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Response Mode Effects in Consumer Judgments: Percentages vs Numbers

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Abstract

Literature on ratio bias as well as consumer processing of percentage data shows that due to over emphasis of type 1 processes on whole numbers, consumers tend to neglect information about the base or denominator while making judgments. Consumers also adjust numerical judgments to maintain intuitive plausibility which can result in systematically biased judgments. Drawing on these findings, we explore response mode effects for judgments of the same quantity elicited in numbers vs percentages. Two studies across multiple domains show that number judgments are lower than percentage judgments in cases where the bases are large. Another study shows that the difference persists while making such judgments for others. Finally, a fourth study shows that in the face of increases in base value, number judgments reduce as a ratio of the base while percentage judgments remain stable. A possible mechanism accounting for the results and future research directions are discussed.

Keywords*: Response mode effects; ratio bias; base value neglect; dual process thinking; value estimation*

1. Introduction

"In our affidavit to the Supreme Court, we had reported the poverty line in terms of monthly expenditure for a family because this is how the household budgets are normally understood. However, in public discussion, the monthly consumption figure has been converted into a daily per capita figure namely Rs. 32 for urban areas and Rs. 26 for rural areas which makes it appear very low". (Affidavit by Montek Singh Ahluvalia quoted by Swaraj, 2011)

"I don't know what percentage figures your officers give to you, but the common man doesn't understand the language of percentages. The common man understands the language of what is going out from his pocket, and what is he getting in return". (Swaraj, 2011)

The above excerpts are from a discussion on inflation held on the floor of the lower house of the Indian parliament in 2011. The leader of opposition in the house Sushma Swaraj, in the first instance was countering an explanation provided by the vice chair of the planning commission, who had tried explaining that the figures for the poverty line in India appeared too low due to a change in frame from the amount available to the household per month to the amount available to an individual per day. Sushma Swaraj in the second instance was criticizing the government's use of percentage figures to explain movement of people above the poverty line and the prevalent high inflation at the time. Her main criticism hinges on the view that common people find percentages difficult to understand.

Over the past two decades or so, especially since research on the ratio bias phenomenon (Kirkpatrick & Epstein, 1992 ; Denes-Raj & Epstein, 1994; Pacini & Epstein, 1999), we have come to understand that the same quantities could carry very different meanings due to a change in frame. This growing body of research points to the general tendency of people to underweight and at times completely ignore information about the base on which number values are provided. For instance 1286/10,000 is considered riskier than 24.14/100 due to

both the numerator and denominator being larger and people not fully considering the difference in denominators (100 vs 10,000), (Yamagishi, 1997). Reyna (2004) refers to this tendency as denominator neglect.

In the past decade and a half, a research program focussing specifically on consumer utilization and understanding of percentage data (Chatterjee, Heath, Milberg, & France, 2000; Chen & Rao, 2007) has contributed to our knowledge of how consumers react to percentage data available to them. Denominator neglect has been an implicit part of many studies in this research program. More recently, Chen, Marmorstein, Tsiros, & Rao (2012) have referred to the tendency of disregarding the base while processing percentages as base value neglect or BVN.

We hope to contribute to the research on base value neglect and the research on consumer understanding and utilization of percentage data, through the exploration of systematic differences in consumer expectations, when they are expressed in numbers (be it in terms of currency as rupees or dollars or in terms of number of individuals etc…), versus when they are expressed in percentages. Extant literature has not studied the difference between judgments in numbers and percentages. Moreover, most studies have focussed on evaluation or preference of numbers provided to consumers, and there are few studies which have looked at judgments freely generated by consumers. The paper outlines our efforts to understand such differences.

The organization of the paper is as follows. We first review some effects, uncovered in Psychology, Economics, and Marketing which are related to individuals neglecting the denominator or base value, and making their judgments on the basis of the number associated with the judgments rather than real values that these numbers represent. We then show across four studies that systematic and predictable differences occur when consumers

are asked to generate quantitative judgments like discounts, mark-ups etc… due to the number vs percentage response mode. Finally, we conclude with a discussion on the limitations and future research possibilities.

2. Denominator Neglect Effects

2.1. Ratio Bias

The ratio bias program of research was developed by Epstein and Colleagues, to effectively delineate what they called the experiential and the rational systems posited as a part of the dual processes cognitive experiential self-theory of personality (Epstein, 1991, 94). The ratio bias research, itself based on an experimental paradigm developed by Miller, Turnbull, & McFarland (1989), consisted of exposing participants to outcomes, which were identical in terms of objective probability, however differed in terms of number of successful outcomes and number of total outcomes, for example 1/10 vs 10/100. For instance, Kirkpatrick & Epstein (1992) asked participants to draw from one out of two bowls containing different colour beans. One bowl contained 1 red out of a total of 10 beans while the other bowl contained 10 red beans out of a total of 100 beans. The participants were told they would win money if they drew a red bean. Kirkpatrick and Epstein found that even though the probability of success was the same across the two bowls, participants preferred the bowl with the larger number of red beans over the one containing the smaller number of red beans. Subsequent studies on the ratio bias phenomenon showed that even in cases where the probability was lower for the condition which had a higher absolute number of winning cases (bowl containing 7 red beans out of 100 vs 1 red bean out of 10), some participants preferred to draw from the bowl containing the higher absolute number (but lower probability) of winning outcomes (Denes-Raj & Epstein, 1994). Moreover, the participants seemed to do this despite knowing that the probabilities were higher in the bowl containing only one red bean.

Pacini & Epstein (1999) in an investigation utilizing the Rational Experiential Inventory (REI), an instrument which measured rational and experiential thinking styles, also showed that participants relying more on the rational system were less prone to committing the ratio bias (Also see Alonso & Fernandez-Berrocal, 2003).

Epstein and colleagues took these results to mean that the experiential system relied on absolute numbers rather than ratios, since the absolute numbers are more concrete, and therefore more amenable to encoding by the concretive, effortless, automatic and rapid experiential system. Encoding and processing ratios on the other hand was seen to be the task of the abstract, effortful, deliberative, and slow rational system. This reliance on absolute numbers rather than ratios reduces among individuals with a more rational thinking style.

