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Making Sense of Nonsense: The Visual Salience of Units Determines Sensitivity to Magnitude

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Abstract

When are people sensitive to the magnitude of numerical information presented in unfamiliar units, such as a price in a foreign currency or a measurement of an unfamiliar product attribute? We propose that people exhibit *deliberational blindness*, a failure to consider the meaning of even unfamiliar units. When an unfamiliar unit is not salient, people fail to take their lack of knowledge into account, and their judgments reflect sensitivity to the magnitude of the number. However, subtly manipulating the visual salience of the unit (e.g., enlarging its font size relative to the font size of the number) prompts recognition of the unit's unfamiliarity and reduces magnitude sensitivity. In five experiments, we demonstrated this unit-salience effect, provided evidence for deliberational blindness, and ruled out alternative explanations, such as nonperception and fluency. These findings have implications for decision making involving numerical information expressed in both unfamiliar units and familiar but poorly calibrated units.

Keywords

judgment, heuristics, decision making, visual attention, number comprehension, money illusion, evaluability

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Reasoning effectively about magnitude is central to information-based decision making in all aspects of life. People process information involving numerical stimuli every day, with examples as diverse as prices, distances, weights, amounts, times, and ratings. Such information is represented as a magnitude holding no meaning on its own and a unit of measurement denoting a meaningful standard quantity. The judgment of such information should be based on a multiplication of the magnitude and the unit. For the most commonly encountered units (e.g., inches), the standard quantity represented is well known. However, in many cases, people encounter units representing poorly known quantities (e.g., megapixels; Hsee, Yang, Gu, & Chen, 2009). How do people make judgments about quantities described with numerical information, such as the aptitude of a student who has a score of 21 points on the American College Test, the size of a 3-acre property, the performance of a 24-mm camera lens, the hearing risk of a 110-dB rock concert, the power of a 150-horsepower (hp) engine, or the price of a hotel room costing 138 Brazilian real? Specifically, how does the numerical component of the information (the magnitude) affect people's judgments when they have limited knowledge about the standard quantity represented by the accompanying unit?

Previous research on numerical reasoning suggests contradictory answers to this question. Research on the money illusion (e.g., Fehr & Tyran, 2001; Raghubir & Srivastava, 2002; Shafir, Diamond, & Tversky, 1997; Wertenbroch, Soman, & Chattopadhyay, 2007) has demonstrated that people overrely on numerical information (e.g., the face value of unfamiliar currencies), and therefore, this research would predict that judgments are sensitive to magnitude. However, research on evaluability (e.g., Hsee & Rottenstreich, 2004; Hsee, Yang, Li, & Shen, 2009; Hsee & Zhang, 2010; Kahneman & Knetsch, 1992; Shen, Hsee, Wu, & Tsai, 2012) has documented that people underutilize numerical information when they lack a frame of reference, which would predict insensitivity to magnitude. Consider an international traveler who sees a single hotel room price of either 138 or 344 Brazilian real. The

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traveler could either (a) make different judgments depending on which price was seen because of the money illusion or (b) make similar judgments regardless of which price was seen because of low evaluability.

We propose that these contradictory predictions can be reconciled by a previously unidentified tendency not to take into account knowledge of the unit. We demonstrated that a subtle manipulation, the visual salience of the unit presentation, affects people's sensitivity to the magnitude of numerical information.

From Eye-Catching to Mind-Catching

When people process information in familiar units (e.g., $15), the unit information ($) is simply recognized and deliberation primarily focuses on the magnitude of the number (15). This can occur when the magnitude is a cue that, compared with the unit, has been more diagnostic in the past (Kruschke, 2011), presents more variability (Dunn, Wilson, & Gilbert, 2003), or has greater potential for discrimination (Burson, Larrick, & Lynch, 2009). Thus, we anticipated that in the absence of specific deliberation about the unit, people's judgments would generally be sensitive to the magnitude of the numerical information. This tendency not to deliberate about the meaning of the unit, which we call *deliberational blindness*, may be reasonable when the standard quantity represented by a unit is well known, but it also (correctly or incorrectly) extends to contexts in which the quantity represented by a unit is poorly understood (a tendency consistent with the money illusion; Shafir et al., 1997).

Deliberational blindness, which results in a failure to assess the meaningfulness of information, is different from the failures in perception that have been shown in prior research. Inattentional blindness (Mack & Rock, 1998; Simons & Chabris, 1999) occurs when focus on one cue (e.g., people passing a basketball) blocks perceptual recognition of an otherwise highly noticeable cue (e.g., a person in a gorilla suit walking between basketball players). Similarly, people's expectations of what they will see can block the perceptual recognition of change in the stimulus (Grimes, 1996). In contrast, deliberational blindness is more akin to a failure of insight (Metcalfe & Wiebe, 1987), occurring without perceptual failure. Thus, even when the unit information is accurately read, recognized, remembered, and recalled, deliberational blindness may still occur.

Although not a perceptual failure, deliberational blindness can be reduced by altering the visual salience of the unit.[1] Visual representation can affect which heuristics are used in numeric reasoning (Coulter & Coulter, 2005; Monga & Bagchi, 2012), and people use visually salient cues more than visually nonsalient cues (as shown in associative learning; Kruschke, 2011). When the eye is drawn to an unfamiliar unit (e.g., because it is presented in a larger or darker font than the magnitude), the shift in attention from the magnitude (the default focus) to the unit can prompt deliberation about the latter. Because it is necessary to know the quantity represented by the unit in order to interpret the full information, recognition of the unit's unfamiliarity makes people's judgments correspondingly less sensitive to the magnitude information (an outcome consistent with evaluability theory; Hsee & Zhang, 2010). For example, presenting the unit of a hotel price in a relatively eye-catching format, such as 138R (as opposed to 138R), can draw attention to the unit, which in turn sparks deliberation and prompts the realization that *R* is an unfamiliar unit. Given our deliberational-blindness account, a decision context that directly increases deliberation about even a nonsalient unit should have a similar effect. For example, asking people to first evaluate other familiar and unfamiliar units can prompt them to assess the meaning of the unit in a new stimulus, regardless of the unit's visual salience. Thus, whenever attention is drawn to an unfamiliar unit, the tendency for deliberational blindness will be reduced.

In five experiments, we tested the proposed effect of unit salience on magnitude sensitivity, as well as the effects of possible moderators predicted by the deliberational-blindness account. Across all experiments, we employed a 2 (unit salience: nonsalient vs. salient) × 2 (magnitude: small vs. large) between-participants design to investigate the *unit-salience effect*: that people's judgments are less sensitive to magnitude when unfamiliar units are more visually salient. We began by demonstrating the unit-salience effect and then explored the underlying mechanism and the generality of the effect.

Experiment 1: The Unit-Salience Effect

Method

Participants in Experiment 1 made a monetary valuation with real financial consequences. Eighty-four U.S. college students, after completing an unrelated prior experiment, were given an opportunity to buy an amount of foreign money that would be converted into U.S. dollars (USD). They were told that they would be shown how much the money was worth in an unspecified foreign currency, denoted as *X*, but that they would learn which currency *X* represented only after they had made their decision. Each participant saw one of four randomly assigned stimuli, which varied in numeric magnitudes (X0.69 vs. X6.83) and in the relative font size of the unit (nonsalient: 22 point vs. salient: 66 point). All stimuli were presented on a computer screen. Although the relative salience of the number and the unit varied (i.e., whether the number was larger than the unit or vice versa), even the smaller font size (22 point) was quite large, and therefore participants could easily read all the information.[2]

After learning the bidding procedure (Becker, DeGroot, & Marschak, 1964), participants submitted a bid in USD that represented the highest price they were willing to pay. They were then asked to guess the unspecified currency represented by *X*, and finally were told either that *X* stood for British pounds (in the X0.69 conditions) or that *X* stood for Chinese yuan (in the X6.83 conditions), both amounts equaling 1.00 USD at the time of the experiment. As described in the bidding procedure that participants read, a price was then drawn at random, and participants whose bid was higher than the random price paid that price and received 1.00 USD.

