ON NUMERACY AND PRICING

A Dissertation

by

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ABSTRACT

Across two laboratory studies, an eye tracking experiment, a facial recognition experiment, and a secondary data analysis, I reveal the unique interaction of numerical processing fluency and consumer numeracy as a significant determinant of consumer response to 99-ending prices. I argue that less numerate individuals create mental analog representations around 99-ending prices' left digits, whereas highly numerate individuals encode 99-ending prices as their one-cent neighbor, with consumers responding more favorably to prices when they mentally encode them around a fluent number. Specifically, highly numerate individuals respond more favorably when 99-ending prices (e.g., 17.99) border a fluent number (i.e., 18). Conversely, less numerate individuals respond more favorably when 99-ending prices (e.g., 18.99) contain fluent left digits (i.e., 18). I provide empirical evidence for the effects of this processing difference on liking, purchase intentions, and actual sales. I also obtain evidence for the underlying process using eye tracking technology that reveals that highly numerate individuals fixate more frequently and for longer durations on the right digits of a price than less numerate individuals, and using facial recognition technology that reveals that less numerate individuals exhibit greater fear than highly numerate individuals when processing multi-digit prices. The findings represent a significant contribution to the price processing literature and yield substantial managerial implications.

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INTRODUCTION

Research in behavioral pricing has evidenced the nonmonotonic nature of price response, with consumers exhibiting increased preference for certain price types (Kalyanam and Shively 1998). Such findings have set researchers on a quest to unearth the intricacies of consumer response to prices, with discoveries such as the left-digit effect (Thomas and Morwitz 2005), the right-digit effect (Coulter and Coulter 2007), and the precision effect (Thomas, Simon, and Kadiyali 2010), among others. While there still remains much to be investigated in this stream of research, the extant outcomes highlight the fact that pricing decisions should involve more than just determining the magnitude of the optimal price; marketers must also decide what type of digits to use to achieve price optimization (Thomas and Morwitz 2009).

In this dissertation, I advance the current literature by revealing the unique interaction of numerical processing fluency (King and Janiszewski 2011) and consumer numeracy (Peters et al. 2006) as a significant determinant of consumer response to prices. More specifically, I develop a theoretical framework that predicts and accounts for significant heterogeneity in consumer response to 99-ending prices as a function of one's numeracy and the associated fluency of the price in question—the result of less numerate individuals creating mental analog representations around 99-ending prices' left digits, and highly numerate individuals encoding 99-ending prices as their one-cent neighbor. Across two laboratory studies, an eye tracking experiment, and a secondary data analysis, I test the hypothesized interaction and find evidence for my conceptual framework. I find a significant difference in price processing among highly numerate and less numerate individuals such that highly numerate individuals are shown to fixate more frequently and for longer durations on the right digits of a price than less numerate individuals. The downstream effects of this processing difference are manifested in differential liking, purchase intentions, and actual sales for specifiable 99-ending prices as consumers respond more favorably to prices that they mentally encode around a fluent number (King and Janiszewski 2011). That is, because highly numerate individuals encode 99-ending prices (e.g., 17.99) around their one-cent neighbor (i.e., 18), they respond more favorably when 99-ending prices border a fluent number. Conversely, because less numerate individuals encode 99-ending prices (e.g., 18.99) around their left digits (i.e., 18), they respond more favorably when 99-ending prices contain fluent left digits. The results yield substantial managerial implications and shed light on current literature discrepancies concerning left- vs. right-digit processing.

My research contributes to the pricing literature in multiple ways. I perform, to the best of my knowledge, the first biometric investigation into consumer multi-digit processing—providing direct evidence not only for the processing mechanism set forth in this dissertation, but also for some of the previously inferred theoretical mechanisms in the price processing literature. My research also constitutes the first formal investigation of numeracy in the realm of pricing—introducing this psychological construct into the pricing literature. In doing so, my results shed light on (a) the long-standing dichotomy of left- vs. right-digit price processing; (b) the mechanism driving

99-ending prices' effectiveness; and (c) the discrepancies in the literature concerning an absent or weakened 99-ending effect.

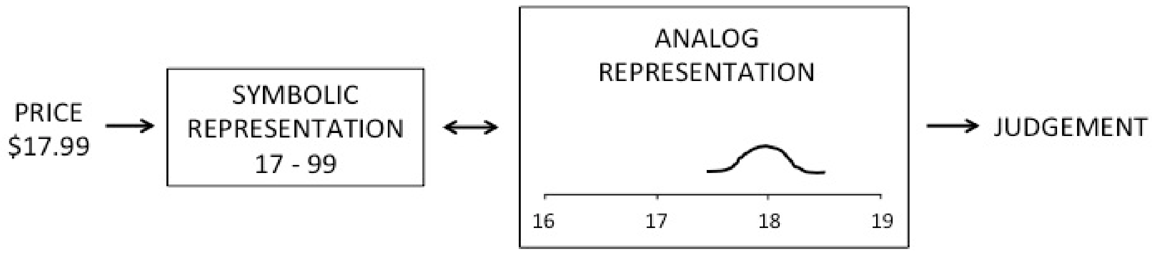
The remainder of the dissertation proceeds as follows. First, I develop a theoretical framework through a brief literature review on price processing, numeracy, and processing fluency respectively. The interplay of these phenomena in 99-ending price processing is then discussed and hypothesis are set forth. Study 1 establishes the unique interaction of numeracy and fluency in consumer processing of 99-ending prices. Study 2 reveals the underlying mechanism driving this unique interaction using biometric data from eye-tracking equipment. Study 3 demonstrates the managerial relevance of these findings in an application to product advertising and consumer purchase intentions. Finally, a secondary data analysis corroborates these findings with supermarket sales data. The dissertation then concludes with a brief recapitulation and general discussion.

LITERATURE REVIEW

Price Processing

Price processing research has largely converged on a holistic (analog) model of numerical cognition in which numbers are processed through a dedicated cognitive subsystem that assimilates and encodes numerical information as holistic magnitude representations along a mental number line oriented from left to right (Dehaene 1992, 1997; Dehaene, Dupoux, and Mehler 1990; Hinrichs, Yurko, and Hu 1981; Monroe and Lee 1999). In this process, multidigit numbers are holistically encoded as single analog representations, rather than exact numerical values, thereby affecting the precision of the encoded numbers. To illustrate through an example, this model suggests that as consumers encounter a given price (e.g., $17.99), a dedicated cognitive subsystem first detects the symbolic representation of the price (i.e., the visual Arabic numerals 17-99) and then promptly encodes it as a single analog magnitude representation (e.g., around 18) along a mental analog scale (see Figure 1). This conversion is believed to occur both automatically and subconsciously (Dehaene 1997; Pavese and Umilta 1998; Tzelgov, Meyer, and Henik 1992).

Figure 1. Holistic (Analog) Model of Numerical Cognition



*Adapted from Thomas and Morwitz

While in this example $17.99 is ultimately encoded around 18 on an internal analog scale, there is research to suggest that due to left-to-right processing (Poltrock and Schwartz 1984) consumers may alternatively tend to anchor on the leftmost digits (Thomas and Morwtiz 2005) or even ignore the right digits all together (Bizer and Schindler 2005), thereby creating a holistic magnitude representation around 17 rather than 18 on the mental number line. This processing difference can have significant downstream effects. One common marketing context where this processing dichotomy has been particularly debated is in the 99-ending literature.

99 Ending Prices. It has long been established that 9-ending prices are highly overrepresented in the marketplace (Rudolph 1954; Schindler and Kirby 1997; Schindler 2009; Twedt 1965). 99-ending prices have particularly gained the attention of marketers and researchers as they have been shown to carry an “on sale” or low-price appeal (Quigley and Notarantonio 1992; Schindler 1984, 2006; Schindler and Kibarian 2001). However, the psychological mechanism behind their popularity has been highly disputed. One common account cites prospect theory (Kahneman and Tversky 1979), suggesting that because 99-ending prices are processed as a function of their nearest reference point (i.e., the neighbor whole number), the one-cent difference constitutes a small gain through which individuals experience an increased utility (Schindler and Kirby 1997). As previously mentioned, an alternative explanation is that consumers anchor on the leftmost digits (or ignore the 99-ending completely), causing the price's magnitude to be encoded as a dollar smaller than the actual one cent difference (Thomas and Morwitz 2005). While some research has shown that 99-ending prices increase sales (Anderson and Simester 2003; Blattberg and Neslin 1990; Kalyanam and Shively 1998), other research has reported inconsistencies in, and even the absence of, 99-ending prices' effect on revenues (Blattberg and Wisniewski 1987; Georgoff 1972, Stiving and Winer 1997).

