Focusing on the Left Digit: an Encoding Or an Estimation Bias?
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This research investigates the mechanisms that underlie the left-digit effect. We argue against the biased encoding account and in favor of the rounding-up aversion account. Three studies demonstrate that consumers encode price endings, use them in their estimation strategy choices and become less averse to rounding-up in memory-based price comparisons.

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EXTENDED ABSTRACT.
This paper focuses on a well-documented and one of the most pervasive biases in numerical cognition known as the left-digit effect (Manning and Sprott 2009; Thomas and Morwitz 2005). While its robustness and implications have been demonstrated in a variety of contexts, the mechanisms that underlie the left-digit effect continue to be debated (Thomas and Morwitz 2009). It remains unclear whether the left-digit bias occurs due to biased encoding or due to incorrect choice of estimation strategies at the magnitude comparison stage. Some scholars have attributed this effect to consumers’ inattention to prices right digits’ during price encoding (e.g. Basu 2006; Stiving and Winer 1997). According to the biased encoding account the effect manifests itself because consumers do not pay attention to the right digits to minimize their cognitive effort during price encoding (e.g. Basu 2006; Stiving and Winer 1997); or because consumers, reading prices from left to right, remember left-most digits more vividly. However, the above account is not consistent with the findings in the numerical cognition domain which show that people automatically attend to right digits (e.g. Dehaene, et al. 1990; Nuerk et al., 2001). Given that, the left-digit bias should emerge at the stage of mental computations due to consumers’ aversion to round-up fractional prices. This research develops and tests the competing predictions that emerge from the biased encoding and the biased estimation accounts.

Rounding-Up Aversion Account
Rounding fractional prices to the closest whole dollar amounts (e.g. 2.99 to 3.00), in most cases, eliminates the left-digit effect. If instead consumers round the prices down (e.g. 2.99 to 2.00), they are likely to overestimate the difference between 2.99 and 4.00. Why are people reluctant to round-up numbers in multi-digit subtractions? Unlike the proponents of the biased encoding account who argue that the left-digit bias is caused by cognitive miserliness or left-to-right reading, we believe that aversion to round-up is caused by the motivation to preserve the integrity of multi-digit numbers.

According to our account, when performing magnitude comparisons consumers are intrinsically motivated to preserve prices’ magnitude and visual representations intact (Dehaene 1992). Rounding-up a number, compared to rounding-down, inevitably reduces the perceived symbolic similarity between the original number and the rounded number. For example, 2.75 seems more visually similar to 2.00 than to 3.00. The rounding-up aversion account suggests that the left-digit effect is more likely for stimulus-based than for memory-based price comparisons, since the former make visual similarity between actual and rounded prices more accessible (Zhang and Wang 2005). In contrast, the biased encoding account suggests that memory-based comparisons, being more cognitively demanding (e.g. Lynch and Srull, 1982), should make the left-digit bias more likely.

Further, to preserve the price magnitude information consumers’ should be more willing to round prices’ that are close to whole dollar amounts in magnitude. Thus, the rounding-up aversion account predicts that the left-digit bias is more likely to manifest for 2.75 (less “roundable”) than for 2.99 (more “roundable”). The biased encoding account, in contrast, predicts that roundability has no effect on the left-digit bias. The account suggests that boundedly rational consumers only encode prices’ left-most digits or are more likely to memorize them (Bizer and Schindler 2000; Coulter 2001), irrespective of prices’ right digits. Three studies provide support to the predictions of the rounding-up aversion account.

Study 1
To test the effect of price roundability on the left-digit bias we asked participants to evaluate the magnitude of the difference between regular and sale prices and to report which computational strategy they had used for each price pair. Regular and sale prices were manipulated on two key dimensions: left-digit difference between regular and sale prices (misleading vs. control) and price roundability. The study employed a 2 (left-digit difference: misleading vs. control) x 2 (roundability: high vs. low) x 3 (numerical distance: small vs. medium vs. large) within-subjects design (n = 99). The results suggest that the left-digit effect is reduced for prices high in roundability. The analysis of retrospective strategy reports shows that people are more likely to use rounding-up for prices high in roundability.

Study 2
This study tested the prediction of the rounding-up aversion account that memory-based processing makes people more likely to round up fractional prices and thus reduces the left-digit effect. The study employed a 2 (evaluation mode: stimulus-based vs. memory-based) x 2 (left-digit difference) x 6 (numeric difference) mixed factorial design, with price difference evaluation mode as the only between-subjects factor (n=120). Half of the participants made memory-based evaluations of differences between regular and sale prices while the other half made stimulus-based evaluations. Consistent with our predictions, the effect of left-digit difference was larger under stimulus-based processing than under memory-based processing.

Study 3
Just as people are motivated to preserve the integrity visual representations of prices, they are motivated to preserve the price magnitude information. We predict that the effect of memory-based processing will not manifest for prices low in roundability. Magnitude representations should become more salient under memory-based processing when visual symbolic representations are no longer available. Since rounding is likely to distort magnitude representations, memory-based processing should not induce rounding for prices low in roundability. The study employed a 2 (evaluation mode) x 2 (left-digit difference) x 2 (roundability) x 3 (numeric difference) mixed factorial design (n=99). The effect of processing mode was replicated for prices high in roundability: memory-based processing significantly reduced the left-digit bias for prices high in roundability. No effect of processing mode was observed for prices low in roundability.

General Discussion
Three studies provide evidence against the biased encoding account of the left-digit effect (Basu 2006; Schindler and Kirby 1997) and find support for the rounding-up aversion account. Study 1 shows that when prices get closer to whole dollar amounts the left-digit effect is reduced. Study 2 identifies memory-based processing as a mitigating factor reducing the left-digit effect, and study 3 identifies roundability as a moderator of the effect of memory-based processing.
REFERENCES