Results and discussion

An analysis of variance on the log-transformed bids revealed an interaction between unit salience and magnitude, $F(1, 80) = 5.02$, $p < .05$, $\eta_p^2 = .06$ (Fig. 1). Specifically, in the unit-nonsalient conditions, participants who saw the X6.83 amount made higher bids than those who saw the X0.69 amount (geometric *M*s = \$5.39 vs. \$0.93, respectively), $t(38) = 6.61$, $p < .01$, $d = 2.16$, whereas bids did not differ significantly between participants who saw the X6.83 and X0.69 amounts in the unit-salient conditions (geometric *M*s = \$3.32 vs. \$1.98, respectively), $t(42) = 1.11$, n.s. These results demonstrate the unit-salience effect: that numerical judgments are less sensitive to the magnitude of unfamiliar numerical information when the accompanying unit was more salient. Magnitude sensitivity in the unit-salient conditions was not explained by participants' guesses as to the currency. Furthermore, we found no interaction between the unit-salience effect and response time, which suggests that the effect was not due to rushed judgments. Thus, Experiment 1, using real transactions, provided initial evidence that the subtle manipulation of unit salience changes the effect of magnitude on people's valuations.

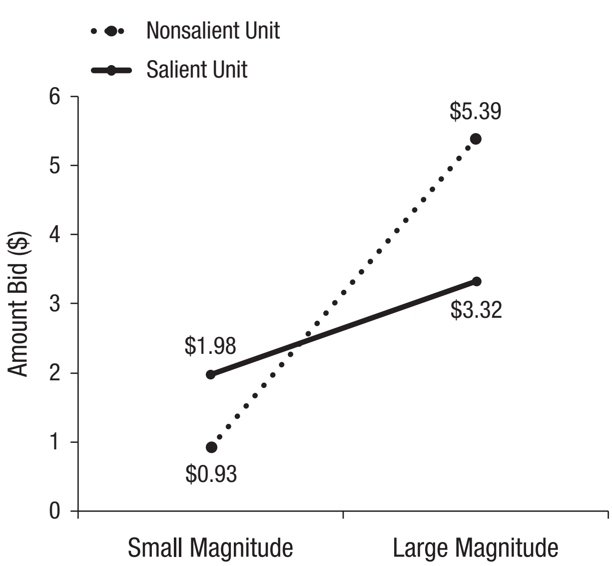

Fig. 1. Results from Experiment 1: geometric mean of the amount bid as a function of the magnitude of the stimulus amount and the salience (relative font size) of the currency unit.

Experiment 2: Numerical Judgment on a Nonnumerical Scale

Method

In Experiment 2, we used relative font darkness (nonsalient: gray vs. salient: black) as the manipulation of unit salience and measured the effect on a nonnumerical scale. One hundred four U.S. graduate students participated for a course bonus point. They read, "You are traveling in a small foreign country where people use different units of measurement than we do. For example, they use the unit *zq* to measure length." Participants then indicated how long they thought a matchstick with a length specified in *zq* was by marking their estimate on an unnumbered 15.50-cm line. The length information was randomly determined using a 2 (unit salience: nonsalient vs. salient; both in 16-point font) × 2 (magnitude: 3 zq vs. 12 zq) between-participants design. In the unit-salient conditions, the number was gray and the unit was black, whereas in the unit-nonsalient conditions, the number was black and the unit was gray.

Results and discussion

We performed an analysis of variance on estimated length. Replicating the unit-salience effect, our results showed a significant interaction between unit salience and magnitude, $F(1, 100) = 17.73$, $p < .001$, $\eta_p^2 = .15$. Participants' estimates were sensitive to the length information in the unit-nonsalient conditions (3-zq condition: $M = 4.09$ cm; 12-zq condition: $M = 8.83$ cm), $t(50) = 5.94$, $p < .001$, $d = 1.69$, but not in the unit-salient conditions (3-zq condition: $M = 5.14$ cm; 12-zq condition: $M = 5.56$ cm), $t(50) = 0.64$, n.s. These results demonstrate that the differences in magnitude sensitivity were specifically due to unit salience (as opposed to a potential interaction of magnitude and font size; Coulter & Coulter, 2005). These results show that the unit-salience effect extends to a nonnumerical behavioral measurement.

Experiment 3: Unit Familiarity and Deliberation of Unit Familiarity as Moderators

In Experiment 3, we tested two predictions derived from the proposed deliberational-blindness account. First, we anticipated that people would be magnitude sensitive when viewing information in familiar units, regardless of visual unit salience. This result would be contrary to alternative predictions that nonsalient magnitudes might be processed less fluently and thus receive less weight than salient magnitudes (Shah & Oppenheimer, 2007) or that people might infer magnitude from the unit itself when the unit is more salient (Monga & Bagchi, 2012). These alternative accounts would instead predict that magnitude will have less impact in unit-salient conditions than in unit-nonsalient conditions, even for familiar units. Second, we anticipated that when people were directly or indirectly prompted to assess unit familiarity, they would be magnitude insensitive when viewing numbers with unfamiliar units, regardless of visual unit salience.

Method

This experiment had four versions. In the deliberational-blindness version (3a), we expected to replicate the unit-salience effect with an unfamiliar unit, whereas in the other three versions, we expected to debias the effect by showing participants a familiar unit (deliberation-irrelevant version, 3b), having participants make a prior usefulness assessment (deliberation-prompted version, 3c), or having participants make a prior unit evaluation (deliberation-primed version, 3d). Across the versions, 764 U.S. adults completed online surveys.[3] They read about "Hotel Rio" in Rio de Janeiro, Brazil, including the nightly room rate. Within each version, we used the same 2 (unit salience: nonsalient vs. salient) × 2 (magnitude: 138 vs. 344) between-participants design. In the unit-salient conditions, the number was in 14-point font and the unit was in 24-point font; in the unit non-salient conditions, the number was in 24-point font and the unit was in 14-point font.

In the deliberational-blindness version (3a; n = 192), participants saw the hotel rate in Brazilian real (R); participants in the deliberation-irrelevant version (3b; n = 193) saw the rate in USD ($). In two additional versions, we also used the unfamiliar unit (R) but either prompted or primed deliberation. In the deliberation-prompted version (3c; n = 189), participants read the hotel scenario and then indicated how useful the price information seemed. In the deliberation-primed version (3d; n = 190), participants first rated their knowledge of six units (two unfamiliar: cubit and bushel; four familiar: inch, kilogram, cup, and pound) before proceeding to the hotel scenario. Finally, all participants rated the price on a 5-point scale (from 1, *very low price*, to 5, *very high price*) and identified the price information they had seen (both recalling the given price and recognizing it from a list).

Results

As predicted, the unit-salience effect was replicated in the deliberational-blindness version (3a) but not in the other versions (Fig. 2).

Version 3a: the unit-salience effect for the unfamiliar unit. In the deliberational-blindness version, participants were more price sensitive when the currency was nonsalient than when it was salient, $F(1, 188) = 5.27$, $p < .05$, $\eta_p^2 = .03$. When participants were shown prices in Brazilian real, their judgments were price sensitive in the unit-nonsalient conditions (138R condition: $M = 2.80$; 344R condition: $M = 3.29$), $t(97) = 3.71$, $p < .001$, $d = 0.75$, but price insensitive in the unit-salient conditions (138R condition: $M = 3.11$; 344R condition: $M = 3.09$), $t(91) = 0.08$, n.s.

Version 3b: no unit-salience effect for the familiar unit. Price sensitivity was not affected by unit salience in the familiar-currency condition, as indicated by the lack of a two-way interaction: $F(1, 189) = 0.07$, n.s. When participants were shown prices in USD, their judgments were equally price sensitive in both the unit-nonsalient condition ($138 condition: $M = 3.24$; $344 condition: $M = 4.39$), $t(99) = 6.64$, $p < .001$, $d = 1.15$, and the unit-salient condition ($138 condition: $M = 3.22$; $344 condition: $M = 4.44$), $t(90) = 7.19$, $p < .001$, $d = 1.22$.

Version 3a vs. Version 3c: the moderating effect of assessing usefulness. Participants who were asked to rate the usefulness of the price information before assessing the price (in Brazilian real) showed less of a unit-salience effect than those who were not, as indicated by a three-way interaction: $F(1, 373) = 5.05$, $p < .05$, $\eta_p^2 = .01$. Presumably, assessing usefulness facilitated awareness of participants' unfamiliarity with the unit, and there was therefore no effect of unit salience on magnitude sensitivity, as indicated by the lack of a two-way interaction: $F(1, 185) = 0.49$, n.s.