This potential difference in processing outcomes for 99-ending prices highlights a significant dichotomy in the pricing literature; specifically, that of left-digit (e.g., "digit-drop-off") versus right-digit ("e.g., price-endings") processing. While some empirical evidence has been collected for a truncation or "digit-drop-off" mechanism (Bizer and Schindler 2005), the wealth of research on price-endings would suggest that at least in some situations, if not most, consumers are processing the rightmost digits as well (Anderson and Simester 2003; Coulter and Coulter 2007, 2010; Kalyanam and Shively 1998; Schindler and Kibarian 1996; Schindler and Kirby 1997). These apparent discrepancies in the literature highlight the need for further research on numerical cognition and price processing. In the current research, I propose and identify consumer numeracy as an explanatory variable for the interplay between left- vs. right-digit processing. I also provide a potential explanation for the reported inconsistency of the 99-ending effect.

Numeracy

Numeracy is defined as the ability to process basic probability and numerical concepts (Peters et al. 2006). While there still remains much to be investigated in this stream of research, the extant findings highlight a significant difference in numerical cognition among highly numerate and less numerate individuals. As compared with highly numerate individuals, less numerate individuals have been shown to exhibit a greater susceptibility to framing effects (Peters et al. 2006), an increased propensity for mortgage default (Gerardi, Goette, and Meier 2013), and a less accurate assessment of risk in medical decision making (Reyna et al. 2009). Overall, heterogeneity in numeracy has been shown to influence the extent to which individuals correctly retrieve and apply numerical information in judgment and decision making.

Correlating these findings with the previously discussed dichotomy of left-digit versus right-digit processing, I propose that less numerate consumers, whom Peters et al. describe as “left with information that is less complete and less understood, lacking in the complexity and richness of that available to the highly numerate” (p.142), will be more likely to anchor on the left digits of a price, ignoring the full array of numerical information, and exhibiting behavior that is more consistent with the left-digit effect. Highly numerate individuals, conversely, will be more likely to give attention to the full array of digits. Consequently, I suggest that less numerate individuals will tend to create mental analog representations around a 99-ending price’s left digits, whereas highly numerate individuals will tend to encode the 99-ending price around its one-cent neighbor.

This processing difference, as I argue next, can yield substantial downstream effects, particularly when taking into account the fluency of the number around which a price is mentally encoded.

Processing Fluency

Processing fluency can be defined as the subjective experience of ease with which an incoming stimulus is processed as it enters the neural system (Reber, Wurtz, and Zimmerman 2004). Beginning with its introduction to the literature as "the mere exposure effect" (Zajonc 1968) and subsequently being recognized to encompass multiple sources and instantiations (for a review, see Alter and Oppenheimer 2009), fluency has demonstrated its far-reaching effects on consumer behavior. One of the most notable of these effects, and the most pertinent to the current research, is an amplified liking of the processed stimuli (Lee and Labroo 2004; Labroo, Dhar, and Schwartz 2008).

Research has shown that when using numbers in marketing, number liking can be an important consideration (Boyd 1985; King and Janiszewski 2011; Pavia and Costa 1993). Fluency is a substantial source of number liking, and certain numbers have been identified as more fluent than others. The repetition with which individuals practice common arithmetic problems in childhood education (e.g., 1 + 1 through 10 + 10 and 1 x 1 through 10 x 10), and the natural frequency with which these numbers are encountered in daily life, has proven to create an associative network for these numbers that is mentally more accessible and fluent (Baroody 1985). Among these numbers, fluency effects are shown to be more pronounced for common "product numbers" (i.e., 1 x 1 through 10 x 10) than "sums numbers" (1 + 1 through 10 + 10), most likely due to the common use of rote memorization in their learning as well as their inherent exclusion of prime numbers (King and Janiszewski 2011). As an example, the number 24 is found to be more fluent than the number 23. This is because 24, as a non-prime number, naturally occurs more frequently in daily interactions, and is also a common product number (i.e., 4 x 6, 3 x 8). Demonstrating the effects of this numerical fluency in marketing, King and Janiszewski (2011) establish that alphanumeric brand names employing these more fluent numbers yield increased liking from consumers. They further establish that the effect of this fluent processing not only improves brand liking, but it can also spill over to improve advertisement liking and purchase intention as well.

THEORETICAL FRAMEWORK

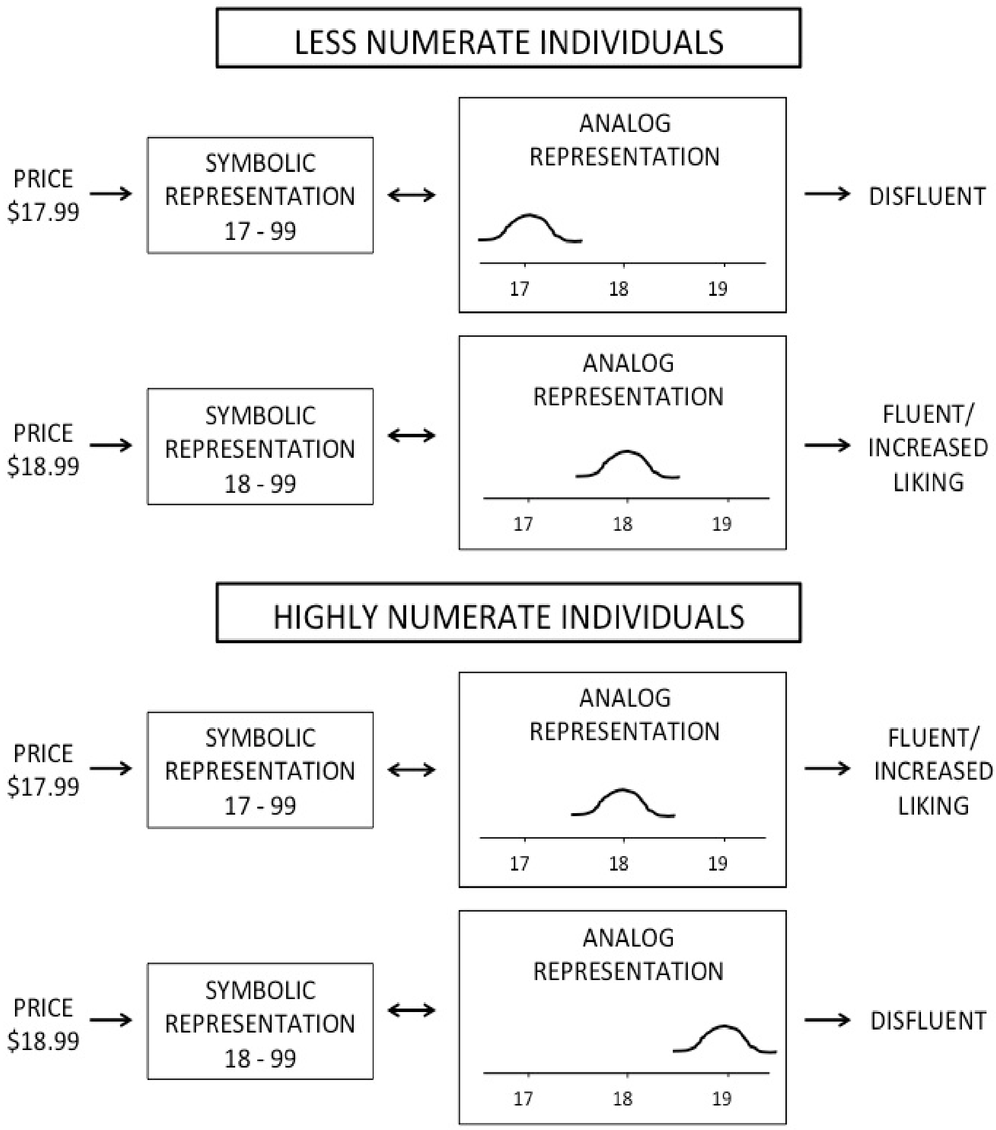
Applying this argument to the realm of pricing, one could expect fluent-base 99-ending prices such as 18.99 (i.e., a common product number: 6 x 3, 9 x 2) to be more liked than disfluent-base prices such as 17.99 (i.e., a prime number), if consumers anchor and create mental analog representations around a 99-ending price's left digits. Conversely, if consumers process the full price and analogically encode 99-ending prices around their one-cent neighbors, I would expect fluent-neighbor prices such as 17.99 (i.e., encoded around 18) to be more liked than disfluent-neighbor prices such as 18.99 (i.e., encoded around 19—a prime number). Consumer liking of 99-ending prices should therefore vary in a predictable manner with consumer numeracy, which, as I argued earlier, systematically affects how 99-ending prices are encoded.

