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Is broad bracketing always better? How broad decision framing leads to more optimal preferences over repeated gambles

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Abstract

The effect of choice bracketing — the consideration of repeated decisions as a set versus in isolation — has important implications for products that are inherently time-sensitive and entail varying levels of risk, including retirement accounts, insurance purchases, and lottery preferences. We show that broader choice brackets lead to more optimal risk preferences across all risk types, including negative expected value and pure-loss gambles, suggesting that broad decision framing can help individuals make better choices over risks more generally. We also examine the mechanism behind these bracketing effects. We find that bracketing effects work by attenuating (magnifying) the weight placed on potential losses for positive EV (non-positive EV) gambles and by providing aggregated outcomes that might not otherwise be calculated. Thus, decision frames that provide probability distributions or aggregated outcomes can help individuals maximize expected value across different types of risky prospects.

Keywords: choice bracketing, myopic loss aversion, risk-taking, risk perception, repeated gambles

1 Introduction

Individuals often face financial decisions in which outcomes and feedback accrue over time or over several repeated transactions. Many financial risks with positive expected value (EV) can thus be thought of as either segregated transactions (disconnected single trials of a repeated gamble) or as an integrated set (a probability distribution over many trials of a repeated gamble). For example, in the context of portfolio allocation, an investor can evaluate returns on a short-term basis (e.g., once a day, once a week, or once a quarter) or on a long-term basis (e.g., once a year or once every couple of years). Assuming that the underlying risk associated with the portfolio does not change over time, the information available to the investor is identical under either evaluation strategy. However, short-term evaluations will usually lead to more experienced losses, as even positive EV assets typically entail some chance of loss. In contrast, long-term evaluations of these same multiple positive EV risks will lead to higher cumulative gains, less experienced losses, and a better sense of the underlying probability distribution. If investors are loss averse, information that helps an investor visualize or understand how positive EV outcomes are aggregated over time can lead to investment decisions with higher value outcomes.

What happens if these repeated financial risks have a negative EV rather than a positive EV, such as lotteries, or even entail only losses, such as insurance? How would the presentation of information about a series of primarily negative outcomes (monthly premiums, daily lottery tickets) affect the decision to take such risks? Arguably, an individual would again make different choices depending on whether the risks are represented as occurring over only one or a few trials or aggregated over a larger set of trials. In contrast to positive EV risks, repeated non-positive EV risks will result in larger cumulative losses relative to a narrow evaluation strategy. Thus, individuals may shift their preferences depending on the decision frame (broad or narrow). More generally, we evaluate whether information about aggregated outcomes (broader bracketing) leads to decisions with higher payoffs for non-positive EV gambles as well.

We demonstrate that how a repeated financial risk is represented — either broadly or narrowly — affects preferences for that risk. Specifically, for positive EV gambles, individuals prefer a smaller certain gain in isolation (narrow bracketing), but prefer the gamble, with its higher EV, over the certain amount when the probability distribution is provided (broad bracketing). For negative EV gambles and pure-loss gambles, individuals prefer the gamble (with its larger potential loss) in isolation (narrow bracketing), but prefer a smaller certain loss with its higher EV when they see the probability distribution over many trials (broad bracketing). Our results thus imply that broad bracketing prevents preference reversals for repeated financial risks and leads to more optimal

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preferences (i.e., choices that maximize the expected value of returns), whether those risks are predominantly positive or negative.

2 Choice Bracketing

Choice bracketing describes how choices are grouped together (Read et al., 1999). When encountering repeated related choices, individuals can consider each of those choices separately in isolation, or they can consider those choices as a set with cumulative, aggregated outcomes. The former is considered narrow bracketing — only one or a small number of choices are considered together — while the latter is considered broad bracketing — each choice is considered in the context of many other choices in a set. Thus, narrow bracketing is focused on local outcomes, while broad bracketing is focused on more global outcomes. For example, consider the choice of whether or not to eat dessert at the end of a meal. Bracketing this choice narrowly means deciding whether the pleasure of eating the dessert outweighs the costs (e.g., caloric intake, breaking a diet). Bracketing this choice broadly means considering all times (before and after) that one may eat dessert and considering the cumulative effects of those desserts combined. Thus, an individual may choose to impulsively eat each dessert when considered alone, but if presented with the cumulative effect of eating dessert every meal, may reject that set outright (Ainslie, 1975). This means the individual's choices are different depending on the bracketing involved — narrow or broad. This is called a bracketing effect and occurs whenever choices differ depending on the bracket through which they are evaluated.

Bracketing effects subsume many concepts. Specifically, in their paper defining choice bracketing, Read et al. (1999) consider sequential and simultaneous choice, narrow and broad decision frames, isolated and distributed choice, acts and patterns, and local and overall value functions, all as forms of narrow and broad choice bracketing. For this reason, we use the terminology of "choice bracketing," though many of our effects could also be defined in other ways (e.g., narrow or broad framing). Choice bracketing can also be applied to many different choices — not just risky choice. For example, research on choice bracketing and mental budgeting has found that which product categories are combined together in a budget category can have a direct effect on how budgets are formed and followed (Read et al., 1999; Thaler, 1999). However, we focus specifically on the effects of choice bracketing as they relate to decisions over repeated financial risks.

To manipulate bracketing, we use an exact replication of a technique used in previous research (Benartzi & Thaler, 1999). Specifically, in their Study 2, Benartzi and Thaler (1999) showed subjects repeated positive EV mixed gambles described either in words (i.e., "*N* plays of gamble *1*, with probability *p* of winning *x*, probability *1-p* of losing *y*") (narrow bracketing) or as a visual display of the distribution of possible outcomes for the aggregated set of gambles (broad bracketing). An example of this manipulation is shown in Figure 1.[1] The difference between the narrow and broad bracket is only in how the information is displayed; in the narrow format the number of trials is described in words, while in the broad format the number of trials is only implicit in the distribution.

3 Repeated Gambles & Myopic Loss Aversion

The question of how individuals approach repeated plays of a gamble, and its implications for investment behavior, has been well explored in the literature (see, e.g., Keren, 1991; Klos et al., 2005; Redelmeier & Tversky, 1992; Thaler & Johnson, 1990; Wedell & Böckenholt, 1994). This work has generally found that individuals are more willing to accept multiple plays of a gamble than any single trial or play of that gamble. Thus, broad bracketing (combining repeated plays of a gamble into one choice set) reduces risk aversion and leads to expected value maximization.[2]

Perhaps one of the most well-known demonstrations of how choice bracketing aligns with repeated gambles is the work on myopic loss aversion (Benartzi & Thaler, 1995; Benartzi & Thaler, 1999; Gneezy & Potters, 1997; Langer & M. Weber, 2001; Thaler et al., 1997). In Benartzi and Thaler's (1999) work on the equity premium puzzle, the authors were able to change risk preferences through choice bracketing such that individuals' choices over repeated positive EV gambles were less risk-averse when the gambles were broadly bracketed versus narrowly bracketed. The authors describe these findings as supportive of the concept of myopic loss aversion: individuals are loss averse for mixed gambles, but also myopic, since they appear to consider the gambles in isolation (narrowly) rather than thinking about each one as a piece of a larger set of gambles with an overall outcome distribution that favors gains (broadly). Benartzi and Thaler conclude that broader framing attenuates the effect of loss aversion, and changes preferences towards what is predicted by expected value calculations.

[1]The example for the Positive EV gamble is taken directly from Benartzi and Thaler's (1999) materials. We requested these materials from the authors and used the same format in our studies. For the non-positive EV gambles, which were not used by the original authors, we created new gambles that conformed to the same general principles used in the construction of the positive EV gambles.