Version 3a vs. Version 3d: the moderating effect of deliberating about units. The unrelated unit evaluation was designed to prompt participants' deliberation about the meaning of subsequently encountered units. Indeed, participants who completed the unit evaluation before assessing the price (in Brazilian real) showed less of a unit-salience effect than those who did not, as indicated by a three-way interaction: $F(1, 374) = 4.86$, $p < .05$, $\eta_p^2 = .01$. After the unrelated unit evaluation, unit salience did not affect magnitude sensitivity; there was no two-way interaction: $F(1, 186) = 0.52$, n.s.

When participants were prompted to consider the meaningfulness of the information (Versions 3c and 3d), there was no effect of unit salience and lower (but significant; both ps < .05) magnitude sensitivity. Using a bootstrap difference-of-difference test ($p < .05$), we found that participants' ratings were significantly more sensitive to the magnitude in the Version 3a unit-nonsalient condition (138R condition: $M = 2.80$; 344R condition: $M = 3.29$; $d = 0.75$) than in the combined data for Versions 3c and 3d (combined 138R conditions: $M = 2.89$; combined 344R conditions: $M = 3.15$, $d = 0.41$).

Discussion

Excluding participants who incorrectly identified the unit did not materially affect the results (83% spontaneously provided correct unit information, and 94% correctly identified magnitude and unit from a list of options). Likewise, response time did not moderate the findings in a regression testing the interaction between the unit-salience effect and the response time, which further rules out simple oversight as an alternative account. Thus, we conclude that it is deliberational blindness (facilitated by nonsalient presentation of units), rather than a simple failure to perceive the unit, that influences magnitude sensitivity.

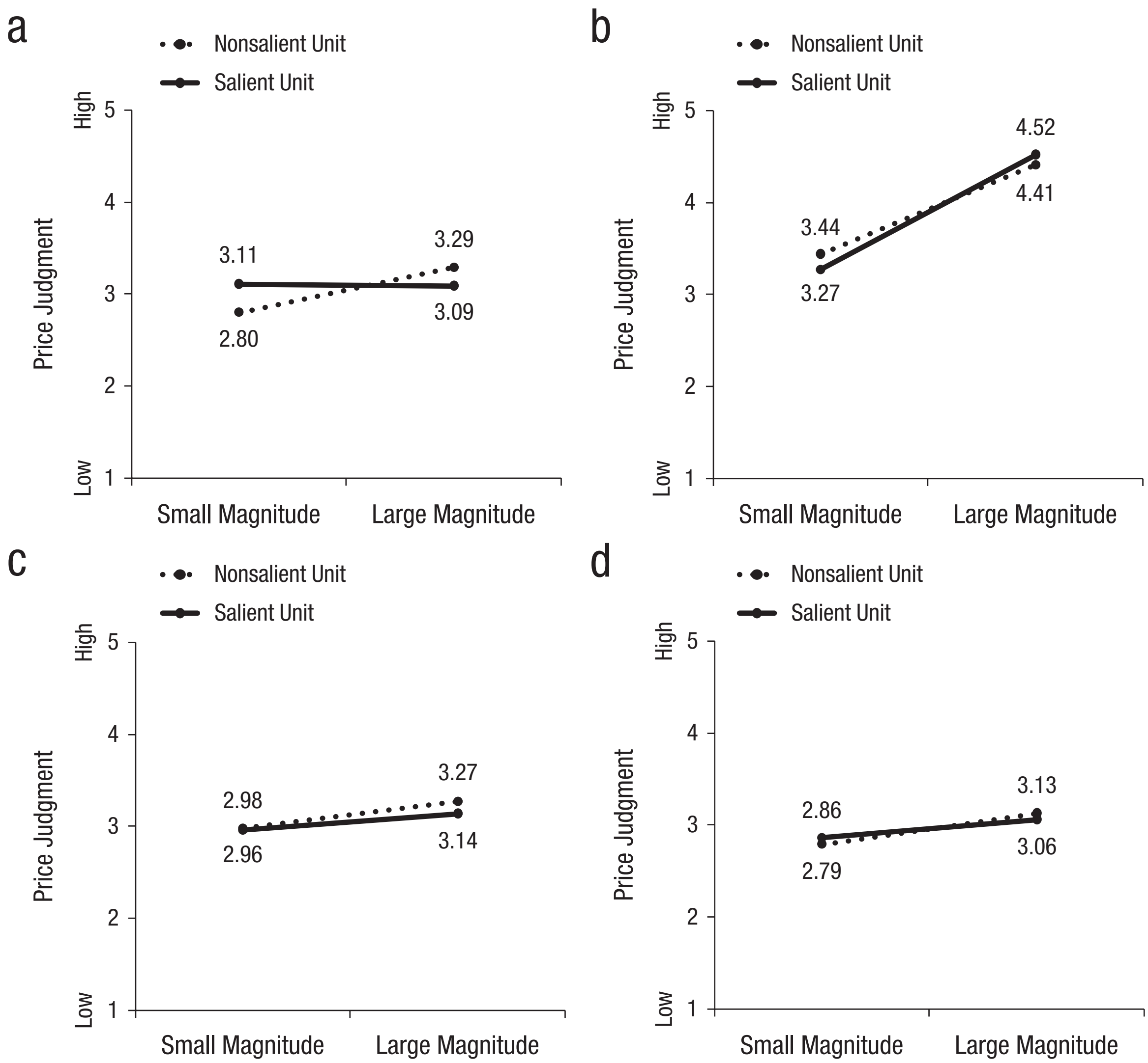

Fig. 2. Results from Experiment 3: mean price rating as a function of the actual magnitude of the price and the salience (relative font size) of the currency unit. Results are shown separately for four versions of the experiment. In three versions (a, c, and d), participants were unfamiliar with the currency in which the price was given, whereas in the other version (b), participants were familiar with the currency. Prior to rating the price in two of the unfamiliar-currency conditions, participants either (c) made a judgment about the usefulness of the price information or (d) assessed their knowledge of six units of measure.

Furthermore, in Experiment 3, we replicated the unit-salience effect and provided evidence for two key moderators of the effect. Unit familiarity consistently yielded high magnitude sensitivity, whereas prompting deliberation about the meaning of an unfamiliar unit consistently yielded low magnitude sensitivity. In support of the deliberational-blindness account, the unit-salience effect occurred only for unfamiliar units and disappeared when people were prompted to deliberate about the unit.

Experiment 4: The Unit-Salience Effect in a Multiattribute Judgment

In Experiment 4, we investigated whether the unit-salience effect persists even when another, more familiar attribute could serve as the basis of judgment.

Method

One hundred nine U.S. students working on their Master of Business Administration degree completed this experiment for a course bonus point. A majority (83%) indicated that they had stayed in a hotel outside the United States at least once in the past year.

Each participant saw one of four listings for a four-star hotel, "Hotel Rio," in Rio de Janeiro, Brazil, and evaluated the value of the hotel room on a 5-point scale from 1, *very bad value; a terrible deal*, to 5, *very good value; a great deal*. The listings included two attributes, price and location. The hotel location and the number in the price were consistently presented in 18-point font, but the currency unit (R) was written either in 11-point font (nonsalient condition) or 24-point font (salient condition). The price of the hotel room was either

138R or 344R. The experiment thus had a 2 (unit salience: nonsalient vs. salient) × 2 (magnitude: 138R vs. 344R) design. The hotel location was either one block from the beach (a better location) in the 138R conditions or three blocks from the beach (a worse location) in the 344R conditions.

Results and discussion

We found that participants were more price sensitive when the unfamiliar currency was nonsalient than when it was salient, $F(1, 105) = 5.82$, $p < .05$, $\eta_p^2 = .05$ (see Fig. 3). Further analyses revealed that in the unit-nonsalient condition, participants who were told that the room cost 138R rated it as a better value than did participants who were told that the room cost 344R (*M*s = 3.69 vs. 3.07, respectively), $t(54) = 3.16$, $p < .01$, $d = 0.86$. The value ratings were not significantly different in the unit-salient conditions (138R condition: $M = 3.35$; 344R condition: $M = 3.41$), $t(51) = 0.30$, n.s.

If participants in Experiments 1 through 3 used the unfamiliar numerical information merely because of a lack of alternative cues, judgments in Experiment 4 should no longer have varied with unit salience. In other words, participants should have ignored the pricing information and relied on the easy-to-evaluate location information. We found the opposite, and this finding suggests that the unit-salience effect generalizes to judgments involving other, easier-to-interpret attributes.

