Comparison-Induced Anchoring Effects

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Abstract

We investigated the possibility that verbal comparisons (Choplin & Hummel, 2002) mediate the effects of anchors on estimation. Consistent with patterns of bias documented by previous research on anchoring effects, verbal comparisons would most often bias estimates toward anchor values. Undocumented by previous research, however, verbal comparisons would occasionally bias estimates away from anchor values. In particular, verbal comparisons ought to bias estimates away from anchor values when unknown values are judged larger (or smaller) than anchor values and the differences between unbiased estimates and anchor values are less than the differences suggested by these comparisons. We tested these predictions in two experiments. In Experiment 1, we constrained the range of acceptable estimates and participants compared the unknown value to the anchor and then estimated the value. We found that comparisons sometimes bias estimates away from anchor values. In Experiment 2, we replicated some of the findings of Experiment 1 without constraining the range of acceptable estimates. The results of these experiments suggest that verbal comparisons mediate the effects of anchors on estimation.

Anchoring Effects

In a well-known study, Tversky and Kahneman (1974) asked their participants to judge whether African nations represented a higher or lower percentage of UN-member nations than an arbitrary numeric value called the anchor. Participants then estimated the actual percentage. A bias in estimation towards the anchor was observed. When the anchor was 10% of UN-member nations, the median estimate was 25%; but when the anchor was 65% of UN-member nations, the median estimate was 45%.

Several explanations for biases toward anchor values have been proposed. Tversky and Kahneman (1974) suggested that anchor values might give participants a starting point in their search for an acceptable estimate. Participants might then adjust their estimate toward values they think are likely to represent the true value, but settle on a value before sufficiently adjusting their estimate away from the anchor (see also Jacowitz & Kahneman, 1995). Wilson, Houston, Brekke, and Etling (1996) suggested that anchor values might prime values near anchors that participants are then unable to ignore. Strack and Mussweiler (1997) suggested that anchors might bring to mind attributes that are diagnostic or suggestive of values. By this account, biases towards anchors would be observed because large anchor values would bring to mind attributes that suggest large values while small anchor values would bring to mind attributes that suggest small values. Schwarz (1990) noted that in some cases conversational factors might suggest that anchor values are reasonable responses.

The goal of the research reported here was to investigate whether verbal comparisons (Choplin & Hummel, 2002) mediate the effects of anchors on estimation. The issue of whether verbal comparisons mediate anchoring effects is largely orthogonal to the issues raised by previous accounts of anchoring effects as verbal comparisons could affect estimation by altering search strategies (Jacowitz & Kahneman, 1995; Tversky & Kahneman, 1974), priming values (Wilson et al., 1996), bringing to mind diagnostic attributes (Strack & Mussweiler, 1997), appealing to conversational norms (Schwarz, 1990), or any combination thereof. Orthogonal to the issues raised by these theories, however, the possibility that verbal comparisons mediate anchoring effects is nevertheless of interest, because it suggests patterns of bias that have not yet been documented by previous research. We start by describing the patterns of bias created by verbal comparisons. We then describe two experiments in which we found support for the view that verbal comparisons mediate the effects of anchors on estimation.

Comparison-Induced Anchoring Effects

Verbal magnitude comparisons suggest quantitative values. To investigate the values suggested by English age comparisons, for example, Rusiecki (1985) gave his participants sentences, such as, "Mary is older than Jane" and "Martin's wife is older than Ken's wife," and asked them to report the ages they imagined. He found that in response to the comparison "Mary is older than Jane" participants imagined Mary to be 20.2 years on average and Jane to be 17.9 years on average. In response to the comparison "Martin's wife is older than Ken's wife" participants imagined Martin's wife to be 37.2 years on average and Ken's wife to be 33.0 years on average. We will call these values *comparison-suggested values,* because they are the values that are suggested by comparisons.

To investigate the values that might be suggested by comparing unknown values to anchor values, we performed a pilot study similar to Rusiecki's (1985) study wherein our participants imagined skyscrapers whose heights were more and less than an anchor of 1,367 feet (the midway point between the height of the Empire State Building in New York City and the height of the Petronias Towers in Kuala Lumpur, Malaysia). One group of participants (n=40) imagined a skyscraper whose height was "much more" than 1,367 feet and a second skyscraper whose height was "much less" than 1,367 feet. Another group (n=40) imagined a skyscraper whose height was "slightly more" than 1,367 feet and a second skyscraper whose height was "slightly less' than 1,367 feet. The results indicated that "slightly more" than 1,367 feet suggests a median value of 1,390 feet and "much more" suggests a median value of 1,458.5 feet,

while "slightly less" suggests a value of 1,350 feet and "much less" suggests a value of 1,270 feet (see Table 1).

