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Effects of valence and framing in decision-making: Assessing decision-makers' perceived domains of choice

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Abstract: In comparison between choice alternatives, judgments of "How much better is a preferred option?" and "How much worse is a less preferred option?" may differ in their magnitudes. Such discrepancies are called "valence effects". Previously, Yamagishi and Miyamoto (1996) observed systematic positive valence effects ("Better" exceeding "Worse") in the domain of gains and systematic negative valence effects ("Worse" exceeding "Better") in the domain of losses. The current experiments used the directions of valence effects as a tool to assess decision-maker's interpretation of choice tasks under "framing effects" (Tversky & Kahneman, 1986). Preferences under the framing effect switch from certain options in the domain of gains to uncertain options in the domain of losses. Two experiments showed that preferences for certain options were associated with positive valence effects, whereas preferences for uncertain options were associated with negative valence effects. Moreover, conditions wherein the framing manipulations lose the effectiveness were examined. Valence effects showed that framing effects ceased to occur when decision-makers maintained consistent domain perceptions as pertaining to gains or to losses, across the domains of gains and losses. Implications are discussed.

Key words: decision-making, comparative judgment, framing effects, valence effects.

Previous research has shown that judgments made in superficially different yet logically equivalent forms may not agree with each other. In this paper, such discrepancies are referred to as asymmetries. Asymmetries have been documented in a variety of psychological research. Tversky's (1977) participants rated North Korea as more similar to China than China was to North Korea. In social comparisons (Dunning & Parpal, 1989), college students at their first choice schools rated various qualities of life to what they could have been at each student's second choice. Magnitude judgments showed disagreements between the focus of judgment being the first choice and being the second choice. Such asymmetries led researchers to investigate whether the discrepancies arise due to differences in mental representations of the tasks, or differences between mental processes involved.

This paper analyzes the cognitive processes that underlie a well-known preferential asymmetry, namely "framing effects" (Tversky & Kahneman, 1981, 1986). First, how the framing manipulation leads to asymmetric preferences between the domains of gains and losses is reviewed. The review introduces more recent developments of this approach that seek boundary conditions under which the preferential asymmetry ceases to occur. This part of the

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review will indicate a necessity of a tool that can assess decision-maker's perceived domain as pertaining to gains or losses. The last part of the review introduces another asymmetry in strength-of-preference judgments, which was investigated independently of the line of framing research. It shall be suggested that asymmetries in strength of preference, namely "valence effects" (Yamagishi, 1996; Yamagishi & Miyamoto, 1996), may be used as a diagnostic tool to assess a decision-maker's perceived domain as pertaining to either gains or losses. Two experiments attempted to use valence effects to see whether decision-makers who exhibit the "gain pattern" of preference also exhibit a "gain pattern" of the valence effect, whereas those who show the "loss pattern" of preference also show the "loss pattern" of the valence effect. My goal in this paper is to examine the effectiveness of valence effects as a diagnostic tool of decision-makers' domain perception.

Framing and unframing effects in preferential choice

Framing refers to a manipulation where choice Options K, L, K′, and L′ are described such that a choice between K and L seemingly pertains to gains, whereas a choice between K′ and L′ seemingly pertains to losses ("unframing" shall be explained later). However, Options K and K′ lead to an identical final asset position, whereas Options L and L′ lead to a different final asset position, hence these pairwise choices are equivalent to each other. An example is shown below (Tversky & Kahneman, 1986; p. 258):

Gain frame. Assume yourself richer by $300 than you are today. Choose between:

- Option K: A sure gain of $100 [72%]
- Option L: A 50% chance to gain $200 and a 50% chance to gain nothing [28%]

Loss frame. Assume yourself richer by $500 than you are today. Choose between:

- Option K′: A sure loss of $100 [36%]
- Option L′: A 50% chance to lose $200 and a 50% chance to lose nothing [64%]

Note that the K and L pair and the K′ and L′ pair differ only superficially, because the latter pair was provided with the $200 increase in the initial endowment, and Options K′ and L′ were generated by subtracting $200 from its counterpart. The percentages in the square brackets show the proportion of Tversky and Kahneman's (1986) participants who chose the option provided with either the former or the latter pair. The certain option was predominantly preferred (72%) in the gain frame, whereas the uncertain option was predominantly preferred (64%) in the loss frame. Thus, preference for the certain or uncertain option switched between the gain and loss frames.[2]

Subsequent research in the laboratory setting showed numerous replications of the framing effect (Fagley & Miller, 1990; Jou, Shanteau, & Harris, 1991, 1996; Takemura, 1992, 1993, 1994). Moreover, McNeil, Pauker, Sox, and Tversky (1982) noted that medical practitioners and patients were also susceptible to the framing effect in their choice of medical care options. It has been observed that certain options are preferred in the gain frame, whereas uncertain options are preferred in the loss frame.

