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FlashReport

The power of precise numbers: A conversational logic analysis

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HIGHLIGHTS

- Precise numbers ($29.75) influence estimates more than round numbers (e.g., $30).
- But precision only matters when consistent with Gricean conversational norms.
- That is, when relevant to the task and presented by a human communicator

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ABSTRACT

The role of conversational processes in quantitative judgment is addressed. In three studies, precise numbers (e.g., $29.75) had a stronger influence on subsequent estimates than round numbers (e.g., $30), but only when they were presented by a human communicator whose contributions could be assumed to observe the Gricean maxims of cooperative conversational conduct. Numeric precision exerted no influence when the numbers were presented as the result of an automated procedure that lacks communicative intent (Study 1) or when the level of precision was pragmatically irrelevant for the estimation task (Study 2).

Introduction

Suppose two sports fans tell their friends about a marathon race. One reports the winner's completion time as 2 h 48 min, whereas the other reports it as 2 h 48 min 2.92 s. Whose friends are more likely to infer that the race was tight? Supporting your likely intuition, 82% of the participants in a pilot study ($N = 45$) believed that the second report is more likely to convey that the runner-up finished closely on the winner's heels. Different processes may contribute to this impression. First, listeners may assume that the speaker's level of precision conveys relevant information — why would a speaker report on split seconds if the race was won by minutes? This intuition is consistent with Grice's (1975) maxims of conversation, which entail that speakers should provide all the information that is relevant to a task, but not more (nor less). Second, theorizing in numerical cognition (Janiszewski & Uy, 2008) suggests that more precise expressions of quantities are represented along more fine-grained mental scales. Mapping a given subjective difference onto a more fine grained scale, say a scale of split seconds rather than minutes, gives rise to smaller estimates of objective difference, also resulting in the impression of a tighter race between the winner and runner-up. These accounts are not mutually exclusive. Mental representations of fine-grained numbers are indeed likely to differ from mental representations of coarse-grained numbers — yet no detailed representation needs to be formed when the precise number seems uninformative to begin with.

Numerical cognition and the logic of conversation

In everyday life, conversational conduct is guided by tacit norms of cooperative communication (Grice, 1975). A maxim of relation requires speakers to provide only information that is relevant to the aims of the ongoing conversation; a maxim of manner encourages them to do their best to be understood by recipients, which implies that utterances should not be more complex than needed; and a maxim of quantity asks speakers to provide as much information as recipients need, but neither more, nor less. Finally, a maxim of quality urges speakers to only say things they know to be true and accurate. Although violations of these maxims are common in everyday conversations, linguistic and behavioral research (for reviews, see Hilton, 1995; Levinson, 1983; Schwarz, 1994) show that recipients interpret speakers' utterances "on the assumption that they are trying to live up to these ideals" (Clark & Clark, 1977, p. 122).

Empirically, communicators and recipients observe these tacit norms. Compared to coarse expressions (e.g., one year), fine-grained expressions (e.g., 12 months) are more likely to be used when communicators have

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confidence in what they say (Goldsmith, Koriat, & Weinberg-Eliezer, 2002; Yaniv & Foster, 1995). Recipients, in turn, consider fine-grained expressions more precise and are more likely to rely on what they convey (Zhang & Schwarz, 2012). When the communicator's cooperation, expertise or trustworthiness are called into question, the granularity of the expression ceases to be informative and does not influence recipients' judgments (Zhang & Schwarz, 2012). The same logic should apply to precise (vs. rounded) numbers: their use is only consistent with cooperative conversational conduct when the implied level of precision is warranted and useful for the task at hand.

Implications for judgment

Janiszewski and Uy (2008) reported more pronounced anchoring effects when the anchor was presented with a high (e.g., 3.998 or 4.002) rather than low (e.g., 4) level of precision. Given the very small difference of 0.002 between these anchor values, their differential effect is difficult to derive from the two process models that account for the bulk of anchoring effects, namely the selective accessibility model (Strack & Mussweiler, 1997) and the anchor-and-adjust account (Epley & Gilovich, 2001). Complementing a numerical anchor-and-adjust explanation, Janiszewski and Uy (2008) suggested that more precise anchor values are mapped onto more fine-grained subjective representational scales than less precise anchor values. This difference in the underlying representation can result in differential anchoring effects because "X units of adjustment along a fine-resolution scale (…) cover less objective distance than the same number of units along a coarse-resolution scale" (Janiszewski & Uy, 2008, p. 121). From a conversational perspective, the observed advantage of precise over rounded numbers should be limited to conditions where the speaker is assumed to be cooperative. We tested this prediction in two studies, using different strategies to vary the pragmatic implicatures of the numbers presented to participants.