[2]Note that broad bracketing's effects on expected value maximization may also lead to overall utility maximization if outcomes are not monetary, yet utilities are additive over time. With monetary gambles over short periods, it is safe to assume that the utilities are a function of total monetary gain or loss.

Figure 1: Example of Within-Subject Bracketing Manipulation by Gamble Type, Study 1.

Narrow Bracket Version	Broad Bracket Version		
	Positive Expected Value		
The gamble:	The gamble:		
10% * Win $0.75	1%	#	Win $12
90% ********* Lose $0.01	1%	#	Win $11
The gamble is played 90 times.	4%	####	Win $10
	7%	#######	Win $9
The certain amount: $3	12%	############	Win $8
	16%	################	Win $7
	18%	##################	Win $6
	16%	################	Win $5
	12%	############	Win $4
	7%	#######	Win $3
	4%	####	Win $2
	1%	#	Win $1
	1%	#	Win $0
	The certain amount: $3		
	Negative Expected Value		
The gamble:	The gamble:		
10% * Win $0.25	2%	##	Lose $8
90% ********* Lose $0.10	5%	#####	Lose $7
The gamble is played 60 times.	13%	#############	Lose $6
	22%	######################	Lose $5
The certain amount: –$2 (Lose $2)	26%	##########################	Lose $4
	20%	####################	Lose $3
	9%	#########	Lose $2
	2%	##	Lose $1
	The certain amount: –$2 (Lose $2)		
	Pure-Loss		
The gamble:	The gamble:		
90% ********* Lose $0.10	1%	#	Lose $11
10% * Lose $0.50	7%	#######	Lose $10
The gamble is played 50 times.	7%	#######	Lose $9
	10%	##########	Lose $8
The certain amount: –$4 (Lose $4)	28%	############################	Lose $7
	15%	###############	Lose $6
	12%	############	Lose $5
	14%	##############	Lose $4
	2%	##	Lose $3
	1%	#	Lose $2
	The certain amount: –$4 (Lose $4)		

Benartzi and Thaler's (1999) framing work and related empirical tests of myopic loss aversion have clearly demonstrated that broad bracketing leads to more normative and financially optimal choices in a world of positive EV risks (Benartzi & Thaler, 1995; Gneezy & Potters, 1997; Haigh & List, 2005; Thaler et al., 1997). However, less work has been done to understand how bracketing and loss aversion combine when the expected value of the risks is not positive. The original context for myopic loss aversion was the U.S. stock market, which has a positive EV over time (Benartzi &

Thaler, 1995). However, there are also environments where individuals face choices with negative outcomes or negative expected values over time, such as insurance policies or state lotteries. In this paper, we investigate whether broader choice bracketing can lead to better choices for all gamble types. More specifically, we investigate whether bracketing changes risk preferences for negative EV gambles and gambles over pure losses. We do this by assessing preferences for a gamble versus a sure loss (negative certainty equivalent) where the sure loss is a smaller absolute value loss than the expected value of the gamble. Our findings imply that broad bracketing can be used to help individuals make more optimal choices over risky prospects that have a negative EV or solely entail losses, not just positive EV ones.

4 Mechanisms Underlying Bracketing Effects for Repeated Gambles

Beyond extending the usefulness of broad bracketing to other types of gambles, our work also explores more deeply what mechanisms underlie the documented bracketing effects. Prior studies on myopic loss aversion and choice bracketing (Benartzi & Thaler, 1999) have not clearly identified the reasons for the effects, beyond the finding that broad brackets overcome loss aversion by effectively showing that losses are almost entirely compensated for by gains (for positive EV gambles). Other studies have proposed that broadly bracketed gambles reduce risk perception or the level of risk associated with the gambles (Coombs & Meyer, 1969; Read et al., 1999). Thus, the bracketing effect could be due to outcome aggregation, which changes the expected benefits and costs of the prospect (under the assumption that individuals cannot construct the probability distribution when a gamble is described narrowly), or due to a change in the perceived level of risk which makes the gamble more (or less) acceptable in accordance with the individual's risk attitude.

In addition to testing the main effect of bracketing type on risk preferences, in Study 1, we test whether bracketing effects occur because of changes in perceived risk, such that for positive EV (negative EV, pure-loss) gambles, broad brackets reduce (increase) perceived risk. Risk perception is a subjective judgment that represents the beliefs or feelings that individuals have about the level of risk inherent in the prospect under consideration (Blais & E. U. Weber, 2006; Holtgrave & E. U. Weber, 1993; Klos et al., 2005; E. U. Weber & Hsee, 1998; E. U. Weber et al., 2002). In psychological models of risk-return, risk perception has been shown to account for much of the variance in risk preferences (E. U. Weber & Hsee, 1998; E. U. Weber & Milliman, 1997). Previous work on perceived risk has also shown that framing effects can result from differences in risk perception across the frames (Mellers et al., 1997; Schwartz & Hasnain, 2002). Given the work on risk perception and framing, it is possible that bracketing effects are explained entirely by changes in risk perception. To this end, we ask each subject to rate perceived risk after they make a choice for each gamble (measured via a 7-point Likert scale, see E. U. Weber et al., 2006).

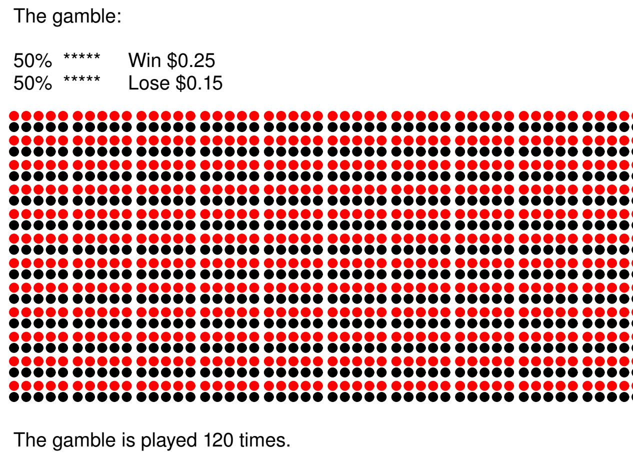

Figure 2: Schematic Illustration of Broad-Trial Condition. Red dots represent the probability of losing; black, winning.

In Study 2, we directly test whether the effect of broad bracketing comes from adding up the cumulative effects of repeated trials. We hypothesize that there are two possible components of these adding up effects. First, adding together the outcomes of multiple gambles can affect loss aversion by changing the perceived size and probability of an overall loss. For example, the aggregation of multiple positive EV gambles will result in a distribution of outcomes where cumulative losses are very unlikely, and the majority of possible outcomes are positive. In contrast, for non-positive EV gambles, aggregation will result in a probability distribution with a larger number of more probable cumulative losses. Thus, broad brackets can either increase or decrease the salience of the losses (situational weight on losses), depending on the type of gamble.

The second possible component of adding up effects results from individuals not making sufficient adjustment from the outcomes of a single gamble to the effects of many such gambles. Decision makers are likely to evaluate the outcomes of a gamble, especially the higher probability outcome, within a single trial and insufficiently adjust for the multiplicative effect of many trials. For example, with a positive EV gamble, individuals may focus on the higher probability gain from a single trial of the gamble and not multiply it appropriately for repeated plays, thus underappreciating the impact of the large number of trials.

To test the separate effects of these two explanations, we manipulate broad bracketing in three ways: (1) narrow, (2) broad, and (3) broad-trial. The broad manipulation provides the full distribution of aggregated outcomes. The broad-trial manipulation presents each trial as a block with ten colored dots. Within the block, dots are colored either red (to represent the probability of losing) or black (to represent the probability of winning). For example, a positive EV gamble that has a 10% chance of winning $0.75 and a 90% chance of losing $0.01, played 90 times, would have 90 blocks. Within each block, there would be one black dot and nine red dots. Figure 2 provides an example, using a different gamble. By including the broad-trial format, we can assess whether simply making the repeated-trial nature of the gamble more salient changes risk preferences or if explicit outcome aggregation is needed for a bracketing effect to occur. We also directly measure situational weight on losses and the importance of the number of trials to see which hypothesized mechanism is reported by subjects as having a larger influence on their decisions.