More recent developments report conditions under which participants ceased to switch their preferences between the gain and loss frames (Fagley & Miller, 1990; Jou, Shanteau, & Harris, 1991, 1996; Takemura, 1992, 1993, 1994). In this paper, such findings are called *unframing effects*. These studies commonly showed that the unframing effect occurs when participants try to take a more mindful approach to the task than typical undergraduate participants ordinarily would. Another common aspect is that the following "Disease Problem" (Tversky & Kahneman, 1981) is widely used:

[2] The experiments in this article were part of the author's doctoral dissertation submitted to University of Washington. I would like to thank John Miyamoto (advisory committee chair), Richard Gonzalez, Earl Hunt, Elizabeth Loftus, and Deborah McCutchen for their encouragement, guidance, and criticism throughout my graduate career. That Jerwen Jou provided me with his choice tasks is gratefully acknowledged. A preliminary report of this research was presented at the 34th annual meeting of The Psychonomic Society, Washington, DC, 1993.

> Imagine that the US is preparing for the outbreak of an unusual foreign disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows …

In the gain frame, decision-makers were required to choose between: 200 people will be saved for sure; or a 1/3 probability that 600 will be saved. In the loss frame, the choice alternatives consisted of: 400 people will die for sure; or a 1/3 probability that nobody will die. Regardless of the gain–loss framing, the choices are equivalent because either alternative lead to an identical final asset positions; that is, letting 200 live (and 400 die) or a 1/3 chance of letting everyone live (and 2/3 chance that 600 die).

Fagley and Miller (1987) observed that MBA students maintained their preference for the uncertain option in a task analogous to the Disease Problem. Miller and Fagley (1991) requested that participants explain the rationale for their choice in the Disease Problem. In such conditions, most participants preferred the uncertain option in both frames. Likewise Takemura (1994) also observed that the majority of his participants maintained their preference for an uncertain option when they were required to justify their choice. Moreover, the majority of Takemura's (1992) participants preferred an uncertain option when they were allowed to spend a sufficient amount of time to analyze the question, whereas those who were under time pressure exhibited the standard framing effect.

Why do unframing effects occur? Various suggestions have been made regarding intervening variables that contribute to unframing. However, empirical measurement of such variables was not always attempted. After Hagafors and Brehmer (1983), Takemura (1992, 1993) assumed that decision-makers can adopt an "analytical mode" of decision-making if necessary. Manipulations such as allowing a sufficient amount of time for analyzing the task, or having to justify one's preference, would facilitate such an analytical mode. Yet, little observation of indicator variable has been attempted regarding the particular "mode" being employed under framing and unframing manipulations. For instance, Takemura (1993) could have reported protocol analysis of the justification of choice provided by participants, but such analysis was not reported.

An exception is found in Jou et al. (1996), who analyzed the content of the rationale for choice provided by decision-makers. They questioned why decision-makers under framing fail to recognize the "reciprocal" relationship in choice options, such that saving 200 lives means that 400 lives would be lost in the Disease Problem. They argued that the failure to recognize such a relationship reflects the difficulty of interpreting pieces of information in the choice task by the participants' own schema, like pragmatic reasoning schemas (Cheng & Holyoak, 1985). Jou et al. inferred that causal schemas would be relevant in interpreting choice tasks, and provided participants with the modified version of the Disease problem. The modified version described each choice alternative with the explanation of the specific causal agents that produced the particular outcome. Such task description would make it easier to interpret the problem by the participants' own causal reasoning schemas, thereby participants would become more aware of the reciprocal relationship. Their unframing description of the Disease problem was as follows (Jou et al., 1991).[3]

> Imagine that the US is attacked by an unusual foreign disease, which was found to be fatal. Without treatment, a person with the disease is sure to die. Six hundred people were diagnosed to have contracted the disease. However, there are only enough medical resources to treat 200 such patients,

[3] Because monetary gambles are used in Options K, L, K′, and L′, one may want to characterize the preference reversals as an example of "Reflection Effect" (Kahneman & Tversky, 1979). It is possible to claim that the preference reversal from Option K to L′ stems from the reflection effect without contradicting to the argument in the text.

> because the treatment is extremely expensive. Two alternative programs to combat the situation have been proposed. Assume that the exact scientific estimate of the consequences for each program is as follows …

In the gain frame, the options were paraphrased as follows:

- Program One: The total resources are applied to 200 people. If this is done, 200 people will be saved for sure.
- Program Two: The total resources are shared among the 600 patients. If this is done, there is a 1/3 probability that all 600 people will be saved, and a 2/3 probability that nobody will be saved.

In the loss frame, the options were paraphrased as follows:

- Program One′: The total resources are applied to 200 people. If this is done, 400 people will die for sure.
- Program Two′: The total resources are shared among the 600 patients. If this is done, there is a 1/3 probability that nobody will die, and a 2/3 probability that all 600 people will die.

