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Scott D. Swain
Clemson University, sdswain@clemson.edu

Danny Weathers
Clemson University

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Scott D. Swain
Clemson University

Danny Weathers
Clemson University

ABSTRACT

Marketplaces and media sources frequently present consumers with information or measurements that involve "extreme" quantities (e.g., the size of the national debt or the number of pounds of plastic in the Earth's oceans). Often, communicators express these quantities in spatial terms in an effort to influence the perceptual impact of the information (e.g., expressing the national debt in terms of the number of miles it would extend if laid out in paper currency form). Across three experiments, we find evidence that perceptual impact diminishes with spatial dimensionality (e.g., expressing a quantity as a length makes it seem larger than expressing it as a volume).

EXTENDED ABSTRACT

Consumers frequently encounter information or measurements that involve "extreme" quantities. For example, in early 2021, the Bloomberg Billionaires Index estimated that the three people with the highest total net worth in the world were Elon Musk ($199B), Jeff Bezos ($189B), and Bill Gates ($133B). Similarly, the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) reports that the largest marine oil spill in U.S. history was 134M gallons in three months (Deepwater Horizon drilling platform).

The question of whether and how consumers comprehend, evaluate, remember, or reason about such measurements has been posed by a variety of interested observers, including educators, information architects, academic researchers, and consumer advocates (Barrio, Goldstein, and Hoffman 2016; Brown and Siegler 1993; Camilleri and Larrick 2014; Hullman et al. 2018; Landy, Silbert, and Goldin 2013; Schkade and Payne 1994; Ungemach et al. 2018).

One tactic that many communicators deploy is to express a measured quantity in spatial terms, with the presumed intention of enhancing the perceptual impact of the information. For example, a politician campaigning against income inequality might choose to point out that Bill Gates could use his total net worth of $133B to create a line of $100 bills that extends for 128,885.7 miles. Yet, some expressions of measurements may have an effect that is the opposite of a communicator's intentions. For example, NOAA describes the 134M gallon Deepwater Horizon marine oil spill as "…*equivalent to the volume of over 200 Olympic-sized swimming pools*." This

shift from a small unit ("gallons") to a large unit ("Olympic-sized pools") results in a much smaller numerical component for the measurement (200 versus 134M). As a result, the expression may inadvertently lead consumers to conclude that the oil spill was not particularly large or perhaps not as large as they originally thought (Burson, Larrick, and Lynch 2009; Hsee and Zhang 2010; Lembregts, Christophe and Pandelaere 2013; Monga, and Bagchi 2012; Resnick et al. 2017; Weathers, Swain, and Carlson 2012).

The present research examines the extent to which consumers' responses to spatial expressions for extreme quantities are influenced by changes in dimensionality (i.e., volume > area > length). Hypotheses regarding the influence of spatial dimensionality are derived from research in developmental psychology and psychophysical perception. These literatures document a general tendency for individuals to underestimate quantities to a greater degree in higher (versus lower) spatial dimensionalities (e.g., Carbon 2016; Ekman and Junge 1961; Krider, Raghubir, and Krishna 2001; Teghtsoonian 1965).

In Experiment 1a (n = 258, within-subjects design), participants were provided with three different expressions of a national debt of $17,000,000,000. Specifically, the debt was expressed either as an amount of dollars, the length of a line of $1 bills, or the number of Olympic-sized pools that could be filled with $1 bills. Participants viewed the three unique pairings of expressions and indicated which expression made the debt seem larger. More participants (79.1%, p < .001) felt that expressing the debt as a length (66,157 trips around the equator) made it seem larger than expressing it as a volume (7,704 Olympic-sized swimming pools). Similarly, a majority of participants felt that the debt seemed larger as a length than it did as a dollar value (58.5%, p < .005) but only a minority felt the same way when the debt was expressed as a volume (39.9%, p < .001).

Experiment 1b replicated experiment 1a, using $100 bills instead of $1 bills to compute length and volume (n = 112, within-subjects design). The results were similar to those of experiment 1a. More participants (77.7%, p < .001) felt that expressing the debt as a length (662 trips around the equator) made it seem larger than expressing it as a volume (77 Olympic-sized swimming pools). Similarly, a majority of participants felt that the debt seemed larger as a length than it did as a dollar value (63.4%, p < .005) but only a minority felt the same way when the debt was expressed as a volume (40.2%, p < .01).

Experiment 2 (n = 235, between-subjects design) focused on perceptions of volume and involved expressions for the size of a marine oil spill. Participants were randomly assigned to view one of two spill sizes (smaller, larger) and one of four possible expressions (number of gallons, number of barrels, number of tanker trucks, number of Olympic-sized swimming pools). Participants rated the spill expressions using the item, "The size of the oil spill seems…" (1 = small, 7 = large). In the smaller spill condition, participants viewed the spill as larger when expressed as 2,000 gallons (M = 5.06) than when expressed in equivalent but larger units of volume: 48 barrels (M = 3.8, p < .01), 1/5th of a tanker truck (M = 3.93, p < .05), and .30% of an Olympic-sized pool (M = 3.87, p < .01). The effects were similar, though smaller, in the larger spill condition. Participants viewed the spill as larger when expressed as 200,000 gallons (M = 5.76)

than when expressed in equivalent but larger volume units: 4,762 barrels (M = 5.2, p < .10), 22 tanker trucks (M = 5.15, p < .10), and 30% of an Olympic-sized pool (M = 4.82, p < .05).

