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How Evaluations of Multiple Percentage Price Changes Are Influenced by Presentation Mode and Percentage Ordering: The Role of Anchoring and Surprise

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Abstract

To advance theory, this study details how consumers evaluate multiple percentage price changes (discounts or surcharges). If they consider two discounts—for example, take 18% off the list price, then take an additional 12% off—consumers weight the two percentages to make their evaluations. Cues endogenous to the communication of those percentages also influence the weights applied, according to whether the two percentages appear presented at the same time (simultaneously) or temporally separated (sequentially) and whether the first percentage is larger or smaller. Depending on both the presentation mode and the ordering, consumers use different processes. In addition to providing practical guidance, this article extends understanding of anchoring and adjustment processes; information presented simultaneously leads consumers to anchor on the first piece of information. Sequential presentation instead induces surprise and shifts attention to the latter percentage change, which serves as the anchor in subsequent judgments. In addition to the underlying theory for these effects, this article delineates some boundary conditions and reveals the effects on consumers' evaluations and choices, with findings from 11 studies.

Keywords

anchoring, multiple percentages, numeracy, order effects, presentation effects, pricing, surprise

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Retailers often use multiple percentage price discounts that combine or "stack" discount codes, coupons, and sales. For example, a retailer might offer two discounts on a $90 jacket: Take 18% off the original price, then take an additional 12% off. Percentage price increases associated with taxes, surcharges, and other fees also are common and often are combined. For example, a bakery might sell standard cakes for $17, impose a 10% surcharge for larger cakes, and then require an additional 5% surcharge for customization. Such situations arise frequently in the marketplace (e.g., see Web Appendix A), yet managers may be unsure about how to best present these price changes. With this article, we provide some guidance.

Specifically, we consider the influence of two cues—presentation mode and order—that are endogenous to the presentation of multiple percentages. When two different percentages appear, they must be presented either at the same time (i.e., simultaneous mode) or with a temporal separation (i.e., sequential mode), and their order also varies (i.e., large percentage presented first or second). We posit that both the mode and the order of the presentation affect evaluations of the overall price change, and we detail how and why this effect occurs.

Normatively speaking, presentation mode and order should not influence evaluations, because the total discounts are mathematically equivalent, regardless of how the discounts appear. Consider the algebraic formulation: Let the original price be P, and the first and second discounts be X% and Y%, respectively. The final discounted price is $P(1 - [X/100])(1 - [Y/100])$. Replacing X with Y (i.e., reversing the order of discounts) does not affect the final sale price, which is simply $P(1 - [Y/100])(1 - [X/100])$. A similar equivalence holds for surcharges.

However, consumers might not perform these computations, because they are cognitive misers (Dehaene 1992). Instead, as the anchoring literature (Epley and Gilovich 2010; Tversky and Kahneman 1974) suggests, consumers might anchor on a single percentage value, weight it more, and adjust insufficiently for the other. Consider our opening jacket example again: Relative

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to the base price, the larger (vs. smaller) discount leads to a greater change in the final price. Therefore, if consumers anchor on the larger percentage (weight it more), they may infer that the discounts offered are very good and so is the deal. Weighting the larger discount more should lead to relatively positive evaluations. However, if attention shifts away from the larger percentage, they may weight the larger discount less, which might lower their evaluations.

We posit that the way in which multiple percentages get communicated (presentation mode and order) can shift attention toward (away) from the larger percentage, which may lead to judgments that the overall price change is larger (smaller). In particular, consumers likely weight the first percentage more with a simultaneous presentation, so they should judge the offer more positively if the larger discount is presented first (vs. second). This prediction reverses for sequential presentations, in which the second percentage price change is unexpected, so it induces surprise. This surprise shifts consumers' attention to the second percentage, and the first percentage becomes less impactful in terms of informing evaluations.

This research in turn makes several important contributions. At a fundamental level, we provide insights into how consumers process multiple percentages, which extends prior research (e.g., Chen and Rao 2007) and contributes to core numeracy and mathematical literacy literature (Dehaene 1992; Ginsburg, Manly, and Schmitt 2006). From a practical perspective, our research can help marketers devise appropriate strategies to communicate multiple percentages. We discuss the conceptual underpinnings of our theorizing next.

Conceptual Development

Although the role of percentages has been studied extensively—from bonus packs to Bayesian inference (Bagchi and Chandon Ince 2016; Chen et al. 2012, DelVecchio, Krishnan, and Smith 2007, Gigerenzer and Hoffrage 1995; Levin and Johnson 1984)—we still know little about how consumers evaluate multiple percentage price increases or decreases (cf. Chen et al. 2012; Chen and Rao 2007; Mazumdar and Jun 1993). Thus, we seek a theory to describe how consumers process and evaluate percentage changes. We suggest that consumers do not always perform the necessary computations and instead might weight one percentage more and then adjust, rather insufficiently, for the effect of the other. Cues that stem from the method used to communicate two percentage changes (presentation mode and order) may systematically influence these applied weights.

At a theoretical level, we consider two countervailing mechanisms: anchoring and surprise. Anchoring research predicts that people pay less attention to later stimuli (Epley and Gilovich 2010; Tversky and Kahneman 1974), whereas surprise literature predicts that their attention shifts to surprising or unexpected stimuli (Chen and Rao 2002; Heilman, Nakamoto, and Rao 2002; Noordewier, Topolinski, and Van Dijk 2016), which can serve as a new judgment anchor. Anchoring effects can be operationalized by manipulating the order of presentation, and surprise can be induced by temporally separating the presentation (sequential vs. simultaneous), such that the item presented second is unexpected. These two cues endogenous to the communication of percentage price changes thus help us assess the interplay of anchoring and surprise and its influence on decision making, leading to deeper theoretical insights. We begin by specifying the differences between simultaneous and sequential presentation modes, before detailing our expectations regarding how consumers process two percentage changes in each mode. (We purposefully limit this investigation, for the reasons detailed in the General Discussion.) We also discuss how different orders might interact with the presentation mode to influence decision making.

