CONSUMER UNDERSTANDING AND USE OF NUMERIC INFORMATION IN PRODUCT CLAIMS

by

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Numeric information is often presented to consumers in order to communicate important and precise information that is not well communicated through non-numeric information. The assumption of marketers, then, seems to be that numeric information is useful for consumers in evaluating products. Do consumers understand and use such numerical information in product claims? Recent research suggests that many people are "innumerate" and about half of Americans lack the minimal mathematical skills needed to use numbers embedded in printed materials. This suggests that many Americans lack the minimal mathematical skills needed to use numbers embedded in product claims and other marketing communications. In a series of five experiments, I investigated if and how consumers understand and use numeric information presented in product claims in their evaluation of consumer goods.

The results demonstrated that participants, and especially less numerate individuals, were susceptible to an Illusion-of-Numeric-Truth effect: they judged false claim as true when numeric meaning was inaccurately translated (e.g., "30% of consumers" inaccurately translated to "*most* consumers"). Mediation analysis suggested that highly numerate participants were better at developing affective reactions toward numeric information in product claims and using these affective reactions as information when they were faced with truth judgments.

Highly numerate individuals were also more sensitive to different levels of numeric information in their product evaluations. This sensitivity also seemed to depend on their drawing affective meaning from numbers and number comparisons and using this information in product evaluations. Although less numerate individuals reported that numeric information is important, they were less sensitive to numeric information unless they were encouraged to process numeric information more systematically. The results from this dissertation indicate that not all numeric information will be used and be useful to all consumers. Therefore, simply presenting numeric information may not be sufficient for numeric information to be useful for all consumers.

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CHAPTER I

INTRODUCTION

Numeric information is often presented to consumers in order to communicate important and precise information that is not well communicated through non-numeric information. For example, marketers use numeric information intending to convey favorable information about their products. PepsiCo, in a recent television campaign, claimed that their Diet Pepsi tastes more like real cola than Diet Coke because in a test comparing the two colas, *56%* believed Diet Pepsi tasted most like real cola. In addition, interactive Web sites allow customers to evaluate their products using numeric information. Amazon.com, for example, features star ratings ranging from 0 to 5 stars. The average star rating for each product appears as an icon, and sample size and distribution (both in frequency and percentage format) are also available. On dell.com you can find claims similar to "89% (85 out of 96) of customers would recommend this product to a friend" (dell.com, 2009a) and "Avg Customer Rating 4.3 of 5" (dell.com, 2009b). These consumer reviews are available to any customer who visits their Web site.

The assumption of marketers, then, seems to be that consumers value numeric information, and that they can understand and use such numeric information when evaluating a product. There are several reasons why, however, consumers may be less sensitive to numeric information in their product evaluations. One is consumers' basic ability to conduct and understand simple math (e.g., 15% off of $30). In addition, although consumers may recognize each piece of numeric information, they may fail to draw meaning out of numeric information in given contexts and may unsuccessfully use the numeric information in their judgments. In fact, data from the National Adult Literacy Survey indicates that about half of Americans lack the minimal mathematical skills necessary to use numbers embedded in printed materials (Kirsch et al., 2002). This suggests that about half of all Americans may lack the skills to understand simple numerical information used in product information and other marketing communications. For these reasons, some consumers may read, "35% of consumers preferred Diet Pepsi" as "only few consumers preferred," whereas other consumers may read it as "consumers preferred Diet Pepsi" because they fail to incorporate the numeric information into the product claim. In addition, some consumers may realize that more information may be needed to truly understand the meaning of numeric information in this claim. For example, "35%" has a different meaning if 35% of consumers preferred Diet Pepsi between two diet cola drinks, or among ten different diet cola drinks. Another reason consumers may be insensitive to numeric information is a lack of motivation to process numeric information in depth. Consumers may feel overwhelmed to work with complicated numbers, or they may feel numeric information is not useful for their decisions. They may also prefer to make judgments using a heuristic due to, for example, time pressure or limited cognitive ability. In addition, they may prefer and weigh nonnumeric information part of marketing communication more than numeric information in their judgments. For example, they may focus on how they feel about brand images or the wording of product claims rather than on factual numeric information. Some consumers may trust the source or the numeric information more than others (Gurmankin, Baron, & Armstrong, 2004).

Insensitivity to numeric information may influence not only online judgments of a product and product claims but also later judgments about a product and product claims. Research has demonstrated that when consumers engage in low-involvement information processing they tend to rely on familiarity of claims when they later judge truthfulness of claims. This truth effect was also observed when claims were explicitly identified as true when consumers were evaluating them for the first time (cf. Illusion-of-Truth effect). If people engage in low-involvement numeric information processing, then consumers may be susceptible to the Illusion-of-Truth effect when judging the truthfulness of numeric product claims. That is, consumers may use familiarity of non-numeric information when judging the truthfulness of claims involving numeric information. For example, claims like "*most* consumers preferred Diet Pepsi" may be judged accurate when in fact only 35% of consumers preferred Diet Pepsi, because the nonnumeric part of information seems familiar. This familiarity effect may be particularly strong for people who are unable to develop precise feelings about numeric information (e.g., "I am not sure how good or bad I feel about the numeric information "35%" given the context of this claim").

Research Objectives

The main objective of this dissertation is to investigate if and how consumers understand and use the numeric information presented in product claims and consumer polls. A second interest is to explore how we can help consumers, especially consumers with limited numerical ability (cf. less numerate consumers), use crucial numeric information more in their judgments and decisions. There are three major research goals in this dissertation. First, this research will investigate evidence for a novel version of the Illusion-of-Truth effect (Skurnik, Yoon, Park, & Schwarz, 2005) using product claims that contain crucial numeric information that may or may not be consistent with the rest of the information written in the text. In this study, the Illusion-of-Numeric-Truth effect is observed when participants judge claims to be true even if the numerical meanings of the claims are inaccurately translated (e.g., "30% of consumers" inaccurately translated to "*most* consumers"). The relationship between the Illusion-of-Numeric-Truth effect and numeracy (the ability to process basic probability and numerical concepts: Peters et al., 2006) will be investigated as well. Second, the influence of numeric information in product evaluations among participants that are lower or higher in numeracy will be investigated. Last, I test ways to help less numerate individuals improve their use of numeric information in their product evaluations.

CHAPTER II

LITERATURE REVIEW

Numeracy

Conceptualization and Development of Measurement

Numeracy may be broadly defined as a basic ability to understand and work with numbers. Numbers may be expressed in various forms, such as in probability, proportion, time, money, and measurement. In order to work with numbers, we may need to understand the absolute and relative magnitude of numbers and the contextual information around the numbers, and be able to compare numbers and engage in simple calculation. In marketing contexts, we see numbers used in the descriptions of discounts, price, consumer polls, rebates, and product and service attributes. Therefore, in order to be competent with numbers in the marketplace, we may need to, for example, understand the magnitude of price and discount, be able to compare prices and product attributes, and calculate change, tax, and tips. One interesting characteristic of numeric information is its dependency on context: the meanings of numeric information change dramatically from one context to another. For example, the following information has very different meanings even though they have exactly the same numbers: $32, 32 Fahrenheit, 32%, and 32 out of 250.

Numeracy has been operationalized slightly differently by different researchers. Paulos (1988) defined innumeracy as "inability to deal comfortably with the fundamental notions of number and chance" (p. 3). Schwartz, Woloshin, and Rimer (2001) defined numeracy as facility with basic probability and numerical concepts, and measured numeracy with three simple math-like questions. One of the questions asked: "Imagine that we flip a fair coin 1,000 times. What is your best guess about how many times the coin would come up heads in 1,000 flips?" Only about half of the women (54%) recruited from communities in the U.S. answered this question correctly. Their study results demonstrated that the accurate use of numeric information in assessing perceived risk related to breast cancer was more strongly associated with numeracy than how the information was presented.

Lipkus, Samsa, and Rimer (2001) defined numeracy as "how facile people are with basic probability and mathematical concepts," and added eight questions to the three items from the Schwartz et al. (2001) study to measure numeracy. The additional items were designed to assess individuals' ability to compare risks, and move between decimal representations, proportions, and fractions (e.g., 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). In their paper, Peters, Dieckmann, Dixon et al., (2007) added four more items that are more difficult to the 11-item scale developed by Schwartz et al. and Lipkus et al. The items were added to test the understanding of base rate as well as the ability to make more complex likelihood calculations. The additional four questions helped the measure to be more normally distributed.

Previous Findings: Influence of Numeracy on Judgments and Decisions

Dieckmann, Slovic, and Peters (2009) tested if people with different levels of numeracy focus on different information sources—likelihood assessments in numeric or narrative evidence without numeric likelihood estimates—in judging risk of terrorist attack forecast. They demonstrated that individuals with lower numeric skills used their perceptions of the narrative evidence more, whereas respondents with higher numeric skills focused more on the numeric likelihood assessment. They concluded that factors that influence the judgments of less and highly numerate individuals may be different. In Peters's et al. (2006) study, participants were presented with a statement that included a probability. For example, a student, "Emily," was described as receiving 74% correct on her exam in one condition and 26% incorrect on her exam in another condition. They found that judgments made by those who were lower in numeracy were more sensitive to how the numeric information was framed: "26% incorrect" was perceived more negative than "74% correct." They argued that this is because highly numerate individuals are better at transforming a number in one format (e.g., 74% correct) into another format (e.g., 26% incorrect).

There were several studies conducted to test the associations of numeracy and the understanding and the use of numeric information in risk and health domains (e.g., Hibbard, Peters, Dixon, & Tusler, 2007; Lipkus et al., 2001; Nelson, Fagerlin, Lipkus, & Peters, 2008; Peters, 2008; Peters et al., 2009; Peters, Hibbard, Slovic, & Dieckman, 2007; Peters & Levin, 2008; Woloshin, Schwartz, Black & Welch, 1999). Sheridan and Pignone (2002) investigated medical students' numeracy level, and its association to the ability to interpret risk information. The results demonstrated that, although 94% reported that they thought they were good with numbers, only 77% of the participants answered all three relatively simple numeracy questions correctly. In addition, they demonstrated that numeracy and interpretation of risk information were related: students with perfect numeracy scores did better in both risk comparison tasks and quantitative interpretation tasks than those who did not receive perfect numeracy scores. Feldman-Stewart et al. (2000) tested whether formats of displaying quantitative information, such as probabilities of treatment risks and benefits, influence patients' accuracy and speed regarding the use of quantitative information. Their results suggest that the formats that are best for making a choice are different from the formats that are best for estimating the size of an amount. Gurmankin, Baron, and Armstrong (2004) investigated whether patients trust and are more comfortable with doctor's verbal and numeric risk estimates. In the experiment, participants were presented with scenarios that discussed the likelihood of a certain cancer, and were asked to rate (a) how likely they think they have the cancer, (b) how comfortable they were with the information they were given about the risk of the cancer, and (c) how much they trusted the information given by the doctor. Each scenario contained either only verbal (cf. non-numeric) information, or verbal information along with numeric information (either percentages or fractions). They found that participants were more likely to trust the scenarios with both numeric and verbal estimates more than the scenarios with only verbal estimates. However, this effect was qualified by numeracy: trust and numeracy were positively correlated. This suggests that people with lower number proficiency were more likely to trust verbal information than numeric information, whereas people with higher number proficiency were more likely to trust numeric information.

One factor that has been identified to influence individuals' judgment processes is "evaluability." Hsee and associates demonstrated that individuals tend to put more weight on the attributes that are easily evaluated than attributes that are not easily evaluated (Hsee, 1996; Hsee, Blount, Loewenstein, & Bazerman, 1999). Participants in Hsee's (1996) study evaluated two used dictionaries—one contained 10,000 words and looked like new, and another contained 20,000 words and had a torn cover. Half of the participants were presented with one of the dictionaries and asked how much they would pay for it (cf. separate-evaluation condition), and the rest of the participants were presented with both dictionaries and asked how much they would pay for each dictionary (cf. joint-evaluation condition). In the separate-evaluation, participants gave a higher price for the dictionary with 10,000 words than for the dictionary with 20,000 words, whereas participants gave a higher price for the dictionary with a 20,000-word entry than with a 10,000-word entry in the joint-evaluation condition. Hsee (1996) argued that number of entries was hard to evaluate in the separate-evaluation condition because the evaluator does not know how good a 10,000-word entry is. Physical conditions of the dictionaries are, on the other hand, relatively easier to evaluate (e.g., a new cover is good and a torn cover is bad). Therefore, participants weighed the aesthetics of the dictionary cover in their judgments more than the number of word entries when the two dictionaries were evaluated separately. In the joint-evaluation condition, the dictionaries with a 10,000-word entry and a 20,000-word entry were presented together. Participants could therefore compare the number of word entries. Because participants were able to evaluate how good a 20,000-word entry was compared to a 10,000-word entry and, arguably, word entry was more important factor than the cosmetics of the dictionary, they were willing to pay more for the dictionary with a 20,000-word entry. Peters et al. (2009) manipulated "evaluability" by providing affective labeling to numeric ratings. They presented participants with hard-to-evaluate healthcare ratings (e.g., score of 93 out of 100 for a survival rate), and provided affective categories (e.g., good, poor) to help the healthcare ratings become more "evaluable." They demonstrated that participants were more likely to focus on a more important attribute than a less important attribute when they were presented with affective categories.

Interestingly, most of the hard-to-evaluate attributes were expressed in the numeric information in these studies. Numeric information may be chosen as hard-to-evaluate attributes, partially because numeric information is often completely dependent on its context (e.g., 20% correct on exam vs. 20% wrong on exam), and many individuals are "innumerate" (Paulos, 1988). This suggests that simply presenting numeric information may not be sufficient for consumers to effectively use numeric information in their judgments and choices.

In summary, one of the consistent themes in the numeric cognition literature is that people may differ substantially in numeric ability (Lipkus et al., 2001; Woloshin et al., 1999), and that many may be "innumerate" (Paulos, 1988). Data from the National Adult Literacy Survey also indicates that about half of Americans lack the minimal mathematical skills necessary to use numbers embedded in printed materials (Kirsch, Jungeblut, Jenkins, & Kolstad, 2002). For example, only 23% of participants in the work force could determine correct change using information in a menu. In addition, many individuals are insensitive to numeric information, and different levels of numeric ability may lead to different judgments and risk perceptions (e.g., Peters et al., 2009). The underlying mechanisms that lead to differential judgments and risk perception are not entirely clear. To communicate with consumers effectively, it is important to have an understanding of the underlying mechanisms of consumers' judgments and decisions. However, consumers' numeric information processing, with the exception of pricing cognition, has not yet received much attention in the marketing literature.

Some research demonstrate that affect towards numeric information may play an important role in the use of numeric information in individuals' judgments and decision makings (Peters et al., 2006; Peters et al., 2009).

Affect

Definitions of Affect

Broadly speaking, affect includes discrete emotions, feelings, and mood. Slovic, Finucane, Peters, and MacGregor (2002) defined affect as the "special quality of goodness or badness." Affect is to be "experienced as a feeling state," and people experience affect rapidly and automatically, with or without consciousness. Affect is further categorized into two different types (Peters, 2008). Incidental affect is defined as positive or negative feeling (e.g., mood state) without any specific target objects. Although incidental affect is not directly elicited from a specific stimulus, it has been shown to be misattributed to a stimulus (Peters et al., 2009). On the other hand, integral affect is defined as "positive and negative feelings about a stimulus that are generally based on prior experiences and thoughts and are experienced while considering the stimulus" (Peters et al., 2006). It is demonstrated that integral affect is an essential part of individuals' judgment and decision making (e.g., Damasio, 1994; Epstein, 1994; Peters, Slovic, & Gregory, 2003; Slovic et al., 2002). Integral affect and its relationship to judgment, decision making, and numeracy is the focus of this dissertation.

Discrete emotions, such as anger and fear, are short-lived and more intense, and have salient cause (Forgas, 2000). Each discrete emotion provides a tendency to perceive events and objects in ways that are consistent with the cognitive-appraisal dimensions of the emotion (Lerner & Keltner, 2000). For example, Lerner and Keltner demonstrated that fearful people are more pessimistic in judging future events than angry people. Unlike emotions, moods are usually viewed as relatively low-intensity and do not have salient cause (Ekman, 1999; Forgas). Different moods with the same valence are demonstrated to have differential effects on information processing and choice tendency. More specifically, for example, individuals in happy moods, compared to those in sad moods, were demonstrated to rely more on heuristics and other easily accessible information, such as stereotypes and expectations (e.g., Bodenhausen, Kramer, & Süsser, 1994). Some researchers argue that emotions and moods have different functions. Davidson (1994) argued that mood biases cognition while emotion biases behavior. Other researchers suggested that, whereas emotions direct behavior and result in action tendencies (Lerner & Keltner, 2000), moods bias cognition by influencing information processing—moods can hider or accentuate the accessibility of certain cognitive information.