Table 1: Comparison-suggested differences.

Comparison Words	Anchor Value	Suggested Values
Slightly more	1,367 ft.	1,390 ft.
Much more	1,367 ft.	1,458.5 ft.
Slightly less	1,367 ft.	1,350 ft.
Much less	1,367 ft.	1,270 ft.

We propose that comparisons between unknown, to-be-estimated values and anchors, whether presented to participants explicitly in conversation, on a research instrument, or articulated by participants themselves sub-vocally, might bias estimates towards the values suggested by comparisons. For example, the judgment that the height of one of the world's tallest skyscrapers is slightly more than 1,367 feet might suggest that the skyscraper is approximately 1,390 feet (i.e., the median imagined height slightly more than 1,367 feet; see Table 1). Likewise, the judgment that one of the world's tallest skyscrapers is slightly less than 1,367 feet might suggest that the skyscraper is approximately 1,350 feet. Estimates might then be biased toward these comparison-suggested values. Sometimes people might hesitate to describe a value as larger (or smaller) than the anchor and prefer to describe it as "approximately the same as" or "similar to" the anchor. In such cases, the comparison-suggested value would be the anchor value and estimates would be biased toward the anchor.

Verbal comparisons would most often produce patterns of bias that are consistent with the patterns of bias documented by previous research. That is, verbal comparisons would most often produce biases toward anchor values. They would produce biases toward anchor values whenever unknown, to-be-estimated values are judged "approximately the same as" or "similar to" anchor values. They would also produce biases toward anchor values whenever unbiased estimates are more than a comparison-suggested difference away from anchor values. For example, if a person's unbiased estimate of a skyscraper's height were 1,700 feet (i.e., more than 1,458.5 feet), then the judgment that its height is much more than 1,367 feet would produce a bias toward 1,458.5 feet (the comparison-suggested value; see Table 1). This bias toward 1,458.5 feet would coincidentally also produce a bias toward the anchor.

Nevertheless, verbal comparisons should occasionally produce patterns of bias that have not yet been documented by previous research. In particular, they should occasionally bias estimates away from anchor values. Judging an unknown value to be much more or much less than the anchor, for example, might exaggerate differences from the anchor. For example, if a person's unbiased estimate of a skyscraper's height were 1,400 feet (i.e., less than 1,458.5 feet), the judgment that its height is much more than 1,367 feet would again produce a bias toward 1,458.5 feet. This time, however, the bias toward 1,458.5 feet would produce a bias away from the anchor.

If verbal comparisons mediate the effects of anchors on estimation, then the words used to compare unknown, to-be-estimated values to anchors should affect estimation. In particular, comparisons that suggest values that are close to the anchor (i.e., slightly more or less) should produce stronger anchoring effects—greater biases toward the anchor—than comparisons that suggest values that are far from the anchor (i.e., much more or less). For example, the values suggested by the comparisons "slightly more than 1,367 feet" and "slightly less than 1,367 feet" (i.e., 1,390 and 1,350 feet respectively) are closer to 1,367 feet than are the values suggested by the comparisons "much more than 1,367 feet" and "much less than 1,367 feet" (i.e., 1,458.5 and 1,270 feet respectively). Since estimates would be biased towards these values stronger anchoring effects should be observed if the adjective "slightly" modifies comparisons than if the adjective "much" modifies comparisons.

The purpose of Experiments 1 and 2 was to investigate these predictions. To investigate whether comparisons bias some estimates away from anchor values, our participants estimated the height of the Sears Tower (a Chicago landmark and one of the world's tallest buildings; actual height=1,450 feet) twice using two different measures: once before (unbiased graphic estimate; see Figure 1) and once after (biased numerical estimate) the presentation of the anchor. This procedure allowed us to match estimates in the experimental condition to estimates in the control condition and compare them. To maximize the percentage of estimates that would be biased away from the anchor, we constrained the range of acceptable estimates in Experiment 1. We did not constrain the range of estimates in Experiment 2.