Extending the ratio bias research to risk assessments, Stone, Yates, & Parker (1997) enhanced this effect by increasing the salience of the numerator through graphical representation of risk information. Similarly, Bonner and Newell (2008) showed that when the statement "100 people die from cancer everyday" was translated to the annual equivalent of "36,500 people die from cancer every year", the participants judged the risk to be higher in the year frame. Burson, Larrick, & Lynch (2009) extended this research on denominator neglect to multi-attribute judgments, where they showed that expanded scales (for instance price per year) exaggerate the differences between two options as compared to contracted scales (price per month/week). Pandelaere, Briers, & Lembregts (2011) in a recent set of studies showed that the use of expanded scales made the attribute differences appear larger as compared to contracted scales and that this effect could be mitigated by making people think about alternative units that may be used to represent the attribute information. For instance, in one study they provided subjects with a delivery schedule in either months (3/12) or days (91/365 days) and gave them the choice of deciding to pay more for earlier delivery by 1 month or 31 days. Subjects in the day frame showed greater preference for expedited delivery, when prior

to making the choice they were exposed to a slider containing periods described using only the focal unit (either months or days), but not when exposed to a slider which contained half of the periods described in days and the other half in months.

2.2. Numerosity

The numerosity of a stimulus is defined as the number of discernible units that are contained in it (Brannon & Terrace, 1998). Pelham, Sumarta, & Myaskovsky (1994) in a set of explorations separate from the ratio bias research showed that people tend to focus on the number of units while making decisions rather than the size of the units. For instance in one of the studies, subjects judged an addition problem containing many terms (3.6 + 5.3 + 6.5 + 10.2 + 2.1 + 3.7 + 1.8 + 0.8) as representing a greater sum than a problem containing fewer terms (7.7 + 12 + 6.2 + 8.1) which actually contained the same sum. They termed this sensitivity to the numerosity of the stimulus "the numerosity heuristic". They also showed that people were especially prone to basing their judgments on the numerosity when they were making difficult judgments, when they were short of cognitive resources (for instance, when they were performing a concurrent activity) or when they were under time pressure.

2.3. Money Illusion and Currency Effects

A third line of research has studied effects of the tendency to focus on the nominal value, and disregarding the real value associated with monetary information. Shafir, Diamond, & Tversky (1997) investigated the phenomenon they termed "money illusion", and found that individuals based their judgments of happiness from salary increases on nominal rather than real increases, and they did so despite knowing which of the two situations was economically superior. In one of the experiments, Shafir et al told the participants about two individuals, one of which got a raise of 2% at the end of her first year when there was no inflation, while the other got a raise of 5% at the end of her first year when there was 4% inflation. They then asked the participants to judge who was economically better off, and who was happier. They

found that while most of the participants correctly identified the individual with the 2% raise as being economically better off, most participants judged the individual with the nominally higher raise of 5% to be happier. Shafir et al suggested that an economic transaction was represented in nominal and real terms and the relative weights assigned to these representations determined whether the judgments were biased in favour of the option that was nominally better, but was either inferior or similar in real terms.

Gamble, Garling, Charlton, & Ranyard (2002), in studying the potential effect of change from local currencies to the Euro, documented a phenomenon related to money illusion. They termed this effect "Euro illusion". They found participants showed a tendency to assess prices expressed in Euros to be lower as compared to their local currency when the local currency was valued lower than the Euro, and a higher number of the local currency was used to represent the same amount (for instance Swedish crowns which had an exchange rate of 1 Euro to 8.60 SC). On the other hand, when the local currency was valued higher, for instance pound sterling, and a lower number of pounds was used to represent the same amount, there was a reversal in this tendency. Gamble et al attributed this effect to the participants being biased by the numbers of the Euro and the local currency involved when evaluating prices. Similar effects in case of price estimates were reported by Dehaene & Marques (2002).

Raghubir & Srivastava (2002) also extended the work on money illusion to the effects of foreign currency face values on product valuations. They found in a set of studies that the amount participants were willing to pay for a product in a foreign currency was lower than what they were willing to pay in the local currency when the foreign currency was lower in value and therefore more numerous than the local currency. Raghubir & Srivastava evoked an anchoring and adjustment effect (Tversky & Kahneman, 1974) as the explanation for the results. They suggested that due to familiarity, the value in local currency automatically served as the anchor, and the participants adjusted for the currency difference to come up

with the price they were willing to pay. They suggested that since the adjustment was effortful it was prone to be insufficient, especially under time pressure, and in situations when participants were inexperienced with the conversion. In a subsequent set of studies extending this work, Wertenbroch, Soman, & Chattopadhyay (2007) showed that when the participants were given budget constraints, they ended up spending more in the low value - more numerous currency than in the high value – less numerous currency. They suggested that this happened, since the leftover budget after reducing the payment appeared higher in the more numerous currency, leading participants to believe they had a higher amount leftover after the payment.

2.4. Percentage Processing

Research on the processing of percentages over the years has found biases similar to the biases resulting from denominator neglect, or overweighting of nominal values. Chen & Rao (2007) in an investigation of multiple percentage discounts found that a double price discount of 25% followed by 20%, where the absolute numbers add up to 45 (25+20) but the discount added up to only 40% (25% + 20% of 75% of the price), was preferred over a single discount of 40%. Similarly, Kruger & Vargas (2008) found that consumers felt that the subjective price difference between two quantities ($1500 and $1000) was higher, when the larger value was referred to as 50% higher than the lower value as compared to when the lower value was described as 33% lower than the higher value. Similarly, Chen, et al., (2012) in a set of field and laboratory experiments investigating the relative preferences for bonus packs and price discounts found a similar tendency among the participants to disregard the base values while processing percentage information. Participants found a 50% bonus pack to be more attractive than an economically equivalent price discount of 33%, and they preferred a 33% reduction in quantity over an economically equivalent price increase of 50%.

