Are "10 Grams of Protein" Better than "Ten Grams of Protein"? How Digits versus Number Words Influence Consumer Judgments

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Numerical information can be communicated using different number formats, such as digits ("5") or number words ("five"). For example, a battery product may claim to last for "5 hours" or "five hours." And while these two formats are used interchangeably in the marketplace, it is not clear how they influence consumer judgments and behavior. Via six experimental studies, two online ad campaigns, and one large secondary dataset analysis, we find that digits, compared to number words, positively affect consumer behavior. We refer to this phenomenon as the *number format effect*. We further show that the number format effect occurs because consumers feel that digits (vs. number words) are the right way to present numerical information: digits lead to a sense of feeling right that then affects consumer behavior. Finally, we show that the number format effect is amplified when credibility of the source of information is low, and attenuated when source credibility is high. The current research advances knowledge of how numerical information influences consumer judgments and behavior and carries important implications for marketers and policymakers as they communicate numerical information to consumers.

Keywords: numerical cognition, number format, feels right, purchase intentions, reviews

Both digits and number words are used to communicate numerical information in the marketplace. For example, some medical testing sites claim to provide results within 3 days, while others promote results within

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three days; some amazon.com customer reviews state that a product is 5 stars versus five stars; and some pizza shops promote 3 free toppings versus three free toppings (see these and other real-world examples in web appendix A). And while these formats are seemingly interchangeable across many marketing contexts, little is known about how number format influences consumer judgments and choice or which format marketers should use.

We propose and show that communicating numerical information to consumers using digits (vs. number words) leads to more positive consumer judgments and behavior. We explain our findings through a "feelings as information" process (Schwarz et al. 2021) in which incidental feelings generated by digits (vs. number words) are attributed to a source, subsequently enhancing judgments and behavior. We theorize that consumers perceive digits (vs. number words) as the norm when presented with numerical information. Therefore, when marketing communications use digits (vs. number words), consumers perceive it as feeling more right which then positively affects judgments and behavior. We dub this phenomenon the number format effect. In addition, we propose that the incidental influence of the number format on consumer judgments is amplified when there is some uncertainty about the source. That is, we identify source credibility as a relevant moderator, such that the influence of digits on judgments and behavior is stronger when consumers have lower (vs. higher) confidence in the source.

We demonstrate the number format effect via six experimental studies and two online ad campaigns that support our theorizing using a variety of important consumer contexts, such as product reviews, ads communicating nutritional information, and public health guidelines. We provide further evidence for the number format effect by analyzing a database of 72 million consumer reviews.

Our findings contribute to the growing literature on number presentation and processing in consumer behavior (Fisher and Mormann 2022; Monga and Bagchi 2012; Park and Kwon 2022; Pena-Marin and Bhargave 2016; Schindler and Kirby 1997; Stiving and Winer 1997; Wadhwa and Zhang 2015; Yan and Pena-Marin 2017). Prior work has shown how small changes to the number itself enhance numerical precision (Park and Kwon 2022) and information credibility (e.g., 4.15 vs. 4; Lembregts and Pandelaere 2019). Others have shown that the mere sound of numbers can influence how large a number feels (Coulter and Coulter 2010) and that price endings can influence product evaluations (Choi et al. 2014). We add to this literature by demonstrating that the number format influences consumers' reactions to numerical information and that it can do so even though the quantity communicated is the same. Further, we contribute to research in the numerical cognition literature to show that different number formats can systematically alter consumers' feelings toward information, subsequently influencing consumer judgments and behavior.

Finally, our findings can benefit consumers, as well as marketers and policymakers. Consumers can benefit by being aware of the number format effect, which can help them avoid succumbing to numerical biases when making judgments and choices. Marketers and policymakers can select the appropriate number format to communicate numerical information and thus affect behavior in a way that is consistent with their organizational objectives.

CONCEPTUAL DEVELOPMENT

Digits Are the Norm When Communicating Numerical Information

Digits (40) and number words (forty) use two different number formats. Number words use alphabetical notation, similar to any other word in the English language (Damian 2004), while digits utilize ideographic notation (Besner and Coltheart 1979), making them a distinct and succinct type of information (Wong et al. 2022). Both formats arbitrarily assign meaning to a combination of characters and are learned, mastered, and used interchangeably by consumers from an early age (Dehaene and Akhavein 1995).[1]

Through everyday experiences, consumers develop mental representations as to how information should be arranged or the format in which it should be presented. Digits, rather than number words, have been universally adopted for computations and arithmetic (Tang et al. 2006). From a very young age, children are exposed to digits in the context of mathematical operations. Research finds that children learn the quantity that digits represent even before starting school (Mix et al. 2014), which is then strengthened through formal mathematical instruction. As individuals grow, the pairing between digits and math becomes even stronger. Digits not only become associated with math, in general, but with numerical values and specific operations. Most primary school arithmetic education focuses on teaching exact operations conducted with digits (Gilmore, McCarthy, and Spelke 2007). To be successful in school, children must master the "ability to read and write Arabic numerals, an understanding of the place value system, and the ability to recall memorized addition, subtraction, and multiplication facts" (Libertus, Feigenson, and Halberda 2013, 830). Thus, digits are foundational to successfully learning mathematical operations (Lourenco et al. 2012). The link between digits and mathematics is also reinforced using instruments in our environment.

1 Numbers can be notated in one of three ways: an Arabic digit ("3"), a number word ("three"), and an analog format ("III") (Dehaene 1992). The analog format is a relative judgment of size that is arranged in a left-to-right increasing manner. However, space constraints limit the use of the analog format in many marketing contexts. Thus, this research centers primarily on understanding the differences between Arabic digits and number words.

Digits (vs. number words) are the main representation of quantity in calculators (Gigerenzer and Hoffrage 1995), measuring devices (e.g., weight scales), and point-of-sale systems. Much as precise numbers are associated with credibility (e.g., 4.15 is more credible than 4; Lembregts and Pandelaere 2019) digits may be perceived as the more appropriate manner to communicate numerical information.

Thus, we theorize that consumers expect numerical information to be communicated in digits in everyday situations. If so, then what is the impact of representing numerical information in digits (vs. number words) on consumer judgments and behavior?

Presenting Numerical Information in Digits Feels More Right

Processing information in today's marketplace can be burdensome for consumers as the amount of information they are exposed to daily has grown exponentially. Against this background, even subtle changes in the format and presentation of marketing communications can make a difference in how consumers process that information. Further, consumers must often evaluate claims from new or ambiguous sources that involve quantitative information. Marketing cues can be especially helpful when consumers evaluate new products or lesser-known entities (Kirmani and Rao 2000; Xie and Kronrod 2012). For example, advertising has a larger impact on the evaluation of unfamiliar (vs. familiar) brands as consumers lack experience with the focal product. Their inexperience makes them rely more heavily on external cues (Rosengren et al. 2020). Research has also found that when a source is ambiguous, the influence of affective input on judgment is stronger (Greifeneder, Bless, and Pham 2011). For instance, research finds that mood influences brand evaluations without other information about the source (Fedorikhin and Cole 2004). Thus, this literature suggests that when consumers lack firsthand experience with a product, contextual cues can shape their judgments. We theorize that number format is such a contextual cue that can shape consumer judgments of unfamiliar products through metacognitive processes.

Metacognition refers to thoughts about one's own thoughts or cognition (Flavell 1979) and metacognitive experiences include feelings of ease or difficulty associated with information-processing activities (Schwarz 2010). More importantly, extensive literature has demonstrated that positive metacognitive experiences positively influence consumers' reactions to marketing communication. For example, ease of processing increases liking (Biswas, Labrecque, and Lehmann 2021; Labroo, Dhar, and Schwarz 2008; Lee and Aaker 2004; Pandelaere, Millet, and Van den Bergh 2010; Winkielman and Cacioppo 2001), reduces choice deferral (Cho and Schwarz 2010), and decreases risk perceptions (Song and Schwarz 2009).

In the realm of numerical cognition, metacognitive experiences have been shown to lead to changes in product evaluation. Thomas and Morwitz (2009) find that consumers believe that it is easier to judge larger (vs. smaller) differences. Further, consumers use their feelings to make assessments of the magnitude of a difference. When consumers feel that a difference is easy (vs. hard) to compute, they believe that it is a larger difference. The positive experience is misattributed to the magnitude difference and "easily" processed becomes "large" in magnitude. King and Janiszewski (2011) also document the effect of fluency in a numerical context. They find that computing frequently processed sums (e.g., $1 + 1$) or common multiplication problems (e.g., 10×10) enhances fluency in processing and positively affects downstream outcomes, such as brand liking.