Presented with this description, Jou et al.'s (1996)[4] participants exhibited consistent preferences for the uncertain options; that is, under both frames, the uncertain options were preferred by more than 55% of the participants. Moreover, the rationale for choice provided from the unframing group mentioned the reciprocal relationship more frequently than the control group, whose data replicated the classic framing effect.

Jou et al.'s contribution lies in providing an empirical measurement of participants' domain perception: their work indicated *when* participants' domain perception ceases to change from the gain to the loss frame. Still, is not necessarily clear *why* some participants committed themselves to the certain option, whereas others committed themselves to the uncertain option, when they recognized the reciprocal relationship.

Therefore, it would be desirable to assess decision-makers' perception of choice domain under framing and unframing. The claim that the perceived domains cease to switch from gains to losses would be strengthened if the decision-maker's task perception were assessed by some empirical criterion. The following section discusses how "valence effects" may be utilized as such a criterion.

Positive and negative valence effects

Yamagishi and Miyamoto (1996) noted an asymmetry in strength of preference judgments. In binary choice, they contrasted questions of "How much better is a more preferred option?" and "How much worse is a less preferred option?" The former and the latter are called judgments of superiority and inferiority, respectively. They called it "positive valence effects" when superiority judgments exceeded corresponding inferiority judgments in their magnitudes. Asymmetries in the opposite direction were called "negative valence effects." Yamagishi and Miyamoto (1996) found that systematic positive valence effects were observed in intrinsically pleasant domains of choice, whereas systematic negative valence effects were observed in intrinsically unpleasant domains. For instance, on a 16-point scale, a choice between two vacation plans produced a significant positive valence effect (the mean superiority and inferiority ratings were 10.48 and 7.42, respectively). Conversely, a choice between two painful treatments of cancer produced a significantly negative valence effect (the mean superiority and inferiority ratings were 9.33 and 10.60, respectively). Yamagishi and Miyamoto argued that the positive and negative valence effects reflect how decision-makers selectively assign subjective weights onto different features of choice options, as a function of the valence of assessment.

[4] Although the disease problems used by Jou et al. (1991) and Jou et al. (1996) differ in their details, modifications were minimal and both papers reported essentially the same results.

That the direction of valence effects varied depending upon the intrinsic pleasantness of the choice domain led Yamagishi and Miyamoto (1996) to speculate whether the directions of valence effects may be used as a diagnostic tool to assess the intrinsic pleasantness of particular domains of choice. Regarding the framing and unframing research, it would be desirable to investigate whether the two empirical indexes that assess decision-makers' domain perception would coincide. Would participants who chose the certain option (typically "gain preference") exhibit positive valence effects (typically "gain pattern") between subsequent judgments? Conversely, would participants who chose the uncertain option (typically "loss preference") exhibit negative valence effects (typically "loss pattern") in subsequent judgments? Pursuit of such inquiries may provide insights as to whether different measurements of preferential performance accumulate converging evidence of decision-maker's perceived domains.

My empirical questions in this paper are as follows. First, would preference for certain options indicate that participants interpret the choice as pertaining to gains? If so, from the previous results, it would follow that those who prefer certain options would exhibit positive valence effects. Conversely, would preference for uncertain options indicate that participants interpret the choice tasks as pertaining to losses? Then, those who prefer uncertain options would exhibit negative valence effects. Experiments 1 and 2 tested this idea under both framing and unframing manipulations. In replication of previous studies (Tversky & Kahneman, 1981, 1986; Jou, 1991, 1996), Experiment 1 used the gain–loss frame as a between-participant treatment. Experiments 2 administered the gain-loss framing as a within-participant variable.

Experiment 1

Method

Participants. Participants were 813 University of Washington undergraduates. They were enrolled in an introductory psychology course and participated to earn extra course credits.

Material. Two kinds of decision tasks, each having a framing and an unframing version of task description, were used. Jou et al.'s (1991) problems were previously introduced. Another problem that presented a hypothetical situation with a part-time job was also given for the framing condition in the gain frame (hereafter referred to as the "Cab Problem"):

> You are hired for a part-time position as a taxi driver for the next two weeks. The policy of the taxi company is as follows: They pay you $200 in advance, and will reward you extra money if your performance is above their standard. The management assigns each driver to a particular zone of the city, where the driver mostly picks up her/his customers. Currently two zones are available and you can choose to work in either zone.

- Zone 1: You will earn extra $67 for sure.
- Zone 2: There is a 1/3 chance to earn extra $200, and a 2/3 chance to earn no extra money.

A loss frame version of this problem was created by stating the management policy as "They pay you $400 in advance, but deduct some amount from that if your performance does not meet their standard." Consequently, the options were described as:

- Zone 1′: They will deduct $133 for sure.
- Zone 2′: There is a 1/3 chance to avoid any deduction, and a 2/3 chance that they deduct $200.

The unframing description of the Cab Problem was created by modifying the presentation of the options. At the end of the description of the situation, the following Zones were presented in the gain frame.