5 Overview and Contribution

To summarize our approach and preview the contributions of this paper, we extend the work on bracketing effects by examining how broad bracketing influences not only positive EV mixed gambles, but also negative EV (mixed) and pure-loss gambles. In two studies, we show bracketing effects (different preferences under broad brackets versus narrow brackets) across all gamble types. However, we find that the direction of this effect is different for positive EV gambles versus non-positive EV gambles (negative EV and pure-loss). Specifically, for positive EV gambles, subjects prefer the certain (smaller) gain when evaluating a choice in a narrow bracket, but prefer the gamble when evaluating the same choice in a broad bracket. For negative EV and pure-loss gambles, subjects prefer the gamble when evaluating a choice in a narrow bracket, but prefer the certain (smaller) loss when evaluating the same choice in a broad bracket. Across gamble types, our empirical findings imply that broader choice brackets lead to more optimal choice strategies, as defined by maximizing expected value.

We also evaluate possible mechanisms for our documented bracketing effects. We specifically focus on whether bracketing effects are the result of outcome aggregation that affects the weight placed on losses, or of trial aggregation, under which the higher salience of repeated gambles overcomes insufficient adjustment from the single gamble. Ultimately, we find that the bracketing effect for repeated-play gambles is primarily due to changing the weight placed on losses via outcome aggregation rather than an effect of highlighting the repeated trials inherent in the risky prospect. These findings suggest that targeted interventions that help individuals calculate aggregated outcomes and change the salience of losses can improve decision-making for all risk types.

6 Study 1: Broad Bracketing Produces More Optimal Preferences for all Gamble Types

In Study 1, we begin by replicating Benartzi and Thaler's (1999) Study 2, in which we ask subjects to state their preferences across several gambles. Using the original study design, subjects see the same gambles in both a narrow bracket (a text description of the gamble with the number of trials specified) and in a broad bracket (a probability distribution of the outcomes across all trials). We then extend the authors' work by including negative EV and pure-loss gambles under the same set-up. We replicate the authors' findings for positive EV gambles by showing that individuals switch from predominantly choosing the offered certainty equivalent (which is less than the EV of the gamble) under the narrow bracket to predominantly choosing the gamble under the broad bracket. For negative EV and pure-loss gambles, the opposite occurs: individuals switch from predominantly choosing the gamble under the narrow bracket to predominantly choosing the offered (negative) certainty equivalent (which is a smaller loss than the EV of the gamble) under the broad bracket. This pattern of results suggests that broad bracketing can be used to help individuals make more normatively optimal decisions over risk.

6.1 Method

Study 1 was conducted online with 144 subjects[3] (39.6% female, M_{age} = 35.7 years) recruited through Amazon's Mechanical Turk (mTurk). This study was a replication and extension of Benartzi and Thaler's (1999) Study 2. We ran the exact same study but with two additional gamble types: negative EV and pure-loss, since the authors of the original study asked only about positive EV mixed gambles. In their study, Benartzi and Thaler (1999) asked subjects to consider N independent trials of a gamble with a probability p of winning an amount x, and a probability $1-p$ of losing an amount y. The bracketing manipulation involved either describing the gambles as "being played N times" (narrow bracket) or providing the full probability distribution of outcomes from the repeated plays (broad bracket). We used this same bracketing manipulation across all three gamble types. For the pure-loss gambles, subjects considered N independent plays with a probability p of losing an amount x, and a probability $1 - p$ of losing an amount y. The negative EV gambles appeared the same as the positive EV gambles except that they had an expected value less than zero, while the positive EV

[3]We recruited 150 subjects. One-hundred-forty-nine subjects successfully completed the survey. Of those, five subjects were dropped because they did not complete a second part of the survey (the loss aversion section described later).

Table 1: List of Gambles Used in Study 1.

	Type	Bracket	EV	Certain Amount	Description
Gamble 1	Positive EV	Narrow	$6	$3	10% win $0.75, 90% lose $0.01, 90 trials
Gamble 2	Positive EV	Narrow	$6	$3	90% win $0.10, 10% lose $0.50, 150 trials
Gamble 3	Positive EV	Narrow	$6	$3	50% win $0.25, 50% lose $0.15, 120 trials
Gamble 4	Positive EV	Broad	$6	$3	Truncated distribution
Gamble 5	Positive EV	Broad	$6	$3	Full distribution
Gamble 6	Positive EV	Narrow	$60	$30	High-stakes: 50% win $2.50, 50% lose $1.50, 120 trials
Gamble 7	Positive EV	Broad	$60	$30	High-stakes truncated distribution
Gamble 8	Pure-Loss	Narrow	-$7	-$4	90% lose $0.10, 10% lose $0.50, 50 trials
Gamble 9	Pure-Loss	Narrow	-$7	-$4	50% lose $0.15, 50% lose $0.25, 35 trials
Gamble 10	Pure-Loss	Narrow	-$7	-$4	10% lose $0.75, 90% lose $0.01, 80 trials
Gamble 11	Pure-Loss	Broad	-$7	-$4	Truncated distribution
Gamble 12	Pure-Loss	Narrow	-$70	-$40	High-stakes: 50% lose $2.50, 50% lose $1.50, 35 trials
Gamble 13	Pure-Loss	Broad	-$70	-$40	High-stakes truncated distribution
Gamble 14	Negative EV	Narrow	-$4	-$2	50% win $0.15, 50% lose $0.25, 80 trials
Gamble 15	Negative EV	Narrow	-$4	-$2	10% win $0.25, 90% lose $0.10, 60 trials
Gamble 16	Negative EV	Narrow	-$4	-$2	90% win $0.01, 10% lose $0.50, 100 trials
Gamble 17	Negative EV	Broad	-$4	-$2	Truncated distribution
Gamble 18	Negative EV	Narrow	-$40	-$20	High-stakes: 50% win $1.50, 50% lose $2.50, 80 trials
Gamble 19	Negative EV	Broad	-$40	-$20	High-stakes truncated distribution

Notes: (1) The gambles are ordered sequentially for ease of exposition — in the actual study, all subjects saw the Positive EV gambles first, and then the non-positive EV gambles with Pure-Loss and Negative EV types counterbalanced), and the order of the gambles within each of the three types was randomized for each subject. (2) The truncated distributions show all outcomes that occur with a probability of 1% or greater. (3) High-stakes gambles are a version of one of the narrowly bracketed gambles with the outcomes multiplied by 10.

gambles had an expected value greater than zero. A list of all of the gambles used in Study 1 is shown in Table 1, with additional explanation provided below. We also provide the gambles (as displayed to subjects) and the complete Study 1 materials in Appendix 2.

We measured risk preference as the choice between the gamble and a certainty equivalent (CE). The certain amount that was offered to subjects varied by gamble type. For the positive EV gambles, the certain amount was $3, which is less than the EV of the gamble.[4] For the negative EV gambles, the certain amount was –$2 (lose $2). This amount is greater (a smaller loss) than the EV of the negative EV gambles. Similarly, for the pure-loss gambles, the certain amount was –$4 (lose $4). This certain amount is greater (a smaller loss) than the EV for the pure-loss gambles. To ensure that choices were incentive compatible, ten subjects were randomly chosen to have one of their positive EV choices played for real (i.e., if they chose the gamble, the gamble would be played out for them, if they chose the certain amount they would be given the certain amount for that question). All subjects were told about this possibility before beginning the survey.

