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The 1 in 1,000,000: Context effects of how numbers cue different kinds of incidental environmental anchoring in marketing communications

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ABSTRACT

Drawing from the literature on incidental environmental anchoring, alphanumeric brand names, and number activation, this article demonstrates that random numerical values used in marketing communications can influence consumers' price perceptions. Surprisingly, even one number can represent many different incidental values depending on the context. The mechanism potentially involves consumers unknowingly using relevant associations to modify numbers to fit the given context. The authors examine this multifaceted nature of single numerical values in three studies, each of which concentrates on a specific association (i.e., shifting decimal, negative, and inverse) that modifies the given number to suit the context. In a fourth study, they establish external validity of the associations. Overall, this research demonstrates that a single number appearing in marketing communications can be multifaceted and that people employ one of the automatically generated values—the one most applicable to the given context—as an incidental anchor when making decisions.

1. Introduction

Companies pervasively use numbers in their brand names and marketing communications. Research in marketing suggests that consumers employ the numerical information they gather from brand names to infer product attributes and evaluate brands (Boyd, 1985; Coulter & Roggeveen, 2014; Gunasti & Ozcan, 2016; Gunasti & Ross, 2010; Kara, Gunasti & Ross, 2015; Pavia & Costa, 1993). For example, consumers tend to infer quality from the numbers contained in model names when comparing products (Gunasti & Ross, 2010; Pavia & Costa, 1993). Although a Canon A530 is inferior to a Canon A460, consumers, especially those low on need for cognition, may surmise that A530 is indeed a better product, employing "the higher, the better" heuristic (Gunasti & Ross, 2010). Even when these products are considered in isolation, the numbers appearing in product names may indicate exclusivity or improved products, as in the case of Chanel No. 5 (Pavia & Costa, 1993). The numbers may also serve as anchors for estimating product attributes, such as size, price, weight, and volume (Yan & Duclos, 2013).

Studies on the effects of numeric marketing elements on behavior mainly focus on alphanumeric brand and product names, paying less attention to any non-brand numbers appearing in marketing communications (e.g., address numbers, license plate numbers, numbers on digital displays). Although these numbers may seem irrelevant for judging the attributes of a product, prior work suggests that the random numbers consumers observe before making decisions can affect their numeric decisions (Blanton & Stapel, 2008; Tversky & Kahneman, 1974; Wilson, Houston, & Brekke, 1996). Even incidental numbers with no obvious link to the judgment task can affect numerical estimates (Critcher & Gilovich, 2008; Dogerlioglu-Demir & Kocas, 2015). Therefore, any seemingly irrelevant number that appears in marketing communications has the potential to serve as an anchor, influencing consumers' judgments about the product (Wilson et al., 1996).

An example is the 1893 cola that PepsiCo launched in 2016 on the U.S. market to expand its craft cola lineup. The 1893 cola is frequently sold for $1.89 in convenience stores. The name reportedly pays homage to PepsiCo's founding year, 1893, and the $1.89 price appears to be an MSRP, the highest price at which this product is available on shelves. A parallel example is the McDonald's 1955 burger, which was sold in most European countries beginning in 2010. Similar to the PepsiCo 1893 cola, the associated commercials and printed material emphasized the number 1955, explaining it as the "Year It All Began," again honoring the year Ray Kroc incorporated the fast-food chain. In almost all markets, the 1955 burger meal was available typically for €7.50 to €12.50. In these examples, the numbers appear in such a way that they do not seem to have any obvious link to the price. However, on closer examination, we can reasonably argue that these seemingly random numbers are, in effect, non-random. We posit that such numerical values serve a specific purpose; that is, they act as incidental environmental anchors (IEAs) to manage consumers' price expectations.

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Kalyanaram and Winer (1995) and Krishna, Briesch, Lehmann, and Yuan (2002) survey the marketing literature for generalizations in reference price research and find that varying presentations of prices and reference prices influence perceived savings. We argue, however, that not only prices and reference prices but also inferential numbers can influence perceived savings. That is, when clear price information is lacking, an incidental number higher than the MSRP of a product leads to a compensatory inference on price (Gunasti & Ross, 2015) and enhances price expectations; that is, the real price appears more reasonable when it is finally revealed. We suggest that such numbers serve as price guidelines to influence consumers' judgments. Furthermore, it is not the exact number that serves as the anchor. In the McDonald's example, it is not the name of the hamburger (i.e., 1955) but rather the associated number (e.g., $19.55) serves as the incidental anchor. In the case of 1893 cola, it is not the product name 1893 but the related number $1.89 is the incidental anchor. That is, numbers have different anchoring effects depending on their context, and consumers may use different heuristics or associations to interpret the IEAs differently.

This article contributes to the literature in two ways: First, we suggest that not only the values in alphanumeric brand names but also the non-brand numbers appearing in marketing communications can influence consumer judgments. Second, we show that consumers do not use the seemingly random values as they are but modify them to fit a given context; that is, they use the most relevant value in the associative network of the given number when making numerical estimations. The choice depends on certain common arithmetic inferences (Coulter & Roggeveen, 2014; King & Janiszewski, 2011).

Drawing from the work on incidental environmental anchoring (Critcher & Gilovich, 2008; Dogerlioglu-Demir & Kocas, 2015), alphanumeric brand names (Boyd, 1985; Gunasti & Ozcan, 2016; Gunasti & Ross, 2010; Kara, Gunasti, & Ross, 2015; Pavia & Costa, 1993), and number activation (Ashcraft, 1983; Lefevre, Bisanz, & Mrkonjic, 1988), we test the multifaceted nature of single numerical values and their context-dependent anchoring effects in four experimental studies. We find that any random number appearing therein may serve as an incidental anchor, influencing consumer assessments. Numbers perceived as higher than the MSRP are generally sufficient to guide price expectations, as they make the real price seem more reasonable. Note, however, that not all high numbers are appropriate, as people use certain associations to modify the values to fit a context.

