

*Full Length Research Paper*

# Effect of font size and appearance in left-digit price cognition

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Research has indicated that changes in price endings can result in left digit effects (\$3.99 vs. \$4.00). In this study, we report on the effects of price font size and appeared model on a nine-ending price where the leftmost digit is changed. Cognition of comparative price can be magnified or weakened depending on such factors. First, when the same font size is used for the price or the size-value congruency conditions are the same, the magnitude of price difference between the target and standard prices will be perceived as larger when the leftmost digit of a 9-ending price is changed (for example, \$299 versus \$300). Enlarging the price font size causes the perceived magnitude of the size-value incongruence of the left-digit effect in nine-ending prices to diminish. Second, when the price appears vertically it will facilitate the comparison of two prices and diminish the perceived magnitude of difference in price in comparison between the regular price and the sale price.

**Key words:** Left-digit effect, 9-ending price, font size, vertical appeared model.

## INTRODUCTION

The issue of price cognition has always been of great concern. Both theory and practice suggest that the processing of price information by the consumer typically includes both conscious and non-conscious processes (Monroe and Lee, 1999). Consumers do not always process comparative price information in a conscious, deliberate, and rational manner. Furthermore, non-conscious processes may have a greater influence on price and value assessments (Dehaene et al., 1993; Dehaene and Mehler, 1992). In comparative advertisement peripheral elements, such as color or layout, could influence price perceptions (Babin et al., 2003; Coulter, 2003).

A number of studies have been carried out probing the effects of nine ending numbers on magnitude of price perceptions (Schindler, 2001; Thomas and Morwitz, 2005; Manning and Sprout, 2009). Thus, one can often observe on advertisements that the rightmost digit of a retail price is nine. It has recently been found that left-digit prices

affect magnitude of perceptions.

It has been suggested that changes in price endings that change the leftmost digit, even when the two prices differ by only 1 cent (for example, 3.99 and \$4.00), can increase the perceived distance between the two prices being compared. In other words, the nine-ending prices are perceived to be smaller than a price that is one cent higher if the leftmost digit changes (for example, \$ 2.99 versus \$3.00), but not if it remains unchanged (Thomas and Morwitz, 2005). Based on these findings, this study further discusses the left-digit effect on price magnitude perception by removing cognitive biases. We design two experiments to examine the effects of physical display of digits with differences in font size and appeared position to probe their effects on a 9-ending price that results in a left digit change. How these factors affect (facilitating or diminishing) perceived magnitude in a comparative price context is probed. The appearance should make an important contribution to the processing of price information.

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**Abbreviations:** SNARC, Spatial Numerical Association of Response Codes; USB, universal serial bus.

## CONCEPTUAL FRAMEWORK

### Left digit effect

The left digit effect refers when a nine ending versus a

zero ending is used (for example, \$2.99 versus \$3.00), and the leftmost digit changes (that is, the leftmost digit changes from two to three) and that it is this change in the left digit rather than the one cent drop that has an impact on the consumer's perception of the magnitude of the price. Recent research has suggested that the left-digit effect is perceived to be larger when the leftmost digits of the prices differ (for example, \$2.99 versus \$3.00) than equal (for example, \$2.59 versus 2.60). The closer the two prices that are being compared, the more likely will the left-digit effect be to affect perception (Thomas and Morwitz, 2005). Furthermore, when multi-digit numbers are encoded holistically as one analog representation (Hinrichs et al., 1981; Monroe and Lee, 1999), these digits are represented as one analog quantity on the internal scale and this affects the magnitude perception. According prior studies, under specific conditions, the leftmost digit can exert a relatively greater influence than the other digits on the magnitude perception between the target and standard price. Following the approach suggested by Thomas and Morwitz (2005), we examine the effects associated with such leftmost digits in three digit integers using Taiwan material.

