Making Each Unit Count: The Role of Discretizing Units in Quantity Expressions

CHRISTOPHE LEMBREGTS
BRAM VAN DEN BERGH

Consumers typically infer greater quantity from larger numbers. For instance, a 500 gram box of chocolates appears heavier than a .5 kilogram box. By expressing quantities in alternative units or attribute dimensions, one can represent an otherwise identical quantity in a more versus less discretized manner (e.g., a box containing 25 chocolates vs. a box weighing 500 grams). Seven experimental studies show that a difference between more discretized quantities (e.g., 25 vs. 50 chocolates) appears larger relative to a difference between less discretized quantities (e.g., 500 grams vs. 1,000 grams), above and beyond effects of number magnitude. More discretized quantity expressions enhance the consumers' ability to discriminate between choice options and can also nudge consumers to more favorable choices. Because more discretized quantities are more evaluable, expressing a quantity in terms of a collection of elements particularly helps individuals who are less numerically proficient. By identifying how discretization functions as a novel antecedent of evaluability and by distinguishing two different conceptualizations of numerosity (i.e., symbolic and perceptual numerosity), this article draws important connections between the numerical cognition literature and General Evaluability Theory.

Keywords: numerosity, numerical cognition, framing effects, units, evaluability, judgment and decision making, nudge

Consumers frequently encounter quantitative information, such as weight (e.g., 500 gram box of chocolates), size (e.g., 6,000 square foot mansion), or distance (e.g., 400 meter walk to the local store). Most quantitative information can be specified with various units: a box may contain 10 chocolates rather than weigh 500 grams, a mansion might have 10 bedrooms rather than measure 6,000 square feet, and the distance to a local store could be specified as 4 blocks rather than 400 meters. These alternative specifications affect how consumers evaluate quantitative product information (Burson, Larrick, and Lynch 2009; Monga and Bagchi 2012; Pandelaere, Briers, and Lembregts 2011). While prior research notes how judgments of quantity may depend on the magnitude of the number symbol (e.g., 10 kilograms vs. 10,000 grams), we address the effect of specifying quantities as a number of individual elements. We propose that when quantitative information is specified in more "discretizing units" (e.g., chocolates, bedrooms, blocks), consumers are more likely to represent it as a collection of individual elements (e.g., a set of individual chocolates, bedrooms, blocks) compared

Christophe Lembregts (lembregts@rsm.nl) is an assistant professor in the Department of Marketing Management at Rotterdam School of Management, Erasmus University, P.O. Box 1738, 3000 DR Rotterdam. Bram Van den Bergh (bbergh@rsm.nl) is an associate professor in the Department of Marketing Management at Rotterdam School of Management, Erasmus University, P.O. Box 1738, 3000 DR Rotterdam. Please address correspondence to Christophe Lembregts. The authors appreciate comments on previous drafts and presentations received from the review team, Stefano Puntoni, Gabriele Paolacci, and Dan Schley; members of the marketing departments at Ghent University, Rotterdam School of Management, Bocconi University, and London Business School; and participants of the 10th Triennial Invitational Choice Symposium at Lake Louise and the 2016 Frankfurt Marketing Wintercamp. Research assistance from Nuree Ha is gratefully acknowledged. Financial support to the first author from the Netherlands Organisation for Scientific Research (NWO – VENI grant 451-16-007) is gratefully acknowledged. Supplementary materials are included in the web appendix accompanying the online version of this article.

Editor: Gita Johar

Associate Editor: Rajesh Bagchi

Advance Access publication April 13, 2018

 • Vol. 45 • 2019
DOI: 10.1093/jcr/ucy036

The main point of the paper

with when the information is specified in less discretizing units (e.g., grams, square feet, meters).

We demonstrate that specifying quantitative information in more discretizing units has important consequences for perceived differences between products. An identical difference expressed in more discretizing units appears larger than one expressed in less discretizing units. For example, consumers might perceive that the difference between a small and a large box of chocolates is greater if the boxes are described by the number of chocolates they contain (10 vs. 20) than if their quantity is specified in grams (500 vs. 1,000). This assertion may sometimes contradict the predictions of prior research: if people primarily rely on number magnitude to evaluate quantity (Pandelaere et al. 2011), the difference should appear larger if it is specified in larger numbers (1,000 – 500 > 20 – 10). But by integrating research on numerical cognition (Butterworth 2000, 2001, 2007), numerosity (Pelham, Sumarta, and Myaskovsky 1994), and evaluability (Hsee and Zhang 2010), we posit that expressing quantities as collections of individual elements increases the evaluability of quantitative product information (defined as the ease with which a value or a comparison of values can be mapped onto an evaluation), resulting in greater perceived differences.

This work makes several contributions. First, we document a previously unexplored effect of specifying quantitative information in discretizing units and disambiguate the "numerosity" concept, which has been defined differently across streams of literature (Lembregts and Pandelaere 2013; Monga and Bagchi 2012; Pelham et al. 1994). Second, we contribute to research on evaluability (Hsee, Rottenstreich, and Xiao 2005; Hsee and Zhang 2010) by identifying how the featured unit might function as a novel antecedent of evaluability. Third, we identify an easy-to-implement intervention to help consumers make better choices (Thaler and Sunstein 2008), by demonstrating that discretizing units can nudge consumers to prefer healthier products and attenuate the differences exhibited by more versus less numerically proficient consumers.

NUMEROSITY AND DISCRETIZING UNITS

Quantitative information expressed symbolically consists of two components: a number (e.g., 500) and a unit (e.g., grams). An extensive research stream demonstrates that when consumers assess differences between *symbolic* presentations of quantities (e.g., expressed using Arabic numerals), they mostly rely on the magnitude of the number component, in what is referred to as the numerosity effect (Adaval 2013; Bagchi and Li 2011; Lembregts and Pandelaere 2013; Monga and Bagchi 2012; Schley, Lembregts, and Peters 2017; Wertenbroch and Soman 2007; for a review, see Bagchi and Davis 2016). For instance, specifying symbolic presentations of two quantities in larger numbers (using a smaller unit, e.g., comparing 500 vs. 1,000 grams) increases the perceived difference between these quantities, relative to smaller numbers (using a larger unit, e.g., .5 vs. 1 kilograms).

Somewhat analogously, when judging *perceptual* presentations of a quantity (e.g., via stimulus arrays such as •••••), consumers rely on the number of elements and thereby judge identical quantities as greater if they consist of more elements (also dubbed a numerosity effect; Alba et al. 1994, 1999; Capaldi, Miller, and Alptekin 1989; Jansen-Osmann and Wiedenbauer 2006; Palat, Delhomme, and Saint Pierre 2014; Pelham et al. 1994; Price et al. 2014; Wolfe and Kaplon 1941). For example, people estimate the monetary value of an array of US coins as higher if the perceptual array contains 20 coins (e.g., one quarter, two dimes, and 17 nickels) than if it contains eight coins (e.g., four quarters, two dimes, and two nickels; Pelham et al. 1994). As a consequence, 500 grams of chocolate could be perceived as a larger quantity if represented as 10 smaller chocolates (••••••••••) rather than five larger chocolates (●●●●●).

Consumers insufficiently account for unit size (e.g., kilogram vs. gram) and are overly influenced by *number magnitude* when evaluating *symbolic* quantities (i.e., they are subject to the symbolic numerosity effect, or an overreliance on the magnitude of an Arabic numeral). In a similar vein, they insufficiently account for element size (e.g., small vs. large chocolates) and overly rely on the *number of individual elements* when comparing *perceptual* quantities (i.e., they are subject to the perceptual numerosity effect, or an overreliance on the number of elements in an array). Both phenomena have been labeled numerosity effects (i.e., larger numbers confer larger magnitudes), but it is crucial to emphasize that number magnitude and the number of elements are orthogonal constructs. For instance, the same quantity (e.g., box of chocolates) can be represented with smaller numbers (e.g., .5 kilograms of chocolate) or larger numbers (e.g., 500,000 milligrams of chocolate), and that same box of chocolates might contain fewer (e.g., five chocolates) or more elements (e.g., 10 chocolates). Prior research uses the term "numerosity effect" interchangeably to refer to the effects of number magnitude and the number of elements, but clearly, the same quantity could be expressed in a smaller number and contain more elements or in a larger number and contain fewer elements.

We seek to investigate how the type of unit (e.g., more discretizing units, such as chocolates, vs. less discretizing units, such as grams) affects whether symbolic quantities are more or less likely to be represented as a collection of elements (akin to perceptual numerosity), which may generate effects beyond those induced by number magnitude (i.e., symbolic numerosity effect). More and less discretizing units appear in extant studies (Burson et al. 2009;

Monga and Bagchi 2012), but these studies test only the effects of number magnitude (e.g., 7 vs. 9 new movies/week < 364 vs. 468 new movies/year; Burson et al. 2009), not the effect of discretizing units on magnitude perceptions.

When quantitative information is specified in more discretizing units (e.g., chocolates, bedrooms, blocks), the quantity is discretized in the sense that it is more likely to be represented as a collection of elements, and each individual element of the collection is in one-to-one correspondence with a number ("1, 1, 1, 1, 1, 1, 1, 1, 1, 1"; Butterworth 2000; Dantzig and Mazur 1930/2005; Wiese 2003). In contrast, if quantitative information is specified in less discretizing units (e.g., 500 grams, 6,000 square feet, 400 meters), the quantity is less likely to be represented as a collection of individual elements. Even if consumers evaluate symbolic quantities, specifications in more discretizing units might yield different responses (akin to perceptual numerosity) than specifications in less discretizing units, because the former triggers a quantity representation in terms of a collection of elements.