2. Conceptual framework and hypotheses

2.1. Incidental environmental anchors

Selecting numbers to communicate brands is extremely important for marketers because consumers use them not only when making purchase decisions but also to assess the desirability of a deal. Recent studies in neuroscience (Karmarkar, Shiv, & Knutson, 2015; Karmarkar & Yoon, 2016; Knutson et al., 2008; Knutson, Rick, Wirnmer, Prelec, & Loewenstein, 2007) suggest that the human brain simultaneously engages at least two separate reward circuits during the buying process. Specifically, the ventral striatum focuses on the desirability of the item itself, while the medial prefrontal cortex evaluates the deal (Knutson et al., 2008). As people are open to any numerical input when judging a transaction and search for compensatory inferences to complete omitted data (Gunasti & Ross, 2015), and as the price is the most prominent feature (Kalyanaram & Winer, 1995; Krishna et al., 2002), an incidental number higher than the MSRP of an item may automatically translate as a deal.

The idea that numbers act as anchors to manage people's numerical estimates is not new. Researchers have long known that people given a number as an anchor and then asked to provide estimates are influenced by the random initial value (Tversky & Kahneman, 1974). While ample research suggests that numbers activated before the decision is made affect consumers' numeric decisions, research has paid relatively less attention to understanding when and how incidental numbers affect valuations. An exception is Critcher and Gilovich (2008), who show that even jersey numbers on football players affect the probability estimates of sacking the quarterback. Participants who saw a player wearing number 94 estimated his probability of sacking the quarterback in his next game higher (due to the anchor 94%) than those who saw a player wearing number 54, which acted as 54%.

Numerical priming essentially indicates that any number in the environment at the moment of judgment can serve as an anchor. In the jersey number experiment, use of numbers is straightforward, as the percentage estimation calls for a number between 0 and 100. These findings notwithstanding, questions still remain about the choice of numbers as anchors. Although previous studies provide important insights into how IEAs operate, they do not discuss the multifaceted nature of such random values as their settings do not call for any number modification. The current research tries to fill this gap.

2.2. Multifaceted nature of incidental environmental anchors

Consider a sign reading “The 99 Store.” In line with the multifaceted nature of IEAs, customers should be keen to arrive at $0.99 in a fast-food setting, $9.9 in a clothing retailer setting, and $99 in a jewelry store setting. People do not use 99 (the seed value) as is but rather employ certain established memory traces, or associations, to adapt the number to a given context. The $0.99 price falls within the range of acceptable prices for a fast-food item, $9.90 is an appropriate price for a clothing item, and $99 is a reasonable price for a piece of jewelry. Therefore, these numbers act as potential anchors to guide consumers' price expectations. We contend that the perception and representation of numbers are multifaceted. A single number has the potential to trigger many different values (i.e., an associative network of related numbers), and which value consumers employ is dependent on the cues in the environment. That is, consumers seem to use certain associations to arrive at related numerical values in the associative network given the seed value.

Prior research establishes that memory assumes a central role in number processing and mental arithmetic (Dehaene, 2011). Numerical values are represented as nodes in a network of associative links in memory. Activation spreads from these nodes along associative connections so that linked number nodes, such as basic arithmetic inferences (sum and/or product of the numbers), are retrieved along with the original numerical values (Ashcraft, 1982, 1983). According to this framework, a single value is multifaceted, denoting many related numbers. In other words, a single value has an associative network containing many related numbers that are triggered by the original seed value. For example, a 2 (seed value) serves as not only a 2 but also a -2, 0.2, 20, 200, and even 5, due to the common arithmetic inference ($0.2 = 1/5$). In this sense, all these numbers are in the associative network of 2, and people use certain associations to reach those related values (Ashcraft, 1982). In a similar vein, when 2 and 3 are presented simultaneously, not only 2 and 3 but also 5 ($2 + 3$) and 6 (2×3) are activated in memory. Researchers argue that the results of basic one-digit arithmetical problems (i.e., addition and multiplication) are stored as declarative knowledge in a semantic memory network and consumers retrieve the sums and products of such frequently encountered numbers automatically without actual computation (Ashcraft, 1982). These arithmetic facts are learned as a result of repetition and stored as verbal associations. These linkages or associations are, in effect, language-based representations, and therefore retrieval of such arithmetic facts basically relies on classic language areas of the left hemisphere of the brain (Dehaene, 2011).

The number activation theory of Ashcraft (1983) aligns well with Lefevre et al.'s (1988) work, which shows that retrieving answers from a network of stored facts may lead to misjudgments. The authors presented participants with pairs of numbers (e.g., 2 and 3), and then after a delay, the pairs of numbers disappeared, and a probe value appeared. If the probe was one of the numbers presented previously (e.g., 2), participants responded “yes”; otherwise, they responded “no.” The authors suggest that initial number pairs act as seed values from which various numerical inferences originate. In other words, seed values activate basic common arithmetic calculations, such as the sum or product of the seed values. The results reveal that participants are as likely to pick 5 (the sum of 2 and 3) or 6 (the product of 2 and 3) as 2 or 3 (original/seed values). Because these numbers and other potential associative values (e.g., −2, 0.2, 20, 200, −3, 0.3, 30, 300) are active in memory, people tend to forget which numbers were the initial seed values. Lefevre et al. (1988) argue that when learned, these simple calculations become automatic with practice. People compute 5 and 6 when they are exposed to 2 and 3, even when this calculation interferes with the current task they are trying to perform. Likewise, Campbell (1994) suggests a complex encoding architecture for numerical cognition. Her analyses of operation errors ($2 + 4 = 8$), operand-naming errors ($2 + 8 = 8$), and operand-intrusion errors ($9 \times 6 = 36$) identify a strong connection between number reading and number–fact retrieval processes, demonstrating that several associated values come to mind in number processing that can hinder calculations.