2.5. Common Dual Process Thread in the Denominator Neglect Literature

Dual process theories of the mind (Epstein 1994; Evans 2006; Kahneman & Frederick 2002; Sloman 1996; Stanovich & West 2000; Strack & Deutsch, 2004) have posited the presence of two different sets of processes that contribute to human reasoning, judgments and decision making. Although the theories differ in specifics, they more or less agree that one set of processes are automatic, fast, effortless, experiential or affect driven, and largely uncontrolled. These processes are believed to be shared by humans with other animals and therefore are considered to be evolutionarily old in origin. These set of processes are collectively known as type 1 processes (Evans & Stanovich, 2013). The other set of processes are deliberate, slow, effortful, driven by rules, and largely controlled. These processes are thought to be especially and atypically characteristic of humans, and considered to be evolutionarily new and of relatively recent origin. The preferred term for these processes is type 2 processes. Type 1 processes allow for quick and effortless generation of solutions to focal problems but may lead to responses that deviate from normatively correct responses, especially in logical and mathematical contexts. Type 2 processes on the other hand may lead to the normatively correct answers but are resource intensive.

A common thread in the different streams of research investigating the effects of neglecting the denominator values is that such biases are due to the focus of type 1 processes on numbers associated with the quantity, rather than the real value these numbers represent. The ratio bias literature has its origins in the investigation of the interaction between the experiential system which is analogous to type 1 processes and the rational system which is similar to type 2 processes. Denes-Raj & Epstein (1994) reported the participants feeling conflicted between the numerator based non normative response, and the ratio based normative response. They suggested that the conflict was due to the competition between parallel responses provided by the experiential system (numerator based response) and the

rational system (ratio based response). Therefore the ratio bias literature developed as a demonstration of Epstein's (1994) parallel competitive dual process theory.

The focus of low effort, fast processes on quantity numerosity is implicit in the work of Pelham et al (1994) as well, who demonstrated that people show greater susceptibility to the bias in conditions that suppress type 2 processing. They reported participants showing greater numerosity bias when participants were put under cognitive load, and when they were put under time pressure. Both of these two conditions are classic manipulations which dual process theorists utilise to enhance type 1 processing (see Evans & Curtis-Holmes, 2005 for a time pressure based investigation), (see DeNeys & Franssens, 2009 for a cognitive load based investigation). Hence numerosity literature also highlights the greater utilization of numerosity in conditions where individuals have to rely on type 1 processes.

Money illusion and subsequent currency effects also mention two valuations, that people arrive at in different manners. Shafir et al (1997) attribute the money illusion to overweighting of the nominal valuation of the focal situation over the real valuation. Raghubir & Srivastava (2002) in their extension on processing foreign currency values note that the nominal or face value based valuation which serves as the anchor in judgments in foreign currency is arrived at automatically, while the adjustment according to the conversion rates is an effortful controlled and deliberate process.

Chen et al (2011) in trying to explain the base value neglect in preference of bonus packs have also relied on processes resembling type 1 processes. They suggested that these effects could have evolutionary underpinnings since the intuitive number system that we share with other animals, see Izard & Dehaene (2008), for a discussion on the nature of the intuitive numerical representations), is frequentist and functions with whole numbers rather than with ratios and percentages (Cosmides & Tooby, 1996).

Hence, people show a tendency towards basing their decisions and judgments regarding quantities on the basis of the number rather than the real value associated with the quantity. This tendency could be thought of as resulting from automatic responses provided by type 1 processes, and are therefore enhanced when people have to rely on such processes. On the other hand, these tendencies should be mitigated if people rely on systematic type 2 processing.

3. Research Focus and Hypotheses

There could be cases when the same quantity could be elicited in numbers or percentages, for instance one could ask a potential new recruit about salary expectations and the person could express his expectations in terms of a minimum percentage or currency increase over the previous salary. Similarly, while bargaining, consumers may ask for a rupee or a percentage discount from the seller. A sales target could involve a percentage or number of units or revenue increase over the last year's figure and this could produce different targets since the numbers associated with the increase in each of these scales would vary. Elicitation of judgments in different scales could produce systematic differences which can have important business implications. Such differences remain as yet unexplored.

3.1. Differences in Number and Percentage Judgments of Same Quantity

Every percentage point corresponds to a number depending on the base value. For example, 1% of 100 is 1 while 1% of 100,000 is 1000. The same 1% can vary widely depending on the base. Due to the way people process numbers and percentages, a percentage figure which is intuitively plausible may become implausible when converted to the corresponding number, depending on whether the % figure translates to a small or large number. For instance, if people are asked the percentage of households in Bengaluru with annual income of more than Rs. 1000,000, they may respond with say 6%, which is a single digit number. However, due to the large number of households (approx. 1,800,000) the corresponding figure in number

translates to 1,08,000 which could appear intuitively too high to some individuals leading them to adjust the figure downwards.

When bases (denominators) increase, number judgments, but not percentage judgments, have to increase to maintain the ratio, (For example, judgment of 500 patients out of 5000 would have to increase to 1000 if the base (denominator) increased to 10,000 patients to maintain the ratio, however remains 10% for percentage judgments no matter the base/denominator). Therefore, as the number increases with the base (denominator), some downward adjustment to maintain intuitive plausibility may occur. This prediction is supported by the results of the first experiment in Raghubir & Srivastava (2002). They studied the willingness to pay for neckties across 6 currencies. The currencies ranged in terms of the conversion ratio to dollar from Norwegian Kroner ($1.00 = 9.5 Norwegian Kroner) to Turkish Lira ($1.00 = 685,000 Turkish Lira). The willingness to pay was the highest for the Norwegian Kroner ($15.85) and reduced steadily as the conversion ratio increased, to reach the lowest for Turkish Lira ($10.77). Hence, as the numbers associated with the judgment increased, subjects adjusted them downwards.

The above discussion leads to the following two specific hypotheses

H1: For large enough bases, percentage judgments (when converted to numbers) will be more numerous than number judgments.

H2: With increase in base value, number judgments (as a ratio of base value) will decrease, while percentage judgments will remain stable.

3.2. Differences in Judgments for Self and Others

Pronin, Olivola & Kennedy (2008) suggested that individuals are likely to be in a relatively cold state and the emotional experience of their decision is likely to be less intense when

choosing for others as compared to choosing for themselves. Apart from this, Mukherjee (2010) in his discussion of factors influencing involvement of type 1 processes in risky decision making suggests that decisions for self are likely to have greater involvement in type 1 processes. Therefore we expect reduced involvement of type 1 processes when individuals make judgments for others as compared to for self. This reduced type 1 involvement should in turn reduce the differences between percentage and number judgments when individuals make such judgments for others.