An important implication of specifying information in discretizing units is that it may speak to an innate, hardwired reference system for processing collections of elements. That is, humans seem born with an ability to evaluate the magnitude of a collection of elements, even before they can read, interpret, or understand Arabic numerals (Butterworth 2000, 2001, 2007; Harvey et al. 2013). By their first week of life, infants seem sensitive to changes in the magnitude of a collection of individual elements (Antell and Keating 1983; Starkey and Cooper 1980; Wynn 1992). When two puppets are added one at a time behind a screen, babies are more surprised to see only one puppet when the screen is lowered than to see two puppets (Wynn 1992). In another study, Starkey, Spelke, and Gelman (1983) show that infants can associate visual numerosities with the appropriate auditory numerosities (e.g., three objects with three drumbeats). The development of numerical cognition for counting and arithmetic almost universally starts with the use of a collection of individual elements (e.g., set of fingers), suggesting that the processing of a collection of elements may be rooted in our evolutionary past (Butterworth 2000, 2001). It is perhaps not surprising that many ancient measurement units were essentially discretizing units, such as the number of pebbles, cattle, or warriors (Stevens 1958). In further support of the evolutionary nature of this sensitivity to the magnitude of a collection, even lower-order animals display sensitivity to the number of food elements (Capaldi et al. 1989; Wolfe and Kaplon 1941). For example, in chickens, a kernel of corn functions as a more effective reward when it is divided in four separate parts than a single kernel (Wolfe and Kaplon 1941). Evaluations of the magnitude of a collection of elements seem effortless and automatic, because magnitude judgments of perceptual arrays (such as coins) are particularly affected by the number of elements when cognitive resources are taxed (Pelham et al. 1994).

Whereas prior work has mostly focused on perceptual presentations of a collection of elements (Ma and Roese 2013; Pelham et al. 1994), we take a novel approach and contribute to the literature by investigating the effects of symbolic presentations of a collection of elements (e.g., "6 dots" rather than "••••••"). We argue that even for symbolic presentations of quantitative information, discretizing a quantity with alternative unit specifications (e.g., chocolates vs. grams) may tap into an ancient, evolutionary reference system to enable evaluations of the magnitude of a collection of perceptual elements. In turn, this form of processing could have important implications for the ease with which people evaluate symbolic quantitative information and develop magnitude perceptions.

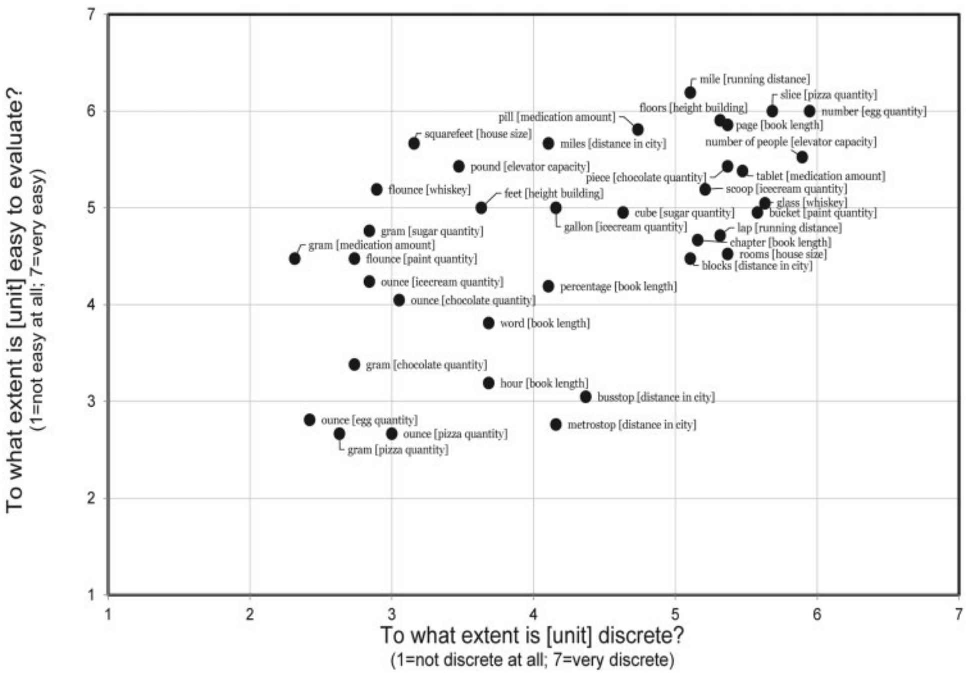
EVALUABILITY AND PERCEIVED DIFFERENCES

How do consumers evaluate numeric values specified in a symbolic format? For example, how do they assess the difference between 500 and 1,000 grams of chocolate or between 5 and 10 chocolates? Prior work has predominantly focused on how consumers rely on the magnitude of the number, so they perceive larger differences when the quantitative information is specified in larger numbers (Aribarg, Burson, and Larrick 2017; Burson et al. 2009; Monga and Bagchi 2012; Pandelaere et al. 2011). Pandelaere et al. (2011) asked participants to evaluate the difference between two warranties, specified in either months (84 vs. 108 months) or years (7 vs. 9 years), and find that people are more sensitive to different warranty values (i.e., they perceive a greater difference) when the expression uses larger numbers (i.e., a smaller unit, such as months) rather than smaller numbers (i.e., a larger unit, such as years).

Another body of research reveals how sensitivity to numeric values depends on the evaluability of the quantitative information (Hibbard et al. 2002; Hsee 2000; Hsee et al. 1999, 2005, 2009; Hsee and Zhang 2010; Slovic et al. 2007; Yeung and Soman 2005, 2007). We define evaluability as the ease with which a value or a comparison of values can be mapped onto an evaluation (for similar conceptualizations, see Hsee 2000; Hsee et al. 1999; Slovic et al. 2007; Yeung and Soman 2005). In general, greater evaluability improves value sensitivity, so the person may perceive larger differences between numeric values. For example, college students likely have abundant information about grade point averages (GPA), but little knowledge of the value of jade jewelry (expressed in carats). Because GPA is more evaluable than carats, students perceive greater differences between a GPA of 2.8 and a GPA of 3.8 than between a 10 carat jade and a 15 carat jade, even though GPA is expressed in smaller numbers.

FIGURE 1

RELATION BETWEEN DISCRETIZING UNITS AND EVALUABILITY OF PRODUCT ATTRIBUTES



NOTES.—We recruited 40 people (M_{age} = 32 years, 12 women) from amazon Mechanical Turk, in exchange for a small payment. Half of the sample rated all 37 units on discreteness, and the other half rated all 37 units on evaluability. Before providing the ratings on seven-point scales, in random order, participants read a short definition of either evaluability ("We want to know how a measurement unit makes it more or less easy to understand information. that is, does the unit make it easy to evaluate numerical information specified in that unit?") or discreteness ("We want to know how measurement units make you think about the number as a count of a collection of elements. That is, does the unit make you think of the numerical information as a collection of discrete units? For example, in the case of '3 sugar cubes,' to what extent does the number '3' refer to three individual, discrete elements (1 cube; 1 cube; 1 cube)? if it makes you think about individual, discrete units, then this unit scores high on discreteness. If not, the unit scores low on discreteness").

General Evaluability Theory specifies three conditions in which information might become more or less evaluable (Hsee and Zhang 2010). First, evaluability increases when consumers evaluate choice alternatives jointly rather than separately (i.e., mode, Hsee 1996). Because evaluators can use one number as a reference value to evaluate another number in a joint evaluation mode, but not in a separate evaluation mode, evaluability increases when numbers can be compared. Second, evaluability increases when people have acquired more information (e.g., about the distribution or how values map onto evaluation) about a target attribute (such as GPA or carat) through learning (i.e., knowledge, Hsee and Zhang 2010). Third, evaluability is greater if an attribute refers to an innate, stable reference system (i.e., nature, Hsee et al. 2009). For example, people generally lack an innate reference system to judge the value of a diamond, an interest rate, a refrigerator's energy consumption, the fuel economy of a car, and so on (Hsee et al. 2009; Hsee and Zhang 2010). But they can rely on an innate reference system for variables such as temperature, because even without learning or social comparison, they can gauge what temperature feels comfortable.

We argue that specifying information using more discretizing units may increase evaluability by tapping into humans' inherent reference systems for evaluating the magnitude of a collection of elements. Stated differently, expressing quantitative information in more discretizing units may provide consumers with diagnostic reference information that facilitates their effort to map numeric values onto evaluations. Some support for this contention comes from research showing that numerical information, such as conditional probabilities, is easier to evaluate if it is framed as a collection of elements (Gigerenzer and Edwards 2003; Gigerenzer and Hoffrage 1995). More direct evidence for the relationship between discretizing units and evaluability comes from a pilot study, in which we asked participants to rate different units (e.g., grams, chocolates) associated with different product attributes (e.g., chocolate quantity). The pilot study (figure 1) suggests a strong positive correlation between the extent to which a particular unit appears to discretize the quantity (i.e., the extent to which a quantity is represented as a collection of elements) and how easy it is to evaluate information expressed in that particular unit ($r = .57$, $p < .001$). Although this pilot study provides only correlational evidence, it suggests that information expressed in more discretizing units is easier to evaluate than information expressed in less discretizing units.

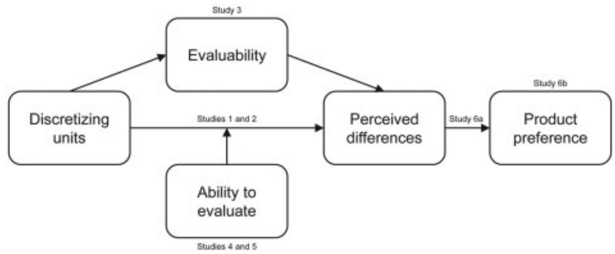
Therefore, we predict that specifying information in more discretizing units enhances evaluability and increases the perceived differences between products, relative to when the information is specified in less discretizing units. This increase in evaluability may weaken the influence of number magnitude on perceived differences (Pandelaere et al. 2011), and sometimes even dominate the number magnitude effect: when information is specified in a more discretizing unit with smaller numbers, it may lead to larger perceived differences than a specification in a less discretizing unit with larger numbers. Our reasoning is based on the observation that the number of elements in a collection may sometimes be a more powerful driver of magnitude judgments than symbolic number magnitude. For instance, Pelham et al. (1994) demonstrate that people judge the outcomes of addition problems with more elements (e.g., $3.6 + 5.3 + 6.5 + 10.2 + 2.1 + 3.7 + 1.8 + .8$) as larger than addition problems with fewer elements (e.g., $7.7 + 12.0 + 6.2 + 8.1$), even when the average symbolic number magnitude (e.g., 4.25 vs. 8.50) of the individual elements is larger in the latter case.