Study 1

Participants in Study 1 (modeled after Janiszewski & Uy, 2008, study 1) were told how much a retailer charges customers for a DVD player; the price was given as \$29.75 or \$30, which served as the precise or rounded numeric values. To manipulate perceived communicative intent, the price was allegedly conveyed by the retailer or by a computer program that samples prices at several retailers and reports the average price. Previous research (Schwarz, Strack, Hilton, & Naderer, 1991) showed that messages from a human communicator are attributed more communicative intent than automated messages; hence, number precision should influence judgment under human communicator conditions more than under computer message conditions.

Method

In an online study, 112 U.S. participants recruited from Amazon Mechanical Turk read a scenario modeled after Janiszewski and Uy (2008, Study 1). They were asked to estimate what retailers pay for a DVD drive that is currently offered to consumers at the price of \$29.75 (*precise number*) [or \$30 (*round number*), respectively]. For half of the participants, these numeric values were presented as the current price of the DVD drive "at a major retailer". The other half was told that the computer would determine the average price at three retailers of the participants' choice. Next, they selected three retailers from a list of five major online retailers and the computer program allegedly calculated the average price of the drive at the chosen retailers; during this time the screen displayed the message, "Fetching price data and calculating." After a few seconds, the message changed to "Based on your selection, the average retail price of this DVD drive in these stores is \$29.75 [\$30]." Finally, all participants provided their best estimate of the retailer cost of the DVD drive.

Results and discussion

Analysis of variance revealed the predicted interaction of communicator and number precision, $F(1, 107) = 4.5$, $p < .04$. When the retailer provided the store's retail price, participants estimated that the retailer's cost is $M = \$8.2$ ($SD = 5.0$) below the round retail price of \$30, but only $M = \$4.7$ ($SD = 3.4$) below the precise retail price of \$29.75, $F(1, 107) = 6.5$ $p < .02$, for the simple effect; $d = .82$. This influence of number precision replicates Janiszewski and Uy (2008). It was not observed when the retail price was determined by a computer program, whose output is presumably void of communicative intent. In this case, participants estimated that the retailers' cost is $M = \$7.6$ ($SD = 5.1$) below the round, and $M = \$8.1$ ($SD = 5.4$) below the precise retail price, $F < 1$, $d = .1$.

From a conversational perspective, the number participants received conveyed most information when it was precise (\$29.75) and provided by a cooperative human communicator. Consistent with this prediction, this condition differed reliably from all other conditions, $t(109) = 2.95$, $p < .005$, $d = 1.30$, which did not differ from one another, $F < 1$.

In sum, precise numbers elicited smaller adjustment than round numbers, but only when they were intentionally chosen by a human communicator rather than calculated by a computer program. This is consistent with earlier findings that indicate that human communicators are assumed to observe Gricean maxims of conversation in tailoring their message, whereas computational algorithms are not (Schwarz, 1994).

Study 2

Even in the case of human communicators, however, task characteristics can render the same level of detail differentially relevant. To return to our introductory example of a marathon race, pilot study participants inferred from numeric precision that the race was tight, indicating that people consider split seconds relevant to the distance between the winner and the runner-up, but not to the distance between the winner and the stragglers. If so, the precision with which the time of the winner is conveyed should affect performance estimates of close competitors but not of distant competitors. This does not imply, however, that information about the performance of the winner is without any informational value for the performance of much worse placed runners — learning, for example, that it took the winner more than 4 h to complete the race might suggest that it was held under particularly difficult conditions. Hence, the absolute value of comparative information may influence estimation even when the precision of this information is deemed irrelevant.

To test these predictions we presented information about the shooting percentage of the 5th ranked player in the National Basketball Association (NBA) in a precise vs. rounded format and assessed its impact on estimates of the shooting percentage of the 8th ranked vs. the 108th ranked player (Study 2a). We predicted that the precision of the information about the 5th ranked player (round vs. precise numbers) would affect estimates of the 8th ranked player, but not of the 108th ranked one. This does not entail, however, that drawing the pragmatic relevance of precise numbers into question is sufficient to eliminate the influence of comparison values in general; it merely entails that precise numbers do not exert more influence than round numbers under these conditions. Accordingly, Study 2b compared participants' estimates of the shooting percentage of the 108th ranked player after they received information about the shooting percentage of the 5th ranked player in either a precise or rounded format or received no information. We predicted that comparison information about the 5th ranked player would influence estimates pertaining to the 108th ranked player, but that this influence would be independent of numeric precision.