H3: The difference between number and percentage judgments will reduce for judgments made for others as compared to judgments made for self.

4. Research Contribution

Our research contributes to the literature in three ways. Firstly, although literature establishes framing effects on numerical judgments, most of the studies have dealt with the perception and evaluation of numbers provided to subjects. Researchers have rarely asked subjects to generate subjective numerical judgments using different scales. Differences in freely generated judgments in different response modes consisting of numerical scales thus remain understudied. There can be differences in consumers' processing of numbers depending on whether they are asked to evaluate a number or generate a number. For instance, Desvuoges, Gable, Dunford, & Hudson, (1993) studied contingent valuation of passive losses. These are situations where the value of a natural resource doesn't depend on whether humans actually use the natural resources they are being asked to value. The authors reported that when they used the "referendum technique" and asked people if they were willing to pay an unreasonably high amount ($1000 in this case), 34% accepted the amount. However, when respondents were asked the maximum amount they were willing to pay, only 4% gave an amount higher than $1000.

Secondly, previous research has implicated biased encoding for denominator neglect effects. Recall that Epstein and colleagues had suggested that biased encoding by the experiential system was responsible for the ratio bias phenomenon. The study of produced or generated amounts is also important since it helps in distinguishing effects based on biased encoding and effects based on biased responding. If a similar effect exists for generated amounts then it cannot be attributed completely to biased encoding, since the responder is not encoding numbers provided by the researcher.

Thirdly, the denominator neglect literature has compared ratio with ratios, but not ratios with numbers. As one of the major points in the inflation debate (Swaraj, 2011) was the difference in processing numbers vs percentages by the common Indian people, the current piece of research contributes to our understanding of such processing by studying systematic differences in judgments generated in numbers vs percentages.

5. Study 1: Differences in Number and Percentage Judgments across Three Domains

In the first study (conducted online), we elicited consumer expectations in three domains. The domains were selected in such a manner that in one of them the consumer would be better off as the number/percentage figure increased (gain domain) and in another, the consumer would experience both loss as well as gain, and would be economically worse off as the number/percentage figure increased, but not necessarily experience negative affect. In this particular scenario, economic loss would be offset by positive affect (neutral domain). In the third scenario, the consumer would be worse off as the number/percentage figure increased (loss domain). This approach was chosen to establish robustness across domains. In all the three situations, we expected the number judgments to be lower than the percentage judgments.

5.1. Method

5.1.1. Participants and Design

91 (average age = 32; females = 37) participants recruited from the Amazon Mechanical Turk crowd sourcing platform participated in the study. A questionnaire was set up on www.qualtrics.com, which is an online survey tool, and link to the questionnaire was provided to participants at Amazon Mechanical Turk. As two of the scenarios contained figures in Rupees, the sample consisted only of individuals residing in India. The participants were provided a sum of 5 cents for their participation in the study.

The study was a 2 (response scale: Number vs percentage) X 3 (Scenario: Gain, Neutral and Loss) mixed design, with the response scale manipulated between groups and response scenario within groups.

5.1.2. Procedure

The participants were asked to participate in a small study, and were randomly assigned to the percentage and number conditions. They were then asked to provide their responses to the following three situations, the order of exposure of these situations was randomized. Participants in the number condition were required to type in a number in a box allotted, while those in the percentage condition were required to move a slider between 0 – 100 to indicate their judgment.

Loss Domain: *Imagine that you suffer from a major ailment which has left you suffering chronic pain, which is not controlled by pain killers. The doctors have informed you of a new surgical procedure which will result in the removal of the pain. The procedure is not risk free, and there is a chance of you losing your life. Last year 21,387 people underwent that surgery.*

Number response: What is the highest number of deaths out of those who took the surgery last year at which you would still consider undergoing the surgery?

Percentage Response: What is the highest percentage of deaths out of those who took the surgery last year at which you would still consider undergoing the surgery?

Neutral Domain: *Imagine that you earn Rs. 5,63,452 per year. After paying for rent and other expenses, you want to donate some of your money to charity.*

Number response: What amount of your annual income would you like to donate as charity?

Percentage response: What percentage of your annual income would you like to donate as charity?

Gain Domain: *Imagine that you are going to buy a flat in your place of residence. The flat costs Rs. 67,90,000. You like the house but are currently considering other similar options. You think a little discount from the builder can make you lean towards this property.*

Number response: At what discount amount in Rs. Would you choose to buy the property?

Percentage response: At what discount percentage would you choose to buy the property?

The participants thereafter answered some questions regarding their personal details and also answered attention check questions. We removed the responses of participants who did not answer the attention check questions correctly.

5.2. Results and Discussion:

For each scenario, we converted the responses in the number condition into percentages and compared the mean of this figure with the mean percentage figure provided by the participants responding in percentages. As can be seen in Figure 1, independent samples t tests show that participants responding in numbers (patients or rupees) provided a judgment

significantly lower than the judgment provided by participants responding in percentages, t (91) = 3.43, p = .001 for the surgery, t (91) = 3.97, p<.001 for charity, and t(91) = 3.46, p = .001 for home discount. (See table 1 for details)

