Distortion of Price Discount Perceptions: The Right Digit Effect

KEITH S. COULTER
ROBIN A. COULTER*

We use four experiments to examine consumers' processing of comparative regular and sale price information in advertisements. Consistent with our hypothesized right digit effect, we find that, when consumers view regular and sale prices with identical left digits, they perceive larger price discounts when the right digits are "small" (i.e., less than 5) than when they are "large" (i.e., greater than 5). As a result, they may attribute greater value and increased purchase likelihood to higher-priced, lower-discounted items. We examine alternate processing explanations for this right digit effect, as well as the moderating impact of price presentation format.

The widely used practice of comparative price advertising has been a focal point of consumer and marketing research for decades (Compeau and Grewal 1998; Della Bitta, Monroe, and McGinnis 1981). Marketers typically engage in comparative price advertising by contrasting a higher regular price with a lower sale price (Compeau and Grewal 1998; Compeau, Grewal, and Chandrashekaran 2002). The higher regular price serves as an externally supplied frame of reference, which leads consumers to perceive less benefit from continued search (Urbany, Bearden, and Weilbaker 1988) and to associate less sacrifice with the lower sale price (Compeau et al. 2002). Consequently, comparative price advertising tends to engender more favorable consumer value perceptions. Thus, marketers embrace this form of advertising as a means to communicate price discounts, affect consumers' purchase decisions, and stimulate sales.

In this article, we focus on consumers' processing of the information provided by individual digits within specific advertised price comparisons. For our theoretical underpinnings, we draw on the numerical cognition literature to suggest that consumers' reactions to advertised regular and sale price information—and, hence, their perceptions of price discounts—are influenced by (1) the manner in which they typically compare multidigit prices and (2) how they interpret the relationship between regular and sale price endings. With regard to the former, research has demonstrated that consumers read prices from left to right and, in the event that left digits are identical, pay less attention to these digits when making price comparisons (Poltrock and Schwartz 1984). With regard to the latter, research has indicated that consumers' perceptions of the distances between numeric stimuli are compressed as digit size is increased (Algom, Dekel, and Pansky 1996). Because comparisons are made in relative terms, the distance between smaller digits (i.e., 1, 2, 3, and 4) is typically perceived as greater than the distance between larger digits (i.e., 6, 7, 8, and 9; Dehaene, Bossini, and Giraux 1993).

Based on these findings, we hypothesize a "right digit effect": we expect consumers exposed to comparative regular and sale prices with identical left digits to perceive larger percentage discounts for small right digit endings than for large right digit endings. This perceptual distortion is particularly interesting because consumers may attribute greater value and higher purchase likelihood to a particular item at a higher price with a lower discount than to that same item at a lower price with a higher discount. We use four experiments to investigate the conditions under which the right digit effect occurs and to understand the processing mechanisms behind its manifestation.

CONCEPTUAL BACKGROUND

Research to date indicates that consumers tend to evaluate price reductions relatively rather than in absolute dollar terms (Grewal and Mamorstein 1994). For example, even if the percentage discount is not explicitly stated, consumers perceive a $10 price reduction on a $100 camera to be of greater value than a $10 reduction on a $500 camera, be-

*Keith S. Coulter is associate professor of marketing, Graduate School of Management, Clark University, Worcester, MA 01610-1477 (kcoulter@clarku.edu). Robin A. Coulter is professor of marketing and Ackerman Scholar at the School of Business, University of Connecticut, 2100 Hillside Road, Storrs, CT 06269-1041 (robin.coulter@business.uconn.edu). Correspondence: Keith Coulter. The authors would like to thank the associate editor and reviewer A in particular, along with the other reviewers, for their insightful comments and guidance related to this article.

John Deighton served as editor and Kent Monroe served as associate editor for this article.

Electronically published June 1, 2007

cause in the former instance the relative savings is greater (i.e., 10% vs. 2%; Chen, Monroe, and Lou 1998; Heath, Chatterjee, and France 1995). Thus, the attractiveness of a price discount depends not only on the absolute dollar savings but also on the price level of the promoted product.

Additional research documents that, if both the regular and sale prices are presented within an advertisement but the difference is not specified in either absolute dollar or percentage terms, consumers often employ mental heuristics to avoid the effort of calculating the difference (Hinrichs, Berie, and Mosell 1982). One such heuristic involves comparing the columns of numbers from left to right (Stiving and Winer 1997), a process referred to as the sequential place-value model (Poltrock and Schwartz 1984). According to this model, when the left digits of two prices differ, these disparate digits become the primary focus of attention. Thus, consumers may perceive the ($14) difference between $93 and $79 as greater than the ($14) difference between $89 and $75, due to the greater left-most digit disparity in the former pair (Monroe 1979, 47). Alternatively, if the left digits are the same, then less attention is directed toward these digits, and more attention is focused on the disparate right digits in the price comparison process (Monroe and Petroshius 1981; Plous 1993).

An important consideration related to processing of numerical information concerns the specific numbers being compared. Research has demonstrated an asymmetry in response times (termed the "magnitude effect") when participants compare two numerals. Specifically, the time required to compare two numbers ending in digits less than 5 (e.g., 2 and 3) is typically less than the time required to compare two numbers ending in digits greater than 5 (e.g., 7 and 8), even though the numerical distances between the two numbers are the same (Dehaene, Dupoux, and Mehler 1990). One explanation for this effect is that numerical magnitude comparisons obey the Weber-Fechner Law; that is, digit comparisons follow a log-linear function such that consumers' perceptions of the distances between numbers are compressed as digit size is increased (Algom et al. 1996). The Weber-Fechner Law is based on people's tendency to compare disparate digits (and, hence, price reductions) in relative terms. For example, because 3 is 50% greater than 2, and 8 is 14% greater than 7, the absolute difference between 2 and 3 is perceived to be greater than that between 7 and 8, even though their absolute differences are identical.

These theoretical perspectives form the basis of our hypothesized right digit effect related to consumers' processing of comparative price information. Consider the case of a $23-to-$22 price reduction versus a $19-to-$18 price reduction. As a result of sequential (left-to-right) place-value processing, the identical left digits should receive less attention in both comparisons, and consumers' primary focus should be on the disparate right digits. The Weber-Fechner Law suggests that consumers should perceive a larger discount related to the smaller right digits in the $23/$22 regular/sale price comparison (representing a smaller actual discount of 4.34%) than to the larger right digits in the $19/$18 comparison (representing a larger actual discount of 5.26%). Thus, the right digit effect implies that consumers who compare regular and sale prices with identical left digits will perceive larger discounts for prices with small right digit endings than for large right digit endings.