Other research in metacognition has shown how experiencing fit is a positive subjective experience that can lead to more positive outcomes in persuasion contexts (Cesario, Grant, and Higgins 2004; Deng, Han, and Wang 2019; Higgins et al. 2020; Humphreys, Isaac, and Wang 2021). In numerical cognition, specifically, Wadhwa and Zhang (2015) find that experiencing a fit between a round (vs. non-round) number and a decision context can lead to a sense of feeling right that then positively impacts product evaluations. Similarly, Lembregts and Pandelaere (2013) note that presenting information in units that customers are more accustomed to (i.e., default units) increases ease of processing and ultimately improves product evaluations when compared to non-default units. In other words, when there is a fit between the number type presented in marketing communications and the decision context or when a number is presented in a manner consumers are accustomed to (Lembregts and Pandelaere 2013), consumers experience a positive metacognitive experience that evokes a sense of feeling right that ultimately enhances purchase intentions or message compliance.

Based on the metacognitive literature in consumer research, we theorize that when consumers see numerical information presented in digits (vs. number words), they experience a sense of feeling right, leading to more positive judgments and behavior. This theorizing is also corroborated by the discrepancy attribution hypothesis (Whittlesea and Williams 2001a) that proposes people evaluate the coherence of their processing of information to arrive at a subjective experience (i.e., their metacognitive experience). Further, this literature suggests that while metacognitive experiences do not always affect evaluations, experiences are more likely to do so when expectations are violated (Whittlesea and Williams 2001b; Zane, Smith, and Reczek 2020). That is, the impact of metacognitive experiences depends upon the diagnosticity of the feelings (Sela and Berger 2012). Given that consumers do not expect to see

numerical information presented in number words (vs. digits), it is likely that in this context, consumers will use the metacognitive experience to guide evaluations. In sum, these insights on metacognitive experience lead to our hypotheses:

H1: Communicating numerical information to consumers using digits (vs. number words) will lead to more positive judgments and choices.

H2: The positive influence of the number format on judgments and choices will be mediated by consumers' sense that digits (vs. number words) feel more right.

Credibility of the Source as a Moderator of the Number Format Effect

We theorize that number format functions as an incidental cue that can influence consumer behavior and, further, that this effect will be amplified when there is some uncertainty about the source of information. This idea is in line with previous research that showed that using contextual cues, such as advertising creativity, has a stronger impact on evaluations when the source is questionable compared to when it is highly credible (Eisend and Tarrahi 2022; Rosengren et al. 2020). More specifically, regarding the use of affective input, previous research has found that cues have a stronger influence when judgments related to the target are more malleable (Greifeneder et al. 2011). As such, when source credibility is high, contextual cues provide less value and are less likely to impact judgments or behavior as the source is already viewed as competent. Recent research on affective responses to stimuli also suggests that the influence of affective input on judgments is higher when there is uncertainty (Bar-Anan, Wilson, and Gilbert 2009; Faraji-Rad and Pham 2017). Thus, we expect that source credibility will moderate the effect of number format on consumer judgments and behavior:

H3: When source credibility is low, communicating numerical information to consumers using digits (vs. number words) will lead to more positive judgments and behavior, while the effect will attenuate when source credibility is high.

OVERVIEW OF STUDIES

Six experimental studies, two online ad campaigns, and one large database analysis test our hypotheses. Studies 1a and 1b demonstrate the influence of number format on real consumer behavior (i.e., ad clickthrough rates [CTRs]). Next, studies 2a and 2b test our hypothesized process and demonstrate that digits (vs. number words) feel like the correct manner to present numerical information. Study 2c uses a moderation-of-process approach in which we manipulate the source of feeling right by making salient the appropriateness of using digits versus number words to communicate numerical information. Study 3 tests our full proposed model. That is, we provide evidence for the mediating role of a sense of feeling right on behavioral intentions. In studies 4a and 4b, we test source credibility as a boundary condition. Study 4a manipulates source credibility to show that the number format effect is stronger when participants are making evaluations involving low source credibility (vs. high). Study 4b replicates these findings in a public policy context. Finally, study 5 provides further evidence for the robustness of the number format effect by testing the influence of the number format on consumer judgments using a large dataset of consumer reviews. Table 1 reports a summary of the results across all studies. All experimental datasets are available at https://researchbox.org/1749.

STUDY 1A

In study 1a, we conducted a display ad campaign via the Facebook Ads platform to test the number format effect in a real consumer behavior context. The Facebook Ads field experiment was conducted in collaboration with an online retailer specializing in local-context clothing in a U.S. city.

Method

Facebook Ads provides a platform to split test, or A/B test, campaigns. Campaigns are paid for on a pay-per-click basis. The Facebook Ads algorithm works with a predetermined daily budget. Experiments are set up for a specific duration, and Facebook Ads reports the number of impressions and clicks generated by the ads. The budget spent every day fluctuates due to the bidding system. In collaboration with the online retailer, we set up an ad campaign for seven days with a daily budget of $20 for an overall campaign budget of around $140. While we specified $140 as a maximum, the actual total spent for digits was $49.97, while the total spent for the number word condition was $50.03. The ads were shown to a target audience within a specific geographic area (metro area) as the advertised products have a local context. The retailer allowed us to use a promotional message featuring how long the store had been open for business (i.e., "2 (vs. Two) years in business, giving back to the community!"; see web appendix B for stimuli). One of the two ads was displayed at random. We examined the effects of number format on the CTR, which is the number of ad clicks divided by the impressions (the number of times an ad is shown online) and indicates customer interest.

Results

The Facebook Ads experiment was active for seven days, generating 10,109 impressions and 167 clicks. Specifically, the digit format received 103 clicks and 5,362

TABLE 1

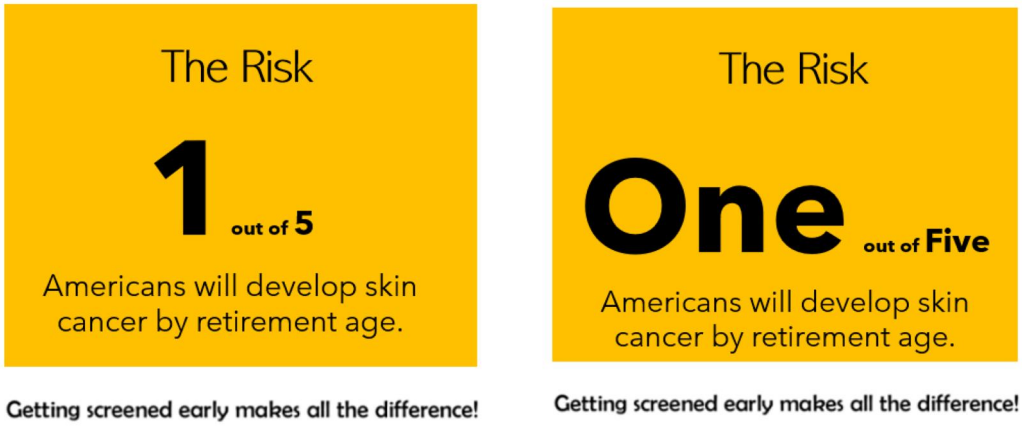
OVERVIEW OF RESULTS OF STUDIES 1–4B

Study 1a					
DV	Digits	Words			Statistical test
Clickthrough rate	1.92%	1.35%			$\chi^2(1) = 5.08$, $p = .024$
Study 1b					
DV	Digits	Words			Statistical test
Clickthrough rate	1.97%	1.02%			$\chi^2(1) = 25.14$, $p < .001$
Study 2a					
Average number of trials (out of 10) on which digits (vs. words) feel correct	$M = 8.82$ (3.10)				$t(49) = 8.71$, $p < .001$
Study 2b					
DV	Digits	Words			Statistical test
Sense of feeling right	5.31 (1.46)	4.42 (1.68)			$F(1, 287) = 26.08$, $p < .001$
Study 2c					
	Expectation: number words		Expectation: digits		
DV	Digits	Words	Digits	Words	Statistical test
Product interest	3.56 (1.62)	3.61 (1.69)	3.72 (1.75)	3.22 (1.70)	$F(1, 782) = 5.32$, $p = .021$; expect number words: $F(1, 782) = 0.10$, $p = .751$; expect digits: $F(1, 782) = 8.62$, $p = .003$
Study 3					
DV	Digits	Words			Statistical test
Sense of feeling right	5.24 (1.27)	4.84 (1.42)			$F(1, 398) = 8.83$, $p = .003$
Precision	4.67 (1.53)	4.35 (1.59)			$F(1, 398) = 4.38$, $p = .037$
Review helpfulness	6.08 (1.59)	5.55 (1.48)			$F(1, 398) = 12.06$, $p < .001$
Study 4a					
	Low credibility (LC)		High credibility (HC)		
DV	Digits	Words	Digits	Words	Statistical test
Purchase Intention	3.56 (1.62)	3.61 (1.69)	3.72 (1.75)	3.22 (1.70)	$F(1, 338) = 9.18$, $p = .003$; LC: $F(1, 339) = 13.52$, $p < .001$; HC: $F(1, 339) = 0.004$, $p = .948$
Study 4b					
DV	Digits		Words		Statistical test
	Low baseline Bbelief (–1 SD)	High baseline belief (+1 SD)	Low baseline belief (–1 SD)	High baseline belief (+1 SD)	
Intentions to maintain distance	5.82	6.80	5.15	7.15	$t(198) = 3.56$, $p < .001$; low baseline belief: $t(198) = -3.24$, $p = .001$; high baseline belief: $t(198) = 1.57$, $p = .118$

NOTE.– Standard deviation is presented in parentheses.