Figure 1: Number and Percentage Judgments for Gain, Neutral, and Loss Domains

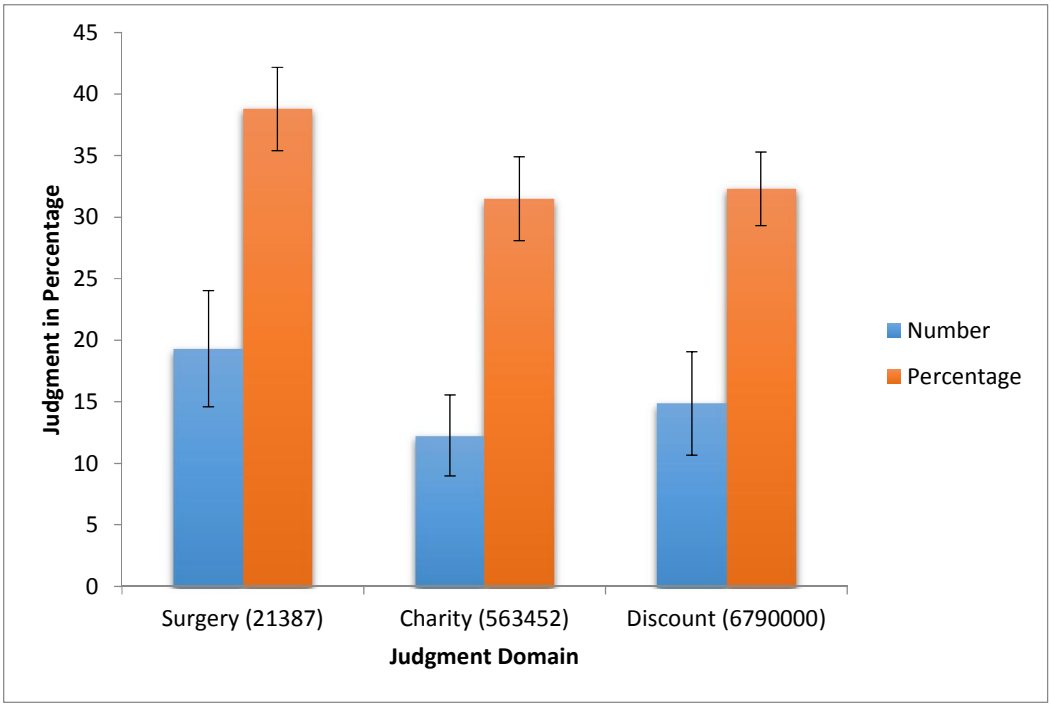


Table 1: Number and Percentage Judgments for Gain, Neutral, and Loss Domains

Response Elicitation/ Scenario	Surgery (21,387)	Charity (5,63,452)	Discount (67,90,000)
Number	19.31 (29.8)	12.25 (20.5)	14.86 (26.62)
Percentage	38.78 (24.21)	31.49 (24.29)	32.29 (21.39)
P Value	.001	<.001	.001

Note: Number responses have been converted to percentages

Thus, responses were significantly larger when provided in percentages as compared to those provided in numbers. Importantly, the pattern was the same across scenarios where increase in the elicited judgment would have a positive, neutral or negative effect among the participants. This finding is consistent with our prediction that the judgments elicited in percentages would be systematically higher than those elicited in numbers.

6. Study 2: Persistence of Difference between Number and Percentage Judgments

6.1. Motivation for the Study

There were two reasons for doing the study. First, we wanted to try a pen and paper replication of the effects found in study 1. This replication was also important, since although study 1 showed the predicted difference between the judgments produced in whole numbers and percentage, it is possible that this difference was present not due to the differences in mental representations of the judged quantities in the two scales but rather due to the fact that in one of the response conditions (percentage), the ratio of judged quantity to total was represented visually, while in the other condition, only the final quantity was produced. There is evidence that the differences due to denominator neglect are exaggerated due to graphical representation (Stone et al 1997; Stone, et al 2003), which increases the visual salience of the difference. Hence, it is possible that the effect seen in the previous study was due to the differences in salience of the judged remaining amounts. Hence, we wanted to check the difference between judgments made in number and percentage when both judgments are elicited in the exact same manner.

The second reason for this study was to check the effect of exposure to figures on the other scale on judgments given in the focal scale. For instance, it would be interesting to see if the judgments given in rupees change when the participants are exposed to corresponding figures on a percentage scale and vice versa. Pandelaere et al (2011) found that bringing people's

attention to the fact that the same figures can be expressed on an alternative unit, reduced the effect of difference in numerosity between two scales. They asked participants whether they were ready to pay more for earlier delivery specified as days (high numerosity) or month (low numerosity). The participants were willing to pay more in the day condition than the month condition however this effect was eliminated when the participants in each condition was reminded of the possibility of representing the duration in the alternative temporal unit. This study explores whether the judgments provided in numbers of percentages change when the participants are made aware of the corresponding figure on the other scale.

6.2. Method

6.2.1. Participants and Design

61 subjects (average age = 18.3, females = 53), pursuing their undergraduate studies in Psychology participated in the experiment and were given course credit as incentive for their participation in the study. Response unit (Percentage vs Rupees) was manipulated in a between groups design, with participants in both groups giving two responses (initial response, and a final response post exposure to the conversion table converting figures in the response scale to corresponding figures in the alternative scale). The dependent variable was the discount expected for purchasing a mobile handset.

6.2.2. Procedure

The participants were told they would be participating in a small study, and were thanked for their participation. The participants were then showed the following vignette.

You are all set to buy a mobile phone. The handset that you like a lot costs Rs. 23499 (MRP). You decided to bargain with the retailer so that you can get some discount on MRP of the handset.

The participants were then asked to write the % or Rs discount that they would ask the retailer to provide for the handset. In both groups, the participants wrote the desired discount in a box.

Once they had provided their expected discount, the participants were shown the percentage to rupee or rupee to percentage conversion table and asked to circle the amount they had indicated in the earlier question. Participants in each group were told to circle the figure in the alternative scale closest to the one they had provided. This was done to ensure that the participants correctly identified the equivalent discount in the alternative unit, and so that the alternative figure was salient. Thereafter they provided a second judgment in the same unit as earlier, by writing the desired discount in a box.

6.3. Results and Discussion

We converted the discount provided in rupees into percentages and then used them along with the percentage figures provided by participants in the percentage condition to run a 2 X 2 mixed measures ANOVA, with initial and final expected discount as the within groups variable, and the response unit (rupee vs percentage) as the between groups variable (See Figure 2). The ANOVA showed a main within groups effect $F(1,59) = 5.95$, $p < .02$, partial $\eta^2 = .09$ and a main between groups effect of unit $F(1, 59) = 22.13$, $p < .001$, partial $\eta^2 = .27$ (See table 2 for the details).

Independent samples t tests showed that the mean percentage discount was higher than the mean rupee discount in case of both the initial $t(59) = 4.29$, $p < .001$, and final responses $t(59) = 4.68$, $p < .001$. Paired samples t tests for comparison of the initial and final responses in the two conditions showed that the final expected discount was significantly higher than the initial discount when the expectation was given in rupees $t(31) = 2.55$, $p < .02$. However

the final expected discount was not significantly higher than the initial discount when the expectation was given in percentages t (30) = 1.69, p > .1.