An experienced driver told you the following:

- *Zone 1: Close to downtown. The need for cabs is not too high, but stable.* You will earn extra $67 for sure.

- *Zone 2: If the weather is good, there are frequent rides between a subway station and an amusement park. Otherwise, this is a rather quiet zone.* There is a 1/3 chance to earn extra \$200, and a 2/3 chance to earn no extra money.

For the loss frame, the italicized parts were added to the descriptions of Zones 1′ and 2′ (see above). Each version of the choice tasks was presented in a questionnaire, along with other filler tasks.

Variables. The independent variables were task descriptions (framing or unframing), frame (gain or loss), valence of judgment (positive or negative), and preference between the two alternatives (certain or uncertain). The task description and frame were between-participant variables, in replication of the experimental design in Tversky and Kahneman (1981) and Jou et al. (1996). For the preference variable, the assignment depended on each participant's response. The valence was a within-participant variable. The dependent variables were superiority and inferiority ratings on a 16-point scale that ranged from 0 (no difference) to 15 (maximum difference).

Procedure. Data were gathered in a group setting. Each participant worked on a booklet of problems that showed one of the four variations of choice tasks (framing-gain, framing-loss, unframing-gain, or unframing-loss). The booklet contained other filler tasks. For each choice task, participants first expressed their preferences. Subsequently, they evaluated the provided options in terms of "How much better is the option that you chose than the option that you did not choose?" and "How much worse is the option that you did not choose than the option that you chose?" The orders of presentation of the tasks, as well as "Better" and "Worse" questions, were counterbalanced across participants.

Prediction. The following was predicted: First, for the framing description, certain options would be preferred in the gain frame, whereas uncertain options would be preferred in the loss frame. Conversely, for the unframing description, preferential patterns would not change between the gain and loss frames. Second, participants who preferred certain options would exhibit positive valence effects, whereas those who preferred uncertain options would exhibit negative valence effects. Figure 1 shows an illustration of a pattern that follows from the prediction.

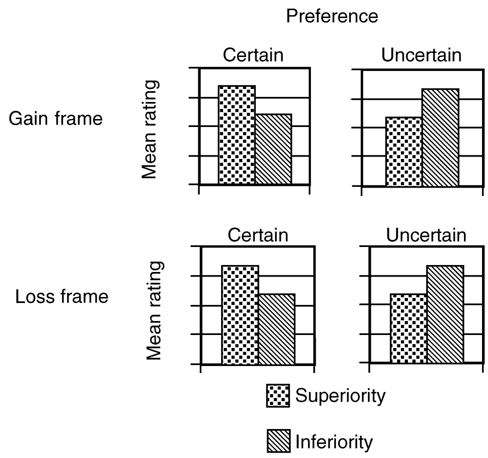

Figure 1. The predicted pattern of valence effects in Experiment 1.

Results and discussion

Two-tailed tests were used throughout this paper. Hereafter, in the text and tables ,*,**, and *** denote a statistical significance at 0.05, 0.01, and 0.001 levels, respectively.

Framing and unframing effects. For each choice task, Table 1 shows a 2×2 table showing the frequency of participants who preferred the certain or uncertain option in either frame. The proportion of participants who preferred the certain option was compared between the frames. The differences were compared by Goodman's (1964) test statistic,

$$z = \frac{\hat{p}_x - \hat{p}_y}{\sqrt{\dfrac{\hat{p}_x(1-\hat{p}_x)}{n_x} + \dfrac{\hat{p}_y(1-\hat{p}_y)}{n_y}}}.$$

Table 1. Participants' preference for the certain and uncertain options in Experiment 1

Disease Problem, Framing Description

Frame	Certain	Uncertain
Gain	67	31
Loss	22	65

Disease Problem, Unframing Description

Frame	Certain	Uncertain
Gain	57	68
Loss	54	71

Cab Problem, Framing Description

Frame	Certain	Uncertain
Gain	72	29
Loss	20	68

Cab Problem, Unframing Description

Frame	Certain	Uncertain
Gain	54	41
Loss	48	46

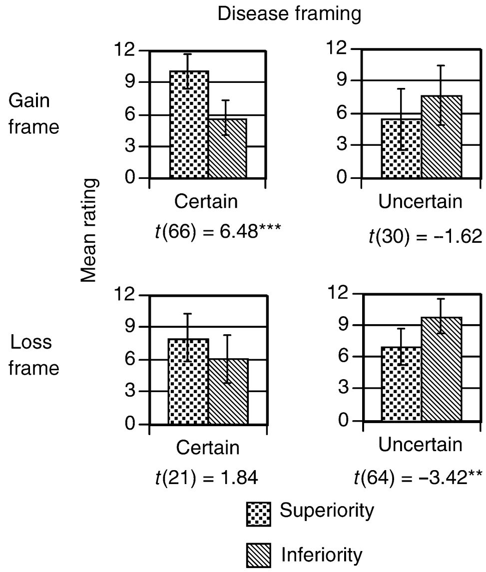

Figure 2. The mean superiority and inferiority ratings for the Disease Problem, framing description. *p = 0.05; **p = 0.01; ***p = 0.001.

