement, *A river is like time* is nonsensical. The general observation is that, whenever two items differ in prominence due to such factors as familiarity, salience, or concreteness, the less prominent item is compared to the more prominent item.

What is the source of these comparison asymmetries? That is, given that two items are recognized as being similar, why should one direction of comparison be more natural and meaningful than the other? Clearly, the answer to this question is important to any psychologically plausible model of comparison. Indeed, the existence of comparison asymmetries has been used to argue for and against different theories of similarity (e.g., Tversky, 1977) and metaphor comprehension (e.g., Glucksberg & Keysar, 1990; Ortony, 1979). In this paper we evaluate two different accounts of the cognitive factors underlying comparison asymmetries.

The Standard Account

Comparison asymmetries are most commonly explained in terms of Tversky's (1977) *contrast model* of similarity which predicts that, under certain circumstances, the similarity of item *a* to item *b* will actually seem greater than that of item *b* to item *a*. According to the contrast model, the perceived similarity of item *a* to item *b*, *s(a, b)*, is given by

$$s(a, b) = qf(A \cap B) - af(A - B) - bf(B - A)$$

where *A* and *B* are the features of *a* and *b*, *f* is a measure of salience, and q, a, and b are weights assigned to the feature sets. The basic idea is that the similarity of two items increases as a function of their common features and decreases as a function of their distinctive features. Asymmetries in the similarity of two items are predicted in terms of the *focusing hypothesis*: Because the target (first term) of a directional comparison is the subject of the statement, it will receive more attention than the base (second term). This means that the distinctive features of the target are weighted more heavily than those of the base – that is, $a > b$. Thus, the similarity of *a* to *b* will seem greater than that of *b* to *a* whenever *b* possesses the larger or more salient set of distinctive features.

Consistent with the contrast model, asymmetric similarity ratings have been obtained in a wide range of stimulus domains, such that less prominent items are seen as being more similar to more prominent items (e.g., Bartlett & Dowling, 1988; Holyoak & Gordon, 1983; Ortony, Vondruska, Foss, & Jones, 1985; Tversky, 1977). But how does this explain the fact that people typically prefer one direction of comparison between two items over the other? The standard answer is that, when interpreting a similarity comparison, the hearer seeks to maximize the similarity of the items. In other words, people prefer *North Korea is similar to*

China over the reverse direction of comparison precisely because North Korea is judged as being more similar to China than the reverse – presumably reflecting differences in the featural complexity of the two items. In support of this position, both Tversky (1977) and Ortony et al. (1985) found that items in the preferred comparison order typically received higher similarity ratings than the same items in the non-preferred order.

To summarize, the standard account of comparison asymmetries makes two claims. First, comparison asymmetries reflect underlying asymmetries in the perceived similarity of the items. And second, these underlying asymmetries are due to attentional factors, such that the distinctive features of the target are weighted more heavily than the distinctive features or spatial density of the base.

Cognitive Reference Points

Although the contrast model has been widely adopted, there is an alternative explanation of comparison asymmetries – namely, that such asymmetries follow from principles of reference point reasoning (e.g., Gleitman, Gleitman, Miller, & Ostrin, 1997; Roese, Sherman, & Hur, 1998; Rosch, 1975; Shen, 1989). One of the central claims of this position is that certain highly prominent items act as *cognitive reference points* that other items are seen in relation to. Some well-known examples of cognitive reference points are prototypes and ideals, which may be used to understand less prominent category members (Rosch, 1975), and the self concept, which serves as a habitual landmark in social judgments (e.g., Holyoak & Gordon, 1983; Srull & Gaelick, 1983). The basic idea is that many domains of knowledge are at least partially structured in terms of a small number of reference items.

Of course, the claim that non-reference (or deviant) items are seen in relation to reference items raises the question of what is meant by "seen in relation to." One way in which this relationship may manifest itself is *conceptual location*: Cognitive reference points provide landmarks that can be used to better specify the location of deviant items in a semantic or perceptual space. By doing so, reference items lend stability to the representations of deviant items. For example, it may be easier to conceptualize and reason with non-standard quantities (e.g., a length of two feet and nine inches) in terms of certain standards of measurement (e.g., a length of one yard). The beneficial use of reference items as landmarks for locating deviant items has been demonstrated in several studies of magnitude comparisons, where pairs of deviant items were discriminated with greater speed and accuracy when they were in the vicinity of a cognitive reference point (e.g., Holyoak & Mah, 1982; Hutchinson & Lockhead, 1977; te Linde & Paivio, 1979).