Simultaneous Versus Sequential Presentations

Our operationalization of simultaneous and sequential presentation modes is straightforward and follows prior approaches (e.g., Jonas et al. 2001; Simonson 1990). No temporal separation exists between information provided in simultaneous presentations; temporal separation exists in sequential presentations. In our study contexts, consumers see both percentage changes at the same time in the simultaneous presentations. For example, a retailer could display an 18% discount and an additional 12% discount on the same web page. These percentages are temporally separated in the sequential presentations, such that a consumer might see the 18% discount on the first page and then learn about the 12% discount on the next page. The additional 12% discount is unknown when the consumer processes the initial 18% discount, such that it is unexpected and should be relatively surprising. This distinction then should have an important influence on how people process the two percentage changes. Please note that in order to observe anchoring-based effects and to test our theorizing, one percentage must be larger. However, we report experimental results in Web Appendix B (experiment 8) where both percentages are the same.

Information Processing in Simultaneous Presentation Mode

When two percentages appear simultaneously, consumers likely anchor on the first percentage and adjust insufficiently for the second percentage. Previous research indicates that people often anchor on the first piece of information they encounter, then use it as a basis to form their judgments. They then may adjust (if insufficiently) for subsequent information. For example, Tversky and Kahneman (1974) show that time-constrained participants give very different estimates of 8!, depending on the presentation order ($1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8$ vs. $8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$). Because people focus on initial numbers to generate their overall estimates, the descending sequence produces higher estimates. Although anchoring effects in evaluations of multiple percentages have not been investigated, these effects are robust across a wide variety of contexts (Bagchi and Davis 2012; Epley and

Gilovich 2010; Hogarth and Einhorn 1992; Kardes and Kalyanaram 1992; Tversky and Kahneman 1974).

Returning to our discounted jacket example, when the larger percentage is first (18%, then 12%), consumers should anchor on and weight it more, resulting in more favorable overall evaluations of the deal. When the larger percentage is second (12%, then 18%), consumers instead anchor on the smaller percentage and do not fully adjust for the larger percentage. This lower weighting of the larger percentage should result in less favorable overall evaluations. That is, from a process perspective, the order may influence how much weight or impact the larger percentage has on evaluations; when a higher percentage is presented first, it exerts a greater impact on evaluations relative to when it is presented later. Therefore, for simultaneous presentations, these impact perceptions then should mediate the effects of the presentation order on evaluations of the overall change.

Information Processing in Sequential Presentation Mode

In sequential presentations, the second percentage is unexpected, and consumers only learn of it upon receipt. Receiving an unexpected discount should result in surprise, and we expect this surprise to shift people's attention toward the second discount, which then serves as the anchor for their evaluations.

Unexpected events trigger surprise (Chen and Rao 2002; Heilman, Nakamoto, and Rao 2002; Meyer, Reisenzein, and Schutzwohl 1997; Noordewier, Topolinski, and Van Dijk 2016). Models of surprise, including temporal (Noordewier, Topolinski, and Van Dijk 2016) and cognitive-evolutionary (Meyer et al. 1991; Meyer, Reisenzein, and Schutzwohl 1997) models, delineate the steps involved in processing unexpected events. If an (unexpected) event is not consistent with a schema, it triggers an appraisal, followed by surprise. People then reallocate their processing resources to the unexpected event. Research in numerical cognition also suggests that attention shifts to surprising numerical information (Munnich, Ranney, and Song 2007). Contextual effects, including surprise, lead to greater weighting of the information in decision making (Rinne 2010). Taken together, these different streams of research provide evidence that unexpected events trigger surprise, which increases attention to the surprise-eliciting event, making it more salient.

Returning to the jacket example once more, when the larger percentage appears first in a sequential presentation (18%, then 12%), surprise should shift attention toward the smaller percentage. The second percentage then acts as the anchor for evaluations (cf. simultaneous presentations), and consumers might not adjust for the larger percentage. Thus, the impact of the larger discount diminishes, lowering their evaluations. However, when the larger percentage is presented later (12%, 18%), surprise shifts people's attention toward the larger percentage, increasing its impact and leading to higher evaluations (cf. simultaneous presentation).

Hypotheses and Caveats

We predict that in presentations of two percentage increases (decreases), the presentation mode and order interact, such that evaluations will be higher (lower) if the larger percentage comes first in simultaneous presentations and second in sequential presentations. From a process perspective, we expect our results to be driven (mediated) by the self-reported impact of the larger percentage. When the larger percentage is perceived as more impactful (i.e., weighted more), people's evaluations should be more (less) positive for favorable (unfavorable) changes (e.g., discounts vs. price increases). We also expect effects to emerge for downstream behaviors, such as choice (see Experiment 1). As we stated previously, to test our theorizing, we must use two different percentages, because order effects for two equal changes would be impossible to detect (see Web Appendix B, Experiment 8).

With respect to surprise, we consider the question: Do percentages of different sizes lead to different levels of surprise? When a larger (smaller) discount appears later, does it induce a greater (lesser) level of surprise? In our study contexts, the second percentage in a sequential presentation mode is unexpected. The actual percentage values that we use (large or small) are not unexpected; they are commensurate with marketplace expectations and comparable to each other. Therefore, the percentage values should not lead to varying levels of surprise (for confirmation, see Experiments 8 and 9 in Web Appendix B). But do percentages of different sizes instead induce surprise that differs in its valence? That is, a larger (smaller) discount might evoke more positive (negative) surprise. We believe this effect is unlikely too. We keep the valence of the changes constant in a given context, such that respondents experience either favorable changes (discounts) or unfavorable changes (surcharges). Numerical differences should not lead to alterations in the valence of the surprise. If an 18% discount is judged positively, it is unlikely that another gain, in the form of a 12% discount, would judged negatively. The results of a supplemental study (Experiment 9, Web Appendix B) support this conceptualization of surprise.

Our work relates conceptually to Chen and Rao's (2007) study but differs in fundamental ways. Chen and Rao study how people compute multiple percentage changes. After presenting multiple percentage values, they ask participants to indicate the total percentage change (their experiments 2A, B, and C). They find that consumers often just add the two percentages, because they ignore the different base values used in multiple percentage change calculations. In their experiment 1, Chen and Rao also compare attitudes and purchase intentions toward multiple versus single equivalent changes, similar to our study, and the results indicate the use of addition. In their experiment 3, they find that actual sales are higher with two discounts (20% and 25%) compared with one equivalent discount (40%). They explain this finding by asserting that consumers add the two discounts and infer a better deal than the single discount.

