A Reexamination of Frequency-Depth Effects in Consumer Price Judgments

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Previous research has shown that when there are multiple possible prices for two brands, the brand that is discounted frequently but at shallow levels is perceived to have a lower average price than the brand that is discounted infrequently but at deeper levels (the "frequency effect"). However, when there are only two possible prices for each brand, the brand discounted infrequently but at deeper levels is perceived to have a lower average price (the "depth effect"). Over a series of experiments, we demonstrate that these frequency and depth effects do not generalize to other temporal price distributions.

Pricing research has demonstrated that price perceptions are subjective and that the context in which prices are perceived influences consumers' pricing judgments. One recent finding suggests that, depending on the underlying temporal distribution of the prices of competing brands, the frequency and magnitude of discounts may have different effects on consumers' price perceptions (Alba et al. 1994, 1999).

FREQUENCY VERSUS MAGNITUDE EFFECTS

One question facing managers who have decided to promote a product periodically is whether to offer frequent and shallow or infrequent and deep discounts. Previous research does not offer clear insights on the superiority of one tactic over the other. For example, it has been shown that frequent but modest discounts lead to perceptions of greater value and higher rates of purchase than do less frequent but deeper discounts (Buyukkurt 1986). It has also been reported that a temporal price distribution characterized by deep discounts results in higher overall sales than does a price distribution characterized by shallow discounts (Meyer and Assuncao 1990). Moreover, other research suggests that perceived promotion frequency is inversely related to the price consumers are willing to pay (Krishna 1991).

Contrasting the frequency and magnitude effects with each other, Alba et al. (1999) presented participants the prices of two competing brands of shampoo over simulated multiple months. For any trial (month), each brand was offered at either its regular price or a discounted price. The frequency brand was discounted more frequently but at shallower levels, whereas the depth brand was discounted less frequently but at deeper levels than the other. Although the regular and average prices of both brands over the trials were identical, when there were only two possible prices for the brands (a dichotomous price distribution), participants estimated the depth brand to have a lower average price. However, when the discounted prices differed over trials (a nondichotomous price distribution), the frequency brand was judged to have a lower average price. Although others (e.g., Neidrich, Sharma, and Wedell 2001; Swait and Erdem 2002) have cited these results as a basis for their research, in fact, neither the generalizability, robustness, nor possible boundary conditions of these results have been examined. Further, the underlying explanation for these results remains unclear.

Numerical Cognition Explanation for the Frequency-Depth Effects

There are two numerical cognition results that are relevant in this situation (Monroe and Lee 1999). First, the distance effect indicates that numbers close in magnitude are more difficult to compare and are less discriminable. Consider the prices used by Alba et al. (1999) in the nondichotomous condition (see Alba et al. 1999, 112–13). All prices involve a magnitude of 2, and overall eight different prices were used, resulting in a price distribution that had no "clear cut" discounted price. If this situation led to a blurring of the distinction between the regular and discounted prices, then the magnitude of discounts would not be salient, and therefore, less helpful in discriminating between the brands. In-

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stead, given that the frequency brand was discounted 24 of 36 trials, it is feasible that the discount frequency attribute was more salient to the participants. The abundant research on salience effects suggests that participants overweigh salient attributes relative to less salient attributes in their judgments (e.g., Taylor et al. 1979; Taylor and Fiske 1978). Thus, in the nondichotomous condition, the brand that was superior on this attribute (the frequency brand) would be more likely to be perceived as having a lower average price than the depth brand.

Conversely, in the dichotomous price distribution condition, with only two prices for each of the brands, consistent in magnitude, and repeated 12 times, the salience of discount depth should be enhanced. Indeed, Krishna and Johar (1996) suggest that deep discounts being more salient would contrast more with a regular price relative to shallow discounts and, hence, would be more likely to influence price perceptions. Thus, if the magnitude of the discounts was more salient, the participants would be likely to overweigh this attribute in their judgments, and the brand superior on this attribute (the depth brand) would be more likely to be perceived to have a lower average price than the frequency brand. As reviewed below, considerable research suggests that people are likely to overweigh salient stimuli, even when illogical or irrelevant.