Given that numerical values yield spontaneous activation of relevant knowledge structures in memory (Ashcraft, 1995; Parducci, 1965), one major question is whether triggering arithmetic facts can influence people's subsequent judgments. In other words, do the associative numerical values serve as IEAs in numerical estimates? Although research shows that any number in the environment at the moment of decision making can serve as an anchor (Wilson et al., 1996) and that estimates assimilate to that value (Critcher & Gilovich, 2008), given the multifaceted nature of numbers, the question then becomes which of the associative values will serve as the main anchor. As common arithmetic facts are retrieved on exposure to a number, we expect that people will be influenced by one of the previously generated associative values in successive endeavors. We suggest, however, that the associative value used as the incidental anchor is dependent on the context. In particular, we argue that multifaceted values elicit assimilative anchoring effects; that is, context-congruent values will serve as IEAs and assist the person in the selection process.

Consider the case of a restaurant versus a burger place where customers are exposed to ubiquitous numbers such as 17, 97, 099, and 1999. Is it possible that customers will assimilate to seed values 97 and 099 as suggested check amounts approaching $100 dollars ($97 and $99) in the restaurant setting but assimilate the same values as suggested prices for a hamburger meal at a fast-food restaurant at less than $10 ($9.7 and $0.9.9) or a single burger at less than $1 ($0.97 and $0.99)? Furthermore, can the seed values 17 and 1999 be considered suggested check amounts approaching $20 ($17 and $19.99) in both the restaurant and the burger place? We expect that consumers will assimilate to the contextual cues in the environment supplied by the product category and that multifaceted values will prompt assimilative anchoring effects. We specifically argue that consumers will use the *shifting decimal* rule and modify the random numbers to fit the given context. That is, consumers will move the decimal point to either the left or the right or equivalently add or remove zeros depending on the context to ensure that the new number is an appropriate value for the given context. Table 1 provides an overview of the shifting decimal association in alternative restaurant settings.

H1. Given incidental anchors, the *shifting decimal* association will drive consumers' estimates to be assimilated to the associative value most applicable to the given category.

In their study, Strack and Mussweiler (1997) discover that when participants estimated the mean winter temperature in the Antarctic given a high versus low anchor (−20° vs. −50 °C), they used −20 and −50 as they are. That is, −50 pulled estimates lower than −20. However, when the same anchors were used to estimate temperatures in Hawaii, a reverse effect occurred; that is, −50 (acting like 50) pushed estimates higher than −20 (which was viewed as 20). Strack and Mussweiler argue that when activated, semantic knowledge (−50) is inapplicable to the critical judgment (mean temperatures in Hawaii) and, thus, semantic influences cannot operate. They refer to this phenomenon as the contrast effect. However, they do not specify how and why such a reversal occurred. Drawing from number activation theory and the multifaceted nature of numbers, we argue that the reason for this finding is that people pick context-dependent anchors. When they are exposed to −20 as the anchor value, a set of associated values (e.g., 20, 2, 0.2) appears in their minds. If the judgmental target is the Antarctic, then −20 is readily used. However, if the target is Hawaii, because 20 is the most applicable value, 20 becomes the anchor. More specifically, we anticipate that the context will determine whether a negative or a positive sign is required, and the person will pick one of the congruent values in the associative network of the original number. We contend that because IEAs by nature provide no activated semantic knowledge and the person is open to pure numeric influences, the *negative* association will drive consumers' numerical estimates to be assimilated to the associative value most applicable to the target. Specifically, we expect that consumers will ether drop or add a negative sign to the given value depending on the context.

Peled, Resnick, and Mukhopadhyay's (1988) study on stages in children's development of number concepts discusses negative–positive number associations, lending support to our hypothesis on the negative association. In children's development of number concepts, a first stage includes only positive numbers, and a second stage includes positive and negative numbers, structured symmetrically around zero along a mental number line. In other words, each negative number (e.g., −2) is constructed with its positive counterpart (e.g., 2). Fischer (2003) demonstrates that negative integers display parallel distance and size effects as do positive integers. Negative numbers are arranged by analogy with the positives; they are denoted on a mental number line that runs backward. Following the same logic, we posit:

H2. When the anchor is a negative numerical value, but the context calls for a positive numerical estimate, consumers, using the *negative* association, will omit the negative sign and assimilate the estimates to that associated value.

King and Janiszewski (2011) demonstrate that fluent processing of numbers in communications is a factor in brand liking. The results of common arithmetic calculations (e.g., $1 + 1$, 2×2, 6×2), for example, are more fluently processed. Therefore, consumers would likely favor a Volvo S12 (product number: 6×2) over a Volvo S29 (nonproduct number). Solving common problems such as 6×2 makes the number more accessible, affecting consumer liking. Similarly, the relationship between elements of numerical information in a price discount offer may influence deal liking and purchase intentions because of processing fluency (Coulter & Roggeveen, 2014). If elements in a price discount offer (e.g., regular price, sale price, relative discount) are members of approximation sequences (e.g., 2, 4, 6, 8) or can be presented as multiples (e.g., 33, 66, 99), they are easily processed. In turn, these numbers are favored more, leading to higher purchase intentions. Accordingly, existing reproductive processes that rely on rapid fact

Table 1
The shifting decimal association in alternative restaurant settings.

Seed value	Perception in a restaurant meal context	Perception in a hamburger meal context	Perception across contexts
17	$17	$17	Same
97	$97 or $9.7	$9.7 or $0.97	Potentially different
099	$99 or $9.9	$9.9 or $0.99	Potentially different
1999	$19.99	$19.99	Same

Table 2
Associations used for related value formation.

Name of association	Association	Example
Shifting decimal	X → 10X	2 → 20
	X → 100X	2 → 200
	…	…
	X → X/10	2 → 0.2
	X → X/100	2 → 0.02
	…	…
Negative	X → −X	2 → −2
Inverse	X → 1/X	2 → 0.5

retrieval may generate response-based associations between numbers (i.e., 2 and 12, as in 2 × 6 = 12). If so, associative networks of numbers may serve as context-relevant results to potentially unconscious queries (Coulter & Roggeveen, 2014; King & Janiszewski, 2011).