FIGURE 1

STUDY 1B STIMULI



NOTE.– Facebook Ads used in study 1b. Participants either saw an ad that presented information in digits ("1 out of 5"; on the left) or in number words ("One out of Five"; on the right).

impressions, while the number word format received 64 clicks and 4,747 impressions. We find that, as hypothesized, the CTR (clicks/impressions) was higher for the ads that communicated numerical information in digits compared to number words ($CTR_{digits} = 1.92\%$ vs. $CTR_{words} = 1.35\%$, $\chi^2(1) = 5.08$, $p = .024$).

STUDY 1B

In study 1b, we use the same design as in study 1a but situated in a different context—cancer screenings. We expect consumers to show higher interest in learning more about the ad (i.e., higher CTRs) when the risk information is presented in digits (vs. number words).

Method

Using a display ad campaign via the Facebook Ads platform, we presented an actual skin cancer fact using digits ("1 out of 5 of Americans. . .") versus number words ("One out of Five Americans will develop skin cancer by retirement age."). Please refer to figure 1. The campaign ran for seven days. Given the cancer screening context, we presented it to a U.S. target audience aged 30 and above. Participants who clicked on the link were redirected to a real skin cancer awareness page to learn more about the health issue (http://aad.org/public/public-health/skin-cancer-awareness). This study was preregistered (https://aspredicted.org/rc6nd.pdf).

Results

The Facebook Ads experiment was active for seven days and generated 219 clicks and 16,409 impressions for a total budget of $104.56. The digit format received 107 clicks and 5,420 impressions, while the verbal rating format received 112 clicks and 10,989 impressions. Once again, we find that the CTR (clicks/impressions) was higher for the ads that communicate numerical information in digits compared to number words ($CTR_{digits} = 1.97\%$ vs. $CTR_{words} = 1.02\%$, $\chi^2 = 25.14$, $p < .001$).

Discussion

Studies 1a and 1b provide support for the number format effect. We find that digits, compared to number words, positively influence consumer behavior. However, it is worth noting that online split test campaigns have their limitations. It has recently been acknowledged that such A/B testing conforms to the platform's targeting algorithms that may not be fully randomized (Braun et al. 2023), which may explain the difference in the number of impressions for the two different versions of the ad in study 1b. Thus, we next conduct several controlled experiments to further substantiate the number format effect and to examine the underlying mechanism that gives rise to it.

STUDIES 2A–2C: DIGITS AS THE NORM FOR COMMUNICATING NUMERICAL INFORMATION

In studies 2a–2c, we directly test whether consumers feel that digits (vs. number words) are the correct manner to

TABLE 2

TESTING WHETHER DIGITS OR NUMBER WORDS FEEL MORE CORRECT

Trial	Share of participants selecting digits as feeling more correct (%)
2 versus two	68
4 versus four	78
5 versus five	72
8 versus eight	84
10 versus ten	78
12 versus twelve	76
13 versus thirteen	80
15 versus fifteen	88
20 versus twenty	78
31 versus thirty-one	88
47 versus forty-seven	92

NOTE.– Percentages represent the share of participants that selected digits as the correct manner of presenting numerical information.

present numerical information. In study 2a, we test the effects of using digits versus number words by presenting numerical values in isolation, void of context. In study 2b, we embed digits and number words in marketing communications materials to test consumer judgments across a range of marketing contexts. Finally, in study 2c, we use a moderation-of-process approach to test the underlying role of the sense of feeling right on consumer judgments.

Study 2a

Method. Fifty Prolific panelists (M_{age} = 38.58 years; 54.0% female) participated in study 2a. We displayed the same magnitude in two number formats: one in number words and the other in digits (e.g., two and 2). We asked participants: "Take a look at the same number presented in two different formats below. Which of the formats would feel like the intuitively correct way to present numerical information in an ad?" Participants were presented with 11 pairs of numbers, as shown in table 2. The order of presentation of the two number formats (left vs. right) was randomized per trial, as was the magnitude order. Finally, participants provided some general demographic information to conclude this and all other studies.

Results and Discussion. Table 2 reports the choice share for each pair of numbers. We conducted a series of chi-squared tests and found that, across all pairs, the digits (vs. number words) were chosen as the format that feels intuitively more correct (all ps $< .02$). Further, we tested whether the average number of trials in which digits were selected ($M = 8.82$) differed from five, corresponding to an equal probability of choosing either number format. We find that digits were selected significantly above chance ($t(49) = 8.71$, $p < .001$, Cohen's $d = 1.23$; one-sample t-test).

Study 2b

Method. Two hundred ninety-nine MTurk panelists (M_{age} = 39.98 years; 45.8% female) took part in a single-factor, between-subjects 2 (number format: digits vs. words) × 3 (scenario replicates: protein content, battery life earbuds, and percentage of overhead for a charity) experiment. The first factor was manipulated between subjects, and the second factor was manipulated within subjects. We created three ads (protein content, battery life earbuds, and percentage of overhead for a charity) while manipulating the number format used. In an ad for a protein shake, we presented the protein content as "5 Grams of Protein" versus "Five Grams of Protein." In an ad for earbuds, we presented the product battery life as "6 hours on a single charge, 20 hours with charging case" versus "Six hours on a single charge, Twenty hours with charging case." In a charity ad, we presented overhead spending as "10% of funds go to overhead rather than the cause" versus "Ten percent of funds go to overhead rather than the cause." The order of presentation of the ads was randomized. See figure 2 for one set of stimuli and see web appendix C for all stimuli.

After being shown an ad, participants indicated how right the number format used in the ad felt to them via three items: the number format used to present (protein content/charge time/percentage) in the ad feels intuitively correct to me/right to me/appropriate to me (1 = strongly disagree, 7 = strongly agree). We averaged the three items to create an index of a sense of feeling right for each one of the ads (α = 0.92). This study was preregistered (https://aspredicted.org/mh5g7.pdf); 10 participants that failed the preregistered attention check were removed from the analyses.

Results and Discussion. We ran a repeated-measures ANOVA with the number format as the independent variable and the three-product scenario replicates' sense of feeling right as the dependent variable. The results revealed a significant main effect of the scenario replicate ($F(2, 286) = 3.43$, $p = .034$, $\eta_p^2 = 0.023$). We did not find a significant number format × replicate interaction ($F(2, 286) = 1.23$, $p = .295$). More importantly, as hypothesized, we found that participants reported that digits feel more right than number words ($M_{digits} = 5.35$, SD = 1.08 vs. $M_{words} = 4.63$, SD = 1.30; $F(1, 287) = 26.08$, $p < .001$, $\eta_p^2 = 0.083$). Finally, t-tests revealed that the effect holds for each of the three ads (all ps $< .001$).

Study 2c

We theorize that the reason why digits (vs. number words) feel more right stems from a long-standing association between digits and mathematical operations, as well as how practical they are to use. However, individuals also learn other types of rules related to communicating numerical information. Specifically, writing guidelines instruct

FIGURE 2

STUDY 2B STIMULI

NOTE.– Example of stimuli used in study 2b.

people to write numbers in words when the quantity is small or when a number starts a sentence (Masterclass.com 2021). We capitalize on this rule to test whether the expectation of seeing numerical information presented in digits indeed drives the number format effect. That is, we propose that while word numbers may not be the default mental representation of numbers, reminding consumers of the writing guidelines that call for writing out numbers may affect the number format effect. More specifically, we predict that if we increase the salience of the guidelines to write out specific numbers in words, consumers will have justification as to why numbers are written out. This would then lead consumers to feel that it is right to use both digits and number words, which would attenuate the number format effect. This study was preregistered (https://aspredicted.org/t3h55.pdf); 14 participants failed the preregistered attention check and were excluded from the analysis.

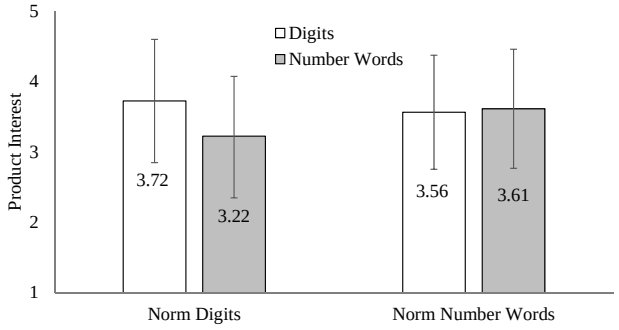
Method. Eight hundred Prolific panelists (M_{age} = 39.29 years; 46.9% female) participated in a 2 (number format: digits vs. number words) × 2 (norm: presentation of numerical information in digits vs. writing out small numbers in words) between-subjects study. Before seeing the number format manipulation, participants were first asked to read through an excerpt of an article. In the article, we described the rules of presenting numbers in marketing. Half of the participants read that presenting numerical information in digits is the preferred manner for marketers as numbers provide facts and consumers expect digits. Participants were also shown examples of how marketers use digits in marketing communications (e.g., "7 grams"). The other half of the participants read the writing guidelines that indicate that numbers below 11 should be written out. Participants were also shown examples of marketing communications that use number words (e.g., "Seven grams"). After reading the article, we asked participants to indicate how clear the rule described above felt to them on a 7-point scale (1 = not at all clear, 7 = very clear).