Of course, in our example, the left digits are identical within but not across (i.e., 2 in the former comparison and 1 in the latter comparison) the regular/sale price combinations. To the extent that consumers process left digit information within each comparison (e.g., see Thomas and Morwitz [2005] for a discussion), they would tend to attribute a greater relative discount to the difference between two prices beginning with "1" than they would to the difference between two prices beginning with "2." Because of differences attributable to left digit variation, controlling for the cross-condition disparity in actual percentage discounts allows us to more effectively isolate the impact of the perceptual distortion associated with the right digit effect. If the small right digits are associated with a smaller actual discount (as in our $23/$22 vs. $19/$18 example), then adjusting for actual discounts allows us to detect a right digit effect that might not otherwise become manifest across conditions. Moreover, if the small right digits are associated with a larger actual discount (e.g., $29/$28 vs. $13/$12), then adjusting for actual discounts allows us to factor out the effect attributable to left digit variation and therefore is a more stringent test of the right digit effect. Hence, our hypotheses involve not only consumers' perceived price discounts but also a calculated adjusted price discount: (perceived price discount − actual price discount)/actual price discount. To summarize, we expect:

> **H1:** Consumers who are exposed to comparative regular and sale prices with identical left digits will (H1a) report larger perceived discounts and (H1b) have larger adjusted price discounts for small right digit endings (e.g., $23/$22) than for large right digit endings (e.g., $19/$18).

We further anticipate that, if consumers are to some degree price sensitive and product quality is uniform, the value that they associate with the product will reflect the perceived price difference. In other words, greater perceived discounts will foster greater value assessments and increase purchase intentions (Della Bitta et al. 1981; Grewal, Krishnan, Baker et al. 1998; Grewal, Monroe, and Krishnan 1998; Urbany et al. 1988). Thus, as in our example, consumers may attribute greater value and purchase likelihood to a particular item at a higher (e.g., $22) price (discounted a relatively lesser [4.34%] amount) than to that same item at a lower (e.g., $18) price (discounted a relatively greater [5.26%] amount). We expect:

> **H2:** Consumers who are exposed to comparative regular and sale prices with identical left digits will perceive greater discounts and, hence, attribute (H2a) greater value and (H2b) purchase likelihood to small right digit endings (e.g., $23/$22) than to large right digit endings (e.g., $19/$18).

TABLE 1

EXPERIMENT 1: SUMMARY OF MEANS

Price information (regular/sale price, in $)	Actual percent discount	Perceived percent discount	Adjusted price discount[a]	Perceived sale value[b]	Purchase likelihood[c]
Small right digit, left digit is 2	4.72	5.53	.17	5.20	4.78
244/233	4.51	5.29	.17	4.71	4.29
233/222	4.72	5.53	.17	5.41	5.21
222/211	4.95	5.76	.16	5.47	4.85
Large right digit, left digit is 1	5.85	4.37	−.26	4.49	3.98
199/188	5.52	4.18	−.24	4.71	4.50
188/177	5.85	4.41	−.25	4.29	3.53
177/166	6.21	4.53	−.27	4.47	3.91

NOTE.—Means were derived using a between-subjects mixed model nested ANCOVA; $n = 34$ for all cells.
[a]Calculated as (perceived price discount − actual price discount)/actual price discount.
[b]Assessed on a seven-point scale (1 = lower value; 7 = greater value).
[c]Assessed on a seven-point scale (1 = lower purchase likelihood; 7 = greater purchase likelihood).

ASSESSING THE RIGHT DIGIT EFFECT

Experiment 1

Method and Procedures. To examine the robustness of the right digit effect across multiple small and large right digit price comparisons, we used six regular/sale price combinations—three with a left digit of 2 and small right digits ($244/$233, $233/$222, $222/$211) and three with a left digit of 1 and large right digits ($199/$188, $188/$177, $177/$166; see table 1). We chose three-digit prices rather than two-digit prices so that the absolute price discounts would be greater, and the "smallness" or "largeness" of the price endings would be more easily recognized (Dehaene 1992). Thus, for each combination, the left (hundreds) digits were identical (i.e., 1 or 2), and the absolute difference in prices ($11) was the same, but the actual relative discount varied from 4.51% to 6.21% (table 1). We next constructed six print ads for a fictitious brand of in-line skate, the "Earthquake Pro Aggressive." The ads contained the identical headline, copy, and illustration, as well as one of the regular/sale price combinations. To facilitate digit comparison, the regular price appeared directly above the sale price in each ad (see the appendix, fig. A1).

In a pretest, 60 undergraduate students rated one of the six regular prices on three seven-point semantic differential items: "realistic," "typical," and "the likelihood that the price is associated with a sale or a discount." ANOVA results indicated no significant differences among the prices on either realism ($F(5, 53) = .46$, $p = .47$) or typicality ($F(5, 53) = .14$, $p = .68$); the correlation between the two items was .74. Additionally, we found no significant difference across price points with regard to sale/discount likelihood perceptions ($F(5, 53) = 1.06$, $p = .09$).

A total of 204 students were randomly assigned to one of the six regular/sale price conditions and were instructed that they would be analyzing a video case study involving a local retail department store chain. As background for the case, they were to examine a booklet containing eight print ads for eight products carried by the retailer. The target ad was embedded in the sixth position; the seven filler ads were visually similar to the target ad but contained no price information. After viewing the ad booklet, participants were exposed to a filler infomercial for a fictitious brand of lawn tractor, which also contained no price information. Participants returned their ad booklets and then completed a paper and pencil questionnaire.

Our measures are described next, in order of assessment. To determine value assessments, participants rated the skates on two seven-point scales (1 = more expensive, 7 = less expensive; and 1 = less value, 7 = more value; Krishnan and Chakravarti 1999; Monroe and Lee 1999). Purchase likelihood was assessed with two seven-point items that asked participants to assume that they were in the market for a brand of in-line skates and to rate (1) how likely they would be to purchase and (2) how willing they would be to buy the Earthquake skates at the sale price. The correlations for the value and purchase likelihood scales (formed by averaging the two unweighted items) were .63 and .51, respectively. Perceived price discount was measured by asking participants to list the approximate sale price discount in percentage terms for the Earthquake Pro Aggressive skates. To account for the effects of cross-condition differences in actual percentage discounts, we derived the adjusted perceived price discount (APD): (perceived price discount − actual price discount)/actual price discount.