STUDY OVERVIEW

We test our hypotheses in a series of seven studies (see figure 2 for an overview). With studies 1 and 2, we establish evidence of the effect of discretizing units on perceived differences between products. In study 3, we suggest that enhanced evaluability mediates the effect of discretizing units on perceived differences and explore the role of related constructs, such as ease of visualization, concreteness, and vividness. Study 4 offers additional support for General Evaluability Theory, by demonstrating that the ability to evaluate (knowledge, Hsee and Zhang 2010) moderates the effect of discretizing units. Specifically, we measure the ability to process numerical concepts (i.e., numeracy). Study 5 further demonstrates that when attribute values are difficult to evaluate—even when specified in more discretizing units—the effect of discretizing units on perceived differences no longer holds. Finally, in studies 6a and 6b, we reveal that specifying information in more discretizing units can nudge consumers toward healthier alternatives. For all these studies, we excluded participants whose responses on the dependent variable were more than three standard deviations from the group mean. All exclusions are described for each study individually and they were determined before the statistical analyses. In the web appendix, we report all results without excluding outliers.

FIGURE 2

CONCEPTUAL MODEL



STUDY 1

In study 1, we seek to show that specifying quantitative information in a more discretizing unit (i.e., collection of elements) leads to larger perceived differences between products than specifying information in a less discretizing unit. We also aim to demonstrate that the effect of discretizing units may even dominate the effects of number magnitude (using smaller vs. larger unit sizes; Pandelaere et al. 2011). That is, we hypothesize that a difference specified in a more discretizing unit, but in smaller numbers, may be perceived as larger than one specified in a less discretizing unit, but in larger numbers.

Method

In total, 100 people ($M_{\text{age}} = 30$ years, 31 female) were recruited from Amazon Mechanical Turk (MTurk) in exchange for a small payment. All participants rated the difference in sugar content between two soft drinks; we manipulated the unit in which the sugar content of the two sodas was expressed (between-subjects): (1) larger numbers–less discretizing units ("a sugar pile of 10 grams" vs. "a sugar pile of 65 grams"), or (2) smaller numbers–more discretizing units ("2 sugar piles [of 5 grams each]" versus "13 sugar piles [of 5 grams each]"). Note that the magnitude of the numbers in the more discretizing unit condition is smaller than in the less discretizing conditions. An account based on number magnitude would anticipate that the difference is perceived to be larger for the unit associated with the largest numbers. However, we predict that the difference specified in more discretizing units might be perceived as larger.

A pretest ($N = 49$) confirmed that piles are perceived as more discretizing ($M = 4.78$, $SD = 1.95$) than grams

($M = 3.73$, SD = 2.11; $t(48) = 2.86$, $p < .01$), measured with the item, “To what extent do you think about sugar quantity in [unit] as a collection of individual units?” (1 = not at all, 7 = very much). Because the perceived magnitude difference may be affected by familiarity (i.e., more familiar units might increase perceived differences; for a discussion of how familiarity leads people to categorize at a finer level, see Lembregts and Pandelaere 2013), we also asked participants in the same pretest to rate their familiarity with the units (“How familiar does [unit] feel to you?”; 1 = not familiar at all, 7 = very familiar). Results showed that, if anything, the more discretizing unit (i.e., piles) was less familiar than the less discretizing unit (i.e., grams), ($M_{\text{piles}} = 3.49$, SD = 2.04 vs. $M_{\text{grams}} = 5.41$, SD = 1.73; $t(48) = -4.44$, $p < .001$), thus providing a conservative test of our hypothesis.

All participants judged the perceived difference between the sugar content of two sodas by positioning a slider along an unnumbered scale, with semantic endpoints labeled “very small difference” and “very large difference.” Numerical values were not displayed along the scale, but we later assigned values of 0 to 100. Two participants were omitted because their responses on the dependent variable were more than three standard deviations from the mean.

Results and Discussion

An independent samples t-test revealed that specifying information in the more discretizing unit ($M = 87.96$, SD = 15.05) results in larger perceived differences than less discretizing units, despite the greater number magnitude of the latter ($M = 78.80$, SD = 20.95; $t(96) = -2.48$, $p < .05$, Cohen’s $\delta = .50$).

In sum, a difference specified in a more discretizing unit (piles) appears larger than a difference specified in a less discretizing unit (grams), even if the former is expressed in a less familiar unit using relatively smaller numbers.

STUDY 2

Study 2 has three main goals. First, we hope to demonstrate the generalizability of the proposed effect by exploring it in two different domains (meat consumption and amount of work) and using different sets of numbers. Second, we aim to parse the effects due to the different numerical combinations from those due to discretization. Therefore, we keep numerical information constant across discretization conditions and also test whether perceptions of more versus less discretizing units vary according to whether they are multiplicative (“How many times does 2 fit in 13?”) or subtracted (“What is 13 minus 2?”) differences. Third, we aim to further explore how the unit affects perceived differences between quantities through number magnitude (Pandelaere et al. 2011) and level of discretizing. In the prior study, we found that discretizing dominated number magnitude. Evidently, we do not expect this to be always the case; the relative strength of both effects probably depends on number magnitude and perceived level of discretizing. In the current study, we orthogonally manipulate both factors while keeping the overall quantity constant across all conditions, thereby exploring whether the two factors operate independently or interact.

Method

We recruited 203 people ($M_{\text{age}} = 35$ years, 104 female) from MTurk, in exchange for a small payment. This experiment employed a 2 (discretizing: more vs. less) × 2 (number magnitude: smaller vs. larger) × 2 (replicate: meat vs. work) mixed design, with the first two factors manipulated between-subjects and the latter within-subjects.

In the first scenario, participants compared two families’ weekly meat consumption. We expressed identical quantities of meat in pounds (less discretizing) or portions (more discretizing) for the smaller numbers conditions, and in ounces (less discretizing) or balls (more discretizing) in the larger number conditions (see table 1 for stimuli). In the second replicate scenario, participants compared the weekly amount of work of two consultants (with equal capabilities and both working 8 hours a day) who offer individual fiscal advice to teams of employees (1 team = 8 employees and 1 employee = 1 hour of advice) in a company. We expressed identical quantities of work in days (less discretizing) or teams (more discretizing) for the smaller numbers conditions, and in hours (less discretizing) or employees (more discretizing) in the larger number conditions (see table 1). Note that the total quantity is held constant within each scenario and that the total quantity is simply divided in more elements/units within the larger numbers conditions.

A pretest using the same measure as in study 1 ($N = 103$; three participants failed to complete the “employees” scenario) confirmed that portions were rated as more discretizing ($M = 5.02$, SD = 1.61) than pounds ($M = 3.95$, SD = 1.94; $t(102) = 4.60$, $p < .001$) and that balls were rated as more discretizing ($M = 5.25$, SD = 1.47) than ounces ($M = 3.60$, SD = 1.67; $t(102) = 6.58$, $p < .001$). Furthermore, for the work scenario, teams were rated as marginally more discretizing ($M = 4.79$, SD = 1.61) than days ($M = 4.35$, SD = 1.74; $t(102) = 1.91$, $p = .06$) and employees were rated as more discretizing ($M = 5.06$, SD = 1.57) than hours ($M = 4.26$, SD = 1.73; $t(99) = 4.09$, $p < .001$).

Next, participants judged the difference between the two families’ weekly meat consumption and the difference between the two consultants’ weekly amount of work by positioning a slider along an unnumbered scale, with semantic endpoints labeled “very small difference” and

TABLE 1

STIMULI AND RESULTS: STUDY 2

	Smaller numbers		Larger numbers	
	Less discretizing	More discretizing	Less discretizing	More discretizing
Meat quantity	*"1 versus 6 pounds"*	*"1 versus 6 portions"*	*"16 versus 96 ounces"*	*"16 versus 96 balls"*
Difference rating	$M = 72.33$; SD = 24.97	$M = 80.70$; SD = 18.91	$M = 82.43$; SD = 17.41	$M = 86.90$; SD = 15.01
Work quantity	*"1 versus 6 days"*	*"1 versus 6 teams"*	*"8 versus 48 hours"*	*"8 versus 48 employees"*
Difference rating	$M = 62.67$; SD = 25.18	$M = 72.70$; SD = 24.39	$M = 79.24$; SD = 17.99	$M = 81.20$; SD = 19.89

"very large difference" (one slider for each scenario). Later, we assigned values from 0 to 100 to the scale. Finally, at the end of the survey, we inquired about how participants assessed the difference between quantities by asking, "When assessing the differences between the two quantities, did you: A) look at the difference between the two numbers (e.g., difference between 1 vs. 6); B) look at how many times one number is more than the other (e.g., 1 fits X times in 6); or C) use an alternative strategy?"

Arguably, in the work scenario, the discretizing unit (time vs. person) may also yield various inferences in terms of, for example, switching costs or other costs. To minimize these effects, we communicated information about both units before the focal difference judgment. For example, in the employees condition, participants were also provided with the corresponding time unit (i.e., 1 employee = 1 hour; 1 team = 1 day), but the target difference judgment task was framed in the focal unit.