After viewing the article related to one of the norms, we told participants to imagine that a paid influencer shared a new energy bar product online and that, on the next page, they would see the packaging of this new energy bar. We asked a comprehension of the scenario and respondents could only proceed when they answered the question correctly. Participants then saw the image of the product packaging that displayed the protein content in digits versus number words ("10 grams of Protein" vs. "Ten grams of Protein"). Participants next answered: How interested would you be in learning more about the product (i.e., energy bar) above? (1 = not at all interested, 7 = very interested). For full stimuli, see web appendix D.

Results. We conducted a 2 (number format: digits vs. number words) × 2 (norm: presentation of numerical information in digits vs. writing out small numbers in words) ANOVA on product interest. The results show a marginal effect of number format ($F(1, 782) = 3.46$, $p = .063$, η_p^2

FIGURE 3

STUDY 2C: NUMBER FORMAT AND NORMS MANIPULATION



NOTE.– Error bars show the standard deviation of the mean.

$= 0.004$) and a significant interaction between the two factors ($F(1, 782) = 5.32$, $p = .021$, $\eta_p^2 = 0.01$). As shown in figure 3, replicating the number format effect, planned contrasts revealed that when participants read that numerical information should be presented in digits, participants wanted to learn more about the product when the packaging included digits compared to number words ($M_{digits} = 3.72$, SD = 1.75 vs. $M_{words} = 3.22$, SD = 1.70; $F(1, 782) = 8.62$, $p = .003$; $\eta_p^2 = 0.01$). However, when they read the guidelines suggesting to write out small numbers in words, the influence of the number format on product interest attenuated ($M_{digits} = 3.56$, SD = 1.62 vs. $M_{words} = 3.61$, SD = 1.69; $F(1, 782) = 0.10$, $p = .751$).

Next, we also tested the difference in product interest between norms set at the beginning of the study within each number format. We found that when numerical information was presented in digits, interest in the product remained the same regardless of the norm that participants read ($M_{norm\text{-}digits} = 3.72$, $M_{norm\text{-}words} = 3.56$; $F(1, 782) = 0.896$, $p = .344$). However, when product information was presented in number words, reminding participants of the norm to write out numbers in words increased product interest ($M_{norm\text{-}digits} = 3.22$, $M_{norm\text{-}words} = 3.61$; $F(1, 782) = 5.381$, $p = .021$, $\eta_p^2 = 0.01$).

Discussion. Studies 2a and 2b show that consumers feel that digits (vs. number words) are the correct manner to present numerical information in marketing communications. Study 2c provides further support for this finding using a moderation-of-process approach. That is, we show that when consumers are reminded that numerical information should be presented in digits, we replicate the number format effect. However, when we remind consumers that it is appropriate to write out small numbers in words, the number format effect is attenuated. It is important to note that we do not find any differences between the digit conditions regardless of the norms set before product exposure, providing further support for the robustness of the number format effect. Next, we test our full hypothesized model.

STUDY 3: TESTING THE FULL MODEL

Study 3 has two goals. First, the main purpose of this study was to test the hypothesized mediating effect of the sense of feeling right on the number format–consumer judgments relationship. Second, we test an alternative explanation for the number format effect that is also consistent with the discrepancy-attribution mechanism: a precision inference mechanism. The basic premise of the discrepancy-attribution hypothesis is that people evaluate the coherence of their processing of stimuli or information to arrive at a subjective experience (their metacognitive experience) and then make inferences about the sources of the discrepancy or incongruity (Thomas and Park 2014). In the context of digits versus number words, it is possible that consumers experience a sense of unease when they are evaluating number words which leads consumers to make an inference to explain the unease they experience. Specifically, given that consumers are commonly exposed to digits in the context of calculations (Tang et al. 2006), it is possible that they perceive number words as being less precise than the equivalent digits. Since precision is perceived as a sign of accuracy (Pena-Marin and Yan 2021) and confidence (Jerez-Fernandez, Angulo, and Oppenheimer 2014), as well as credibility (Zhang and Schwarz 2012), it is possible that number words are evaluated less favorably because of perceived lack of a precision. Thus, we examine this complementary precision mechanism in study 3. Finally, study 3 is conducted in the context of online product reviews. This is important given that online reviews can reduce consumer uncertainty and facilitate decision-making (Ceylan, Diehl, and Proserpio 2024), and the degree to which a review is perceived as helpful can be consequential for brands and consumers making this context informative from both theoretical and managerial perspectives.

Method

Four hundred MTurk panelists took part in a 2 (number format: digits vs. number words) × 2 (review summary rating: positive [5-star reviews] vs. negative [1-star reviews]) × 10 (scenario replicates) mixed design experiment. We manipulated the number format between subjects and review summary ratings within subject, with the summary rating order counterbalanced. While we do not have predictions about the format interacting with the summary rating to affect helpfulness (Janiszewski and van Osselaer 2022), we included both low and high ratings for generalizability.

For positive ratings, we selected 10 different review summaries taken from products on amazon.com, which is a headline synopsis of the review. Examples of review

summaries include "5 stars!" (vs. "Five stars!") and "On my Top 10" (vs. "On my Top Ten"). Similarly, for the negative ratings, we selected 10 summaries, such as "It only smells great for 5 minutes" compared to "It only smells great for five minutes." Each participant first viewed 10 positive review summaries and rated each review on helpfulness. Then, they saw the 10 negative review summaries and rated each review on helpfulness. The order of presentation of the review rating was randomized. We asked participants how helpful it would be if they saw each of the featured review summaries online on a 10-point scale (1 = not at all helpful, 10 = very helpful; $\alpha = 0.92$). After completing the evaluation of the review summaries, we measured how right the number format used in the review summaries felt to them (same scale items as study 2b; 1 = strongly disagree, 8 = strongly agree; $\alpha = 0.94$). Moreover, we measured the degree to which the numbers across the reviews felt exact/precise/specific (1 = strongly disagree, 8 = strongly agree; $\alpha = 0.96$). See web appendix E for stimuli.

As we intend to test both the precision and feels right mechanisms, we first report the correlation between the dependent variable (DV) (helpfulness) and each one of the mediators (precision and the sense of feeling right). We found that the correlation between helpfulness and precision is significant ($r = 0.427$, $p < .001$). The correlation between helpfulness and the sense of feeling right is also significant ($r = 0.475$, $p < .001$). We also verified that the items loaded onto two separate factors through factor analysis (precision eigenvalue = 4.39, variance explained = 73.20%; feels right eigenvalue = 1.07, variance explained = 17.75%; see web appendix F for factor loadings).

Results

For completeness, we first ran a 2 (number format) × 2 (valence) × 10 (scenario replicates) repeated-measures ANOVA on the review summary helpfulness measure. The results revealed a main effect of valence ($F(1, 358) = 86.45$, $p < .001$, $\eta_p^2 = 0.20$), a main effect of trial ($F(9, 350) = 75.90$, $p < .001$, $\eta_p^2 = 0.66$), a significant interaction of trials × number format ($F(9, 350) = 3.02$, $p = .002$, $\eta_p^2 = 0.072$), and a significant three-way interaction ($F(9, 350) = 3.15$, $p = .001$, $\eta_p^2 = 0.075$). Given that the trials themselves are not ordered in any particular way such that comparison within the trials is meaningful (see the results per trial in web appendix G), we next conducted a repeated-measure ANOVA with perceived helpfulness of the negative and positive averages as repeated measures and the number format as the between-subjects independent variable.

The results revealed a within-subjects main effect of the review rating summary valence such that the positive review summaries were rated as more helpful than the negative review summaries ($M_{positive} = 6.21$, SD = 1.71 vs. $M_{negative} = 5.43$, SD = 1.77; $F(1, 398) = 103.00$, $p < .001$, $\eta_p^2 = 0.206$). The review summary rating valence did not interact with the number format ($F(1, 398 = 1.20$, $p = .27$). Thus, we collapsed across the summary ratings to form a single review helpfulness composite.

Next, we conducted a one-way ANOVA on perceived helpfulness with the number format as the independent variable. Participants reported higher review helpfulness when the review included digits versus number words ($M_{digits} = 6.08$, SD = 1.60 vs. $M_{words} = 5.55$, SD = 1.48; $F(1, 398) = 12.06$, $p < .001$; $\eta_p^2 = 0.029$). Similarly, a one-way ANOVA with the sense of feeling right as the dependent variable revealed a significant effect of number format such that participants reported that digits felt more right compared to number words ($M_{digits} = 5.24$, SD = 1.27 vs. $M_{words} = 4.84$, SD = 1.42; $F(1, 398) = 8.83$, $p = .003$; $\eta_p^2 = 0.022$). At the same time, a one-way ANOVA with precision as the dependent variable revealed a main effect of number format such that participants reported that digits felt more precise compared to number words ($M_{digits} = 4.67$, SD = 1.53 vs. $M_{words} = 4.35$, SD = 1.59; $F(1, 398) = 4.38$, $p = .037$; $\eta_p^2 = 0.011$).