We expected participants' selective attention to, and relative comparison of, the right-most digits in the price comparisons would result in the right digit effect. Because attention may lead to retention (McGuire 1978) and retention is assessed via recall measures (Edell and Staelin 1983; Lynch, Marmorstein, and Weigold 1988), we derived two of these measures (i.e., recall of the regular and sale price left digits and recall of the regular and sale price right digits) by asking participants to "list the regular price of the skates" and "list the sale price of the skates." The measures were included as covariates in order to assess the extent to which digit recall was associated with our hypothesized effects. Skate quality perceptions were assessed on a seven-point

TABLE 2

F-VALUES FOR BETWEEN-SUBJECTS MIXED MODEL NESTED ANCOVA

	Perceived price discount	Adjusted price discount	Perceived sale value	Purchase likelihood
Experiment 1:				
Right digit (RD) size[a]	60.71	219.71	38.48	26.18
	(< .001)	(< .001)	(< .001)	(< .001)
Price combination within RD[b]	1.34	.08	5.81	6.34
	(.26)	(.99)	(< .001)	(< .001)
Quality evaluation[c]	.03	.15	.42	1.84
	(.87)	(.70)	(.52)	(.18)
Recall regular and sale price left digits[c]	.07	.03	.18	2.48
	(.79)	(.86)	(.67)	(.12)
Recall regular and sale price right digits[c]	.74	.85	.10	1.26
	(.39)	(.36)	(.76)	(.26)
Experiment 2:				
Right digit (RD) size[a]	1,482.53	156.99	66.27	76.90
	(< .001)	(< .001)	(< .001)	(< .001)
Price combination within RD size[b]	7.34	.15	.65	.93
	(< .001)	(.96)	(.63)	(.45)
Quality evaluation[c]	.44	.85	.36	2.08
	(.51)	(.36)	(.55)	(.15)
Recall regular and sale price left digits[c]	1.63	1.95	.31	.39
	(.20)	(.17)	(.58)	(.54)
Recall regular and sale price right digits[c]	.16	.74	.03	.05
	(.69)	(.39)	(.87)	(.83)
Experiment 3:				
Right digit (RD) size[a]	4.52	5.59	3.34	.49
	(.04)	(.02)	(.07)	(.49)
Price combination within RD size[b]	.72	.69	1.74	2.09
	(.58)	(.61)	(.16)	(.10)
Quality evaluation[c]	.08	.10	.61	9.15
	(.78)	(.76)	(.44)	(.01)
Recall regular and sale price left digits[c]	1.62	1.64	.01	1.38
	(.21)	(.21)	(.99)	(.25)
Recall regular and sale price right digits[c]	2.27	2.35	1.15	.97
	(.14)	(.13)	(.28)	(.33)

NOTE.—*p*-values are reported in parentheses.

[a]Degrees of freedom calculation: numerator calculated as [levels of right digit − 1]; denominator calculated as [(levels of right digit) × (number of price combinations) × (sample size in cell − 1) − (number of covariates)], with experiment 1 = 1/195; experiment 2 = 1/112; experiment 3 = 1/51.

[b]Degrees of freedom calculation: numerator calculated as [(levels of right digit) × (number of price combinations − 1)]; denominator calculated as above, with experiment 1 = 4/195; experiment 2 = 4/112; experiment 3 = 4/51.

[c]Degrees of freedom for covariate is: experiment 1 = 1/195; experiment 2 = 1/112; experiment 3 = 1/51.

"low" to "high" rating scale, which was also included as a covariate.

Results. To assess our hypotheses, we used a mixed model nested ANCOVA (Tabachnick and Fidell 2001, 633–38). Because right digit "size" is a function of the specific regular/sale price combinations employed in each condition, the small ($244/$233, $233/$222, $222/$211) and large ($199/$188, $188/$177, $177/$166) right digit price combinations were nested within the right digit between-subjects variable. This nested analysis allowed us not only to test the independent variable (i.e., right digit effect) but also to examine whether there was variation in participants' responses across the different price combinations within the small or large right digit conditions. The means and F-values for the analyses are reported in tables 1 and 2, respectively. All covariates are nonsignificant. The nested price combination variable is nonsignificant with regard to perceived and adjusted price discount; it presents a minor nuisance effect related to consumer perceptions of value and purchase likelihood, because the variation in nested price combination means is substantially less than the variation in nonnested dependent variable means across conditions.

Our findings are consistent with hypotheses 1a and 1b. Participants' viewing small right digit prices reported significantly greater discount perceptions ($M_{\text{SRD}} = 5.53\%$) than those viewing large right digit prices ($M_{\text{LRD}} = 4.37\%$; $F(1, 195) = 60.71$, $p < .001$), and (after accounting for the effects of cross-condition differences in actual percentage discounts) APD was significantly greater for participants viewing the small right digit prices ($M_{\text{SRD}} = 0.17$) than for those viewing the large right digit prices ($M_{\text{LRD}} = -0.26$; $F(1, 195) = 219.71$, $p < .001$). Additionally, consistent with hypotheses 2a and 2b, we find right digit effects related to value assessments ($F(1, 195) =$

TABLE 3

EXPERIMENT 2: SUMMARY OF MEANS

Price information (regular/sale price, in $)	Actual percent discount	Perceived percent discount	Adjusted price discount[a]	Perceived sale value[b]	Purchase likelihood[c]
Small right digit, left digit is 1	8.27	9.23	.11	5.34	5.44
144/133	7.64	8.51	.12	5.20	5.28
133/122	8.27	9.15	.11	5.35	5.53
122/111	9.02	9.98	.11	5.48	5.52
Large right digit, left digit is 2	3.82	2.48	−.35	3.58	3.67
299/288	3.68	2.43	−.34	3.40	3.45
288/277	3.82	2.50	−.35	3.50	3.58
277/266	3.97	2.51	−.37	3.85	3.98

NOTE.—Means were derived using a between-subjects mixed model nested ANCOVA; $n = 21$ for the \$122/\$111 cell, and $n = 20$ for all other cells.
[a]Calculated as (perceived price discount − actual price discount)/actual price discount.
[b]Assessed using two seven-point items ($r = .54$; $p < .001$; 1 = lower value; 7 = greater value).
[c]Assessed using two seven-point items ($r = .63$; $p < .001$; 1 = lower purchase likelihood; 7 = greater purchase likelihood).

38.48, $p < .001$) and purchase likelihood ($F(1, 195) = 26.18$, $p < .001$), with the pattern of responses closely mirroring price discount perceptions. Participants' value perceptions ($M_{\text{SRD}} = 5.20$; $M_{\text{LRD}} = 4.49$) and purchase intentions ($M_{\text{SRD}} = 4.78$; $M_{\text{LRD}} = 3.98$) were significantly greater for the small than for the large right digit price comparisons.