Despite some similarities between Chen and Rao's (2007) studies and our present research, there are also important differences. First, we investigate the effects of presentation mode and order on evaluations and choice; they do not. Second, Chen and Rao find that consumers add the two percentages when estimating. To confirm their findings, we conducted two estimation studies (Experiments 3 and 7; Web Appendix B) and find that roughly half of the participants add when estimating. However, in support of our theorizing, the remaining half of the participants offer estimations that map onto our predictions, reflecting the underlying process we propose. With this evidence, this article extends understanding of estimation processes. Third, in their experiment 1, Chen and Rao find that both attitudes and purchase intentions are influenced by an addition strategy when the respondents compare two percentages against one. For example, they present improvements in fuel efficiency using either two percentages (30% and 25%) or one (62.5%). Consistent with their theory, participants evaluate the single percentage more favorably. Our theory is not predictive in this context; instead, if the comparisons involved 30% and 25% versus 25% and 30%, we would predict that the first set elicits higher evaluations. Chen and Rao do not address order within the scope of their research. Fourth, if every person used addition-based strategies to estimate or evaluate, the manipulations in our current study would have no effect (sum is the same, regardless of presentation mode or order; 30% + 25% = 25% + 30%). However, we study a variety of contexts and identify differences, suggesting that though some people add, not everyone does. Thus, our research extends previous findings while also expanding their scope.

Experimental Overview

We test our theorizing with five experiments and present an overview of the main findings in Table 1 (Evangelidis and Van Osselaer 2018). For brevity and clarity, we report only the key statistical tests in each experimental discussion and Table 1; other details are available in Web Appendix B. In Experiment 1, we study real behavior in a choice context. In experiment 2 we demonstrate effects on consumption related variables and evaluations with price discounts. In Experiment 3, we integrate our findings with those from Chen and Rao (2007) by demonstrating estimation effects. Experiments 4 and 5 provide process support. Specifically, in Experiment 4, we investigate price increases and confirm the predicted interaction with a mirrored pattern of means (relative to price decreases) on evaluations. Experiment 5 provides process support for the role of surprise.

We report six additional studies in Web Appendix B. Experiment 6 integrates our results with results from Mazumdar and Jun (1993). Experiment 7 replicates Experiment 3 with percentage increases, and it also measures evaluations. In Experiments 8 and 9, we provide further support for the role of surprise, as briefly discussed in Experiment 5. Pricing contexts are our focus, yet we expect the effects to be general. Therefore, in Experiments 10 and 11, we examine percentage changes in health risk and energy efficiency, respectively. Table 2 in Web Appendix B summarizes the key findings from these additional studies. We report the results of a within-paper meta-analysis in Web Appendix C.

A similar procedure was used to manipulate order and presentation mode in all experiments, so we present the procedure here and do not repeat them for each experiment. The order (large first vs. large later) varied between subjects. In the simultaneous presentations, both percentages appeared on the same screen. In the sequential presentations, the first percentage appeared on one screen, and then the second percentage appeared on the next screen. Thus, participants were initially aware of both percentages in the simultaneous but not in the sequential presentations. We collected their evaluations after all percentages had been presented. Participants were not allowed to use calculators or outside aids in these studies. The stimuli, supplemental analyses, and data exclusions are detailed in Web Appendix B.

Experiment 1: Consumption and Real Consequences

We use a discounted gift card purchase context to demonstrate the hypothesized effects on real consumer choice, with a 2 (presentation mode: simultaneous vs. sequential) $\times$ 2 (order: large first vs. large later) between-subjects factorial design. The order of discounts varied between subjects as well.

The participants ($N = 124$) were recruited from a university community ($M_{age} = 23.62$ years, range 18–60 years, 52% female) to take part in a paid study (for $4). Participants completed a paid, unrelated study, then were informed of an opportunity to purchase a discounted $5 Starbucks gift card. The two discounts (13% and 8%), when applied, brought the price of the $5 card down to $4. However, participants only saw the value of the gift card and the discounts. After the manipulations, participants chose to purchase the gift card or not, and their choice served as our dependent variable. Participants also indicated their liking for Starbucks and demographic information.

The presentation mode $\times$ order two-way interaction is significant (Wald $\chi^2 = 10.36$, $p = .0013$, partial $\eta^2 = .092$). The choice proportions are consistent with our predictions, such that in the simultaneous mode, participants purchased the gift card proportionally more often when they saw the large percentage first ($M_{large\text{-}first} = 35.29\%$, $M_{large\text{-}later} = 10.00\%$; $p = .0103$, partial $\eta^2 = .089$), but the results reverse in the sequential mode ($M_{large\text{-}first} = 23.33\%$, $M_{large\text{-}later} = 53.33\%$; $p = .0120$, partial $\eta^2 = .095$). The main effect of presentation mode is marginally significant (Wald $\chi^2 = 3.73$, $p = .0536$, partial $\eta^2 = .032$; $M_{simultaneous} = 22.65\%$, $M_{sequential} = 38.33\%$). Including liking for Starbucks or demographic variables as covariates does not change the pattern of effects.

This finding supports our theoretical prediction that the presentation mode and order interact to influence deal attractiveness. The motivation to evaluate these discounts should have been high among the participants, because the choices had monetary consequences. Furthermore, individual differences

Table 1. Summary of Experiments and Key Findings.