To summarize, Study 1 has a 3 (Gamble Type: Positive EV, Negative EV, Pure-Loss) x 2 (Bracket: Broad, Narrow) completely within-subjects design. Each subject was asked to evaluate seven positive EV gambles, six negative EV gambles, and six pure-loss gambles. Since only the Positive EV gambles were used for the incentive compatible lottery task, all subjects saw the positive EV gambles first. The order of the Positive EV gambles was randomized once and then counterbalanced across subjects. After the positive EV gambles, subjects saw the non-positive EV (negative EV and

[4]It is important to note that the EV is equal for all of the gambles within a gamble type (positive EV, negative EV, pure-loss), with the exception of the high-stakes gambles, where the EV (and individual outcomes) are multiplied by ten.

pure-loss) gambles. The order of the non-positive EV gambles was randomized for each subject and the two conditions were counterbalanced across subjects.

Following Benartzi and Thaler (1999), four of the gambles from each type were presented in a narrow bracket and two were presented in a broad bracket. The EV for all of these gambles was the same (the EV for all narrowly bracketed gambles and the two broadly bracketed gambles within a gamble type was the same). For all gamble types, one of the narrow and one of the broad bracket gambles was a high-stakes version that had outcomes multiplied by ten. These two gambles had the same EV. This version was included to ensure that the same pattern of preferences holds over larger possible outcomes. For most of the broadly bracketed gambles, we truncated the distribution to exclude any outcome with less than a one percent chance of occurring (mimicking Benartzi and Thaler's (1999) approach). However, to verify that the bracketing effect still occurs when small probability losses are included in the distribution, we also added one positive EV gamble with a non-truncated probability distribution (the seventh positive EV gamble).[5] The gambles we used for each gamble type were constructed to have approximately the same aggregated payoff distribution, but different characteristics. In this sense, the bracketing manipulation is a framing effect since the information in both versions of the problem (narrow versus broad) is identical, and only the presentation of that information changes. An example of the bracketing manipulation for each gamble type is shown in Figure 1.

To see whether differences in risk perception explain the bracketing effects, as found in prior literature (Mellers et al., 1997; Schwartz & Hasnain, 2002), we asked subjects to provide risk perception ratings for each of the gambles. This allows us to compare perceived risk levels for the same gamble in a narrow bracket and a broad bracket, thus testing whether the bracketing effect we observe is simply due to changes in perceived risk. Risk perception was collected for each gamble. After making a choice for the gamble, risk perception was measured on a scale from one ("Not at all Risky") to seven ("Extremely Risky") (Blais & E. U. Weber, 2006).[6]

[5]We do not include a full distribution version of the gamble for the non-positive EV gambles since we do not expect loss aversion for these gamble types. While it's possible that small probability gains could change preferences, the gambles we used for the non-positive EV gamble types do not have even small probability gains when outcomes are aggregated across all trials.

[6]At the end of the survey, we also measured loss aversion at the individual-level using the Dynamic Experiments for Estimating Preferences or DEEP method (Toubia et al., 2013). This measure was included to test whether individual-level (but not gamble-specific) loss aversion predicts risk preferences. Finally, after completing the DEEP questions, we asked subjects to self-report gender and age.

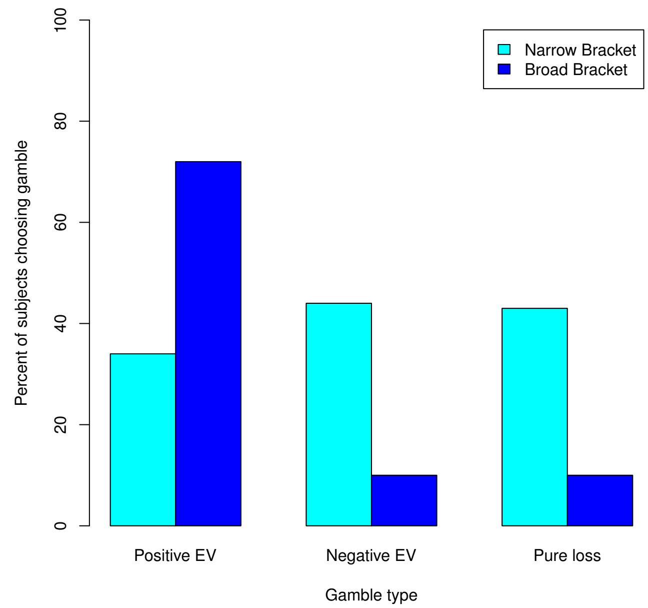

Figure 3: Percent of Subjects Choosing the Gamble by Gamble & Bracket Type, Study 1.

Notes: (1) Broad Bracket and Narrow Bracket collapse across all gamble choices within that bracket for a given gamble type (e.g., the number displayed for the Broad Bracket Positive EV gambles is the average choice share across the broadly bracketed truncated gamble, non-truncated gamble, and high-stakes version of the gamble). (2) The differences between the Narrow Bracket and Broad Bracket manipulations are significant at the $p < 0.001$ level for all gamble types.

6.2 Results

We first compare risk preferences (as measured by subjects' choice of the gamble[7]) by bracket (broad versus narrow) for each gamble type (positive EV, negative EV, pure-loss). These results by gamble type and bracket are summarized in Figure 3.

For the positive EV gambles, we see a replication of Benartzi and Thaler's (1999) findings: subjects are relatively risk averse when considering the gambles in the narrow bracket, but relatively risk-seeking when considering them in the broad bracket. If we average the gambling choice shares across all of the narrowly bracketed gambles (Gambles 1–3, 6) and compare this to the average for the broadly

[7]Since the DV asked for a choice of the gamble, the certain amount, or indifference between the two, we focus on the choice of the gamble. Thus, subjects who chose indifference are counted as preferring the certain amount. While this is imprecise in terms of capturing true indifference, it provides a conservative measure for risk-taking preferences, which we believed was a better approach for the analyses we report. Treating indifference as choosing the gamble does not significantly affect the pattern of results as only a small proportion of subjects chose indifference for each gamble (of total choices within a gamble type, 3.1%, 8.0%, and 6.0% of subjects chose indifference for the Positive EV, Pure-Loss, and Negative EV gambles, respectively).

bracketed gambles (Gambles 4, 5, 7), the difference in choice shares is highly significant (M_{Narrow} = 33.7% vs. M_{Broad} = 72.2%, $t(283.55) = -9.19$, $p < 0.001$). While we present this information collapsed across all of the individual gambles, the pattern of results holds for each narrowly bracketed version (excluding the high-stakes version) of the gamble when compared to the broadly bracketed gamble (both truncated and full versions, but not high-stakes version). For example, if we compare the choice shares for Gamble 1 (narrow) to Gamble 4 (broad, truncated distribution) the choice shares are significantly different ($M_{Gamble1}$ = 36.1% vs. $M_{Gamble4}$ = 77.1%, $t(281.05) = -7.68$, $p < 0.001$). For a summary of choices by each individual gamble, see Figure A1 in Appendix 1. These results demonstrate a bracketing effect for positive EV gambles: displaying the same financial risk in different bracketing formats leads to a preference reversal. Specifically, subjects are relatively risk averse over the gamble when presented in a narrow bracket, but become relatively risk-seeking when that same gamble is presented in a broad bracket.