Specifically, I hypothesize that less numerate individuals will be more likely to anchor on and mentally encode 99-ending prices around their left digits. This will lead to a greater liking for fluent-base 99-ending prices (e.g., $18.99) than disfluent-base 99-ending prices (e.g., $17.99). Conversely, highly numerate individuals will be more likely to process the full digits and mentally encode 99-ending prices around their one-cent neighbor. This will lead to a greater liking for fluent-neighbor 99-ending prices (e.g., $17.99) than disfluent-neighbor 99-ending prices (e.g., $18.99) (see Figure 2). Following the above logic, I therefore propose:

> **H1:** (a) Less numerate consumers exhibit greater liking for fluent-base 99-ending prices (e.g., $18.99) than disfluent-base 99-ending prices (e.g.,

$17.99), whereas (b) highly numerate consumers exhibit greater liking for fluent-neighbor 99-ending prices (e.g., $17.99) than disfluent-neighbor 99-ending prices (e.g., $18.99).

Figure 2. Graphical Representation of Hypothesis



EMPIRICAL RESEARCH

Study 1: Numeracy and Fluency Interaction

H1 proposes that highly numerate consumers should demonstrate an increased liking for fluent-neighbor 99-ending prices (e.g., $19.99) relative to disfluent-neighbor 99-ending prices (e.g. $18.99), while less numerate consumers should demonstrate an increased liking for fluent-base 99-ending prices (e.g. $18.99), relative to disfluent-base 99-ending prices (e.g., $19.99). A laboratory experiment was conducted to provide initial empirical support for this hypothesis.

Design and Procedure

Participants. Two hundred and ninety eight undergraduate students (152 females) from a large public university participated in the experiment in return for partial course credit. The study consisted of two parts with participants completing a twenty-minute unrelated task between each session.

Part I. Participants indicated their implicit liking or disliking for a series of 150 unique numbers (Appendix A) presented at random on a 20-inch computer screen in size 26 font. Each price was automatically populated in succession at the center of the computer screen and advanced immediately upon the participant's keyed response. A single between-subjects factor (price or number) was included in the design to account for potential processing differences in viewing numerical information as a price or a number. Participants were randomly allocated to either condition at the beginning of the survey and were presented with instructions informing them that they would be evaluating a series of prices (or numbers) during the study. In order to maintain an equal number of digits to be processed, all prices consisted of two left digits and two right digits (e.g., __ __ . __ __). Additionally, no dollar signs were included in the price condition. Instead, a small picture of a shopping aisle (abacus) was positioned at the top of the screen in the price (number) condition. This prevented the need to process an extra digit in the price condition, and served as a subtle reminder throughout the study of the type of stimuli participants were being asked to evaluate (price or number).

Participants completed a total of four evaluation sessions comprised of 99-ending prices (numbers) interspersed among filler prices (numbers) and presented at random, with a 25-second rest between each session. In order to minimize confounds and facilitate the testing of H1, my focal stimuli consisted of 99-ending prices that were inherently both fluent-base and disfluent-neighbor or disfluent-base and fluent-neighbor.[1] This allowed me the ability to distinguish consumers' mental encoding in connection with their price response. Conversely, prices such as 20.99, that are both fluent-base and fluent-neighbor, would not provide insight into consumers' processing mechanism. This is because left-digit anchoring and full price processing would both result in an increased liking, thereby masking the mechanism employed and causing any processing differences to become indistinguishable.

In order to capture participants' immediate response to each of the prices (numbers), participants were instructed to place their left index finger over the "D" key

[1] Fluent-neighbor/Disfluent-base: 17.99, 19.99, 29.99, 31.99, 87.99 and 89.99; Disfluent-neighbor/Fluent-base: 16.99, 18.99, 28.99, 30.99, 86.99, and 90.99.

and their right index finger over the “L” key, and to keep their hands in this position throughout the entirety of each evaluation session. This ensured that participants were able to respond as quickly and consistently as possible. In the task instructions, participants were encouraged to provide their initial and immediate response to the price, responding as quickly as possible while still being accurate. D was pressed for dislike and L was pressed for like. To help participants become accustomed with the method for indicating their liking or disliking for each price (number), a brief practice session with 20 random prices (numbers) was conducted before the four evaluation sessions began. Upon completing the evaluation task, participants engaged in an unrelated research study for 20 minutes before being presented with Part II.

Part II. As a measure of numeracy, participants responded to a series of eight brief computational problems which constitute the Rasch-based numeracy scale established by Weller et al. (2013). The full list of questions can be seen in Appendix B. Instructions were provided at the beginning of the study informing participants to do their best but not take too long on any single question. No calculators were made available to participants. After completing the questions, participants briefly provided some demographical information and were dismissed.

Method and Results

Variables. Numeracy was calculated as the sum of correct responses to the Rasch-based numeracy scale questions divided by the time spent answering each question. The average participant score on the Rasch-based numeracy scale was 4.65, with a median of 5, a maximum of 8, and a minimum of 0. The dependent variable was liking for each of the 99-ending prices. Price/Number condition was a binary between-subjects factor, and 99-ending price type was a binary within-subjects factor (fluent-base/fluent-neighbor). Recognizing that differences may exist in liking as a result of price magnitude (i.e., lower numbers are more frequently encountered and consumers may intrinsically respond more favorably to lower prices), I also generated a within-subjects factor to account for six different price levels among the 99-ending prices.

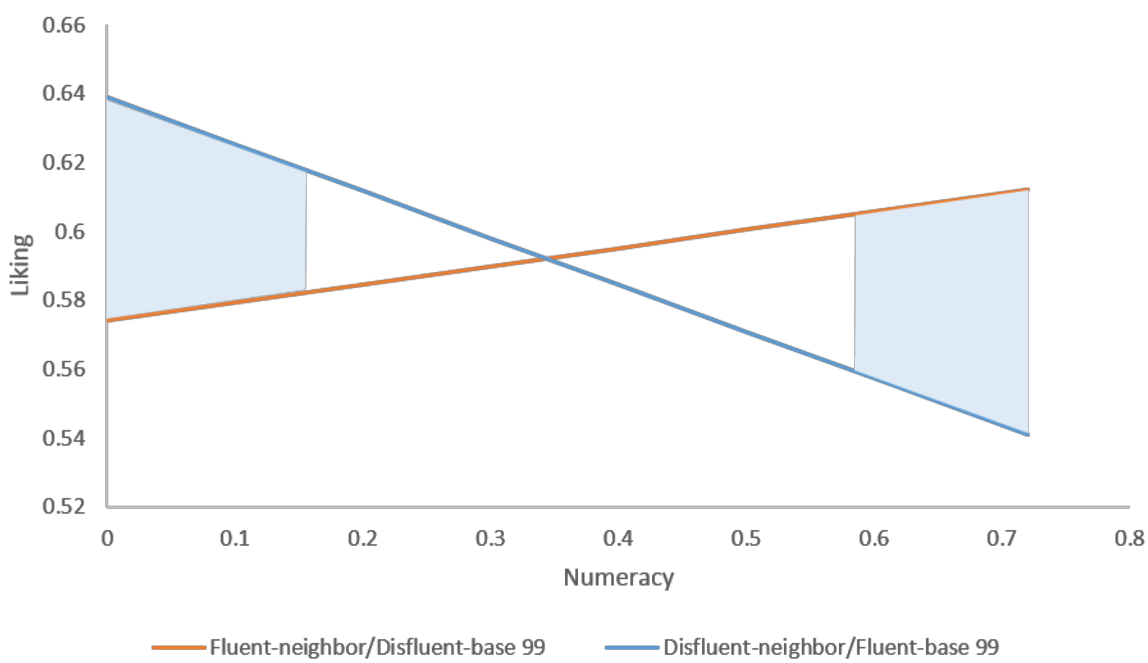
Results. Based on the experimental design and associated structure of the data, I employed a 6 (price level) x 2 (price/number) x 2 (99-ending price type) repeated measures general linear model to test for the hypothesized effects and interactions. The results indicated that neither the four-way interaction nor any of the three-way interactions reached significance. As predicted, a significant two-way interaction of numeracy and 99-ending price type emerged ($F(5, 294) = 5.38$, $p = .021$), indicating a disparity in liking for the two 99-ending price types as a function of numeracy and providing evidence for the proposed hypothesis. A price level x number/price condition interaction also reached significance, confirming that individuals exhibit higher liking for more commonly encountered lower prices (vs. numbers) ($F(5, 294) = 4.08$, $p = .044$). While the significance of the two-way interactions precludes interpretation of any of the lower order terms, there were significant main effects for price level ($F(5,294) = 6.90$, $p = .000$) and 99-ending price type ($F(5,249) = 4.933$, $p = .027$). No other effects or interactions in the model reached significance.