Our results indicate a strong right digit effect, which dominates cross-condition differences in left digits and results in a noncorrespondence between perceived and actual price discounts. Specifically, participants perceived larger discounts and reported greater value assessments and higher purchase likelihood for the higher-priced, lower-discounted items (e.g., \$222 regular/\$211 sale) than for the lower-priced, higher-discounted items (e.g., \$199 regular/\$188 sale). In the former case participants overestimated price discounts, whereas in the latter case they underestimated price discounts (table 1). The nonsignificant quality covariate indicates that higher prices (and smaller relative discounts) were not linked to superior quality (i.e., prices were the primary driver of value perceptions). The nonsignificant recall covariates indicate that neither left nor right digit recall was related to variation in dependent measures, and therefore neither was required for the right digit effect to manifest. One implication of this finding is that participants' judgments were formed during target stimulus exposure. If the judgments were made subsequently during questionnaire item completion, then participants would necessarily have retrieved prices from memory, and thus one might expect a right digit effect only if the right digit recall covariate were also significant.

Experiment 2

Method and Procedures. To examine the robustness of our predictions under alternate numerical conditions, we conducted a second experiment in which we used the same digit information as in experiment 1 but reversed the left digits. The left digit 1 was paired with the small right digits (e.g., regular price \$144/sale price \$133), and the left digit 2 was paired with the large right digits (e.g., regular price \$299/sale price \$288). This procedure not only increased the range of actual discounts (i.e., 3.68%–9.02%) but also resulted in the small right digits being associated with larger actual discounts than the large right digit combinations (table 3). Consequently, experiment 2 involved a more stringent test of hypothesis 1b.

We pretested ($n = 56$) the six regular prices for the in-line skate and found no significant differences with regard to realism ($F(5, 49) = .53$, $p = .32$) or typicality ($F(5, 49) = .36$, $p = .54$); the correlation between the items was .63. We then constructed six new test ads for the three small and three large right digit price comparisons. Our procedures, measures, and analyses were identical to experiment 1; 121 undergraduates participated in experiment 2 (there was no duplication of subjects across the four experiments reported herein).

Results. F-values and means for the ANCOVA analyses are reported in tables 2 and 3, respectively. All covariates were nonsignificant, and the nested price combinations present a minor nuisance effect related to perceived price discount, explaining minimal variance relative to the hypothesized effect. Our results were again consistent with our hypotheses. Participants viewing the small right digit prices ($M_{\text{SRD}} = 9.23\%$) reported significantly greater price discount perceptions than those viewing the large right digit prices ($M_{\text{LRD}} = 2.48\%$; $F(1, 112) = 1{,}482.53$, $p < .001$). More important, however, after accounting for the effects of cross-condition differences in actual percentage discounts (which were greater in experiment 2 than in experiment 1), we again observed a right digit effect; APD was significantly greater ($F(1, 112) = 156.99$, $p < .001$) for participants viewing the small right digit prices ($M_{\text{SRD}} = 0.11$) than for those viewing the large right digit prices ($M_{\text{LRD}} = -0.35$). Further, the same pattern of under-/overestimation of percent discounts associated with large/small right digit price comparisons evident in experiment 1 emerged in these findings. We again found right digit effects related to value assessments ($F(1, 112) = 66.27$, $p < .001$) and purchase likeli-

TABLE 4

EXPERIMENT 3: SUMMARY OF MEANS

Price information (regular/sale price, in $)	Actual percent discount	Perceived percent discount	Adjusted price discount[a]	Perceived sale value[b]	Purchase likelihood[c]
Small right digit, left digit is 9	1.18	4.05	2.44	4.47	3.67
944/933	1.17	3.30	1.82	3.70	2.85
933/922	1.18	4.15	2.52	4.80	4.00
922/911	1.19	4.76	3.99	4.90	4.15
Large right digit, left digit is 8	1.24	2.75	1.23	3.57	3.43
899/888	1.22	3.30	1.71	3.20	3.85
888/877	1.24	2.60	1.10	3.30	3.55
877/866	1.25	2.35	.88	4.20	3.90

NOTE.—Means were derived using a between-subjects mixed model nested ANCOVA; $n = 10$ for all cells.
[a]Calculated as (perceived price discount − actual price discount)/actual price discount.
[b]Assessed on a seven-point scale (1 = lower value; 7 = greater value).
[c]Assessed on a seven-point scale (1 = lower purchase likelihood; 7 = greater purchase likelihood).

hood ($F(1, 112) = 76.90$, $p < .001$), with the pattern of responses closely mirroring price discount perceptions. In summary, the results in experiment 2 replicate our findings in experiment 1.

Experiment 3

As noted, the sequential place-value model argues that numbers are processed and compared from left to right, on a digit-by-digit or column-by-column basis. Although identical left-most digits receive less attention in the price comparison process, recent work by Thomas and Morwitz (2005) suggests that the size of the left digits can impact the subsequent processing of right digits. Thus, consumers may compare left digits not only within columns (across prices) but also within prices (across columns, i.e., to the digits on their right; Schwarz and Stein 1998). Further, one could argue that initial within-price digit comparisons could impact subsequent cross-price digit comparisons by means of a contrast effect (Dehaene 1992; Slonim and Garbarino 1999). As a consequence, a small within-price digit difference could cause a given cross-price digit difference to be perceived as greater, whereas a large within-price digit difference could cause that same cross-price digit difference to be perceived as smaller.

To illustrate, consider the $244/$233 and $199/$188 regular/sale price comparisons. In the former case, if the difference between the 2 and the 4 in $244 and the 2 and the 3 in $233 is perceived as small, then the difference between the 4's and the 3's might be perceived as large. Conversely, if the difference between the 1 and the 9 in $199 and the 1 and the 8 in $188 is perceived as large, then the difference between the 9's and the 8's might be perceived as small.

Thus, in experiment 3 we use large left digit (8 or 9) prices to examine this alternate explanation for the right digit effect. Because within-price digit contrast effects would cause the discounts associated with small right digits to be perceived as less than those associated with large right digits, a pattern of results similar to experiments 1 and 2 would rule out this explanation.

Method and Procedures. Testing a possible within-price contrast effect required a set of large left digit price points and, consequently, a higher-priced product category; thus, we chose flat-screen televisions. Consistent with experiments 1 and 2, we again used six regular/sale price combinations—three with a left digit of 9 and small right digits and three with a left digit of 8 and large right digits (table 4). Regular prices were again pretested ($n = 73$); we found no significant differences with regard to realism ($F(5, 65) = .23$, $p = .61$) or typicality ($F(5, 65) = .29$, $p = .63$; $r = .67$). We next constructed six print ads for a fictitious brand of flat screen television, the "Picture Pro," and we used the same procedures and measures as in previous experiments. Because the correlation between the value and expensive items was .10 (perhaps not surprising for this "big ticket" product), we used only the former item as our value assessment measure. The correlation between the two purchase likelihood items was .58 ($p < .001$). Sixty graduate and undergraduate students participated in experiment 3.