The bracketing effect is significant for the high-stakes version of the positive EV gamble as well (when the outcomes are multiplied by ten) ($M_{NarrowHigh\text{-}Stakes}$ = 35.4% vs. $M_{BroadHigh\text{-}Stakes}$ = 75.0%, $t(283.22) = -7.34$, $p < 0.001$). Further, the gamble with the non-truncated probability distribution still garnered significantly higher choice shares for the gamble compared to the narrowly bracketed (non-high-stakes) gambles (M_{Narrow} = 33.1% vs. $M_{BroadNon\text{-}Truncated}$ = 64.6%, $t(259.56) = -6.39$, $p < 0.001$; *ps* < 0.001 for all pairwise comparisons between the narrowly bracketed gambles and the non-truncated broad gamble).[8] Thus, we have replicated the bracketing effect found by Benartzi and Thaler (1999).

Next, we turn to the gamble choice shares for the two gamble types not included in Benartzi and Thaler's (1999) original study: negative EV and pure-loss. As Figure 3 shows, we see the opposite pattern of results for these gamble types compared to the positive EV gambles. Subjects are significantly more likely to accept the gamble when displayed in a narrow bracket than when displayed in a broad bracket[9] (for negative EV gambles: M_{Narrow} = 41.9% vs. M_{Broad} = 8.3%, $t(254.15) = 8.25$, $p < 0.001$; for pure-loss gambles: M_{Narrow} = 42.8% vs. M_{Broad} = 11.1%, $t(273.04) = 7.55$, $p < 0.001$). As with the positive EV gambles, this pattern of results holds both when combined across bracket type and when individual gambles are analyzed separately (as shown in Figure A1, Appendix 1). The results also hold for the high-stakes version of the gambles ($M_{NarrowHigh\text{-}StakesNegEV}$ = 50.0%, $M_{BroadHigh\text{-}StakesNegEV}$ = 11.8%, $t(244.51) = 7.68$, $p < 0.001$; $M_{NarrowHigh\text{-}StakesPure\text{-}Loss}$ = 42.4%, $M_{BroadHigh\text{-}StakesPure\text{-}Loss}$ = 8.3%, $t(224.50) = 7.19$, $p < 0.001$). Thus, the results for the non-positive EV gambles also show a significant bracketing effect: risk preferences reverse across bracket types, such that subjects are relatively more risk-seeking when evaluating narrowly bracketed gambles and relatively more risk averse when evaluating those same gambles in a broad bracket. These results extend the previous research by showing that broad bracketing can lead to more optimal choices across many risk types, not just risks with positive expected values. It appears that broad bracketing (via outcome aggregation) consistently helps individuals adopt more normative choice strategies over sequential risks.

Risk perception. To test whether changes in risk perception may explain bracketing effects, we measured risk perception for each gamble. If perceived risk varies by the type of bracket used (and behavior follows beliefs), then we would expect to see higher perceived risk for the narrowly bracketed positive EV gambles compared to the broadly bracketed positive EV gambles. For the non-positive EV gambles, we would expect to see lower perceived risk for the narrowly bracketed gambles compared to the broadly bracketed gambles. We do see this expected pattern, with perceived risk higher (lower) for the narrowly bracketed positive EV (non-positive EV) gambles compared to the broadly bracketed versions of the gambles (positive EV: M_{Narrow} = 3.66 vs. M_{Broad} = 2.86, $t(286) = 5.15$, $p < 0.001$; negative EV: M_{Narrow} = 4.44 vs . M_{Broad} = 5.10, $t(286) = -3.67$, $p < 0.001$; pure-loss: M_{Narrow} = 4.19 vs. M_{Broad} = 5.07, $t(286) = -4.48$, $p < 0.001$) (risk perception ratings for each gamble are shown in Figure A2, Appendix 1).[10] This suggests that bracketing

[8]It is interesting to note that there is a significant difference in gamble choice shares between the truncated distribution broad gamble (gamble 4) and the full distribution (non-truncated) broad gamble (gamble 5), such that subjects are significantly less likely to choose the gamble with the full distribution than with the truncated distribution ($M_{BroadTruncated}$ = 77.1% vs. $M_{BroadFull}$ = 64.6%, $t(281.36) = 2.35$, $p = 0.02$). We attribute this attenuation in gamble choice shares to loss aversion since the full distribution shows small probability, larger losses compared to the truncated distribution. (Note that the full distribution also shows small probability, larger gains but given loss aversion, we expect the effect of the losses to have a larger impact on choice shares, which is also supported by an attenuation, rather than increase, in gamble shares for the full distribution gamble.) Even though the difference between these two gambles is significant, the difference between the full distribution broad gamble and the narrowly bracketing gambles is large and significant. Thus, a bracketing effect still occurs.

[9]For this comparison we calculate the average gamble choice share across all narrowly bracketed (non-high-stakes) gambles and compare it to the average gamble choice share for the non-high-stakes broadly bracketed gamble (e.g., for Negative EV gambles, it compares the average across gambles 14-16 to gamble 17).

[10]Within-subject regressions of choice on bracketing, EV (positive vs. non-positive), and their interaction, with and without the inclusion of risk perception as a covariate, indicate that inclusion of risk perception in the models generally reduced the interaction term. Because risk perception may not be perfectly measured, we cannot say whether risk perception can fully account for the interaction.

effects work, at least in part, by changing the perceived risk associated with the gamble.

Overall, Study 1 confirms our main predictions: broad bracketing leads to more optimal risk preferences compared to narrow bracketing for all types of risks (positive EV, negative EV, and pure-loss).

7 Study 2: Possible Mechanisms Behind Bracketing Effects

The findings from Study 1 suggest that broad bracketing helps individuals make more optimal choices over many different types of financial risk. In Benartzi and Thaler's (1999) original study, the authors suggest that broad bracketing attenuates myopic loss aversion. While the authors did not directly test this mechanism, the implication is that broad bracketing works both by overcoming loss aversion (the weight put on losses relative to gains) and by overcoming insufficient adjustment for the larger number of trials. In Study 2, we introduce a measure that we refer to as "situational weight on losses" to directly test how the weight put on possible losses within the task shifts with the bracketing manipulation.[11] Since we use non-positive EV gambles, a conventional measure of loss aversion is not applicable across all gamble types. To maintain consistency across gamble types, we focus only on the weight placed on losses (or the importance of potential losses in the decision calculus) without making a comparison to the weight placed on gains. We expect the situational weight placed on losses to be higher (lower) for the narrowly bracketed positive EV (non-positive EV) gambles compared to the broadly bracketed gambles for each type. This is because losses will be more salient in these bracketing formats (i.e., for broadly bracketed positive EV gambles, the distribution shows the small probability of incurring a loss across all trials; for broadly bracketed non-positive EV gambles, the distribution shows the large probability of incurring a loss even greater than the sure loss (CE) across all trials).

Study 1 is also limited in its ability to test whether broadly bracketed presentations help individuals recognize the impact of a large number of trials on cumulative outcomes, thus overcoming insufficient adjustment from a single gamble to many repeated ones. We directly test this by using an additional bracketing manipulation that makes salient the number of repeated trials without directly aggregating the outcomes across trials (i.e., without providing the probability distribution). We call this manipulation Broad-Trial because we emphasize the number of trials (see Figure 2 for an illustration of this manipulation). By including this version of the bracketing manipulation, we are also able to test whether bracketing effects are attributable to a lack of consideration of the aggregated outcomes. If the Broad-Trial manipulation is statistically different from the Narrow bracketing manipulation, we know that bracketing works, in part, by facilitating mental adjustment for more trials. If only the Broad manipulation (probability distribution format) is statistically different from the Narrow manipulation (and the Narrow and Broad-Trial conditions are statistically equivalent), this would suggest that broad bracketing primarily works because of its impact on the situational weighting of losses (via outcome aggregation). We also add a measure rating the importance of the number of trials to try to address the mental adjustment individuals make for the repeated trials inherent in the gamble, and whether the Broad and Broad-Trial conditions facilitate this adjustment. Thus, in Study 2 we are focused on further disentangling the process behind the bracketing effects documented in Study 1.