We next ran Process model 4 (Hayes 2018) with 10,000 bootstrap samples (0 = digits, 1 = number words) with the sense of feeling right, as well as precision, as parallel mediators. The results revealed an indirect effect of the number format through both the sense of feeling right mechanism ($b = -0.1511$, SE = 0.06, CI = [−0.2699, −0.0491]) and the precision mechanism ($b = -0.0706$, SE = 0.04, CI = [−0.1616, −0.0043]). While the precision mechanism was also a significant mediator, it explains less variance (13.1% of the total effect's variance) compared to the sense of feeling right process (28.5% of the total effect's variance).

Discussion

In support of our theorizing, study 3 shows that the number format can influence behavioral intentions and that this effect is driven by the sense that the number format feels right. In study 5 below, we provide further support for the effects of number format on helpfulness evaluations in the context of real customer review evaluations from amazon.com. In addition, in a preregistered, supplementary study 1 (web appendix H; https://aspredicted.org/4t9vr.pdf), we provide further evidence for the mediating role of the sense of feeling right in a different context using nutritional information.

The design of study 3 allowed us to test two potential mechanisms that give rise to the number format effect: the sense of feeling right and precision. We find that while both mechanisms seem to be involved, the sense of feeling right mechanism explains more variance. Nonetheless, we discuss precision as a potential mechanism in more depth

in the general discussion section. Next, we explore the moderating role of source credibility.

STUDIES 4A AND 4B: MODERATION BY SOURCE CREDIBILITY

Study 4a

Study 4a tests the prediction that when the source of information is of higher (lower) credibility, there is less (more) malleability in the judgment, and thus the number format effect will be attenuated (persist). That is, consumers will be less (more) likely to use feelings to guide their intentions toward the product (Greifeneder et al. 2011). Study 4a manipulates the number format and source credibility in the context of nutritional information disclosure.

Method. Three hundred forty-three students from a public U.S. university (M_{age} = 20.61 years; 61.8% female) completed a 2 (number format: digits vs. words) × 2 (credibility of source: low vs. high) between-subjects study. Participants were first told that they would be evaluating a new energy bar. To manipulate source credibility, participants in the low (high) credibility condition were instructed that as they were going over the package information, they should keep in mind that the company has a negative (positive) reputation and has been accused of falsifying advertising information (i.e., received awards for the transparent manner with which it conducts business; adapted from Zhang and Schwarz 2013). Participants answered a question to ensure they read the credibility scenario and could not view the subsequent ad until they passed the attention check.

Next, participants were presented with a website for a new energy bar. The energy bar claimed to provide 10 (vs. ten) grams of protein. They then indicated their intentions to purchase the product on a five-item, seven-point scale (1 = very low, 7 = very high; α = 0.90). Finally, we asked participants to indicate how many grams of protein were in the bar (i.e., an open-recall question) and how frequently they buy energy bar products (1= never, 7 = very frequently). See web appendix I for stimuli.

Results and Discussion. We conducted a 2 (number format) × 2 (credibility of the source) ANOVA with number format and source credibility as the between-subjects factors. The results revealed a significant main effect of credibility ($F(1, 339) = 27.86$, $p < .001$, $\eta_p^2 = 0.08$), a main effect of number format ($F(1, 339) = 6.54$, $p = .011$, $\eta_p^2 = 0.02$), and, more importantly, an interaction effect between the number format and source credibility ($F(1, 339) = 7.01$, $p = .008$, $\eta_p^2 = 0.02$). Consistent with hypothesis 3, and as shown in figure 4, planned contrasts revealed that when perceived source credibility was low, participants reported a greater likelihood of purchasing the energy bar when the information was presented in digits rather than number words (M_{digits} = 3.54, SD = 1.43 vs. M_{words} = 2.75, SD = 1.41, $F(1, 339) = 13.52$; $p < .001$, $\eta_p^2 = 0.038$). However, when perceived source credibility was high, the difference between the two formats was attenuated (M_{digits} = 3.93, SD = 1.29 vs. M_{words} = 3.94, SD = 1.41; $F(1, 339) = 0.004$, $p = .948$).

Finally, we coded whether participants accurately recalled the number of protein grams in the product (0 = incorrect, 1 = correct). We ran a logistic regression on recall with the number format and source credibility as the independent variables. We found no significant main effects or interaction ($p > .22$). We also ran a logistic regression on recognition of the number of protein grams and found no significant effects ($ps > .40$). These results suggest that there is no difference in how much consumers process information regardless of the number format. Our next study replicates these results using a different source credibility operationalization.

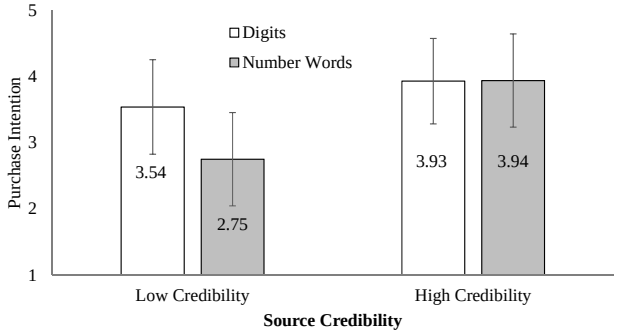
Study 4b

Study 4b replicates the observed pattern of results from study 4a using a relevant public policy context. This study was run in early 2020 when coronavirus disease 2019 (COVID-19) distancing guidelines were put in place. Specifically, we operationalized source credibility in terms of an individual's baseline beliefs that social distancing guidelines are effective mechanisms to mitigate the spread of COVID-19. Given that supporting a viewpoint is positively related to credibility (Schaewitz et al. 2020), high (low) belief in the effectiveness of distancing suggests high (low) credibility in the guidelines. Thus, consistent with our theorizing, we expect to observe the number format effect under low (but not high) credibility.

Method. Two hundred two MTurk panelists (M_{age} = 39.51 years; 55.0% female) participated in a 2-level single factor (number format: digits vs. words) between-subjects study. Participants were asked to look at a poster that provided social distancing guidelines. The poster stated: "Please do your part. Stay 6 (vs. Six) FT apart." After viewing the poster, participants indicated how likely they would be to follow the prescribed distancing guidelines if they were in a public place on a 7-point scale (1 = not at all likely, 7 = very likely). To assess source credibility, we measured participants' baseline beliefs about the credibility of the guidelines: "In general, how effective do you think the distance guidelines (i.e., keeping a distance) are in preventing COVID-19 spread?" (1 = not at all, 7 = very effective; M = 5.51, SD = 1.64). In line with our theorizing, we expect that participants who already believe these measures are effective and already find the guidelines highly credible will be less likely to be affected by the number format. At the same time, for those who do not believe these measures are effective and believe that the guidelines are not credible, providing information in a way that feels right should

FIGURE 4

STUDY 4A: NUMBER FORMAT AND SOURCE CREDIBILITY



NOTE.– Error bars show standard deviation of the mean.

be beneficial. We measured political views, but this variable did not impact our effects and will not be discussed further. See web appendix J for details and stimuli.

Results and Discussion. We conducted a regression on the likelihood of following the guidelines as a function of the number format and baseline beliefs in following COVID-19 guidelines. We find a significant interaction between the two factors ($b = 0.33$, SE $= 0.09$, $t(198) = 3.56$, $p < .001$, $\eta_p^2 = 0.06$), as well as a significant main effect of perceived distancing effectiveness ($b = 0.32$, SE $= 0.07$, $t(198) = 4.81$, $p < .001$, $\eta_p^2 = 0.36$). To visualize the direction of the interaction, we ran Process Macro, model 1 (Hayes 2018). As shown in figure 5, consistent with the results of study 4a, participants who did not believe the social distancing guidelines were effective to begin with (−1 SD) were more likely to report intentions to keep their distance if they saw the distancing guidelines displayed in digits rather than number words ($M_{digits} = 5.83$ vs. $M_{words} = 5.15$; $b = -0.68$, SE $= 0.21$, $t(198) = -3.24$, $p = .001$; JN $= 5.09$ [−0.42 mean centered]). At the same time, for participants who already believed that the guidelines are effective, the influence of the number format on distancing intentions was smaller and non-significant ($M_{digits} = 6.80$, $M_{words} = 7.13$; $b = 0.33$, SE $= 0.21$, $t(198) = 1.57$, $p = .118$).[2]

In sum, in studies 4a and 4b, we demonstrate the boundary condition for the influence of number format on behavioral intentions. We find that digits (vs. number words) play a larger role in behavioral intentions when perceived source credibility is low (vs. high). Thus, we highlight specific situations in which marketers should be more vigilant about their use of the number format in marketing communications. If a company has not established credibility with consumers, we show that it is better to use digits instead of number words to communicate information to consumers. In addition, we extend our findings to an important context for policymakers related to public health (Thomas 2020) that could be used not only for COVID-19 but also for other health issues that often promote statistics and guidelines, such as sexually transmitted disease transmission information (see web appendix A for some real-world examples). In our next and final study, we demonstrate the effect of the number format using secondary data (i.e., a large database of consumer product reviews).