Experiment 1

The goal of Experiment 1 was to test the prediction that verbal comparisons will sometimes bias estimates away from anchor values. To test this prediction, we measured participants' estimates of the height of the Sears Tower twice: once as a graphic estimate as shown in Figure 1 and once as an estimate in feet. To maximize the chance that unbiased estimates would be closer to the anchor than the comparison-suggested values, we limited the range of acceptable estimates to be between the height of the Empire State Building and the height of the Petronias Towers.

Method

Participants. Four hundred ninety five passengers on the Chicago elevated train system participated voluntarily.

Materials and Procedure. To limit the range of acceptable estimates, participants were first told that the Empire State Building in New York City was the tallest building in the world until the Sears Tower was built and that the Sears Tower was the tallest building in the world until the Petronias Towers in Kuala Lumpur, Malaysia, were built.

We then measured participants' unbiased estimates by showing participants the in-scale silhouettes of the Empire State Building and the Petronias Towers as shown in Figure 1. Participants placed a tick mark between the horizontal line representing the height of the Empire State Building and the horizontal line representing the height of the Petronias Towers to represent how tall they believed the Sears Tower to be (henceforth, called the unbiased graphic estimate). The distance between the horizontal line representing the height of the Empire State Building and the horizontal line representing the height of the Petronias Towers was 23mm.

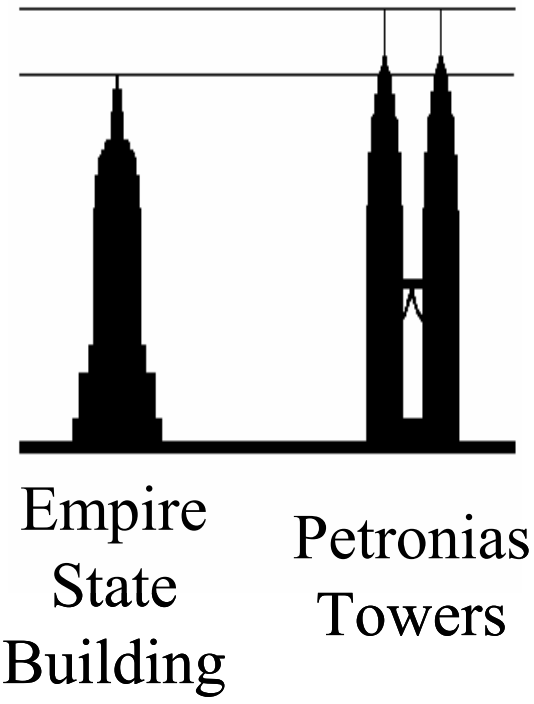

Figure 1. Graphic estimate of the height of the Sears Tower. Participants placed a tick mark between the horizontal line representing the height of the Empire State Building and the horizontal line representing the height of the Petronias Towers to represent how tall they believed the Sears Tower to be.

We then limited the range of acceptable estimates for the height of the Sears Tower in feet by telling participants that the height of the Empire State Building is 1,250 feet tall and the height of each of the Petronas Towers is 1,483. There were two experimental groups. Participants in one experimental group (n=165) judged the height of the Sears Tower to be "slightly more than," "approximately the same as," or "slightly less than" 1,367 feet (slightly condition). Participants in the second experimental group (n=165) judged the height of the Sears Tower to be "much more than," "approximately the same as," or "much less than" 1,367 feet (much condition). A control group (n=165) did not compare the height of the Sears Tower to 1,367 feet. Finally, all participants estimated the height of the Sears Tower in feet.

Results

Scatter plots of the results are presented in Figure 2. Graphic estimates measured in millimeters from the line representing the height of the Empire State Building are plotted along the x-axis. Numerical estimates are plotted along the y-axis. As predicted, the estimates of participants in the experimental conditions who judged the height of the Sears Tower approximately the same as the anchor appear to cluster around the anchor. The estimates of the participants who judged the height to be more or less than the anchor appear to cluster around comparison-suggested values and appear to be biased away from the anchor particularly among participants who judged the height more than the anchor.

To test whether these apparent biases were significant, we needed to compare responses in the experimental conditions to responses in the control conditions. We could not directly compare estimates for each type of judgment (more, approximately the same, less) to estimates in the control condition, however, because the subsets of participants who made each type of judgment were precisely the participants most likely to estimate the height greater than, closest to, and less than the anchor respectively even if comparisons to anchor values did not in themselves bias estimates. To control for this selection effect, we compared the estimates from participants in the experimental groups who had judged the height more than the anchor to the largest estimates in the control group; we compared the estimates from participants in the experimental groups who had judged the height approximately the same as the anchor to the estimates in the control group that were closest to 1,367 feet; and we compared the estimates from participants in the experimental groups who had judged the height less than the anchor to the smallest estimates in the control group. While these control groups are potentially biased (i.e., we cannot know whether the unbiased estimates of the participants who judged the Sears Tower more than the anchor would necessarily resemble the largest estimates in the control group), these control groups are—if anything—biased against the hypothesis that comparisons will bias estimates away from the anchor.