Although affect may have broader meanings in some literature, in this dissertation I use the definition developed by Slovic et al. (2002).

Affect and Attitude

Eagly and associates (Eagly & Chaiken, 1993a, 1993b) defined attitude as "a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (p. 1). Several researchers (Crites, Fabrigar, & Petty, 1994; Eagly & Chaiken, 1993a, 1993b; Lutz, 1981) have discussed the tripartite view of attitude; specifically, that attitude has three underlying components—cognition, affect, and behavior (cf. conation). Cognition refers to all beliefs that an individual holds with respect to the object, and affect refers to positive or negative emotional reactions towards the object. The behavior part pertains to intended and actual behaviors with regard to the object. Based on the tripartite view of attitude, every attitude has greater or lesser degrees of each component. One major criticism of this tripartite view is that it lacks empirical evidence, and with a few exceptions (e.g., Peters & Slovic, 2007), researchers often measure only the overall attitude, particularly the affective component, rather than each component.

Conceptualization and Functions of Integral Affect

The role of affect in everyday decisions has received an increasing amount of attention in recent literature in the last 15 years. Epstein (1994), for example, proposed that we have analytical and experiential systems that are interrelated but separable, and that we generally use both systems to make decisions. It has also been suggested that affect is central to human cognitive processing and acts as information (Damasio, 1994; Peters, Lipkus, & Diefenbach, 2006; Slovic et al. 2002; Zajonc, 1980). Zajonc claimed that all perception contains some affect, and this affect can influence the ensuing cognitive processing to a significant degree. Further, affective reactions are argued to be hardly escapable and are often the most remembered facet of an experience. Damasio argued that life experiences lead options and attributes to be "marked" by positive or negative feelings linked to somatic or bodily states. When the positive somatic marker is activated, we are drawn towards options. Whereas, when the negative somatic marker is activated, it acts as a warning signal to drive us away. Relying on somatic markers can lead to better and more efficient decisions. Slovic et al. proposed the *affect heuristic*, stating that we often use affect as a shortcut to guide judgment and decision making processes in our information-rich and complex world. Similarly, Peters et al. conceptualized *affect as information*: affect may serve as cues for many judgments, such as probability and risk. This is consistent with Damasio's somatic-marker hypothesis, and is substantially similar to models of "risk as feelings" (Loewenstein, Weber, Hsee, & Welch, 2001) and "mood as information" (Schwarz & Clore, 1996). According to these models, affect can be experienced immediately as individuals encounter the events and objects, or it can be experienced after some cognitive processing. Reliance on affect is also thought to be quicker, less effortful, and more efficient for making decisions in a complex and uncertain world.

Peters et al. (2006) discussed four functions of affect. The first function is the previously discussed *affect as information*. The second function proposed is *affect as a motivator* of information processing and behavior. Stronger affect, for example, was demonstrated to lead to more effort in choosing which lottery to play (Peters et al., 2003). Another function proposed is *affect as common currency*. Because affect is much simpler than cognition, affect allows us to compare apples to oranges (Cabanac, 1992). Peters et al. also proposed that affect plays a role as a spotlight in a 2-step process (cf. *affect as spotlight*). First, the extent or type of affective feelings focuses consumers on certain new information, and then the new information is processed to guide their further judgments or choices. Once people experience affective states, the affective states influence subsequent information searching and information processing. Peters et al. provided an example that a cancer patient who is worrying and hence in a negative affective state may spend more time looking at risk information rather than benefit information of a certain treatment.

Affect and Memory

Some research suggests that affect plays an important role in the formation and retrieval of memory (Graf & Mandler, 1984; Graf, Mandler, & Haden, 1982; Posner & Snyder, 1975). Zajonc (1980) discussed that, although the cognitive basis of affective reactions may be forgotten, the affective reaction itself can be dissociated from its cognitive basis and still be retrieved. Kida, Smith, and Maletta (1998), for example, found that affective memories of responses to numerical data, compared to memories of actual and approximate numerical data, were the most enduring and accessible. This suggests that when we try to recall events, people, or other objects, the affective quality is among the first elements to emerge, and its emergence can occur with very little effort. For example, you might not be able to remember the details of the product description in ads you saw last week, but you probably automatically remember whether or not you liked the product and the ads. Often, we use this affect to further guide our judgments and decisions. For example, although you do not remember the details of ads and the product, you may be more likely to choose the advertised product over its competitors if you remember liking the product and the ads.

Affect and Numeric Information

As discussed earlier, recent research on affect and social decision making suggests that affect is an essential part of preference formation, judgment formation, decision making, and more. However, until recently, numerical information was considered to be processed purely cognitively and, thus, free from affect. A few exceptions exist. Participants in Slovic, Finucane, Peters, and MacGregor's (2004) study were asked to rate how attractive a bet is. Half of the participants received a simple bet—7 out of 36 chances to receive $9, or otherwise win nothing. The remaining participants received a bet in which they may lose a small amount of money—7 out of 36 chances to receive $9, and 29 out of 36 chances to lose $.05. Slovic et al. demonstrated that participants rated the bet with a chance to lose $.05 more attractive than the bet with no loss. This is an interesting finding because it violates economic theory that people should prefer a bet with the highest expected return. Peters et al. (2006) extended this study by demonstrating that this effect is driven by highly numerate individuals: only the highly numerate group rated the bet with a chance to lose significantly more attractive than a bet without a loss. In addition, Peters et al. demonstrated that highly numerate individuals, compared to those who were less numerate, had a clearer feeling about the goodness or badness of their feelings toward numeric information. Peters et al. argued that highly numerate individuals are more likely to draw affective meaning from probability (e.g., 7/36 chances) and numeric comparison (e.g., $9 and $.05). In evaluating the bet, highly numerate individuals may find $9 very attractive in the presence of a $.05 loss compared to $9 alone because $9 has much higher value than $.05.

The results from Peters et al. (2006) suggests that highly numerate individuals were more likely to deliberate about and compare numeric quantities, and hence develop a more precise affective reaction to the numeric information. The results from this study suggested that highly numerate individuals may better understand and use the numerical information in product claims and other marketing communications. On the other hand, less numerate individuals' choices have been demonstrated to be influenced by incidental affect (i.e., their moods) when choosing an option that was described with numeric information (Peters et al., 2009). This suggests that when presented with numeric and non-numeric information, less numerate individuals may rely more on non-numeric information in their judgments and choices. In the context of marketing communications, less numerate consumers may rely more on non-numeric information in evaluating a product, such as brand images, pictures in advertisements or wording of product claims.

As was argued earlier, consumers often are faced with judgments and decisions that involve numeric information. And the numeric information may or may not be available to them at the time of their judgments and decisions. Prior research demonstrated that individuals tend to believe information that has been presented to them, regardless of its actual truthfulness (Illusion-of-Truth Effect; Skurnik et al., 2005). Although individuals are often faced with much numeric information, the effect of Illusion-of-Truth on numeric information has never been tested. Because numeric and non-numeric information are processed differently (Gurmankin et al., 2004), and many people are innumerate (Kirsch et al., 2002; Lipkus et al., 2001; Paulos, 1988; Woloshin et al., 1999), the effect of Illusion-of-Truth may work differently for numeric and non-numeric information.

The Illusion-of-Truth Effect

It has been shown that people are not particularly good at judging truthfulness (cf. accuracy) of product claims when they are asked to rely on their memory (Hasher, Goldstein, & Toppino, 1977; Hawkins & Hoch, 1992). Hawkins and Hoch examined how participants' level of involvement during exposure to consumer information influenced what they learned and what they subsequently came to believe. They found that low-involvement information processing and repetition leads to an increase in the truth effect. Truth effect occurs when individuals are more likely to believe information presented to them is true than false. Familiarity was found to mediate this truth effect; the more familiar the information, the more believable it is for participants. Skurnik et al. (2005) showed that perceived familiarity leads to credibility even when product information has been explicitly identified as false. They argued that participants lose contextual information (e.g., claim is true or false) or connection between two pieces of information (cf. product information and truthfulness) after some time, and they simply remember having seen the product information. Therefore, participants tend to judge familiar claims as true regardless of actual truthfulness. This is the Illusion-of-Truth effect (Skurnik et al., 2005).

Although the Illusion-of-Truth effect has been examined in several research studies, no study has focused on the relationship between numeric information and the Illusion-of-Truth effect. In everyday life, we often encounter product claims that use numeric information, and we sometimes have to rely on the information from memory to make our judgments and decisions regarding products and product claims. It has been shown that numeric and nonnumeric information are processed differently (Gurmankin et al., 2004). This suggests that numeric and nonnumeric information may be stored as two sets of information rather than one set of information. The connection between the two sets of information may be lost after some time. Because many individuals are not very good with numbers (Kirsch et al., 2002; Paulos, 1988), this may lead them to rely more on the nonnumeric part of product claim and neglect the numeric part of product claim.

Drawing from the literature on affect and memory, consumers may also rely on affect when they are faced with a truth judgment: if they remember positive feelings about a certain product, for example, they are more likely to believe the favorable statements about the product. Given that highly numerate individuals are more likely to draw affective meanings from numeric information, they may be better able to use affective information derived from numeric information (e.g., good or bad feelings about the meaning of numeric information in a given context) in their truth judgments (Peters et al., 2006). They can do so by checking the consistency of affective information derived from the numeric information encountered earlier and the affective information derived from the claims they need to make truthfulness judgments. If they are consistent, then the claims may seem more likely to be true. However, if they are not consistent, then the claims may seem to be false. For example, if highly numerate consumers are presented with the claim that "90% of consumers believed Diet Pepsi tastes more like real cola than Diet Coke," then they are likely to draw positive affective meanings about Diet Pepsi in terms of its cola taste from the numeric information. Therefore, when faced with the statement that "most consumers believed Diet Pepsi tastes more like real cola," highly numerate consumers are likely to believe the claim because they remember their positive affect towards Diet Pepsi in terms of its cola tastes. On the other hand, if they were presented with the claims that "35% of consumers believed Diet Pepsi tastes more like real cola than Diet Coke," then they are likely to draw negative affective meaning from the numeric information. As a result, because they remember having negative feelings about Diet Pepsi in terms of its cola taste, they may be less likely to believe the claim "consumers believed Diet Pepsi tastes more like real cola."

The focus on this dissertation is the role of numeracy and affect in truth judgments (Studies 1 and 3) and product evaluations (Studies 2 through 5). More specifically, the dissertation examines how numeric ability influences the ability to draw affective meanings from numeric information, and in turn influences subsequent judgments, such as truth judgments and product evaluations.

Hypotheses

One of the main goals of this dissertation is to test the evidence of Illusion-of-Numeric-Truth effect using product claims that contain important numeric information. In the literature, an Illusion-of-Truth effect is observed when familiar claims are judged as true although they were originally presented as false (Skurnik et al., 2005). In this study, an Illusion-of-Numeric-Truth effect would be observed if participants incorrectly judged false claims as true if the numerical meanings of the claims were translated or remembered inaccurately from the original claims (e.g., if "30% of consumers" was inaccurately translated to "*most* consumers"). I will also investigate the relationship between the Illusion-of-Numeric-Truth effect and numeracy. It is hypothesized that highly numerate individuals are less susceptible to the Illusion-of-Numeric-Truth effect because they can draw more affective meaning from numeric information than can the less numerate individuals (Gurmankin et al., 2004; Peters et al., 2006).

H1a: Participants are more likely to judge inaccurate numeric claims as true than judge new claims as true if claims seem familiar.

H1b: Highly numerate individuals are able to make more accurate truth judgments than less numerate individuals.

Highly numerate individuals have been found to be better at using numeric information in their judgments (e.g., Peters et al., 2006). In some experiments, participants were asked to judge the favorability of the target products that were described by important numerical values. It is hypothesized that highly (vs. less) numerate individuals would be better able to integrate numeric information and, thus, their product evaluations would be influenced more by numeric information. When making truth judgments, highly numerate individuals are expected to be better able to rely on feelings towards a product that they developed earlier based on numeric information when engaging in truth judgments. When encouraged to process numeric information more systematically by experimental manipulation, less numerate individuals will be more likely to use numeric information in their judgments than when they were not encouraged to do so.

H2a: Highly (vs. less) numerate individuals are more likely to use numeric information when evaluating a product.

H2b: Highly (vs. less) numerate individuals are more likely to use their feelings towards a product when judging the truthfulness of claims.

H2c: Less numerate individuals are more likely to use numeric information in their product evaluations when they are encouraged to process numeric information more systematically than when they were not encouraged to do so.

Meanings of numeric information are often context dependent, and we often draw meanings by comparing numbers. For example, scoring 85% correct on an exam may feel better or worse depending on the average score for the exam. There is evidence suggesting that highly numerate individuals are more likely to draw affective meanings from number comparisons and use those affective meanings in their judgments (Peters et al., 2006). Therefore, it is hypothesized that highly numerate individuals are more likely to draw affective meanings from comparing numeric information and to use the meanings in their product evaluations, whereas less numerate individuals will be less likely to draw meanings from number comparisons.

H3a: Highly (vs. less) numerate individuals are more likely to draw affective meanings by comparing numbers.

CHAPTER III

STUDIES

Overview

The main goals of this dissertation are to investigate (a) if and how consumers understand and use numeric information in their truth judgments and affective product evaluations; (b) if and how numeracy influences the understanding and the use of numeric information; and (c) how consumers, especially less numerate consumers, can be helped to use consequential numeric information more in their affective product evaluations. Five studies are proposed to accomplish these goals. Scenario-based surveys were used in all five studies. In general, participants read scenarios that include fictitious product claims, and they answered various questions. All participants were college students recruited from the Psychology and Marketing Departments at the University of Oregon.

Studies 1 and 3 rely on a Signal-Detection-Theory paradigm to test an Illusion-of-Numeric-Truth effect (Hypotheses 1a and 1b). Participants were shown a series of numeric product claims that contained either an unfavorable or a favorable numerical value in percentage format. Later, they were asked to judge if the gist of the claims was true, false, or new. It was hypothesized that participants would be more likely to believe that inaccurate numeric claims were true if claims seemed familiar, and further, highly numerate individuals would be better able to make accurate truth judgments than less numerate individuals.

Studies 2 and 3 tested whether highly numerate individuals would be better able to use numeric information and, thus, would be influenced more by numeric information in each product claim (Hypothesis 2a). Participants were shown product claims containing different levels of important numeric information, and were asked to judge the favorability of the target claims. In addition, Study 3 tested whether highly numerate individuals' affective product evaluations and truth judgments were associated (Hypothesis 2b). Study 3 also investigated the influence of numeracy on the use of numeric information in affective product evaluation.

Study 4 aimed to help participants, and especially less numerate participants, use numeric information more in their product judgments by using methods thought to increase depth of processing (Hypotheses 2c). It was hypothesized that less numerate, as well as highly numerate, individuals would use numeric information more when they are encouraged to engage in more systematic processing of numeric information by presenting the numeric information in a hard-to-read font (Study 4).

Study 5 tested whether highly numerate individuals would be influenced by additional numeric information that is not necessarily diagnostic to the affective product evaluations they are making (Hypothesis 3a). More specifically, it tested whether highly numerate participants draw meanings by comparing two ratings expressed as numbers of stars—one for target product and another for the accompanying product—and use the meanings they draw by comparison in their affective product evaluations. Less numerate individuals, on the other hand, are hypothesized to be less influenced by the additional numeric information (Hypothesis 3b).

Study 1: Numeric Memory for a Product Claim

Study 1 used a Signal-Detection-Theory paradigm to test an Illusion-of-Numeric-Truth Effect. It was hypothesized that participants would be more likely to believe that inaccurate numeric claims were true if the claims seemed familiar (Hypotheses 1a), and further, that highly numerate individuals would be able to make more accurate truth judgments than less numerate individuals (Hypotheses 1b).

Method

Design. Study 1 was a mixed design. Claim type (True, False vs. New) and numerical values (Unfavorable vs. Favorable) were within-subjects factors and numeracy was a between-subjects factor. In the information phase, participants were shown a series of product claims with numeric information in a percentage format. Thirty-six claims were divided into three groups of 12 claims each. For each participant, one third of claims were randomly paired with a percentage ranging from 35% to 45% indicating unfavorable numeric information, and another third of claims were randomly paired with a percentage ranging from 75% to 85%, indicating favorable numeric information. The rest of the claims were never used in the information phase. The claims were worded in such a way that it was always more favorable to have a higher numerical value.

In the test phase, participants were presented with a series of product claims including 12 new claims and 24 claims previously seen during the information phase.