Second, research suggests that people may be more likely to rely on the frequency of stimulus over the magnitude of stimulus (for a review see Pelham, Sumarta, and Myaskovsky 1994), making it the default basis for judgments (Pansky and Algom 2002). However, as the magnitude of the stimulus becomes more salient, people are more likely to rely on that attribute over the frequency of the stimulus. Conversely, if the frequency of the stimulus becomes more salient, people are more likely to rely on that attribute over the magnitude (Pansky and Algom 1999, 2002). Thus, both salience and numerical cognition research suggest that whichever attribute of a stimulus—frequency or depth—is more salient, the brand superior on that attribute would receive more weight in judgment formation.

Perceptual Salience

Considerable evidence suggests that salient stimuli "engulf people's attention" and have a disproportionate effect on their judgments, even when logically they are uninformative or irrelevant (Taylor et al. 1979). Further, the evaluative characteristics of salient stimuli are exaggerated and more is learned about them. Salience of stimuli has been used to explain a wide range of important social processes ranging from self-esteem, reactions to integration situations, and emotional disorders (Taylor and Fiske 1978). Furthermore, salience effects have been shown to be robust and generalizable. Salience effects are not moderated by quantity of information encoded or participant involvement (Taylor et al. 1979). Moreover, salience effects persist even after participants are thoroughly "debriefed" and informed of the irrelevance of the salient stimuli (Ross, Lepper, and Hubbard 1975). Indeed, "the effect itself may be an automatic perceptual bias (not unlike optical illusions, orienting to novel stimuli, and the principles of figural emphasis uncovered by Gestalt psychologists). . . . [They] are automatic responses . . . and . . . occur without intention" (Taylor et al. 1979, 367).

An important determinant of salience is the intensity or the discriminability of the stimulus, "which causes [it] to be perceived as figural rather than as ground . . . [creating] a bigger impression on observers . . . and [is] evaluated more extremely" (Sullins 1989, 584–85). In the context of the present research, one determinant of the intensity and, hence, salience of the depth brand may be the magnitude of discounts. Conversely, one determinant of the intensity of the frequency brand may be the number of times it is discounted.

Recent research indicates that the salience of either the frequency or magnitude of numerical stimuli can be independently manipulated, and participants made to base their judgments on the salient attribute (Pansky and Algom 1999, 2002). Thus, to determine whether salience of the discount frequency produced the frequency effect in the nondichotomous price distribution, it is necessary to make the discount magnitudes more salient. This objective can be accomplished by increasing the absolute discount sizes. Then as the salience of the magnitude of discounts increases, participants should rely more on discount depth than on discount frequency, and we predict that the frequency effect previously found in the nondichotomous condition should disappear.

We report three studies that investigate the relative salience explanation for the frequency and depth effects. In study 1 we replicated the Alba et al. results, thereby eliminating several possible rival hypotheses about their results as they are not unique to the researchers involved, the specific study setting, or the study participants. Then, in study 2 we increased the discriminability of the discount magnitudes resulting in the predicted shift from a frequency effect to a depth effect in the nondichotomous condition. We predict that in the dichotomous condition, the magnitude of discounts will continue to be salient, leading to a replication of the observed depth effect. Finally, in study 3 we explore whether stimulus complexity can be an alternate explanation of the findings of studies 1 and 2 instead of relative salience. In study 3 we (1) contrast the relative salience hypothesis against the stimulus complexity hypothesis and (2) demonstrate an ability to obtain a frequency effect in both price distribution conditions.

STUDY 1

We first replicated the findings of Alba et al. (1999) using the same procedure, product, and prices as in their experiment 5 (112–13). Fifty-seven undergraduate students participated in a 2 (price distribution: nondichotomous vs. dichotomous; between subjects) × 2 (type of discount: frequent and shallow vs. infrequent and deep; within subjects) experiment. Participants were told that they would see the prices of two brands of shampoo for 36 trials (weeks) and they should indicate which brand they would choose if they were actually buying shampoo that week. Participants estimated the average price of the two brands after the 36 trials.