Figure 2: Percentage and Rupee discount Expectations Pre and Post Exposure to Conversion Table.

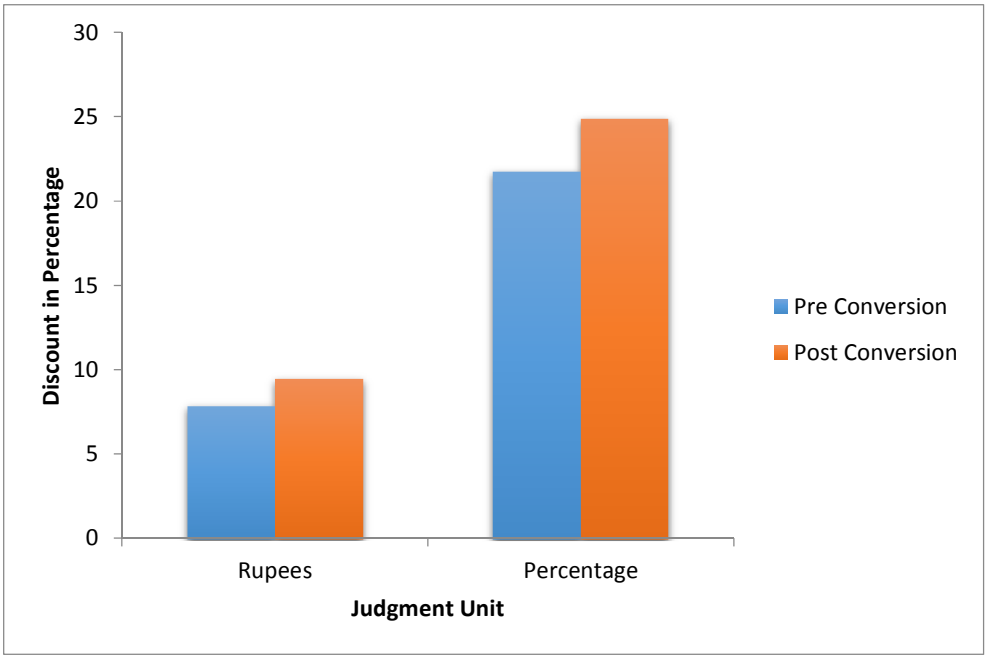


Table 2: Discount Expectation in Rupees and Percentage, Pre and Post Exposure to Conversion Table

Condition	Percentage	Rupee	P value
Discount pre exposure	21.76 (16.33)	7.85 (7.51)	<.001
Discount post exposure	24.9 (16.15)	9.43 (8.70)	<.001
P value (paired sample t test)	.101	.016	

Note: Rupee judgments have been converted to percentages

Thus we find the expected difference between the discounts asked in percentages and in rupees, with the percentage expectations being significantly higher than the rupee expectations. Hence we have replicated the findings of the first study, and find that the difference between percentage and rupee expectations is robust and in the direction predicted, and cannot be explained as a difference generated by greater visual salience of the judgments in one response mode. Although both the groups increased their discount expectations post exposure to the conversion table, the increase was significant among those who gave the response in rupees, but not significant among those giving the response in percentages.

7. Study 3: Price Mark-ups in Dollar and Percentages across Price Points

This study explores how response modes affect mark-ups when there is a change in price within the same product category. We predicted that the judgments provided in percentages for different prices will remain the same, thereby showing a linear relationship between increase in price and increase in mark-up added to the price. The currency mark-ups for different prices on the other hand are not expected to increase proportionally to the increase in price, and are expected to decrease when converted to percentages.

7.1. Method

7.1.1 Participants and Design

199 participants, (average age = 37.1, females = 115) residing in the United States of America, recruited on the Amazon Mechanical Turk crowd sourcing platform participated in the study. The study had a 2 (Units: Dollars vs Percentage) X 3 (Researvation Price: $ 5000, $15000, $25000) between subjects design. The dependent variable was the amount of mark-up put over the price for selling a car.

7.1.2. Procedure

After recruitment and being randomly assigned to different conditions, the participants were exposed to the following vignette. The participants were asked to respond to the imaginary scenario as they would if the scenario was present in real life. They were also informed of two information check questions they would have to respond to at the end of the study, and were told to answer the questions carefully.

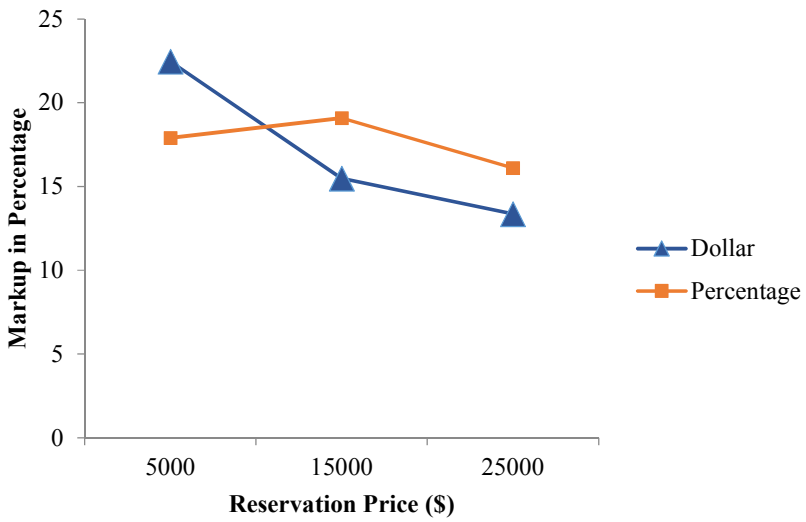
Imagine that you currently own a car. You are trying to sell this car and the lowest price you will accept for this car is $ 5000/15000/25000. You anticipate some bargaining on the price. You expect that the buyer will negotiate and bring down the first price you quote. Hence you decide to add a mark-up (some %/ $ amount over the lowest selling price) and quote a price higher than the lowest selling price of $ 5000/15,000/25000. Keeping that in mind what %/$ mark-up will you add to get the price you will quote to the customers?

They were then instructed to provide the % or $ mark-up in a box made available for the response. The participants then gave personal details like their age, gender and educational qualifications and thereafter proceeded to answer the attention check questions. The responses given by participants who did not answer both the attention check questions correctly were removed.