In addition to conceptual location, there is a second and more complex way in which deviant items may be seen in relation to cognitive reference points – namely, *conceptual assimilation*. The idea here is that deviant items are more easily assimilated to reference items than the reverse (e.g., Bowdle & Gentner, 1997; Rosch, 1975; Shen, 1989). Such assimilation effects have been obtained in numerous studies. For example, people are more likely to project new properties from prototypical category members to less prominent members than vice versa (Rips, 1975), and are more willing to make inferences and predictions about others based on the self than vice versa (e.g., Kunda & Nisbett, 1988; McFarland & Miller, 1990). Whenever such assimilation occurs, the representation of the deviant item is changed to make it more concordant with that of the reference item.

The above discussion of the functions of cognitive reference points suggests that, even prior to being placed in a comparison, there is a directional or asymmetric relationship between two items whenever one makes a better cognitive reference point than the other. But how does this translate into preferred comparison orders? An answer commonly given by reference point models is that the target and base terms of a comparison play different semantic roles, which specify the placement of deviant and reference items in the comparison frame.

It has been claimed that items in the subject and complement positions of many sentence types are assigned the roles of *figure* and *ground*, respectively (Gleitman et al., 1997; Langacker, 1990; Talmy, 1978). The figure is characterized as a moving or conceptually movable object whose site or path is the issue of interest. In contrast, the ground is characterized as a stationary landmark with respect to which the figure's site or path is defined. Thus, whichever item makes a more natural cognitive reference point will be the preferred ground of the sentence. In directional comparisons, this predicts that deviant items should be placed in the target position and reference items in the base position.

Perhaps the most notable distinction between the standard account of comparison asymmetries and the reference point account is that the latter does not rely on the notion of underlying asymmetries in the perceived similarity of the comparison items. That is, one does not have to judge whether item *a* seems more similar to item *b* or item *b* seems more similar to item *a* in order to determine their preferred ordering. Rather, comparison asymmetries reflect the fact that deviant items are more concordant with the semantic constrains of the target position, and reference items with the semantic constraints of the base position. Simply put, using a cognitive reference point as the base of a directional comparison results in a more natural and informative statement.

Comparing the Positions

Both the standard account and the reference point account are able to explain many of the comparison

asymmetries that have been observed in the literature, albeit using different mechanisms. In the present study, we sought to address an important limitation of existing research in this area. Specifically, the available evidence almost exclusively involves asymmetries in similarity comparisons, for which the two accounts make essentially the same predictions concerning which direction of comparison should be preferred. If one turns to consider the relationship between similarity and difference comparisons, however, then the two accounts can be shown to make distinct predictions.

According to the standard account, people prefer the direction of a similarity comparison that maximizes the perceived similarity of the target to the base. By analogy, then, people should also prefer the direction of a difference comparison that maximizes the perceived difference of the target from the base. This suggests that comparison asymmetries should go in opposite directions for similarity and difference statements, as asymmetries in similarity and difference ratings tend to be inversely related (Tversky, 1977). For example, if North Korea seems more similar to China than the reverse, then China will seem more different from North Korea than the reverse. Therefore, people should not only prefer *North Korea is similar to China* over *China is similar to North Korea*, they should also prefer *China is different from North Korea* over *North Korea is different from China*. In both cases, the preferred direction of comparison maximizes the value of the dimension specified by the comparison predicate.

In contrast to the standard account, the reference point account states that people simply prefer the direction of comparison that uses the better cognitive reference point as the ground, because this ordering maximizes the informativity of the statement. Given that the position of figure and ground in a statement should not be affected by the particular comparison predicate, the preferred direction of comparison between two items should place reference items in the base position for both similarity and difference statements. Thus, if people prefer *North Korea is similar to China* over the reverse, then they should also prefer *North Korea is different from China* over the reverse.