7.1 Method

Study 2 was conducted online through mTurk with 291 subjects[12] (37.5% female, $M_{age} = 33.2$ years), and was structured similarly to Study 1. A main difference in Study 2 is that the bracketing manipulation is now a between-subjects factor, so subjects saw all gambles in one presentation format only. Thus, Study 2 is 3 (Bracket Type: Broad, Broad-Trial, Narrow) x 3 (Gamble Type: Positive EV, Negative EV, Pure-Loss) mixed design. Bracket Type is a between-subjects factor and Gamble Type is within-subjects. In each Bracket Type, subjects evaluated six gambles total: two positive EV, two negative EV, and two pure-loss. One of the gambles in each gamble type was a high-stakes version, as in Study 1. The specific gambles are listed in Table 2. Subjects saw all gambles in the bracket type they were assigned to, and the gambles were the same across conditions, so that only the format they were displayed in differed. An example of all of the gambles and other study materials can be found in Appendix 2.

Subjects in the Broad condition saw all gambles in the broad bracket format used in Study 1 (i.e., they saw the truncated probability distribution for the full set of gambles). Subjects in the Narrow condition saw all gambles in the narrow bracket format used in Study 1 (i.e., they saw the gambles described in text only). Finally, subjects in the Broad-Trial condition saw the static text information (as in the Narrow presentation) but also saw colored dots representing the full set of gambles and their outcomes, with red dots for losses and black dots for gains.[13] For example, one of the positive

[11]In Study 1, we found that loss aversion as an individual trait variable does not attenuate the documented bracketing effects; however, it does not rule out the possibility that broad brackets change the weight put on losses within the context of the gamble.

[12]We recruited 300 subjects. Nine subjects were dropped either because they had the same IP address as another subject or because they did not complete the second part of the survey (the DEEP loss aversion measure).

[13]For the pure-loss gambles, the dots were two different shades of red, since all outcomes were losses, to distinguish the two different outcomes

Table 2: List of Gambles Used in Study 2.

	Type	EV	Certain amount	Description
Gamble 1	Positive EV	\$6	\$3	50% win \$0.25, 50% lose \$0.15, 120 trials
Gamble 2	Positive EV	\$60	\$30	High-stakes: 50% win \$2.50, 50% lose \$1.50, 120 trials
Gamble 3	Pure-Loss	–\$7	–\$4	50% lose \$0.15, 50% lose \$0.25, 35 trials
Gamble 4	Pure-Loss	–\$70	–\$40	High-stakes: 50% lose \$2.50, 50% lose \$1.50, 35 trials
Gamble 5	Negative EV	–\$4	–\$2	50% win \$0.15, 50% lose \$0.25, 80 trials
Gamble 6	Negative EV	–\$40	–\$20	High-stakes: 50% win \$1.50, 50% lose \$2.50, 80 trials

Note: The gambles are ordered sequentially for ease of exposition — in the actual study, the order of the gambles was randomized across subjects within each condition (Narrow, Broad, Broad-Trial).

EV gambles used was a 50% chance to win \$0.25 and a 50% chance to lose \$0.15, played 120 times. In the Broad-Trial condition, this gamble was described as in the Narrow condition (120 plays of a gamble with these outcomes) but below the text description there was an illustration of 120 blocks (representing each trial) with five red dots (representing loss probabilities) and five black dots (representing gain probabilities) per block (see Figure 2). Again, broad bracketing could work by helping individuals properly adjust the EV for the multiple repeated trials (rather than just focusing on a single trial of the gamble) or by aggregating outcomes and making losses more or less salient as a result. To this end, the Broad-Trial condition illustrates the number of choices without explicitly aggregating outcomes so we can distinguish whether the bracketing effect from Study 1 is driven by a focus on the larger number of trials (addressing insufficient adjustment) or by providing information about the probability and size of cumulative losses (changing the situational weight placed on losses).

The order of the gambles was randomized and counterbalanced across subjects within a condition. For each gamble, subjects were asked to choose between (1) taking the gamble, (2) taking the certain amount, and (3) expressing indifference between the gamble and certain amount. After making their choice, subjects were asked to rate the perceived risk for each gamble (as in Study 1). In addition to risk perception, we also asked all subjects to rate the importance of losses (situational weight on losses) and the importance of the number of trials (a measure of adjustment for the repeated trials) for each gamble. For the situational weight on losses measure we asked subjects, "how important was the chance of losing money in your decision of whether or not to take the gamble?" For the adjustment measure, we asked subjects, "how important was the number of trials in your decision of whether or not to take the gamble?" Subjects responded to both measures on a seven-point scale ranging from one ("Not at all Important") to seven ("Extremely Important"). The situational weight on losses measure is especially interesting in that it allows us to test whether the weight placed on potential losses is affected by the bracketing manipulations.[14]

and their associated probabilities from each other.

7.2 Results

Our analysis proceeds as follows: first we address how the bracketing manipulations affect overall risk preferences (as measured through choice shares); next we turn to process variables — situational weight on losses and importance of the number of trials; we then briefly address perceived risk.

Risk Preferences. We first evaluated how risk preferences (choice shares) varied across bracketing conditions for each gamble type. These results are displayed in Figure 4 (further details are shown in Figure A3, Appendix 1). As Figure 4 shows, we replicate our bracketing effect from Study 1 across gamble types: subjects in the Broad bracketing condition are significantly more likely to take the positive EV gambles than subjects in the Narrow condition (M_{Broad} = 77.5% vs. M_{Narrow} = 63.0%, $t(188.16) = 2.58$, $p = 0.005$, one tailed); significantly less likely to take the negative EV gambles than subjects in the Narrow condition (M_{Broad} = 12.0% vs. M_{Narrow} = 41.7%, $t(145.86) = –5.91$, $p < 0.001$); and significantly less likely to take the pure-loss gambles than subjects in the Narrow condition (M_{Broad} = 9.5% vs. M_{Narrow} = 36.5%, $t(144.40) = –5.41$, $p < 0.001$).

The same pattern of results emerges when comparing the Broad condition to the Broad-Trial condition, suggesting that the Broad condition also leads to a bracketing effect relative to the Broad-Trial condition. Specifically, subjects in the Broad condition were more likely to take the positive EV gambles than in the Broad-Trial condition (M_{Broad} = 77.5%

[14]At the end of the survey, after all of the gambling questions, we asked subjects to respond to questions measuring individual-level loss aversion (lambda) via the DEEP method, and to self-report gender and age, as we did in Study 1.

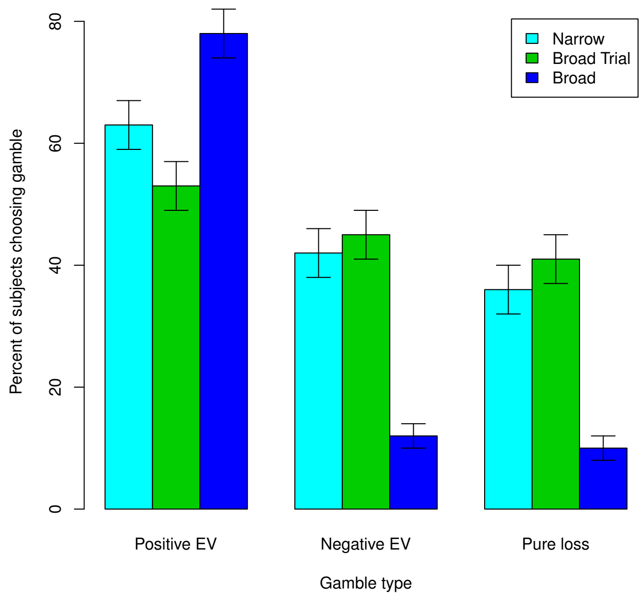

Figure 4: Choice Shares for the Gamble Across Bracketing Conditions and Gamble Type, Study 2.