The assimilation hypothesis, as well as priming experiments, has repeatedly documented activation of domain-specific knowledge structures due to exposure to primes. The context leads to an excitation in people's cognitive networks related to a given value, which enhances their ability to access the parallel judgment schemas, making those schemas more likely to become activated as guides to ensuing judgments (Blanton & Stapel, 2008; Zou, Morris, & Benet-Martinez, 2008). Lefevre et al. (1988) suggest that people automatically engage in computations when exposed to seed values. As seed values trigger common arithmetic calculations, related values become active in memory. A number such as 0.2 then easily suggests a 5 because of the common arithmetic inference 1/5. Note that there might be other associations at play when people adapt these numbers to fit a given context. For example, 0.2 could easily be perceived as 2 or 20. One way to overcome this hurdle and test the inverse association is to give people a choice set that includes one of the numbers in the associative network. If given the seed value, they will pick one of the related values rather than the alternative number, indicating that people indeed generate related values. Blanton and Stapel (2008) argue that the assimilation effect is the default reaction to contextual cues; it is the most straightforward response. Therefore, we anticipate that people will associate one of the numbers in the network if the context supplies that particular number in the next task. Specifically, we anticipate that a person will take the inverse of a numerical value (x becomes 1/x) as the context dictates.

H3. Given incidental anchors, when a choice set includes an associative value created by the *inverse* association, people are more likely to select that number.

Table 2 lists some common associations of generating a set of related values given a seed number. We conducted four experimental studies, including a semi-field study, to test our predictions. Table 3 summarizes our experiments and tested hypotheses.

3. Study 1

The goal of Study 1 was to demonstrate the multifaceted nature of single values in an IEA context and prove that when people are exposed to seed numbers that have nothing to do with the judgmental task, they use numbers modified by the shifting decimal association in subsequent tasks. If the seed number does not fit as is, people select an associative value and use it as an anchor.

3.1. Pretest

Our objective was to discover the most relevant numbers within the associative value set that customers would view as most fit to a given context. Consider, for example, the seed value 17 and its associative set 0.17, 1.7, 17, and 170 formed by shifting the decimal. We wanted to select the member of the associative set that is most relevant to both a hamburger meal and a meal at a restaurant. In our pretest, we randomly assigned 120 participants from Amazon Mechanical Turk (MTurk)[1] (107 of whom completed the survey) to the two conditions (a hamburger meal/a meal at a restaurant). Depending on the condition the participants either viewed a picture of a restaurant or a picture of a hamburger meal (Fig. 1 upper panel). We asked, “Which of the following is likely to be the price of a meal (for one) at the restaurant above?” to the participants in the restaurant meal condition and “Which of the following is likely to be the price of a hamburger meal (for one) as shown above?” to the participants in the hamburger meal condition.

Customers found the same numbers (17 and 19.99) relevant in both the restaurant meal and hamburger meal settings given seed values 17 and 1999 (see Table 1). Given seed values 97 and 99, the associative values specific to the given restaurant setting vary. For the restaurant setting, we find that 97 and 99 as well as 9.7 and 9.9 are relevant numbers among the associative set, while for the hamburger setting, 9.7 and 9.9 are relevant. Thus, the numbers 97 and 099 serve our purpose of pulling consumers in opposite directions across contexts, whereas 17 and 1999 act similarly across contexts. Therefore, we chose the numbers 17, 97, 099, and 1999 as our seed values. Note that we do not use decimal points in the seed values because we expect participants to place and shift decimal points as the context dictates. Table 4 reports the results using word cloud visualizations to denote distributions of alternative interpretations of seed numbers for the restaurant and hamburger meal contexts. With this pretest, we were able to form a short list of the most prominent values in the associative network given a context.

We test H1 in Studies 1a and 1b. We anticipate that given IEAs, the *shifting decimal* association will drive consumers' estimates (i.e., WTP) to be assimilated to the associative value most applicable to the given category, such that (1) WTP will be higher (lower) for an average meal at a restaurant named Studio 97 (Studio 17) than at a restaurant named Studio 1999 (Studio 099) and (2) WTP will be higher (lower) for Burger 1999 (Burger 099) than for Burger 97 (Burger 17).

3.2. Study 1a

3.2.1. Method

In a between-subjects design, we randomly assigned 120 participants from MTurk (103 of whom completed the survey) to one of the four conditions and asked them to report their WTP for an average meal at a restaurant named Studio 17, Studio 97, Studio 099, and Studio 1999 (“How much would you be willing to pay for your own meal at this restaurant?”). The stimuli were simple pictures, depicting the product with an incidental number. In Study 1a, participants saw a picture of a restaurant with the name “Studio X” depicted below the picture (see Fig. 1 lower panel).

3.2.2. Results and discussion

We found significant differences in WTP for a meal at Studio 17 versus Studio 97 ($M_{Studio17\_meal} = 24.17$, SD = 10.32; $M_{Studio97\_meal} = 33.43$, SD = 21.94; $t(57) = -0.26$, $p < .01$). For the restaurant named Studio 17, participants' expectations of price for a meal were significantly lower than for the restaurant named Studio 97. Although there was no obvious price connection, the anchoring effect held. We also found differences in WTP for a meal at Studio 099 versus one at Studio 1999 ($M_{Studio099\_meal} = 41.15$, SD = 35.71; $M_{Studio1999\_meal} = 28.08$, SD = 10.96; $t(42) = 1.70$, $p = .09$). As hypothesized, in a restaurant meal domain, consumer responses were consistent with an interpretation of the number 1999 as $19.99 and the number 099 as $99. Thus, 099 increased but 1999 decreased WTP, demonstrating the context-dependent nature of anchoring.

[1] This pretest, as well as Studies 1–3, used brief surveys on MTurk that typically took participants less than 1 min to complete in return for monetary compensation (10 cents in all studies). All MTurk participants were from North America.

Table 3
Summary of the studies.