Results

In a mixed ANOVA, number magnitude and discretizing unit were between-subjects factors, and scenario was a within-subject factor. The analysis revealed a main effect of scenario ($F(1, 199) = 18.67$, $p < .001$, partial $\eta^2 = .09$), a main effect of number magnitude ($F(1, 199) = 17.36$, $p < .001$, partial $\eta^2 = .08$), and a main effect of discretizing units ($F(1, 199) = 6.26$ $p = .01$, partial $\eta^2 = .03$), but no significant interaction between number magnitude and discretizing units ($F(1, 199) = 1.45$, $p = .23$, partial $\eta^2 < .01$). No other effects were significant (all $ps > .16$). Across number magnitude and scenarios, a difference specified in more discretizing units ($M = 80.49$, SD = 16.49) was perceived as larger than one specified in less discretizing units ($M = 74.29$, SD = 19.99). As expected, a difference specified in a unit associated with larger numbers was perceived as larger ($M = 82.38$, SD = 14.56) than one associated with smaller numbers ($M = 71.87$, $SD = 20.84$). Although the interaction effect between number magnitude and discretizing was not significant (and contrast testing thus not appropriate), a closer inspection of the results yields two interesting interpretations (see table 1). First, the effect of number magnitude seems smaller when units are more discretizing. For instance, a "16 versus 96" difference appears larger than a "1 versus 6" difference, but this number magnitude effect seems weaker when more discretizing units are employed, an interpretation more or less in line with the conclusion of study 1. Second, the effect of discretizing units seems smaller when number magnitude is larger, a possibility we build upon in study 5.

With respect to the participants' computation strategies, we did not find any differences between the more versus less discretizing units in terms of their use of a subtraction (more: 56%, less: 61%), multiplication (more: 38%, less: 34%), or other (more: 6%, less: 5%; $\chi^2(2, N = 203) = .72$, $p = .70$) strategy.

Discussion

Study 2 provides further support for the effect of discretizing units by demonstrating robustness across different domains and numbers. Because the effect of discretizing units occurs even when number magnitude is held constant, interpretations based on different numbers triggering different computational strategies appear unlikely. While study 1 seems to suggest that effects of discretizing units can dominate effects of number magnitude, the current study demonstrates that effects of number magnitude and discretizing units may occur simultaneously (see study 5 for further investigation of how increasing number magnitude, by changing total quantities, moderates the effect of discretizing units). Both studies demonstrate that representing symbolic quantities as a collection of elements generates an effect independent from number magnitude, and thus that the "numerosity" concept needs to be disambiguated.

STUDY 3

Study 3 has two goals. First, to control for any differences between existing units (e.g., pounds vs. portions), we manipulate the representation of quantity as a collection of elements directly by using an artificial unit. Second, we want to provide evidence for evaluability (i.e., the ease with which a value or a comparison of values can be mapped onto evaluation) as the underlying process of discretizing units. We will also explore the role of related processes such as concreteness, ease of visualization, and vividness. If specifying information in more discretizing units taps into an inherent reference system, representing a quantity as a collection of elements may also render it more concrete, easier to visualize, and more vivid, even for artificial and unfamiliar units.

Method

Participants ($N = 100$; $M_{\text{age}} = 38$, 57 females) were recruited from MTurk in exchange for a small payment. All participants were introduced to "RD," a novel distance measurement unit. We indicated that the unit had no clear relation to the distance units they were familiar with. As a consequence, participants had no idea what the numeric values represented (i.e., whether they represented small or large distances). In the more discretizing unit condition, participants were asked to represent distance as a collection of individual distances of "1 RD," whereas in the less discretizing unit condition, participants were asked to represent distance as a continuous, uninterrupted distance in RD. We provided them with a few examples (e.g., more discretizing: "a distance of 2 RD becomes a distance of 2 individual '1 RD' distances"; less discretizing: "a distance of 2 RD becomes a distance of one uninterrupted and continuous distance of 2 RD").

Participants completed a manipulation check ("To what extent do you think about distance in RD as a collection of individual units?" 1 = not at all, 7 = very much) and judged two distances, of 2 RD and 13 RD, individually (though on the same page) by positioning a slider along an unnumbered scale with semantic endpoints labeled 1 = "not a long distance" and 10 = "very long distance." To create an index of the magnitude of the perceived difference, we subtracted the perceived distance of 2 RD from the perceived distance of 13 RD (for the results using the individual scores and their interpretation, see the web appendix). This different, indirect method to measure the dependent variable (cf. studies 1 and 2) eliminates the possibility that our results are due to a methodological artifact or depend on a particular measurement method. One participant who indicated a negative difference was excluded. The participants also indicated the extent to which it was easy to evaluate the distances on a seven-point scale (1 = not at all easy, 7 = very easy). For both the individual unit and the distance, they also rated the level of vividness ("How vivid was the individual unit (1 RD) / distance in RD?" 1 = not at all vivid; 7 = very vivid), ease of visualization ("How easy was it to visualize the individual unit (1 RD) / distances in RD?" 1 = not at all easy, 7 = very easy), concreteness ("How concrete was the individual unit (1 RD) / distances in RD?" 1 = not at all concrete, 7 = very concrete), and perceived familiarity ("How familiar was the individual unit (1 RD) / distances in RD?" 1 = not at all familiar, 7 = very familiar).

Results

Manipulation Check. The results of the manipulation check showed that our manipulation was successful: participants in the more discretizing unit condition were more likely to indicate thinking about distance as a collection of elements than participants in the less discretizing unit condition ($M_{\text{more}} = 5.49$, SD = 1.24 vs. $M_{\text{less}} = 3.30$, SD = 1.97; $t(97) = -6.59$, $p < .001$, Cohen's $\delta = 1.32$).

Perceived Differences, Evaluability, and Related Variables. Consistent with studies 1 and 2, the difference in distance appeared larger when RD was specified as a more discretizing unit ($M = 4.47$, SD = 1.78) than as a less discretizing unit ($M = 3.18$, SD = 2.64; $t(97) = -2.84$, $p < .01$, Cohen's $\delta = .57$). Participants also indicated that it was easier to evaluate distance specified in a more discretizing unit ($M = 4.73$, SD = 1.59) than in a less discretizing unit ($M = 3.70$, SD = 1.95; $(97) = -2.89$, $p < .01$, Cohen's $\delta = .58$). In addition, representing distance as a collection of elements not only affected evaluability, but also increased vividness, ease of visualization, and concreteness, and even affected perceived familiarity marginally (see table 2, middle columns).

Mediation Analyses. We first examined whether evaluability mediated the effect of unit type on perceived differences and ran a mediation analysis with unit type as the independent variable (less discretizing = 0; more discretizing = 1), evaluability as the mediator, and perceived difference as the dependent variable. We used bias-corrected bootstrapping (10,000 bootstrap samples) to generate a 95% confidence interval around the indirect effect of unit type. The analysis revealed an indirect effect with a confidence interval excluding zero, $a \times b = .43$, SE = .20; CI (.12, .95), suggesting that enhanced evaluability mediates the effect of unit type on perceived differences. When we controlled for unit type (less vs. more discretizing), evaluability increased perceived differences ($\beta = .41$, SE = .12, $t(96) = 3.40$, $p < .01$). The direct effect of unit type on perceived differences became marginally significant ($\beta = .86$, SE = .45, $t(96) = 1.92$, $p = .06$).

As representing distance as a collection of elements also increased vividness, ease of visualization, and concreteness and even affected perceived familiarity marginally, we also tested whether each of these variables separately mediated the effect of unit type on perceived differences. None of these variables did (see table 2, right column). As expected, these dimensions correlate significantly with evaluability (see table 3), indicating that these dimensions are hard to distinguish empirically. A factor

TABLE 2

EFFECT OF UNIT TYPE ON VIVIDNESS, CONCRETENESS, EASE OF VISUALIZATION, AND FAMILIARITY, AND MEDIATION ANALYSES: STUDY 3

	Less discretizing *"2RD versus 13RD"*	**More discretizing** *"2 × 1RD versus 13 × 1RD"*		Mediation of perceived difference in distance
Perceived difference in distance	3.18 (SD = 2.64)	4.47 (SD = 1.78)	$p < .01$	
Evaluability	3.70 (SD = 1.95)	4.73 (SD = 1.59)	$p < .01$	a×b = .43, SE = .20; CI (.12, .95)
Vividness distance	3.82 (SD = 1.83)	4.65 (SD = 1.55)	$p < .05$	a×b = .11, SE = .16; CI (–.10, .55)
Vividness unit	3.46 (SD = 1.75)	4.63 (SD = 1.75)	$p < .01$	a×b = .04, SE = .18; CI (–.28, .44)
Concreteness distance	3.52 (SD = 1.90)	4.78 (SD = 1.52)	$p < .001$	a×b = .08, SE = .21; CI (–.28, .57)
Concreteness unit	3.30 (SD = 1.89)	4.71 (SD = 1.72)	$p < .001$	a×b = .06, SE = .22; CI (–.35, .51)
Ease of visualization distance	3.56 (SD = 1.83)	4.57 (SD = 1.76)	$p < .01$	a×b = .05, SE = .17; CI (–.20, .55)
Ease of visualization unit	3.18 (SD = 1.76)	4.55 (SD = 1.89)	$p < .001$	a×b = .08, SE = .22; CI (–.27, .62)
Familiarity distance	2.68 (SD = 1.88)	3.37 (SD = 2.03)	$p < .1$	a×b = –.01, SE = .10; CI (–.23, .17)
Familiarity unit	2.50 (SD = 1.94)	3.22 (SD = 2.07)	$p < .1$	a×b = –.05, SE = .11; CI (–.34, .12)
One-factor solution without evaluability				a×b = .06, SE = .21; CI (–.29, .55)
One-factor solution with evaluability				a×b = .13, SE = .22; CI (–.21, .66)

TABLE 3

CORRELATIONS BETWEEN EVALUABILITY, VIVIDNESS, CONCRETENESS, EASE OF VISUALISATION, AND FAMILIARITY: STUDY 3

Variables	1	2	3	4	5	6	7	8	9	10
1. Perceived difference in distance	—									
2. Evaluability	.36**	—								
3. Vividness distance	.14	.62**	—							
4. Vividness unit	.08	.54**	.77**	—						
5. Concreteness distance	.14	.65**	.79**	.67**	—					
6. Concreteness unit	.11	.56**	.63**	.79**	.82**	—				
7. Ease of visualization distance	.10	.67**	.79**	.64**	.84**	.71**	—			
8. Ease of visualization unit	.12	.58**	.65**	.81**	.74**	.84**	.82**	—		
9. Familiarity distance	–.002	.43**	.54**	.54**	.46**	.50**	.48**	.52**	—	
10. Familiarity unit	–.04	.30**	.45**	.53**	.40**	.48**	.41**	.55**	.85**	—

NOTE.—**: correlations are significant at the $p < .01$ level; all other correlations $p > .05$.

analysis confirmed the strong interrelationships between these dimensions, as a single factor solution with and even without evaluability explained the large majority of the total variance (factor solution without evaluability: 69%; factor solution with evaluability: 67%). However, these factor solutions did not statistically mediate the effect of unit type on perceived differences (see table 2, bottom rows).