	Large First	Large Later	Contrast
A: Choice Share, Experiment 1 (Predicted Interaction: Gift Card; $N = 124$, $M_{age} = 23.6$ years, range 18–60 years, 52.0% female, community sample)			
Simultaneous	35.29%	10.00%	$p < .02$, partial $\eta^2 = .089$
Sequential	23.33%	53.33%	$p < .02$, partial $\eta^2 = .095$
Main finding	The presentation mode × percentage order interaction has the predicted effect on actual behavior (choice). The gift card was chosen more often when the larger discount came first in simultaneous but second in sequential presentations.		
B: Deal Evaluations and Behavioral Likelihoods, Experiment 2 (Predicted Interaction: Vacation; $N = 217$, $M_{age} = 32.0$ years, 54.0% female, MTurk)			
Deal Evaluations			
Simultaneous	5.62 (0.92)	5.21 (1.15)	$p < .06$, partial $\eta^2 = .037$
Sequential	5.38 (1.33)	5.82 (1.04)	$p < .05$, partial $\eta^2 = .035$
Purchase Likelihood			
Simultaneous	5.41 (0.98)	4.66 (1.49)	$p < .001$, partial $\eta^2 = .061$
Sequential	4.75 (1.84)	5.42 (1.10)	$p < .05$, partial $\eta^2 = .047$
Recommendation Likelihood			
Simultaneous	5.61 (1.12)	5.07 (1.31)	$p < .05$, partial $\eta^2 = .047$
Sequential	5.05 (1.61)	5.58 (1.30)	$p < .05$, partial $\eta^2 = .032$
Main finding	As predicted, the presentation mode × percentage order interaction affects evaluations and downstream behavioral likelihoods.		
C: Estimate of Total (%), Experiment 3 (Predicted Interaction: Overall and Non-Addition Strategies: $N = 158$, $M_{age} = 32.2$ years, 59.3% female, MTurk)			
Full Sample			
Simultaneous	19.57 (2.10)	18.29 (2.94)	$p < .05$, partial $\eta^2 = .024$
Sequential	19.08 (4.06)	20.51 (2.44)	$p = .064$, partial $\eta^2 = .030$
Non-addition			
Simultaneous	18.62 (2.32)	16.87 (2.77)	$p < .05$, partial $\eta^2 = .109$
Sequential	16.82 (5.11)	19.87 (3.44)	$p < .03$, partial $\eta^2 = .069$
Main finding	As predicted, presentation mode × percentage order interaction affects estimates of total percentage change. The effect is stronger for those who do not use an addition strategy. The findings replicate and extend findings by Chen and Rao (2007).		
D: Deal Evaluations for Price Increases, Experiment 4 (Predicted Interaction: Cake surcharge; $N = 192$, $M_{age} = 36.7$ years, 43.0% female, MTurk)			
Deal Evaluations			
Simultaneous	4.09 (1.48)	4.60 (1.43)	$p = .0794$, partial $\eta^2 = .024$
Sequential	4.27 (1.49)	3.60 (1.48)	$p < .03$, partial $\eta^2 = .055$
Impact of Larger			
Simultaneous	4.77 (1.05)	4.12 (1.46)	$p < .02$, partial $\eta^2 = .051$
Sequential	4.67 (1.26)	5.09 (1.47)	$p < .01$, partial $\eta^2 = .071$
Main finding	As predicted, presentation mode × percentage order interaction affects evaluations of price increases (surcharges). Process evidence of the role of surprise in sequential but not simultaneous presentation modes.		
E: Deal Evaluations and Impact of Surprise Present Versus Absent, Experiment 5 (Moderated Mediation: Gift Card; $N = 643$, $M_{age} = 35.2$ years, 55.4% female, MTurk)			
Deal Evaluations			
Surprise Present			
Simultaneous	4.99 (1.50)	4.43 (1.24)	$p < .01$, partial $\eta^2 = .041$
Sequential	4.37 (1.36)	5.03 (1.10)	$p < .001$, partial $\eta^2 = .067$
Surprise Absent			
Simultaneous	4.86 (1.16)	4.39 (1.21)	$p < .03$, partial $\eta^2 = .038$
Sequential	5.07 (1.23)	4.48 (1.28)	$p < .01$, partial $\eta^2 = .055$
Impact			
Surprise Present			
Simultaneous	4.91 (1.34)	4.36 (1.23)	$p < .01$, partial $\eta^2 = .045$
Sequential	4.23 (1.54)	5.20 (1.02)	$p < .001$, partial $\eta^2 = .102$
Surprise Absent			
Simultaneous	4.96 (1.16)	4.24 (1.34)	$p < .001$, partial $\eta^2 = .076$
Sequential	5.07 (1.12)	4.41 (1.50)	$p < .01$, partial $\eta^2 = .060$
Main finding	Moderated mediation: When surprise is present, the predicted presentation mode × percentage order interaction affects evaluations, in support of the predicted process. When surprise is absent, we only observe a main effect of order on evaluations, with impact as the mediator.		

Note. Standard deviations are in parentheses.

in liking of Starbucks or demographics do not explain the results. We next delve into why these effects might emerge.

Experiment 2: Consumption and Evaluations

We recruited 220 panelists from Amazon Mechanical Turk (mTurk.com) and paid them a nominal fee (M_{age} = 32 years, 54% female). Three participants were removed for failing attention checks (see Web Appendix B), leaving 217 participants in the analysis. We use a consumer context (four-day vacation at an all-inclusive resort for $590) to determine whether evaluations of multiple percentage discounts are influenced by the presentation mode and order. We also identify effects on downstream variables (purchase and recommendation likelihood). The two discounts (11% and 4%) were presented using the previously described procedure. Thus, Experiment 2 features a 2 (presentation mode: simultaneous vs. sequential) × 2 (order: large first vs. large later) between-subjects factorial design.

Participants answered two consumption-related questions: "How much would you like to purchase this vacation package?" (1 = "Not much at all," 7 = "A lot") and "How likely are you to recommend this deal to friends?" (1 = "Not likely at all," 7 = "Very likely"). They then responded to two deal evaluation questions: "How good of a deal is this vacation package?" and "How good are these discounts?" (1 = "Not good at all," 7 = "Very good" for both), which we combined (α = .85). An analysis of variance (ANOVA) with deal evaluations as the dependent variable confirms the predicted two-way interaction ($F_{(1,213)} = 7.96$, $p < .01$, partial $\eta^2 = .036$), such that participants in the simultaneous mode thought the package was a better deal when they saw the large discount first ($M_{large\text{-}first} = 5.62$, $M_{large\text{-}later} = 5.21$; $p < .06$, partial $\eta^2 = .037$), but the results reversed in the sequential mode ($M_{large\text{-}first} = 5.38$, $M_{large\text{-}later} = 5.82$; $p < .05$, partial $\eta^2 = .035$). Separate ANOVAs with purchase and recommendation likelihoods also produce the predicted two-way interaction ($F_{(1,213)} = 13.95$, $p < .001$, partial $\eta^2 = .061$; $F_{(1,213)} = 8.45$, $p < .01$, partial $\eta^2 = .038$, respectively), with similar patterns of means (see Table 1 for the means; see Web Appendix B for additional measures and analyses).