New claims had not been seen by participants. In the 24 claims from the information phase (with unfavorable or favorable numeric information), the numeric information was replaced by the word "most." Therefore, modified claims were always accurate for those claims with favorable numerical values in the evaluation phase, and inaccurate for those claims with unfavorable numerical values.

Stimuli development and pretest. Forty fictitious product claims were created using real product names currently available on the market. All of the products in the claims were consumer products and included beverages (e.g., Diet Pepsi, Samuel Adams Beer), automobiles (e.g., Ford F-150), banks (e.g., Bank of America), and airline companies (e.g., United Airlines). A pretest of the claims was conducted with 68 psychology students (see Appendix A). Each of the participants rated their attitude towards 40 products on a 7-point scale ranging from 1 to 7 (-3 was very unfavorable and 3 was very favorable). Fourteen products that received a favorability score of above 5 points were either deleted or replaced with less popular products (e.g., Hilton was replaced with Hampton Inn) in order to avoid using products towards which participants had a strong preexisting attitude. In the end, 36 product claims were retained (see Appendix A).

Procedure. Participants were 150 psychology students. They received a link to the study programmed with online survey software Qualtrics, and could take the survey at the time and place of their choosing. After the consent form, each participant received 44 product claims one at a time and were asked to engage in a low-involvement comprehension task (Hawkins & Hoch, 1992; Lichtenstein & Srull, 1987) by rating how easy or difficult it was to understand each claim on a 7-point scale ranging from 1 (very easy) to 7 (very difficult) (see Appendix B). Among the 44 claims in this evaluation phase, 12 were described with unfavorable numerical values and another 12 were described with favorable numerical values. The remaining 20 claims were filler items and appeared in a random order among the target claims. The format of these filler claims differed from the format of the target claims in order to provide the participants with variety (see Table 1). The first two claims were always filler claims so as to reduce a primacy effect (Law, Hawkins, & Craik, 1998). Following this evaluation phase and after some unrelated tasks that took approximately 15 to 20 minutes, participants proceeded to the test phase. During the test phase, each participant received 38 claims without any numeric information. The first two claims were filler claims. Of the remaining 36 claims, 24 were modifications of the earlier claims presented in the evaluation phase, and 12 claims were completely new. Among the modified claims, 12 were accurately based on the earlier claim described with favorable numerical values, and another 12 were inaccurately based on the earlier claim that was described with unfavorable numerical values. Participants were informed that some of the claims were accurately based and some of the claims were inaccurately based on the claims they saw earlier in the evaluation phase of the study. They were also informed that some of the claims were never presented to them during the study. For each claim presented, they identified whether it was true (i.e., accurately based on the earlier claim), false (i.e., inaccurately based on the earlier claim), or new. They also completed a various demographic questions and numeracy scale, in which participants attempt to solve 11 math-related questions (Lipkus et al., 2001; Peters et al. 2006) (see Appendixes G and H).

Table 1

Examples of Product Claim

Target claims in evaluation phase

In a double-blind taste test, consumers tasted two cola drinks with a bite of cracker or sip of water before each tasting. Among these consumers, 35% believed that Diet Pepsi tasted most like real cola.

85% of consumers preferred the original Nestlé's Crunch over the new Snickers Cruncher.

Filler claims in evaluation phase

A study suggested that drinking eight ounces of cranberry juice cocktail at a time may be better than drinking four ounces for women trying to prevent a bladder infection.

Modified target claims in test phase*

Most people in double-blind taste test believe that Diet Pepsi tastes most like real cola.

Most consumers prefer the original Nestlé's Crunch over Snickers Cruncher.

*Gist of claims is always consistent with claims with favorable numerical value.

Results

Recognition performance. Participants' response options were "new," "true" and "false," and these responses were coded based on accuracy. The percentage of correct judgments was calculated for each claim type (true, false, and new) for each participant.

Participants correctly identified repeated claims 87% of the time. A paired sample t-test was conducted with percent correct for new and repeated items (i.e., the hit rate for new items and correct rejection for repeated items). It showed that participants were better at correctly identifying repeated claims (M = .87) than identifying new claims (M = .54, $t(150) = -11.9, p < .001$). This is consistent with previous research (Hawkins & Hoch, 1992).

Truth judgment. The basic Illusion-of- Truth effect was observed (see Table 2). The results of a repeated-measures ANOVA demonstrated that repeated claims (both true and false, M = .66) were judged as true significantly more often than new claims (M = .25, $F(1,151) = 262, p < .001$). This suggests that participants are more likely to believe the familiar claims than unfamiliar claims. An Illusion-of-Numeric-Truth effect was also demonstrated. Among the repeated claims, participants accurately judged true claims as true (M = .68) more often than false claims as true (M = .64), $F(1,149) = 6.4, p < .01$). Further, participants were more likely to inaccurately judge false claims as true (M = .64) than new claims as true (M = .25, $F(1,151) = 231, p < .001$). These results support previous findings of the Illusion-of-Truth effect (Skurnik et al., 2005): participants were more likely to believe inaccurate claims as true if they were familiar (Hypothesis 1a). These results also indicated that although participants could correctly judge true claims as true in general, they were likely to judge claims as true if they had seen them before regardless of the actual accuracy.

Numeracy and truth judgment. The mean numeracy score was 8.4 (median = 9) out of 11 possible (range = 1–11, α = 67). Because the distribution was highly skewed (=

Table 2

Percentages of Participants Who Judged True for Each Type of Claims

	New claims	Repeated	True claims	False claims
Less numerate participants	30	65	65	65
Highly numerate participants	21	68	71	65
All Participants	25	66	68	65

-1.2, Standard error of skewness = .20), a median split was performed (Peters et al., 2006), therefore participants with numeracy scores of 9 or lower were coded as less numerate (M = 6.7, SD = 1.8) and those with numeracy scores of 10 or 11 were coded as highly numerate (M = 9.7, SD = .8). Results from a repeated-measures ANOVA indicated that both less and highly numerate individuals were more likely to judge repeated claims as true (M = .65 and M = .68 respectively) than new claims (M = .30 and M = .21 respectively) as true ($F(1,149) = 267, p < .001$) (see Figure 1). For individuals low and high in numeracy, the proportion of true ratings was higher, on average, for false claims (65% for both less and highly numerate individuals) than for new items (30% for less numerate individuals: $F(1,65) = 73, p < .001$, 21% for highly numerate individuals: $F(1,83) = 179, p < .001$; see Figure 1). This indicates that both less numerate and highly numerate individuals are susceptible to the Illusion-of-Numeric-Truth effect.

In order to assess the Illusion-of-Numeric-Truth effect further, a measure of d' from signal detection theory was calculated (Law et al., 1998; Singh & Churchill, 1986). The d' value is a summary report of each participant's truth judgment performance. In

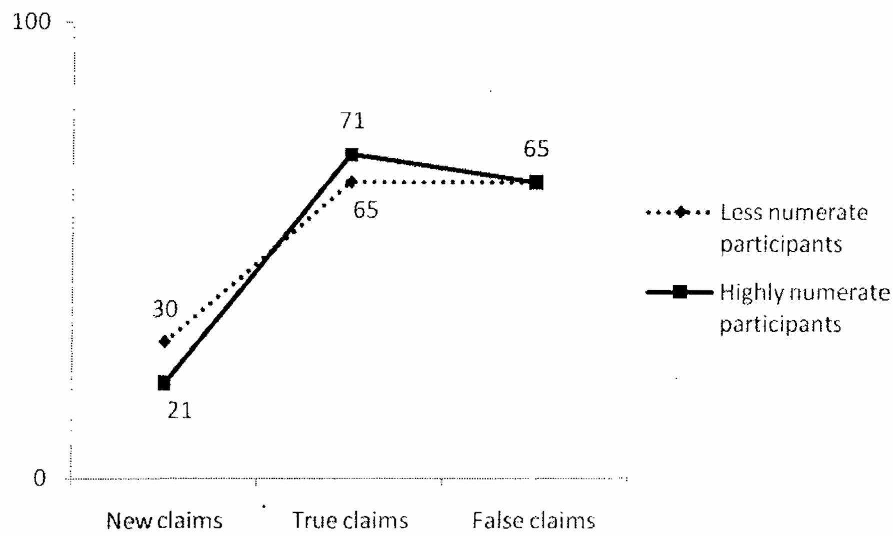


Figure 1. Percentages of new and false claims judged true by the less numerate and the highly numerate groups.

order to calculate *d'*, the hit rate (HR) and the false-alarm rate (FAR) for each participant was calculated first. The HR is the proportion of times that participants accurately judged true claims as true; the FAR is the proportion of times they inaccurately judged false claims as true. In order to compute *d'*, HR and FAR values of 0% and 100% were converted to 1% and 99% (Law et al., 1998; Macmillan & Creelman, 1991). Then the *d'* was calculated using a formula $z^{far} - z^{hr}$, where z^{far} is the standardized score for the FAR and z^{hr} is the standardized score for the HR. Because *d'* represents the difference between standardized HR rate and FAR, a larger number indicates better truth judgment performance.

Results of an ANOVA demonstrated that *d'* scores were higher for individuals higher in numeracy (*d'* = .25) than for those lower in numeracy (*d'* = .03, $t(148) = -1.8$, $p < .05$). These results indicate that highly numerate individuals were better at truth judgments than less numerate individuals (Hypothesis 2). Results of a one sample *t*-test indicated that, although *d'* for highly numerate individuals was significantly different from zero ($t(83) = 3.5, p < .001$), *d'* for less numerate individuals was not significantly different from zero ($t(65) = .4, p = ns$). This result indicates that the accuracy of truth judgments made by individuals lower in numeracy was not significantly better than chance.

Discussion

Consistent with previous research, our participants more often judged repeated claims as true (whether they were true or false) than they judged new claims as true. In addition, they demonstrated an Illusion-of-Numeric-Truth effect: they were more likely to judge false claims as true than new claims as true. This suggests that people rely on the familiarity of the non-numeric part of the claims to judge the truthfulness of the claims. Individuals' numeric ability seems to influence their Illusion-of-Numeric-Truth effect: highly numerate individuals were significantly more successful at judging true claims as true compared to the less numerate individuals. Prior research demonstrated that highly numerate individuals were better at drawing meaning from numeric information (Peters et al., 2006). Therefore, the meaning of numeric information may be more readily available for them at the time of truth judgments. Judgment accuracy of the less numerate individuals was not significantly different than chance. It may be that less numerate participants were less sensitive to numeric information and relied more heavily on the familiarity of non-numeric parts of the claim to judge truthfulness.

It is possible that our respondents did not accurately understand the meaning of *most*. Therefore, a follow-up study was conducted using a similar sample population (n = 130). Participants were asked, in order for the claim ("Most consumers preferred Levantra over Phemanide") to be accurate, "What is the smallest percentage of consumers who must have preferred Levantra over Phemanide?" The results demonstrated that 95% of participants reported that a minimum of 50% of consumers should prefer Levantra over Phemanide in order for the claim to be accurate. When analyzed separately for less numerate and highly numerate groups, 100% of the highly numerate group stated that 50% of consumers should prefer Levantra, and 92% of the less numerate group stated the same. Among 8% of less numerate participants who did not report that 50% of consumer should prefer Levantra, 4% (n = 3) stated that 49% should prefer Levantra. Therefore, only 4% of less numerate participants stated a number below 49%. This suggests that both less and highly numerate groups have a basic understanding of what "most" means.

Study 1 successfully demonstrated that less numerate individuals were more susceptible to an Illusion-of-Numeric-Truth Effect. However, the mechanism underlying this effect is still unclear. It is unlikely that participants remembered the exact numeric information because each participant saw more than 24 pieces of numeric information in a very short amount of time. However, they might have remembered their affective reaction to the product. A number of studies have shown that people can develop affect towards numeric information and later use this affect in making their decisions (e.g., Kida et al., 1998; Peters et al., 2006). Further, Kida et al. demonstrated that affective memories of numerical data, as opposed to memories of actual and approximate numerical data, were the most enduring and accessible. This suggests that when decision makers cannot access either the actual or the approximate numerical data, they seem to construct memories that are consistent with their affective responses. In return, they use affect to make choices. This suggests that our participants may have developed affect while reading the product claims, then, in turn, used this affect in their truth judgments. Highly (vs. less) numerate individuals were also shown to develop clearer feelings towards numeric information (Peters et al., 2006). Therefore, affective responses to numeric information may be more accessible to highly numerate individuals than to less numerate individuals.

Study 2 tests if highly numerate participants, compared to less numerate participants, are more likely to use numeric information in developing affect and, hence, whether their affect towards products are more influenced by numeric information.

Study 2: Use of Numeric Information in Affective Product Evaluation

Study 2 tested if highly numerate individuals, compared to those lower in numeracy, would be better able to use numeric information and, thus, their affect towards product would be more influenced by numeric information in each product claim (Hypothesis 2a).

Method

Design. Study 2 was a mixed design. Numerical values (unfavorable vs. favorable) were repeated as within-subjects factors and numeracy was between subjects. Each product claim contained two fictitious products and three pieces of numeric information (see Appendix C). Numeric information in each claim was always either between 35% and 45% (unfavorable) or between 75% and 85% (favorable) as in Study 1. Each claim contained unfavorable numeric values for half of the participants and favorable numeric values for the rest of the participants. As in Study 1, favorable numeric information was always preferable to unfavorable numeric information.

Procedure. Data were collected in a computer lab from 92 college students. Participants were informed that they would be presented with claims that compared two products in order to make sure that any values above 50% in the product claims indicated favorable numeric information. Then, each participant was shown six fictitious product claims on a computer screen, one at a time, and asked to rate their affect towards each product on a 7-point scale ranging from 1 (very unfavorable) to 7 (very favorable). At the end of the study, they completed the same demographic questions and numeracy scale used in Study 1 (see Appendixes G and H).

Results

The mean numeracy score was 9.4 (median = 9.5) out of 11 possible (range = 1-11, Cronbach's $\alpha = .67$). It was somewhat negatively skewed (skewness = -.69, standard error of skewness = .25), therefore participants with numeracy scores of 9 or lower were coded as less numerate ($M = 8.2$, $SD = .95$) and those with numeracy scores of 10 or 11 were coded as highly numerate ($M = 10.5$, $SD = .50$).

A repeated-measures ANOVA was conducted on the favorability scores with unfavorable (between 35% and 45%) versus favorable (between 75% and 85%) numeric information claims used as a repeated measure (see Table 3). The median split of numeracy scores was entered as a between-subjects factor. A significant main effect revealed that claims with high values ($M = 5.4$), were judged significantly more favorably than those with unfavorable numeric values ($M = 3.8$, $F(1,90) = 104.51$, $p < .05$). A significant interaction with numeracy was also found ($F(1,90) = 4.24$, $p < .05$) (see Figure 2). The means indicate that the difference between highly numerate participants' judgments of favorability towards products with favorable numeric information and claims with unfavorable numeric information was larger than for less numerate participants ($M_{difference} = 1.2$ for less numerate and $M_{difference} = 1.9$ for highly numerate; Hypothesis 2a). The additional test revealed that highly numerate participants' feelings towards products with unfavorable numeric information ($M = 3.6$) was significantly below the midpoint (cf. labeled as "neutral," $t(45) = -2.57$, $p < .05$) and their feeling towards products with favorable numeric information was significantly ($M = 5.5$) above the midpoint ($t(45) = 12.3$, $p < .001$). For the less numerate participants, on the other hand, only feelings towards products with favorable numeric information ($M = 5.3$) were significantly different from the midpoint ($t(45) = 9.97$, $p < .001$) whereas feelings towards products with unfavorable numeric information ($M = 4.1$) were not significantly different from the midpoint ($t(45) = .5$).

Table 3

Significance Test From ANOVA and Mean Affect Towards the Products by Numeric Conditions and Numeracy

Numeric levels (df = 1, 90)	F = 104.5 (p = .001)	Unfavorable numeric		Favorable numeric	
		3.84 (1.03)		5.38 (.85)	
Interaction with Numeracy	F = 4.24 (p = .042)	Less numerate	Highly numerate	Less numerate	Highly numerate
		4.08 (.96)	3.61 (1.06)	5.30 (.90)	5.46 (.80)

Parentheses indicate the standard deviations of the mean

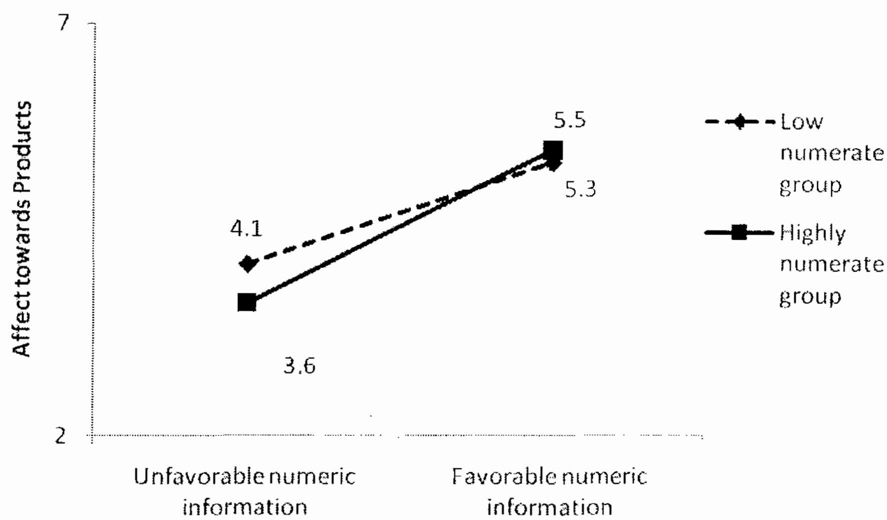


Figure 2. Affect towards product with unfavorable and favorable numeric information reported by the less numerate and the highly numerate groups.