The lack of empirical distinctiveness between the different constructs (see table 3) makes other mediation analyses quite problematic. Statistical models in which evaluability is paired with every other explanatory variable (e.g., models testing for serial or parallel mediation) or models including all explanatory variables simultaneously lead to nonmeaningful results due to severe multicollinearity issues (Pieters 2017). Because the mediation analyses reported in table 2 merely provide correlational evidence, we provide stronger and further support for an account in terms of evaluability using moderation designs in the subsequent studies.

Discussion

Study 3 provides further support for the effect of discretizing units on perceived differences. By using an artificial unit, this study substantially reduces the possibility of confounds due to inherent differences between existing units. In addition, representing a quantity as a collection of elements enhances evaluability and increases perceived differences between quantities as a consequence. Representing information as a collection of elements also enhances other important aspects of information processing (such as concreteness, vividness, visualization, and—to a lesser extent—familiarity), but these variables seem less strongly related to perceived differences between quantities (see table 3).

STUDY 4

The main goal of study 4 is to provide an additional test of an account in terms of enhanced evaluability. Specifying information using discretizing units should increase evaluability by tapping into humans' inherent reference system for evaluating a collection of elements (nature, Hsee et al. 2009; Hsee and Zhang 2010). General Evaluability Theory also specifies that other factors might enhance evaluability, such as learned evaluability (knowledge, Hsee and Zhang 2010). For example, diamond traders have extensive knowledge about diamond sizes and are thus more sensitive to differences in diamond size than ordinary consumers. In this study, we predict that the ability to evaluate moderates the effect of discretizing units on perceived differences. By measuring the ability to evaluate quantitative information, we show that when the ability to evaluate is already high (due to higher cognitive abilities), the effect of discretizing units weakens.

We examine an individual disposition that relates to the ability to process and evaluate numerical concepts (i.e., numeracy; Peters et al. 2006). In line with General Evaluability Theory, more numerically proficient consumers (i.e., those with a higher ability to evaluate) are more sensitive to numeric differences than less numerically proficient consumers (i.e., those with a lower ability to evaluate; Peters et al. 2006). As a consequence, when quantitative information is less evaluable—because it is specified in less discretizing units—people with a higher ability to process, manipulate, transform, and use numerical information (i.e., higher numeracy) may perceive greater differences than those with a lower ability (i.e., lower numeracy). However, this difference between more and less numerically proficient consumers might attenuate when quantities are represented in a more evaluable format, such as a collection of elements, because specifying quantitative information in discretizing units enhances its evaluability.

Method

In exchange for a small payment, 133 students (M_{age} = 23 years, 75 female) from a large European university were recruited for a 50 minute series of unrelated lab studies, including the current one. Type of unit (more vs. less discretizing) was manipulated between-subjects. At the beginning of the lab session, participants completed an abbreviated numeracy scale (Weller et al. 2013) with eight items, including, "Imagine that we roll a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up as an even number?" and "If the chance of getting a disease is 10%, how many people would be expected to get the disease out of 1,000?" After completing this task, they completed a range of unrelated tasks. At the end of the session, the participants had to judge a difference in the duration of two lab sessions on the same, unlabeled slider as in study 1 (0 = very small difference; 100 = very large difference). In the less discretizing unit condition, session A was described as consisting of "2 minutes of doing tasks" and session B as consisting of "13 minutes of doing tasks." In the more discretizing unit condition, the former was described as consisting of "doing 2 tasks of one minute each" and the latter as consisting of "doing 13 tasks of one minute each." A pretest ($N = 51$) confirmed that tasks were rated as a more discretizing unit ($M = 5.08$, SD = 1.70) than minutes ($M = 4.06$, SD = 2.18; $t(50) = 2.73$, $p < .01$).

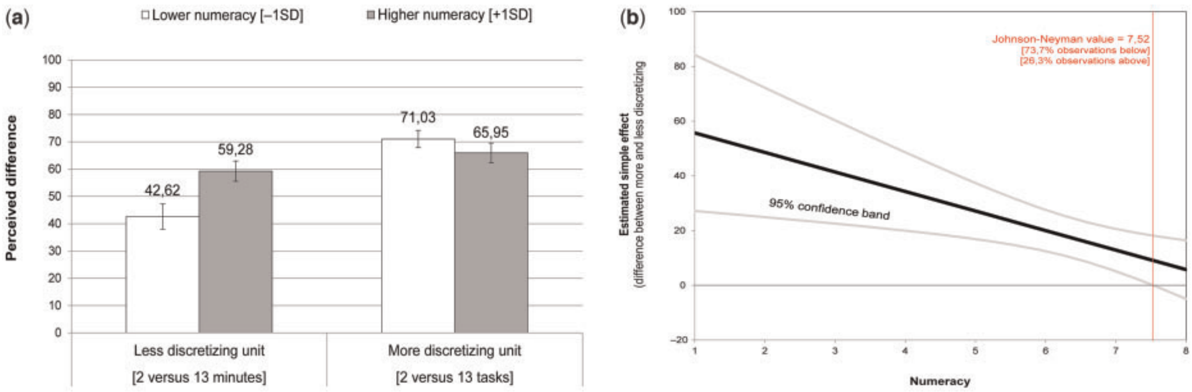
Results

We calculated the number of correct answers on the numeracy scale for every participant (min = 1; max = 8; mean = 6.35; SD = 1.52), then regressed the perceived difference ratings on the type of unit (0 = less discretizing, 1 = more discretizing) and mean-centered numeracy scores (see figure 3). We observed significant main effects of numeracy ($\beta = 5.47$, $t(129) = 2.56$, $p = .01$) and discretizing units ($\beta = 17.54$, $t(129) = 4.77$, $p < .001$), but these were qualified by the expected interaction between discretizing units and numeracy scores ($\beta = -7.14$, $t(129) = -2.76$, $p < .01$). We hypothesize that when information is less evaluable—because it is specified in less discretizing units—participants with more knowledge (i.e., higher numeracy) perceive greater differences than those with less knowledge (i.e., lower numeracy), which would be consistent with General Evaluability Theory. Indeed, in the less discretizing unit conditions, people with higher numeracy scores (1 SD above the mean) perceived larger differences than those with lower numeracy scores (1 SD below the mean) ($\beta = 5.47$, $t(129) = 2.56$, $p < .05$; figure 3, panel A). However, the difference in magnitude perceptions between those with lower (–1 SD) and higher (+1 SD) numeracy scores disappeared when the information appeared in more discretizing units—that is, when it was inherently more evaluable ($\beta = -1.67$, $t(129) = -1.14$, $p = .26$).

Our theorizing predicts that this latter finding would be driven by participants with less knowledge (i.e., lower numeracy scores), rather than those with more knowledge (i.e., higher numeracy scores), because discretizing should have the greatest impact on those with less knowledge. Confirming this hypothesis, participants with lower numeracy scores were most affected by the discretizing manipulation: these participants perceive larger differences between two quantities when they are specified in more discretizing units than when they are specified in less discretizing units ($\beta = 28.41$, $t(129) = 5.11$, $p < .001$). In contrast, discretizing has no impact on consumers with higher numeracy scores ($\beta = 6.68$, $t(129) = 1.28$, $p = .20$). This result is further highlighted by a floodlight analysis (figure 3, panel B), which indicates that specifying information in more discretizing units increases perceived differences between quantities for the majority of our sample: only those with a maximum numeracy score (8/8 correct answers) do not significantly benefit from information that is specified

FIGURE 3

PERCEIVED DIFFERENCE AS A FUNCTION OF UNIT TYPE AND NUMERACY: STUDY 4



NOTE.—Error bars represent standard errors.

in a more evaluable format (i.e., in a more discretizing unit).

Discussion

Study 4 provides support for an account in terms of evaluability, because it highlights the role of the ability to evaluate quantitative information. More knowledge about numerical information, due to higher numerical proficiency, increases perceived differences between products if information is specified in less discretizing units (i.e., is inherently less evaluable), but much less so when it is specified in more discretizing units (i.e., is inherently more evaluable). Study 4 not only provides empirical support for an explanation in terms of evaluability, but also offers substantive implications for consumer welfare. Specifying information in more discretizing units helps consumers who are less numerically proficient. In the web appendix, we report an additional study in which we manipulate, rather than measure, the ability to evaluate. The study reported in the web appendix further corroborates the results of study 4 by showing that discretizing units increase perceived differences, especially among people with a lower ability to evaluate numerical information.

STUDY 5

We seek to provide further support for an account based on enhanced evaluability by demonstrating that the ancient reference system allows people to evaluate the magnitude of a collection of elements only up to a certain point (i.e., when the collection is relatively small). We draw from the well-documented finding that the mapping of symbolic numbers to internal magnitude representations is inexact (Dehaene 2003; Dehaene, Dehaene-Lambertz, and Cohen 1998; Parkman 1971; Shepard, Kilpatric, and Cunningham 1975; see also Chesney and Matthews 2013; Rips 2013). For instance, according to the magnitude effect, it is more difficult to discriminate between two larger number symbols, compared with two smaller numbers, when the absolute difference between the two number symbols is held constant (e.g., 102 vs. 113 is more difficult to evaluate than 2 vs. 13; Parkman 1971).

Similar limits and constraints have been documented in the perceptual numerosity literature. For instance, when the absolute difference is the same, humans experience more difficulty distinguishing between two larger (relative to two smaller) collections of perceptual elements (e.g., 27 vs. 30 dots is more difficult to evaluate than 5 vs. 8 dots; Dehaene et al. 1998; van Oeffelen and Vos 1982), suggesting a magnitude effect for perceptual stimuli. These findings indicate that the ancient reference system responsible for the processing of collections of elements is also constrained by certain processing limits, and that larger collections of elements are probably less evaluable than smaller collections.