Thus, either the first or second percentage change can serve as an anchor, depending on their presentation mode and order. When two discounts appear simultaneously, people anchor on the first discount and evaluate the deal more positively when the larger percentage is first. When the second discount is unexpected, as in sequential presentations, their attention shifts to the second discount, and it serves as an anchor, so consumers evaluate the deal more positively when the larger discount is second. These findings would not have emerged had participants computed the change accurately or even just added the two discounts to form their deal evaluations (because the sum is invariant). Instead, the systematic differences in their choices and evaluations reflect their differential weightings of inputs; in other words, the evaluation patterns reflect the differential impacts of the larger percentage on participants' overall evaluations.

In the following studies, we primarily focus on evaluations. However, with Experiment 3, we consider actual estimates to integrate our findings with Chen and Rao's (2007) prediction that consumers add to estimate total percentage changes. We investigate the role of a computation strategy (addition or otherwise) in estimation processes and expect results consistent with our hypotheses to emerge and be driven by participants who do not add.

Experiment 3: Estimation

We recruited 160 panelists (mTurk) for a nominal fee (M_{age} = 32.2 years, 59.3% female). Two participants failed attention checks, leaving 158 participants in the analyses. This study used a 2 (presentation mode: simultaneous vs. sequential) × 2 (order: large first vs. large later) between-subjects factorial design. To measure the estimates of total percentage change, the study scenario closely resembles a math problem, such that participants imagined they found an item to purchase that was discounted (by 13% and 8%; see Web Appendix B for the stimuli). They then provided total discount estimates (as a percentage) and reported the computation strategy they used to obtain those estimates (open-ended question). Their responses were coded, 1 for addition strategies (78 participants, 49.4% of sample) and –1 if they used a process more susceptible to our manipulations (e.g., "I started with the second discount and added a little bit more for the first discount," as indicated by a participant in the 8–13 sequential condition). Eighty participants (50.6%) fell into this category.

We log-transformed the estimates to reduce skewness. We report the statistics using the transformed variable and untransformed means for clarity; the statistical conclusions are the same whether we consider the transformed or untransformed variables. According to the ANOVA, we find a significant presentation mode × order interaction ($F_{(1,154)} = 4.96$, $p = .027$, partial $\eta^2 = .031$). Participants in the simultaneous mode gave higher estimates when they saw the larger discount first ($M_{large\text{-}first} = 19.57\%$, $M_{large\text{-}later} = 18.29\%$; $p < .05$, partial $\eta^2 = .024$), and participants in the sequential mode did the reverse ($M_{large\text{-}first} = 19.08\%$, $M_{large\text{-}later} = 19.41\%$; $p = .064$, partial $\eta^2 = .030$).

Furthermore, we expected the two-way interaction to be driven by participants who did not add. An ANOVA with estimates as the dependent variable and the presentation mode, order, and self-reported computation strategy as independent variables reveals a significant main effect of the estimation strategy ($F_{(1,150)} = 17.98$, $p < .0001$, partial $\eta^2 = .091$). That is, addition leads to higher estimates (20.797%) than other strategies (18.045%). The presentation mode × order two-way interaction remains significant ($F_{(1,150)} = 5.734$, $p < .02$, partial $\eta^2 = .066$), and the effects are consistent with our previously presented results. The predicted three-way interaction also emerges ($F_{(1,150)} = 4.19$, $p < .05$, partial $\eta^2 = .029$). With an addition strategy, participants indicate no differences in their estimates (simultaneous $M_{\text{large-first}} = 20.88\%$, $M_{\text{large-later}} = 20.62\%$; $p > .50$, partial $\eta^2 = .012$; sequential $M_{\text{large-first}} = 20.71\%$, $M_{\text{large-later}} = 20.98\%$; $p > .40$, partial $\eta^2 = .010$). Consistent with our expectations, the mode × order interaction is not significant for these participants ($p > .40$, partial $\eta^2 = .009$). However, for participants who use non-addition strategies, the mode × order interaction is significant ($p < .003$, partial $\eta^2 = .110$), and the patterns of means fit our theorizing (simultaneous $M_{\text{large-first}} = 18.62\%$, $M_{\text{large-later}} = 16.87\%$; $p < .05$, partial $\eta^2 = .109$; sequential $M_{\text{large-first}} = 16.82\%$, $M_{\text{large-later}} = 19.87\%$; $p < .03$, partial $\eta^2 = .069$). Thus, the larger percentage exerts a greater impact on overall estimates when it appears first in simultaneous presentations but second in sequential presentations.

Although our thesis centers on evaluations, we replicate Chen and Rao's (2007) findings that many people simply add percentages when estimating and also add nuance: The estimates by participants who do not simply add (about half the sample) are influenced by the presentation mode and order. These results converge with our previous experimental results. In a supplemental study (Web Appendix B, Experiment 7), we measure evaluations and estimates of percentage increases and find the predicted results for both variables. In the following studies, we return our focus to evaluations, to hone in on the underlying processes.

Experiment 4: Price Surcharges and Process

This experiment has two objectives. First, we demonstrate parallel effects for unfavorable changes, such as surcharges or price increases. Price increases are unfavorable, so evaluations should be lower when the large percentage is first in simultaneous presentations and when it is second in sequential presentations. Second, we provide process evidence. Specifically, we measure two key process variables, surprise and the impact of the larger percentage on evaluations (henceforth, "impact"). We expect surprise to influence the sequential but not the simultaneous mode. We expect differences in impact to reflect different anchors in simultaneous versus sequential presentations. A larger percentage should be more impactful when it comes first in simultaneous presentations and when it comes second in sequential presentations. These impact perceptions in turn should mediate the effect of presentation mode and order on evaluations. We recruited 200 panelists (mTurk) for a nominal fee ($M_{\text{age}} = 36.67$ years, 43.0% female). Eight participants failed attention checks, leaving 192 participants in the analysis. The scenario indicated that participants wanted to purchase an extra-large, customized cake for a party. The base price was \$17.00. There was a 10% surcharge for an extra-large cake and an additional 5% surcharge for customization. Thus, this study used a 2 (presentation mode: simultaneous vs. sequential) × 2 (order: large first vs. large later) between-subjects factorial design.