### Font size

Research has demonstrated the "size congruency effect" (Dehaene, 1989). Meaning that when participants attempt to judge the larger of two numbers, response time is shorter when the larger of the compared numerals is presented in larger font size and vice versa. Conversely, participants take a longer response times if the larger of the two numbers is presented in smaller font size. Numerical font magnitude and numerical value magnitude are closely related, while in cases of value and size incongruence interference occurs (Dehaene and Mehler, 1992). When there is congruency between the font magnitude and numerical value, reinforcement will occur. The positive effects of reinforcement increase the consumer's ability to reliably distinguish between numbers (Coulter and Coulter, 2005). We argue that numerical size-value congruency will increase the perceived difference of price comparisons. The reinforcement of font size perceptions makes it easier and thus faster to distinguish the largeness of the higher standard price relative to the smaller target price. The perceived distance between two prices is increased due to the left-digit effect meaning that a nine-ending price causing a leftmost digit change (for example, NT\$299 versus NT\$300) is more likely to affect the price's magnitude perception difference when comparing the two prices. Conversely, if the font size of the lower target price is larger font than the font size of the numerically larger standard price, this interferes with the processing of the numbers, leading to the discount being perceived as smaller. Hence, we argue that this size-value

incongruence will diminish perceived difference in magnitude in two price comparison. According to prior relative research of the left-digit effect and price font size:

H1a: A change in the leftmost digit of the target price to a lower level in nine-ending prices (for example, NT\$300 versus NT\$299) will increase the perceived magnitude of the difference in comparison to the standard price than if the leftmost digit remains unchanged (for example, NT\$370 versus NT\$369).

H1b: Perceived differences in magnitude are less (more) likely to be affected by nine-ending prices when the leftmost digit is changed and there is numeric size-value incongruence (for example, \$300 vs. \$299) as opposed to congruence (for example, \$300 versus \$299).

### Physical distance effect

The spacing or physical distance between two prices is also expected to have an impact (either through interference or reinforcement) on perceived numerical difference. Studies of numerical cognition have demonstrated the existence of a size congruency effect. The physical distance should have an effect similar to physical size (Dehaene, 1989). In a comparison of two prices it appears that position has an effect. Research findings have suggested that when the left hand price is relatively smaller in size the response is faster than when the relatively smaller price is on the right. Therefore when the relatively larger numbers are on the right the response is faster than when on the left. The association between number and spacing has been termed the spatial numerical association of response codes (SNARC) (Dehaene, 1992). Related research has revealed that the introspective number lines of participants frequently showed a predominant left-to-right orientation. To test this, in Experiment 1, the smaller target price appears to the left of the standard price.

In addition, past findings also indicated that the response times are not significantly shorter when the smaller number appears on the left rather than on the right (Coulter and Norberg, 2009). Accordingly, in line with general practices in Taiwan, the positions of the regular and sale price adopted mean that the larger price appears to the left of the smaller price as in Experiment 2. Increasing the physical distance between two prices aids participants to discriminate numeric differences. In other word, such a strategy should help consumers discriminate price differences. More specifically, the encoding of a magnitude representation and the distance dimension should facilitate price comparisons. Coulter and Norberg (2009) have suggested that a greater horizontal distance between two prices leads to greater difference perception, but not if those two prices are separated by large vertical distances. Due to the fact that formulas for addition and subtraction formulas are usually displayed vertically in mathematics, it should be easier for

Table 1. Stimuli used in experiment 1.

Price font size	Same		Target price displayed diploid		Standard price displayed diploid	
	Nine-ending conditions	Zero-ending conditions	Nine-ending conditions	Zero-ending conditions	Nine-ending conditions	Zero-ending conditions
<b>Pair 1. General USB flash drive (nine-ending target price has a lower left digit)</b>						
Target price (Alion)	299	300	299	300	299	300
Standard price (See power)	400	400	400	400	400	400
<b>Pair 2. Pen model USB flash drive (nine-ending target price has the same left digit)</b>						
Target price (Alion)	369	370	369	370	369	370
Standard price (See power)	400	400	400	400	400	400

participants to distinguish between prices when they are displayed vertically rather than horizontally. Hence, we suggest that a vertical price display model should have an effect similar to the interference effect of incongruence in physical font size. The separation of two prices by a vertical distance rather than appearing horizontally should facilitate price comparisons, and should weaken the effect of a left-digit change in a nine-ending price. Accordingly, we propose that the perceived difference in magnitude of a nine-ending price with a change in the leftmost digit (for example, NT\$299 vs. NT\$300) will be less when the two compared prices are displayed vertical rather than horizontally. Thus: H2: A nine-ending price caused by leftmost-digit change is less likely to affect the price’s magnitude perception difference when the prices being compared appear vertically rather than horizontally.