The framing description of the Disease Problem indicated that a reliably greater number of participants preferred the certain option in the gain frame than in the loss frame $\frac{67}{67+31} > \frac{22}{22+65}$ ($z = 6.501$). For the unframing description, however, the preference for the certain option did not show a reliable difference between two frames ($z = 0.364$, $p = 0.712$). For the Cab Problem, the framing description showed that reliably more participants preferred the certain option in the gain frame than in the loss frame $\frac{72}{72+29} > \frac{20}{20+68}$ ($z = 7.315$). For the unframing description, the certain options were preferred by 56.8% of the participants in the gain frame and by 51.1% of the participants in the loss frame. These proportions failed to show a reliable difference ($z = 0.788$, $p = 0.431$). Thus, in both the Disease and Cab problems, the data from the framing condition replicated the standard framing effect in Tversky and Kahneman (1981, 1986), whereas the results from the unframing condition were consistent with Jou et al. (1991, 1996).

Valence effects. Figures 2–5 show mean superiority and inferiority ratings, as well as the 95% confidence intervals for the cell means, separately for gain versus loss frames and for the preference for the certain versus uncertain option. For each condition, a paired t-test compared the mean superiority to inferiority rating. A positive t-value indicates a positive valence effect, whereas a negative t-value indicates a negative valence effect.

Figures 2–5 show that preference for the certain options is associated with positive valence effects, whereas preference for the uncertain options is associated with negative valence effects. Although the valence effects tended not to show statistically reliable differences when the degrees of freedom were fewer than 50, the directions of valence effects were consistent with the prediction in Figure 1.

Thus, positive valence effects were associated with the preference for the certain options, which was the typical preference in the domain

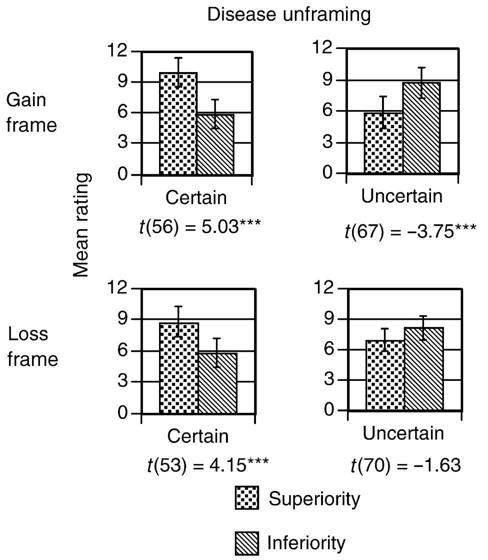

Figure 3. The mean superiority and inferiority ratings for the Disease Problem, unframing description. *$p = 0.05$; **$p = 0.01$; ***$p = 0.001$.

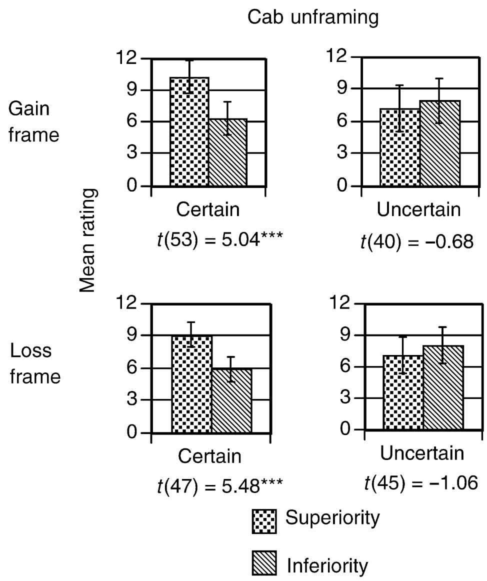

Figure 5. The mean superiority and inferiority ratings for the Cab Problem, unframing description. *$p = 0.05$; **$p = 0.01$; ***$p = 0.001$.

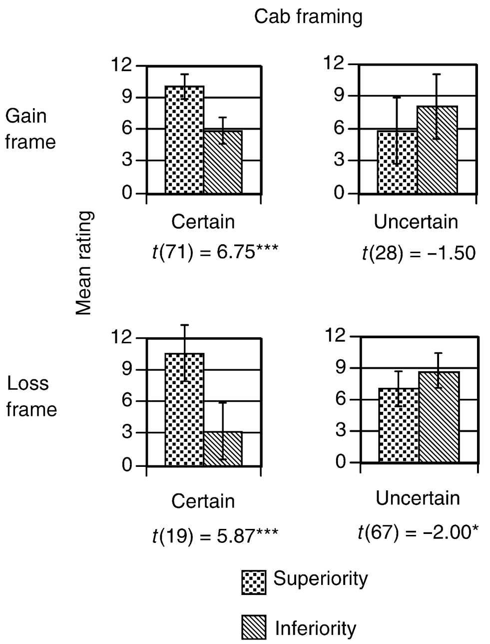

Figure 4. The mean superiority and inferiority ratings for the Cab Problem, framing description. *$p = 0.05$; **$p = 0.01$; ***$p = 0.001$.

of gains. Negative valence effects were associated with the preference for the uncertain options, which was the typical preference in the domain of losses. In combination with the results from the unframing condition, it may be claimed that unframing occurred when participants' interpretation of the choice options ceased to switch from pertaining to gains in the gain frame to pertaining to losses in the loss frame.