Method

Study 2a. Participants (N = 104; mostly undergraduate students) received \$10 for a 1 h questionnaire session that included unrelated tasks from several investigators. For the present study, they were asked to guess the shooting percentage of an NBA player given the percentage of another player (adapted from Janiszewski & Uy, 2008, study 1). Following a 2 (precise vs. round number) × 2 (high vs. low relevance) between-participants design, they read: "NBA's 2011–2012 field goals leaders' board ranks 110 leading players' shooting percentage in the league. LeBron James from Miami Heat currently ranks No. 5 on the list. His shooting percentage is 50.2% (*precise*) [50% (*rounded*)]." Next, participants were asked to guess the shooting percentage of Steve Nash, who "currently ranks No. 8 on the same list" (*high relevance*) or of Carmelo Anthony, who "currently ranks No. 108 on the same list" (*low relevance*).

The estimates of 6 participants exceeded the shooting percentage of the 5th ranked player, indicating that they did not understand the task; the estimates of 3 participants deviated by more than three standard deviations. These 9 participants were removed, leaving 95 participants in the analysis.

Study 2b. Undergraduate students (N = 70) taking introductory marketing classes participated for course credit. As in Study 2a, some were told that the shooting percentage of the 5th-ranked James was either 50.2% (*precise*) or 50% (*rounded*) before they estimated the shooting percentage of the 108th-ranked Anthony, whereas others received no information about James (*control*).

Results and discussion

Study 2a. In the high-relevance condition, the shooting percentage of the 8th-ranked Nash was estimated as 47.3% ($SD = .02$) when the performance of the 5th ranked James was described with a precise number, but as 41.0% ($SD = .07$) when it was described with a round number; $F(1, 91) = 4.9$, $p = .03$, $d = 1.27$, for the simple effect. Precision exerted no influence under low-relevance conditions. The shooting percentage of the 108th-ranked Anthony was estimated as 27.9% ($SD = .11$) under precise and 32.0% ($SD = .13$) under round number conditions, $F(1, 91) = 2.3$, $p > .1$, $d = .34$, for the simple effect. This pattern is reflected in the predicted interaction of number precision and relevance, $F(1, 91) = 6.9$, $p = .01$. In short, the influence of number precision was eliminated when the nature of the task rendered the pragmatic implications of precise numbers irrelevant. However, one might wonder whether this manipulation eliminated the influence of comparison information overall, rather than merely the influence of its precision. Study 2b addresses this issue.

Study 2b. Replicating Study 2a, the precision with which information about the 5th ranked James was conveyed did not influence participants' estimates of the 108th ranked Anthony's shooting percentage (M's = 32.5% and 34.0%, $SD = .11$ and .11, under precise and round number conditions, respectively; $t < 1$, $d = .14$). However, both of these conditions differed significantly from the no-anchor control condition, where Anthony's shooting percentage was estimated to be 42% ($SD = .14$), $t(68) = 2.9$, $p = .005$, $d = .71$. Thus, information about the 5th ranked player influenced participants' estimates of the performance of the 108th ranked player, yet the precision of that information was irrelevant under these conditions.

General discussion

In sum, participants' estimates were more strongly influenced by quantitative information that was conveyed in precise rather than round numbers, consistent with previous research (Janiszewski & Uy, 2008). However, an increased impact of precise numbers was only observed when the message came from a human communicator (Study 1), whose choice of quantitative expression could be assumed to reflect communicative intent, and pertained to a task where fine-grained distinctions were relevant (Study 2). These findings extend the pragmatic analysis of the granularity of quantitative expressions (Zhang & Schwarz, 2012). Our previous work showed that the same objective quantity is perceived as more precise and reliable, and exerts more influence in judgment and choice, when it is expressed in fine-grained (e.g., 120 min) than in coarse (e.g., 2 h) units. The present findings extend this observation to precise vs. round numbers as indicators of precision. More important from a social psychological perspective, the precision of a communicator's expression ceases to exert an influence when the communicator's cooperativeness (Grice, 1975) is called into question, either because the communicator is not human (Study 1) or the level of precision is inadequate for the task (Study 2). This extends previous observations that precision fails to exert an influence when the communicator is seen either as generally untrustworthy, self-interested, or incompetent in the domain of judgment (Zhang & Schwarz, 2012).