We constructed these conservative control groups by classifying the participants in the control group based upon their responses on the graphic estimate (Figure 1) and the percentage of participants in the experimental groups who had made each type of judgment. In particular for each millimeter of the unbiased graphic estimate scale, we calculated the percentage of participants in the experimental groups who had judged the height of the Sears Tower to be more than, less than, and approximately the same as the anchor. Then we classified the same percentages of participants in the control group (inclusive) as controls for each type of judgment. In Experiment 2, for example, 30% of the participants in the much condition with an unbiased graphic estimate of 18mm above the line that represented the height of the Empire State Building judged the height of

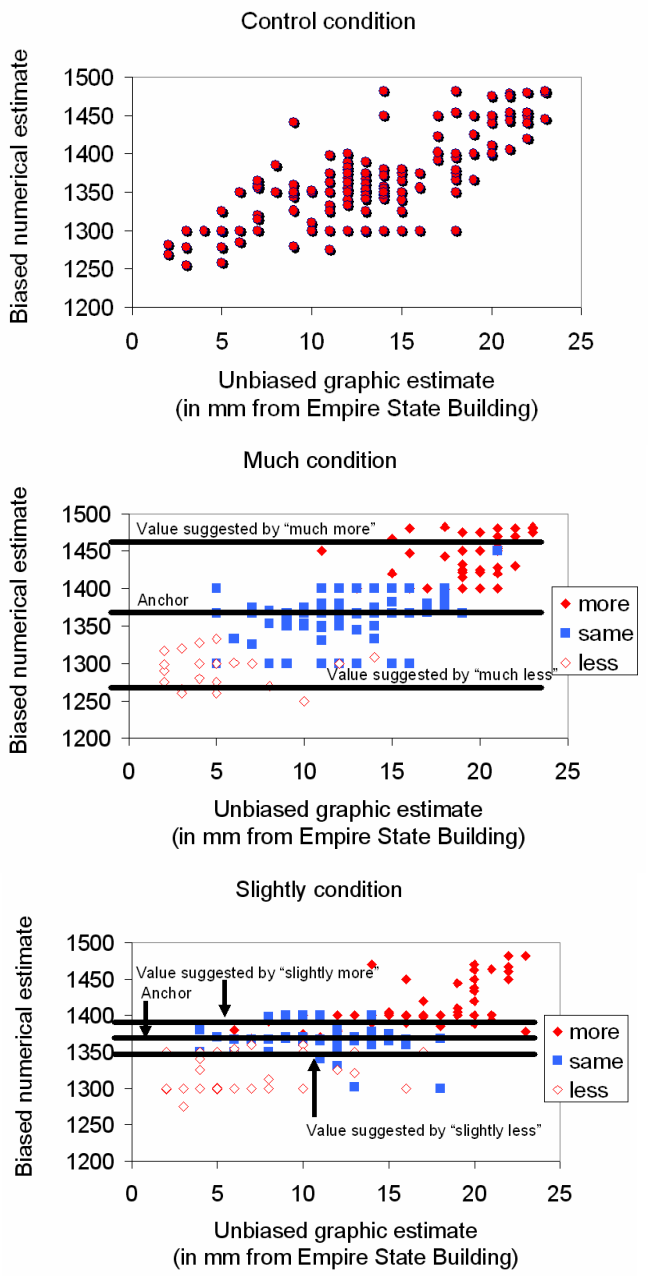

Figure 2. Results of Experiment 1. Graphic estimates are plotted along the x-axis. Numerical estimates are plotted along the y-axis. Estimates in the experimental conditions appear to cluster around comparison-suggested values.

the Sears Tower to be much more than 1,367 feet and 70% judged it to be approximately the same as 1,367 feet. We then classified participants in the control group based upon these percentages. Of the participants in the control condition whose unbiased graphic estimate was 18mm above the line that represented the height of the Empire State Building, 30% with the largest estimates were placed in the more-than control group and 70% whose estimates were closest to 1,367 feet were placed in the approximately-the-same control group. Participants in the control conditions were categorized in this manner twice: once to provide control groups for the slightly experimental condition and once to provide control groups for the much experimental condition.