Participants responded to several questions, including our primary deal evaluation measure, and indicated how much impact the larger surcharge had on their evaluations, such that higher numbers signaled a higher impact. Participants also noted how surprised they were to receive a second surcharge (1 = "Not surprised at all," 7 = "Very surprised"). An ANOVA with deal evaluations as the dependent variable indicates a marginal main effect of presentation mode ($M_{\text{simultaneous}} = 4.35$, $M_{\text{sequential}} = 3.94$; $F_{(1,188)} = 3.81$, $p = .0526$, partial $\eta^2 = .026$). The predicted two-way interaction emerges ($F_{(1,188)} = 8.04$, $p = .0051$, partial $\eta^2 = .031$), such that participants in the simultaneous mode thought the deal was worse when the larger surcharge came first ($M_{\text{large-first}} = 4.09$, $M_{\text{large-later}} = 4.60$; $p = .0794$, partial $\eta^2 = .024$), but those in the sequential mode thought it was worse when the larger surcharge was second ($M_{\text{large-first}} = 4.27$, $M_{\text{large-later}} = 3.60$; $p = .0260$, partial $\eta^2 = .055$). This pattern of means mirrors those for discounts, because surcharges are unfavorable. An ANOVA with surprise as the dependent variable reveals a main effect of presentation mode ($F_{(1,188)} = 8.09$, $p = .0049$, partial $\eta^2 = .041$); participants were more surprised in the sequential presentations ($M_{\text{simultaneous}} = 4.33$, $M_{\text{sequential}} = 5.07$). An ANOVA with the impact of the larger percentage indicates a two-way interaction ($F_{(1,188)} = 12.93$, $p = .0004$, partial $\eta^2 = .061$), such that participants in the simultaneous mode believed the larger percentage had a greater impact when it was presented first ($M_{\text{large-first}} = 4.77$, $M_{\text{large-later}} = 4.12$; $p = .0169$, partial $\eta^2 = .051$), whereas the sequential mode produced the opposite perceptions ($M_{\text{large-first}} = 4.67$, $M_{\text{large-later}} = 5.09$; $p = .0081$, partial $\eta^2 = .071$).

We ran several sets of analyses to determine whether surprise affects how sequential, but not simultaneous, presentations get evaluated (see Web Appendix B). For the most comprehensive model, we ran a structural equation model (SEM) in AMOS, in which presentation mode predicts surprise, and then order and surprise interact to predict impact, which in turn predicts evaluations. The model achieves good fit (confirmatory fit index [CFI] = .983, non-normed fit index [NNFI] = .970, root mean square error of approximation [RMSEA] = .080). Presentation mode predicts surprise ($p = .006$); order, surprise, and the order × surprise interaction all predict impact (all ps $< .001$); and impact predicts evaluations ($p < .001$).

The impact measure also indicates different anchoring processes in the simultaneous versus sequential presentations. Therefore, impact perceptions should mediate the mode × order interaction effect on evaluations, not just influence sequential presentations (as surprise does). To test this prediction, we use Hayes's (2013) PROCESS SPSS macro (5,000 bootstrapped samples, Model 4). The interaction effects predict impact ($p < .001$) and deal evaluations ($p < .0001$); however, the direct effect of this interaction on deal evaluations is no longer significant when we include impact as a mediator ($p = .2779$). We find support for an indirect pathway (lower level confidence interval [LLCI] = .0537, upper level confidence interval [ULCI] = .2589). Thus, the effects of presentation mode and order on evaluations are mediated by impact.

Using percentage price surcharges, we observe the predicted mode × order interaction effect on evaluations, in support of our proposed process. In sequential presentations, impact perceptions are driven by surprise; in turn, they fully mediate the effects of the manipulations on deal evaluations, and we also find a mediating role of surprise in sequential presentations. Notably, we find no effect of order or the mode × order interaction on surprise, suggesting that the level of surprise only depends on the presentation mode (see also Experiment 8, Web Appendix B). In the next study, we moderate surprise to provide additional process evidence. By manipulating the proposed process, we offer a further test of our theorizing: If the effects are due to the unexpected receipt of the second percentage, which shifts people's attention, informing participants they will receive two discounts in advance should eliminate this effect.

Experiment 5: Removing Surprise

We recruited 643 panelists (mTurk) for a nominal fee (M_{age} = 35.18 years, 55.40% female). The scenario indicated that participants found a deal on a $5 gift card. Half of the participants were informed that two discounts would be applied, prior to viewing the discounts, so they should not be surprised by the second discount. The other half of participants were not forewarned, and the study otherwise followed our standard methodology. It relied on a 2 (surprise: present vs. absent) × 2 (presentation mode: simultaneous vs. sequential) × 2 (order: large first vs. large later) between-subjects factorial design. The dependent variables are deal evaluations ($\alpha = .92$), the impact of the larger discount on evaluations (impact), and surprise related to the second discount (see Web Appendix B). We expect the surprise manipulation to moderate the process, such that when surprise is present, the effects should be consistent with our prior studies. When surprise is absent (forewarned), participants' attention instead should not shift to the second percentage in the sequential presentations, and we predict only a main effect of order on evaluations and impact, such that large-first orderings should be rated better.

For brevity, we report the tests central to our theory here, with the other results in Web Appendix B. An ANOVA with surprise as the dependent variable reveals a significant main effect of surprise ($M_{surprise\text{-}present} = 4.96$, $M_{surprise\text{-}absent} = 4.28$; $F_{(1,635)} = 30.79$, $p < .001$, partial $\eta^2 = .046$). The manipulation does not have a main effect on the other dependent variables (Fs < 1). Separate ANOVAs with evaluations and the impact of the larger percentage indicate significant three-way interactions ($F_{(1,635)} = 11.46$, $p = .001$, partial $\eta^2 = .018$; $F_{(1,635)} = 12.92$, $p < .001$, partial $\eta^2 = .020$, respectively).

We now turn to the presentation × order effect for each level of surprise (present vs. absent). When surprise is present, the effects match those of prior studies for all three dependent variables. For surprise, we obtain a main effect of presentation mode ($F_{(1,635)} = 18.94$, $p < .001$, partial $\eta^2 = .056$), such that surprise is higher in sequential (M = 5.32) than simultaneous (M = 4.60) presentations. For evaluations, the presentation × order interaction is significant ($F_{(1,635)} = 19.06$, $p < .001$, partial $\eta^2 = .053$), and evaluations in the simultaneous mode are higher when the larger percentage is first ($M_{large\text{-}first} = 4.99$, $M_{large\text{-}later} = 4.32$; $p < .01$, partial $\eta^2 = .041$), but evaluations in the sequential mode are higher when the larger percentage is second ($M_{large\text{-}first} = 4.37$, $M_{large\text{-}later} = 5.03$; $p < .0001$, partial $\eta^2 = .067$). For impact, the interaction again is significant ($F_{(1, 635)} = 28.27$, $p < .001$, partial $\eta^2 = .080$) with a consistent pattern of means (simultaneous $M_{large\text{-}first} = 4.91$, $M_{large\text{-}later} = 4.36$; $p < .01$, partial $\eta^2 = .045$; sequential $M_{large\text{-}first} = 4.23$, $M_{large\text{-}later} = 5.20$; $p < .001$, partial $\eta^2 = .102$). We find no other effects (all ps > .13).