In a follow-up question at the end of the study, participants were asked how important the numeric and the non-numeric information were to their affective product evaluation. Results of a MANOVA revealed a significant effect of numeracy (F(2,89) =

3.5, $p < .05$). An examination of the means suggested that less numerate participants reported that numeric ($M = 4.9$) and non-numeric ($M = 4.3$) parts of the information were equally important ($t(45) = 1.7$, $p = ns$); whereas highly numerate participants reported that the numeric part ($M = 4.8$) of the information was more important than the non-numeric part of the information ($M = 3.6$, $F(2,89) = 3.5$, $p < .05$). Although less and highly numerate participants reported numeric information as equally important, the less numerate participants relied on it less in the Illusion-of-Numeric-Truth effect demonstrated in Study 1 and in developing feelings towards products as shown in Study 2.

Discussion

Study 2 demonstrated that highly (vs. less) numerate individuals successfully relied on numeric information more in developing their feelings towards products. This may lead highly numerate individuals to better judge the truthfulness of claims. More specifically, highly numerate individuals may be better at truth judgments because, when making truth judgments, they can use the favorability judgments they made earlier. It may be that they pay more attention to numeric information and translate the numeric information into favorability judgments, and in turn use feelings of favorability in truth judgments.

The next study investigates the use of affect towards products among highly numerate individuals when they are asked to make truth judgments (Hypothesis 2b). It also tests whether less numerate participants become more sensitive to numeric information when they are encouraged to process numeric information more systematically.

Study 3: Use of Numeric Information in Affective Product Evaluation and in the Illusion-of-Numeric-Truth Effect

In Study 3, I attempt to replicate the basic findings of Studies 1 and 2, and test whether highly numerate individuals are more likely to use their previous favorability judgments when they are asked to judge the truthfulness of a claim (Hypothesis 2b). A fluency of numeric information was manipulated by changing how easy or difficult it is to read numeric information in the text in order to encourage participants to process information more systematically (Schwarz, 2004). Metacognition of disfluency also appears to reduce the impact of heuristics and can activate analytic information processing. Therefore, it was hypothesized that participants, especially less numerate participants, would be more likely to use numeric information in their product judgments if the numeric information was hard to read (cf. disfluent, Hypothesis 2c).

Method

Design. Study 3 had two between-subject manipulations: two levels of numeric information (unfavorable and favorable) and two levels of fluency or font readability (fluent and disfluent). Numeric information in the claim was either between 25% and 30% (unfavorable) or between 70% and 75% (favorable). Unlike in the previous study, crucial numeric information was presented outside of product claims in a separate table in order to test if participants would still use numeric information in their judgments even when it required extra effort to look up (see Appendix D). For half of the participants, all of the information in the table (cf. summary of claims and numeric information) was in an easy-to-read fluent font (16-point Arial), and for the other half of participants, the information was in a hard-to-read disfluent font (50% gray italicized 15-point TypoUpright BT). The choice of font was based on a pretest, in which participants judged (a) if each of various fonts was readable, and (b) how easy or difficult it was to read each font. The gist of each claim was written in bold.

Procedure. Two hundred thirty-one college students participated in this study. At the beginning of the study, participants were explicitly informed that they would be presented with product claims comparing two products. Then each participant was presented with the fictitious product claim used in Study 2 on a computer screen. Participants were asked to rate how they felt about the target product on a 7-point Likert-type scale ranging from very unfavorable (1) to very favorable (7). After a 1- to 3-minute distracter task, they were asked to engage in truth judgments similar to those of Study 1. In this study, however, no new claims were presented for truth judgments. Participants were then asked various follow-up questions assessing their affect towards each product name and the self-rated importance of the product name and numeric information in their judgments. Finally, they were asked to complete the numeracy scale used in previous studies and demographic questions (see Appendixes G and H).

Results

The mean and median numeracy score was 9.0 (Cronbach's $\alpha = .68$). Because the distribution was negatively skewed (-1.3), a median split was used in the subsequent analysis. The fluency manipulation did not have any significant effects on affective product evaluations ($F(1,223) = .14$), and it was, therefore, excluded from further analyses. The manipulation of favorability of numeric information was significant

($F(1,227) = 76.5$, $p < .001$): a product described with favorable numeric information was judged more favorably ($M = 5.4$) than one described with unfavorable numeric information ($M = 4.0$, see Table 4). Although the main effect of numeracy was not significant ($F(9,227) = 2.4$, $p = ns$), the interaction between numeracy and favorability of numeric information was significant ($F(8,227) = 6.2$, $p < .05$). As demonstrated in Study 2, means indicated that highly numerate participants' feelings were more sensitive to numeric information ($M = 3.7$ in the unfavorable numeric condition and $M = 5.5$ in the favorable numeric condition, respectively) than less numerate participants ($M = 4.3$ and $M = 5.3$, respectively) (see Figure 3).

Table 4

Significance Levels ($df = (1, 227)$)

Favorability	Numeracy	Interaction
76.5 ($p = .001$)	2.4 ($p = .13$)	6.2 ($p = .013$)

Truth effect. The results also replicated the basic truth-effect findings from Study 1: highly numerate participants were better at judging the truthfulness of claims than less numerate participants ($F(18,396) = .84$, $p = .01$). Unlike in Study 1, however, both less numerate and highly numerate groups were equally able to correctly identify the true claim (92% and 89% respectively). In addition, highly numerate participants (60% correct judgments) were better at correctly identifying false claims than less numerate

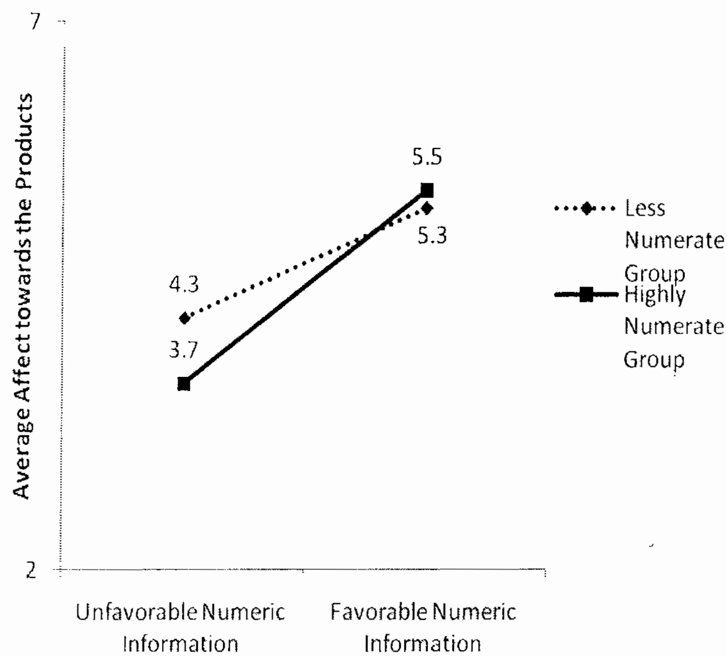


Figure 3. Affect towards product with unfavorable and favorable numeric information reported by the less numerate and the highly numerate groups.

participants (36% correct judgments). It is speculated that the number of product claims participants evaluated drove this inconsistencies between Study 1 and Study 3. The participants in Study 1 were presented with 30 product claims, whereas the participants in Study 3 were presented with only 2 claims in the information phase. Therefore, in general, participants in Study 3 did a better job of judging the truthfulness of product claims than did those in Study 1. The low rates of correct responses are surprising because there were only two claims presented and about 5 minutes of a distracter task between the presentation of claims and the truth judgment. A measure of *d'* was calculated in the same manner described in Study 1. The analysis revealed a main effect of numeracy

($F(9,199) = 2.6, p < .01$), with highly numerate individuals ($d' = 2.4$) better able to distinguish false claims from true claims than less numerate individuals ($d' = 1.4$).

Affect and truth judgments. The relationship between affect towards products and the truth judgments were investigated. Kida et al. (1998) argued that, when making judgments, individuals are more likely to rely on affective feelings towards numeric information when the exact numeric information is not available either physically or in memory. This suggests that participants in Study 3 may have relied on their feelings when faced with truth judgments. So far, this dissertation demonstrated that the favorability of numeric information and numeracy were keys to developing feelings towards products described with important numeric information. Numeracy was also shown to be associated with truth judgments. Therefore, Study 3 tested whether feelings towards a product are associated with truth judgments. More specifically, participants may judge favorable claims as true if they had positive feelings towards the product or the product claims when they evaluated the original claims. On the other hand, they may judge favorable claims as false if they did not report having positive feelings towards the product or the product claims.

In order to test the relationships between affect and truth judgments, two regressions were conducted. The first regression was run to test if favorability of numeric information, numeracy, and the interaction between these two variables predicted participants' feelings towards the product. Favorability of numeric information was coded as -1 (unfavorable) and 1 (favorable). Numeracy was used as a continuous variable to reduce the number of categorical predictor variables. Because numeracy was negatively skewed, it was transformed cubically (skewness = -.3). Scores were then mean centered. Affect rating ranged from 1 to 7, with higher numbers indicating participants' favorable feelings. The influence of numeric information and numeracy on participants' feeling towards the product was then tested.

The overall model was significant ($F(4,226) = 28.9, p < .001$) (see Table 5). The results indicated that the main effect for favorability of numeric information ($t(226) = 7.9$, $p < .001$) and the interaction were significant ($t(226) = 2.4, p < .05$) while the main effect of numeracy was not ($t(226) = -.6, p = ns$). The coefficient indicates that favorable numeric information predicts higher positive affect. Numeracy mattered only in the unfavorable numeric condition – those higher in numeracy had less positive feelings towards the product. The reason numeracy did not predict feeling towards product in the favorable numeric conditions seems to be due to the relatively positive feelings that less numerate individuals gave regardless of numeric information. Therefore, both less and highly numerate individuals gave positive affective evaluations in the favorable numeric condition.

Next, a logistic regression was performed in order to test what factors predict the accuracy of participants' truth judgments. Favorability of numeric information, affect towards a product, and numeracy, as well as all 2-way interactions and a 3-way interaction, were entered to the analysis to predict truth judgments (true = 1 and false = 2). Favorability of numeric value was coded in the same manner as in the previous regression. In addition, feelings towards a product were mean centered. The overall model ($X^2(7) = 75.5, p < .001$) was significant (see Table 6). The main effect of

Table 5

Results From Linear Regression Analysis

	B	*t*	Sig.
Numeric levels	.44	7.93	.000
Numeracy	-.03	-.56	.573
Affect towards the name	.29	5.29	.000
Interaction between numeric levels and numeracy	.13	2.43	.016

favorability of numeric value demonstrated that participants were more likely to (correctly) judge a claim as true when the favorability of the numeric value was favorable than unfavorable ($p < .05$).

Table 6

Results From Logistic Regression Analysis

	B	*SE*	Wald	Sig.
Numeric levels	-2.63	1.17	5.06	.024
Affect towards the product	.45	.59	.58	.445
Numeracy	.00	.00	2.67	.102
Numeric levels * numeracy	.00	.00	3.76	.053
Numeric levels * affect towards the product	1.01	.59	2.88	.089
Numeracy * affect towards product	.00	.00	2.02	.155
3-Way interaction	.00	.00	4.03	.045

A significant 2-way interaction between numeracy and feelings toward a product demonstrated that highly numerate individuals were more likely to use their feelings about the product to correctly judge the false claim as false than less numerate individuals ($p = .05$). This 2-way interaction was qualified by a significant 3-way interaction ($p < .05$). Further analysis showed that feelings towards a product predicted truth judgments only among highly numerate individuals in unfavorable numeric conditions. More specifically, less positive feelings towards a product led highly numerate individuals to correctly judge false claims as false. This suggests that highly numerate participants use their feelings towards a product that were developed at least in part from reactions to numeric information in judging the truthfulness of product claims while less numerate individuals may rely on the familiarity of claims (Law et al., 1998; Skurnik et al., 2005).

Importance of numeric information. A repeated measures analysis indicated that the participants rated the importance of numeric information ($M = 4.8$) significantly higher than that of product name ($M = 3.1$, $F(1,228) = 134$, $p < .001$). Further, a significant interaction with numeracy was revealed. The less numerate group ($M = 3.4$) rated product name importance higher than the highly numerate group ($M = 2.8$), whereas both groups rated the importance of numeric information equally ($M = 4.8$, $F(1,228) = 4.6$, $p < .05$). This is consistent with the results from Study 2 that less (vs. highly) numerate participants report non-numeric information (i.e. product name in this study) as being relatively more important than numeric information.

Development of affect. In order to investigate what factors may have contributed to the development of participants' feelings towards products, a regression was conducted.

Predictor variables were numeric levels used in the product claim (unfavorable coded as 1 and favorable coded as 2), cubic transformed numeracy, and the relative importance rating of numeric information and product name. 2-way and 3-way interaction terms among these variables were included in the analysis as well. The variance of affect towards the product name was entered as a control in the analysis. The relative importance rating of information for each participant was calculated by subtracting the importance rating of the product name from the importance rating of the numeric information. Therefore, the higher the relative importance rating is, the more numeric information is important, relative to the product name. Rather than importance rating, the relative importance rating was used in the analysis. As demonstrated above, both less numerate and highly numerate groups reported that numeric information was important in their judgments. However, the earlier analyses suggest that less numerate individuals' feelings towards products were not always sensitive to important numeric information in the product claims. Taken together, how much more important participants think numeric information is may be the key to predicting their feelings towards products. In addition, the importance rating for the name itself should not contribute to the prediction of the feelings towards products in the current study, because we measured their affect towards product names after participants evaluated products. Therefore, affect towards product names may be at least partially influenced by the product claim that includes numeric information.

The overall model was significant ($F(8,221) = 15.8$, $p < .001$). The results demonstrated that the favorability of numeric information, affect towards the product name and the relative importance of numeric information significantly predicted feelings towards products (see Table 7). Standardized coefficients indicated that participants' feelings towards products were more positive in the favorable numeric level condition ($p < .05$), and that higher levels of positive affect towards the product name was associated with more positive feelings towards the product ($p < .001$). Relative importance was positively associated with positive affect towards the products ($p < .05$): the more participants rated numeric information as important, the more positive their affect towards the product, regardless of the favorability of the numeric information. The main effect of favorability of numeric information and relative importance were qualified with significant interactions. An interaction between numeracy and relative importance rating was significant ($p = .01$). A significant 3-way interaction further qualified these effects.

In order to better understand the 3-way interaction, the predicted means of the affect were graphed separately for the unfavorable numeric condition and the favorable numeric condition. Numeracy scores of 6 (cf. 10 percentile), 9 (cf. 50 percentile), and 11 (cf. 90 percentile) were used to graph the predicted affect towards the product. Figure 4 indicates that the relative importance of numeric information was strongly associated with affect tiwards the product in the unfavorable numeric condition. In addition, numeracy had a stronger influence in the unfavorable numeric condition; specifically the more important the numeric information was, as reported by highly numerate participants, the less positive their affect towards the product is in the unfavorable numeric condition. Hence, the more highly numerate participants report that numeric information is important in the unfavorable condition, the more sensitive their affect towards the

Table 7

Coefficients and Significance Levels for Predicting Participants' Affect Towards Products

	Unstandardized Coefficients	Standardized Coefficients	*t*	Sig.
Favorability of numeric Information	1.10	.38	5.49	.000
Affect towards product name	.31	.29	5.22	.000
Numeracy	.00	-.04	-.21	.837
Relative importance rating	.62	.96	2.11	.036
Favorability * numeracy	.00	.07	.32	.750
Favorability * relative importance	-.30	-.76	-1.66	.099
Numeracy * relative importance rating	.00	-1.23	-2.58	.011
3-Way interaction	.00	1.09	2.27	.024

product are to numeric information. Less numerate participants' self-reported importance of numeric information, however, was only weakly correlated with their affect twowards the product. This indicates that affective product evaluations made by less numerate participants who reported that numeric information was important were nonetheless not influenced by the numeric information in product claims.