Experiment 2

Experiment 1 used the gain-loss frame as a between-participant treatment in examining participants' domain perception (as pertaining to gains or losses) in the framing versus unframing descriptions. Having the frame as a between-participant treatment was a necessity for replicating the experimental designs of Tversky and Kahneman (1981, 1986) and Jou et al. (1991, 1996). In Experiment 2, the frame was administered as a within-participant manipulation. Such a design allowed estimation of the proportion of participants who maintained their task interpretations across the gain versus loss frames.

Table 2. A result from Experiment 1 and hypothetical cell frequencies that may follow from the marginal frequencies

Frame		Certain	Uncertain	
Gain		57	68	
Loss		54	71	
		Loss frame		
		Certain	Uncertain	
Gain frame	Certain	?	?	57
	Uncertain	?	?	68
		54	71	
		Loss frame		
		Certain	Uncertain	
Gain frame	Certain	0	57	57
	Uncertain	54	14	68
		54	71	
		Loss frame		
		Certain	Uncertain	
Gain frame	Certain	54	3	57
	Uncertain	0	68	68
		54	71	

A result from Experiment 1 may be used to illustrate what remains ambiguous in a between-participant experiment. The top table of Table 2 shows the previous result from the unframing description of the Disease Problem. Suppose that this result was obtained by using the gain-loss frame as a within-participant variable. The second table in Table 2 shows the numbers from the top table constituting the marginal frequencies. The third and the fourth tables show extreme examples of the cell distributions that may follow from the marginal frequencies. The "Certain-Certain" and "Uncertain-Uncertain" cells show the hypothetical numbers of participants who would choose the corresponding options across gain and loss frames. Apparently, the conclusion regarding the interframe consistency in preferences differs substantially between the third and fourth tables in Table 2. Assuming the third table, one would claim that 11.2% (14/125) of the participants chose the equivalent choice options under both frames, whereas assuming the fourth table, the percentage would increase to 97.6% ([54 + 68]/125).

Takemura (1992, 1993) provided examples of unframing studies that administered the gain-loss framing as a within-participant treatment. Recall that Takemura (1993) noted an unframing effect when participants were required to justify their choice. In his control group, 40.51% of the subjects fell into the cell for the certain option in the gain frame and the uncertain option in the loss frame (hereafter, this cell is called "Conventional framing" cell). In the unframing condition, however, 30.38% of the participants fell in this cell. Thus, Takemura (1993) characterized his unframing group as: "Most of the subjects showed the consistent choice pattern and did not show the preference reversal" (p. 39).

Experiment 2 tested for the unframing effects observed in Experiment 1, but used the framing as a within-participant manipulation to see whether preferences stay constant between the frames when unframing occurred. Jou et al. (1996) argued that participants should recognize the reciprocal relationship between gain and loss when the task presentation activates participants' causal schema. It could follow from their argument that preferences should stay consistent between the gain-loss frames under unframing. In addition, the directions of valence effects should be examined separately for those who preferred the certain option and for those who preferred the uncertain option. The valence effects tested whether preferences for certain options would be associated with positive valence effects, whereas the preference for uncertain options would be associated with negative valence effects. The combination of administering the frame as a within-participant variable and examining valence effects enabled me to test if unframing was associated with the increase of participants whose domain perceptions (as pertaining to gains or losses) stayed constant between the gain-loss frames. Furthermore, additional choice problems were tested in Experiment 2 to examine the generality of the unframing manipulation across stimulus domains.

Method

Participants. Participants were 1241 University of Washington undergraduates. They were enrolled in an introductory psychology course and participated to earn extra course credits.

Variables. The independent variables were: framing-unframing description; frame (gain or loss), valence of judgment (positive or negative), and preference between two alternatives (certain or uncertain). The dependent variable was superiority or inferiority rating on a 16-point scale that ranged from 0 (no difference) to 15 (maximum difference).

Material. In addition to the Disease and Cab Problems used in Experiment 1, three additional problems were used (see Appendix). The new problems were variants of the Disease Problem, with changes in the nature of matters in danger (precious metal, lives of ship crew, lives of newborns). Hereafter the problems are referred to as Crew, Metal, and Pregnancy Problems. The choice alternatives for the gain and the loss frames also appear in Appendix. The Crew and Metal Problems were originally used by Jou et al. (1991). The Pregnancy Problem was developed by the author.