	Typical seed	Associative network	Associative value elicitation	Association Tested
Study 1a (H_{1a})	97	0.97, 9.7, 970, etc.	How much would you be willing to pay for your own meal at this restaurant?	Shifting decimal
Study 1b (H_{1b})	97	0.97, 9.7, 970, etc.	How much would you be willing to pay for your own hamburger meal?	Shifting decimal
Study 2 (H_2)	−20	20, −2, −200, etc.	How much would you pay for a watch?	Negative
Study 3 (H_3)	0.2	5, 20, −2, −200, etc.	How much would you pay for a lipstick? Pick one (5, 3)	Inverse
Study 4 (H_1)	0.2	5, −0.5, 2, 50, etc.	How much would you pay for a mug?	Shifting decimal
Study 4 (H_2)	−3	3, 0.3, 30, 300, etc.	How much would you pay for a mug?	Negative
Study 4 (H_3)	−0.2	5, −0.5, 2, 50, etc.	How much would you pay for a mug? Pick one (5, 3)	Inverse

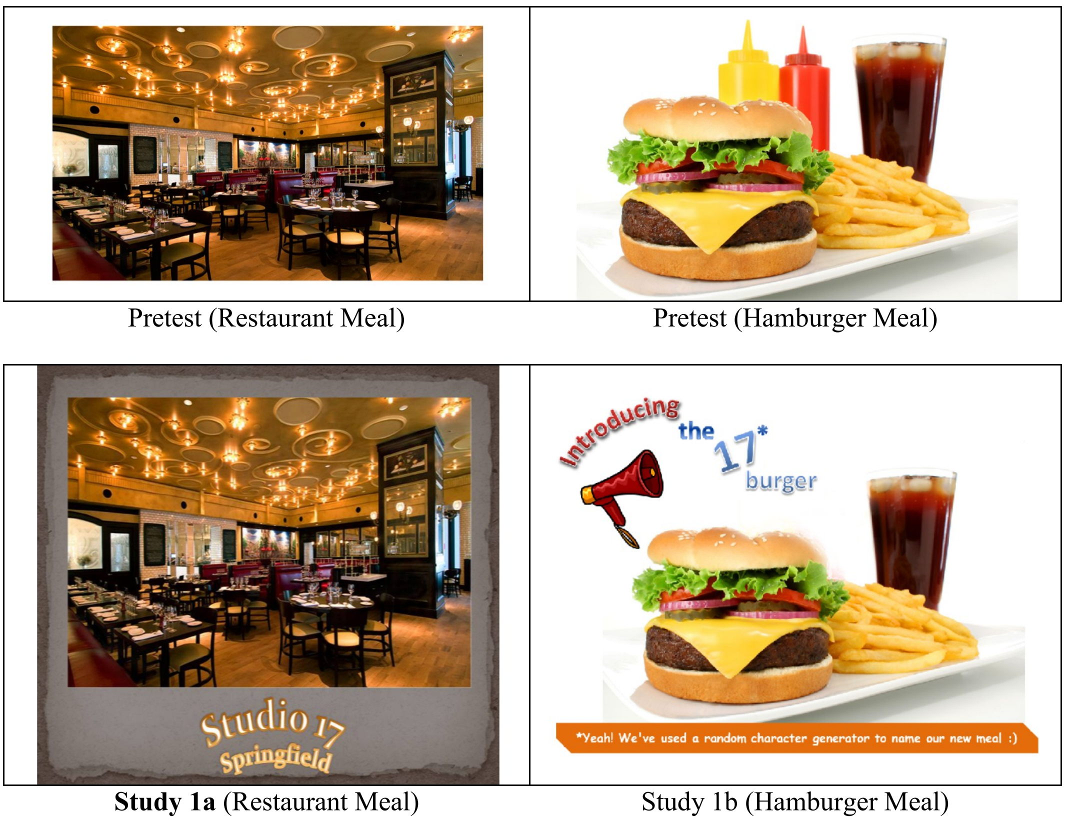


Fig. 1. Stimuli used in Study 1.

3.3. Study 1b

3.3.1. Method

Because different anchor values affect consumers' WTP for a product with a strong internal reference price only when the number is part of the product identity (Dogerlioglu-Demir & Kocas, 2015), we used numbers as part of the product name for the hamburger (17 vs. 97 burger). We used a between-subjects design with four conditions (17 burger, 97 burger, 099 burger, and 1999 burger) to test the effect of different anchors in the product names on consumers' WTP for a product with a strong internal reference price. We randomly assigned 160 participants from MTurk (152 of whom completed the survey) to one of the four conditions. This time, we used a hamburger meal ad and a slogan that read, "Introducing the 17/97/099/1999 burger." We specifically mentioned that "we used a random character generator to come up with such a name" to ensure that participants perceived the numbers as product names, not prices (see Fig. 1 lower panel). Then we asked participants to report their WTP by the following question "How much would you be willing to pay for your own hamburger meal (as shown)? ".

3.3.2. Results and discussion

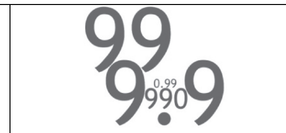
We found significant differences in WTP for the 17 burger meal versus the 97 burger meal ($M_{17burger} = 8.40$, SD = 3.62; $M_{97burger} = 6.24$, SD = 3.78; $t(78) = 2.59, p < .01$). As expected, while consumer responses were consistent with an interpretation of the number 17 as $17, the WTP averages indicated an interpretation of the number 97 as $9.7 or $0.97 when consumers were operating in the hamburger meal context. Therefore, 17 increased WTP, and 97 decreased WTP. Although the relationship between incidental numbers and the price of the product is unknown to consumers, when they are asked their WTP, they seem to use the readily available random numbers in their environment to make estimates. However, their use of such numbers is not straightforward; the product category serves as the context, and the consumer adapts a single value from the alternatives to fit the domain. We also found significant differences in WTP for the 099 burger meal versus the 1999 burger meal ($M_{099burger} = 5.33$, SD = 2.94; $M_{1999burger} = 6.56$, SD = 2.00; $t(70) = -1.96, p < .01$). As proposed, while 099 decreased WTP, 1999 increased WTP, suggesting that consumers most likely take 099 as the lower bound and 1999 as the upper bound for hamburger meal prices. Thus, the results of Study 1 provide support for H1 (see Table 5 and Fig. 2).