7.2. Results and Discussion

A 2 (Response Unit) X 3 (Price) between subjects ANOVA (See Figure 3) showed a marginally significant interaction of response unit and reservation price $F(1, 193) = 2.98$, $p = .05$, partial $\eta^2 = .03$. There was no main effect of response unit $F(1, 193) = .158$, $p > .6$. partial $\eta^2 = .001$

Figure 3: Markup in Dollar and Percentage for Three Reservation Price Points.



Planned contrasts for price differences in mark ups, showed that for percentage mark ups, there was no significant difference between mark ups for $5000 and $15000, t (64) = .46, p > .6; between mark ups for $5000 and $25000, t (58) = .69, p > .45; and between mark ups for $15000 and $ 25000, t (64) = 1.57, p > .1. On the other hand, for mark ups provided in dollars (converted to percentage), mark-up was significantly higher for $ 5000 than for $ 15000, t (70) = 2.32, p = .02; mark up was significantly higher for $ 5000 than for $ 25000, t (66) = 3.21, p = .002; mark-up was not significantly different for $ 15,000 and $ 25,000, t (64) = .84, p > .4.

Planned contrasts for differences in mark ups due to response unit showed that for a reservation price of $5000, the $ mark-up was nominally higher than the percentage mark-up but this difference was not significant, t (65) = 1.4, p > .15; for the reservation price of $ 15,000, the percentage mark-up was nominally higher than the $ mark-up but again this difference was not significant t (69) = 1.51, p > .1; for the reservation price of $ 25,000 the

difference between the percentage and $ mark-up was not significant t (59) = 1.39, p > .16 (See table 3 for details).

Table 3: Markup in Dollar and Percentage across Three Reservation Price Points.

Mark up (mean) /Price	$ 5000	$ 15000	$ 25000	Total
Dollar	22.46 (13.7)	15.48 (11.5)	13.35 (8.4)	17.34 (12.16)
Percentage	17.9 (12.4)	19.08 (8.2)	16.1 (9.37)	17.78 (9.37)
Total	20.42 (13.27)	17.31 (10.1)	14.7 (7.78)	17.56 (10.88)

Note: Dollar judgments have been converted to percentages

Hence, as expected, the mark up provided in dollars reduced in proportion to the price as the reservation price increased, while the mark up provided in percentages did not show significant change with the price increase. These results confirm our predictions that percentage responses are relatively more stable than responses in currency values. This could be because for the actual ratio to remain the same, the number has to increase with the increase in base value, hence if the base value is 25,000 rather than 5000, for the ratio of mark up to price to remain at 1:5, the $ mark-up has to increase from $ 1000 to $ 5000, and a negotiation of $ 1000 may seem acceptable to people, a negotiation of $ 5000 may seem like too much. On the other hand for the ratio to remain at 1: 5, the percentage need not change from 20% as the price increases, and a negotiation of 20% would remain the same no matter the price.

8. Study 4: Percentage and Number Expectations for Self and Others

We investigate how the difference between currency (whole number) and percentage discount changes when the purchase is for others rather than themselves. We expect the difference to reduce when the discount expectations are provided for others as compared to when they are provided for self. Hence the purpose of the study is to check whether there is support for H3.

8.1. Method

8.1.1. Participants and Design

101 participants (average age = 20.58, females = 83) pursuing their undergraduate studies in a Bangalore University participated in a 2 X 2 between subjects study and were provided course credit for their participation. The between subjects independent variables were response unit (Percentage vs Rupees) and discount recipient (Self vs Friend).

8.1.2. Procedure

The participants were recruited for the study from a basic psychology class, and told that they would be participating in a small study. They were then randomly assigned to the four groups and were told to provide the most preferred response that came to their mind for the situation. The scenario for friend is provided below as an illustration.

You have accompanied a friend who wants to buy a mobile handset. Your friend has looked at various options and decided on which handset to buy. The handset that your friend likes costs Rs. 13499 (MRP). You recommended to your friend to bargain with the retailer so that your friend can get some discount on MRP of the handset.

They were then asked to give the figure in a box provided for that purpose. In both the rupee and the percentage conditions, the participants had to write the discount they would ask for/ recommend in the box.

8.2. Results and Discussion

We conducted a 2 (Self vs Friend) X 2 (Rupee vs Percentage) between subjects ANOVA, to assess the differences in discount elicitation due to the two independent factors (See Figure 4). As expected, there was a main effect of response unit $F(1, 97) = 12.51$, $p = .001$, partial $\eta^2 = .114$. There was also a main effect of recipient $F(1, 97) = 6.83$, $p = .01$, partial $\eta^2 = .06$. However, the expected interaction between recipient and the response unit was not significant $F(1, 97) = .237$, $p > .6$, partial $\eta^2 < .01$.

Expected contrasts (See table 4) showed that among those who gave the discount expectations for themselves, the discount elicited in percentage was significantly higher than the discount elicited in rupees, $t(48) = 2.3$, $p < .03$. The pattern of results was the same among those who gave discount expectations for a friend, with discount in percentage being significantly higher than the discount in rupees, $t(49) = 3.08$, $p < .01$.

We also further analysed the main effect seen for discount recipient, and found that the discount expected for self was significantly higher than that for the friend, $t(99) = 2.51$, $p < .02$.