Recognizing that repeated observations on the same participant are not independent, and seeking to account for this potential interdependence of within participant responses, I also employed a 6 x 2 x 2 generalized linear mixed model to check the robustness of the focal interaction between numeracy and 99-ending price type. The results corroborated those of the previous analysis with a significant two-way interaction of numeracy and 99-ending price type ($\beta = 1.360$, $p = .038$). Following the guidelines set forth by Spiller et al. (2013), I probed the pattern of this interaction by performing a floodlight analysis to investigate the simple effects of 99-ending price type at each level of numeracy, as well as identify the Johnson-Neyman (1936) region of significance. As seen in Figure 3, highly numerate participants exhibited greater liking for fluent-neighbor 99-ending prices than disfluent-neighbor 99-ending prices, while less numerate participants exhibited greater liking for fluent-base 99-ending prices than disfluent-base 99-ending prices. The results support H1.

Discussion

The collective results of these analyses evidence a robust interaction of numeracy and 99-ending price type as predicted in H1. As hypothesized, highly numerate and less numerate individuals respond differently to 99-ending prices as a function of their numeracy. More specifically, for highly numerate individuals, greater liking was demonstrated for fluent-neighbor 99-ending prices (e.g., $17.99) than for fluent-base 99-ending prices (e.g., $18.99)—suggesting an analog processing mechanism whereby highly numerate individuals are more likely to process the full price and encode it as its one-cent-neighbor than its base. Conversely, for less numerate individuals, a greater liking was exhibited for fluent-base 99-ending prices (e.g., $18.99) than disfluent-base 99-ending prices (e.g., $17.99)—suggesting an analog processing mechanism consistent with the left-digit effect (Thomas and Morwitz 2005) whereby less numerate individuals are more likely to ignore the right digits and encode the price around its base. Having provided empirical support for H1, Study 2 aims to investigate the proposed mechanisms for these observed effects through an in-depth, biometric analysis using eye-tracking equipment.

Figure 3. Liking for 99-ending Price Type by Numeracy



Study 2: Eye Tracking

Eye tracking equipment provides arguably one of the most direct and objective means of measuring individuals' attention as they encode and process target information. Through examining the movements of an individual's eyes, one can reveal the order, frequency, and duration of an individual's visual attention as he/she processes information. Seeking to investigate the hypothesized mechanism driving the effects in Study 1, and recognizing the great opportunity to objectify much of the previously inferred processes in the marketing literature, I conducted an eye tracking study to uncover the unique processes whereby highly numerate and less numerate individuals process numerical price information. To the best of my knowledge, this is the first study to biometrically examine the manner in which consumers process price digits, and thus provides a substantial contribution to both the numerical cognition and marketing literatures.

Design and Procedure

The experiment was run using a Tobii Pro TX300 screen-based eye tracker with a sampling rate of 120Hz (i.e., 120 data samples were collected for each eye per second), and a standard gaze accuracy of 3° - 6° (i.e., 4 -7 millimeters). The precision of this premium research equipment provided an ideal means for investigating the hypothesized effect of numeracy on multi-digit price processing, and the unobtrusive nature of a screen-based system allowed for a natural experience among participants (unlike other systems that require a chin rest or detached monitor).

Central to the experiment's focal research question of price processing differences among highly numerate and less numerate individuals, was the relative frequency and duration with which participants view the right and left digits of multi-digit prices. This was operationalized through two key eye-tracking metrics: *fixation count* and *fixation duration*. As a brief explanation of these metrics and overview of eye tracking in general, the movement of an individual's eyes while processing visual information is characterized by a series of sequential *fixations* and *saccades* that can be used to identify the visual attention of the individual. More specifically, fixations are pauses in the continual movement of the eyes (generally between 60-600 milliseconds) that are connected by an endless frequency of rapid saccades (on average between 20-40 milliseconds each) while jumping from one fixation to another. Eye trackers use near-infrared light to create reflections on an individual's eyes and infer fixation and saccade location through sensors that send and receive this infrared illumination. The location of these fixations indicates what information was processed by an individual when viewing a given stimulus. As such, one can use the frequency and duration of an individual's fixations to determine the extent of an individual's attention to specific *areas of interest* (*AOIs*) as defined by the research question. In this particular study, the AOIs were defined as the left and right digits of the multi-digit prices.

As outlined in my theoretical framework, I propose that a difference in price processing exists among highly numerate and less numerate individuals such that less numerate individuals are more likely to ignore the right digits of prices and mentally encode them around their left digits while highly numerate individuals are more likely to process the full price. This difference in processing mechanisms should be evident in an increased focus on the right digits by highly numerate individuals relative to less numerate individuals as operationalized by fixation count and fixation duration in the right digits AOI. Formally,

H2: Highly numerate consumers (a) fixate more frequently and (b) fixate longer on the right digits of prices than less numerate individuals.

Participants. Two hundred and one undergraduate students (118 females) from a large public university participated in the experiment in return for partial course credit. The study consisted of two-parts with roughly one week between each session.

Part I. Participants responded to the eight Rasch-based numeracy scale questions (Weller et al. 2013) as outlined in Study 1. Instructions were once again provided at the beginning of the study informing participants to do their best but not take too long on any single question, and no calculators were made available to participants. After completing the questions, participants provided some brief demographical information and then signed up for a return appointment roughly one week later.

Part II. Participants indicated their immediate liking or disliking for a series of 92 multi-digit prices presented in size 57 font at the center of a 23" eye tracking monitor. Participants were instructed to use the "D" and "L" keys to indicate their implicit disliking or liking for each given price, and the order was once again counterbalanced to be completely random. The study administrator ensured that participants were seated at the ideal distance (58 cm) and visual angle (< 35̊) from the screen for precise data collection, and then proceeded to calibrate the equipment to each individual's unique eyes. Following calibration, the study administrator left the room and allowed the participants to complete the study alone (candidly observing behind two-way glass from the neighboring room). Participants first completed a brief practice session with 20 prices to become acquainted with the procedure before the evaluation sessions began. Participants completed a total of four evaluation sessions, each with 99-ending and filler prices presented at random, and a 25 second rest between each session. Following the study, participants were debriefed, thanked, and dismissed.

Results

The average numeracy score was 4.91 with a median of 5, a maximum of 8, and a minimum of 1. The results of a Cooks D, DFBetas, and Externally Studentized Residuals analyses recommended the removal of three outliers. As predicted, the results confirmed numeracy as a significant predictor of right digit fixation count ($\beta = 5.501$, $p = .032$) with highly numerate individuals fixating more frequently on the right digits than less numerate individuals. Right digit fixation duration was likewise significantly predicted by numeracy ($\beta = 1.296$, $p = .030$) with highly numerate individuals fixating for longer on the right digits than less numerate individuals. As expected, no significant differences existed for numeracy on left digit fixation count ($\beta = -1.056$, $p = .700$) or left digit fixation duration ($\beta = -.602$, $p = .465$), confirming that individuals gave roughly the same focus to the left digits regardless of numeracy.[2]

[2] While H2 does not predict any differences for 99-ending prices relative to other multi-digit prices, we also analyzed the data exclusively for the same twelve focal 99-ending prices in Study 1 and found the same results (Right-digit fixation count: $\beta = 0.686$, $p = .032$; Left-digit fixation count: $\beta = 0.061$, $p = .874$; Right-digit fixation duration: $\beta = 0.143$, $p = .048$; Left-digit fixation duration $\beta = -0.034$, $p = .765$).