Table 4
Results of the pretest as word cloud visualizations and distribution statistics of alternative interpretations of seed numbers for the restaurant and hamburger meal contexts.

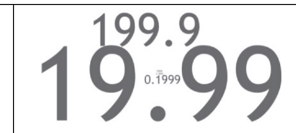
RESTAURANT MEAL

Num.	Freq	z-score	p-value
1.7	0	4.243	0.000
17	**36**	**6.958**	**0.000**
170	17	1.018	0.308
0.17	1	4.073	0.000

Num.	Freq	z-score	p-value
9.7	**25**	**3.564**	**0.000**
97	**22**	**2.546**	**0.010**
970	6	2.376	0.017
0.97	1	4.073	0.000



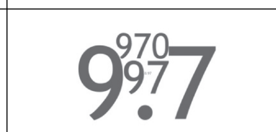
Num.	Freq	z-score	p-value
9.9	**22**	**2.546**	**0.010**
99	**22**	**2.546**	**0.001**
990	7	2.043	0.041
0.99	3	3.394	0.000



Num.	Freq	z-score	p-value
1.999	1	3.334	0.000
19.99	**34**	**7.900**	**0.000**
199.9	15	1.286	0.198
0.1999	4	2.388	0.016
1999	0	3.674	0.000

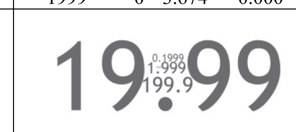
HAMBURGER MEAL

Num.	Freq	z-score	p-value
1.7	8	1.681	0.092
17	**31**	**5.548**	**0.000**
170	14	0.168	0.866
0.17	0	4.203	0.000



Num.	Freq	z-score	p-value
9.7	**29**	**4.876**	**0.000**
97	13	0.168	0.866
970	10	1.177	0.239
0.97	1	3.867	0.000

Num.	Freq	z-score	p-value
9.9	**30**	**5.212**	**0.000**
99	11	0.841	0.400
990	10	1.177	0.239
0.99	2	3.531	0.000



Num.	Freq	z-score	p-value
1.999	6	1.638	0.101
19.99	**36**	**8.736**	**0.000**
199.9	8	0.910	0.362
0.1999	3	2.730	0.006
1999	0	3.640	0.000

Table 5
Study 1: reported WTP values in the restaurant and hamburger meal contexts for given anchors.

Seed values (17 & 97)	Anchor 17		Anchor 97		Statistics		
	Mean WTP	SD WTP	Mean WTP	SD WTP	N	t	p
Restaurant Meal (1a)	24.17	10.32	33.43	21.94	59	−0.26	0.01
Hamburger Meal (1b)	8.40	3.62	6.24	3.78	80	2.59	0.01

Seed values (099 & 1999)	Anchor 099		Anchor 1999		Statistics		
	Mean WTP	SD WTP	Mean WTP	SD WTP	N	t	p
Restaurant Meal (1a)	41.15	35.71	28.08	10.96	44	1.70	0.09
Hamburger Meal (1b)	5.33	2.94	6.56	2.00	72	−1.96	0.01

4. Study 2

Study 2 tests the negative association (H2). All participants were instructed to view an ad for a trekking watch with an altimeter function (see Fig. 3). They were randomly assigned to one of two watch conditions. Both watches were the same, but the displays differed in (seemingly random) values (either −80 or −20). Note that numerical displays (−80 and −20) were not listed as part of the set of attributes but were displayed as arbitrary values. Therefore, any type of conscious inference about quality or price is unwarranted. When numerical information is displayed, we anticipate that consumers will modify those numbers to fit the context. That is, the adapted numbers will act as IEAs, guiding consumers' WTP. More specifically, we expect that participants will drop the negative signs, such that −80 will increase their WTP and −20 will decrease their WTP.

4.1. Method

We randomly assigned 200 participants from MTurk (186 of whom completed the survey) to two trekking watch conditions, in which numbers (−80 vs. −20) were displayed on the watch screen. We also listed a set of attributes of the watch. We then asked participants to report their WTP for such a product.

4.2. Results and discussion

A *t*-test comparing the two conditions showed statistically significant differences in WTP (M_{-80} = 78.38, SD = 54.53; M_{-20} = 63.37, SD = 47.83; $t(184) = -1.99$, $p = .04$). As proposed, seemingly incidental numbers (random numerical displays on the digital watch) acted as anchors to affect consumers' WTP. Similar to our findings in Study 1, these numbers did not act as they are; rather, −80 acted as 80, pushing estimates higher, and −20 acted as 20, pulling estimates lower, in support of H2.

5. Study 3

We designed Study 3 to test H3 and observe the associative value created as a result of the inverse association. To facilitate the inverse association, we used a single-digit decimal number (i.e., 5). The seed