Design and prediction. A mixed design was used. Frame and valence were within-participant variables. For each problem, participants were presented with the gain and loss conditions and provided superiority and inferiority ratings. The framing-unframing description was a between-participant variable. As in Experiment 1, participants assigned themselves to the preference for the certain or the uncertain option by their spontaneous responses.

Procedure. Data were gathered in a group setting. Each participant worked on a booklet of problems that showed either the gain or loss frame of choice tasks. The booklet contained other filler tasks.

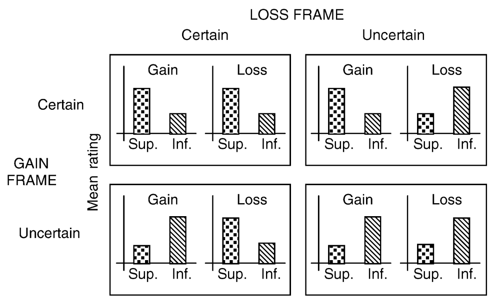

Figure 6. The predicted pattern of results in Experiment 2. Sup, superiority, Inf, inferiority.

At each experimental session, participants received one of the booklets. They first expressed their preferences and provided superiority and inferiority ratings in the same way as in Experiment 1. The experiment met for two sessions, and the order of administering either the gain or the loss frame was counterbalanced across the sessions. Within each session, the order of obtaining superiority and inferiority ratings was counterbalanced.

Prediction. The following was predicted: First, for the framing descriptions of the problems, certain options would be preferred in the gain frame, whereas uncertain options would be preferred in the loss frame. Conversely, for the unframing description of the problems, preferential patterns would not change between the gain and loss frames. As for the direction of valence effects, participants who preferred certain options would exhibit positive valence effects, whereas those who preferred uncertain options would exhibit negative valence effects. Figure 6 shows the predicted pattern of valence effects for both framing and unframing descriptions of the problems. The "rows" correspond to participants' preferences in the gain condition, whereas the "columns" correspond to participants' preferences in the loss frame. In each "cell," the right and left panels correspond to participants' responses under the gain and loss frames, respectively. "Sup" denotes superiority judgment and "Inf" denotes inferiority judgment.

Table 3. The frequency of participants who preferred the certain and uncertain options in Experiment 2

	Loss frame									
	Disease		Cab		Crew		Metal		Pregnancy	
Gain frame	UC	C	UC	C	UC	C	UC	C	UC	C
Framing description										
Certain	30	59	16	77	9	53	27	48	13	78
Uncertain	8	19	10	31	4	32	11	30	3	36
Unframing description										
Certain	53	15	54	28	27	14	91	24	28	24
Uncertain	6	42	12	63	7	73	5	18	6	57

C, certain, UC, uncertain.

Results and discussion

Framing and unframing effects. Table 3 shows the patterns of preferences exhibited by participants in the Disease, Cab, Crew, Metal, and Pregnancy Problems, for the framing and unframing description of each problem. Each cell shows the frequency of participants who preferred the certain and uncertain options in the gain and loss frames.

For each Problem, two tests were performed on the changes in the proportion of participants between the framing and unframing descriptions. The Type I error rate for each test was controlled for by dividing the α by two (Bonferroni correction) for each Problem. Whether the number of participants in the Conventional framing cell decreased from the framing to the unframing descriptions was tested by comparing the difference between the corresponding cells using Goodman's test statistic. For instance, for the Disease Problem, 59/(30+59+8+19) was tested against 15/(53+15+6+42). The test statistics for the Disease, Cab, Crew, Metal, and Pregnancy problems were 6.875***, 7.548***, 7.313***, 4.286***, and 6.830***, respectively. Thus, there was a reliable decrease in the number of participants shifting their preferences from the framing to the unframing descriptions in each problem.

In addition, the difference in the number of participants in the diagonal cells was tested to examine preferential consistency from the framing to the unframing descriptions. For instance, for the Disease Problem, the difference was compared between (53+42)/(53+15+6+42) and (30+19)/(30+59+8+19). Goodman's test statistics for the Disease, Cab, Crew, Metal, and Pregnancy problems were 6.821***, 7.315***, 6.736***, 5.150***, and 6.137***, respectively. In each problem, more participants showed consistent preferences in the unframing than in the framing description.

Valence effects. Figures 7–11 show the mean superiority and inferiority ratings, as well as the 95% confidence intervals for the cell mean, for the framing and the unframing descriptions of the Disease, Cab, Crew, Metal, and Pregnancy Problems. The top and bottom panels in Figures 7–11 show the results from the framing and unframing descriptions, respectively. In Figures 7–11, the shaded bars represent mean superiority rating and the striped bars represent mean inferiority rating. Notice that the patterns exhibited by the mean superiority and inferiority ratings were mostly consistent with the prediction in Figure 6. Most importantly, in the framing descriptions, the Conventional framing cell shows positive valence effects in the gain frame and negative valence effects in the loss frame. In turn, in the unframing descriptions, the "Certain-Certain" cells show positive valence effects in both gain and loss frames, whereas the "Uncertain-Uncertain" cells show negative valence effects in both frames.