Experiment 5: Deliberational Blindness Extends to Common Unfamiliar Units

Finally, in Experiment 5, we investigated whether deliberational blindness can occur even in decisions with commonly encountered but poorly understood units. Although most U.S. consumers know that the power of a car's engine is represented by horsepower (hp), few are familiar with the quantity represented by the unit. Therefore, magnitude sensitivity should depend on deliberation about the unit.

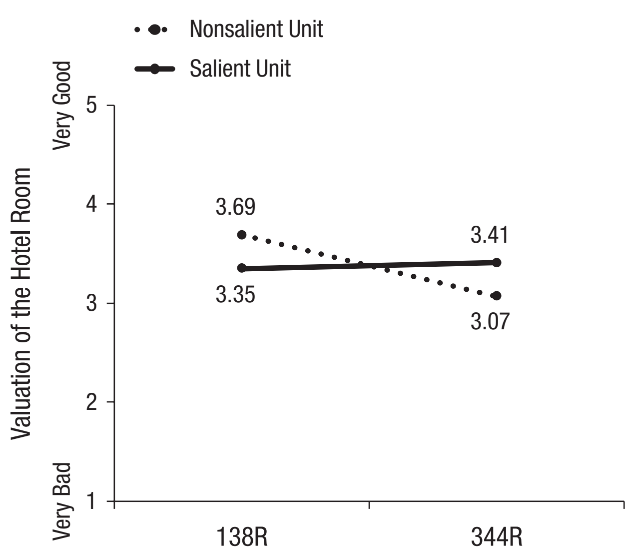

Fig. 3. Results from Experiment 4: mean rating of the value of a hotel room as a function of the price (in Brazilian real, R) of the hotel room and the salience (font size) of the currency unit.

Method

We collected 116 completed online surveys from U.S. native-English speakers. Participants were shown information about a car engine's power, represented as a number and the unit *hp* (either 150 hp or 300 hp), and were asked to rate the car on a 5-point scale (from 1, *very low-powered*, to 5, *very high-powered*). The information was presented in 14-point font, but in the unit-nonsalient conditions, the number was in black font and the unit was in gray font, whereas in the unit-salient conditions, the number was in gray font and the unit was in black font. Thus, the experiment had a 2 (unit salience: nonsalient vs. salient) × 2 (magnitude: 150 hp vs. 300 hp) between-participants design. Participants then estimated the list price and provided their own valuation of the car, completed both a free-recall and a recognition task about the power information, answered what the unit *hp* stood for, evaluated the usefulness of the power information provided, and rated the importance of power in their own car preferences. Participants also completed the Need for Cognition (Cacioppo & Petty, 1982) and Numeracy (Lipkus, Samsa, & Rimer, 2001) scales.

Results

Judged power. Participants in the unit-nonsalient condition were more sensitive to magnitude than participants in the unit-salient condition, $F(1, 112) = 4.38$, $p < .05$, $\eta_p^2 = .04$. Ratings of car power depended on magnitude in the unit-nonsalient conditions (150-hp condition: $M = 2.61$; 300-hp condition: $M = 3.74$), $t(44) = 3.93$, $p < .001$, $d = 1.18$, but were only marginally sensitive in the unit-salient conditions (150-hp condition: $M = 2.78$; 300-hp condition: $M = 3.16$), $t(68) = 1.75$, $p = .08$, $d = 0.44$.

Consistent with a deliberational-blindness account, analysis of the additional questions showed that participants recalled and understood the unit information. Specifically, 96% of participants spontaneously recalled the unit, 99% identified the correct magnitude and unit from a list of options, and 98% provided the correct definition of *hp* ("horsepower"). Excluding participants who incorrectly identified the unit did not materially affect the results. A lack of time, motivation, or ability to think about the information also could not account for the effect. Although the unit-salience effect was slightly stronger for participants who took more time to respond or who had higher need for cognition, neither moderation was significant (both *p*s > .1), and there was no moderation by numeracy.

Car valuation. Judgments of the car's power correlated with both estimated list price ($r = .72$, $p < .01$) and the participant's own willingness to pay ($r = .56$, $p < .01$). To test whether unit salience affected valuation, we modeled the joint effects of the unit salience and magnitude manipulations and the self-reported importance of car power on willingness to pay, controlling for estimated list price. This yielded a significant three-way interaction, $F(1, 107) = 9.71$, $p < .01$, $\eta_p^2 = .08$. Car valuations were sensitive to magnitude primarily among the participants who saw the nonsalient unit and considered car power to be important.

Discussion

In Experiment 5, we replicated the unit-salience effect for a familiar product attribute and demonstrated the consequences for product valuation. Deliberational blindness affected judgments involving a seemingly familiar unit whose underlying value may not have been well understood. Such judgments, in turn, affected personal willingness to pay, even when we controlled for estimated list price, among participants who considered car power important. Thus, deliberational blindness and the resulting sensitivity to magnitude may have a wide-ranging influence on commonly encountered decisions.

General Discussion

We found that subtly making an unfamiliar unit more salient (via relative font size or color) increases deliberation about the meaning of the unit and reduces magnitude sensitivity for unfamiliar numerical information. These findings shed light on how people reason with numerical information and have important implications for how numerical information is presented and used in decision making.

Our findings imply that decisions involving completely unfamiliar units (e.g., foreign currencies or measures) will be highly prone to deliberational blindness, yielding spurious magnitude sensitivity. This magnitude sensitivity arises from failing to consider the unit rather than from equating the unit with another moderately familiar unit (e.g., a known foreign currency) or approximating it from the best-known unit (e.g., one's home currency; Wertenbroch et al., 2007). This suggests, for example, that for hotels catering to foreign tourists, low prices would be more effective when the currency is not salient, but when the currency is made salient, high prices would be less likely to scare off potential customers.

Judgments with completely unfamiliar units, though important, are fairly infrequent. However, deliberational blindness may extend far more broadly to decisions involving commonly encountered but poorly calibrated units, as demonstrated in Experiment 5. Prior exposure to units such as horsepower may lead to less spontaneous deliberation because of a false sense of meaningfulness for the unit. In fact, in an additional experiment, participants ($N = 61$) were magnitude sensitive when evaluating either a 150-hp or a 300-hp car, $t(59) = 2.16$, $p < .05$, $d = 0.56$, with no visual salience manipulations (i.e., all magnitudes and units were in the same font color and size). Thus, negotiators, marketers, and policy advocates may all enhance the persuasiveness of their appeals by making the poorly calibrated unit salient when the magnitude at issue is low but maintaining the general low salience of the unit when the magnitude is high.

A notable exception involves situations in which the judgment itself may prompt deliberation about the unit. For example, magnitude insensitivity has been shown in contingent valuation (Kahneman & Knetsch, 1992), such as the finding that people generated similar intended donations for saving 2,000 versus 2,000,000 birds when they did not have a well-defined monetary value per unit (bird saved; Desvousges et al., 1993). The task of valuation in such contexts may prompt deliberation about the unit and recognition that the value of the unit is difficult to evaluate, which yields magnitude insensitivity. In contrast, a different judgment (i.e., a purely quantitative one) with the same stimuli might not arouse deliberation about the unit, which would yield magnitude sensitivity.

The implications of our findings potentially extend beyond the single-option judgments tested in these experiments to attribute differences in multiple-option choices. Distinguishing between better and worse attribute values is easier when multiple options are assessed, but knowing the quantity represented by the unit is still necessary for effectively making trade-offs, such as judging how much more to pay for a 300-hp car than for a 150-hp car. Thus, in multiple-option decisions, people may be less sensitive to differences in magnitude for attributes defined by poorly calibrated but salient units. This suggests that, paradoxically, making the unit more salient might be an effective neutralizing tactic for a competitor who is weaker on that attribute when doing so prompts people to recognize their lack of knowledge.

Finally, our findings have important implications for how individuals should approach decisions with potentially unfamiliar units. From a strictly normative view, magnitude sensitivity for unfamiliar units is irrational because the numbers are not informative unless the quantity represented by the unit is known. However, we do not argue that the mere presence (or absence) of magnitude sensitivity necessarily constitutes a bias. In fact, magnitude sensitivity constituted an error in Experiment 1 simply because of the experimental design, whereas in the other experiments, the lack of magnitude sensitivity constituted an error. As with other cognitive heuristics, the effect of deliberational blindness on decision quality depends on the context, and under certain circumstances, it may be ironically beneficial. Nevertheless, in general, decision makers will be able to better calibrate their magnitude sensitivity to match their knowledge of the units under consideration if they make units salient for themselves and deliberate about those units.