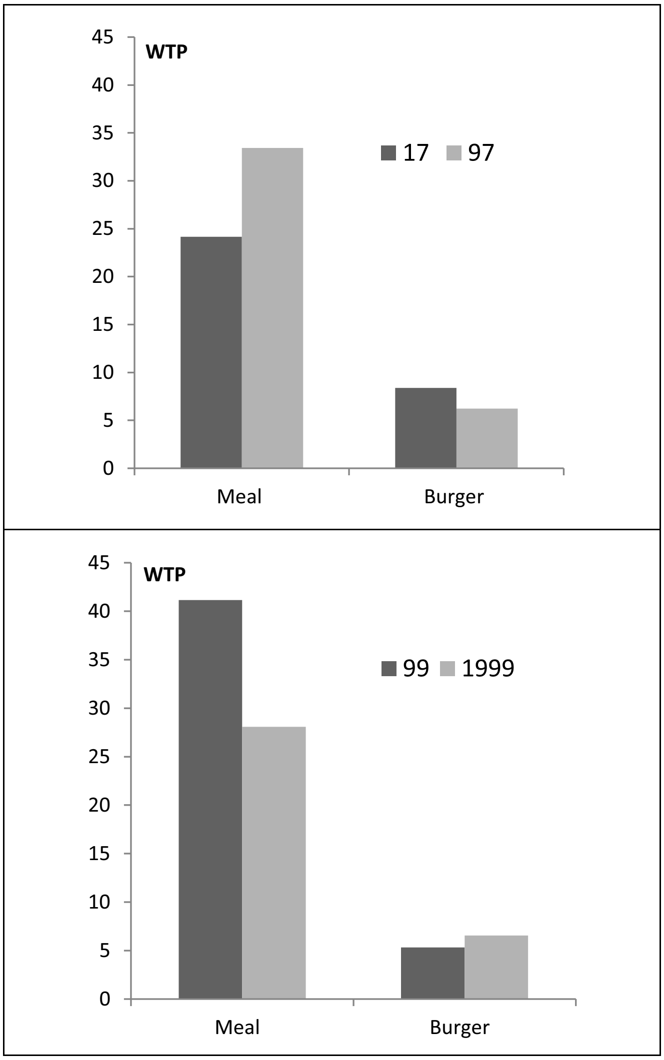


Fig. 2. Reported WTP values in the restaurant and hamburger meal contexts for given anchors.

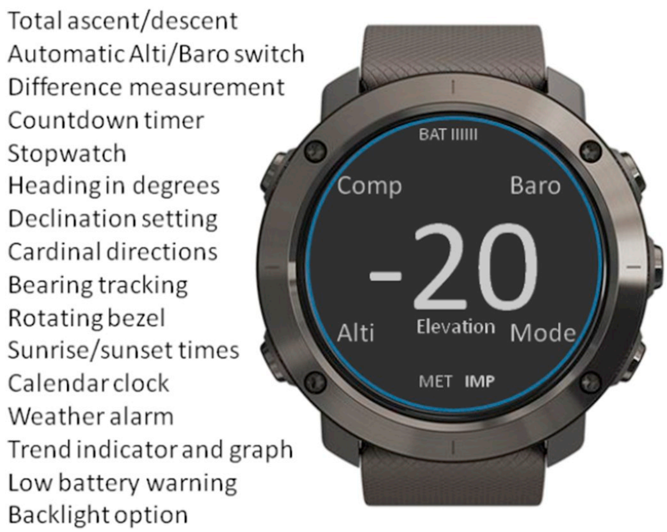


Fig. 3. Stimuli used in Study 2.

0.2 leads to a simple single-digit number ($0.2 = 1/5 \rightarrow 5$) when inversed. We expect that when people are asked to estimate a price of a product with an incidental value (0.2) and the choice set includes an

Fig. 4. Stimuli used in Study 3.

associative value created by the inverse association (5), they will tend to choose 5 over any other random value. Note that in this experiment, rather than asking participants to report their WTP as in the previous studies, we provided them with a choice set to better determine how the inverse association works. As 0.2 has other associative values (e.g., 2, 20, 200, …), to activate inverse association, we needed to provide a set of options from which participants could pick the most appropriate number. If, given the seed value, participants pick one of the related values, we can conclude that the inverse association operated as anticipated. Forcing participants to pick one number from a set of two enables us to isolate the effect of the inverse association, as other associations can be at play at the same time (e.g., shifting decimal). If we had participants freely list their judgments, we could have easily observed the effect of the shifting decimal association (e.g., $0.2 \rightarrow 2$) rather than that of the inverse association.

5.1. *Method*

We drew 60 people from MTurk, 57 of whom completed the survey. We asked them to indicate the price of a 0.2-oz. lipstick (see Fig. 4) given two options: 5 and 3. In this case, 3 serves as the random number, and 5 represents the associative value. We randomized the order of the numbers to rule out any order effects.

5.2. *Results and discussion*

We calculate the significance level (*p*-value) using a general z-test. We found that more than 50% of participants chose the associative value (5) when the choice task involved a random (3) and an associative (5) value. Of the 57 participants, 35 chose the associative value (5) when they were exposed to a 0.2-oz. lipstick ($z = 1.72$, $p = .08$). Order of presentation of the numbers did not have a significant effect on choice ($p > .1$). Thus, H3 was supported.

6. Study 4

Study 4 is a semi-field study to establish external validity of the findings—namely, a test of the *shifting decimal*, *negative*, and *inverse* associations. It replicates Studies 1–3 using real consumers instead of

Fig. 5. Stimuli used in Study 4.

MTurk workers. We anticipated that the numerical information displayed on a real product (i.e., a mug) would affect consumers' WTP. However, we also expected consumers to modify the given numbers to fit the context (WTP for a mug). In other words, the adapted numbers would act as IEAs, directing consumers' WTP. We expected that when adopting the numbers, consumers would either shift decimals or drop the negative sign to fit the context. Specifically, the *shifting decimal* and *negative* associations using WTP serve as the dependent variable, while we demonstrate the *inverse* association through a choice task, similar to Study 3.

6.1. Method (shifting decimal and negative associations)

In this part of the study, research assistants at a major European university recruited participants (n = 162) using street intercepts. They intercepted participants at four different but similar points on a shopping strip and told them that they were selling mugs specifically for a fundraising campaign of the algebra club. At each point along the strip, participants were exposed to only one of the four versions of a mug, so that they could be assigned to one of the four conditions. The mugs displayed one of the following numbers: −3, −7, 0.3, or 0.7 (see Fig. 5). All the mugs were the same, with the only difference being the number that appeared on each mug. After participants viewed the mug, the assistants asked them to report their WTP for the mug, which was noted by another assistant.