**METHODOLOGY**

**Experiment 1**

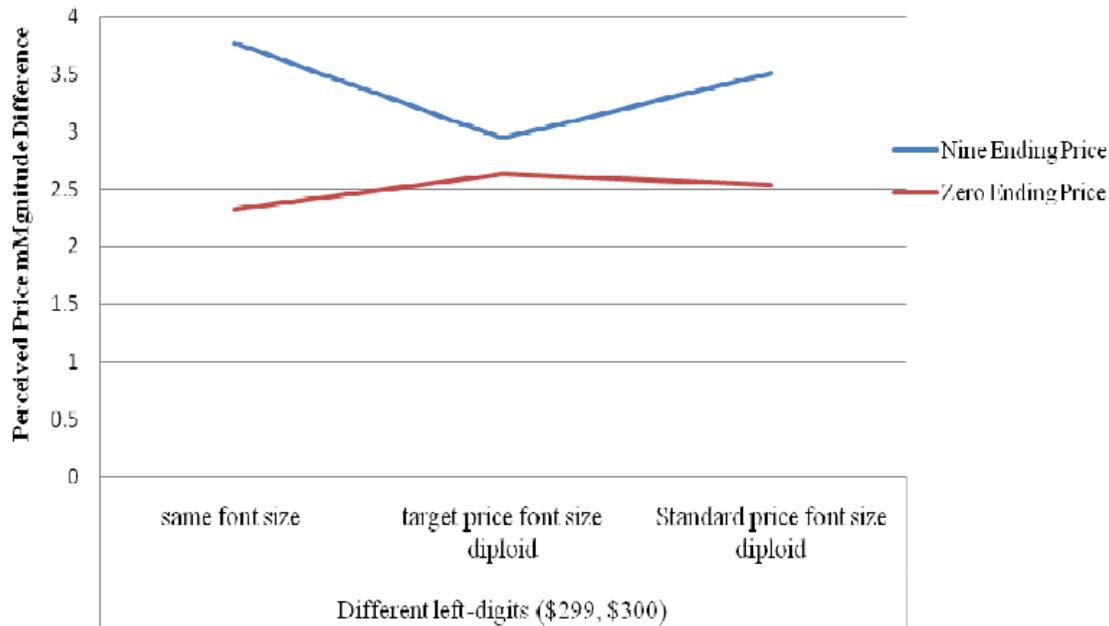
A total of 180 undergraduate students from a major

northern university in Taiwan participated in Experiment 1. Participants, who received a gift of chocolate for participating, were randomly assigned to groups with different conditions: 2 (price endings: nine versus zero) x 3 (font size of regular and sales price: same versus. target price was displayed as double the standard price in size (size-value incongruence) versus standard price was displayed as double in size the target price (size-value congruence) between subjects. The stimuli for this study were the prices of the Universal Serial Bus (USB) flash drives. Each participant saw prices for four USB flash drives in two different categories: two general USB flash drives and then two pen-model USB flash drives. In each category, one product was the target USB flash drive and the other was the comparison standard. The endings for the target USB flash drive price were manipulated to two different levels (zero or nine). Part of the participants saw target prices that ended in the digit nine (NT\$299 and NT\$369) and the others in the digit zero (NT\$300 and NT\$370). The price of the target general USB flash drive was designed so that the price ended in a zero but with a higher hundred-digit (NT\$300 versus NT\$299). The pen-model USB flash drive price ending manipulation did not affect the hundred-digit (NT\$370 versus NT\$ 369). The dependent variable was the perceived difference in magnitude between the target price and the standard price being compared which was held constant (NT\$400) across all conditions. Thus in each condition, the participants saw four different prices (Table 1). In addition, the experiment

contained three different groups. For one group, the target and standard price were displayed in regular size, for another group, the font size of the target price was displayed double that of the standard price, and for the final group the font size of the standard price was double that of target price, that is size-value congruence conditions.

**Experiment 2**

Study 2 was similar to the previous experiments except for the following: first, the target advertisement was for a fictitious pizza brand (Jenbon). Participants were given information with advertisements for the promotion of seafood pizza. Product details included a headline, copy, size, selected material and sense of taste. The regular price and sales price of each pizza is written to the right of the illustration. Secondly, the target price and standard price were changed to the regular price and sales price to examine the effects on pizza promotion. Thirdly, a different price set was used to measure perceived difference in magnitude between the regular and sale price. The regular price was NT\$600 and sale price was NT\$499 across conditions with a 2x1 factorial design. Fourthly, the position of the regular and sales prices was manipulated between subjects using two different models (horizontal versus vertical). The distance between the regular and sales prices was the same (21 mm) for the two different



**Figure 1.** Perceived difference in magnitude between the target and standard prices (different left-digits).

conditions. Thus any affect associated with the distance of price placement was not expected to confound results.