A mediation analysis (PROCESS Model 4, bootstrapping samples=5,000, Hayes 2018) further revealed a significant indirect effect of numeracy on liking for fluent-neighbor 99-ending prices through right-digit fixation count (95% CI=.0014~.0854)), while the direct effect of numeracy on liking for fluent-neighbor 99-ending prices was not significant (p = .279). These results were likewise replicated for fixation duration, with right-digit fixation duration significantly mediating the effect of consumer numeracy on liking for fluent-neighbor 99-ending prices (95% CI=.0001~.0854; p = .282 for the direct effect).

Discussion

Consistent with the basic premise of my theoretical argument, the results of this eye tracking study reveal a meaningful difference in multi-digit price processing for highly numerate and less numerate individuals. Specifically, the results indicate that highly numerate individuals fixate more frequently and for longer durations on the right digits of prices than less numerate individuals, and that this difference mediates the effect of consumer numeracy on liking for fluent-neighbor 99-ending prices. This processing difference supports the hypothesized mechanism that less numerate individuals tend to ignore the right digits of prices, thus creating a mental representation around the left digits, while highly numerate individuals are more likely to process the full digits thus encoding the price around its one-cent-neighbor.

Figure 4. Eye Tracking Results

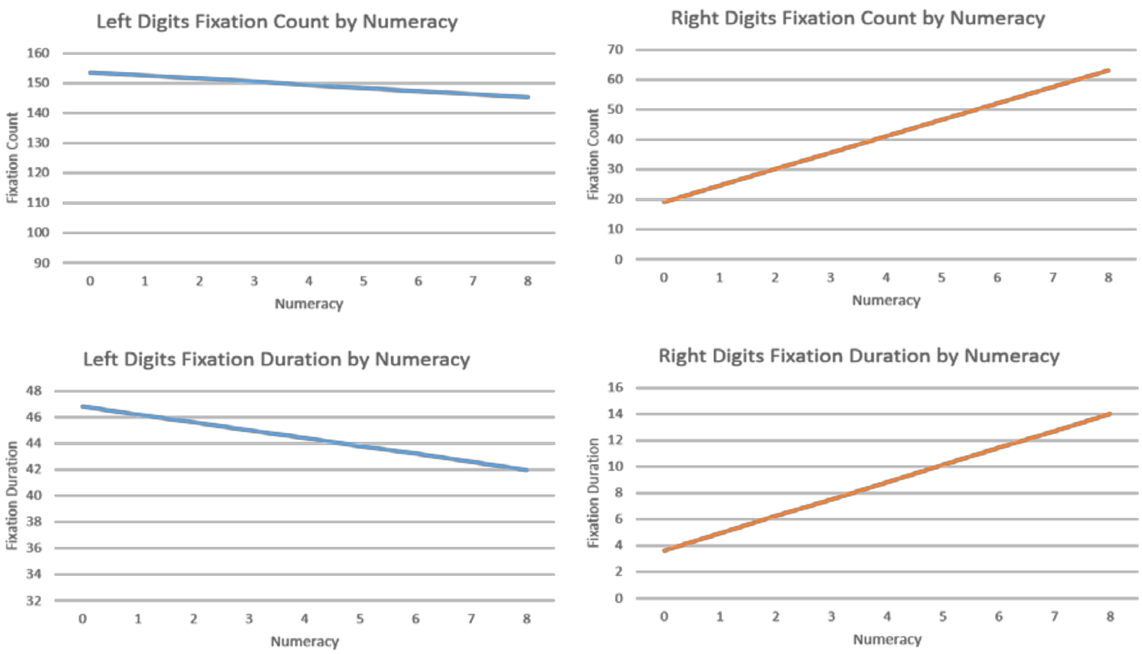
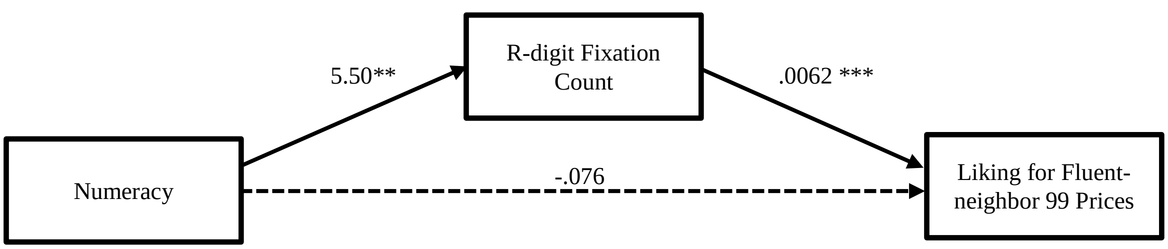


Figure 5. Study 2 Mediation Results



* *p*<.1; ** *p*<.05; *** *p*<.01

Study 3: Facial Recognition

Recognizing this fundamental processing difference among highly numerate and less numerate individuals, and having demonstrated its effect on consumer response to

99-ending prices in Study 1, in this study I aim to further illuminate the underlying process for this effect through an additional biometric investigation. Specifically, while Study 2 provides objective eye tracking evidence for the proposed theoretical framework (i.e., that less numerate individuals are more likely to anchor on and mentally encode 99-ending prices around their left digits, while highly numerate individuals are more likely to process the full digits and mentally encode 99-ending prices around their one-cent neighbor), an understanding of *why* less numerate and highly numerate individuals behave this way warrants further investigation.

Drawing on research in math education and psychology, I propose that a potential explanatory variable for the observed processing difference among highly numerate and less numerate individuals is that less numerate individuals may experience greater negative emotion relative to highly numerate individuals when processing multi-digit prices. Specifically, akin to the construct of math anxiety (Ashcraft 2002; Tobias 1995) and its ability to hamper working memory and executive functioning (Ashcraft and Kirk 2001; Ashcraft and Krause 2007), I suggest that less numerate individuals may, to some degree, experience anxiety or fear in tasks involving numbers. Indeed, Peters et al.'s (2006) initial investigation of numeracy, appears to provide some preliminary evidence that less numerate individuals may experience greater negative emotion relative to highly numerate individuals when processing numerical information (p. 412). Formally, I postulate that

> **H3:** (a) Less numerate consumers exhibit greater negative emotion while processing multi-digit prices than highly numerate consumers.

Design and Procedure

Seeking to employ an objective means of measuring consumer emotion, I ran the experiment using iMotions Affectiva AFFDEX Facial Expression software to capture participants' facial expressions in real time as they processed multi-digit prices. The software uses camera sensors at 30Hz (i.e., 30 data samples per second) to detect and instantaneously classify 20 unique muscle movements (AUs-Actions Units) produced by the facial nerve that combine to constitute facial expressions as classified by the Emotion Facial Action Coding System (EMFACS) developed by Ekman and Friesen (1978, 2002). These facial expressions are then algorithmically mapped onto 7 basic emotions by the Affectiva AFFDEX emotion recognition engine of the software (Joy, Anger, Disgust, Surprise, Fear, Sadness, Contempt). The equipment and software were completely non-invasive to participants, helping facilitate and capture their natural behavior as they completed the price processing task.

Participants. One hundred and seventy undergraduate students (84 females) from a large public university participated in the experiment in return for partial course credit. The study consisted of two-parts with roughly one week between each session.

Part I. Participants responded to the same eight Rasch-based numeracy scale questions (Weller et al. 2013) as outlined in the previous two studies. The procedure was identical to that of Study 2 with no calculators being made available to participants. After completing the questions, participants provided some brief demographical information and then signed up for a return appointment roughly one week later.

Part II. Participants completed the same task as in the previous two studies, using the “D” and the “L” keys to indicate their immediate liking or disliking for a series of 150 multi-digit prices presented in size 57 font at the center of a 20” screen. Prior to beginning, the study administrator ensured that participants were seated correctly in front of the screen to allow for collection of the facial expression data and then left the room to allow the participants to complete the study alone (while candidly observing behind two-way glass from the neighboring room). As with the previous studies, participants completed a total of four evaluation sessions, each with 99-ending and filler prices presented at random, and a 25 second rest between each session. Following the study, participants were debriefed, thanked, and dismissed.