These associations between numeracy and the importance of numeric information and its influence on affective product evaluations were not observed in the favorable numeric condition (see Figure 5). This may be due to the lack of variance in feelings

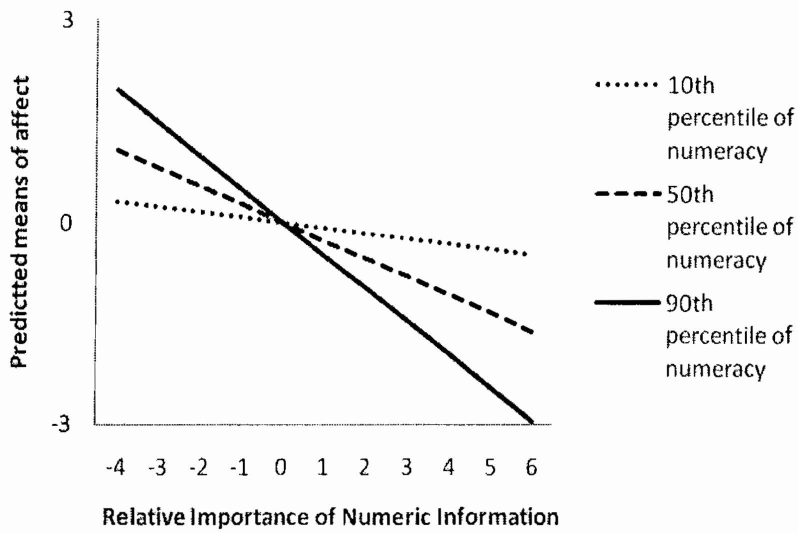


Figure 4. Predicted affect towards the product in the unfavorable numeric condition depicted by three different levels of numeracy.

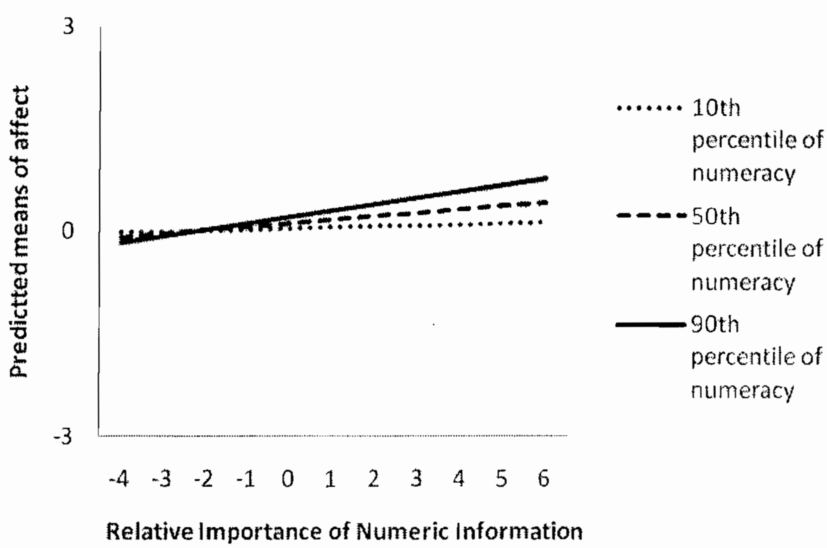


Figure 5. Predicted affect towards the product in the favorable numeric condition depicted by three different levels of numeracy.

towards products: more than 95% of participants gave neutral or positive evaluations in the favorable numeric condition.

Discussion

The first three studies demonstrated that less numerate individuals were less likely to (a) draw affective meaning from numeric information, and (b) use numeric information forming in their feelings towards products. This, in turn, appears to make less numerate individuals more susceptible to the Illusion-of-Numeric-Truth effect. On the other hand, highly numerate individuals are better at drawing affective meaning from numeric information, particularly among those who think numeric information is more important than non-numeric information (i.e. a product name). They, in turn, appear to use the affective meaning in their product evaluations and truthful judgments.

The results from first three studies suggest that both less numerate and highly numerate participants evaluate products favorably in favorable numeric conditions. Therefore, influences of numeracy on affective product evaluations were not observed. This does not necessarily suggest that both groups were equally sensitive to numeric information. Favorable feelings may result from a general tendency to respond favorably to advertised products because all the information in product claims, except for numeric information, presented the product in a favorable way (e.g., consumers preferred the product).

The influence of numeracy on the sensitivity to, and the use of, numeric information was evident in the unfavorable numeric conditions. In general, highly numerate participants' affective product evaluations in the unfavorable numeric condition were relatively unfavorable whereas less numerate participants' affective product evaluations were relatively neutral. This may be because evaluating unfavorable numeric information in product claims may be counterintuitive to some extent because consumers do not expect to see unfavorable product claims. It may be that less numerate participants failed to develop more precise affective reactions towards numeric information in these counterintuitive situations (Peters et al., 2006).

The fluency manipulation in Study 3 did not have an effect on participants' product evaluations. Less numerate participants were not more sensitive to numeric information in the disfluent condition. This could be due to a lack of ability, although all the participants were college students. It is therefore more likely that they were able to understand and use simple numeric information in their affective product evaluations. It is also possible that less numerate consumers do not value numeric information in their affective product evaluations. The results from studies two and three, however, consistently demonstrated that less numerate participants report that numeric information is important. The lack of a fluency effect may be because the manipulation did not work as well as it was intended for a couple of reasons. First, the table format introduced in Study 3. This might have discouraged less numerate participants from looking at the information in the table because it involved extra effort. Second, the digital numbers in disfluent font may have been too easy to read. Therefore, the table format was eliminated in Study 4, and the numeric information was written out rather than in digital format (e.g., thirty-three percent rather than 33%).

Participants in Studies 2 and 3 were asked to report how favorable or unfavorable they felt about the target product. However, a product claim may not be the most useful information because they only communicates about the popularity (or unpopularity in the case of unfavorable numeric condition) of the target product when it is compared to another product. Therefore, in a strict sense, participants may never know what is the "absolute goodness" of the target product. In the next study, participants were also asked to report their preferences between target products and non-target products.

Study 4: Systematic Processing of Numeric Information in Affective Product Evaluation

Study 4 examined whether it is possible for less numerate participants to more effectively use numeric information in their affective product evaluations by presenting written numeric information in harder-to-read (disfluent) font. Numeric information in disfluent font is hypothesized to lead participants to process numeric information more systematically (Schwarz, 2004). Therefore, both less and highly numerate groups are hypothesized to be more sensitive to numeric information when they are asked to report their feelings towards products in the disfluent condition (Hypothesis 2c). Only the highly numerate group is hypothesized to be sensitive to numeric information in the fluent condition (Hypothesis 2a).

Method

Design. Study 4 had two levels of within-subject numeric manipulation (unfavorable numeric value vs. favorable numeric value) and two levels of within-subject fluency manipulation (disfluent vs. fluent numeric value). Numeric information in each claim varied from 26% to 30% in unfavorable numeric condition, and from 76% to 80% in favorable numeric condition. In the disfluent condition, numeric value was written in 50% gray 11-point Old English Text MT (see Appendix E).

Procedure. Three hundred twenty-two university students participated in this study. Each participant was presented, one at a time, with two fictitious claims on a computer monitor. Two products, the target product (cf. Levantra and the non-target product (cf. Phemanide), were mentioned in each of the two fictitious claims. After reading the claim, participants were asked to rate their affect about the target product and the non-target product using a 9-point Likert-type scale (ranging from 1 = very unfavorable to 9 = very favorable). They were also asked to rate their relative preference between the target and non-target product. The 9-point Likert-type scale ranged from +4 = strongly prefer *target product* to -4 = strongly prefer *non- target product*. After 1 to 3 minutes of an unrelated task, they were asked truth judgment questions similar to those in Study 1. Further, they were asked to rate the importance of the product name, numeric information, wording of the claim, and how much weight was placed on each of this information when asked to report their feelings towards products. They also rated their affect towards each of the product names that appeared in the product claims presented earlier, and completed a manipulation check to ensure that disfluent texts were readable. Finally, they completed the same 11-point numeracy scale used in Studies 1 through 3, and demographic questions (see Appendixes G and H).

Results

The mean numeracy score was 8.8 and the median numeracy score was 9 out of 11 possible (range = 1 to 11, Cronbach's $\alpha = .56$). Because it was negatively skewed (-.7), a median split was performed.

Affect and preference. A MANOVA was conducted on participants' affect toward the target products, the non-target products, and their preference between the target product and the non-target product with three variables as between-subjects factors: (a) favorable versus unfavorable numeric information, (b) fluent versus disfluent numeric information, (c) and the median split of numeracy (see Tables 8 and 9).

Table 8

Significance Levels of MANOVA

Independent Variables	Target product	Non-target product	Preference
Favorability of numeric information	.000	.000	.000
Fluency	.078	.110	.085
Numeracy	.019	.108	.088
Favorability * fluency	.068	.214	.016
Favorability * numeracy	.033	.233	.012
Fluency * numeracy	.163	.726	.400
3-Way interaction	.458	.302	.759

Table 9

Means and Standard Deviations

	Fluent condition				Disfluent condition			
	Less numerate group		Highly numerate group		Less numerate group		Highly numerate group	
	Unfavorable numeric level	Favorable numeric level	Unfavorable numeric level	Favorable numeric level	Unfavorable numeric level	Favorable numeric level	Unfavorable numeric level	Favorable numeric level
Affect towards target product	5.37	6.29	5.00	6.36	5.14	6.40	4.10	6.27
(1 = Very unfavorable, 9 = Very favorable)	(1.12)	(1.38)	(1.59)	(1.27)	(1.57)	(1.34)	(1.36)	(1.3)
Affect towards non-target product	4.89	4.18	5.18	4.42	5.19	4.41	5.66	4.28
(1 = Very unfavorable, 9 = Very favorable)	(1.16)	(1.24)	(1.3)	(0.82)	(1.35)	(1.04)	(1.19)	(1.32)
Preference between the products	.57	1.24	.04	1.47	.06	1.45	-.85	1.50
(1 = Strongly prefer target and 9 = Strongly prefer non-target)	(1.34)	(1.31)	(1.72)	(1.39)	(1.45)	(1.71)	(1.45)	(1.40)

( ) represents standard deviation

Favorability of numeric information was significant for all three dependent variables—affect towards target and non-target product, and preference between the target and non-target products. When the target products were described with favorable numeric information, subjects reported significantly more positive feelings for the target products ($M = 6.3$) and significantly less positive feelings for the non-target products ($M = 4.3$) than when the target products were described using unfavorable numeric information ($M = 5.0$, $F(1,303) = 82.4$, $p < .001$ for the target products; $M = 5.2$, $F(1,303) = 44.2$, $p < .001$ for the non-target products). Participants also preferred the target products to the non-target products when the target products were described with favorable numeric information ($M = 1.4$) than with unfavorable numeric information ($M = .02$, $F(1,303) = 74.9$, $p < .001$). The fluency manipulation had marginally significant effects on participants' feelings and preferences toward the target products ($F(1,303) = 3.1$, $p = .078$, and $F(1,303) = 3.0$, $p < .085$, respectively). Participants reported higher level of positive feelings toward the target products in the fluent condition ($M = 5.8$) than in the disfluent condition ($M = 5.5$), and they preferred the target products in the fluent condition ($M = .9$) more than in the disfluent condition ($M = .56$). In addition, less numerate participants reported more positive feelings towards the target products ($M = 5.8$) and a marginally significant preference towards the target products ($M = .8$) than did highly numerate participants ($M = 5.5$, $F(1,303) = 5.5$, $p < .05$, and $M = .57$, $F(1,303) = 74.9$, $p = .088$, respectively).

The main effects discussed above were qualified by two significant 2-way interactions: an interaction between favorability of numeric information and numeracy, and an interaction between favorability of numeric information and fluency manipulation. Consistent with Studies 2 and 3, less numerate participants' feelings towards products inclaims with unfavorable (M = 5.3) and favorable numeric information (M = 6.3) were not as different as those of highly numerate participants' (M = 4.6 and M = 6.3, respectively, $F(1,303) = 4.6$, $p < .05$). Participants' preferences towards the target products, as compared to the non-target products, demonstrated the same trend: less numerate participants' preference for the target products in a claim with unfavorable (M = .3) and favorable numeric information (M = 1.3) were not as different as those of highly numerate participants' (M = -.4 and M = 1.5, respectively, $F(1,303) = 6.4$, $p < .05$) (see Figure 6).

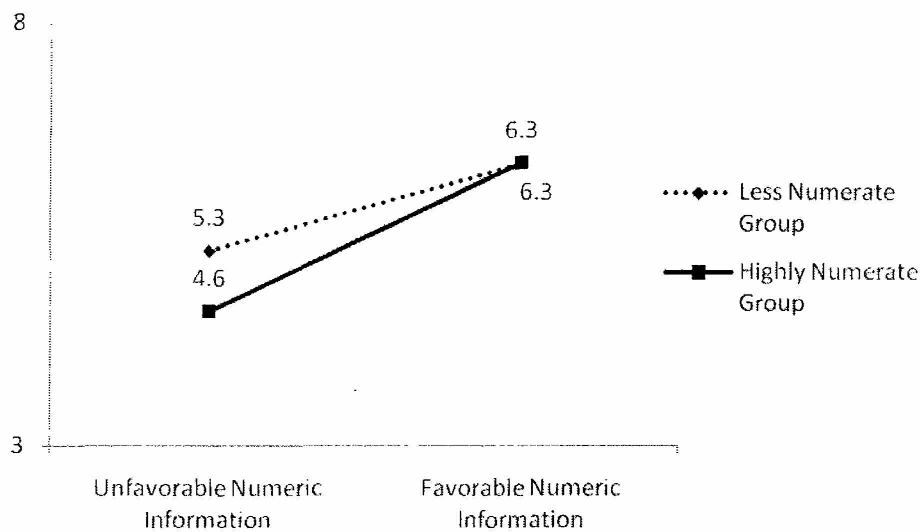


Figure 6. Mean affect towards the target product in the unfavorable numeric condition depicted by numeracy.

Fluency and favorability of numeric information also had marginally significant effects on participants' feelings towards the target products ($F(1,303) = 3.4$, $p = .068$) and significant effects on participants' preference towards the target products ($F(1,303) = 5.8$, $p < .05$) (see Figure 7). Subjects' feelings towards the target product were more sensitive to numeric information in the disfluent condition ($M = 4.7$ in the unfavorable numeric condition and $M = 6.4$ in the favorable numeric condition) than in the fluent condition ($M = 5.2$ in the unfavorable numeric condition and $M = 6.4$ in the unfavorable numeric condition). Participants' preference towards the products was more sensitive to numeric information in the disfluent condition ($M = -.3$ in the unfavorable numeric condition and $M = 1.5$ in the favorable numeric condition) than in the fluent condition ($M = .3$ in the unfavorable numeric condition and $M = 1.4$ in the favorable numeric condition) (see Figure 8). A 3-way interaction did not reveal any significant effects on any of the dependent measures, suggesting that the disfluent font had similar effects as those low and high in numeracy.

The significant 2-way interactions seem to be driven by the participants' feelings and preferences towards the target products with the unfavorable numeric information. Participants in the fluent (vs. disfluency) condition and the less (vs. highly) numerate group reported relatively positive feelings and relatively stronger preferences towards the target products in the unfavorable numeric claims. These results replicate those from Studies 2 and 3 in that highly numerate groups were more sensitive to numeric information in product claims regardless of the level of numeric information. In addition, this study demonstrated that participants were more sensitive to numeric information in

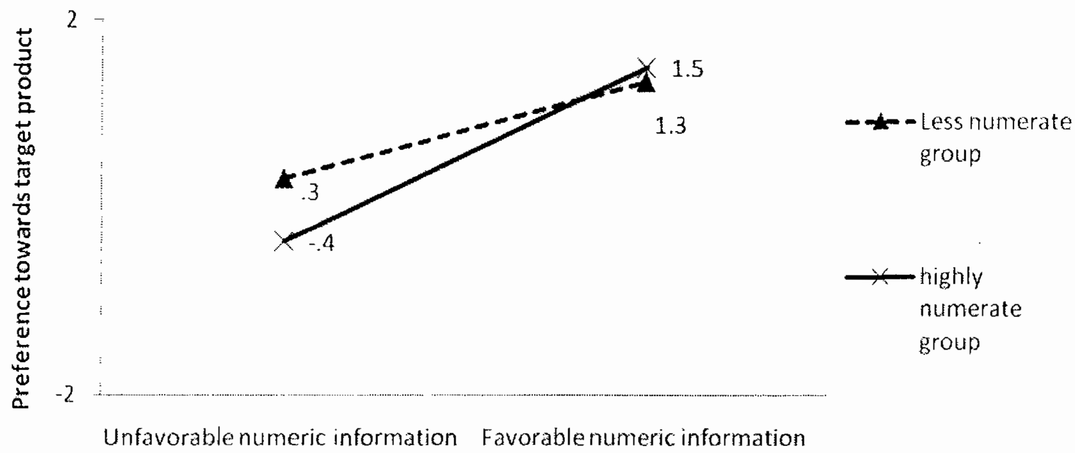


Figure 7. Participants' preference towards the target product in the unfavorable and the favorable numeric conditions depicted separately for the less numerate and the highly numerate groups.