6.2. Results and discussion

In an independent samples *t*-test comparing conditions, we found statistically significant differences in WTP for the mug across the 0.3 and 0.7 conditions ($M_{0.3} = 8.14$, SD = 3.97; $M_{0.7} = 9.70$, SD = 5.32; $t(92) = -1.68$, $p = .048$) and across the −3 and −7 conditions ($M_{-3} = 7.27$, SD = 3.10; $M_{-7} = 10.67$, SD = 4.48; $t(52) = -3.41$, $p = .00$). As predicted, incidental values (a random number appearing on the mug) acted as anchors to influence consumers' WTP. Similar to our findings in the previous studies, these numbers did not act as they are. While −3 (acting as 3) pulled WTP down, −7 (acting as 7) pushed WTP up, demonstrating the *negative* association. Moreover, while 0.3 (acting as 3) pulled WTP down, 0.7 (acting as 7) pushed it up, showing the *shifting decimal* association. We also found statistically significant differences in WTP for the mug between the 0.3 and −7 conditions ($M_{0.3} = 8.14$, SD = 3.97; $M_{-7} = 10.67$, SD = 4.48; $t(55) = -2.54$, $p = .00$) and the −3 and 0.7 conditions ($M_{-3} = 7.27$, SD = 3.10; $M_{0.7} = 9.70$, SD = 5.32; $t(79) = -2.60$, $p = .00$). That is, both −3 and 0.3 (acting as 3) pulled WTP down significantly more than both −7 and 0.7 (acting as 7) pushed WTP up, demonstrating that the *negative* association and the *shifting decimal* association can work in a mix-and-match style to create significant differences (for a summary of these findings, see Table 6 and Fig. 6).

Table 6
Study 4: results of the *t*-tests for four conditions.

Stimuli	0.3	−3	0.7	−7
0.3				
−3	1.10			
0.7	−1.67**	−2.60***		
−7	−2.54***	−3.41***	−0.86	

*** Significant at the 0.01 level.
** Significant at the 0.05 level.

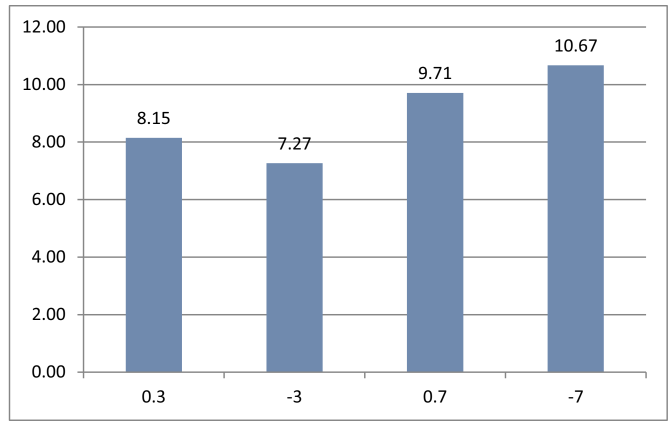


Fig. 6. Study 4: mean WTP across four conditions.

6.3. Method (inverse)

In this part of the study, research assistants at a major European university again recruited participants (n = 40) using street intercepts. They told participants that they were selling mugs specifically for a fundraising campaign of the algebra club. The mug displayed the number 0.2. After participants viewed the mug, the assistants asked them to pick one number from two randomly ordered numbers (i.e., 3 and 5).

6.4. Results and discussion

We calculate the significance level (*p*-value) using a general z-test. We found that more than 50% of participants chose the associative value (5) when the choice task involved a random (3) and an associative (5) value. Of the 40 participants, 32 chose the associative value (5) when they were exposed to a 0.2 mug ($z = 3.79$, $p < .01$). Order of presentation of the numbers did not have a significant effect on choice ($p > .1$).

7. General discussion and conclusions

This article makes two major theoretical contributions to the literature on incidental environmental anchoring (Critcher & Gilovich, 2008; Dogerlioglu-Demir & Kocas, 2015), alphanumeric brand names (Boyd, 1985; Gunasti & Ozcan, 2016; Gunasti & Ross, 2010; Kara et al., 2015; Pavia & Costa, 1993) and number activation (Ashcraft, 1983; Lefevre et al., 1988). First, we find that consumers use random numbers in their environment to make numerical valuations. The same numbers, however, may refer to different values depending on the context. Alternative environments pull different values from an initial number and that value serves as an anchor in subsequent judgments. These numbers forge powerful associations in the brain, automatically triggering a set of relevant numerical values (Ashcraft, 1983; Lefevre et al., 1988). Then, people employ the most applicable number given the context as the anchor when making numerical estimates. Second, we demonstrate that specific associations (i.e., *shifting decimal*, *negative*, and *inverse*) govern the number modification process.

The findings also have several important managerial implications. First, managers must understand the effects of IEAs and the role of seemingly random numbers in consumers' numerical judgments in irrelevant domains. Only then can they select the right numbers to create intended anchoring effects. Consumers have ranges of acceptable numbers especially for product prices with which they have some familiarity, and only numbers within this range are the potential right numbers. Second, it is highly likely that an intended anchor will change in unit in a customer's mind and end up working in the undesired direction. As our empirical work demonstrates, 17 is a better anchor for profit maximization than 97 in a burger domain, while the reverse is true in a restaurant domain. Similarly, 099 is a better anchor for profit maximization than 1999 in a restaurant domain, while the reverse is true in a burger domain—that is, the WTP is higher when 1999 is used rather than 099.

Our findings are likely to generalize to other domains. When salient information is yet to be provided, we expect that customers automatically try to infer such information from any available data. As such, different domains may elicit the deduction of different types of information. For example, consider an incidental number such as 47 appearing in a marketing communication. Consumers can easily use this number to infer calorie information at a restaurant (47 → 470 cal), speed in microprocessors (47 → 4.7 GHz), picture resolution in cameras (47 → 4.7 MPs), or engine size in cars (47 → 4.7 LT). Future research could test these and other similar domains.

Use of incidental numbers in marketing communications has clear ethical consequences. Marketers have the discretion to show almost any number in their communications and, as a result, might guide consumers' WTP, rendering them vulnerable to pure numeric influences. Therefore, public policy makers and consumer watchdogs should carefully scrutinize the use of incidental numbers in advertising.

As this work illustrates, there remains a tremendous need for further research within the domain of IEA and on the multifaceted nature of numbers. Given the gamut of marketing appeals made to customers every day, the findings of this research can potentially help inform firms on how to manage price expectations effectively.

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