Results. ANCOVA analyses were similar to experiments 1 and 2; F-values and means are reported in tables 2 and 4, respectively. With one exception (the quality covariate with regard to purchase intention), all covariates and the nested price combinations were nonsignificant. Consistent with hypothesis 1a, participants viewing small right digit prices (with the smaller actual discounts) reported significantly greater discount perceptions than those viewing large right digit prices (with the larger actual discounts; $M_{SRD} = 4.05\%$; $M_{LRD} = 2.75\%$; $F(1, 51) = 4.52$, $p = .04$). We found the same effect for the adjusted price discounts ($M_{SRD} = 2.44$; $M_{LRD} = 1.23$; $F(1, 51) = 5.59$, $p = .02$). Although participants viewing large right digit prices did not underestimate the actual price discounts, our results are consistent with experiments 1 and 2 in that their degree of overestimation was less than that of participants viewing small right digit prices. Participants also reported greater value assessments when right digits were small ($M_{SRD} = 4.47$) than when they were large ($M_{LRD} = 3.57$;

$F(1, 51) = 3.34$, $p = .07$), but the right digit effect was not significant with regard to purchase intention. In summary, we find the same pattern of results in experiment 3 as in experiments 1 and 2, indicating that a within-price left versus right digit contrast effect cannot account for our findings.

Experiment 4

Our first three experiments were designed to assess the right digit effect in the context of a comparative price advertisement. Across the studies, we consistently find our hypothesized effect, as well as no significant differences in recall of the left or right digits. These results support our contention that participants engaged in sequential, digit-by-digit processing and compared the disparate right-most digits in relative terms. Additionally, they suggest that participants formed their price discount estimates during regular/sale price exposure, such that retention of the encoded digits was not associated with our dependent variable results. In instances when consumers must draw on encoded digit information to arrive at price discount perceptions, one might expect that judgments could be differentially affected (Della Bitta and Monroe 1973; Herr 1989; Mayhew and Winer 1992). These differences could be due either to the influence of internal reference price or to the manner in which the digit information is encoded and retained. In experiment 4, we contrast the comparative price advertising context with a context in which we present the regular price prior to the sale price; thus, participants must retrieve the regular reference price from memory to derive their price discounts.

Research suggests that when prices are encoded in memory, consumers' distortion of either absolute or relative price differences may be influenced by the nonconscious processing of price information (Krishnan and Chakravarti 1999; Monroe and Lee 1999). Studies also suggest that numeric stimuli are automatically and nonconsciously represented and encoded in memory as magnitude representations, which are judgments of relative size arrayed in analog format along a left-to-right-oriented mental number line (Dehaene 1992; Dehaene et al. 1993). When numeric stimuli are encoded as magnitude representations, perceived differences among those stimuli are dependent on how their magnitudes are represented in memory (Tzelgov, Meyer, and Henik 1992). Magnitude representations typically involve holistic perceptions of numeric value, which are encoded automatically, effortlessly, and apparently without awareness (Dehaene and Akhavein 1995).

We argue that the regular price magnitude representation retrieved from memory is likely to involve a holistic perception of numeric value, involving all three digits of the number. As a consequence, we expect consumers to engage in a holistic rather than a digit-by-digit comparison of the regular and sale prices and that this holistic comparison should compromise the right digit effect. Of course, the right digit effect could also be compromised if the regular price is distorted due to the influence of internal adaptation-level prices and/or reference scales (Monroe 2003, 1306). However, accurate recall of the advertised price information would argue against this influence. In sum, we expect an interaction effect between right digit size and presentation format, such that:

> **H3:** Consumers exposed to regular and sale prices with identical left digits will (H3a) perceive larger percent discounts, (H3b) have larger adjusted price discounts, and report (H3c) more favorable value assessments and (H3d) greater purchase likelihood for small right digit endings than for large right digit endings. These effects will occur when prices are presented concurrently but not when the regular and sale price information are provided separately.

Method and Procedures. We presented the small and large right digit regular/sale price combinations from experiment 1 (table 5) in both concurrent and nonconcurrent formats. For the concurrent condition, we used the ad booklet stimuli from experiment 1. For the nonconcurrent condition, we used the identical format and price information contained in the target ads from experiment 1; however, we presented the regular price in one ad (position 2) and the sale price in a second (otherwise identical) ad (position 6). Six of our original filler ads were also included.

Experiment 4 ($n = 156$) procedures and measures were similar to experiment 1. The value and expensiveness items comprising the value measure were not correlated; consequently, we used only the former item. The correlation between the two purchase intention items was .71. Because recall served as a holistic processing measure in this study, we examined it in terms of all three digits combined (i.e., "correct recall of both regular and sale prices" [left and right digits], "correct recall of either the regular or sale price," or "incorrect recall of both regular and sale prices"). We expected more accurate recall in the nonconcurrent conditions.

Results. Data again were analyzed using a mixed model nested ANCOVA. The three price combinations were nested within the 2 (right digit: small vs. large) × 2 (price presentation format: concurrent vs. nonconcurrent) between-subjects variables, and recall was included as a covariate. The nested price combination variable was nonsignificant for each of the four dependent variables. Means and F-values are reported in tables 5 and 6, respectively.

Consistent with hypothesis 3a, we found a significant right digit by presentation format interaction ($F(1, 143) = 17.03$; $p < .001$); the pattern of results was as expected (fig. 1), with a right digit effect occurring only when the regular and sale prices were presented concurrently. Similarly, our findings related to adjusted price discount indicate a significant right digit by presentation format interaction ($F(1, 143) = 15.92$, $p < .001$). Consistent with our experiment 1 findings, participants in the concurrent condition viewing small right digit prices overestimated the discount ($M_{SRD} = .34$), whereas participants in the concurrent condition viewing the large right digit prices underestimated the discount ($M_{LRD} = -.12$; table 5). In contrast, partici-

TABLE 5

EXPERIMENT 4: SUMMARY OF MEANS

Presentation format and price information (regular/sale price, in $)	Actual percent discount	Perceived percent discount	Adjusted price discount[a]	Perceived sale value[b]	Purchase likelihood[c]
Concurrent format					
Small right digit mean		6.31	.34	4.67	4.12
244/233	4.51	6.54	.45	4.85	3.77
233/222	4.72	6.21	.32	4.62	4.50
222/211	4.95	6.19	.25	4.54	4.08
Large right digit mean		5.18	−.12	3.49	3.81
199/188	5.52	4.88	−.12	3.92	3.89
188/177	5.85	5.27	−.10	3.62	4.35
177/166	6.21	5.38	−.13	2.92	3.19
Nonconcurrent format:					
Small right digit mean		5.17	.09	4.05	4.06
244/233	4.51	5.15	.14	4.08	4.23
233/222	4.72	5.04	.07	4.23	3.81
222/211	4.95	5.31	.07	3.85	4.15
Large right digit mean		6.10	.04	4.10	3.58
199/188	5.52	5.54	.01	4.31	3.50
188/177	5.85	6.31	.08	4.23	3.35
177/166	6.21	6.46	.04	3.77	3.89