Variables and Results

Numeracy was calculated as the sum of correct responses to the Rasch-based numeracy scale questions divided by the time spent answering each question. The average participant score on the eight questions was 4.54, with a median score of 4, a maximum score of 8, and a minimum score of 1. iMotions facial recognition software calculates each of the seven Affectiva AFFDEX emotion variables (see prior description) as the number of frames in which the respective emotion was expressed by a participant across the stimuli. As predicted, an analysis of the data revealed a significant negative relationship between numeracy and fear ($\beta = -12.937$, $p = .037$) such that as numeracy increased, fear decreased among participants (and vice versa). No other emotions were significantly predicted by numeracy. These results confirm H4, providing objective biometric evidence that less numerate consumers exhibited greater anxiety than highly numerate consumers while processing prices, and giving greater insight into the underlying mechanisms for the effects set forth in this dissertation.

Studies 4A and 4B: Advertising and Purchase Intentions

Having demonstrated the interaction of numeracy and fluency in shaping consumer response to 99-ending price points, and shed light on the underlying process mechanism for this effect using biometric technologies, Studies 4A and 4B aim to demonstrate the managerial relevance of these findings by extending its influence to the realm of product advertising and consumer purchase intentions. Specifically, I hypothesize that the increased liking associated with fluently processed 99-ending prices will spill over to positively influence purchase intention. As before, this increased liking should be a function of consumers' numeracy and the advertised 99-ending price type. Formally,

> **H4:** (a) Less numerate consumers exhibit greater purchase intentions for products advertised with fluent-base 99-ending prices (e.g., \$18.99) than those advertised with disfluent-base 99-ending prices (e.g., \$17.99), whereas (b) highly numerate consumers exhibit greater purchase intentions for products advertised with fluent-neighbor 99-ending prices (e.g., \$17.99) than those advertised with disfluent-neighbor 99-ending prices (e.g., \$18.99)

Design and Procedure

Participants. Two hundred and fifty two undergraduate students (135 females) from a large public university participated in the experiment in return for partial course credit. The study consisted of two-parts with participants completing a fifteen minute filler task between each session.

Part I. Participants evaluated a series of six print advertisements comprised of three test advertisements and three filler advertisements presented in alternating order (i.e., filler, test, filler, test, filler, test) on a 20" computer screen. The test advertisements can be seen in Appendix C. The filler advertisements remained constant across all participants, but the test advertisements were counterbalanced. Participants were randomly allocated to one of two 99-ending price conditions (fluent-base: $18.99, $30.99, $90.99; or fluent-neighbor: $17.99, $29.99, $89.99). After viewing each ad, participants indicated their purchase intention for the advertised item on a nine-point scale (endpoints "Very Likely" and "Very Unlikely") and the next advertisement automatically populated.

Part II. The procedure was identical to that of Part II in Study 1. Participants responded to the eight Rasch-based numeracy questions (Weller et al. 2013) without the use of calculators. Instructions were provided at the beginning of the study informing participants to do their best but not take too long on any single question. After completing the questions, participants briefly provided some demographical information and were dismissed.

Method and Results

Variables. The study used a 3 (ad price level) x 2 (99-ending price type) repeated measures design with numeracy as a continuous variable. Price level was a within-subjects factor and 99-ending price type was a between-subjects factor. Numeracy was calculated as the sum of correct responses to the Rasch-based numeracy scale questions divided by the time spent answering each question. The average participant score on the eight questions was 5.08, with a median score of 5, a maximum score of 8, and a minimum score of 1. The dependent variable was purchase intention as measured on a nine-point scale.

Results. The data was analyzed using a 3 x 2 repeated measures general linear model with numeracy as a continuous variable. As predicted, the results revealed a significant interaction between 99-ending price type and numeracy ($F(1,248) = 7.38$, $p = .007$), indicating that purchase intention for the focal products varied by an individual's numeracy and the 99-ending price type (fluent-base or fluent neighbor).[3] To facilitate the interpretation of this significant interaction, I probed the pattern of the interaction and used the macro provided by Andrew F. Hayes (2009) to perform a floodlight analysis (Spiller et al. 2013) and identify the Johnson-Neyman (1936) region of significance. As shown in Figure 5, highly numerate participants exhibited greater purchase intentions for products advertised with fluent-neighbor 99-ending prices than those advertised with disfluent-neighbor 99-ending prices, while less numerate participants exhibited greater purchase intentions for products advertised with fluent-base 99-ending prices than those advertised with disfluent-base 99-ending prices. The results support H4.

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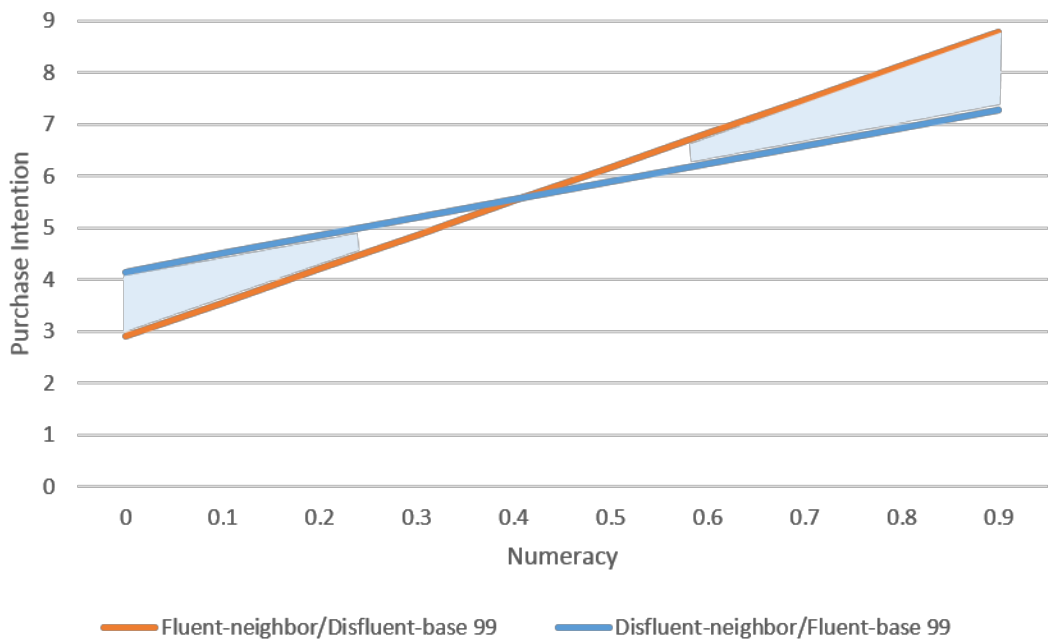
[3] Consistent with Study 1, the main effect for price level was significant ($F(1,248) = 32.06$, $p = .000$), confirming the expected preference for the more common, lower-level prices. The main effect for numeracy was significant ($F(1,294) = 11.91$, $p = .001$), suggesting that participants' liking of the prices increased with their numeracy. The main effect for 99-ending price type was also significant ($F(1,294) = 7.09$, $p = .008$), suggesting that on average participants liked the fluent-base prices more. No other effects reached significance.

Figure 6. Purchase Intention for 99-ending Price Ads by Numeracy



Study 4B

Recognizing a potential confound in Study 4A, and seeking to rule out alternative explanations, we replicated Study 4A using a revised set of prices. While in Study 4A each of the fluent-neighbor prices were coincidentally lower than the fluent-base prices at each of the given price-levels, in Study 4B we revised the price stimuli to reverse this trend (i.e., fluent-base: $18.99, $30.99, $88.99; fluent-neighbor: $19.99, $31.99, $89.99).