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Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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Supplemental Material

Additional supporting information may be found at http://pss.sagepub.com/content/by/supplemental-data

Notes

1. A review of prior research on visual salience and numeric inference can be found in the Supplemental Material available online.
2. Additional details of the methodology and analyses of the five experiments can be found in the Supplemental Material.
3. Four additional participants misread the real currency symbol as the symbol for dollars and were therefore excluded from analyses.

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“Making Sense of Nonsense:

The Visual Salience of Units Determines Sensitivity to Magnitude”

Luxi Shen and Oleg Urminsky

Supplemental Materials

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Additional Review of Prior Research on Visual Salience and Numeric Inference

While the role of visual cues in numerical inference has been an understudied topic, several important recent papers have suggested that visual characteristics in general may play key roles in numerical inference processes.

First, visual cues may influence the decision heuristic used and the relative weight given to different information. Coulter and Coulter (2005) present evidence that jointly displaying lower prices in a smaller font and higher prices in a larger font facilitates comparison, while the reverse presentation inhibits effective price comparisons. In our between-subjects studies, each participant evaluated a single price, and we do not find a difference in magnitude sensitivity when comparing congruent representations (small font / small magnitude vs. large font / large magnitude) versus non-congruent representations. (Also see the discussion regarding Experiment 2 in the paper.)

Landy and Goldstone (2010) show that evaluations of ambiguous arithmetic operations ("2 + 3 x 4") are influenced, in two different ways, by the visual spacing of the elements. First, operations which are physically closer together are more likely to be conducted first (e.g., when the 3 is closer to the 4, people are more likely to do multiplication first). Second, when the items are spaced farther apart, the value represented by the entire expression is judged to be larger. Given that magnitudes with units represent an implicit multiplication, their findings suggest that the spacing (the distance between the number and unit) might influence judgments under some conditions. Our experiments don't test this, however, as we kept spacing constant across the stimuli in each experiment.

Shah and Oppenheimer (2007) provide evidence that quantitative information (numerical or semantic) presented with high visual fluency (a clear rather than blurry stimulus) receives higher weight in making a decision, relative to low visual fluency information. Their research also suggests that numerical information in unfamiliar units with higher lexical fluency (i.e., a more fluent sounding name of the unit) may receive higher weight in multi-attribute choice, although they do not directly test this. While our visual salience manipulation could have also influenced visual fluency, we didn't find any effect of the manipulation on familiar units, suggesting our findings are distinct from fluency (see the discussion regarding Experiment 3B.)

Second, visual cues may also exert a more direct influence on inferences themselves. Monga and Bagchi (2012) argue that when units are salient, quantities represented with larger units (e.g., feet, as opposed to inches) are seen as larger – in effect, people infer magnitude information from whether small units (e.g., days) or large units (e.g., weeks) are used. They link this tendency to construal level, arguing that numerical information is more concrete and therefore more salient in a concrete mindset, while units are more associated with abstract processing. Our results are conceptually analogous to their findings for visual salience, in that heightening the salience of units increases attempts to make sense of the unit. However, while they compare conceptually small and large well-known units, we focus on the physical appearance (font size and font color) of a single unfamiliar or poorly-understood unit.

Our Experiment 3 provides a test of whether their "unitosity" effect (inferring quantity from the unit used rather than the magnitude) contributes to our findings when units are salient. Their predicted effects of salience would be the same or stronger when units are better known, since unitosity is an (over) reliance on the magnitude inferred from the unit presented, and such inferences require knowledge of the unit. However, our unit-salience effect is eliminated in

Experiment 3 when a well-known unit (dollars) is used, supporting the argument that our findings operate via a distinct process from theirs.

It would be very beneficial and interesting for future research to investigate the potential links between our work and other emerging approaches to understanding how visual representation affects numerical reasoning. We anticipate that decisions will be governed by a combination of the identified visual factors, depending on whether numerical cues are evaluated singly or jointly, the familiarity of the units, and the interpretation of visual differences.

Experiment 1: The Unit-Salience Effect

Experimental Procedure.

Participants were shown the following information via MediaLab software.

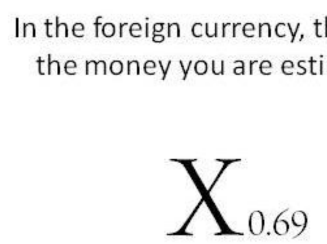
Screen 1: "**Currency Buying Game**
In next task, you will have the opportunity to buy an amount of money in US currency. The information you will have is how much the money is worth in a foreign currency that is not specified.
Here's how the procedure works:
You will say how much you are willing to pay. Then, the computer will draw a price at random.
If your bid is lower than the randomly selected price, there will be no transaction.
If your bid is higher than the randomly selected price, you will buy the item at the randomly selected price (not at your higher price)."

Screen 2: "**This system is designed so that there is no reason to overbid or underbid.**
If you bid too low, you may miss out on the opportunity to buy it at a price you would have wanted to buy at.
If you bid too high, you may wind up being required to buy at a higher price than you want to.
So, the best strategy is always to bid exactly what you think the item is worth, based on your best guess.
On the next page, you will see what you are bidding on, and then on the next screen you will be told the random price and the outcome of the game."

On the third screen, participants were shown a .jpg image of the stimulus (see Fig.1 for an example) and were asked make their bid:

<u>Screen 3:</u> "**How much, in dollars would you pay for this amount of money (to be received in US currency)?**"

Figure 1:



Note: Stimuli in figures not shown in the same scale as stimuli presented to participants.

Data Analyses.

All bids data were log-transformed for analysis due to their positively-skewed distribution. The analysis reported in the paper is shown in Table 1. One potential concern is that if participants had a strong prior guess as to the value of the currency in US dollars that they were estimating, they could have inferred the currency from the amounts. After their bid, we asked participants to guess which currency was represented by X. Only four participants (out of 84) correctly guessed the currency: two in the small amount / UK pounds condition and two in the large amount / Chinese Yuan condition. All four correctly bid approximately one dollar. If we exclude these participants, the results of the ANOVA are nearly identical (F=3.93, p=.051, Table 2).

We also wanted to test whether the effect was related in any way to poor cognitive processing on the part of the participants. First, we find no moderation of the findings by whether or not the participants report being confused by the instructions (Table 3). Second, we find no moderation of the findings by either response time (Table 4) or the log of response time (Table 5). Therefore, we conclude that our findings cannot be attributed to participant confusion or rapid decisions.

Experiment 2: Numerical Judgment on a Nonnumerical Scale

Experimental Procedure.

Participants read a scenario about a foreign unit of measurement during a pencil-and-paper survey, and were asked to indicate their estimate of the length on a line. The stimuli for the low magnitude, unit non-salient condition is shown below.

Figure 2:

You are traveling in a small foreign country where people use different units of measurement than we do. For example, they use the unit, zq, to measure length and a typical match stick in this country is of three such units.

How long do you think a 3zq match stick is? Please indicate your guess by marking “|” on the line below.

Data Analysis.

The analysis reported in the paper is shown in Table 6.

Experiment 3: Unit Familiarity and Deliberation of Unit Familiarity as Moderators

Experimental Procedure.

Participants were asked questions about a hypothetical scenario as part of an online survey about unrelated topics. In the deliberation-primed version (3d) only, participants first rated their knowledge of units of measurement.

Figure 3:

For each of the following units of measurement, please indicate whether or not you know precisely how much that unit of measurement represents.