We first examined the estimates of participants in the experimental groups who had judged the height of the Sears Tower to be approximately the same as the anchor and compared them to the participants in the control group whose estimates were closest to the anchor. A 2 (group: experimental versus control) x 2 (modifying adjective: "slightly" versus "much") between-subjects analysis of variance (ANOVA) on the results of Experiment 2 revealed that participants in the experimental group estimated the height of the Sears Tower closer to the anchor (i.e., the unsigned difference between their estimates and the anchor was smaller) than did participants in the control group, $F(1,341)=23.57$, $p<.01$. Posthoc t-tests revealed that this effect held both when the adjective "slightly" modified comparisons [M=9.81 versus 23.81ft.; $t(262)=9.88$, $p<.01$], and when the adjective "much" modified comparisons [M=18.36 versus 26.71ft; $t(424)=14.94$, $p<.01$]. The ANOVA also revealed a main effect of the modifying adjective [$F(1,341)=6.18$, $p<.05$] most likely because more participants judged the height of the Sears Tower to be approximately the same as the anchor in the much condition than in the slightly condition. There was no interaction [$F(1,341)=1.51$, $p>.05$].

We next examined the estimates of participants who had judged the height of the Sears Tower to be different from (i.e., more or less than) the anchor and compared them to the largest (for more-than judgments) or the smallest (for less-than judgments) estimates in the control group. Consistent with the view that verbal comparisons mediate the effects of anchors on estimation, a 2 (group: experimental versus control) x 2 (modifying adjective: "slightly" versus "much") between-subjects ANOVA on more-than judgments revealed a main effect of the modifying adjective [$F(1,239)=35.80$, $p<.01$] and a marginal interaction between the modifying adjective and group [$F(1,239)=3.5$, $p=.06$] such that biases away from the anchor were significant in the much more-than condition, but not in the slightly more-than condition (see Table 2). No previous account of anchoring effects would have predicted these biases away from the anchor, but they are consistent with the view that verbal comparisons mediate the effects of anchors on estimation. An analogous 2 (group: experimental versus control) x 2 (modifying adjective: "slightly" versus "much") between-subjects ANOVA on less-than judgments also revealed a main effect of the modifying adjective [$F(1,100)=11.2$, $p<.01$] and a significant interaction between the modifying adjective and group [$F(1,100)=4.00$, $p<.05$] such that there was a significant bias toward the anchor in the slightly less-than condition, but a nominal, non-significant bias away from the anchor in the much less-than condition. Note that even the null effects observed in the slightly more-than and much less-than conditions are of theoretical interest as previous models of anchoring effects

would have predicted biases toward the anchor in these conditions.

Table 2: Biases in estimates of the Sears Tower.

Words	Control estimates (in feet)	Exp. estimates (in feet)	Significance
More			
Slightly	1,405.54	1,407.81[a]	$t(149)=0.39, p>.05$
Much	1,424.22	1,443.38[a]	$t(90)=2.84, p<.01$
Less			
Slightly	1303.00	1,320.63[t]	$t(62)=2.51, p=.01$
Much	1,295.42	1,290.71[a]	$t(38)=0.54, p>.05$

Note: *t* denotes nominal bias toward anchor;
a denotes nominal bias away from anchor.

Lastly, consistent with the view that verbal comparisons mediate the effects of anchors on estimation, numerical estimates of the height of the Sears Tower—averaged across more than, approximately the same as, and less than comparisons—were closer to the anchor value of 1,367 feet in the slightly condition (M=32.09 feet away, SD=28.98) than in the much condition (M=42.26 feet away, SD=37.27), $t(328)=2.77$, $p < .01$.

Experiment 2

The goal of Experiment 2 was to replicate the finding in Experiment 1 that the words used to express comparisons affect the strength of anchoring effects and to do so without introducing other values (i.e., the heights of the Empire State Building and the Petronias Towers) that might have also served as anchors as was done in Experiment 1. The view that verbal comparisons mediate the effects of anchors on estimation predicts that anchoring effects ought to be stronger if the adjective *slightly* modifies comparisons (i.e., participants judge whether the unknown value is slightly more than, approximately the same as, or slightly less than the anchor) than if the adjective *much* modifies comparisons (i.e., participants judge whether the unknown value is much more than, approximately the same as, or much less than the anchor).