STUDY 5: AMAZON.COM REVIEW ANALYSIS

To further examine whether the number format correlates with consumer behavior, we utilized a subset of amazon.com review data from Ni, Li, and McAuley (2019). In these data, each submitted review contains a headline summary of the review. We coded whether these summaries contained digits (e.g., "This product is 5 stars!!"; "Lasts 6 hours!") or number words ("This product is five stars!!"; "Lasts six hours!"). Each review is accompanied by the number of times consumers voted the review as helpful (e.g., a particularly helpful review might gain 48 positive votes from readers), reflecting whether a review helped guide shopper decision-making (Chen, Dhanasobhon, and Smith 2008; Lafreniere, Moore, and Fisher 2022; Moore 2015; Zhu, Yin, and He 2014).

Method

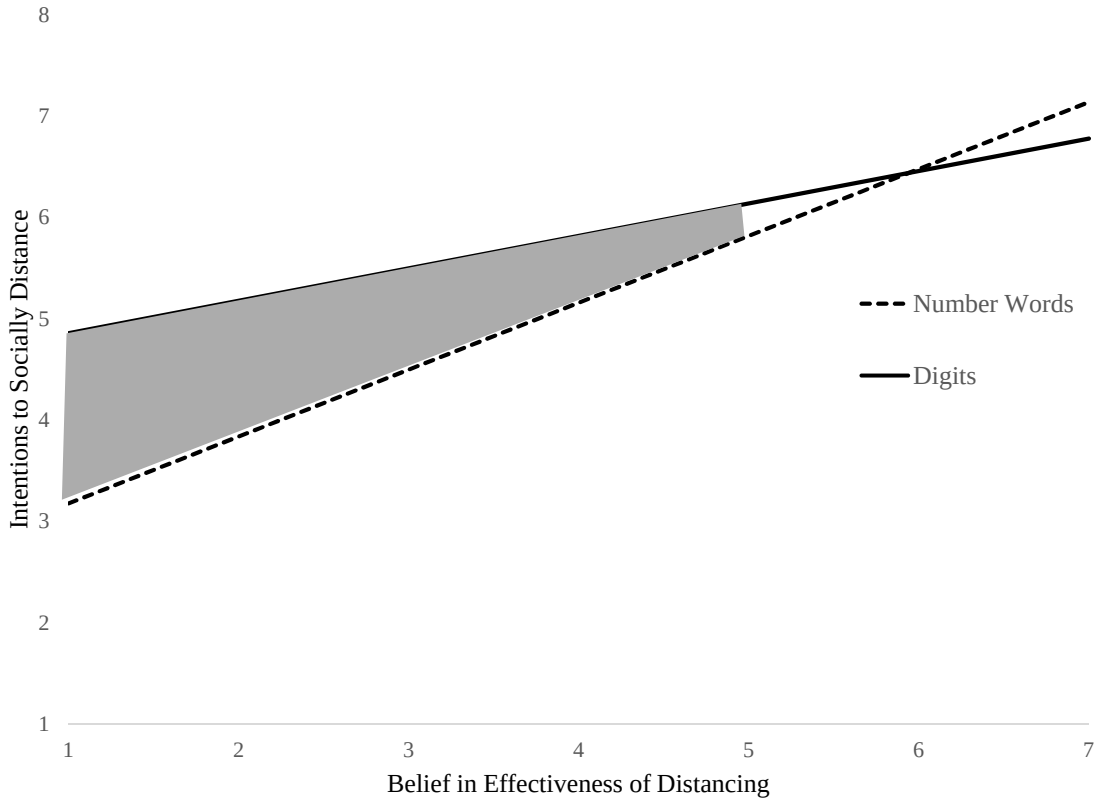
We obtained the amazon.com reviews from a publicly available repository (Ni et al. 2019: https://nijianmo.github.io/amazon/index.html). Within each product review, the data included the full review text, the reviewer's product star rating (1–5, with 5 being the best), the number of people who designated the review as helpful, a headline summary of the review, a product ID number, the time of the review, and whether images were posted along with the review. Our subset, known as the five-core set, contains 75.26 million user-generated reviews for products available on amazon.com from May 1996 to October 2018. The five-core subset is smaller than the full 233.1 million review set, as described by Ni et al. (2019), but is designed to be a more computationally manageable data set. This set contains products with at least five consumer-generated reviews. Even with this subset of data, our analysis includes millions of consumer-generated reviews and the responses to those reviews by other consumers within one of the largest global marketplaces.

Within this dataset, we utilized a string search to code whether the review summary (found at the top of the review) contained a digit or a number integer word for values zero to nine. For example, "5 stars" would be coded as containing a digit, while "Five stars" (or any capitalization

2 Per the visualization output, the mean estimates are predicted values.

FIGURE 5

STUDY 4B: NUMBER FORMAT AND BASELINE BELIEFS



NOTE.– The gray area signifies that the two number formats lead to a significant difference in intentions to distance (i.e., for baseline beliefs below 5.09; $p < .05$).

of any of the f, i, v, or e letters) would be coded as a number word. Both digit and number word coding resulted in a dummy variable for each where zero means absent and one means present. For descriptive statistics, see table 3.

Results

Following prior research (Chen and Lurie 2013; Lafreniere et al. 2022), we extracted the number of helpful votes the review received (i.e., votes given by review readers for the helpfulness of the product review; $M = 1.09$, $SD = 9.33$; table 3) as a proxy for a reader's positive evaluation.[3] We regressed dummy coded presence of digits and number words on the number of helpful votes the review received along with controls for the product star rating assigned by the author of the review ("Star rating"), the number of words in the summary ("N summary words"), and whether the review was for a verified purchase ("Verified"). Table 4, model 1, presents the results of the regression with a log-transformed count variable to account for skewness. Across all categories, when a review headline included a digit, the review received a higher number of helpful votes compared to headlines without any numbers ($b = 0.08$, $SE = 0.00$, $p < .001$). At the same time, when a review headline included a number word, the review received a lower number of helpful votes compared to headlines without any numbers ($b = -0.18$, $SE = 0.00$, $p < .001$). As in Lafreniere et al. (2022), we present the results of a negative binomial regression (table 4, model 2) since the variance of the helpful votes variable exceeded its mean. Additional models (table 4, models 3 and 4) include product-level effects as reviews are nested within products. The key results are consistent across all four models.

Discussion

Across 75.26 million amazon.com user-generated reviews, we find that digits are positively related to the

3 This data set contains only the number of helpful votes, as opposed to helpful and unhelpful votes, utilized in the amazon.com review data sets (McAuley and Leskovec 2013) that do not include data through 2018. amazon.com no longer permits unhelpful voting.

number of helpful votes a review receives, while number words are negatively related to the number of helpful votes. Interestingly, the reviews utilizing number words showed a negative relationship with review helpfulness compared to those that did not include any numbers. These findings suggest that digits can feel right, as well as that number words can feel inappropriate. Future research should test whether communicating information using number words, in some cases, is worse than using no numerical information at all.

We also acknowledge limitations in this analysis that are commonplace with secondary data. First, it is notable that number words occur more frequently in the review summaries (i.e., number words are present in 27% of the reviews, while digits only occur in 4%; table 3). This may arise due to the grammatical norms of writing out numbers smaller than 10 in word format when writing sentences. In addition, while we do not examine the position of the words in summary, future research could explore whether placement of the number word impacts consumer responses. For instance, would consumers evaluate a product differently if a number word were placed at the beginning of a sentence versus in the middle of a sentence? Moreover, we acknowledge that it is possible that reviews with digits may have contained qualitatively different content than those with number words. Additionally, while it is possible to statistically control for ratings and other review characteristics, it is impossible to know whether fake, paid, or bot-generated reviews utilized digits versus number words more frequently (He et al. 2022). Fortunately, our controlled

TABLE 3

STUDY 5 DESCRIPTIVE STATISTICS

Variable	*N*	Mean	Std. dev.	Min	Max
Helpful votes received	48,092,667	1.1	9.3	0	999
Star rating	48,092,667	4.3	1.1	1	5
Verified review	48,092,667				
0 (no)	6,028,105	13%			
1 (yes)	42,064,562	87%			
Number of summary words	48,092,667	4.4	3.6	1	146
Includes digit number	48,092,667				
0 (no)	46,248,037	96%			
1 (yes)	1,844,630	4%			
Includes word number	48,092,667				
0 (no)	34,926,097	73%			
1 (yes)	13,166,570	27%			

NOTE.– This table presents descriptive statistics across all amazon.com categories except for the book category. The book category, with 27 million reviews, was excluded due to computational constraints. Separate descriptives and analyses for this category can be found in web appendix K.