In addition to making different predictions about the direction of comparison asymmetries for similarity and difference statements, the standard and reference point accounts also make different predictions about the relative magnitude of such asymmetries. According to Tversky (1977), difference comparisons will tend to place more weight on the distinctive feature sets than will similarity comparisons. Because the standard account derives asymmetries from distinctive features, this means that difference comparisons should be more asymmetric than similarity comparisons. In contrast, the reference point account suggests precisely the opposite – similarity comparisons should be more asymmetric than difference comparisons. Although the use of reference items to specify the location of deviant items is presumably equally important in similarity and difference statements, conceptual assimilation of deviant items to reference items should be more likely to occur in similarity statements. As noted by a number of theorists, informative similarity comparisons do not merely point out obvious commonalities; rather, they highlight nonobvious commonalities, and promote the creation of new ones through processes such as inference projection (e.g., Bowdle & Gentner, 1997; Medin et al., 1993). While less work has been done concerning the communicative functions of difference comparisons, it is reasonable to assume that difference comparisons are less likely to invite such modes of conceptual assimilation. This is because difference comparisons serve more to suggest differences between items than to suggest commonalities. Thus, although there should be a general preference for comparing deviant items to reference items, the utility of doing so should be greater for similarity statements than for difference statements.

Experiment 1

In Experiment 1, we tested the central predictions of the standard and reference point accounts concerning comparison asymmetries. Subjects were given directional similarity or difference comparisons, each of which contained a less prominent (deviant) item and a more prominent (reference) item. All comparisons were presented in both possible orders – with the reference item in the base position (e.g., *A zebra is similar to/different from a horse*) or in the target position (e.g., *A horse is similar to/different from a zebra*). For convenience, we will refer to statements with the first ordering of items as *forward comparisons*, and statements with the second ordering of items as *reverse comparisons*. For each comparison, subjects were asked to indicate the strength of their preference for one direction of comparison over the other. Again, the standard account predicts that comparison asymmetries should go in opposite directions for similarity and difference statements, and should be stronger for difference statements. In contrast, the reference point account predicts that comparison asymmetries should go in the same direction for similarity and difference statements, and should be stronger for similarity statements.

Method

Subjects. Forty Northwestern University undergraduates participated in partial fulfillment of a course requirement.

Materials and Design. Each subject received 32 directional comparisons between a less prominent (deviant) item and a more prominent (reference) item. (The relative prominence of each item was initially determined by the authors and then confirmed by two judges.) To ensure generality, the 32 comparisons involved eight categories of items: *animals* (e.g., zebra – horse), *artifacts* (e.g., motel – hotel), *colors* (e.g., tan – brown), *countries* (e.g., North Korea – China), *emotions*

(e.g., admiration – love), *famous individuals* (e.g., Saddam Hussein – Adolf Hitler), *measurements* (e.g., $105.00 – $100.00), and *occupations* (e.g., dentist – surgeon).

Half of the subjects received all 32 comparisons as similarity statements (e.g., *A zebra is similar to a horse*), and half as difference statements (e.g., *A zebra is different from a horse*). Subjects saw each statement in both forward and reverse directions, with the two directions separated by a six-point numerical scale. The order of presentation of the two directions (forward first versus reverse first) was counterbalanced within and between subjects.

Procedure. Each subject was given a booklet containing the 32 pairs of comparison statements in a random order. Subjects indicated which direction of comparison they felt was "stronger, more sensible, or more natural" for each pair by circling a number on the six-point scale. They were told that the more strongly they preferred the direction on the left, the closer their answer should be to 1, and the more strongly they preferred the direction on the right, the closer their answer should be to 6.

Results and Discussion

All directional preference ratings were transformed so that higher numbers indicated a preference for forward comparisons over reverse comparisons. For similarity statements, the directional preference (M = 4.77, SD = 0.39) was significantly above the scale midpoint (3.5) by both subjects and items, $t_S(19) = 14.66$, $p < .001$ and $t_I(31) = 19.44$, $p < .001$. For difference statements, the directional preference (M = 4.03, SD = 0.57) was also significantly above the scale midpoint, $t_S(19) = 4.14$, $p < .001$ and $t_I(31) = 6.41$, $p < .001$. Thus, subjects consistently preferred comparing deviant items to reference items in both similarity and difference statements. This is consistent with the reference point account of comparison asymmetries: People prefer the direction of comparison that places the better cognitive reference point in the base position, regardless of the particular comparison predicate used.

Turning to the relative magnitudes of the comparison asymmetries, the preference for the forward direction of comparison was higher for similarity statements than for difference statements, $t_S(38) = 4.83$, $p < .001$ and $t_I(31) = 10.31$, $p < .001$. Again, this is as predicted by the reference point account: Because similarity statements are likely to elicit a greater degree of conceptual assimilation than difference statements, reference point effects should be stronger in similarity statements.