Notes: (1) Broad, Broad-Trial, and Narrow collapse across the two gambles within each bracket for a given gamble type (e.g., the number displayed for the Broad Bracket Positive EV gambles is the average choice share across the two broadly bracketed gambles each subject saw). (2) The differences between the Narrow and Broad conditions are significant at the $p < 0.001$ level for all gamble types. The differences between the Broad and Broad-Trial conditions are significant at the $p < 0.001$ level for all gamble types. The differences between the Broad-Trial and Narrow conditions are not significant ($p > 0.10$) for all gamble types. (3) Error bars are for standard errors.

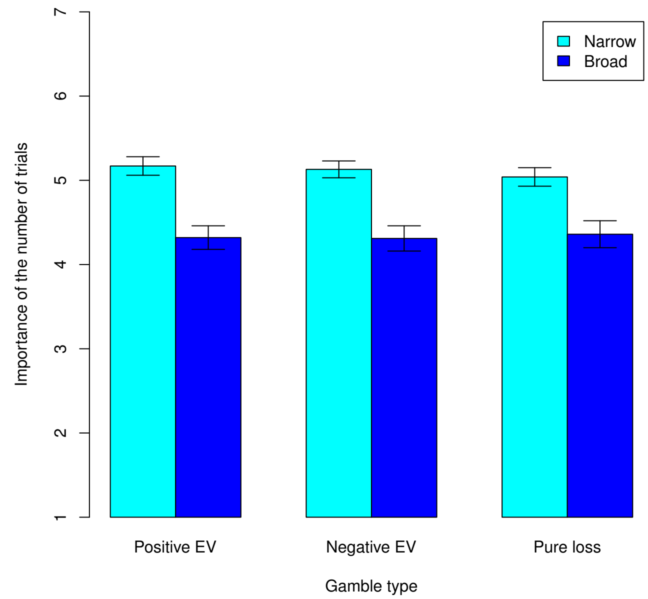

Figure 5: Average Importance of the Number of Trials, Study 2.

Notes: (1) The Narrow condition combines the Narrow and Broad-Trial conditions. (2) Broad and Narrow collapse across all gamble choices within the specified condition for a given gamble type (e.g., the number displayed for the Broad, Positive EV gambles is the average importance rating across the two broadly bracketed gambles each subject saw). (3) The differences between the Narrow and Broad conditions are significant at the $p < 0.001$ level for all gamble types. (4) Error bars are for standard errors.

vs. $M_{\text{Broad-Trial}} = 53.0\%$, $t(190.81) = -4.31$, $p < 0.001$); less likely to take the negative EV gambles than in the Broad-Trial condition ($M_{\text{Broad}} = 12.0\%$ vs. $M_{\text{Broad-Trial}} = 44.9\%$, $t(155.82) = 6.89$, $p < 0.001$); and less likely to take the pure-loss gambles than in the Broad-Trial condition ($M_{\text{Broad}} = 9.5\%$ vs. $M_{\text{Broad-Trial}} = 41.4\%$, $t(151.94) = 6.59$, $p < 0.001$). It appears that a manipulation that illustrates the number of trials does not have the same effect on risk preferences as providing the probability distribution/outcome aggregation. This suggests that the bracketing effects from Study 1 did not occur because the broader bracket helped subjects sufficiently adjust the EV for the gamble across all trials (i.e., broad bracketing does not work by correcting for insufficient adjustment).

Finally, if we compare the Broad-Trial and Narrow conditions, we see no statistically significant differences between the two in terms of choosing the gamble (for positive EV gambles: $M_{\text{Broad-Trial}} = 53.0\%$ vs. $M_{\text{Narrow}} = 63.0\%$, $t(192.00) = -1.64$, $p = 0.10$; for negative EV gambles: $M_{\text{Broad-Trial}} = 44.9\%$ vs. $M_{\text{Narrow}} = 41.7\%$, $t(191.84) = 0.54$, $p = 0.59$; and for pure-loss gambles: $M_{\text{Broad-Trial}} = 41.4\%$ vs. $M_{\text{Narrow}} = 36.5\%$, $t(192.47) = 0.81$, $p = 0.42$). Thus, the Broad-Trial bracketing format is statistically equivalent to the Narrow bracketing format. This result was unexpected, as we predicted that the Broad-Trial manipulation would produce a bracketing effect relative to the Narrow condition through more sufficient adjustment for more trials, however, this was not empirically confirmed. Since there was no difference in risk preferences between the Narrow and Broad-Trial conditions, for the remainder of our analyses we combine the Broad-Trial and Narrow conditions (and refer to the combined data as the Narrow condition) unless otherwise noted.[15]

Other Measures. In previous work on myopic loss aversion, the bracketing effect between broad and narrow framing has been attributed to both an attenuation of loss aversion and the salience of multiple trials. We measured both the importance of potential losses and the importance of the number of trials directly in Study 2 in order to distinguish between these two proposed mechanisms. First, we look at the importance of the number of trials (a proxy for adjustment to the single gamble for the multiple trials). We would expect this

[15]For all of the analyses described below, specific details are provided by condition (Narrow, Broad, Broad-Trial) in Appendix 1.

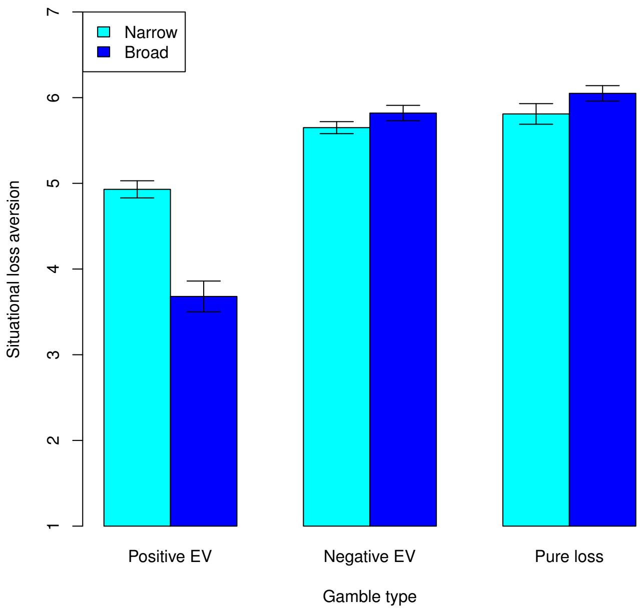

Figure 6: Average Situational Weight on Losses, Study 2.
Notes: (1) Narrow combines the Narrow and Broad-Trial conditions. (2) Broad and Narrow collapse across all gamble choices within the specified condition for a given gamble type (e.g., the number displayed for the Broad, Positive EV gambles is the average situational weight on losses across the two broadly bracketed gambles each subject saw). (3) The differences between the Narrow and Broad conditions are significant at the $p < 0.001$ level for all gamble types. (4) Error bars are for standard errors.

variable to be of greater importance in the Broad condition compared to the Narrow condition since the number of trials is more explicitly illustrated in this condition.