Procedure and Results. One hundred and thirty undergraduate students (54 females) from a large public university participated in the experiment in return for partial course credit. Identical to Study 4A, the study consisted of two parts with participants completing a brief filler task between each session, and with the revised prices replacing the previous prices in each of the original advertisements. The results replicated Study 4A, revealing the same two-way interaction between 99-ending price type and numeracy ($F(1,126) = 3.55$, $p = .062$) with highly (less) numerate individuals exhibiting greater purchase intentions for products advertised with fluent-neighbor (fluent-base) 99-ending prices than disfluent-neighbor (disfluent-base) 99-ending prices.[4]

Study 5: Secondary Data Analysis

In one final test of the demonstrated interaction, and seeking to further establish its managerial relevance, I examined the Dominick's database (provided by the University of Chicago) as has been commonly employed in marketing research (Tsiros and Hardesty 2010; Mace and Neslin 2004). The dataset consists of weekly sales volume and pricing data at the UPC level across 399 weeks for multiple product categories from 96 Dominick's grocery stores in the greater Chicago metropolitan area. The dataset also contains store-level demographic variables, giving each store a unique identity. Combined, these variables afford me the unique ability to test the afore-evidenced interaction of 99-ending prices across Dominick's stores using weekly sales volume as the dependent measure.

Using education as a proxy for numeracy, I first investigated the interaction of 99-ending price type and store-level numeracy across all UPCs and fluent/disfluent

[4] Consistent with Study 1 and Study 4A, the main effects for price level ($F(1,126) = 19.43$, $p = .000$) and 99-ending price type ($F(1,126) = 3.68$, $p = .057$) were significant. No other effects reached significance.

neighbor 99-ending prices in the Dominick's dataset[5] controlling for income, ethnicity, age, and household size. As predicted, the results revealed a significant and positive interaction effect ($\beta = 0.852$, $p < .01$, see Table 1) such that as store education-level increased, more units were sold when UPCs were priced at fluent-neighbor 99-ending prices than fluent-base 99-ending prices. Ruling out a potential alternative explanation that income may truly be driving the effect (despite controlling for it in the previous analysis), I ran the same analysis substituting income for education in the focal interaction, and the interaction was not significant ($\beta = 0.103$, $p = .290$). To provide a more stringent test and control for potential confounds, I subsequently sought to reduce the data to a set of UPCs that were 1) available in the majority of stores, and 2) periodically priced at both fluent-neighbor and disfluent-neighbor prices. This allowed me to test the interaction on the same products, sold in the same stores, but priced periodically at both fluent-neighbor and disfluent-neighbor prices. A search of the data revealed one such set of UPCs—priced periodically at both $10.99 and $11.99 and sold in a total of 74 different Dominick's stores.

An analysis of this reduced dataset once again revealed the hypothesized interaction ($\beta = 3.144$, $p < .05$), suggesting that more of the UPCs were sold when priced at a fluent-neighbor price than disfluent-neighbor price for highly numerate consumers, and more of the UPCs were sold when priced at a fluent-base price than disfluent-base price for low numerate consumers (see Figure 6). In sum, these analyses corroborate the

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[5] 12.99 and 13.99 were withheld from the analysis because of confounding superstitions regarding the number 13. 27.99, 28.99, 29.99 were also withheld because of insufficient observations.

findings of the previous studies, while simultaneously strengthening the managerial relevance of the identified interaction and demonstrating its implications in the marketplace.

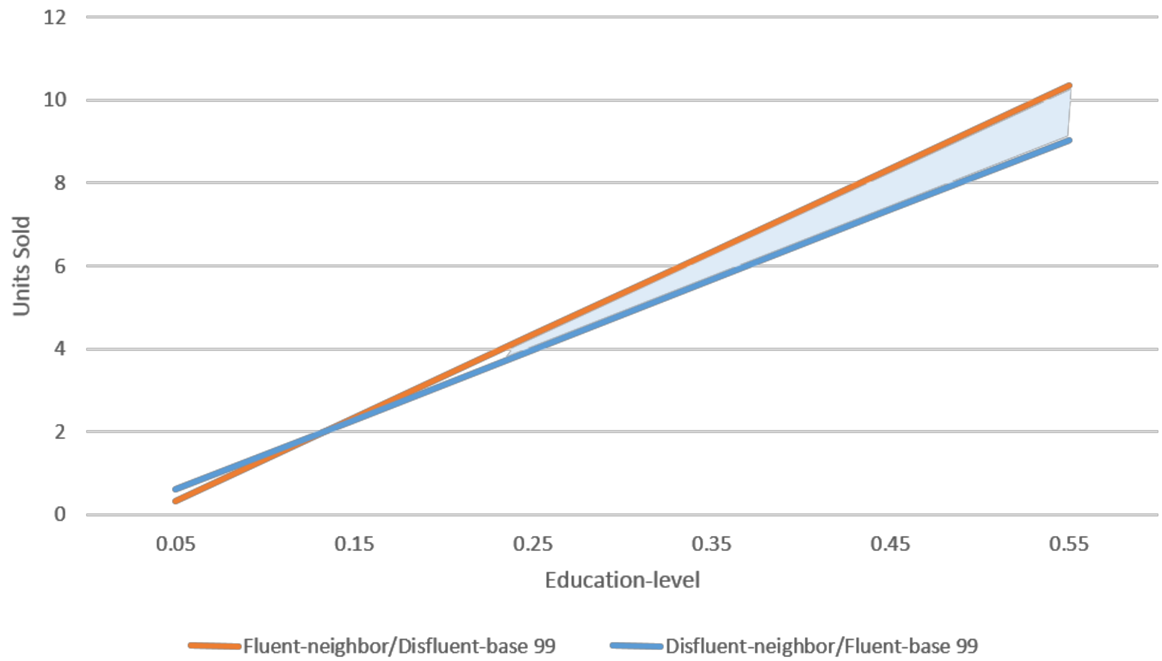
Table 1. Dominick's Data Results

	Full Prices/UPC's				Reduced Set			
	Focal Variables		*With Control Variables*		*Focal Variables*		*With Control Variables*	
Variables[a]	**B**	**(SE)**	**B**	**(SE)**	**B**	**(SE)**	**B**	**(SE)**
Intercept	1.975***	(.038)	-8.456***	(1.220)	1.224***	(0.271)	-0.481	(6.449)
Price Type	0.018	(.061)	0.000	(0.061)	- .612	(0.404)	-0.425	(0.395)
Education	2.354***	(.146)	3.385***	(0.266)	10.942***	(0.967)	16.877***	(1.622)
Price Type*Education	0.760***	(.238)	0.852***	(0.237)	3.893***	(1.449)	3.144**	(1.410)
Income			0.683***	(0.132)			-0.847	(0.739)
Ethnicity			1.655***	(0.139)			2.902***	(0.651)
Age			6.686***	(0.303)			13.727***	(1.932)
Household size			0.576***	(0.091)			2.289***	(0.538)

<.05 *<.01

[a]Education=% College Graduates, Income=Log of Median Income, Ethnicity=% Blacks and Hispanics, Age=% over age 60, Household size=Average Household size

Figure 7. Dominick's Sales for Price Type by Education-Level



CONCLUSION

Across two laboratory studies, an eye tracking experiment, a facial recognition experiment, and a secondary data analysis I reveal the unique interplay of consumer numeracy and processing fluency as a significant determinant of consumer response to 99-ending prices. I identify a significant difference in price processing among highly numerate and less numerate individuals such that highly numerate individuals are shown to fixate more frequently and for longer durations on the right digits of a price than less numerate individuals, and less numerate individuals are found to exhibit greater fear than highly numerate individuals when processing multi-digit prices. The downstream effects of this processing difference are manifested in differential liking, purchase intentions, and historical sales data for 99-ending prices—the result of less numerate individuals creating mental analog representations around 99-ending prices' left digits, and highly numerate individuals encoding 99-ending prices as their one-cent neighbor. More specifically, certain numbers are recognized to evoke greater liking from consumers as a result of the fluency with which they are mentally processed. Because highly numerate individuals encode 99-ending prices around their one-cent neighbor, they respond more favorably when 99-ending prices border a fluent number. Conversely, because less numerate individuals encode 99-ending prices around their left digits, they respond more favorably when 99-ending prices contain fluent left digits. These differential preferences are reflected in consumers' liking, purchase intentions, and actual purchases. These findings represent a significant contribution to the price processing literature and yield substantial managerial implications.

Theoretical Contributions

I perform, to the best of my knowledge, the first biometric investigation into consumer multi-digit processing. Specifically, I employ eye-tracking technology and facial recognition software to capture consumers' digital processing of prices—providing direct evidence not only for the processing mechanism set forth in this dissertation, but also for some of the previously inferred theoretical mechanisms in the price processing literature. My results reveal a substantial difference in consumers' digital processing with highly numerate consumers giving more attention to the right digits of a price than less numerate consumers, and less numerate consumer exhibiting greater fear than highly numerate consumers when processing multi-digit prices.