TABLE 4

STUDY 5 REGRESSION RESULTS

	Model 1		Model 2		Model 3		Model 4	
Predictors	Est.	Stat	IRR	Stat	Est	Stat	IRR	Stat
(Intercept)	0.65* (0.00)	1,431.11	3.39* (0.01)	82.45	0.67* (0.00)	1,303.27	3.42* (0.01)	346.69
Any digit	0.08* (0.00)	165.21	1.34* (0.00)	89.38	0.07* (0.00)	147.26	1.39* (0.00)	98.43
Any word	−0.18* (0.00)	−842.55	0.15* (0.00)	−1,136.75	−0.17* (0.00)	−795.31	0.12* (0.00)	−1,185.30
Star rating	−0.04* (0.00)	−539.73	0.86* (0.00)	−257.85	−0.04* (0.00)	−519.97	0.81* (0.00)	−367.93
Verified	−0.27* (0.00)	−972.52	0.33* (0.00)	−576.31	0.01* (0.00)	368.54	0.33* (0.00)	−524.56
N summary words	0.01* (0.00)	398.34	1.12* (0.00)	612.34	−0.24* (0.00)	−806.60	1.11* (0.00)	485.03
Random effects								
	Model 1		Model 2		Model 3		Model 4	
σ^2					0.35		2.80	
τ_{00}					0.06		0.95	
ICC					0.14		0.25	
Product category	No		No		1,564,171		1,564,171	
Fit indices								
Obs.	48,092,667		48,092,667		48,092,667		48,092,667	
Marginal R^2/conditional R^2					0.0494/0.1831		0.3101/0.4846	
R^2/R^2 adjusted	0.0610/0.0610		0.1568					
Deviance	18,881,644.346		15,276,172.974		88,225,857.031			
AIC	91,517,358.592		73,652,001.465		88,225,967.319		72,277,484.207	
AICc	91,517,358.592		73,652,001.465		88,225,967.319		72,277,484.207	

NOTE.– This table presents the results for all amazon.com categories except for the book category. Standard errors are denoted in parentheses. The results for the book category, replicating the effects here, are presented in web appendix K. Model 1 utilizes ordinary least squares (OLS) with the log-transformed vote-dependent variable. Model 2 utilizes a negative binomial distribution for the vote-dependent measure. Model 3 uses OLS and includes product-level random intercepts. Model 4 uses a negative binomial distribution and includes product-level random intercepts. The incidence rate ratio (IRR) represents the factor by which the vote count increases or decreases between the categorical levels. Values above 1 denote an increase, while values less than 1 denote a decrease.
*$p < .001$.

experimental studies, where we manipulate the number format holding the other factors constant, help alleviate some of these concerns.

GENERAL DISCUSSION

Consumers are frequently exposed to numerical information, such as nutritional content, time estimates, and product attributes. We find that digits and number words, even when expressing exactly the same quantity, influence consumer behavior differently. Specifically, we find that consumer judgments and behavior are positively influenced when numerical information is communicated in digits compared to number words. We dub this phenomenon the number format effect. We further show that the number format effect occurs as number words feel less right when compared to digits (i.e., the digits format is the more correct manner of presenting quantitative information), affecting judgments and behavior. We demonstrate this process using mediation studies, as well as a theoretically-motivated moderator. We find that the number format effect is enhanced (attenuated) when credibility of the source of information is low (high). Finally, we demonstrate that the number format effect occurs in a wide variety of consumer contexts, such as consumer reviews, product attributes, the number of years a business has been in operation, nutritional information, and public health recommendations.

Theoretical Contributions

Our research makes several important contributions. First, we contribute to the growing literature regarding number presentation and consumer behavior (Coulter and Coulter 2005; 2010; Fisher and Mormann 2022; Monga and Bagchi 2012; Yan and Pena-Marin 2017; Yang, Kimes, and Sessarego 2009; Zhang and Schwarz 2013; see Santana, Thomas, and Morwitz 2020 for a summary of the use of numbers at different stages of the customer journey). Unlike previous studies, we demonstrate the unique effect of number format on consumer behavior that occurs even though the magnitude and unit remain unchanged. In particular, we add to the discussion of how representing numbers in different visual formats might affect consumer responses. For instance, Coulter, Choi, and Monroe (2012) found that adding commas and cents to the visual representation of a number adds syllables to how consumers interpret the information and enhances magnitude judgments. While in the current research we do not add phonemes to the number (i.e., two and 2 are pronounced in the same way), we show how digits (vs. number words) can affect consumer judgments and behavior.

We also contribute to the literature documenting that numbers can hold associations that subsequently affect how right they feel in a given context. Prior research has examined numerical information presented using round versus non-round numbers (e.g., 15% vs. 15.29%) and their fit for cognitive versus affective scenarios (Wadhwa and Zhang 2015). They found affective responses stemming from differences in the numbers themselves. Yet, we identify that a change in how right a number feels can occur when the quantity itself is exactly the same, only the presentation format differs.

Further, we contribute to the area of visual marketing (Wedel and Pieters 2008) by exploring innovative theoretical links between visual cues and consumer evaluations. This growing area of research explores, among others, how aesthetics (Shu and Townsend 2014), visual versus verbal assortment presentation (Townsend and Kahn 2014), product brightness (Milosavljevic et al. 2012), product image placement (Deng and Kahn 2009), and the dynamism of a product image (Cian, Krishna, and Elder 2014) influence consumer decisions.

Managerial Implications

From a managerial perspective, given the essential role numbers play in communicating consumer-relevant information, the current findings have important implications. The current research is, to the best of our knowledge, the first to show how communicating the exact same quantity in different number formats affects consumer judgments and behavior. We demonstrate that presenting information in digits rather than number words improves relevant consumer responses. Further, this effect is enhanced for consumers who might be skeptical of marketing practices or when the communicator's credibility (e.g., a company, product, or website) is low. This finding is particularly relevant in today's climate as marketers now operate in an "atmosphere of disbelief" in which young consumers are much less trusting and more knowledgeable about marketing practices than previous generations (Olenki 2017). Moreover, we document one other boundary condition that may be useful for theoretical and managerial implications. In supplementary study 2 in web appendix L, we show that the effect of number format on intentions is higher when consumers rely on affect (vs. cognitions) while they evaluate a product. Our work also highlights the potentially detrimental effects of using number words, despite their grammatical appropriateness. Marketers may decide to use number words because doing so favors the ad layout or because they think the information may stand out in certain communication contexts. Yet, we show that, in doing so, they may be risking creating fewer positive consumer responses and undermining their marketing efforts.

For policymakers, we demonstrate that communicating numerical information in digits (vs. number words) is more effective for persuading skeptical individuals to adopt public policy recommendations. The perceived sense of feeling right helps nudge even skeptical individuals toward the

desired behavior. Further, using a real-world clickthrough measure, we find that digits help guide consumers toward considering important health-related information. At the same time, this pattern of results raises an important concern. Those wishing to spread misinformation may present numerical information utilizing digits to give their communication an aura of "correctness" that could lead to greater acceptance of misleading claims. Thus, we hope that the current work will increase consumer awareness of how number format may be influencing their judgments and behavior.

Potential Alternative Accounts

While in the current research we provide evidence consistent with the feeling-based mechanism as the driver of the number format effect, we briefly discuss related process mechanisms next.

Salience. The current research uniquely identifies the role of number format, which is related to how numbers are visually displayed, on consumer behavior. To control for visual differences between digits and number words, we explored the effect of number format on consumer judgments while reducing differences in how salient, or prominent, the numerical information appeared in our stimuli. We accomplished this by keeping the stimuli relatively uncluttered. That is, we sought to keep the salience of the numerical information equal across conditions in the current research. However, it is possible that the number format effect may be amplified when the format also increases the salience of the numerical information (i.e., when a digit is displayed in a very cluttered textual display). Future research should explore how the influence of the number format on consumer behavior may vary with systematic changes in the visual salience of numerical information.