### Procedure

In Experiment 1, participants were given information stating the purpose of the study and preliminary instructions offering a brief tutorial on the procedure of comparing two prices. Participants were told that they should compare Alion and See power (two fictitious brands) within each product category. The information contained advertisements for all four USB flash drive (first for the two brands of general USB flash drive and next for the two brands of pen model USB flash drive). The pictures and the color of the USB flash drives in each category and the descriptions were short and similar. Product details included brand name, model number, capacity, size, writing speed, reading speed, color and packaging. Each price was printed below the flash drive's illustration. The prices of the two brands of USB flash drive were displayed approximately 9 cm apart within the advertisement, with the target price appearing to the left of the standard price. With the exception of the elements of the target pen prices which were manipulated between conditions, all other information remained the same.

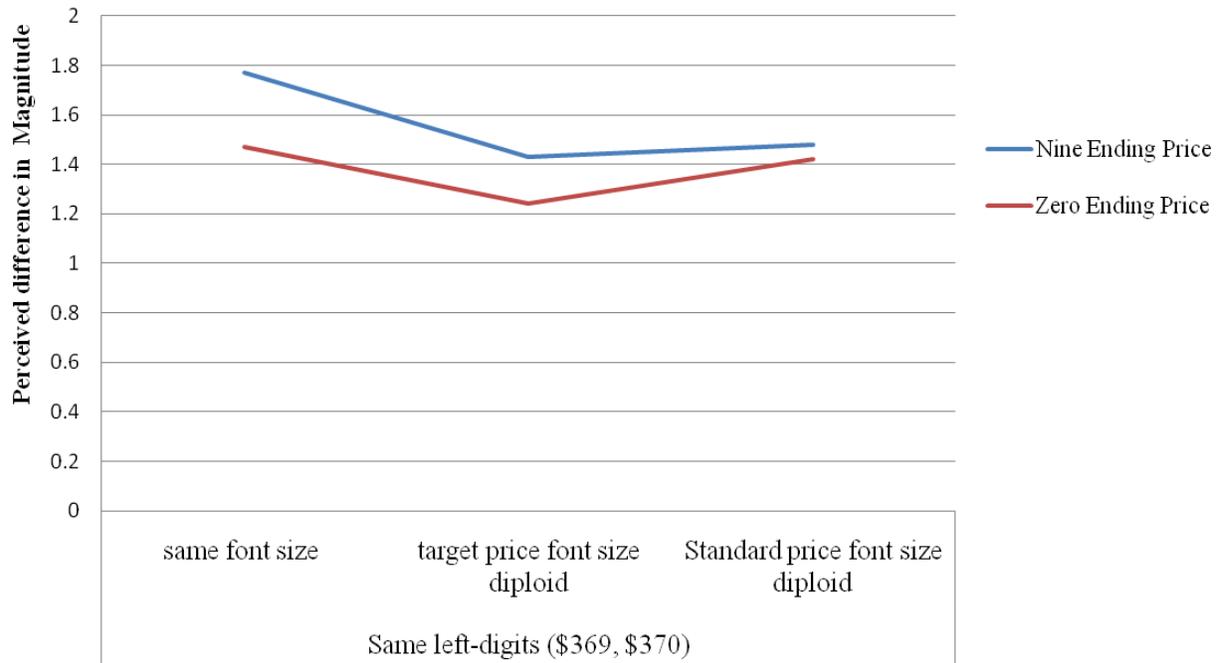
Participants were asked to compare two prices and indicate their relative magnitude perceptions by marking the location of the target or standard price on a 110 mm horizontal line. Then, for each brand, an "X" was placed on an uncalibrated 110 mm horizontal line anchored at low and high. The respondent's perceptions of the magnitude of the target and standard price were recorded by measuring the distance from the left end of the line to the "X" using a ruler calibrated in millimeters. Thus, the range of perceived price magnitude for each brand was from 0 to 110 mm. Perceived difference in magnitude was determined by subtraction from the respondents magnitude perception for target and standard prices. After completing the above procedure, participants were asked to rate the level of agreement of perceived difference between target price and standard price for font size. This was done using the 5 point scale ranging from 1 (strongly disagree) to 5 (strongly agree).