The goal of study 5 is to document the limits of the ancient reference system by exploring effects of discretizing units when people consider smaller (i.e., more evaluable) versus larger (i.e., less evaluable) collections of elements. The current study differs from our earlier studies manipulating number magnitude (studies 1 and 2), because we manipulate number magnitude by changing quantity instead of unit size. In prior studies, we increased number magnitude by decreasing unit size, keeping total quantity constant. In the current study, we increase number magnitude by increasing total quantity, keeping unit size constant. Adding the same quantity to each option (e.g., $2 + 100$ vs. $13 + 100$), and thus keeping the absolute difference constant across smaller and larger number magnitude conditions (e.g., $|13–2| = |113–102|$), increases the likelihood of a magnitude effect compared to increasing number magnitude through decreasing unit size (see study 2). Taken together, we predict that the limits of the ancient reference system imply that larger collections of elements (102 vs. 113) are less evaluable compared to smaller collections of elements (2 vs. 13), thereby attenuating the effect of discretizing units on perceived differences.

Method

In total, 202 people ($M_{age} = 38$ years, 120 female) were recruited from MTurk in exchange for a small payment. This experiment employed a 2×2 between-subjects design in which type of unit (more vs. less discretizing) and quantity (smaller vs. larger) were manipulated.

All participants compared the amount of work of two Human Intelligence Tasks (HITs). We told them that both HITs required them to solve a number of easy puzzles within a certain time period and that each puzzle would take one minute to solve. After one minute, a new puzzle would be offered. Next, we randomly assigned participants to the between-subjects conditions in which quantity and discretizing were manipulated.

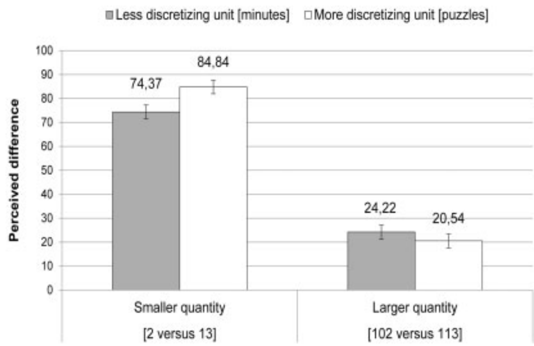
In the smaller quantity conditions, participants evaluated "a HIT of 2 minutes" versus "a HIT of 13 minutes" (less discretizing) or "a HIT of solving 2 puzzles" versus "a task of solving 13 puzzles" (more discretizing). In the larger quantity conditions, participants evaluated "a HIT of 102 minutes" versus "a HIT of 113 minutes" (less discretizing) or "a HIT of solving 102 puzzles" versus "a HIT of solving 113 puzzles" (more discretizing). Note that, to limit the possibility of confounds (e.g., higher perceived switching costs when participants were presented with puzzles rather than minutes), we mentioned both less and more discretizing units to all participants (e.g., 1 puzzle = 1 minute), before they judged the difference specified in the focal unit.

A pretest ($N = 51$) confirmed that puzzles were regarded as more discretizing ($M = 5.67$, $SD = 1.26$) than minutes ($M = 4.22$, $SD = 1.92$; $t(50) = 4.61$, $p < .001$; "To what extent do you think about the amount of work required by this HIT described in [unit] as a collection of individual units?"; 1 = not at all, 7 = very much).

All participants judged the perceived difference between the two HITs by positioning a slider along an unnumbered scale with semantic endpoints labeled "very small difference" and "very large difference" (with values ranging from 1 to 100). Three participants were omitted because their responses on the dependent variable were more than three standard deviations from the group mean.

FIGURE 4

PERCEIVED DIFFERENCES AS A FUNCTION OF UNIT TYPE AND QUANTITY: STUDY 5



NOTE.—Error bars represent standard errors.

Results

The 2 (type of unit: more vs. less discretizing) $\times$ (quantity: smaller vs. larger) ANOVA of participants' difference perceptions yielded a significant main effect of quantity ($F(1, 195) = 382.46$, $p < .001$, partial $\eta^2 = .66$), a nonsignificant main effect of type of unit ($F(1, 195) = 1.35$, $p = .25$, partial $\eta^2 = .01$), and a significant interaction ($F(1, 195) = 5.85$, $p < .05$, partial $\eta^2 = .03$; see figure 4). Consistent with the magnitude effect, we found that the same absolute difference between smaller quantities ($M = 79.45$, $SD = 20.19$) was rated as larger than between larger quantities ($M = 22.42$, $SD = 21.62$). More relevant to the current investigation, when participants were presented with smaller quantities, the difference between quantities was perceived as larger when it was specified in more discretizing units ($M = 84.84$, $SD = 15.22$) than when it was specified in less discretizing units ($M = 74.37$, $SD = 22.95$; $F(1, 195) = 6.50$, $p = .01$, Cohen's $\delta = .54$). However, when participants were presented with larger quantities, this difference disappeared ($M_{less\ discretizing} = 24.22$, $SD = 21.99$ vs. $M_{more\ discretizing} = 20.54$, $SD = 21.29$, $F(1, 195) = .78$, $p = .38$, Cohen's $\delta = .17$).

Discussion

When quantitative information refers to smaller quantities, a more discretizing unit increases perceived differences relative to a less discretizing unit. However, when quantitative information refers to larger quantities, evaluability is lower, because it is also more difficult to evaluate a difference between larger collections of elements (Dehaene et al. 1998; van Oeffelen and Vos 1982), and the discretizing unit effect disappears.

STUDIES 6A AND 6B

Our prior studies examine how specifying information in a discretizing unit increases perceived differences between products. In studies 6a and 6b, we test how this effect might influence consumers' preferences. If consumers perceive greater differences for an attribute specified in more discretizing units, they will probably prefer an alternative with a superior value on that attribute. In the next two studies, we seek to demonstrate whether specifying information in discretizing units nudges consumers toward a relatively healthy alternative, because they become more sensitive to quantitative health information, such as sugar content. In study 6a, we explore whether product preferences are mediated by the perceived difference between attribute values, and then, in study 6b, we replicate the effect in a real choice setting with actual product choices. With this latter study, we aim to show that the effect holds even when choices are consequential for consumers.

Study 6a

Method. In total, 115 students ($M_{age} = 23$ years, 90 female) participated in an online study in exchange for a chance of winning a gift certificate. They all read a description of two sodas that reported their sugar contents and tastiness ratings ("rating of how tasty each soda is according to a panel of consumers"). We manipulated the unit in which sugar content was presented (between-subjects): either in a less discretizing unit (10 vs. 65 grams) or a more discretizing unit (2 vs. 13 cubes). A pretest ($N = 51$) confirmed that cubes were regarded as more discretizing ($M = 5.65$, $SD = 1.39$) than grams ($M = 3.24$, $SD = 1.91$; $t(50) = 7.46$, $p < .001$). The tastiness rating was lower for the less sugary soda (soda A: 5.1/10) relative to the more sugary soda (soda B: 9.2/10) and remained constant across unit type conditions.

After reading the description, participants indicated their preference on a seven-point scale (1 = strongly prefer soda A, 7 = strongly prefer soda B). Finally, they rated the perceived differences between sugar quantities and perceived differences between tastiness ratings on the same 100-point slider.

Results. An independent sample *t*-test reveals that participants have a stronger preference for the less sugary, less tasty alternative when its sugar content appears in a more discretizing unit ($M_{\text{more discretizing}} = 3.97$, $SD = 1.86$; $M_{\text{less discretizing}} = 4.75$, $SD = 1.58$; $t(113) = -2.44$, $p < .05$, Cohen's $\delta = .46$). Consistent with our prior results, the attribute difference appears greater when the sugar content is specified in a more discretizing unit ($M = 82.88$, $SD = 13.10$) compared with a less discretizing unit ($M = 76.02$, $SD = 16.06$; $t(113) = 2.52$, $p < .05$, Cohen's $\delta = .47$). A bootstrap mediation analysis also shows that the perceived difference in sugar content mediates the relationship between discretizing units and preference ($a \times b = .24$, $SE = .12$; 95% CI [.06, .53]). Because unit type for tastiness ratings (i.e., 5.1/10 vs. 9.2/10) was constant across discretization conditions, specifying sugar content in more versus less discretizing units did not affect perceived differences in tastiness between the less and more sugary drink ($M_{\text{more discretizing}} = 68.44$, $SD = 18.66$; $M_{\text{less discretizing}} = 70.59$, $SD = 19.94$; $t(113) = -.60$, $p = .55$, Cohen's $\delta = .11$).

Study 6b

Method. A research assistant recruited 266 students ($M_{age} = 22$ years, 145 female; two participants failed to disclose their age) on the campus of a large Western European university. Students first completed sociodemographic questions and then were presented with a choice between two sodas. This experiment had an identical design and setup as study 6a, except that it involved a consequential choice, such that participants actually received the soda of their choice, and that the sugar quantities were slightly different (1 vs. 11 cubes or 5 vs. 55 grams; matched to actual sugar content).

Results. When sugar quantity appeared in a more discretizing unit, participants opted marginally significantly more for the less sugary alternative (73%) than when the information was specified in a less discretizing unit (63%; $\chi^2(1, N = 266) = 3.06$, $p = .08$).

Discussion

Specifying information in more discretizing units may have important consequences for consumers. Expressing quantitative information about an unhealthy attribute in a more discretizing unit nudges consumers to the healthier option (study 6b), and this preference is mediated by perceived differences between the more and less healthy products (6a).