When surprise is absent however, we only observe main effects of order. There are no significant effects on measured surprise (ps > .250). For evaluations, only a significant main effect of order emerges ($F_{(1,635)} = 15.15$, $p < .001$, partial $\eta^2 = .046$), such that evaluations are higher for the large-first (M = 4.97) versus large-later (M = 4.43) order. For impact, we again find a main effect of order ($F_{(1,635)} = 22.60$, $p < .001$, partial $\eta^2 = .067$); participants judge the impact higher for large-first (M = 5.02) than for large-later (M = 4.33) orderings. No other effects reach significance (all ps > .14).

We test for moderated meditation with two PROCESS Model 7 analyses (5,000 bootstrapped samples, Hayes 2013). In the first analysis, the presentation mode × order interaction is the independent variable, and deal evaluations are the dependent variable. The surprise manipulation serves as the moderator, and impact is the mediator. The conditional indirect effect (presentation mode × order interaction → impact → deal evaluations) receives support in the presence of surprise (LLCI = .1415, ULCI = .3159) but not when surprise is absent (LLCI = –.0842, ULCI = .0894). The direct effect is no longer significant ($p > .50$). The presentation mode × order interaction and the three-way interaction both predict impact, and impact in turn predicts evaluations (all ps < .001).

In the second Model 7 analysis, order serves as the independent variable, deal evaluations provide the dependent variable, the surprise manipulation is the moderator, and impact is the mediator. The conditional indirect effect (order → impact → deal evaluations) is not supported when surprise is present (LLCI = –.1502, ULCI = .0206) but receives support when surprise is absent (LLCI = .1207, ULCI = .2915). The direct effect is not significant ($p = .2177$). Order and the order × surprise manipulation interaction both predict impact (ps < .05), and impact predicts deal evaluations ($p < .001$). The moderated mediation analysis results also hold when we perform the mediation analyses at each level of the surprise manipulation (Web Appendix B).

As in Experiment 4, to address a limitation of PROCESS, we ran an SEM model in AMOS, but rather than the presentation mode predicting measured surprise and surprise interacting with order, in this case, we consider a model in which manipulated surprise (informing participants there are two percentages, or not) interacts with presentation mode. The model achieves good fit (CFI = .940, NNFI = .935, RMSEA = .130). Presentation mode, manipulated surprise, and the mode × manipulated surprise interaction all predict measured surprise (all ps < .01). The order, measured surprise, and the order $\times$ measured surprise interaction all predict impact (all ps $< .01$), and impact predicts evaluations ($p < .001$).

The moderation process that we demonstrate with this study speaks directly to our theorized account. Effects emerge in the sequential presentation condition because the (unexpected) second percentage value induces surprise. When participants know they will receive two discounts, the second discount in sequential presentations is no more surprising than in simultaneous presentations. Without surprise, their attention does not shift to the second percentage in the sequential presentations. Consequently, we identify a main effect of order, such that the large-first order yields higher evaluations for both modes, in keeping with an anchoring process. By removing the element of surprise, which prompts the reversed effects of sequential presentations, we find that the outcomes of sequential presentations are similar to those of simultaneous presentations.

Generalizing the Findings and Additional Process Support

We performed two single-paper meta-analyses (SPM; McShane and Bockenholt 2017), one with evaluations and one with surprise as the dependent variables. These analyses include the supplemental studies in Web Appendix B. The SPMs support our findings, as we detail in Web Appendix C.

To specify the role of surprise, we also ran two additional studies (Experiments 8 and 9; Web Appendix B). Consistent with prior literature (Chen and Rao 2002; Heilman, Nakamoto, and Rao 2002), we propose that consumers experience surprise upon receiving the second percentage in a sequential (vs. simultaneous) presentation mode. To isolate the effect of the presentation mode (i.e., remove order effects), in Experiment 8 we used two identical percentages. As expected, we only find a main effect of mode, such that surprise is higher in the sequential presentation. To assess if the level and valence of surprise depend on the value of the second percentage, in Experiment 9, we test different percentages (12–8%, 12–18%, and 12–28%) in sequential presentations. The value of the second percentage does not affect the level or valence of surprise.

Using different approaches, four studies (Experiments 4, 5, 8, and 9) thus provide triangulating evidence of the role of surprise. Experiment 4 demonstrates that surprise exerts an effect in a sequential (but not simultaneous) mode. Experiment 5 offers support through moderation: When consumers are aware they will receive two discounts, the results are similar in the sequential and simultaneous presentation conditions. Experiments 8 and 9 add nuance, clarifying that surprise only manifests in sequential conditions and is not influenced by the value of the second percentage.

Our focus in this article is on pricing, but we expect similar effects in other contexts. We report three studies in Web Appendix B to affirm this prediction. That is, with Experiment 7, we investigate how consumers interpret two improvements to laptop battery life. In Experiment 10, we use a health risk scenario (risk of contracting malaria), in which two actions could reduce people's infection risk. Then in Experiment 11, we use a home heating/cooling efficiency context. The results of all three experiments conform with our predictions.

General Discussion

By investigating how consumers evaluate two percentage changes, we expand the scope of prior work in marketing (Chen et al. 2012; Chen and Rao 2007; Heath, Chatterjee, and France 1995; Mazumdar and Jun 1993), add to core numeracy literature (Kirsch et al. 1993; Peters et al. 2006), and demonstrate a reversal of anchoring effects (Furnham and Boo 2011; Tversky and Kahneman 1974). Either the first or second percentage value can serve as an anchor, contingent on the interaction of their presentation mode and order. When two discounts appear simultaneously, consumers anchor on the first discount, which produces more positive evaluations if the larger percentage is first. When a second discount is unexpected, as in sequential presentations, people's attention shifts to the second discount, which then serves as an anchor for the first discount. These effects are not restricted to evaluations alone and also influence real consumer choices, as well as estimates of overall change.