My eye tracking results also shed light on some of the previously suggested price processing mechanisms in the literature. I find preliminary support for both the left-digit effect (Thomas & Morwtiz 2005) and a digit-drop-off mechanism (Bizer and Schindler 2005) while simultaneously revealing that these effects are contingent on consumer numeracy. The eye tracking data also supports the long-standing left-to-right processing mechanism suggested by Poltrock & Schwartz (1984).

My research constitutes the first formal investigation of numeracy in the realm of pricing—introducing this psychological construct into the pricing literature (Chen and Rao 2007; Chen et al. 2012). In doing so, my findings help resolve a long-standing debate in the price processing literature concerning left- vs. right-digit processing. While previous research has found evidence for both left-digit and right-digit effects, my research contributes to this dialog through the discovery of consumer numeracy as a significant determinant of digital processing. My results suggest that right-digit effects should be more pronounced among highly numerate consumers while left-digit effects will primarily occur among less numerate consumers.

In addition, my results also shed increased light on the highly-debated mechanism driving 99-ending prices' effectiveness, as well as offer a potential explanation for the discrepancies in the literature concerning an absent or weakened 99-ending effect. As noted at the onset of the dissertation, the literature remains inconclusive as to the reason for 99-ending prices' effectiveness, with the existence of three major theories (a left-digit magnitude effect, a right-digit signaling effect, and a reference-price small gain effect). While not the focus of the current research, my results suggest that highly numerate individuals respond favorably to 99-ending prices either as a result of a right-digit effect or a reference-price effect. Conversely, less numerate individuals respond more favorably as a result of a left-digit effect.

Concerning unresolved literature reports of a weakened 99-ending effect, my results offer a potential explanation; namely, given the numeracy of the sampled population and the type of 99-ending prices investigated, the additive or absent effect of fluency in connection with each of the above-mentioned effects would serve to strengthen or weaken consumer response to 99-ending prices. Specifically, a strengthened 99-ending effect would be expected for fluent-neighbor (fluent-base) 99-ending prices among highly (less) numerate consumers, while a weakened 99-ending effect would be expected for disfluent-neighbor (disfluent-base) 99-ending prices among highly (less) numerate consumers. This is because the strength of consumer response to 99-ending prices should fluctuate according to the combined effect of fluency and the other proposed mechanisms, as dictated by consumer numeracy and the type of 99-ending price in question.

Managerial Implications

In today's marketplace, firms are able to employ personalized pricing with unprecedented ease and at minimal cost given the ever-increasing popularity of computer-mediated shopping environments. Marketers use such information as geographic location (Jank and Kannan 2005), device type (Valentino-Devries, Singer-Vine, and Soltani 2012), and purchase history (Acquisti and Varian 2005) among a myriad of other potential variables (Schiller 2014) to estimate consumers' willingness to pay and then present a customized price accordingly. With the exception of some words of caution (Choudhary et al. 2005; Haws and Bearden 2006; Streitfeld 2000), marketing academics and practitioners alike have found this to be a profitable practice (Acquisti and Varian 2005; Ghose and Huang 2009; Tanner 2014).

My findings corroborate and further highlight the nonmonotonic nature of price response, with consumers responding more favorably to particular price points. This once again highlights the fact that pricing decisions should involve more than just determining the magnitude of the optimal price; marketers must also decide what type of digits to use to achieve price optimization (Thomas and Morwitz 2009). While previous research has primarily focused on the use of fluent numbers in brand names, my research extends these findings to the realm of pricing. More specifically, although 99-ending prices are almost ubiquitous in today's marketplace, my findings suggest that not all 99-ending prices are created equal. I observe significant heterogeneity in consumer response to 99-ending prices, and more importantly, identify the interaction between consumer numeracy and numerical fluency as a managerial guide for determining which consumers will respond more favorably to which 99-ending prices, and why.

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APPENDIX A

Study 1: Price Stimuli Table

0	0.99	0.09	BdayDay	BdayMo	Random	Random	Random	Random	Random
16.00	16.99	16.09	16.day	16.mo	16.37	28.51	86.37	16.38	16.31
17.00	17.99	17.09	17.day	17.mo	16.71	28.61	86.71	17.31	17.62
18.00	18.99	18.09	18.day	18.mo	16.73	28.63	86.73	18.73	18.34
19.00	19.99	19.09	19.day	19.mo	17.42	29.34	87.42	19.72	19.76
20.00	20.99	20.09	20.day	20.mo	17.46	29.47	87.46	20.37	20.41
28.00	28.99	28.09	28.day	28.mo	17.64	29.74	87.64	28.76	28.37
29.00	29.99	29.09	29.day	29.mo	18.47	30.47	88.47	29.61	29.31
30.00	30.99	30.09	30.day	30.mo	18.71	30.71	88.71	30.76	30.21
31.00	31.99	31.09	31.day	31.mo	18.74	30.74	88.74	31.74	31.42
32.00	32.99	32.09	32.day	32.mo	19.34	31.46	89.46	32.73	32.47
86.00	86.99	86.09	86.day	86.mo	19.43	31.47	89.47	86.41	86.34
87.00	87.99	87.09	87.day	87.mo	19.47	31.64	89.64	87.34	87.31
88.00	88.99	88.09	88.day	88.mo	20.67	32.67	90.67	88.37	88.31
89.00	89.99	89.09	89.day	89.mo	20.71	32.71	90.71	89.31	89.71
90.00	90.99	90.09	90.day	90.mo	20.76	32.76	90.76	90.47	90.26

APPENDIX B

Rasch-based Numeracy Scale Questions

1. Imagine that we roll a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up as an even number?
2. In the BIG BUCKS LOTTERY, the chances of winning a $10.00 prize are 1%. What is your best guess about how many people would win a $10.00 prize if 1,000 people each buy a single ticket from BIG BUCKS?
3. In the ACME PUBLISHING SWEEPSTAKES, the chance of winning a car is 1 in 1,000. What percent of tickets of ACME PUBLISHING SWEEPSTAKES win a car?
4. If the chance of getting a disease is 10%, how many people would be expected to get the disease out of 1000?
5. If the chance of getting a disease is 20 out of 100, this would be the same as having a _____% chance of getting the disease.
6. Suppose your friend just had a mammogram. The doctor knows from previous studies that, of 100 women like her, 10 have tumors and 90 do not. Of the 10 who do have tumors, the mammogram correctly finds 9 with tumors and incorrectly says that 1 does not have a tumor. Of the 90 women without tumors, the mammogram correctly finds 80 without tumors and incorrectly says that 10 have tumors. The table below summarizes this information. Imagine your friend tests positive (as if she had a tumor). What is the likelihood that she actually has a tumor?

	Tested Positive	Tested Negative	Totals
Actually has a tumor	9	1	10
Does not have a tumor	10	80	90
Totals	19	81	100

7. A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?
8. In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?

APPENDIX C


In-Store
AVAILABLE
Online
$17 99
EACH
NANTUCKET
BEACH HUTS


In-Store
AVAILABLE
Online
$18 99
EACH
NANTUCKET
BEACH HUTS


NFL
SUNDAY
TICKET
TVU
STUDENT PRICE ONLY
$29 99
FOR REST OF THE SEASON
Out-of-market games only. Eligibility requirements and other conditions apply.
Visit us online for details.


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TIRES PLUS
TOTAL CAR CARE
STANDARD
BRAKE SERVICE
$89 99
Service Includes: · Lifetime Parts Warranty · Free Brake Inspection · Install New Wagner® Thermo-Quiet Brake Pads · Resurface Rotors
Most vehicles, per axle. Installation required. See store for complete service description and Lifetime Pad/Shoe Replacement Warranty details. Redeem this coupon at your participating Tires Plus store. Not to be combined with another offer on same product or service and not to be used to reduce outstanding debt. No Cash value. Offer void where prohibited.


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Most vehicles, per axle. Installation required. See store for complete service description and Lifetime Pad/Shoe Replacement Warranty details. Redeem this coupon at your participating Tires Plus store. Not to be combined with another offer on same product or service and not to be used to reduce outstanding debt. No Cash value. Offer void where prohibited.