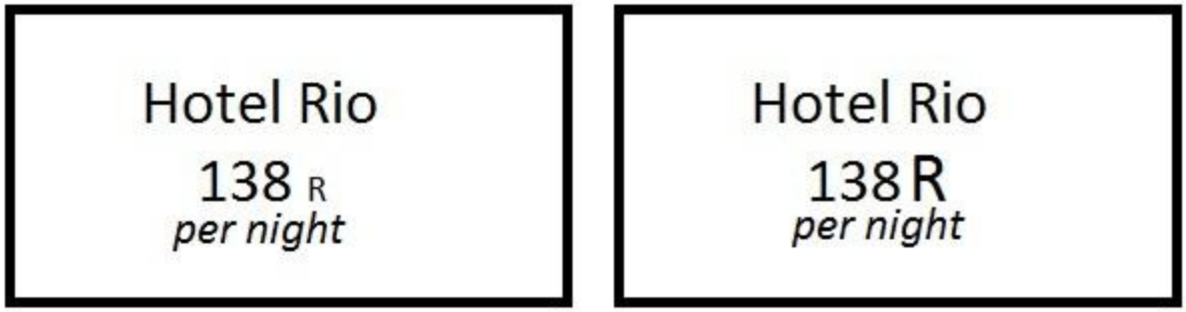
	Know it completely	Know it somewhat	Don't know it at all
An inch	❍	❍	❍
A kilogram	❍	❍	❍
One cup	❍	❍	❍
A cubit	❍	❍	❍
One pound	❍	❍	❍
One bushel	❍	❍	❍

All participants then read a scenario about seeing a price for a hotel room. In the unfamiliar unit versions (3a, 3c and 3d), participants read:

"**Imagine that you are going to Rio de Janeiro in Brazil for a trip. You see the ad below for a hotel there, with the price listed in the local currency.**"

They then saw an "ad" for the hotel. The stimuli for the small magnitude unit non-salient and unit-salient versions are shown below.

Figure 4:



In the familiar unit version (3b), participants read a similar scenario and were shown ads with a dollar sign ($) as the unit in place of "R" (after the number):

"Imagine that you are going to Rio de Janeiro in Brazil for a trip. You see the ad below for a hotel there, with the price listed in US currency."

In the deliberation-prompted version (3c) only, participants were then asked about the usefulness of the information on the following scale:

"Thinking of the ad you just saw, how useful was the pricing information it provided?

- **Very useful**
- **Somewhat useful**
- **Not at all useful"**

All participants were then asked to rate the price of a room in the hotel on the following scale:

"What do you think of the price of a room in this hotel?

- **Very low price**
- **Somewhat low price**
- **Moderate price**
- **Somewhat high price**
- **Very high price "**

Participants were also asked to type in the price they had seen earlier and to pick the price out of a list of possible prices.

Data Analysis.

The ANOVA results for the effect of the interaction between magnitude and unit salience on price judgment for Versions 3a through 3d are shown in Tables 7 to 10, respectively. Additional analyses comparing the results of Version 3a to Versions 3b to 3d are shown in Tables 11 to 13, respectively. We also computed a bootstrap difference-of-difference test to compare the sensitivity of participants' ratings to the magnitude in the Version 3a unit-nonsalient condition compared to in the combined data for Versions 3c and 3d. We generated 1000 sample data sets based on resampling with replacement, and calculated the difference-of-differences score in each one. Out of 1000 resamples, only 44 had a difference-of-difference score at or below zero (.044).

One potential concern is that when the unfamiliar unit was written in a small font, participants were less likely to notice it and instead thought incorrectly that the price was in dollars. If this were the case, then the results would be attributable to misunderstanding the unit, rather than deliberational blindness. We reran the interaction tests in each version, excluding those participants (17%) who were not able to correctly report back the unit they had seen (unprompted recall). We find a near-replication of our findings of an interaction between unit salience and magnitude in the deliberational blindness version (3a, p = .109, Table 14), and no interaction in the other versions (Tables 15-17, respectively). Some of the participants were also asked to identify the price information they had seen from a list (prompted recall). Among those who received the question and correctly identified the price they had seen, we find a marginally significant interaction in the deliberational blindness version (3a, p = .071, Table 18), but not in the other versions.

Another related concern is that our findings might be attributable to people having a very shallow baseline level of processing in the online survey setting. Specifically, trying to rapidly complete survey questions might foster deliberational blindness more so than in people's spontaneous decisions. If this were the case, we should find less evidence of deliberational blindness among those who took longer to answer the survey question. In a series of ANOVAs, we found no evidence that our findings were moderated by response time (Tables 19-22), and we therefore conclude that deliberational blindness is not simply a byproduct of rapid responding.

Experiment 4: The Unit-Salience Effect in a Multiattribute Judgment

Experimental Procedure.

Participants read a scenario about seeing a price for a hotel room in a paper-and-pencil survey.

"Imagine that you are going to Rio de Janeiro in Brazil for a trip. You see the listing below for a four-star hotel, with the price listed in the local currency:"

Each participant then saw one of the four possible stimuli. The stimuli for the two unit-salient versions are shown below.

Figure 5:

Participants were then asked to rate the value of the hotel room on the following scale:

"How good a <u>value for the money</u> do you think this hotel is?
- **___ Very good value; a great deal**
- **___ Good value**
- **___ Average value**
- **___ Poor value**
- **___ Very bad value; a terrible deal"**

Data Analysis.

The analysis reported in the paper is shown in Table 23.

Experiment 5: Deliberational Blindness Extends to Common Unfamiliar Units

Experimental Procedure.

Participants taking an online survey were told they would be answering questions about cars and were shown one of the four possible stimuli. The stimuls for the low-magnitude unit-non-salient condition is shown below.

Figure 6:

To begin, we would like to ask you a few questions about cars. Imagine that you were looking up information about a new car and wanted to know how powerful the engine was.

The specs read: **150 hp**

Participants then rated the power of the engine on the following scale:

"How powerful do you think the engine of this car is?
- ❍ **Very low powered engine**
- ❍ **Somewhat low-powered engine**
- ❍ **Average engine power**
- ❍ **Somewhat high-powered engine**
- ❍ **Very high-powered engine "**

Participants were then asked additional questions on separate screens, including the following:

"Think of the car you just read about. Assuming that it has fuel efficiency equal to that of the average car on the road, what do you think is the list price of this car when it is new?
- **Under $15K**
- **$15-25K**
- **$25-35K**
- **$35-45K**
- **$45-55K**
- **$55-85K**
- **More than $85K"**

"Think again of the car you just read about. Assuming that it has fuel efficiency equal to that of the average car on the road, what is the MOST that you personally would be willing to pay to buy a new model of this car?
- **Under $15K**
- **$15-25K**
- **$25-35K**
- **$35-45K**
- **$45-55K**
- **$55-85K**
- **More than $85K"**

"Do you recall the car power information that was presented a few screens ago? Please type in the complete information below."[Asked on a separate screen]

"Which of the following is the information that you saw?
- **150 hq**
- **150 pwr**
- **150 mw**
- **150 hp**
- **300 hq**
- **300 pwr**
- **300 mw**
- **300 hp**

"The car information you were given referred to "hp". What do you think "hp" stands for?"

"Thinking about cars, how much do you value specifically having a high-powered engine?

- **Higher engine power is not at all important to me**
- **Higher engine power is somewhat important to me**
- **Higher engine power is extremely important to me"**

Data Analysis.

The analyses reported in the paper are shown in Table 24 for judged power and Table 25 for car valuation.

We tested participants' failure to correctly recall or understand the information could explain the effect. Excluding those participants (8%) who failed to correctly report or identify the unit and numeric magnitude, or who did not know what the unit "hp" stood for, we replicate the significant interaction between unit salience and magnitude on judged power ($p < .05$, Table 26). We also tested several moderators and found no significant effect of log-transformed response time (Table 27) or Numeracy (Table 28). We found a marginally significant effect of Need For Cognition, such that those with higher NFC showed a weaker interaction (Table 29).

TABLES.