Asymmetries in Similarity and Difference Ratings

Contrary to the claims of the standard account, the results of Experiment 1 suggest that comparison asymmetries are not due to underlying asymmetries in the perceived similarity or difference of the comparison items. If this were the case, then – assuming that hearers seek to maximize the value of the dimension specified by the comparison predicate – comparison asymmetries should have gone in opposite directions for similarity and difference statements. But how, then, does one explain the fact that comparison asymmetries are typically associated with asymmetries in similarity and difference ratings (e.g., Ortony et al., 1985; Tversky, 1977)? We suggest that such ratings asymmetries might also be due to reference point reasoning.

According to the reference point account, the target and base terms of a directional comparison play different semantic roles, with the target acting as the figure and the base acting as the ground. Thus, information flows directionally from the base to the target, as when the base is used to generate new inferences about the target. Assuming that deviant items are more easily assimilated to reference items than the reverse, this means that assigning the reference item to the base position (forward comparisons) should result in a greater degree of conceptual assimilation than assigning it to the target position (reverse comparisons). Therefore, forward comparisons should elicit higher similarity ratings – and lower difference ratings – than reverse comparisons.

This explanation of ratings asymmetries is radically different from that offered by Tversky's (1977) contrast model. In this model, the representations of the comparison items are assumed to remain static, and asymmetries are simply due to attentional factors. On the reference point view, however, the representations of deviant items may shift towards those of reference items, thereby making the items more similar. This view is, in fact, consistent with a fair amount of evidence. Indeed, asymmetries in conceptual assimilation are often associated with asymmetries in similarity ratings. For example, people not only make more inferences and predictions about others based on the self than vice versa (e.g., Kunda & Nisbett, 1988; McFarland & Miller, 1990), they also rate others as being more similar to the self than vice versa (e.g., Catrambone, Beike, & Niedenthal, 1996; Holyoak & Gordon, 1983; Srull & Gaelick, 1983). We propose that the latter effect may be largely due to the former – projecting novel information from the self to others will make others seem more similar to the self.

In sum, the reference point account can explain asymmetries in similarity and difference judgments, and in fact predicts the same directionalities as the standard account. As was the case for comparison asymmetries, however, these approaches make different predictions about the relative magnitude of asymmetries in similarity and difference ratings. According to the standard account, difference comparisons will tend to place more weight on the comparison items' distinctive feature sets than will similarity comparisons. Because the standard account derives asymmetries from precisely these stimulus properties, this predicts that directional difference ratings should be more asymmetric than directional similarity ratings. According to the reference point account, however, this pattern of results

should not hold. This is because conceptual assimilation is more likely to occur in similarity comparisons. Assuming that conceptual assimilation is in fact a primary source of ratings asymmetries, then, directional similarity ratings should be more asymmetric than directional difference ratings.

Experiment 2

In Experiment 2, subjects were given the same directional comparisons used in Experiment 1, and rated either the similarity or the difference of both the deviant item to the reference item (e.g., *How similar is a zebra to a horse?*) and the reference item to the deviant item (e.g., *How similar is a horse to a zebra?*). Again, the standard account predicts that difference judgments should be more asymmetric, whereas the reference point account predicts that similarity judgments should be more asymmetric. We also gave a second group of subjects *nondirectional* versions these comparison questions (e.g., *How similar are a zebra and a horse?* or *How similar are a horse and a zebra?*). That is, these subjects were asked to rate either the similarity of or the difference between the two items without any specification of which item was the target and which was the base.

The inclusion of the nondirectional ratings condition was inspired by Catrambone et al. (1996), who argued that if the more prominent of two comparison items serves as a cognitive reference point for understanding the other item, then it should act as the implicit base of a nondirectional comparison. That is, nondirectional comparisons should be mentally translated into forward comparisons, in which the deviant item is directionally compared to the reference item. Supporting this claim, Catrambone et al. found that nondirectional similarity comparisons were rated as expressing the same degree of similarity as forward similarity comparisons, and a higher degree of similarity than reverse similarity comparisons. In the present experiment, we sought to replicate this finding for similarity comparisons, and extend it to difference comparisons. If both nondirectional similarity and difference ratings are closer to forward than reverse ratings, then this would further support the claim that asymmetries are due to reference point reasoning.