Precision Inference. Digits (vs. number words) may affect evaluations through inferences consumers make to interpret their feelings (Whittlesea and Williams 2001a). In the framework of numerical information in persuasion contexts, when consumers see numbers communicated in words, their expectation of the format in which this information is presented is violated. Whittlesea and Williams (2001a, 18, Expt. 3) found that violation of an expectation resulted in subjects perceiving their processing as incongruous leading to a feeling that something was wrong. They found that these feelings occurred even with a simple violation of expectations and when there was no strong sense of surprise. This feeling is along the same continuum as the sense of feeling right that we described earlier. Following the logic of the discrepancy-attribution hypothesis, the evaluation of the processing coherence as incongruous leads to a subjective experience that triggers a sense that something does not feel right. The next step, as per this hypothesis, is for consumers to make inferences about the cause of the incongruous aspect of the stimuli. That is, an inference that would explain why the numerical information was communicated in number words (vs. digits). While Schwarz et al. (2021) suggested that multiple lay theories can provide an explanation to interpret the metacognitive experience, Whittlesea and Williams (2000) propose that an incongruous perception leads to an attribution internal to the event. In our context, this refers to the lay theories used to explain how the experience will relate to the stimuli. For example, consumers may perceive digits as conveying more precise, accurate information. To test this possible inference, we ran a within-subjects pretest in which we asked 100 MTurk panelists ($M_{age} = 41.27$, 60% female) to evaluate the precision of the following numbers: 5.10 grams of fat, 5 grams of fat, and five grams of fat. Participants were asked to rate the level of precision of each of these numbers ("How would you evaluate this presentation on the following scale?" ranging from 1 = not at all precise to 7 = very precise). The pairwise comparisons do suggest that 5.10 ($M = 6.34$) was perceived as more precise than 5 ($M = 5.29$; $t(99) = 6.68$, $p < .001$), while 5 was also perceived as more precise than five ($M = 4.79$, $t(99) = 5.00$, $p < .001$). While the level of precision that is achieved with digits in our studies (e.g., 5) is not as high compared to more precise numbers (e.g., 5.10), a perceived precision difference between digits and number words could still impact consumer judgments. Consistent with this idea, in study 3, we found that precision also serves as a mediator, operating in parallel with our main mediator (i.e., the sense that digits feel right) between the number format and intentions. Based on the established relationships between precision, accuracy (Pena-Marin and Yan 2021), and competence (Mason et al. 2013), this difference in perceived precision could lead to enhanced evaluations. Particularly, this precision = accuracy inference may be more active in scenarios where there are stronger expectation violations (Thomas and Park 2014). In the current research, we used small numbers (e.g., two or ten) and limited our exploration to contexts that would not strongly violate expectations (e.g., price displays). Under more surprising uses of number words (e.g., with prices, very non-round numbers, or bidding contexts), the precision inference may be triggered in a way that affects consumer judgments.

Information Valence. In the current research, we theorize and demonstrate that a sense of feeling right shapes judgments and behavior. Yet, we have explored the communication of positive (e.g., protein content). We have also investigated how helpful consumers perceive information presented in digits or number words (e.g., "five star!"). Therefore, a question that remains is whether this effect emerges when numerical information is negative. It is possible that the positive affect arising from fit would transfer

for both negative and positive attributes (e.g., in cases of low involvement; Avnet, Laufer, and Higgins 2013), suggesting that digits will increase product evaluations even when the numerical information refers to an undesirable attribute. This may be consistent with a hedonic fluency model where fluently processed stimuli, even if negative, give rise to positive affective responses (Winkielman and Cacioppo 2001). Alternatively, it is possible that digits would amplify the initial affective direction. A digit would make negative numerical information attributes more negative (i.e., hedonic amplification; Albrecht and Carbon 2014; Wadhwa and Zhang 2015, 2019). We examined this question via three supplementary studies. In supplementary study 3 (https://aspredicted.org/vs2p9.pdf), reported in web appendix M, we presented nutritional information that is positively associated with health (i.e., protein content), as well as nutritional information that is negatively associated with health (i.e., fat content; Bucher, Müller, and Siegrist 2015). We find that regardless of the combination of product type and product attribute, packaging that included digits (M_{digits} = 4.02, SD = 1.44) was evaluated more positively than packaging with number words (M_{words} = 3.71, SD = 1.40; $F(1, 393) = 4.28$, $p = .039$, $\eta_p^2 = 0.011$). We saw a similar effect, reported in supplementary study 4 in web appendix N, when communicating sugar content, a negatively valenced attribute when it comes to health. While these attribute valence studies suggest that the positive influence of digits persists even when presenting negative attribute information, it is also possible that the magnitude of "negative" matters (i.e., how negative is the information?). That is, it may be that "10 (ten) grams of fat" is not a sufficiently negative attribute to participants. Therefore, as a follow-up supplementary study 5, reported in web appendix O, we explored how the number format affects the evaluation of an attribute that is harmful to consumers (i.e., the presence of lead in juices) at different levels of negativity. These results suggest that if the information reaches a very high level of negativity, digits (vs. number words) make the information feel more harmful. That is, it intensifies the negative evaluation in line with an amplification perspective (Albrecht and Carbon 2014; Wadhwa and Zhang 2015, 2019). Thus, we find that the number format effect is quite robust in that it persists not only for positive information, but for negative information as well. However, we also see that when an attribute is extremely negative, digits may amplify the negative aspects. Future research could explore moderators known to be related to other affect-as-information processes and outcomes.

Conversational Logic. An alternative account of how number format may affect consumer judgments stems from conversational logic (Grice 1975). Digits, as compared to number words, constitute a simpler way of communicating numerical information. Consumers expect communicators to present information in a manner that is concise (Zhang and Schwarz 2012) and, as such, they may judge products more favorably when numbers are communicated in digits (vs. words) because the communicator abides by conversational logic rules. That is, if a communicator (company) follows the maxims of conversation (e.g., presents only the amount of information that is necessary), then a recipient (consumer) makes assumptions about the cooperative nature of the communicator and will make positive inferences about the information presented (Zhang and Schwarz 2012). Directly related to our current work, Zhang and Schwarz (2012) find that consumers are sensitive to the granularity (vs. coarseness) of the numerical information (e.g., 365 days vs. one year, respectively) presented as it meets the norms of simplicity and informativeness. As such, granular (vs. coarse) numbers are considered more precise and subsequently increase confidence in a product promise. Further, they demonstrate that if the source is generally untrustworthy, then precision based on conversational logic no longer exerts an influence on judgment and choice (Zhang and Schwarz 2013). Based on this, if our hypothesized number format effects are based on conversational logic, a difference in product evaluation between digits and number words should only occur when consumers trust the source of information. If the source is not trustworthy, then these rules no longer apply to the processing of the information (Zhang and Schwarz 2012) and the effects of digits (vs. words) on evaluations should be attenuated. Yet, we find the opposite. When there is low source credibility, the number format effect is stronger. Therefore, we believe that our current results cannot be explained by this account, but there might be situations, such as price displays, where these rules may apply. We encourage future research to continue exploring the influence of the number format on consumer intentions and behaviors using salience, precision, fluency, and conversational logic perspectives.

Limitations and Future Research

The current research examines the effect of the number format on consumer evaluations and behavior when consumers have limited knowledge about a product. Similar to other contextual cues, we expect that when consumers have personal experience with a product, the effect of the number format on intentions will attenuate. Moreover, we focus on contexts that require low involvement from consumers. In this type of situation, the influence of affect and feelings may make it more likely to occur such that digits (vs. number words) improve evaluations (Avnet et al. 2013). However, in other cases in which involvement is high, such as the evaluation of a car purchase, the influence of the number format may be diminished. Finally, we have kept the amount of information in the display low. This was a purposeful decision in order to minimize the effect of digits

being more salient in the communication display. However, future research should explore the impact of the number format on evaluations when there are competing attributes to evaluate (e.g., fat content vs. protein content) in one display.

We have also focused on exploring differences between number words and digits using small quantities (e.g., 2, 6, and 10) that can be expressed in one word. However, our exploration could be expanded further by looking into bigger numbers or more complex numbers, such as 1,200 (vs. one thousand two hundred). It is possible that when the amounts are larger, the expectation to see numbers in digits increases and other processes could be involved in how number format affects evaluations. Specifically, such an atypical experience in numerical processing may create a processing disruption that could lead consumers to apply an inference to guide their judgments under certain conditions (Thomas and Park 2014). It would be interesting to continue exploring these effects in scenarios in which the number complexity increases.

We have documented how number format can influence consumer outcomes. In study 4b, we identify that low (vs. high) belief in the effectiveness of the distancing measures can accentuate the effect of the number format on compliance. While we find an individual difference variable that moderates the number format effect, we have not explored other individual traits that may influence the number format effect. In particular, recent research shows that number fluency effects can be affected by numeracy (Hodges and Chen 2022). Future research could explore whether the number format effect is stronger for individuals with low (vs. high) numeracy.

Conclusion

Overall, the current research documents a novel effect, the number format effect, where the number format used in marketing communications influences consumer judgment and behavior. Our findings should be of relevance to marketers as they continue to seek ways to engage with consumers. At the same time, we hope that it will motivate consumer researchers to uncover other interesting ways in which subtle number format cues can affect consumers.

DATA COLLECTION STATEMENT

The first author managed the data collection for study 2a (spring 2023), study 2b (spring 2023), study 2c (spring 2023), and study 4b (fall 2020) on Mturk and Prolific. The first and second authors managed the data collection for studies 1a and 1b on Facebook Ads Manager (fall 2022), study 3 (spring 2023) on Mturk, and study 4a (spring 2021) at the University of Kentucky. The first and second authors analyzed the data for all studies. For study 5, the second author downloaded the publicly available data via https://nijianmo.github.io/amazon/index.html. The first and second authors discussed all the results. All data are currently stored on Researchbox.org at https://researchbox.org/1749 under the management of the first and second authors. All other authors have access to the data.

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