Table 1: Interaction of Amount by Unit Font Size on Log Bid (*Exp 1*)

Source	SS	Df	MS	F	*p*
Intercept	63.69	1	63.69	40.26	.000
Amount x Unit Font Size	7.94	1	7.94	5.02	.028
Amount	26.84	1	26.84	16.96	.000
Unit Font Size	0.36	1	0.36	0.23	.633
Error	126.57	80	1.58		

Table 2: Interaction of Amount by Unit Font Size on Log Bid, excluding four participants who correctly guessed the currency (*Exp 1*)

Source	SS	df	MS	F	*p*
Intercept	66.22	1	66.22	40.95	.000
Amount x Unit Font Size	6.35	1	6.35	3.93	.051
Amount	27.53	1	27.53	17.03	.000
Unit Font Size	0.86	1	0.86	0.53	.469
Error	122.89	76	1.62		

Table 3: Interaction of Amount by Unit Font Size by Rated Confusion on Log Bid (*Exp 1*)

Source	SS	df	MS	F	*p*
Intercept	0.00	1	0.00	0.00	.970
Amount x Unit Font Size	4.00	1	4.00	2.51	.117
Amount	3.47	1	3.47	2.17	.145
Unit Font Size	0.06	1	0.06	0.04	.848
Confused	3.21	1	3.21	2.01	.161
Unit Font Size x Confused	0.01	1	0.01	0.01	.930
Amount x Confused	0.58	1	0.58	0.36	.549
Amount x Unit Font Size x Confused	2.14	1	2.14	1.34	.251
Error	121.33	76	1.60		

Table 4: Interaction of Amount by Unit Font Size by Response Time on Log Bid (*Exp 1*)

Source	SS	df	MS	F	*p*
Intercept	26.70	1	26.70	19.74	.000
Amount x Unit Font Size	0.66	1	0.66	0.49	.488
Amount	9.08	1	9.08	6.71	.012
Unit Font Size	1.14	1	1.14	0.84	.362
Response Time	4.79	1	4.79	3.54	.064
Unit Font Size x Response Time	1.06	1	1.06	0.78	.379
Amount x Response Time	1.20	1	1.20	0.89	.350
Amount x Unit Font Size x Response Time	0.36	1	0.36	0.27	.607
Error	94.71	70	1.35		

Note: Response time was not recorded for 6 participants.

Table 5: Interaction of Amount by Unit Font Size by Log-transformed Response Time on Log Bid (*Exp 1*)

Source	SS	df	MS	F	*P*
Intercept	6.17	1	6.17	4.47	.038
Amount x Unit Font Size	0.01	1	0.01	0.01	.936
Amount	1.16	1	1.16	0.84	.363
Unit Font Size	1.65	1	1.65	1.19	.279
Response Time	4.41	1	4.41	3.19	.078
Unit Font Size x Response Time	1.60	1	1.60	1.16	.285
Amount x Response Time	0.69	1	0.69	0.50	.484
Amount x Unit Font Size x Response Time	0.00	1	0.00	0.00	.959
Error	96.67	70	1.38		

Note: Response time was not recorded for 6 participants.

Table 6: Interaction of Magnitude by Unit Salience on Estimated Length (in cm, *Exp 2*)

Source	SS	df	MS	F	*P*
Intercept	361311.79	1	361311.79	528.91	.000
Magnitude x Unit Salient	12114.85	1	12114.85	17.73	.000
Magnitude	17214.06	1	17214.06	25.20	.000
Unit Salient	3211.95	1	3211.95	4.70	.033
Error	68312.62	100	683.13		

Table 7: Interaction of Magnitude by Unit Salience on Price Judgment (*Exp 3a*)

Source	SS	df	MS	F	*p*
Intercept	1806.83	1	1806.83	3307.67	.000
Magnitude x Unit Salient	2.88	1	2.88	5.27	.023
Magnitude	3.20	1	3.20	5.86	.016
Unit Salient	0.00	1	0.00	0.00	.950
Error	102.70	188	0.55		

Table 8: Interaction of Magnitude by Unit Salience on Price Judgment (*Exp 3b*)

Source	SS	df	MS	F	*p*
Intercept	2810.61	1	2810.61	3952.06	.000
Magnitude x Unit Salient	0.05	1	0.05	0.07	.789
Magnitude	67.43	1	67.43	94.81	.000
Unit Salient	0.01	1	0.01	0.02	.888
Error	134.41	189	0.71		

Table 9: Interaction of Magnitude by Unit Salience on Price Judgment (*Exp 3c*)

Source	SS	df	MS	F	*p*
Intercept	1795.62	1	1795.62	5761.18	.000
Magnitude x Unit Salient	0.15	1	0.15	0.49	.484
Magnitude	2.64	1	2.64	8.49	.004
Unit Salient	0.29	1	0.29	0.93	.336
Error	57.66	185	0.31		

Table 10: Interaction of Magnitude by Unit Salience on Price Judgment (*Exp 3d*)

Source	SS	df	MS	F	*p*
Intercept	1663.00	1	1663.00	4074.54	.000
Magnitude x Unit Salient	0.21	1	0.21	0.52	.472
Magnitude	3.55	1	3.55	8.71	.004
Unit Salient	0.00	1	0.00	0.00	.974
Error	75.92	186	0.41		

Table 11: Interaction of Magnitude by Unit Salience by Currency Familiarity on Price Judgment (*Exp 3a vs. 3b*)

Source	SS	df	MS	F	*p*
Intercept	4561.41	1	4561.41	7252.60	.000
Magnitude x Unit Salience	1.08	1	1.08	1.72	.190
Magnitude	49.95	1	49.95	79.42	.000
Unit Salience	0.01	1	0.01	0.02	.883
Currency Familiarity	54.40	1	54.40	86.49	.000
Unit Salience x Currency Familiarity	0.00	1	0.00	0.00	.949
Magnitude x Currency Familiarity	20.57	1	20.57	32.71	.000
Magnitude x Unit Salience x Familiarity	1.85	1	1.85	2.94	.087
Error	237.11	377	0.63		

Table 12: Interaction of Magnitude by Unit Salience by Deliberation Prompt on Price Judgment (*Exp 3a vs. 3c*)

Source	SS	df	MS	F	*p*
Intercept	3602.35	1	3602.35	8379.33	.000
Magnitude x Unit Salience	0.84	1	0.84	1.95	.163
Magnitude	5.83	1	5.83	13.56	.000
Unit Salience	0.17	1	0.17	0.40	.527
Deliberation Prime	0.02	1	0.02	0.05	.824
Unit Salience x Deliberation Prime	0.12	1	0.12	0.28	.595
Magnitude x Deliberation Prime	0.01	1	0.01	0.03	.872
Magnitude x Unit Salience x Prime	2.17	1	2.17	5.05	.025
Error	160.36	373	0.43		

Table 13: Interaction of Magnitude by Unit Salience by Deliberation Prime on Price Judgment (*Exp 3a vs. 3d*)

Source	SS	df	MS	F	*p*
Intercept	3468.03	1	3468.03	7261.84	.000
Magnitude x Unit Salience	0.76	1	0.76	1.59	.209
Magnitude	6.75	1	6.75	14.14	.000
Unit Salience	0.00	1	0.00	0.00	.979
Deliberation Prompt	1.21	1	1.21	2.53	.113
Unit Salience x Deliberation Prompt	0.00	1	0.00	0.00	.945
Magnitude x Deliberation Prompt	0.01	1	0.01	0.01	.916
Magnitude x Unit Salience x Prompt	2.32	1	2.32	4.86	.028
Error	178.61	374	0.48		

Table 14: Interaction of Magnitude by Unit Salience on Price Judgment, excluding participants who failed *unprompted* recall of the price information (*Exp 3a*)

Source	SS	df	MS	F	*P*
Intercept	1504.00	1	1504.00	2997.48	.000
Magnitude x Unit Salient	1.30	1	1.30	2.60	.109
Magnitude	2.11	1	2.11	4.21	.042
Unit Salient	0.25	1	0.25	0.50	.479
Error	80.28	160	0.50		

Table 15: Interaction of Magnitude by Unit Salience on Price Judgment, excluding participants who failed *unprompted* recall of the price information (*Exp 3b*)

Source	SS	df	MS	F	*p*
Intercept	2069.83	1	2069.83	2959.01	.000
Magnitude x Unit Salient	0.66	1	0.66	0.94	.333
Magnitude	50.39	1	50.39	72.03	.000
Unit Salient	0.39	1	0.39	0.56	.455
Error	97.93	140	0.70		

Table 16: Interaction of Magnitude by Unit Salience on Price Judgment, excluding participants who failed *unprompted* recall of the price information (*Exp 3c*)

Source	SS	df	MS	F	*p*
Intercept	1467.13	1	1467.13	3422.15	.000
Magnitude x Unit Salient	0.18	1	0.18	0.42	.520
Magnitude	2.98	1	2.98	6.95	.009
Unit Salient	0.07	1	0.07	0.16	.692
Error	71.17	166	0.43		

Table 17: Interaction of Magnitude by Unit Salience on Price Judgment, excluding participants who failed *unprompted* recall of the price information (*Exp 3d*)

Source	SS	df	MS	F	*P*
Intercept	1339.09	1	1339.09	3218.06	.000
Magnitude x Unit Salient	0.00	1	0.00	0.00	.972
Magnitude	3.22	1	3.22	7.74	.006
Unit Salient	0.00	1	0.00	0.00	.972
Error	60.75	146	0.42		

Table 18: Interaction of Magnitude by Unit Salience on Price Judgment, excluding participants who failed *prompted* recall of the price information (*Exp 3a*)

Source	SS	df	MS	F	*p*
Intercept	1341.71	1	1341.71	2747.57	.000
Magnitude x Unit Salient	1.61	1	1.61	3.30	.071
Magnitude	1.12	1	1.12	2.29	.132
Unit Salient	0.05	1	0.05	0.09	.761
Error	68.37	140	0.49		

Note: A subset of respondents (13%) were not asked the prompted recall question.