NOTE.—Means were derived from a between-subjects mixed model ANCOVA; all cells have $n = 13$.
[a]Calculated as (perceived price discount – actual price discount)/actual price discount.
[b]Assessed on a seven-point scale; 1 is lower value and 7 is greater value.
[c]Assessed on a seven-point scale; 1 is lower purchase likelihood and 7 is greater purchase likelihood.

pants' discount perceptions in the nonconcurrent condition more closely approximated the actual price discounts (i.e., $M_{SRD} = .09$ and $M_{LRD} = .04$). As expected, we found a significant recall effect ($F(1, 143) = 4.47$, $p = .04$) related to APD, with more accurate encoding of holistic magnitude representations (i.e., left and right digits) in the nonconcurrent ($M = 1.60$) than in the concurrent ($M = 1.31$) condition. Less accurate recall in the concurrent condition is consistent with the hypothesized perceptual distortion associated with the right digit effect. Our results indicate that overestimation of the regular price and underestimation of the sale price (both of which lead to discount overestimation) were equally likely in the concurrent-small right digit condition. Similarly, underestimation of the regular price and overestimation of the sale price (both of which lead to discount underestimation) were equally likely in the concurrent-large right digit condition. Presumably because prices are considered in combination, inaccurate recall of both prices occurred more frequently than inaccurate recall of only one price.

TABLE 6

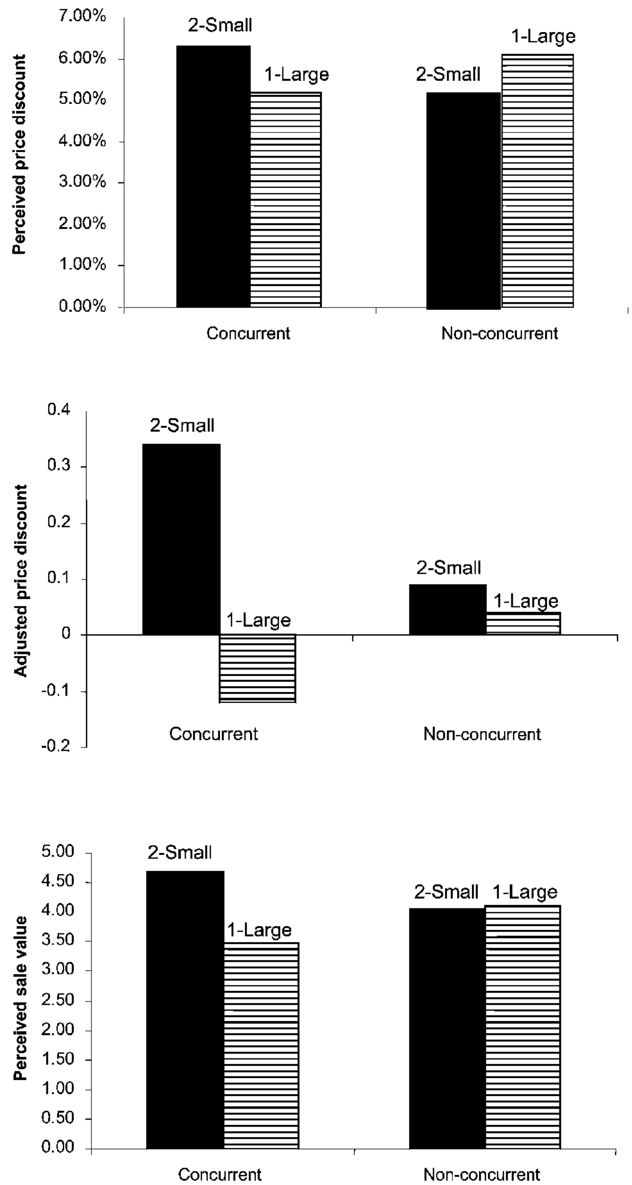
EXPERIMENT 4: *F*-VALUES FOR BETWEEN-SUBJECTS MIXED MODEL NESTED ANCOVA

	Perceived price discount	Adjusted price discount	Perceived sale value	Purchase likelihood
Right digit (RD) size[a]	.08 (.77)	21.83 (< .001)	4.74 (.03)	2.82 (.10)
Presentation (PR) format[b]	.01 (.98)	.15 (.70)	.09 (.77)	.20 (.65)
Price combination within RD x PR effect[c]	.54 (.83)	.51 (.85)	.54 (.83)	.96 (.47)
RD × PR interaction[d]	17.03 (< .001)	15.92 (< .001)	6.79 (.01)	.09 (.76)
Recall[e]	3.67 (.06)	4.47 (.04)	2.17 (.14)	.51 (.47)

NOTE.—*p*-values are reported in parentheses.
[a]Degrees of freedom = 1/143; numerator calculated as [levels of right digit − 1]; denominator calculated as [(levels of right digit) × (levels of presentation format) × (number of price combinations) × (sample size in cell − 1) − (number of covariates)].
[b]Degrees of freedom = 1/143; numerator calculated as [levels of presentation format − 1]; denominator calculated as in note a.
[c]Degrees of freedom = 8/143; numerator calculated as [(levels of right digit) × (levels of presentation format) × (number of price combinations − 1)]; denominator calculated as in note a.
[d]Degrees of freedom = 1/143; numerator calculated as [(levels of right digit − 1) × (levels of presentation format − 1)]; denominator calculated as in note a.
[e]Degrees of freedom for covariate = 1/143.

FIGURE 1

EXPERIMENT 4: INTERACTION EFFECTS FOR PERCEIVED PRICE DISCOUNT, ADJUSTED PRICE DISCOUNT, AND VALUE ASSESSMENT



With regard to value assessment, our results are consistent with hypothesis 3c; we found a significant right digit by presentation format interaction ($F(1, 143) = 6.79$, $p = .01$). This pattern of results closely mirrored that of perceived price discount; however, the recall covariate was not significant. We did not find support for hypothesis 3d, as there were no significant effects with regard to purchase likelihood. Overall, experiment 4 results suggest that the right digit effect is present when participants can compare prices sequentially on a digit-by-digit basis but not when the reference price must be retrieved from memory.

DISCUSSION AND FUTURE RESEARCH

We draw on the sequential place-value model and Weber-Fechner Law to propose a "right digit effect"; that is, when the left digits of comparative prices are identical, consumers compare the right digits in relative terms. Our experiments assess the circumstances under which the right digit effect occurs and offer some understanding about the processing mechanisms that underlie this form of perceptual distortion. We consistently find that (1) participants report larger perceived discounts and have larger adjusted (for actual) price discounts when the right digits are small than when they are large and (2) participants associate greater value with the greater perceived discounts (Della Bitta et al. 1981; Grewal, Krishnan, Baker et al. 1998; Grewal et al. 1998). Our findings regarding purchase likelihood closely mirror those of value assessments but are less consistent due to the likely impact of other internal, external, and situational variables on consumers' intention to purchase.