Method

Participants. One hundred sixty passengers on the Chicago elevated train system participated voluntarily.

Materials and Procedure. To find appropriate anchor values, we asked a control group of participants to estimate the height of the Sears Tower. We then used the 10th percentile (300 feet), the 40th percentile (1162 feet), the 60th percentile (1500 feet), and the 90th percentile (3180 feet) of estimates as anchor values. Participants compared the height of the Sears Tower to one of these anchor values by either identifying it as much more, approximately the same as, or much less than the anchor or by identifying it as slightly more, approximately the same as, or slightly less than the anchor. All participants then estimated the height of the Sears Tower.

Results

To investigate the effects of modifying adjectives on estimation, we ignored whether participants had judged the unknown value to be more than, approximately the same as, or less than the anchor and calculated the distance between every participant's estimate and the anchor value that she or he had seen (i.e., the unsigned difference between the estimate and the anchor value). The results are presented in Table 3. We analyzed these results using a 2 (modifying adjectives: much or slightly) x 4 (anchor values: 10th, 40th, 60th, or 90th percentiles of unbiased estimates) between-subjects analysis of variance (ANOVA). Consistent with the view that verbal comparisons mediate the effects of anchors on estimation, the adjective used to modify comparisons affected estimates. Estimates were closer to anchor values if the adjective *slightly* modified comparisons than if the adjective *much* modified comparisons, $F(1,152) = 5.98$, $p<.05$.

Table 3: Average distance of estimates from anchor values.

Anchor values	Modifying adjective	Distance
10th percentile (300 feet)	Much	929.95
	Slightly	364.19
40th percentile (1162 feet)	Much	1071.7
	Slightly	284.6
60th percentile (1500 feet)	Much	522.45
	Slightly	242.7
90th percentile (3180 feet)	Much	1047.1
	Slightly	1148.5[†]

Note: All results are averaged across more than, approximately the same as, and less than comparisons.
[†] Means contrary to predictions due to outliers.

These results are consistent with the view that verbal comparisons mediate the effects of anchors on estimation. These results also demonstrate that the pattern of biases predicted by the view that verbal comparisons mediate anchoring effects and observed in Experiment 1 is not contingent upon the presentation of values that could have served as additional anchors.

Discussion

We investigated the possibility that verbal comparisons mediate the effects of anchors on estimation in two experiments. In both experiments, participants estimated the height of the Sears Tower. In Experiment 1, participants estimated the height of the Sears Tower twice: once estimating its height graphically on the scale presented in Figure 1 and once estimating its height in feet. This procedure allowed us to match estimates in the experimental condition to estimates in the control condition and, thereby, form conservative control groups. To maximize the percentage of estimates that would be biased away from the anchor, we constrained the range of acceptable estimates in

Experiment 1. Of the participants who judged the height of the Sears Tower different from (more or less than) the anchor, only the estimates of those who had judged the height slightly less than the anchor were biased toward the anchor. The estimates of the participants who judged the height much less and slightly more than the anchor were not biased toward the anchor. The estimates of the participants who judged the height much more than the anchor were biased away from the anchor. The words used to express comparisons also affected estimates. Experiment 2 placed no constraints on the range of acceptable estimates. Replicating the results of Experiment 1, the words used to express comparisons affected estimates. The results of both experiments are consistent with the view that verbal comparisons mediate the effects of anchors on estimation.

The view that verbal comparisons mediate the effects of anchors on estimation can account for the biases in estimation observed in the experiments reported here. The theoretical issues raised by this view are largely orthogonal to the issues raised by previous accounts of anchoring effects, however, as the mechanisms by which verbal comparisons might affect estimation could very well be analogous to the mechanisms by which anchors have been thought to affect estimation. That is, verbal comparisons could affect estimation by altering search strategies (Jacowitz & Kahneman, 1995; Tversky & Kahneman, 1974), priming values (Hummel & Holyoak, 2001; Wilson et al., 1996), bringing to mind diagnostic attributes (Strack & Mussweiler, 1997), appealing to conversational norms (Schwarz, 1990, note that any account that appeals to conversational norms would require a theory of the meaning of verbal comparisons such as the one proposed by Choplin & Hummel, 2002), or any combination thereof. Nevertheless, the results reported here suggest that a complete accounting of the effects of anchors on estimation will need to consider the mediating effects of verbal comparisons.

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