In summary, we find that quantities are perceived as significantly larger when expressed in a lower (versus higher) spatial dimensionality. When holding spatial dimensionality constant, we find evidence of a numerosity effect (smaller units, and thus larger numbers, led to perceptions of a quantity as larger). These findings hold important implications for communicators, educators, policy makers, and individual decision makers.

REFERENCES

Barrio, Pablo J., Daniel G. Goldstein, and Jake M. Hofman (2016), "Improving Comprehension of Numbers in the News," in *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, ACM, 2729-39.

Brown, Norman R. and Robert S. Siegler (1993), "Metrics and Mappings: A Framework for Understanding Real-world Quantitative Estimation," *Psychological Review*, 100 (3), 511–534.

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), 1074-78.

Butterworth, Brian (2007), "Why Frequencies Are Natural," *Behavioral and Brain Sciences*, 30 (3), 259-60.

Camilleri, Adrian R. and Richard P. Larrick (2014), "Metric and ScaleDesign as Choice Architecture Tools," Journal of Public Policy &Marketing, 33 (1), 108-25

Carbon, Claus-Christian (2016), "The Folded Paper Size Illusion: Evidence of Inability to Perceptually Integrate More than One Geometrical Dimension," *i-Perception*, 7 (4), 1-5.

Carlson, Jay P., Danny Weathers, and Scott D. Swain (2016), "Consumer Responses to Bonus Pack and Product Enlargement Claims," *Journal of Marketing Theory and Practice*, 24 (1), 59-71.

Ekman, Gösta, and Kenneth Junge. (1961), "Psychophysical Relations in Visual Perception of Length, Area and Volume," *Scandinavian Journal of Psychology*, 2 (1), 1-10.

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

Hullman, Jessica, Yea-Seul Kim, Francis Nguyen, Lauren Speers, and Maneesh Agrawala (2018), "Improving Comprehension of Measurements using Concrete Re-expression Strategies," in *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, Paper 34, 1-12.

Krider, Robert E., Priya Raghubir, and Aradhna Krishna (2001), "Pizzas: π or Square? Psychophysical Biases in Area Comparisons," *Marketing Science*, 20 (4), 405-25.

Landy, David, Noah Silbert, and Aleah Goldin (2013) "Estimating Large Numbers," *Cognitive Science*, 37, 775-99.

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.

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.

Resnick, Ilyse, Alexandra Davatzes, Nora S. Newcombe, and Thomas F. Shipley (2017), "Using Analogy to Learn about Phenomena at Scales Outside Human Perception," *Cognitive Research: Principles and Implications*, 2 (1), 1-17.

Schkade, David A. and John W. Payne (1994), "How People Respond to Contingent Valuation Questions: A Verbal Protocol Analysis of Willingness to Pay for an Environmental Regulation," *Journal of Environmental Economics and Management*, 26 (1), 88-109.

Teghtsoonian, Martha (1965), "The Judgment of Size," *The American journal of psychology*, 78 (3), 392-402.

Ungemach, Christoph, Adrian R. Camilleri, Eric J. Johnson, Richard P. Larrick, and Elke U. Weber (2018), "Translated Attributes as Choice Architecture: Aligning Objectives and Choices through Decision Signposts," *Management Science*, 64 (5), 2445-59.

Weathers, Danny, Scott D. Swain, and Jay P. Carlson (2012), "Why Consumers Respond Differently to Absolute versus Percentage Descriptions of Quantities," *Marketing Letters*, 23 (4), 947-53.

ABOUT THE AUTHORS

Scott D. Swain is a Professor of Marketing in the Wilbur O. and Ann Powers College of Business at Clemson University. He earned an MBA and Ph.D. in Marketing from the University of South Carolina, a B.S. in Electrical Engineering from Clemson University, and a B.S. in Physics from Francis Marion University. Prior to joining Clemson, Scott served on the faculties of Boston University (Questrom School of Business) and Northeastern University (D'Amore-McKim School of Business). He has taught a variety of courses at the undergraduate, master's, and PhD levels and frequently assists companies and non-profits with issues such as branding, intellectual property litigation, pricing, customer insight, and design. His peer-reviewed research appears in outlets such as the Journal of Marketing, Journal of Marketing Research, Journal of Consumer Research, Journal of the Academy of Marketing Science, and Journal of Retailing.

Danny Weathers is a Professor of Marketing in the Wilbur O. and Ann Powers College of Business at Clemson University. He earned a PhD in Marketing and an MS in Statistics from the University of South Carolina and a BS in Mathematical Sciences from Clemson University. Prior to joining the faculty at Clemson, Danny served as a faculty member at Louisiana State University. He is currently the MS Marketing Director at Clemson, and he teaches courses in Marketing Research and Marketing Metrics. Over his career, Danny has taught a variety of undergraduate, master's, and PhD courses. His research has appeared in outlets including the *Journal of Marketing Research*, *Journal of Retailing*, *Journal of Business Research*, and *Journal of Advertising*.