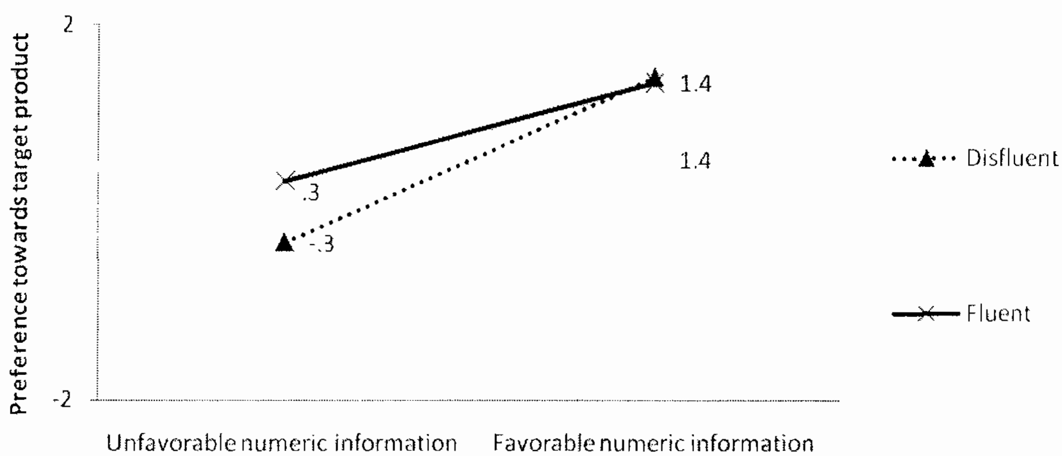


Figure 8. Participants' preference towards the target product in the unfavorable and the favorable numeric conditions depicted seperately for the fluent and the disfluent conditions.

product claims when numeric information was written in hard-to-read font, which presumably led to more systematic information processing.

Importance of numeric information. A repeated measures ANOVA was conducted to test whether there was any difference in how much participants reported that numeric information and product names were important to their affective product evaluations among the less numerate and the highly numerate groups. Two repeated measures—importance ratings for numeric information and product name—were used as dependent variables and the median-split numeracy was used as an independent variable. The results from Studies 2 and 3 were replicated, and this study demonstrated a significant interaction between the type of information (numeric versus product name) and numeracy on importance ratings ($F(1,277) = 3.9, p < .05$). Product name was rated as more important by less numerate group ($M = 3.0$) than by highly numerate group ($M = 2.4$), whereas, numeric information was rated equally important by less numerate and highly numerate groups ($M = 4.9$ and $M = 5.0$, respectively). This suggests that, compared to highly numerate participants, less numerate participants placed more importance on product names relative to numeric information.

Truth judgments. A MANOVA was conducted to test predictors of the accuracy of truth judgments (false = 0 and true = 1) on two claims using favorability of numeric information and numeracy as between-subjects factors. All main effects and 2-way interactions, except for one, were significant (see Table 10). A significant main effect of favorability of numeric information demonstrated that most participants (85% in the first claim, $F(1,259) = 70.7, p < .001$ and 88% in the second claim, $F(1,259) = 106.9, p$

< .001) successfully judged the favorable claim as true. A significantly higher number of less numerate participants (71%) judged the first claim as true than highly numerate participants (54%; $F(1,259) = 9.3$, $p < .01$). This did not reach conventional significance level for the second claim (66% "true" response among less numerate participants and 56% "true" response among highly numerate participants, $F(1,259) = 2.5$, $p = .1$). Significant 2-way interactions demonstrated that more highly numerate participants correctly judged a false claim as false (76% for the first claim and 74% for the second claim) than less numerate participants (42% for the first claim and 55% for the second claim) while 84% to 90% of both less and highly numerate subjects correctly judged a true claim as true in both claims (the first claim: $F(1,259) = 12.2$, $p = .001$, the second claim: $F(1,259) = 5.1$, $p < .05$). These results were consistent with those in Studies 1 and 3.

Table 10

Significance Levels of MANOVA

Independent variables	Claim 1	Claim 2
Favorability of numeric information	.000	.000
Numeracy	.003	.118
2-Way interaction	.001	.025

Discussion

Study 4 demonstrated that systematic processing of numeric information leads to an increased use of numeric information in developing feelings towards products among less and highly numerate groups. This has several important implications. First, although less numerate participants in this dissertation may not be naturally sensitive to numeric information, they are capable of using numeric information in their affective product evaluations. In addition, this study suggests that it is possible to help less numerate consumers use numeric information more in their affective product evaluations by changing the way numeric information is presented. This is consistent with prior research highlighting the importance of how information is presented (Peters et al., 2007). In this current study, however, the manipulation (cf. use of disfluent font) was minimal. This finding can be extremely useful in marketing communications because it may be the most efficient way to help less numerate consumers, compared to, for example, having a third person explain the meaning of numeric information and encourage consumers to use the information in their affective product evaluations and other judgments.

The first four studies in this dissertation investigated individuals' sensitivity to numeric information in their affective product evaluations when they were presented with product claims describing the proportion of consumers favoring one product over another. In this context, participants are presented with only the relevant numeric information. In marketing contexts, however, information is sometimes presented that is not directly related to the product being evaluated. For example, a search for digital cameras on Amazon.com will also yield information on memory cards and camera cases based on other consumers' purchase history. Because it is available and may be relevant, consumers may pay attention to and use the information of those recommended products. In fact, it has been demonstrated that additional information can influence consumers' judgments even when that information is not directly related to products under consideration. For example, Peters et al. (2006) demonstrated that highly numerate individuals' attractiveness ratings towards a bet was higher in the presence of a $.05 loss than in the absence of a $.05 loss because they drew more affective meaning from comparing thc numeric information (i.e. the utility of gaining $9 looks more attractive with the presence of a $.05 loss). Thus, there may be some marketing environments where highly numerate consumers draw inconsistent meaning from numeric information because of the context in which the numeric information is presented. For example, a star rating of 4 (out of 5) for a laptop computer on Amazon.com may look more or less attractive if evaluated in the context of worse or better star ratings for other products (e.g., 3 or 5 star ratings out of 5 for other laptop related products). In effect, the rating for the other product may serve as an anchor.

Study 5 tests whether highly numerate participants' and less numerate participants' affect towards product are influenced differently by additional numeric information provided to describe accompanying products.

Study 5: Number Comparison and Numeracy.

Study 5 tested whether highly numerate participants' affect towards product are influenced by additional numeric information provided to describe accompanying products (Hypothesis 3a). Affect towards product reported by less numerate participants, on the other hand, are expected not to be influenced by this additional irrelevant numeric information (Hypothesis 3b).

Method

Design. Study 5 had three levels of a between-subject numeric manipulation (comparatively worse numeric value vs. comparatively better numeric value vs. no comparative numeric value).

Procedure. Three hundred forty-three university students participated in this study. Each participant was instructed to read the following scenario (see Appendix F).

> Imagine you are looking for a computer that gives you high computing and graphic performance power. You are also looking for a laptop sleeve case to go with the laptop. Below is one computer and one sleeve case. You can purchase them separately or together. Please evaluate the product information on the next page and answer the questions that follow.

On the next page, each participant in the control condition was presented with a picture, product information, and a consumer star rating of a laptop computer. In addition to the information above, those in experimental conditions were presented with a picture, product information, and a star rating of the laptop case. The star rating of the laptop computer in all conditions was 2.5 out of 5.0 which is usually viewed as a relatively low rating on Amazon.com. The star ratings for the laptop case were manipulated in such a way that the star rating for the laptop computer was either much better than the star rating of the laptop case (cf. 4.9 stars out of 5.0; comparatively better star rating) or much worse than the star rating of the laptop case (cf. 1.2 stars out of 5.0; comparatively worse star rating). After evaluating the picture(s) and the product information, participants were asked to type the star ratings provided on the survey as a manipulation check. Then they were asked to report how they feel about the laptop computer (and the laptop case for those in the experimental conditions) on a 9-point scale (very unfavorable to very favorable).

On the next page, participants were asked how important (a) the star rating was in the consumer reviews, (b) the product information was, and (c) the look of the computer was in their evaluations of the laptop computer. They were also asked to report their expertise with purchasing a laptop (How much knowledge do you have about purchasing computers? How often do people come to you for advice about computer purchases?). At the end of the survey, participants completed an 11-point numeracy scale and some demographic questions (see Appendixes G and H).

Results

Numeracy. The mean numeracy score was 8.6 and the median numeracy score was 9 out of 11 possible (range = 1 to 11, Cronbach's α = .63). Because it was negatively skewed (-1.1), a median split was performed. Those with scores of 9 or lower were coded as less numerate participants, and those with scores of 10 or higher were coded as highly numerate participants.

Affect. A MANOVA was conducted using the relative favorability of numeric information (no additional star rating/control = 1, star rating for laptop is comparatively worse condition = 2, star rating for laptop is comparatively better condition = 3) and numeracy as between-subjects factors. The main dependent variables were participants' affect towards the product. Two variables, how much they liked the look of the laptop computer, and an expert index, were entered as covariates. The expert index was calculated by standardizing two questions related to computer expertise, and then summing the answers (Cronbach's $\alpha = .82$). An omnibus test demonstrated significant main effects of the relative favorability of the star rating ($F(6, 658) = 2.7$, $p = .01$) and numeracy ($F(3, 328 = 2.8$, $p < .05$). A significant interaction between the favorability of the star rating and numeracy was also obtained ($F(6, 658) = 2.7$, $p = .01$).

Main effects. A significant main effect of the relative favorability of star ratings was obtained ($F(2, 330) = 2.6$, $p = .01$) (see Table 11). The mean affect towards the laptop computer ranged from 3.6 to 4.4 out of 9 in different conditions, indicating that participants in general had relatively unfavorable to neutral affect towards the laptop computer. Given that the star rating for the laptop computer was 2.5 stars out of 5.0, the low means were expected. Participants' affect towards the laptop were least negative in the control ($M = 4.4$; no comparative rating) condition, followed by the comparatively better star rating condition ($M = 4.0$). Affect was most negative in the comparatively worse star rating condition ($M = 3.6$). There was no other significant main effect of the favorability of numeric information. There was a significant main effect of numeracy on the expert index ($F(1, 330) = 5.5$, $p < .05$). The self-reported expert index was significantly higher for highly numerate participants ($M = .32$) than for less numerate participants ($M = -.20$). Highly numerate participants reported that they weighed the looks of the laptop computer in their affective product evaluations more than less numerate participants (($M = 5.4$ and $M = 5.1$, respectively) did.

Table 11

Results from a MANOVA

	Affect towards product	Looks	Expert index
Relative Favorability of Numeric Information	4.6 (p = .011)	1.4 (p = .255)	2.5 (p = .081)
Numeracy	3.0 (p = .084)	1.6 (p = .205)	5.4 (p = .020)
Interaction	3.2 (p = .042)	3.2 (p = .041)	2.1 (p = .127)

Interaction effects. There were two significant interactions between numeracy and the favorability of numeric information. One of the significant interactions involved the degree to which participants liked the looks of the laptop computer ($F(2, 330) = 29.2$, $p < .05$) (see Figure 9). The means indicated that highly numerate participants liked how the laptop computer looked in the control and in the comparatively better star rating conditions ($M = 5.7$ in both conditions) much more than they liked how the laptop computer looked in the comparatively worse star rating condition ($M = 4.7$). Less numerate participants, on the other hand, liked how the laptop computer looked approximately equally in all conditions ($M = 5.0$ in control and in the comparatively better star rating condition, and $M = 5.2$ in the comparatively worse rating condition).

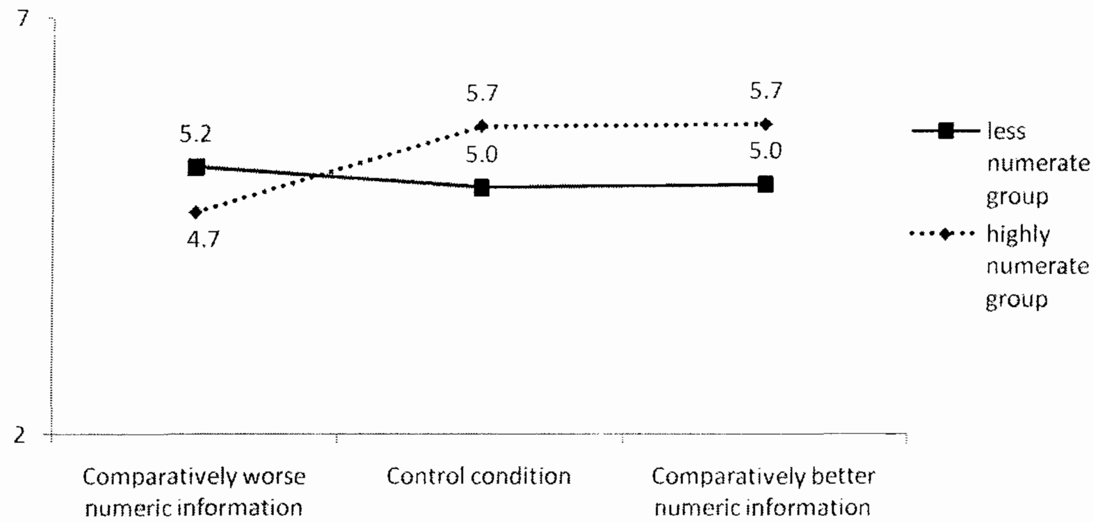


Figure 9. Affect towards the product by the less numerate and the highly numerate groups in each condition.

Another significant interaction was obtained on affective product evaluations (F(2, 330) = 14.6, $p < .05$) (see Figure 10). The means suggest that highly numerate participants' affective product evaluations became more positive as the star rating for the evaluated product (cf. laptop computer) became more positive relative to the accompanying product (cf. laptop case) (see Figure 7). Linear regression analysis on affective product evaluation among highly numerate group marginally support this interpretation (F(1, 132) = 3.5, $p = .07$). A Helmert contrast demonstrated that the less numerate participants' affective product evaluations, however, became less positive when accompanied by additional star ratings, regardless of the favorability of the star ratings ($M = 4.6$ in control condition, $M = 3.4$ in comparatively worse star rating condition, and $M = 3.6$ in comparatively better star rating condition; F(1,203) = 16.3, $p < .001$).

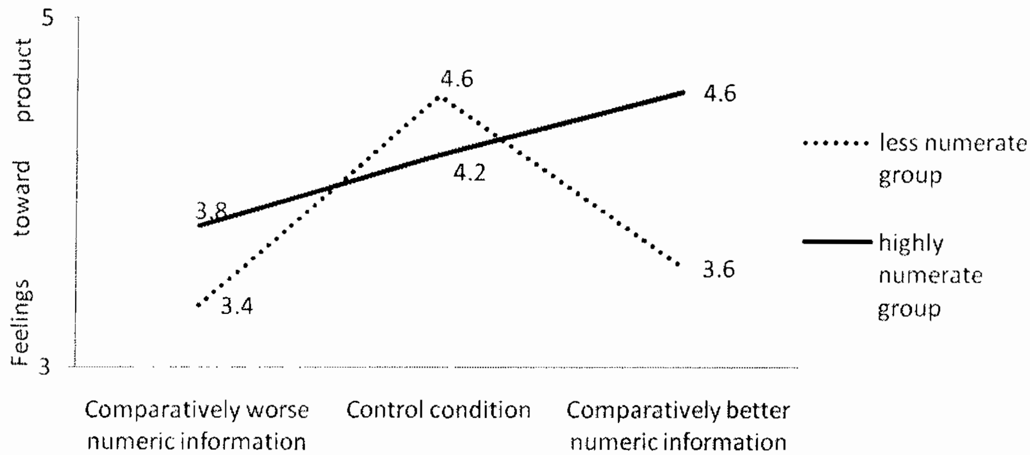


Figure 10. Affect towards product reported by the less numerate and the highly numerate groups in each condition.