From a broader perspective, our findings are consistent with a familiar truism: information that is considered relevant and diagnostic for the task at hand is more influential than information that is not. Nevertheless, even information that is recognized as irrelevant can influence judgment, e.g., by changing the accessibility of related information (Higgins, 1996). This tension also applies to anchoring effects in quantitative judgment. On the one hand, anchors are more influential when they seem relevant to the task at hand; on the other hand, this relevance is not always needed to obtain an anchoring effect. For example, incidental numbers are more influential anchors when researchers follow Tversky and Kahneman's (1974) original procedures by explicitly relating the anchor to the estimation task ("Is X larger or smaller than this number?"), which renders the anchor conversationally relevant (Wilson, Houston, Etling, & Brekke, 1996). On the other hand, anchoring effects of a smaller magnitude can be obtained without such conversational links (Wilson et al., 1996) and under conditions where the implausibility of the anchor is likely to undermine its conversational relevance (e.g., Mussweiler & Strack, 2001). In combination, such findings illustrate that quantitative judgment is subject to cognitive as well as conversational processes, highlighting the need to consider the interplay of both (Schwarz, 1996).

References

Clark, H. H., & Clark, E. V. (1977). *Psychology and language.* New York, NY: Harcourt, Brace, Jovanovich.

Epley, N., & Gilovich, T. (2001). Putting adjustment back in the anchoring and adjustment heuristic: Differential processing of self-generated and experimenter-provided anchors. *Psychological Science*, *12*, 391–396.

Goldsmith, M., Koriat, A., & Weinberg-Eliezer, A. (2002). Strategic regulation of grain size memory reporting. *Journal of Experimental Psychology. General*, *131*, 73–95.

Grice, H. P. (1975). Logic and conversation. In P. Cole, & J. L. Morgan (Eds.), *Syntax and semantics, 3: Speech acts* (pp. 41–58). New York, NY: Academic Press.

Higgins, E. T. (1996). Knowledge activation: Accessibility, applicability, and salience. In E. T. Higgins, & A. Kruglanski (Eds.), *Social psychology: Handbook of basic principles* (pp. 133–168). New York: Guilford Press.

Hilton, D. J. (1995). The social context of reasoning: Conversational inference and rational judgment. *Psychological Bulletin*, *118*, 248–271.

Janiszewski, C., & Uy, D. (2008). Anchor precision influences the amount of adjustment. *Psychological Science*, *19*, 121–127.

Levinson, S. C. (1983). *Pragmatics.* Cambridge, UK: Cambridge University Press.

Mussweiler, T., & Strack, F. (2001). Considering the impossible: Explaining the effects of implausible anchors. *Social Cognition*, *19*, 145–160.

Schwarz, N. (1994). Judgment in a social context: Biases, shortcomings, and the logic of conversation. *Advances in Experimental Social Psychology*, *26*, 123–162.

Schwarz, N. (1996). *Cognition and communication: Judgmental biases, research methods and the logic of conversation.* Hillsdale, NJ: Erlbaum.

Schwarz, N., Strack, F., Hilton, D. J., & Naderer, G. (1991). Judgmental biases and the logic of conversation: The contextual relevance of irrelevant information. *Social Cognition*, *9*, 67–84.

Strack, F., & Mussweiler, T. (1997). Explaining the enigmatic anchoring effect: Mechanisms of selective accessibility. *Journal of Personality and Social Psychology*, *73*, 437–446.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, *185*, 1124–1131.

Wilson, T. D., Houston, C., Etling, K. M., & Brekke, N. (1996). A new look at anchoring effects: Basic anchoring and its antecedents. *Journal of Experimental Psychology. General*, *4*, 387–402.

Yaniv, I., & Foster, D. P. (1995). Graininess of judgment under uncertainty: An accuracy-informativeness trade-off. *Journal of Experimental Psychology. General*, *124*, 424–432.

Zhang, Y. Charles, & Schwarz, Norbert (2012). How and why one year differs from 365 days: A conversational logic analysis of inferences from the granularity of quantitative expressions. *Journal of Consumer Research*, *39*(2), 248–259.