This expectation, however, was not confirmed in the data, as summarized in Figure 5 (more details about this variable are provided in Figure A5, Appendix 1). As Figure 5 shows, the importance of the number of trials in the decision to gamble is significantly *lower* in the Broad condition than in the Narrow condition across all gamble types (positive EV: $M_{Broad} = 4.32$ vs. $M_{Narrow} = 5.17$, $t(207.35) = 4.83$, $p < 0.001$; negative EV: $M_{Broad} = 4.31$ vs. $M_{Narrow} = 5.13$, $t(186.39) = 4.63$, $p < 0.001$; pure-loss: $M_{Broad} = 4.36$ vs. $M_{Narrow} = 5.04$, $t(193.93) = 3.50$, $p < 0.001$). As with the risk preference results, this suggests that the bracketing effect in the Broad condition is not attributable to greater adjustment to the single gamble in order to account for the multiple trials. We believe that this measure is significantly lower (less important) in the Broad condition relative to the Narrow condition because the number of trials is implicit in the distribution (and subjects may not realize that for there to be a probability distribution, there must be multiple trials underlying the gamble).[16]

Next, we consider the effects of bracketing on the importance of losses (our situational weight on losses measure). We predicted that the situational weight on losses measure would be significantly lower in the Broad bracketing condition compared to the Narrow condition for positive EV gambles, since the Broad bracketing condition would show the low probability of losses across all trials. In contrast, losses should be more important and the measure should be significantly higher in the Broad condition for negative EV and pure-loss gambles, since the Broad condition for these gamble types shows the higher probability of incurring a loss even larger than the sure loss (CE). Thus, the weight placed on the possible loss in the gamble should be greater in the Broad condition relative to the Narrow condition (where the cumulative losses are not as clear to subjects).

The results for situational loss aversion are summarized in Figure 6 (for more details on this measure, see Figure A6 in Appendix 1). Again, our hypotheses were not completely confirmed. For the positive EV gambles, the results are as expected: the situational weight on losses is significantly lower in the Broad bracketing condition compared to the Narrow condition ($M_{Broad} = 3.68$ vs. $M_{Narrow} = 4.93$, $t(163.36) = 6.01$, $p < 0.001$). This suggests that the bracketing effect between the Broad and Narrow conditions is attributable to changes in the weight placed on losses for positive EV gambles. For non-positive EV gambles, the evidence for a bracketing effect on the weight placed on losses appears somewhat weaker, although the ratings are near the ceiling, with little room to show effects, very likely because of the large number of losses involved. For negative EV gambles this effect is not quite significant ($M_{Broad} = 5.82$ vs. $M_{Narrow} = 5.65$, $t(216.19) = -1.44$, $p = 0.08$, one tailed). For pure-loss gambles, the situational weight on losses is rated as significantly higher in the Broad condition than in the Narrow condition ($M_{Broad} = 6.05$ vs. $M_{Narrow} = 5.74$, $t(249.56) = -2.38$, $p = 0.01$, one tailed).

The results suggest that the bracketing effect is being driven, in large part, by reducing (positive EV gambles) or increasing (non-positive EV gambles) the situational weight placed on losses. Accordingly, for positive EV gambles, the broad bracket allows subjects to realize the overwhelming likelihood of a gain relative to a loss and, as a result, to weight losses as less important; for the negative EV gambles, the broad bracket allows subjects to realize that the chance of a gain is unlikely, and thus they weight the cumulative losses as more important; for the pure-loss gambles, the broad bracket allows subjects to realize that cumulative losses from the gamble are significantly greater than the sure loss, and thus they weight these higher losses as more important.

[16]It should also be noted that the ratings for the importance of number of trials for the Broad-Trial condition is not significantly different from the ratings for the Narrow condition. This suggests that making the number of trials visually more salient does not increase adjustment more than simply providing information for the number of trials in text format.

Overall, Study 2 has replicated the bracketing effects from Study 1 for all gamble types, and has provided further process evidence for these effects. Across two studies we now know that broad bracketing (via provision of the probability distribution) leads to more optimal risk preferences for gambles of all types. Our results related to the importance of the number of trials suggests that this significant bracketing effect is not due to adjustments made to the single gamble for the multiple trials. Further, our results for this measure suggest that individuals do not consider the multiple trial factor when evaluating a probability distribution (most likely, subjects in Study 1 did not realize that the narrow and broad brackets provided different representations of the same gamble). Our findings for the importance of losses provide evidence that bracketing does affect the decisional weights placed on losses and this is partly responsible for changing preferences between brackets. For positive EV gambles, broad bracketing reduces the weight placed on losses and increases the attractiveness of the gamble, while for non-positive EV gambles, broad bracketing increases the weight placed on losses and decreases the attractiveness of the gamble.

While the situational weight placed on losses is significantly affected by bracketing manipulations, it does not account for the entire effect of bracketing on risk preferences. In combination with the findings regarding the importance of the number of trials, the documented bracketing effects appear to be driven in part by changing the weights placed on losses, but also continue to reflect cognitive capacity constraints that prevent individuals from aggregating outcomes and probabilities across multiple trials. Importantly, this implies that interventions targeted at changing risk preferences over repeated gambles should focus on removing these cognitive constraints by explicitly providing probability distributions or aggregated outcomes.

8 Summary and Discussion

In two studies, we replicate the findings of previous research showing that broad bracketing (via the provision of a probability distribution) leads to relative risk-seeking for positive EV gambles. We were able to extend these findings by confirming that this result occurs because of a decrease in the weight placed on losses that occurs when there is an attenuation of cognitive constraints related to probability distribution construction. We further extend the findings related to choice bracketing and decision framing by demonstrating that broad bracketing can also lead to more optimal risk preferences (reduced risk-seeking) for gambles over losses (i.e., negative EV and pure-loss gambles). This bracketing effect is driven by changes in the situational weight placed on losses (increasing the weight placed on losses) and by alleviating cognitive constraints. Thus, the same mechanism lies behind the bracketing effects for all gamble types, but the direction of the effect varies depending on the expected value domain.

We find that a bracketing effect is only produced via provision of a probability distribution (outcome aggregation) — a similar effect is not found when using a visual aid to illustrate the number of trials. This suggests that bracketing manipulations must explicitly address insufficient adjustment (failing to properly adjust the single gamble for the multiple trials).[17] While providing a probability distribution does this and increasing the visual salience of the number of trials does not, this does not rule out the possibility that another form of broad bracketing could produce a bracketing effect without the explicit provision of the distribution. Identifying other possible broad bracketing manipulations is a potentially interesting avenue for future research.

Our results suggest that in order to help individuals make better decisions over risk, they should be provided with a probability distribution over returns (or aggregated outcomes), rather than just a text description or a visual aid depicting the number of "trials" inherent to the decision. Doing so will lead to relative risk-seeking over positive EV investments, and relative risk aversion over negative EV or pure-loss investments (versus risk aversion and risk-seeking, respectively). Our findings also suggest that, more generally, bracketing or framing manipulations that decrease (increase) the weight placed on losses will lead to more optimal risk preferences for positive EV (non-positive EV) risks.

Ultimately, a large part of the bracketing effect for all gamble types is attributable to cognitive capacity constraints. Individuals change the weight placed on the expected costs/benefits when provided with the probability distribution, and they are not able to replicate or construct the distribution on their own even when the number of trials and cumulative nature of the risk is made more salient. When presented with a description of the risk, individuals rely on heuristics or simplified calculations to determine their preferences (i.e., calculating the EV of one trial and insufficiently adjusting). The provision of the probability distribution does not engage more deliberate or careful thought; rather it provides information that can be used quickly and efficiently to determine preferences that are ultimately more optimal. This further implies that it is unlikely that many subjects even realized that the probability distributions from Study 1 were representative of the other gambles they had encountered. Thus, the simple provision of a probability distribution can improve decision-making over risk, and does so without the need for behavioral change or effortful thought processes.

[17]This is consistent with previous work that tried to disentangle the effects of aggregating choices (making multiple choices at once) and aggregating outcomes (across choices) (Moher & Koehler, 2010). The authors of that work similarly found that outcome aggregation was necessary to produce a bracketing effect.

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