Discussion

In summary, the results in Study 5 demonstrated that less numerate and highly numerate participants were influenced differently in different contexts by the same numeric information (2.5 stars out of 5.0). Highly numerate participants, compared to those lower in numeracy, seem to use the star rating relatively consistently. They seem to also compare two star ratings and draw meaning from the comparison. Given that less numerate participants had lower affective product evaluations in both experimental conditions where the laptop case was present (comparatively better and worse star rating conditions), they did not seem to draw meaning from number comparisons. They may have drawn meaning from other product information about the laptop case. For example, the laptop case looked very inexpensive and was relatively unattractive looking. Therefore, less numerate participants may have used this alternative source of information (i.e., affect towards laptop case) in their evaluations of the laptop computer. In addition, they may have been uncomfortable with the additional numeric information, and this negative affect may have colored their evaluations of the laptop computer. These speculations are consistent with some of the previous findings on how less numerate individuals use irrelevant sources of information, and how they tend to use non-numeric information more in their judgments (Dieckmann, Slovic, & Peters, 2009; Peters et al. 2009; Peters et al., 2006).

A correlational analysis was conducted for the less numerate and the highly numerate groups separately for each condition in order to examine whether numeracy correlated with self-reported use of star ratings in affective product evaluations. Correlations between self-reported uses of star ratings in affective product evaluations might be stronger (cf. more negative) for highly numerate participants in the experimental conditions than in the control condition because they are more likely to compare the star ratings, draw meanings from the number comparison, and use these meanings in their affective product evaluations, and they might be aware of this process. Highly numerate participants' correlations should be higher in the comparatively worse star rating condition than in the comparatively better star rating condition because lower star ratings should be more salient in the comparatively worse star rating condition than in the comparatively better star rating condition. On the other hand, correlations among the less numerate group should not differ much across the different conditions because their affective product evaluations are not derived by the use of star ratings.

These hypotheses were mostly supported (see Table 12). The highly numerate participants' correlation in the comparatively worse rating condition was more negative ($r(49) = -.73$, $p < .001$) than in the comparatively better rating condition ($r(48) = -.43$ ($p < .01$). The correlation in the control condition was not significant ($r = -.12$, $p = ns$). This suggests that highly numerate participants weighted star ratings the most in the comparatively worse rating condition while they did not weight star ratings much in their evaluations in the control condition. The less numerate participants' correlations were approximately the same in both experimental conditions (comparatively worse rating condition: $r(69) = -.40$, $p < .001$, comparatively better rating condition: $r(71) = -.39$ ($p < .001$)). The less numerate participants' correlation in the control condition was not significant ($r = -.10$, $p = ns$). These correlations among less numerate participants indicate that they think they weight the star ratings, to a lesser degree, approximately equally in the different experimental groups while they do not use the star ratings in their affective product evaluations in the control condition.

The correlation analysis above is not sufficient to support my hypothesis, of course. For one thing, we need to assume that participants can accurately self-report how much they weight the star ratings in evaluating the laptop computer. In addition, correlations do not test the direction of effects. Therefore, it is possible that participants reported their use of star ratings by consulting how they evaluated the laptop computer (e.g., I must have used the star ratings in my evaluation because I gave unfavorable product evaluations). Lastly, sample sizes in each cell were small. Therefore, the results should be interpreted with caution.

Table 12

Correlations Between Affective Product Evaluations and the Use of Star Ratings in Affective Product Evaluations for Each Conditions Crossed by Numeracy

		Control	Comparatively better star rating	Comparatively worse star rating
Less numerate participants	Correlation	-.098	-.385**	-.398**
	p values	.436	.001	.001
	N	66	71	69
Highly numerate participants	Correlation	-.124	-.426**	-.734**
	p values	.466	.003	.000
	N	37	48	49

* Significant at $p = .05$
** Significant at $p = .01$

Nonetheless, the correlation analysis is consistent with my hypothesis that highly numerate participants are more likely to compare numbers, draw meaning from the number comparisons, and use the meaning in their affective product evaluations. There is less evidence of such processes for less numerate participants.

Study 5 demonstrated that less numerate and highly numerate participants draw different meanings from the same numeric information, and the meanings may be dependent on the context. Highly numerate individuals' affective product evaluations were relatively stable across contexts, and additional numeric information may act as a reference point. Less numerate individuals, on the other hand, do not appear to draw meaning from comparing two numbers. Rather, they seem to draw affective meaning from something else. Although it is speculated that their evaluations were influenced by their affect towards the laptop case, it is not clear what information less numerate individuals use in their affective product evaluation in this study. Further studies are needed to better understand the source of information less numerate individuals use in their affective product evaluations.

CHAPTER IV

GENERAL DISCUSSION

This dissertation contributes to the understanding of consumers' numeric judgments. More specifically, this dissertation is the first to demonstrate the Illusion-of-Numeric-Truth effect, a novel instantiation of the Illusion-of-Truth effect (Skurnik et al., 2005). It is also the first known study to investigate if and how consumers successfully use numeric information in their affective product evaluations. We are exposed to much product information in numeric form. The assumption of marketers seems to be that numeric information is useful for consumers in their affective product evaluations. However, the results from this dissertation indicate that not all of the numeric information may be used or even useful to all consumers. Less numerate individuals' feelings toward products were neutral when numeric information in a product claim indicated unpopularity, while highly numerate individuals' feelings toward such products were unfavorable. These results suggest that although numeric information in product claims can be very important and alter the gist of claims (e.g., 35% vs. 85% chose Nestlé's Crunch over the new Snickers Cruncher), less numerate individuals may not be sensitive to numeric information in developing their feelings toward products. This may lead consumers, especially those lower in numeracy, to develop their feelings towards products based on incomplete or irrelevant information.

Less numerate individuals were also shown to be more susceptible to the Illusion-of-Numeric-Truth effect. For example, they could not tell the accuracy of favorable claims (e.g., most consumers believed Diet Pepsi tastes more like real cola) better than chance when they were previously presented with unfavorable claims (e.g., 35% of consumer believed Diet Pepsi tastes more like real cola). This not only suggests that less numerate individuals were using incomplete information, but they may also be using inaccurate information in their affective product evaluations.

Although highly numerate individuals were better able to tell the truthfulness of product claims than less numerate individuals, highly numerate individuals were still susceptible to the Illusion-of-Numeric-Truth effect. This Illusion-of-Numeric-Truth effect seems to be underlined by the feelings participants drew from numeric information. Highly numerate individuals, compared to those lower in numeracy, were more successful at using crucial numeric information that was used to describe products when they were asked to rate their feelings towards products. In turn, highly numerate individuals seem to be using their feelings when judging the truthfulness of product claims. This suggests that it is important to have consumers understand numeric information and develop feelings from numeric information in order for them to correctly assess the accuracy of product claims that involve important numeric information.

In addition, this dissertation demonstrates that participants were more sensitive to numeric information when they read numeric information in hard-to-read font (cf. disfluent texts). This occurred presumably because participants processed the numeric information in more depth (Schwarz, 2004), and they used the numeric information in their affective product evaluations. This suggests that less numerate consumers are able to draw meaning from numeric information and use this information in their affective product evaluations. Future studies should investigate other ways to help less numerate people use numeric information in their affective product evaluations.

Consistent with Peters et al. (2006), highly numerate consumers seem to draw affective meanings from number comparison, and use this information in their judgments (Study 5). Based on the results, it can be argued that highly numerate consumers are making objectively worse judgments because they are not consistent in their evaluations. However, the additional numeric information provided in this dissertation and the study in Peters et al. (2006) was arguably diagnostic to individuals' judgments and choices. For example, the star rating for the laptop case on the same Web site is potentially useful information for individuals who are purchasing a laptop computer. It may communicate to them about the possible range of distributions of star ratings on the particular Web site or on the related product categories. Further, it may indirectly communicate the quality of the laptop computer by merely recognizing the quality of the laptop case suggested for consumers who are viewing the laptop computer. Therefore, one could argue that it is rational to use the additional numeric information to interpret the target numeric information (cf. star rating for laptop computer). Future studies can investigate the boundary condition concerning whether highly numerate consumers draw affective meaning from number comparisons and use the information in their affective product evaluations even when comparative products are irrelevant to target products. For example, one may extend Study 5 by adding another experimental condition that presents an oven toaster, for example, instead of laptop computer as a "comparative" product. Do highly numerate participants still draw meaning from comparing star ratings for a laptop computer and an oven toaster? If they do, it suggests that highly numerate consumers draw meaning from number comparisons even when the comparative numeric information is not diagnostic to the target numeric information. If they do not, however, then it suggests that highly numerate consumers draw meaning from number comparison only when the comparative numeric information is diagnostic to some extent.

It is also not clear whether highly numerate consumers also use numeric information when it is not valid. For example, it may be better for us to disregard numeric information if information came from an unreliable source or was based only on three consumer reviews. There may also be contexts where it is better for consumers to rely on non-numeric information when evaluating products in certain product categories, such as hedonic objects. More research is needed to learn if and when highly numerate consumers "overuse" numeric information in their affective product evaluations and product choices.

The results from Study 5 suggest that less numerate participants may have used their affect towards irrelevant sources of information, such as pictures of the laptop computer and the laptop case, in their affective product evaluations of the target product (cf. the laptop computer). This suggests that less numerate consumers may be more likely to rely on non-numeric information when evaluating product that contain numeric and nonnumeric information. This is consistent with previous literature (Dieckmann et al., 2009; Peters et al., 2009). In order to test if less numerate consumers are more likely to use non-numeric information in their affective product evaluations, participants' affect towards, for example, pictures of the product can be manipulated. Less numerate consumers may also develop negative affect due to increased pieces of numeric information because they are not as comfortable with numbers as those high in numeracy. In order to test this, the amount of non-diagnostic numeric information can be manipulated to test if less numerate consumers develop negative affect by viewing numeric information.

Recent research suggests that about half of all Americans lack the basic skills needed to use numbers embedded in printed materials (Kirsch et al., 2002). Although most of the participants in the current dissertation were highly educated (cf. college students), they failed to consistently use numeric information in their judgments, and were susceptible to the Illusion-of-Numeric-Truth effect. These results suggest that a fairly large number of people in the U.S. may be susceptible to the Illusion-of-Numeric-Truth effect.

Most of the product participants evaluated in this dissertation were low in involvement (e.g., snacks and painkillers). Research is starting to suggest that consumers lower in numeracy are less sensitive to numeric information when facing important healthcare and medical decisions as well. However, the mechanisms at process levels for numeric information processing are still unclear. Therefore, future studies should investigate the use of numeric information in important decisions, such as medical and financial decisions.

Using homogeneous college participants presents some limitations to generalizations. It has been demonstrated that decision strategy and information processing style change over the course of life. Therefore, future studies should investigate the sensitivity to numeric information among other generations, especially older adults who often have more limited cognitive capacities and are expected to make important and potentially complicated choices, such as choosing Medicare plans.

More research is needed to illuminate how consumers understand numeric and nonnumeric information in product claims and how their use of numeric information can be facilitated, especially among those lower in numeracy. Having individuals successfully use numeric information in their judgments not only helps their online judgment, but it may also assist their later judgments when complete information is not available. Better understanding will facilitate development of the best practices in using numerical information in communicating with consumers.

APPENDIX A

STUDY 1 PRETEST

Please indicate your attitude toward each product.

Ford F-150

Very Unfavorable			Neutral			Very Favorable
○	○	○	○	○	○	○

Please indicate how familiar you are with each product.
Dr. Scholl's charcoal inserts

Not at all						Very much
○	○	○	○	○	○	○

These were repeated for each of the product shown below.

Diet Pepsi
Sam Adams beer
Folgers Coffee
Dole Pineapple Juice
Jif peanut butter
Mediterranean diet
Elite Oats 'N More by Dymatize
Nestlé's Crunch
Jell-O
Chiquita bananas
Kraft Macaroni and Cheese
Tempur-pedic mattress
Home Depot
Oscar Meyer wieners
Chili's Grill & Bar
Tylenol
Tide Liquid
Nike Shoes
Robitussin
Cadillac SRX
Clorox Bleach
Classic Ivory Bar Soap
Aveda
BIC pens
Southwest Airlines
Chevron with Techron gasoline
Hondas
Hilton hotels
Ford F-150
State Farm homeowner's insurance
Hover Round wheelchairs
Dr. Scholl's charcoal inserts
Kenmore Air Conditioners
Bank of America
Visa Credit Card Inc
Florida's Natural Orange Juice

APPENDIX B

STUDY 1 SURVEY INSTRUMENT

(1) Participants' attitude and familiarity towards each product during the experiment.

Please indicate your attitude toward each product.

Ford F-150

Very Unfavorable			Neutral			Very Favorable
○	○	○	○	○	○	○

Please indicate how familiar you are with each product.

Dr. Scholl's charcoal inserts

Not at all						Very much
○	○	○	○	○	○	○

These were repeated for each of the product shown below.

Diet Pepsi
Sam Adams beer
Folgers Coffee
Dole Pineapple Juice
Jif peanut butter
Mediterranean diet
Elite Oats 'N More by Dymatize
Nestlé's Crunch
Jell-O
Chiquita bananas
Kraft Macaroni and Cheese
Tempur-pedic mattress
Home Depot
Oscar Meyer wieners
Chili's Grill & Bar
Tylenol
Tide Liquid
Nike Shoes
Robitussin
Cadillac SRX
Clorox Bleach
Classic Ivory Bar Soap
Aveda
BIC pens
Southwest Airlines
Chevron with Techron gasoline
Hondas
Hilton hotels
Ford F-150
State Farm homeowner's insurance
Hover Round wheelchairs
Dr. Scholl's charcoal inserts
Kenmore Air Conditioners
Bank of America
Visa Credit Card Inc
Florida's Natural Orange Juice

(2) Information phase

In the next part of the experiment, you will read the various product claims we may use in the advertisements in the future. Please read them carefully and rate how easy or difficult it is to understand the claims.

(a) Examples of product claim and response scales
(i) "In a double-blind taste test, consumers tasted two cola drinks with a bite of cracker or sip of water before each tasting. Among these consumers, 32% believed that Diet Pepsi tasted most like real cola." .

Please rate how easy or difficult it is to understand the claim.

Very Easy			Neutral			Very Difficult
○	○	○	○	○	○	○

(ii) "79% of doctors recommend Robitussin for cough control over other leading brands."

Please rate how easy or difficult it is to understand the claim.

Very Easy			Neutral			Very Difficult
○	○	○	○	○	○	○

(3) Instruction for truth judgments

In the next section, you will be presented with various product claims. Some of them are accurately based on the claims presented earlier in the experiment, and some of them are falsely based on the claims presented earlier in the experiment. There will be some new claims that never appeared in the experiment earlier.

Please read each of the claims carefully and determine if the claim is true, false or new. If you believe the claim is accurately based on the claim you saw earlier, please choose "True." If you believe the claim is falsely based on the claim you saw earlier, please choose "False." If you believe you did not see the claim earlier in the experiment, please choose "New."

(4) Examples of claims and truth judgments in the test phase

"Most people in double-blind test tastes believe Diet Pepsi tastes most like real cola."
Please indicate if you believe this claim is true, false or new.

Please indicate if you believe this claim is true, false or new.

True False New

"Most doctors recommend Robitussin for cough control over other leading brands."
Please indicate if you believe this claim is true, false or new.

Please indicate if you believe this claim is true, false or new.

True False New

(5) Examples of familiarity questions after the test phase.

Please indicate how familiar you are with each product.

Dr. Scholl's charcoal inserts

Not at all Very much

This was repeated for each of the product shown below.

Diet Pepsi
Sam Adams beer
Folgers Coffee
Dole Pineapple Juice
Jif peanut butter
Mediterranean diet
Elite Oats 'N More by Dymatize
Nestlé's Crunch
Jell-O
Chiquita bananas
Kraft Macaroni and Cheese
Tempur-pedic mattress
Home Depot
Oscar Meyer wieners
Chili's Grill & Bar
Tylenol
Tide Liquid
Nike Shoes
Robitussin
Cadillac SRX
Clorox Bleach
Classic Ivory Bar Soap
Aveda
BIC pens
Southwest Airlines
Chevron with Techron gasoline
Hondas
Hilton hotels
Ford F-150
State Farm homeowner's insurance
Hover Round wheelchairs
Dr. Scholl's charcoal inserts
Kenmore Air Conditioners
Bank of America
Visa Credit Card Inc
Florida's Natural Orange Juice

APPENDIX C

STUDY 2 SURVEY INSTRUMENT

In the next part of the experiment, you will read the various product claims we may use in advertisements in the future. Please read them carefully and answer questions regarding the claims.