Caveats and Limitations

Our investigation is limited to two percentage values for a few reasons. First, from an experimental design standpoint, a fully orthogonal presentation mode $\times$ order design with three or more percentages would be unwieldy, though not insurmountable on its own. Second, three percentages make other order sequences possible, whether initially increasing and then decreasing (e.g., 10%, 16%, and 9%), marked by two identical changes and an increase later (e.g., 10%, 10%, and 18%), and so on. A consistent set of theoretically driven predictions is not readily apparent in such cases. Third, consumers likely encounter two percentage changes more frequently than they do three or more changes. With their limited processing abilities (Simon 1990), consumers are unlikely to use additional information systematically to formulate judgments. Likely for similar reasons, past research focuses on two percentage values too. Nonetheless, expanding the number of values may be an important area for research.

We also do not consider mixed percentages (e.g., 10% increase followed by 15% decrease). Mathematically, the actual overall change would differ, depending on whether the increase or decrease comes first (e.g., 10% increase then 15% decrease differs from 15% increase then 10% decrease), so direct comparisons are untenable. We leave this investigation for further research.

The superiority of multiple percentage discounts over a single discount is well-established (Chen and Rao 2007; Mazumdar and Jun 1993), and we confirm it in Experiment 6 (Web Appendix B). Yet comparisons with a single change do not support tests of our hypotheses, so we only situate our research in this prior literature stream. We also do not consider other forms of promotions, such as single discounts with bonus packs (Chen et al. 2012), nor do we compare percentage against dollar amount discounts (for which adding multiple discounts is appropriate). Finally, we do not address the effects of larger discounts (i.e., single changes >30%, as in Experiment 8), which may lead to other inferences (e.g., poor quality). However, large numbers influence decision making in many contexts (Bagchi and Davis 2016; Monga and Bagchi 2012), so continued research could investigate their role in a discount context. Even with these caveats, our theory should hold for many cases and across contexts.

Theoretical Implications

With these caveats in mind, we predict that in any context in which people evaluate two percentage changes in the same direction, the proposed pattern of effects should emerge. Our findings thus have relevance for broad audiences. First, our findings relate to and extend prospect (Kahneman and Tversky 1979) and mental accounting (Heath, Chatterjee, and France 1995; Thaler 1985) theory. Prospect theory suggests that consumers code changes as gains or losses, according to an S-shaped value function relative to a reference point. Thaler (1985) further argues that outcomes from two accounts, such as two gains of $10 and $15, might be integrated and coded jointly ($25) or else segregated and coded separately ($10 + $15), and the chosen coding could affect evaluations. For ease of exposition, we use dollar amounts to describe how our findings advance this theory. Regardless of the coding used, the order should not affect evaluations (i.e., $25 is the same irrespective of order, and $10 + $15 equals $15 + $10). However, we find robust differences in how people evaluate changes that vary in their presentation mode and order, which cannot be explained by prospect theory. The presentation mode and order also influence estimations. Prospect theory would not predict that a consumer would estimate any number other than $25 for the total change. Therefore, extant prospect theory and mental accounting models cannot explain our effects.

Mental accounting about multiple events also tends to relate to changes in two (or more) different accounts, such as winning $100 in a lottery but owing $50 to the landlord (Heath, Chatterjee, and France 1995; Linville and Fischer 1991; Thaler 1985; Thaler and Johnson 1990), whereas the changes we study pertain to the same account. In Experiment 5, when we remove surprise, we observe only a main effect of order on evaluations, so our account is more parsimonious than a mental accounting explanation. Finally, this literature stream mostly deals with changes in the amount (e.g., $100 change in price for a $1,000 item) rather than a single change (e.g., 10%) or repeated percentage changes (cf. Heath, Chatterjee, and France 1995). Nonetheless, it may be possible to extend prospect theory and mental accounting further to account for our findings.

Second, we demonstrate how anchoring effects might be reversed. Anchoring and adjustment processes are robust across many different contexts and seemingly should be difficult to reverse or attenuate (Bagchi and Davis 2012; Furnham and Boo 2011). Yet as we show, presenting an unexpected event (second percentage change) can trigger surprise, which shifts people's attention. Beyond multiple percentages, surprise could alter anchoring effects in other settings, with wide-ranging implications. Additional research should investigate how other surprising changes—such as an unexpected gain or loss—might reverse anchoring effects too.

Third, at a substantive level, we contribute to pricing literature (Cai, Bagchi, and Gauri 2016; Davis, Bagchi, and Block 2015; Lattin and Bucklin 1989). For example, for partitioned prices (e.g., $32 for a shirt +$4.95 for shipping and handling; Morwitz, Greenleaf, and Johnson 1998), the order and mode manipulations we propose may affect consumers' evaluations.

Practical Implications

We offer suggestions for how to communicate percentage value information. When sharing percentage changes, managers should consider whether to use a single value or split it. If they use two percentage values, the chosen presentation mode and order can increase (decrease) evaluations of the overall change in advantageous (adverse) contexts. By altering the presentation of the percentage information, managers can strategically influence judgments. However, percentage changes also may occur sequentially, or consumers may learn about them in a fixed sequence. In those cases, our theory provides insights into how their evaluations likely will be influenced. Armed with this knowledge, managers can better anticipate their audience's evaluations and potentially incorporate other information to enhance a likely positive evaluation or mitigate the impact of a negative evaluation.

From a pricing and retailing perspective, our research provides insights as well. Many firms offer "stackable" discounts—sometimes simultaneously and at other times sequentially (see Web Appendix A). In many situations, consumers encounter both discounts at the same location, such as the retailer's website or store. Chen and Rao (2007) cite several retailers that frequently offer stackable discounts. Likewise, retail stores provide additional discounts when customers open credit card accounts or sign up for loyalty programs. Our research is informative for such situations. In addition, manufacturers and retailers tend to issue coupons online, in flyers, or via email or mail, then provide additional discounts in stores. In those cases, consumers receive two discounts sequentially. However, the receipt of the second discount is conditional on the consumer's decision to visit the store, after receiving the first discount. We leave this case for further research.

Central to our research is the idea that most people do not realize the result of multiple percentage changes is invariant with respect to the order of presentation or that their evaluations are skewed by both presentation mode and order. Informing people of this relationship may enhance their numeracy and aid in their decision making, which can lead to positive outcomes in many domains.

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