GENERAL DISCUSSION

Extending literature into the effects of number magnitude on judgments and decision making (Burson et al. 2009; Monga and Bagchi 2012; Pandelaere et al. 2011), this set of studies reveals the effects of specifying quantitative information as a collection of elements. Quantitative information expressed in more discretizing units—stimulating a representation in terms of a collection of elements—increases both evaluability and the perceived differences between alternatives. We demonstrated that a more discretizing unit increases perceived differences between sodas in terms of sugar content (study 1) and between meat consumption and amount of work (study 2). In study 3, we demonstrated that enhanced evaluability mediates the effect of discretizing units on perceived differences and explored the role of related processes, such as ease of visualization, concreteness, and vividness. Further studies offered more empirical support for General Evaluability Theory by showing that the ability to evaluate numerical concepts moderates the effect of discretizing units. Specifically, the ability to process numerical information enhances perceived differences, but less so if the information is provided in more discretizing units. Information in more discretizing units makes quantity information more evaluable, and being more numerically proficient no longer helps consumers to differentiate between choice alternatives. Study 5 demonstrated that when quantities are difficult to evaluate (i.e., larger quantities), even if they are specified in more discretizing units, the discretizing unit effect disappears. Finally, in two studies (6a and 6b), we showed how specifying information in more discretizing units can nudge consumers to healthier alternatives.

Our studies contribute to two main streams of research. First, we provide a more nuanced perspective on the notion of numerosity, typically characterized as "a property of a stimulus that is defined by the number of discriminable elements it contains" (Brannon and Terrace 1998, 746). Numerosity traditionally refers to the magnitude of a collection of perceptual elements (e.g., "••••••" is more numerous than "•••"; Ginsburg 1976; Krishna and Raghubir 1997; Lechelt 1975; Palat et al. 2014; Pelham et al. 1994; Piazza and Izard 2009; Piazza et al. 2007; Posey and James 1976; Strauss and Curtis 1981), but marketing scholars also have started to adopt this label to describe the magnitude of a symbolic number (6 is more numerous than 3; Lembregts and Pandelaere 2013; Monga and Bagchi 2012; Wertenbroch and Soman 2007). Any quantity can be expressed in smaller versus larger symbolic numbers, independent of whether it is discretized in fewer versus more elements, so our studies highlight the importance of distinguishing perceptual numerosity (i.e., number of elements in an array) from symbolic numerosity (i.e., magnitude of an Arabic numeral). Unit discretizing relates to both types, in the sense that the type of unit affects whether symbolic quantities are more or less likely to be represented as a collection of elements (akin to perceptual numerosity), and thus how the discretization of a quantity generates effects beyond those of number magnitude (akin to symbolic numerosity). To the best of our knowledge, this article offers the first analysis of how people process symbolic quantities in terms of a collection of elements (e.g., "6 dots" rather than "••••••") and how alternative unit specifications (more vs. less discretizing units) affect judgments by tapping into an evolutionary, ancient reference system that enables people to evaluate the magnitude of a collection of perceptual elements.

Second, our research contributes to General Evaluability Theory. The core argument of this theory is that value sensitivity—that is, whether people respond differently to larger versus smaller numeric values—depends on the extent to which a person has relevant reference information to evaluate numeric values (Hsee and Zhang 2010). Three sources of reference information might enhance the evaluability of quantitative information: mode, knowledge, and nature. Mode is "here and now" reference information that resides in the set of numbers presented, such as whether comparisons are possible with other choice alternatives. Knowledge signals reference information acquired through past experience. Nature refers to whether the person has an innate, stable, physiological, or psychological reference system (e.g., whether the room temperature is comfortable); it is the least "here and now." In turn, these three sources represent three types of evaluability: mode is ad hoc evaluability, knowledge is learned evaluability, and nature is inherent evaluability (Hsee and Zhang 2010). We contend that the effect of discretizing units concerns inherent as well as ad hoc evaluability. The former is usually regarded as a characteristic that is either inherently evaluable (e.g., ambient room temperature) or inherently inevaluable (e.g., diamond value; Hsee et al. 2009), but inherent evaluability may be more than just a feature of an attribute. That is, it could also be a function of the unit in which the attribute is specified, because discretizing a quantity taps into an ancient, innate, hardwired reference system that allows beings to evaluate the magnitude of a collection of elements. The effect of discretizing units also relies on ad hoc evaluability, because alternative unit specifications can be readily implemented in the here and now, such as when comparisons fostered between products in a joint evaluation mode increase evaluability relative to presenting a product in isolation. Finally, we provide the first direct measures of evaluability. A common assumption is that evaluability enhances value sensitivity, but we do not know of any study using direct measures of evaluability (study 3) to predict judgments or behavior.

Of course, the current work is not without limitations. First, although we provide evidence for an evaluability account through moderation and mediation, our current set of studies remains inconclusive about how evaluability relates to processes such as concreteness, vividness, or visualization. Although it may have been informative to include more of these measures in our studies (as in study 3), the strong correlations between these components in study 3 indicate that it is difficult to distinguish these components empirically. We believe that investigating the exact nature of the relationship between evaluability and related constructs could open up fruitful avenues for future research. For instance, we do not know whether the effects of discretizing units on concreteness or vividness are antecedents or consequences of evaluability. Second, we chose to study perceived differences between products, because this is relevant for consumers who use numerical information to compare different options. Yet it might also be interesting to explore how perceptions of individual quantities affect perceived differences. The analysis of the individual judgments in study 3 seems to suggest less OVEREstimation of smaller quantities (see the web appendix for full results and discussion), but continued research is needed to confirm this result in a wider range of situations. In any case, specifying information in more discretizing units may be one way to get people to more accurately judge differences in size.

The current study may provide a novel perspective on classic findings. Consider, for example, the widespread marketing practice of reframing large transactions as a series of small expenses (Gourville 1998). Framing an annual subscription that costs US$300 as US85¢ per day is effective, because the pennies-a-day (PAD) frame fosters the retrieval and consideration of small ongoing expenses as a standard for comparison. But an alternative perspective might suggest that consumers fail to realize that the "per day" frame implies paying the penny amount 365 times. This failure to fully account for this frequent activity could result from humans' general inability to evaluate large collections of elements (study 5). Although encouraging consumers to think of this information as a count of daily payments may reduce the effect, smaller frequencies of payments (e.g., monthly) also could render the information easier to evaluate.

This research offers relevant managerial and policy implications. Considering the ubiquity of quantitative information in every aspect of consumers' lives, advancing knowledge of how specific units improve decision making can inform various domains. For example, a recent longitudinal study indicates that displaying calorie information on restaurant menus has little impact on choice (Cantor et al. 2015). A potential explanation could be that food energy information is typically specified in less discretizing units (e.g., calories, kilojoules), which makes it inherently difficult to evaluate. We predict that specifying information in more discretizing units could increase the impact of this information on choice, by increasing the evaluability of the provided information, which might then reduce certain unhealthy food choices. In ecology domains, preferences for fuel-efficient vehicles might change if the fuel economy information were specified as "liters per 100 kilometers" or as "1 liter jerrycans per 100 kilometers." Findings along these lines may offer value, since many scales in diverse domains could be transformed easily into discretizing units. Further research should also investigate how specifying information in discretizing units affects decision making by less numerically proficient consumers, who are highly prone to make suboptimal decisions in relation to numerical information (e.g., eating behavior, financial decisions; Peters et al. 2006). Expressing quantitative information in more discretizing units could hopefully empower these consumers to make better decisions.

DATA COLLECTION INFORMATION

The data for the pilot study (October 2015), study 1 (June 2015), study 2 (September 2017), study 3 (August 2016), study 4b (September 2016), and study 5 (November 2017) were collected by the first author using Amazon Mechanical Turk. The data for study 4a (September 2014) were collected at the consumer lab at Ghent University, Belgium. Study 6a was run with participants from the online subject pool at Ghent University (July 2014). The data of study 6b was collected by a research assistant at the campus of Erasmus University, Rotterdam (June 2017), under the supervision of both authors. These data were analyzed and discussed by both authors.

REFERENCES

Adaval, Rashmi (2013), "Numerosity and Consumer Behavior," *Journal of Consumer Research*, 39 (5), xi–xiv.

Alba, Joseph W., Susan M. Broniarczyk, Terence A. Shimp, and Joel E. Urbany (1994), "The Influence of Prior Beliefs, Frequency Cues, and Magnitude Cues on Consumers' Perceptions of Comparative Price Data," *Journal of Consumer Research*, 21 (2), 219.

Alba, Joseph W., Carl F. Mela, Terence A. Shimp, and Joel E. Urbany (1999), "The Effect of Discount Frequency and Depth on Consumer Price Judgments," *Journal of Consumer Research*, 26 (2), 99–114.

Antell, Sue Ellen and Daniel P. Keating (1983), "Perception of Numerical Invariance in Neonates," *Child Development*, 54 (3), 695–701.

Aribarg, Anocha, Katherine A. Burson, and Richard P. Larrick (2017), "Tipping the Scale: The Role of Discriminability in Conjoint Analysis," *Journal of Marketing Research*, 54 (2), 279–92.

Bagchi, Rajesh and Derick F. Davis (2016), "The Role of Numerosity in Judgments and Decision-Making," *Current Opinion in Psychology*, 10 (August), 89–93.

Bagchi, Rajesh and Xingbo Li (2011), "Illusionary Progress in Loyalty Programs: Magnitudes, Reward Distances, and Step-Size Ambiguity," *Journal of Consumer Research*, 37 (5), 888–901.

Brannon, Elizabeth M. and Herbert S. Terrace (1998), "Ordering of the Numerosities 1 to 9 by Monkeys," *Science*, 282 (5389), 746–9.

Burson, Katherine A., Richard P. Larrick, and John G. Lynch Jr. (2009), "Six of One, Half Dozen of the Other: Expanding and Contracting Numerical Dimensions Produces Preference Reversals," *Psychological Science*, 20 (9), 1074–8.

Butterworth, Brian (2000), *The Mathematical Brain*, New York: Macmillan.

——. (2001), "Statistics: What Seems Natural?" *Science*, 292 (5518), 853–5.

——. (2007), "Why Frequencies Are Natural," *Behavioral and Brain Sciences*, 30 (3), 259–60.

Cantor, Jonathan, Alejandro Torres, Courtney Abrams, and Brian Elbel (2015), "Five Years Later: Awareness of New York City's Calorie Labels Declined, with No Changes in Calories Purchased," *Health Affairs*, 34 (11), 1893–900.