"Among physicians surveyed on the West Coast, thirty-nine percent recommended Pentol over Phemanide for fever reduction and temporary relief of minor aches and pains. Forty-five percent of them said they take Pentol themselves, and forty-four percent of patients also preferred Pentol over Phemanide."

How do you feel about Pentol ?

Very Unfavorable			Neutral			Very Favorable
○	○	○	○	○	○	○

"In a recent blind taste test, Marathon Mega-mint chewing gum was preferred over Supreme Peppermint Blast by thirty-six percent of consumers. Forty-one percent of them said that Marathon has longer lasting fresh taste. In an online poll, forty-four percent of dentists surveyed said they preferred Marathon to Supreme."

How do you feel about Marathon Mega-mint ?

Very Unfavorable			Neutral			Very Favorable
○	○	○	○	○	○	○

"According to a survey in several women's magazines, thirty-seven percent of respondents thought that Arielle Pomegranate shampoo gave more body and shine than Roma Herbal Infusion Plus. In a week-long study, thirty-six percent of women gave favorable ratings to Arielle. When asked which shampoo they were most likely to recommend to their clients, thirty-nine percent of hairstylists surveyed said they would recommend Arielle over Roma."

How do you feel about Arielle Pomegranate?

Very Unfavorable			Neutral			Very Favorable
○	○	○	○	○	○	○

"According to Yoga Times magazine, Prosperity organic cotton flexing trousers are recommended over YogaJamms stretch pants for durability by forty-one percent of yogis. After owning both brands for one year, forth-three percent of owners said they preferred Prosperity to YogaJamms. Over the course of a four year study, Yoga Times found Prosperity's flexing trousers to have thirty-nine percent longer life at the knees than YogaJamms."

How do you feel about Prosperity?

Very Unfavorable			Neutral			Very Favorable
○	○	○	○	○	○	○

"According to the latest issue of Consumer Reports, forty-one percent of moms reported that their kids liked Sammy's Cheesy Mac more than Classic Macaroni & Cheese by Avien. In fact, forty-two percent of children surveyed chose Sammy's Cheesy Mac over Classic Macaroni & Cheese by Avien. Thirty-nine percent of the mothers reported that they would buy Sammy's Cheesy Mac for their kids."

How do you feel about Sammy's Cheesy Mac?

Very Unfavorable			Neutral			Very Favorable
○	○	○	○	○	○	○

"Soap 'em Up sponges beat out Scrubber's brand in thirty-five percent of in-home trials. Soap 'em Up sponges were also chosen by forty-one percent of family-owned restaurants. In a recent poll, forty-three percent of moms said that Soap 'em' Up sponges get their family's dishes the cleanest and leave a great shine."

How do you feel about Soap 'em Up sponges ?

Very Unfavorable			Neutral			Very Favorable
○	○	○	○	○	○	○

What did you think about the part of the study you just completed (e.g., reading various product claims)?

1	QID20		TE	ML

What do you think we are studying in this part of the study?

How important was the numeric information to your judgments?

Not at all important						Very important
○	○	○	○	○	○	○

How important was the rest of the information to your judgments?

Not at all important						Very important
○	○	○	○	○	○	○

APPENDIX D

STUDY 3 SURVEY INSTRUMENT

In this section of the study, you will be presented with product claims that compare two products. Please read each claim carefully and answer questions.

Claim: "According to a national survey, some physicians recommended Levantra over Phemanide for fever reduction and temporary relief of minor aches and pains. Some physicians also chose Levantra over Phemanide themselves. Further, some of their patients preferred Levantra over Phemanide. Please see the table below for more detailed numeric results."

% of physicians who **recommend Levantra** over Phemanide	27%
% of physicians who **take Levantra** themselves	26%
% of patients who **prefer Levantra** over Phemanide	28%

How do you feel about Levantra?

Very Unfavorable			Neutral			Very Favorable
○	○	○	○	○	○	○

Claim: "In a recent study on a college campus, some students preferred Stylite Ballpoint Pens over Basic Ballpoint Pens. Further, some students said they liked the feel and comfort of Stylite Ballpoint Pens over Basic Ballpoint Pens. Stylite Ballpoint Pens were purchased by some students who had a choice between Stylite Ballpoint Pens and Basic Ballpoint Pens. Please see the table below for more detailed numeric results."

% of students who **prefer Stylite Ballpoint** Pens over Basic Ballpoint Pens	75%
% of students who **like** the feel and comfort of **Stylite Ballpoint** Pens over Basic Ballpoint Pens	74%
% of students who **choose Stylite Ballpoint** Pens over Basic Ballpoint Pens	72%

How do you feel about Stylite Ballpoint Pens?

Very Unfavorable			Neutral			Very Favorable
○	○	○	○	○	○	○

In the next section, you will be presented with various product claims. Some of them are accurately based on the claims presented earlier in the experiment, and some of them are falsely based on the claims presented earlier in the experiment.

Please read each of the claims carefully and determine if the claim is true, false or new. If you believe the claim is accurately based on the claim you saw earlier, please choose "True." If you believe the claim is falsely based on the claim you saw earlier, please choose "False." If you believe you did not see the claim earlier in the experiment, please choose "New."

Claim: "According to a national survey, most physicians recommended Levantra over Phemanide for fever reduction and temporary relief of minor aches and pains. Most physicians also chose Levantra over Phemanide themselves. Further, most of their patients preferred Levantra over Phemanide."

Please indicate if you believe this claim is true, false or new.

True	False	New
○	○	○

Claim: "In a recent study on a college campus, most students preferred Stylite Ballpoint Pens over Basic Ballpoint Pens. Further, most students said they liked the feel and comfort of Stylite Ballpoint Pens over Basic Ballpoint Pens. Stylite Ballpoint Pens were purchased by most students who had a choice between Stylite Ballpoint Pens and Basic Ballpoint Pens."

Please indicate if you believe this claim is true, false or new.

True	False	New
○	○	○

What did you think about the part of the study you just completed (e.g., reading various product claims)?

What do you think we are studying in this part of the study?

How much do you like or dislike each of the following product names?
(Product categories are listed in parenthesis)

	Dislike very much	.	.	Neither like nor dislike	.	.	Like very much
Levantra (pain killer)	○	○	○	○	○	○	○
Phemanide (pain killer)	○	○	○	○	○	○	○
Basic Ballpoint Pens	○	○	○	○	○	○	○
Stylite Ballpoint Pens	○	○	○	○	○	○	○

How important was the product name to your judgments?

Not at all important						Very Important
○	○	○	○	○	○	○

How important was the numeric information to your judgments?

Not at all important						Very Important
○	○	○	○	○	○	○

APPENDIX E

STUDY 4 SURVEY INSTRUMENT

In this section of the study, you will be presented with product claims that compare two products. Please read each claim carefully and answer questions.

Claim: " Among physicians surveyed on the West Coast, twenty eight percent recommended Levantra over Phemanide for fever reduction and temporary relief of minor aches and pains. Thirty percent of them said they take Levantra themselves, and twenty-six percent of patients also preferred Levantra over Phemanide. " (*Unfavorable numeric information and disfluent condition*)

How do you feel about Levantra?

Very unfavorable				Neutral				Very favorable
○	○	○	○	○	○	○	○	○

How do you feel about Phemanide?

Very unfavorable				Neutral				Very favorable
○	○	○	○	○	○	○	○	○

What is your preference between Levantra and Phemanide?

Strongly Prefer Levantra		Slightly Prefer Levantra		Equally prefer both product		Slightly Prefer Phemanide		Strongly Prefer Phemanide
○	○	○	○	○	○	○	○	○

Claim: "In a recent study on a college campus, seventy-seven percent of students preferred Stylite Ballpoint Pens over Basic Ballpoint Pens. Further, seventy-six percent of students said they liked the feel and comfort of Stylite Ballpoint Pens over Basic Ballpoint Pens. Stylite Ballpoint Pens were purchased by seventy-eight percent of students who had a choice between Stylite Ballpoint Pens and Basic Ballpoint Pens. (*Favorable numeric information and fluent condition*)

How do you feel about Stylite Ballpoint Pens?

Very unfavorable				Neutral				Very favorable
○	○	○	○	○	○	○	○	○

How do you feel about Basic Ballpoint Pens?

Very unfavorable				Neutral				Very favorable
○	○	○	○	○	○	○	○	○

What is your preference between Stylite Ballpoint Pens and Basic Ballpoint Pens?

Strongly Prefer Stylite Pens		Slightly Prefer Stylite Pens		Equally prefer both product		Slightly Prefer Basic Pens		Strongly Prefer Basic Pens
○	○	○	○	○	○	○	○	○

In the next section, you will be presented with various product claims. Some of them are accurately based on the claims presented earlier in the experiment, and some of them are falsely based on the claims presented earlier in the experiment.

Please read each of the claims carefully and determine if the claim is true, false or new. If you believe the claim is accurately based on the claim you saw earlier, please choose "True." If you believe the claim is falsely based on the claim you saw earlier, please choose "False." If you believe you did not see the claim earlier in the experiment, please choose "New."

Claim: "According to a national survey, most physicians recommended Levantra over Phemanide for fever reduction and temporary relief of minor aches and pains. Most physicians also chose Levantra over Phemanide themselves. Further, most of their patients preferred Levantra over Phemanide."

Please indicate if you believe this claim is true, false or new.

True	False	New
○	○	○

Claim: "In a recent study on a college campus, most students preferred Stylite Ballpoint Pens over Basic Ballpoint Pens. Further, most students said they liked the feel and comfort of Stylite Ballpoint Pens over Basic Ballpoint Pens. Stylite Ballpoint Pens were purchased by most students who had a choice between Stylite Ballpoint Pens and Basic Ballpoint Pens."

Please indicate if you believe this claim is true, false or new.

True False New

What did you think about the part of the study you just completed (e.g., reading various product claims)?

What do you think we are studying in this part of the study?

How important was the product name to your judgments in the product claim task?

Not at all important — Very Important

How much did you weigh this information (product name) in your evaluation of the product?

Not at all — Very much

How important was the numeric information to your judgments in the product claim task?

Not at all important — Very Important

How much did you weigh the numeric information in your evaluation of the product?

Not at all — Very much

How important was the wording of the claims to your judgments?

Not at all — Very

important Important

How much did you weigh this information (wording of the claim) in your evaluation of the product?

Not at all Very much

How much do you like or dislike each of the following product names?
(Product categories are listed in parenthesis)

How much do you like or dislike each of the following product names?
(Product categories are listed in parenthesis)

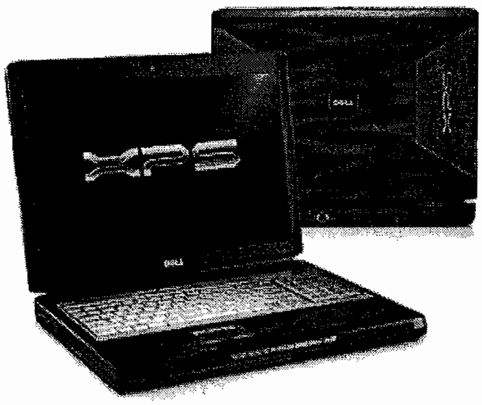
	Dislike very much			Neither like nor dislike			Like very much
Levantra (pain killer)							
Phemanide (pain killer)							
Basic Ballpoint Pens							
Stylite Ballpoint Pens							

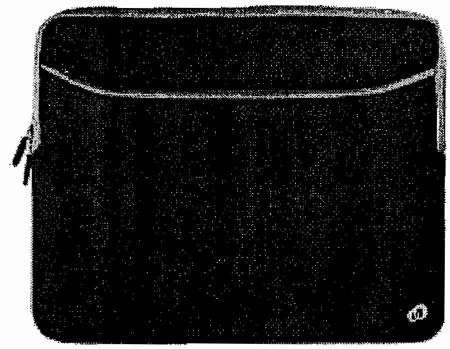
APPENDIX F

STUDY 5 STUDY INSTRUMENT

Imagine you are looking for a computer that gives you high computing and graphic performance power. You are also looking for a laptop sleeve case to go with the laptop. Below is one computer and one sleeve case. You can purchase them separately or together. Please evaluate the product information on the next page and answer the questions that follow.

Please evaluate the product information below and answer the questions that follow.





On Amazon.com, this computer received **2.5 stars** out of 5.	On Amazon.com, this case received **1.2 stars** out of 5.
Product description	Product description
- XPS M1730 - Intel® Core™ 2 Duo Extreme X9000 (2.8GHz/800Mhz FSB/6M L2 Cache) - Genuine Windows Vista® Ultimate Edition SP - 17 inch UltraSharp TrueLife Wide-screen WUXGA - 4GB Shared Dual Channel DDR2 SDRAM at 667MHz - Ultra Performance: 256GB Solid State Drive - NVIDIA® SLI™ Dual GeForce® 8800M GTX (1GB GDDR3 Memory) - 9-cell Primary Battery	- Assorted Colors - Extra Pocket Neoprene Laptop Sleeve Case - Compatible with Dell XPS

(3) Examples of questions

According to the information above, what star rating did the Laptop Sleeve Case receive on Amazon.com?

According to the information above, what star rating did the XPS M1730 receive on Amazon.com?

How do you feel about **the laptop, XPS M1730**?

Very unfavorable				Neutral				Very favorable
○	○	○	○	○	○	○	○	○

How much do you like how the XPS M1730 looks?

Dislike very much				Neither dislike or like				Like very much
○	○	○	○	○	○	○	○	○

If you need a PC laptop computer that gives you high computing and graphic performance power, how likely are you to purchase this **XPS M1730**?

Not at all likely								Very likely
○	○	○	○	○	○	○	○	○

How important was the star rating in the consumer reviews to your evaluation of the laptop computer?

Not at all important								Very important
○	○	○	○	○	○	○	○	○

How much did you weigh the star rating in your evaluation of the laptop computer?

Not at all — Very much

How important was the product description to your evaluation of the laptop computer?

Not at all important — Very important

How much did you weigh this product description in your evaluation of the laptop computer?

Not at all — Very much

How important was the look of the laptop computer to your evaluation?

Not at all important — Very important

How much did you weigh this information (cf. how much you like the look of laptop computer) in your evaluation of the laptop computer?

Not at all — Very much

How much knowledge do you have about purchasing computers?

Not at all — Very much

How many PC laptop have you ever purchased?

0	1	2	3	4	5	6	7	8
○	○	○	○	○	○	○	○	○

How often do people come to you for advice about computer purchase?

Never								Very often
○	○	○	○	○	○	○	○	○

How much do you prefer PC vs. Mac?

Strongly prefer PC				Equally prefer PC and Mac				Strongly prefer Mac
○	○	○	○	○	○	○	○	○

APPENDIX G

NUMERACY MEASURE

In the next section, you will be presented with several questions regarding numbers.

PLEASE DO NOT USE A CALCULATOR OR CONSULT WITH ANYBODY ELSE AT ANY TIME.

Your answers are anonymous. It is VERY IMPORTANT that you answer the questions WITHOUT ANY GUIDE, such as a calculator or your friends. You may, however, use scratch paper and pencil to take notes or make a calculation yourself.

Please proceed at your own pace.

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 even (2,4, or 6)?

_____ times

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?

_____ people

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?

Percent _____

Which of the following numbers represents the biggest risk of getting a disease?

1 in 100	1 in 1000	1 in 10
O	O	O

Which of the following numbers represents the biggest risk of getting a disease?

1%	10%	5%
O	O	O

If Person A's risk of getting a disease is 1% in ten years, and Person B's risk is double that of A's, what is B's risk?

____

If Person A's chance of getting a disease is 1 in 100 in ten years, and person B's risk is double that of A, what is B's risk?

____

If the chance of getting a disease is 10%, how many people out of 100 would be expected to get the disease?

______ people

If the chance of getting a disease is 10%, how many people out of 1000 would be expected to get the disease?

______ people

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.

______ %

The chance of getting a viral infection is .0005. Out of 10,000 people, about how many of them are expected to get infected?

____

Did you get any help from a calculator or your friends on any questions?
(This answer is anonymous and will not affect your right to get a participation credit)

Yes
O

No
O

APPENDIX H

DEMOGRAPHIC QUESTIONS

Thank you for filling out the survey. In order for our researchers to accurately assess a representative cross section of the population, we will need the information below. Remember, all of the information you are providing is **strictly confidential**.

How old are you?

What is your gender?

male female

Are you a native English speaker?

Yes No

Did you have any difficulty understanding any of the tasks in this experiment?

Yes No

What is your overall GPA?

What were your score on the verbal section of SAT?

200-299 300-399 400-499 500-599 600-649 650-699 700-749 750-799

What were your score on the math section of SAT?

200-299 300-399 400-499 500-599 600-649 650-699 700-749 750-799

If you took the ACT, what was your overall score?

Please indicate how many years of education you have completed.

Grade School																			Graduate School
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

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