Method

Subjects. Eighty Northwestern University undergraduates served as paid subjects.

Materials and Design. Half of the subjects were assigned to the directional ratings condition, and half to the nondirectional ratings condition. In the directional condition, subjects received all 32 directional comparisons used in Experiment 1. Half of the subjects in this condition were asked to rate the similarity of the comparison items, and half the difference between the comparison items. For each comparison, subjects gave ratings for both the forward direction and the reverse direction. The order of presentation of the two directions was counterbalanced within and between subjects.

In the nondirectional ratings condition, subjects received nondirectional versions of the 32 comparison statements. As in the directional condition, half of the subjects were asked to rate the similarity of the comparison items, and half the difference between the comparison items. Because nondirectional comparisons lack target and base terms, however, subjects gave only one rating per comparison in this condition. The order of presentation of the deviant and reference items in a comparison (e.g., *How similar are a zebra and a horse?* versus *How similar are a horse and a zebra?*) was counterbalanced within and between subjects.

Procedure. Each subject was given a booklet containing the 32 comparison statements in a random order. Subjects gave similarity or difference ratings by circling a number on a 20-point scale below each comparison. For similarity ratings, the low end of the scale was labeled "not at all similar" and the high end "very similar". For difference ratings, the low end was labeled "not at all different" and the high end "very different".

Results and Discussion

Focusing first on the directional ratings, subjects gave higher similarity ratings to forward comparisons (M = 11.02, SD = 2.44) than to reverse comparisons (M = 9.84, SD = 2.69), $t_S(19) = 3.93$, $p < .001$ and $t_I(31) = 6.57$, $p < .001$. Likewise, subjects gave higher difference ratings to reverse comparisons (M = 13.12, SD = 2.26) than to forward comparisons (M = 12.44, SD = 2.35), $t_S(19) = 3.29$, $p < .005$ and $t_I(31) = 3.42$, $p < .005$. These results are consistent with both the standard account and the reference point account. More critically, however, the directional similarity ratings were more asymmetric than the directional difference ratings: The absolute mean difference in ratings between the forward and reverse comparisons was nearly twice as large for similarity comparisons (M = 1.18, SD = 1.34) as it was for difference comparisons (M = 0.68, SD = 0.92). This is only consistent with the reference point account, according to which conceptual assimilation will result in asymmetric similarity and difference ratings but is more likely to occur in similarity comparisons. However, this difference in the magnitude of the ratings asymmetries was only marginally significant by items, $t_I(31) = 1.91$, $p < .10$, and not by subjects, $t_S(38) = 1.38$, $p < .20$.

Turning now to consider the entire pattern of ratings, the nondirectional similarity ratings (M = 11.42, SD = 2.71) did not differ from forward similarity ratings, but were significantly larger than reverse similarity ratings, $t_S(38) = 2.23$, $p < .05$ and $t_I(31) = 6.41$, $p < .001$. This replicates the findings of Catrambone et al. (1996). Likewise, the nondirectional difference ratings (M = 12.10, SD = 3.12) did not differ from forward difference ratings, but were significantly smaller than reverse difference ratings by items, $t_I(31) = 4.25$, $p < .001$, but

not by subjects, $t_S(38) = 1.58$, $p < .20$. Thus, subjects seemed to interpret nondirectional similarity and difference comparisons as forward comparisons, in which the reference item played the implicit role of ground. This result cannot be explained by Tversky's (1977) contrast model, and further illustrates the centrality of reference point reasoning in comparisons.

Conclusions

Our findings suggest that asymmetries in similarity and difference comparisons cannot be explained in terms of the differential weighting of static representations. Rather, they seem to follow from two general principles. First, certain items act as cognitive reference points that other items are understood in terms of via conceptual location or conceptual assimilation. And second, the target and base terms of a comparison play different semantic roles – the base, acts as the ground, is used to understand the target, which acts as the figure. Thus, comparison asymmetries reflect the fact that deviant items are more concordant with the linguistic constrains of the target position, and reference items with the linguistic constraints of the base position. Directional comparisons are maximally informative when a cognitive reference point is used as the base. Further, this direction of comparison is most likely to result in higher similarity ratings – and lower difference ratings – due to the increased potential for conceptual assimilation. In sum, the comparison process would appear to be far more dynamic than is commonly assumed, with reference-point reasoning playing a prominent role in both similarity and difference.

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