A repeated measures ANOVA indicated an interaction between the two factors ($F(1, 55) = 10.19$, $p < .01$; $r = 0.40$). Pair-wise t-tests revealed that the mean estimated prices for the frequency and depth brands in the nondichotomous condition were $2.30 and $2.35, respectively ($t(40) = 2.40$, $p < .05$; $r = 0.37$; a frequency effect), whereas in the dichotomous condition, they were $2.36 and $2.30, respectively ($t(15) = 2.51$, $p < .05$; $r = 0.54$; a depth effect). These results are very consistent with Alba et al.'s findings.

However, do these effects generalize to other possible price distributions that are more discriminable? To test the hypothesized shift from the frequency effect in the nondichotomous price distribution to a depth effect while maintaining the depth effect in the dichotomous price distribution we used different price distributions using larger prices and discount magnitudes, which are likely to be more salient relative to the frequency of discounts. Hence, we predict a depth effect will occur in each condition.

STUDY 2

Method

The procedure and design were essentially the same as in study 1, except for the product and prices. Ninety-six undergraduate students were randomly assigned to the two between-subject conditions. To test the salience explanation, the prices used in study 1 were increased such that the magnitude of discounts was considerably larger (about 580 times on average from those used in study 1). To maintain equal average prices across conditions, the regular price was changed to $740. Consistent with Alba et al. (1999), on average, the depth discount was twice that of the frequency discount but was promoted about half as often. This resulted in prices ranging from $520 to $740 in the nondichotomous condition and from $530 to $740 in the dichotomous condition. For realism the product used was a desktop computer. As in the previous study, participants were asked to indicate which brand they would buy if they were actually buying the product (here, desktop computer) that week.

Results

A repeated measures ANOVA indicated an interaction between the frequency/depth and dichotomous/nondichotomous factors ($F(1, 94) = 5.40$, $p < .05$; $r = 0.23$). In the nondichotomous condition, the mean estimated prices for the frequency and depth brands after the 36 trials were $714.00 and $710.23, respectively ($t(29) = 1.80$, $p < .08$, $r = 0.32$), indicating that participants perceived the depth brand had a lower average price than the frequency brand. In the dichotomous condition, the mean estimated prices for the frequency and depth brands after the 36 trials were $717.93 and $706.43, respectively ($t(65) = 5.81$, $p < .001$; $r = 0.58$), suggesting that participants perceived the depth brand to have a lower average price than the frequency brand in this condition also.

Discussion

Thus far we have observed that as the discount magnitudes increased from study 1 to study 2, the frequency effect found in the nondichotomous condition of study 1 shifted to a depth effect in study 2. At the same time, we have observed a consistent depth effect in the dichotomous condition. As expected, the results are inconsistent with the findings of study 1 and Alba et al. (1999). Participants estimated the average price of the depth brand to be lower than the frequency brand in both the dichotomous and nondichotomous conditions. Thus, the nature of the price distribution (dichotomous or nondichotomous) seems to be an insufficient explanation for the frequency and depth effects. These findings are consistent with the argument that increasing the discriminability of an attribute (the magnitude of discounts) leads participants to place more attention on that salient attribute than on the less salient attribute (frequency of discounts). The salience of the discount magnitudes lead to judgments favoring the brand that is superior on the salient attribute (the depth brand). However, it is possible that participants might have been influenced by stimulus complexity instead of relative salience, as described next.

The Complexity Hypothesis

The prices in study 1 involved decimals, whereas those in study 2 did not. There is evidence that numbers with decimals are perceived as more complex and are more difficult to process than those without decimals (Hoz and Gorodetsky 1989). Also, the nondichotomous distribution, with more different prices to be processed would require more cognitive effort than the dichotomous distribution (Alba et al. 1999). Past research demonstrates that people are more likely to rely on the stimulus frequency under conditions of high complexity, but not under conditions of low complexity (Pelham et al.1994). Thus, in the nondichotomous condition of study 1, participants may have relied on the frequency of discounts more than on the depth of the discounts because price complexity along with low discriminability might have enhanced the saliency of the discount frequency.

On the other hand, the dichotomous distribution, having only two possible prices, might be perceived as relatively simple and orderly. The complexity of the decimals in that situation might be offset by the simpler nature of the dichotomous distribution, resulting in a price distribution that is relatively easier to process. In contrast, for the dichotomous condition in study 1 and for both the dichotomous and nondichotomous conditions in study 2, the prices overall were less complex and more discriminable, reducing the likelihood of reliance on stimulus frequency. In study 3, we tested this explanation against the relative salience account and also sought to show that when the relative salience of the frequency of discounts is amplified a frequency effect in both price distributions is likely to occur.