In experiment 2, Sixty-four undergraduate students from a northern university in Taiwan were randomly assigned to one of the subject conditions. Participants were told to compare the regular and sales price of the fictitious Jenbon brand of pizza. Thirty-one participants saw the horizontal display model for regular and sales prices and the others saw the vertical display model.

## RESULTS

### Experiment 1

Manipulation checking was conducted to verify that participants perceived there to be a significant difference between the font size of the target and standard prices. Pre-testing ( $n=54$ ) revealed a mean response of 3.74, which was significantly higher than the midpoint of the 5-point scale ( $t(53) = 6.39, p < 0.05$ ), indicating that manipulation was successful. The perceived difference in price magnitude between the target and standard USB flash drive prices was examined by a 3x2 mixed factorial ANOVA with different price font size levels (regular: same size vs. target price displayed diploid vs. standard price displayed diploid). The results indicate that there was significant price font size interaction for the group with different left-digits ( $F(2, 174) = 3.13, p < 0.05$ ; Figure 1), but this not found for the group with the same left-digits ( $F(2, 174) = 0.22, p > 0.05$ ; Figure 2). In the different left-digits group there was a significant main effect for the price ending condition found ( $F(1, 174) = 24.38, p < 0.05$ ), indicating that, as predicted, the difference in magnitude between the target and standard price of the nine-ending price (M9-ending=3.41) was perceived to be significantly larger in magnitude than for the condition with the zero-



**Figure 2.** Perceived difference in magnitude between the target and standard prices (same left-digits).

ending price (M0-ending=2.50), but this was not found to hold true for the same left-digit group ( $F(1, 174)=1.49, p>0.05$ ), which supports hypothesis 1a. There was no significant main effect for the font size condition ( $F(2, 174)=0.82, p>0.05$ );  $M_{\text{same}}=3.05, M_{\text{targetdiploid}}=2.79, M_{\text{standarddiploid}}=3.03$ ). We next conducted a comparison of different font size conditions.

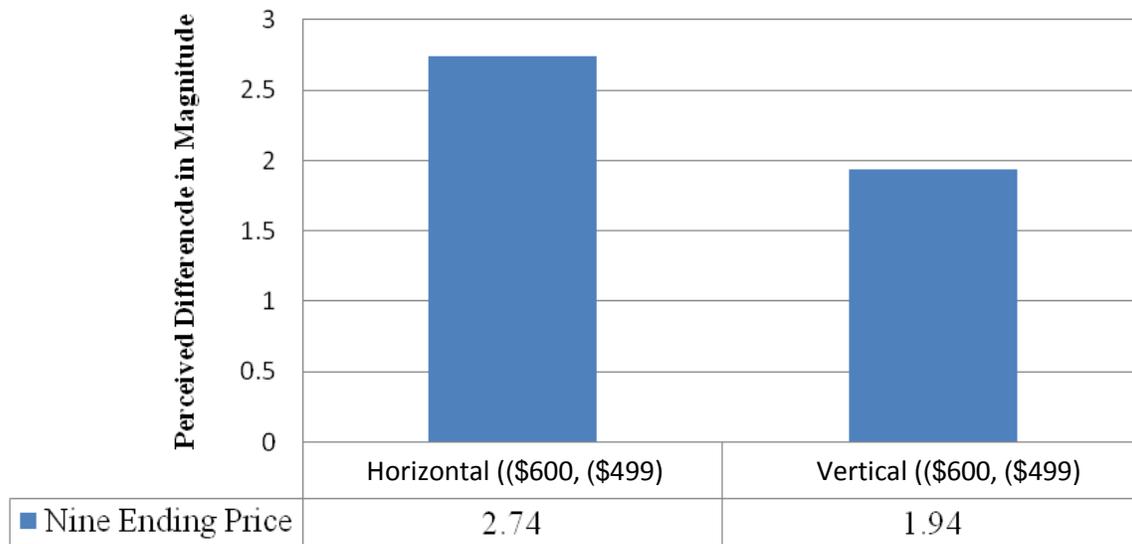
It can be found that for the group with different left-digits but the same target and standard price font size (size-value congruency between target and standard price conditions), the perceived difference in magnitude increased when the leftmost digit of the nine-ending price changed. This increased the difference in the perceived difference in magnitude between the zero and the nine-ending prices, supporting hypothesis 1b (Figure 1). For the same font size condition, the mean perceived difference in magnitude between the price of the target and standard USB flash drive was higher when the price had a nine versus a zero ending ( $F(1, 58)=19.16, p<0.05$ ; M0-ending= 2.33 vs. M9-ending=3.77;). Similarly, in the size-value congruency condition, the mean perceived difference in magnitude between target and standard USB flash drive price was also higher when the price had a nine versus a zero ending ( $F(1, 58)=11.53, p<0.05$ ; M0-ending= 2.54 vs. M9-ending=3.51).