Figure 4: Discount Expectation in Rupee and Percentage for Self and Friend

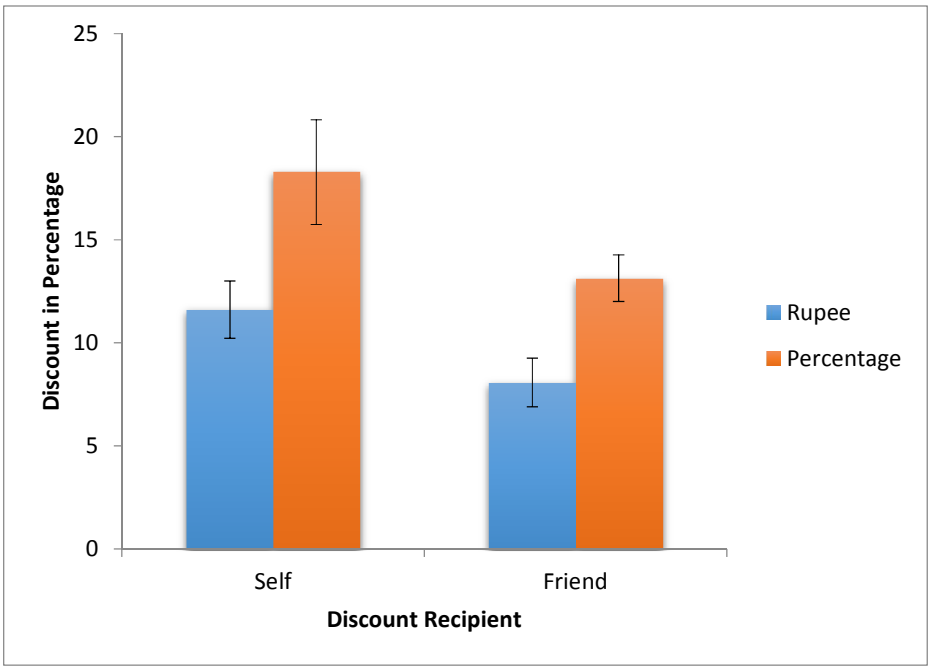


Table 4: Discount Expectation in Rupee and Percentage for Self and Friend

Condition	Percentage	Rupee	P value
Discount for self	18.28 (12.72)	11.61 (6.94)	.02
Discount for friend	13.14 (5.65)	8.08 (6.03)	.003
P value	.07	.058	

The results showed once again the difference in the expectations when elicited in percentage and numbers. The results also showed that the discount expectations in both percentage and rupees dropped for the friend as compared to the self. The results however did not show the expected reduction in the difference between the percentage and rupee discounts when the

discount was to be received by a friend. These results therefore do not provide support for Hypothesis 3. The results do show that individuals in both response modes did engage type 2 processes to make a downward adjustment when judging the discount for a friend, perhaps due to additional emphasis on whether the discount was feasible or not. However, since both groups made similar adjustments to the initial discount figure that appeared in their mind, the difference between discounts in the two modes remained unchanged.

9. General Discussion and Future Research Directions

This research extends prior research in the field of denominator neglect and judgments based on numerical values rather than real values, by showing that similar effects as those seen for evaluation and perception of quantities are maintained even when judgments are freely produced by individuals.

The research shows three main effects. Firstly, the judgments given in percentages are systematically higher than those provided in numbers, when each percentage point translates to a multi digit number and the % figure corresponds to a much larger number. Secondly, this difference in percentage and numbers judgment is present despite exposing subjects to conversions of percentage figures into numbers and vice versa; and present for judgments made for others. Lastly, percentage judgments are more stable than whole number judgments, and change little with changes in base value. Individuals seem to not be able to take into account the numbers that are represented by the percentage judgments and as a result we see these systematic differences. Frederick & Mochon (2012) in their paper on the scale distortion theory of anchoring and adjustment note that people use the points of a scale to signify their perceptions of massiveness and size. It seems that the points that denote the perceptions of their judgments in percentages are highly and predictably different from those in whole numbers.

It is possible that this phenomenon occurs due to an anchoring and adjustment based effect. Gupta & Cooper (1992) in an investigation of discount thresholds among consumers showed that the consumers do not change purchase intentions unless the discount (in percentages) is above a certain threshold. Therefore it could be that the percentage figure that comes immediately to the individuals' mind when asked for an expected discount is based on such a threshold. The individual may then make some adjustment on the basis of the plausibility of the figure, but this adjustment is effortful and therefore usually inadequate. A similar figure and adjustment may also be involved in the number judgment. Crichter & Gilovich (2008) demonstrated in a set of studies that individuals use incidental environment anchors to produce numerical estimates, and these anchors may or may not be relevant to the judgment. It is possible that in some cases, the same principle applies for judgments, and the number judgment is provided on the basis of some anchor available in the environment. For instance in case the price is Rs.13499, then a discount of 499 makes the final price 13000, and so 499 could function as an anchor in this case. Indeed, research has reported preferences for numbers ending in zero for stock prices (Kandel, Sarig, & Wohl, 2001); and for blood pressure readings taken by nurses and physicians (Thavarajah, White, & Mansoor, 2003). This tendency to prefer rounded off quantities where the last digit is 0 or 5 is known as digit preference in medical literature (Wen, Kramer, Hoey, Hanley, & Usher, 1993). Studies on the pay what you want method of pricing have also demonstrated preference for round numbers (Lynn, Flynn, & Helion, 2013). Therefore ending digits may be used as anchors in case of number judgments, as when reduced from the price they result in rounded off prices which are liked by consumers. Thompson (2009) proposed a metacognitive measure called the Feeling of Rightness or FOR to denote the subjective positive feeling resulting from the fluency with which a particular response provided by the type 1 processes registered. It could be that such anchors have a high FOR, resulting in need for little adjustment to be carried out

by type 2 processes. If this is the case, the percentage judgments would be higher, as long as the percentage threshold results in a whole number which is higher than the whole number resulting from the incidental environment anchor.

The study on mark-up showed that percentage judgments were slightly but not significantly higher than the number judgments only for the $15,000, and $25,000 conditions. In this particular case, the price also did not provide anchors that would result in a rounded off price, since the starting point itself was a rounded off price. Hence, one question that bears asking is how the difference changes when the conversion of one percentage point into whole number changes from a two digit number (eg. 1% = 50 for price = 5000), to a three digit number (eg. 1% = 150 for price = 15,000) to a four digit number (1% = 1000 for price = 100,000) in case of other judgments (like discount expected, risk tolerance), and in case of judgments where environmental anchors are present.

Another area of research would be to document the differences in the judgments that come immediately to mind. This research could provide a test of the anchoring and adjustment mechanism that we have proposed above. Immediate judgments in numbers could vary on the basis of the end digits of the base value, however the percentage judgments could remain the same. This phenomenon could also produce other effects such as a possible violation of monotonicity in number judgments, but not in percentage ones.

In sum, individuals generate judgments in numbers and percentages differently and this difference is somewhat predictable. We have, in conducting these studies, just taken the first steps towards understanding these differences and accounting for the processes that underlie them. Future studies should be able to make the picture on these differences clearer.

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