STUDY 3

The relative salience hypothesis predicts that the brand attribute that attracts greater attention, promotional frequency, or discount depth will induce participants to perceive the brand with this salient attribute to have a lower average price. Previous research suggests that increasing the frequency of a stimulus makes it more discriminable and therefore more salient. As a result, participants should be more attentive to the frequency of the stimuli relative to the magnitude of the stimuli (Pansky and Algom 2002). Thus, in comparison to study 1, we increased the number of times the frequency brand was promoted relative to the depth brand and reduced the magnitude of discounts from those in study 2. To make the frequency of discounts salient, the frequency brand was on sale for 20 of the 36 trials, whereas the depth brand was promoted twice (see table 1), giving a ratio of 10 : 1. Using prices with decimals allows us to test the complexity hypothesis. It is noteworthy that in Alba et al. and our study 1, the frequency and depth brands were promoted 24 and 12 times respectively, a ratio of 2 : 1. Thus, in those studies, the number of discounts for the frequency brand relative to that of the depth brand may have been insufficient to offset the salience of the depth of discounts in the dichotomous condition, producing a depth effect. Fifty-eight undergraduate students were assigned randomly to the two between-subject conditions. The procedure, design, and product were the same as in study 1.

If the frequency of promotions is salient in both price distributions, then the relative salience hypothesis predicts a frequency effect would occur in both conditions. In contrast, the stimulus complexity hypothesis suggests that prices with decimals will induce the frequency effect in the nondichotomous condition but would not be sufficiently complex to induce that effect in the simpler dichotomous condition. Hence, the complexity explanation predicts a frequency effect in the nondichotomous condition but not in the dichotomous condition.

The repeated measures interaction between the dichotomous/nondichotomous and frequency/depth factors was not significant ($F(1, 56) = 0.61$; $p > .43$, $r = 0.10$). In the nondichotomous condition, the mean estimated prices for the frequency and depth brands were \$1.95 and \$2.02, respectively ($t(27) = 2.35$, $p < .05$; $r = 0.41$), whereas in the dichotomous condition, they were \$1.93 and \$2.04, respectively ($t(29) = 2.58$, $p < .05$; $r = 0.43$). Thus, the frequency brand was perceived to have a lower average price than the depth brand in both the dichotomous and nondichotomous conditions. These results are consistent with the relative salience hypothesis but not with the complexity hypothesis. Moreover, they do not agree with the conclusion that a dichotomous price distribution results in a depth effect and that a nondichotomous price distribution results in a frequency effect.

GENERAL DISCUSSION

Are the Frequency and Depth Effects Induced by the Temporal Price Distribution?

Our goal was to offer a plausible explanation for the frequency and depth effects reported in the literature. We have proposed that the relative salience of the discount frequency versus discount magnitude may explain the frequency and depth effects. We replicated the findings of Alba et al. in study 1 in that a frequency effect was observed in the nondichotomous condition and a depth effect was observed in the dichotomous condition. However, when we increased the magnitude of discounts (study 2) we observed a depth effect in both price distribution conditions. But, when we increased the salience of the frequency of discounts (study 3) we observed a frequency effect in both price distribution conditions. Hence, the nature of the temporal price distribution, per se, cannot explain the frequency and depth effects.

Can Numerical Complexity Explain the Frequency and Depth Effects?

Study 3 showed that the results in studies 1 and 2 may not be due to the complexity of prices with decimals; rather, the salience of either the frequency or magnitude of discounts is important. Study 3 also indicated that the frequency brand may be perceived to have a lower average price than the depth brand in both price distribution conditions when the discount frequency is more salient.

Is Perceptual Saliency a Feasible Explanation for the Frequency and Depth Effects?