Table 19: Interaction of Magnitude by Unit Salience by Log-transformed Response Time on Price Judgment (*Exp 3a*)

Source	SS	df	MS	F	*P*
Intercept	298.78	1	298.78	536.18	.000
Magnitude x Unit Salience	0.25	1	0.25	0.45	.502
Magnitude	1.23	1	1.23	2.21	.139
Unit Salience	0.12	1	0.12	0.21	.644
Response Time	0.41	1	0.41	0.74	.392
Magnitude x Response Time	0.12	1	0.12	0.22	.639
Unit Salience x Response Time	0.13	1	0.13	0.23	.629
Magnitude x Unit Salience x Response Time	0.04	1	0.04	0.07	.790
Error	101.97	183	0.56		

Note: Response time was not recorded for 1 participant.

Table 20: Interaction of Magnitude by Unit Salience by Log-transformed Response Time on Price Judgment (*Exp 3b*)

Source	SS	df	MS	F	*P*
Intercept	563.06	1	563.06	810.20	.000
Magnitude x Unit Salience	0.00	1	0.00	0.01	.937
Magnitude	18.44	1	18.44	26.54	.000
Unit Salience	0.08	1	0.08	0.11	.740
Response Time	5.33	1	5.33	7.67	.006
Magnitude x Response Time	0.14	1	0.14	0.21	.651
Unit Salience x Response Time	0.08	1	0.08	0.11	.739
Magnitude x Unit Salience x Response Time	0.08	1	0.08	0.11	.743
Error	128.57	185	0.70		

Table 21: Interaction of Magnitude by Unit Salience by Log-transformed Response Time on Price Judgment (*Exp 3c*)

Source	SS	df	MS	F	*P*
Intercept	550.17	1	550.17	1752.95	.000
Magnitude x Unit Salience	0.13	1	0.13	0.42	.519
Magnitude	0.39	1	0.39	1.23	.269
Unit Salience	0.01	1	0.01	0.04	.842
Response Time	0.03	1	0.03	0.11	.746
Magnitude x Response Time	0.16	1	0.16	0.51	.475
Unit Salience x Response Time	0.18	1	0.18	0.57	.452
Magnitude x Unit Salience x Response Time	0.01	1	0.01	0.04	.843
Error	56.18	179	0.31		

Note: Response time was not recorded for 2 participants.

Table 22: Interaction of Magnitude by Unit Salience by Log-transformed Response Time on Price Judgment (*Exp 3d*)

Source	SS	df	MS	F	*P*
Intercept	34.38	1	34.38	85.04	.000
Magnitude x Unit Salience	0.71	1	0.71	1.75	.188
Magnitude	0.17	1	0.17	0.41	.521
Unit Salience	1.07	1	1.07	2.64	.106
Response Time	0.89	1	0.89	2.21	.139
Magnitude x Response Time	0.01	1	0.01	0.01	.914
Unit Salience x Response Time	1.16	1	1.16	2.87	.092
Magnitude x Unit Salience x Response Time	0.60	1	0.60	1.47	.226
Error	73.59	182	0.40		

Table 23: Interaction of Magnitude by Unit Salience on Price Judgment (*Exp 4*)

Source	SS	df	MS	F	*P*
Intercept	1239.63	1	1239.63	2251.59	.000
Magnitude x Unit Salient	3.20	1	3.20	5.82	.018
Magnitude	2.16	1	2.16	3.93	.050
Unit Salient	0.00	1	0.00	0.00	.985
Error	57.81	105	0.55		

Table 24: Interaction of Magnitude by Unit Salience on Judged Power (*Exp 5*)

Source	SS	df	MS	F	*P*
Intercept	1025.50	1	1025.50	1190.96	.000
Magnitude x Unit Salient	3.77	1	3.77	4.38	.039
Magnitude	15.60	1	15.60	18.11	.000
Unit Salient	1.13	1	1.13	1.31	.255
Error	96.44	112	0.86		

Table 25: Interaction of Magnitude by Unit Salience by Power Importance on Own Valuation, controlling for estimated list price (*Exp 5*)

Source	SS	df	MS	F	*P*
Intercept	47.16	1	47.16	1.33	.251
Magnitude x Unit Salience	273.58	1	273.58	7.73	.006
Magnitude	19.45	1	19.45	0.55	.460
Unit Salience	2.08	1	2.08	0.06	.809
Power Importance	52.06	1	52.06	1.47	.228
Magnitude x Power Importance	32.98	1	32.98	0.93	.336
Unit Salience x Power Importance	0.72	1	0.72	0.02	.887
Magnitude x Unit Salience x Importance	343.60	1	343.60	9.71	.002
Estimated List Price	6581.98	1	6581.98	186.05	.000
Error	3785.47	107	35.38		

Table 26: Interaction of Magnitude by Unit Salience on Judged Power, excluding participants who failed to recall the unit or magnitude or did not know what *hp* stood for (*Exp 5*)

Source	SS	df	MS	F	*p*
Intercept	939.87	1	939.87	1065.96	.000
Magnitude x Unit Salient	4.19	1	4.19	4.75	.032
Magnitude	14.61	1	14.61	16.57	.000
Unit Salient	0.59	1	0.59	0.67	.415
Error	90.82	103	0.88		

Table 27: Interaction of Magnitude by Unit Salience by Log-transformed Response Time on Judged Power (*Exp 5*)

Source	SS	df	MS	F	*p*
Intercept	38.65	1	38.65	46.32	.000
Magnitude x Unit Salience	2.47	1	2.47	2.96	.088
Magnitude	0.53	1	0.53	0.64	.427
Unit Salience	1.92	1	1.92	2.30	.132
Response Time	2.33	1	2.33	2.80	.097
Magnitude x Response Time	0.05	1	0.05	0.06	.813
Unit Salience x Response Time	2.92	1	2.92	3.50	.064
Magnitude x Unit Salience x Response Time	1.25	1	1.25	1.50	.223
Error	90.12	108	0.83		

Table 28: Interaction of Magnitude by Unit Salience by Numeracy on Judged Power (Exp 5)

Source	SS	df	MS	F	*p*
Intercept	119.25	1	119.25	134.73	.000
Magnitude x Unit Salience	1.46	1	1.46	1.65	.201
Magnitude	0.92	1	0.92	1.04	.310
Unit Salience	0.69	1	0.69	0.78	.378
Numeracy	0.00	1	0.00	0.00	.955
Magnitude x Numeracy	0.14	1	0.14	0.16	.691
Unit Salience x Numeracy	0.22	1	0.22	0.25	.620
Magnitude x Unit Salience x Numeracy	0.32	1	0.32	0.36	.552
Error	95.59	108	0.89		

Table 29: Interaction of Magnitude by Unit Salience by Need For Cognition (NFC) on Judged Power (*Exp 5*)

Source	SS	df	MS	F	*p*
Intercept	838.42	1	838.42	1028.54	.000
Magnitude x Unit Salience	5.71	1	5.71	7.01	.009
Magnitude	8.45	1	8.45	10.37	.002
Unit Salience	1.50	1	1.50	1.84	.178
NFC	0.32	1	0.32	0.40	.531
Magnitude x NFC	2.72	1	2.72	3.33	.071
Unit Salience x NFC	0.01	1	0.01	0.01	.927
Magnitude x Unit Salience x NFC	2.28	1	2.28	2.80	.097
Error	83.15	102	0.82		

Note: Six participants did not complete all the items in the NFC scale

SUPPLEMENTAL REFERENCES

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