Capaldi, E. J., Daniel J. Miller, and Suzan Alptekin (1989), "Multiple-Food-Unit-Incentive Effect: Nonconservation of Weight of Food Reward by Rats," *Journal of Experimental Psychology: Animal Behavior Processes*, 15 (1), 75.

Chesney, Dana L. and Percival G. Matthews (2013), "Knowledge on the Line: Manipulating Beliefs about the Magnitudes of Symbolic Numbers Affects the Linearity of Line Estimation Tasks," *Psychonomic Bulletin & Review*, 20 (6), 1146–53.

Dantzig, Tobias and John Mazur (1930/2005), *Number: The Language of Science*, Upper Saddle River, NJ: Pi Press.

Dehaene, Stanislas (2003), "The Neural Basis of the Weber—Fechner Law: A Logarithmic Mental Number Line," *Trends in Cognitive Sciences*, 7 (4), 145–7.

Dehaene, Stanislas, G. Dehaene-Lambertz, and Laurent Cohen (1998), "Abstract Representations of Numbers in the Animal and Human Brain," *Trends in Neurosciences*, 21 (8), 355–61.

Gigerenzer, Gerd and Adrian Edwards (2003), "Simple Tools for Understanding Risks: From Innumeracy to Insight," *BMJ*, 327 (7417), 741–4.

Gigerenzer, Gerd and Ulrich Hoffrage (1995), "How to Improve Bayesian Reasoning without Instruction: Frequency Formats," *Psychological Review*, 102 (4), 684–704.

Ginsburg, Norman (1976), "Effect of Item Arrangement on Perceived Numerosity: Randomness vs Regularity," *Perceptual and Motor Skills*, 43 (2), 663–8.

Gourville, John T. (1998), "Pennies-a-Day: The Effect of Temporal Reframing on Transaction Evaluation," *Journal of Consumer Research*, 24 (4), 395–403.

Harvey, B. M., Barrie P. Klein, Natalia Petridou, and Serge O. Dumoulin (2013), "Topographic Representation of Numerosity in the Human Parietal Cortex," *Science*, 341 (6150), 1123–6.

Hibbard, Judith H., Paul Slovic, Ellen Peters, and Melissa L. Finucane (2002), "Strategies for Reporting Health Plan Performance Information to Consumers: Evidence from Controlled Studies," *Health Services Research*, 37 (2), 291–313.

Hsee, Christopher K. (1996), "The Evaluability Hypothesis: An Explanation for Preference Reversals between Joint and Separate Evaluations of Alternatives," *Organizational Behavior and Human Decision Processes*, 67 (3), 247–57.

——. (2000), "Attribute Evaluability: Its Implications for Joint-Separate Evaluation Reversals and Beyond," in *Choices, Values, and Frames*, ed. Daniel Kahneman and Amos Tversky, Cambridge, UK: Cambridge University Press, 543–63.

Hsee, Christopher K., George F. Loewenstein, Sally Blount, and Max H. Bazerman (1999), "Preference Reversals between Joint and Separate Evaluations of Options: A Review and Theoretical Analysis," *Psychological Bulletin*, 125 (5), 576–90.

Hsee, Christopher K., Yuval Rottenstreich, and Zhixing Xiao (2005), "When Is More Better? On the Relationship between Magnitude and Subjective Value," *Current Directions in Psychological Science*, 14 (5), 234–7.

Hsee, Christopher K., Yang Yang, Naihe Li, and Luxi, Shen (2009), "Wealth, Warmth, and Well-Being: Whether Happiness Is Relative or Absolute Depends on Whether It Is about Money, Acquisition, or Consumption," *Journal of Marketing Research*, 46 (3), 396–409.

Hsee, Christopher K. and Jiao Zhang (2010), "General Evaluability Theory," *Perspectives on Psychological Science: A Journal of the Association for Psychological Science*, 5 (4), 343–55.

Jansen-Osmann, Petra and Gunnar Wiedenbauer (2006), "Distance Cognition in Virtual Environmental Space: Further Investigations to Clarify the Route-Angularity Effect," *Psychological Research Psychologische Forschung*, 70 (1), 43–51.

Krishna, Aradhna and Priya Raghubir (1997), "The Effect of Line Configuration on Perceived Numerosity of Dotted Lines," *Memory & Cognition*, 25 (4), 492–507.

Lechelt, Eugene C. (1975), "Temporal Numerosity Discrimination: Intermodal Comparisons Revisited," *British Journal of Psychology*, 66 (1), 101–8.

Lembregts, Christophe and Mario Pandelaere (2013), "Are All Units Created Equal? The Effect of Default Units on Product Evaluations," *Journal of Consumer Research*, 39 (6), 1275–89.

Ma, Jingjing and Neal J. Roese (2013), "The Countability Effect: Comparative versus Experiential Reactions to Reward Distributions," *Journal of Consumer Research*, 39 (6), 1219–33.

Monga, Ashwani and Rajesh Bagchi (2012), "Years, Months, and Days versus 1, 12, and 365: The Influence of Units versus Numbers," *Journal of Consumer Research*, 39 (1), 185–98.

Palat, Blazej, Patricia Delhomme, and Guillaume Saint Pierre (2014), "Numerosity Heuristic in Route Choice Based on the Presence of Traffic Lights," *Transportation Research Part F: Traffic Psychology and Behaviour*, 22, 104–12.

Pandelaere, Mario, Barbara Briers, and Christophe Lembregts (2011), "How to Make a 29% Increase Look Bigger: Unit Effect in Option Comparisons," *Journal of Consumer Research*, 38 (2), 308–22.

Parkman, John M. (1971), "Temporal Aspects of Digit and Letter Inequality Judgments," *Journal of Experimental Psychology*, 91 (2), 191–205.

Pelham, Brett W., Tin Tin Sumarta, and Larissa Myaskovsky (1994), "The Easy Path from Many to Much: The Numerosity Heuristic," *Cognitive Psychology*, 26 (2), 103–33.

Peters, Ellen, Daniel Västfjäll, Paul Slovic, C. K. Mertz, Ketti Mazzocco, Stephan Dickert, and Daniel Vastfjall (2006), "Numeracy and Decision Making," *Psychological Science*, 17 (5), 407–13.

Piazza, Manuela and Véronique Izard (2009), "How Humans Count: Numerosity and the Parietal Cortex," *The Neuroscientist: A Review Journal Bringing Neurobiology, Neurology and Psychiatry*, 15 (3), 261–73.

Piazza, Manuela, Philippe Pinel, Denis Le Bihan, and Stanislas Dehaene (2007), "A Magnitude Code Common to Numerosities and Number Symbols in Human Intraparietal Cortex," *Neuron*, 53 (2), 293–305.

Pieters, Rik (2017), "Meaningful Mediation Analysis: Plausible Causal Inference and Informative Communication," *Journal of Consumer Research*, 44 (3), 692–716.

Posey, Thomas B. and Michael R. James (1976), "Numerosity Discrimination of Tactile Stimuli," *Perceptual and Motor Skills*, 42 (2), 671–4.

Price, Paul C., Nicole M. Kimura, Andrew R. Smith, and Lindsay D. Marshall (2014), "Sample Size Bias in Judgments of

Perceptual Averages," *Journal of Experimental Psychology. Learning, Memory, and Cognition*, 40 (5), 1321–31.

Rips, Lance J. (2013), "How Many Is a Zillion? Sources of Number Distortion," *Journal of Experimental Psychology. Learning, Memory, and Cognition*, 39 (4), 1257–64.

Schley, Dan R., Christophe Lembregts, and Ellen Peters (2017), "The Role of Evaluation Mode on the Unit Effect," *Journal of Consumer Psychology*, 27 (2), 278–86.

Shepard, Roger N., Dan W. Kilpatric, and James P. Cunningham (1975), "The Internal Representation of Numbers," *Cognitive Psychology*, 7 (1), 82–138.

Slovic, Paul, Melissa L. Finucane, Ellen Peters, and Donald G. MacGregor (2007), "The Affect Heuristic," *European Journal of Operational Research*, 177 (3), 1333–52.

Starkey, Prentice and Robert G. Cooper (1980), "Perception of Numbers by Human Infants," *Science*, 210 (4473), 1033–5.

Starkey, Prentice, Elizabeth S. Spelke, and Rochel Gelman (1983), "Detection of Intermodal Numerical Correspondences by Human Infants," *Science*, 222 (4620), 179–81.

Stevens, S. S. (1958), "Measurement and Man," *Science*, 127 (3295), 383–9.

Strauss, Mark S. and Lynne E. Curtis (1981), "Infant Perception of Numerosity," *Child Development*, 52 (4), 1146–52.

Thaler, Richard H. and Cass R. Sunstein (2008), *Nudge*, New Haven, CT: Yale University Press.

van Oeffelen, Michiel P. and Peter G. Vos (1982), "A Probabilistic Model for the Discrimination of Visual Number," *Perception & Psychophysics*, 32 (2), 163–70.

Weller, Joshua A., Nathan F. Dieckmann, Martin Tusler, C. K. Mertz, William J. Burns, and Ellen Peters (2013), "Development and Testing of an Abbreviated Numeracy Scale: A Rasch Analysis Approach," *Journal of Behavioral Decision Making*, 26 (2), 198–212.

Wertenbroch, Klaus and Dilip Soman (2007), "On the Perceived Value of Money: The Reference Dependence of Currency Numerosity Effects," *Journal of Consumer Research*, 34 (1), 1–11.

Wiese, Heike (2003), *Numbers, Language, and the Human Mind*, New York: Cambridge University Press.

Wolfe, J. B. and M. Kaplon (1941), "Effect of Amount of Reward and Consummative Activity on Learning in Chickens," *Journal of Comparative Psychology*, 31 (2), 353–61.

Wynn, Karen (1992), "Addition and Subtraction by Human Infants," *Nature*, 358 (6389), 749–50.

Yeung, Catherine W. M. and Dilip Soman (2005), "Attribute Evaluability and the Range Effect," *Journal of Consumer Research*, 32 (3), 363–9.

——. (2007), "The Duration Heuristic," *Journal of Consumer Research*, 34 (3), 315–26.