The results of experiments 1, 3, and 4 (concurrent condition) are of particular interest because perceived price discounts do not correspond to actual price discounts—that is, the actual price discounts for the small right digit price comparisons are lower than the actual price discounts for the large right digit comparisons. Thus, we find that consumers may attribute higher percentage discounts and greater value to higher-priced, lower-discounted items (e.g., \$244/\$233) than to the otherwise identical lower-priced, higher-discounted items (e.g., \$199/\$188). Although perceived price discounts do correspond to actual price discounts in experiment 2, we again find the right digit effect after adjusting for actual discount, and the pattern of over- or underestimation of discounts associated with the small/large right digit endings mirrors that of experiment 1. Experiment 4 findings argue for a sequential, digit-by-digit comparison of numbers when prices are presented concurrently (i.e., the regular price is positioned directly above the sale price), and a more holistic processing (thereby eliminating the right digit effect) when participants are exposed to the regular price prior to the sale price (nonconcurrently).

Several alternate explanations for the right digit effect also deserve attention but appear unlikely given our results. First, in experiment 3, we document a right digit effect for regular/sale price comparisons involving large (i.e., 8 and 9) left digits. This replication of our findings eliminates within-price (i.e., left versus right) digit contrast effects as a possible alternative explanation for the greater perceived discounts associated with smaller right digits.

Second, it is well documented that consumers' internal reference prices can impact price discount perceptions (Herr 1989). Thus, one could argue that the pattern of over-/underestimation of perceived price discounts observed in experiment 1 is consistent with what one might expect if \$200 were the predominant internal reference price. If advertised sale prices above/below \$200 were seen as losses/gains, then loss aversion could cause consumers to estimate discounts as higher/lower than actual when prices were greater/less than \$200 (Kahneman and Tversky 1979). This loss-aversion explanation appears unlikely for several reasons. First, pretest results indicated that the six regular prices for the in-line skates were equally realistic and typical; thus, a single uniform reference price is unlikely to have affected dependent variable results. Second, in experiment 3 participants overestimated all perceived discounts, and therefore prices below the boundary condition of $900 could not have been seen as gains. Third, in experiment 4, price discount perceptions were significantly different across concurrent versus nonconcurrent conditions for the same regular/sale price combinations. If internal reference price were driving results, those differences should not have become manifest. Further, if reference price were a factor only in the nonconcurrent condition, we would not expect that condition to be associated with more accurate recall results. Together, these findings argue against an internal reference price explanation for the right digit effect.

A third possible explanation for our findings relates to a tendency to round prices to the nearest whole number (Brenner and Brenner 1982; Schindler and Wiman 1989). For example in experiment 1, participants exposed to large right digit prices might have rounded the final sale price up (to $200), whereas those exposed to small right digit prices might have rounded the final sale price down (to $200). Although the final estimated price would have been the same in both cases, a comparison to the initial price would have suggested a better deal in the latter case. This explanation implies that value assessments are driven in part by inaccurate recall of the sale price but accurate recall of the regular price. Yet, we found no significant differences in regular versus sale price left or right digit recall in experiment 1. In addition, this whole number form of rounding behavior cannot account for our findings across price points utilized in experiment 2. Thus, sale price rounding does not appear to be a viable explanation for our findings.

A fourth explanation for the right digit effect relates to consumers' tendency to identify 9-ending prices as sale (rather than regular) prices or to associate them with a discount (Schindler 1991). If this were the case, participants in our study might have perceived that the products with regular prices set at $299, $199, and $899 were already on sale. Consequently, the effects of further price reductions on relative discount magnitude, value, and purchase likelihood might have been attenuated. These 9-ending price image effects, however, could not account for our results in terms of the other large right digit prices (e.g., $288/$277, $177/$166). Moreover, our experiment 1 pretest results revealed no significant differences among the regular prices in terms of sales or discount associations. Finally, for the majority of tests across our four experiments (13 of 16), we found no significant differences among the nested price combinations. Thus, 9-ending price image effects are effectively ruled out as an alternative explanation.

Our findings indicate that comparative price advertising can distort consumers' perceptions in ways unintended by the seller. They also suggest several opportunities for future research. First, we interpret the lack of recall results in our first three experiments to suggest that participants' judgments were formed during sale price exposure; however, recall measured at that time could also yield nonsignificant results, depending on the level of conscious (versus nonconscious) processing. Thus, future research efforts might attempt to more clearly define the impact of memory and consciousness on the right digit effect by utilizing shorter or no distraction tasks and by manipulating levels of involvement or attention. Second, employing a within-subjects design might prove useful to ascertain the impact of multiple comparative price ads and the effects of priming on the right digit effect. Third, concurrent and retrospective verbal protocol reports could provide a more thorough understanding of consumers' comparison, encoding, and retrieval of comparative price information (Ericsson and Simon 1993; Nisbett and Wilson 1977). Finally, examination of either additional price presentation formats (e.g., the regular and sale prices are presented to the left or right of one another) or greater cross-condition differences in left-most digits (Thomas and Morwitz 2005) might help to more specifically define the boundary conditions for the right digit effect.

APPENDIX

FIGURE A1

FORMAT OF COMPARATIVE PRICE ADVERTISEMENT

REFERENCES

Algom, Daniel, Amnon Dekel, and Ainat Pansky (1996), "The Perception of Number from the Separability of the Stimulus: The Stroop Effect Revisited," *Memory and Cognition*, 24 (5), 557–72.

Brenner, Gabrielle A. and Reuven Brenner (1982), "Memory and Markets, or Why Are You Paying $299 for a Widget?" *Journal of Business*, 55 (11), 147–58.

Chen, Shih-Fen S., Kent B. Monroe, and Yung-Chien Lou (1998), "The Effects of Framing Price Promotion Messages on Consumers' Perceptions and Purchase Intentions," *Journal of Retailing*, 74 (3), 353–62.

Compeau, Larry D. and Dhruv Grewal (1998), "Comparative Price Advertising: An Integrative Review," *Journal of Public Policy and Marketing*, 17 (Fall), 257–73.

Compeau, Larry D., Dhruv Grewal, and R. Chandrashekaran (2002), "Comparative Price Advertising: Believe It or Not," *Journal of Consumer Affairs*, 36 (2), 284–94.

Dehaene, Stanislas (1992), "Varieties of Numerical Abilities," *Cognition*, 44 (1), 1–42.