Thus, we argue that the findings from these three studies indicate that it is the relative salience of the discount frequency versus the depth of discounts that induces the observed effects. Indeed, as the discount amounts were increased from a few cents in study 1 to tens of dollars in study 2 the frequency effect disappeared and a depth effect occurred in both price distributions. We believe that in both price distribution conditions the magnitude of the discounts became relatively more salient leading to a depth effect in each condition

An interesting question that arises is why Alba et al. (1999) did not find salience to play a role in influencing frequency and depth effects. In their experiment 1, they found that flagging promotions by including the word “sale” next to the price of the discounted brand did not influence participants’ average price estimates. As Alba et al. (1999) indicated, their manipulation captured “frequency misperceptions” and did not manipulate salience per se (104). That is, neither the magnitude, frequency of discounts, nor the discriminability of the numerical prices was manipulated. In their experiment 2, they found that increasing the percentage by which the depth brand was discounted did not influence participants’ average price estimates. These find-

TABLE 1

PRICES USED IN STUDY 3

Week	Nondichotomous prices		Dichotomous prices	
	Frequency brand	Depth brand	Frequency brand	Depth brand
1	1.98	2.09	1.99	2.09
2	2.09	2.09	2.09	2.09
3	1.92	2.09	1.99	2.09
4	2.09	2.09	2.09	2.09
5	2.05	2.09	1.99	2.09
6	2.09	2.09	2.09	2.09
7	2.01	2.09	1.99	2.09
8	2.09	2.09	2.09	2.09
9	1.96	2.09	1.99	2.09
10	2.09	1.14	2.09	1.09
11	2.02	2.09	1.99	2.09
12	2.09	2.09	2.09	2.09
13	1.95	2.09	1.99	2.09
14	2.09	2.09	2.09	2.09
15	2.03	2.09	1.99	2.09
16	2.09	2.09	2.09	2.09
17	1.94	2.09	1.99	2.09
18	2.09	2.09	2.09	2.09
19	2.04	2.09	1.99	2.09
20	2.09	1.04	2.09	1.09
21	1.93	2.09	1.99	2.09
22	2.09	2.09	2.09	2.09
23	2.05	2.09	1.99	2.09
24	2.09	2.09	2.09	2.09
25	1.92	2.09	1.99	2.09
26	2.09	2.09	2.09	2.09
27	2.06	2.09	1.99	2.09
28	1.91	2.09	1.99	2.09
29	2.07	2.09	1.99	2.09
30	2.09	2.09	2.09	2.09
31	1.97	2.09	1.99	2.09
32	2.01	2.09	1.99	2.09
33	2.09	2.09	2.09	2.09
34	1.96	2.09	1.99	2.09
35	2.02	2.09	1.99	2.09
36	2.09	2.09	2.09	2.09

ings are consistent with our argument that it is the absolute magnitude of the discounts that makes them salient, because it is less likely that the participants calculated the percentages and then encoded them into memory. Accordingly, as we increased the magnitude of discounts in study 2, we observed a shift away from the frequency effect in the nondichotomous condition. These findings are in line with those of Darke, Freedman, and Chaiken (1995, 583), who concluded that "it is the absolute amount of discount rather than the percentage discount that shoppers want to avoid missing out on."

Contributions and Limitations

This research extends behavioral pricing research in several ways. First, it demonstrates that the dichotomous and nondichotomous price distributions are not the sole explanation for the frequency and depth effects. Second, we show that the results cannot be accounted for strictly by stimulus complexity. Third, the results indicate that the salience of frequency or magnitude of discounts influences price perceptions. In the case of magnitude of discounts, the salience is due to the absolute size and not the percentage of discounts. Fourth, the frequency and depth effects can be observed in price distributions other than those previously studied. Finally, as advocated by Monroe and Lee (1999), we utilized numerical cognition research to develop a systematic investigation of the relative superiority of frequent and shallow price discounts versus infrequent but deep price discounts. The answer to this issue seems to rest on whether it is the frequency of a seller's price promotions or the magnitude of the monetary discounts that is most salient to consumers.

A shortcoming of this article was that we did not directly measure the saliency of the frequency and depth brands. Indeed, this was difficult because as suggested by numerical cognition as well as psychological research, perceptual salience, and the numerical comparison process are generally not under the volitional control of the observer and seem to proceed nonconsciously. Hence, asking direct questions may not lead to the source of the effect. Future research should formally test the relationship of saliency with the pricing distribution and perceived price estimates. It should also examine the robustness of the findings in actual shopping situations and when participants are provided with other brand related information (e.g., brand name, attributes).

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