Therefore, there was no significant size-value incongruency condition. The mean perceived difference in magnitude between the target and standard USB flash drive price was weaker when the price had a nine versus a zero ending ( $F(1,58)=.884, p>0.05$  ; M0-ending= 2.63 vs. M9-ending=2.95). As expected, the results support hypothesis 1b. The impact of nine-endings on perceived

price magnitude diminished when the target price was displayed larger than the standard price when the leftmost digit changed. With regard to the price font size conditions, H1b was supported. By reinforcing the font size, numeric size-value congruence or incongruence can reinforce or interfere with the 9-ending digit effect even when the leftmost digit changes. Emphasis on the target price should make it more difficult to distinguish the largeness of that price relative to standard price. Hence, size-value incongruence diminishes perceived difference in magnitude due to the left-digit effect in price cognition of two price comparison. In addition, in the same left-digit group, as predicted, there was no significant main effect for the prices ending condition found ( $F(1, 174)=1.49, p>0.05$ ; M9-ending=1.56, M0-ending=1.38), nor was there a significant main effect for price font size ( $F(2, 174)=0.22, p>0.05$ );  $M_{\text{same}}=1.62, M_{\text{targetdiploid}}=1.33, M_{\text{standarddiploid}}=1.45$ ).

### Experiment 2

To test this hypothesis, we utilized the t-test. The results indicate that the horizontal model for display of the nine-ending price caused a greater perceived difference in magnitude between the regular and sales price than did the vertical display, supporting hypothesis 2. When the prices appear horizontally, the mean perceived difference in magnitude between the regular and sales price is greater than when the prices appear vertically ( $M_h=2.74$  vs.  $M_v=1.94$ ;  $t(62)=2.79, p<0.05$  ; Figure 3). As expected, the vertical display of nine-ending prices (\$499 vs. \$600)



**Figure 3.** Perceived difference in magnitude between the regular and sale prices.

will facilitate price comparisons and diminish the perceived difference in magnitude between the regular and sale prices.

## DISCUSSION

This study discusses factors which will strengthen or diminish the perceived difference in magnitude between two prices due to the left-digit effect in price cognition. We extend the study of 9-ending prices, where changes in the leftmost digit (NT\$300 versus NT\$299) are perceived to cause a larger difference than when the same leftmost digit remains the same (NT\$370 versus NT\$369) into the unconscious realm as a result of biases. In experiment 1, two prices are shown in the same font size (size-value congruency conditions). The perceived difference in magnitude between target and standard prices will be larger when the leftmost digit of a 9-ending price changes (NT\$299 versus NT\$300). Enlarging the price font size caused a size-value incongruence which reduced the magnitude of the left-digit effect making it less likely to occur. Numeric size-value congruence or incongruence had an impact on perceived distance between two prices, but participants were unaware of the specific manipulations made affecting their perception during price cognition. Furthermore, the results of experiment 2 indicate that the vertical display of regular and sale prices diminished the perceived difference in magnitude caused by the left-digit effect in nine-ending prices.

In marketing, the physical price font size is frequently manipulated to catch the consumers' attention (Olsen, 1995). In this study, we found that size-value congruency and incongruency may have different implications for price difference cognition. Enlarging the physical font size

of the larger standard price is more likely to increase the perceived difference in a comparison involving the left-digit effect in nine-ending prices. In other words, increasing the font size of the smaller target price in order to attract the consumer's attention may not be the best marketing strategy to strengthen perceived differences in price comparison. The second important finding is that it may be better to display the regular and sale price horizontally. This is a better strategic option to strengthen consumer perception of a larger distance between two prices than when displayed vertically.

In future we plan to assess the potential perceived difference made by such left-digit effects in a variety of contexts and examine the potential moderating role of perceived distance between the two prices being compared, such as for situational factors (For example, temporal distance and shopping goals) and product attributes (For example, hedonic versus utilitarian products), and how these may moderate the left-digit effect in price cognition. In addition, a related question is whether using a broader range of number combination or more digits can influence that perceived magnitude of the number. These interesting questions and many other worthwhile areas wait future study efforts.

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