Dehaene, Stanislas and Rokny Akhavein (1995), "Attention, Automaticity, and Levels of Representation in Number Processing," *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 21 (2), 314–26.

Dehaene, Stanislas, Serge Bossini, and Pascal Giraux (1993), "The Mental Representation of Parity and Number Magnitude," *Journal of Experimental Psychology: General*, 122 (3), 371–96.

Dehaene, Stanislas, Emmanuel Dupoux, and Jacques Mehler (1990), "Is Numerical Comparison Digital? Analogical and Symbolic Effects in Two-Digit Number Comparison," *Journal of Experimental Psychology: Human Perception and Performance*, 16 (2), 626–41.

Della Bitta, Albert J. and Kent B. Monroe (1973), "The Influence of Adaptation Levels on Subjective Price Perceptions," in *Advances in Consumer Research*, Vol. 1, ed. Peter Wright and Scott Ward, Urbana, IL: Association for Consumer Research, 359–69.

Della Bitta, Albert J., Kent B. Monroe, and John M. McGinnis (1981), "Consumer Perceptions of Comparative Price Advertisements," *Journal of Marketing Research*, 18 (November), 416–27.

Edell, Julie A. and Richard Staelin (1983), "The Information Processing of Pictures in Print Advertisements," *Journal of Consumer Research*, 10 (June), 45–61.

Ericsson, K. Anders and Herbert A. Simon (1993), *Protocol Analysis: Verbal Reports as Data*, Cambridge, MA: MIT Press.

Grewal, Dhruv, R. Krishnan, Judith Baker, and Norm Borin (1998), "The Effect of Store Name, Brand Name and Price Discounts on Consumers' Evaluations and Purchase Intentions," *Journal of Retailing*, 74 (3), 331–52.

Grewal, Dhruv and Howard Mamorstein (1994), "Market Price Variation, Perceived Price Variation and Consumers' Price Search Decisions for Durable Goods," *Journal of Consumer Research*, 21 (December), 453–60.

Grewal, Dhruv, Kent B. Monroe, and R. Krishnan (1998), "The Effects of Price Comparison Advertising on Buyers' Perceptions of Acquisition Value and Transaction Value," *Journal of Marketing,* 62 (April), 46–60.

Heath, Timothy B., Subimal Chatterjee, and Karen Russo France (1995), "Mental Accounting and Change in Price: The Frame Dependence of Preference Dependence," *Journal of Consumer Research*, 22 (June), 90–97.

Herr, Paul M. (1989), "Priming Price: Prior Knowledge and Context Effects," *Journal of Consumer Research*, 16 (June), 67–75.

Hinrichs, James V., Janis L. Berie, and Molaan K. Mosell (1982), "Place Information in Multidigit Number Comparison," *Memory and Cognition*, 10 (September), 487–95.

Kahneman, Daniel and Amos Tversky (1979), "Prospect Theory: An Analysis of Decision under Risk," *Econometrica*, 47 (2), 313–27.

Krishnan, H. Shankar and Dipankar Chakravarti (1999), "Memory Measures for Pretesting Advertisements: An Integrative Conceptual Framework and a Diagnostic Template," *Journal of Consumer Psychology*, 8 (1), 1–37.

Lynch, John G., Jr., Howard Marmorstein, and Michael Weigold (1988), "Choices from Sets Including Remembered Brands: Use of Recalled Attributes and Prior Overall Evaluations," *Journal of Consumer Research*, 15 (September), 225–33.

Mayhew, Glenn E. and Russell S. Winer (1992), "An Empirical Analysis of Internal and External Reference Prices Using Scanner Data," *Journal of Consumer Research*, 19 (June), 62–70.

McGuire, William J. (1978), "An Information Processing Model of Advertising Effectiveness," in *Behavioral and Management Science in Marketing*, ed. Harry J. Davis and Alvin J. Silk, New York: Ronald Press, 156–80.

Monroe, Kent B. (1979), *Pricing: Making Profitable Decisions*, New York: McGraw-Hill.

——— (2003), *Pricing: Making Profitable Decisions*, 3rd ed., New York: McGraw-Hill.

Monroe, Kent B. and Angela Y. Lee (1999), "Remembering versus Knowing: Issues in Buyers' Processing of Price Information," *Journal of the Academy of Marketing Science*, 27 (2), 207–25.

Monroe, Kent B. and Susan M. Petroshius (1981), "Buyers' Perceptions of Price: An Update of the Evidence," in *Perspectives in Consumer Behavior*, 3rd ed., ed. Harold Kassarjian and Thomas S. Robertson, Glenview, IL: Scott-Foresman, 43–55.

Nisbett, Richard E. and Timothy DeCamp Wilson (1977), "Telling More Than We Can Know: Verbal Reports on Mental Processes," *Psychological Review*, 84 (May), 231–59.

Plous, Scott (1993), *The Psychology of Judgment and Decision Making*, Philadelphia: Temple University Press.

Poltrock, Steven E. and David R. Schwartz (1984), "Comparative Judgments of Multidigit Numbers," *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 10 (1), 32–45.

Schindler, Robert M. (1991), "Symbolic Meanings of a Price Ending," in *Advances in Consumer Research*, Vol. 18, ed. Rebecca H. Holman and Michael R. Solomon, Provo, UT: Association for Consumer Research, 794–801.

Schindler, Robert M. and Alan R. Wiman (1989), "Effect of Odd Pricing on Price Recall," *Journal of Business Research*, 19 (November), 165–77.

Schwarz, Wolfgang and Frank Stein (1998), "On the Temporal Dynamics of Digit Comparison Processes," *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 24 (5), 1275–93.

Slonim, Robert and Ellen Garbarino (1999), "The Effect of Price History on Demand as Mediated by Perceived Price Expensiveness," *Journal of Business Research*, 45 (May), 1–14.

Stiving, Mark and Russell S. Winer (1997), "An Empirical Analysis of Price Endings with Scanner Data," *Journal of Consumer Research*, 24 (June), 57–68.

Tabachnick, Barbara G. and Linda S. Fidell (2001), *Computer-Assisted Research Design and Analysis*, Needham Heights, MA: Allyn & Bacon.

Thomas, Manoj and Vicki Morwitz (2005), "Penny Wise and Pound Foolish: The Left-Digit Effect in Price Cognition," *Journal of Consumer Research*, 32 (June), 54–64.

Tzelgov, Joseph, Joachim Meyer, and Avishai Henik (1992), "Automatic and Intentional Processing of Numerical Information," *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 18 (1), 166–79.

Urbany, Joel E., William O. Bearden, and Dan Weilbaker (1988), "The Effect of Plausible and Exaggerated Reference Prices on Consumer Perceptions and Price Search," *Journal of Consumer Research*, 15 (June), 95–110.