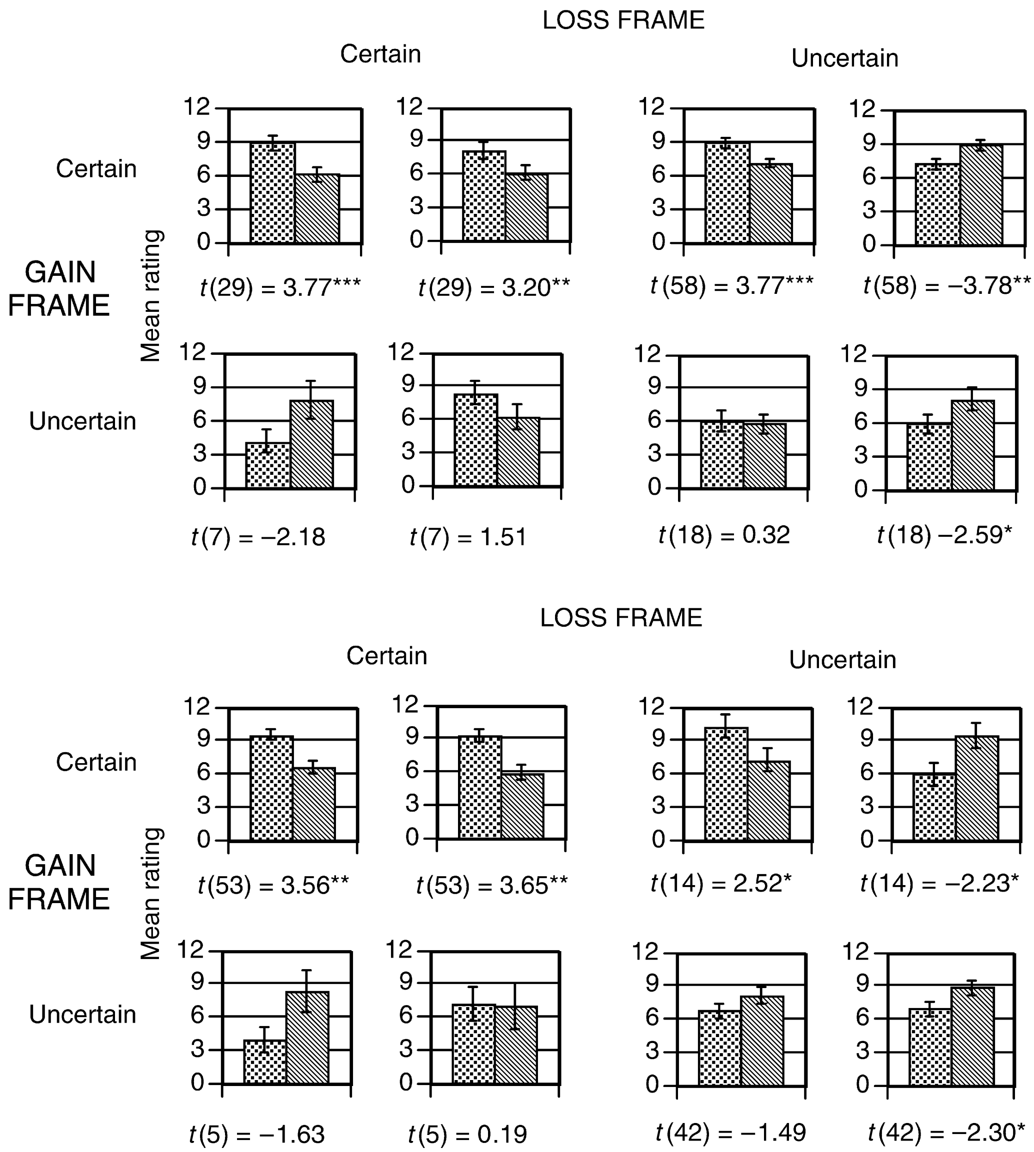

Figure 7. The mean superiority and inferiority ratings for the Disease Problem, framing description (top) and unframing description (bottom). $*p = 0.05$; $**p = 0.01$; $***p = 0.001$.

Taken together, the results from the framing versus unframing effects and valence effects jointly suggest that unframing was associated with the increase of participants whose domain perception (either as pertaining to gains or pertaining to losses) stayed constant between the gain and the loss frames.

General discussion

The current experiments attempted to use positive and negative valence effects to assess decision-makers' perceived domains of choice as pertaining to gains or losses, as speculated by Yamagishi and Miyamoto (1996). Specifically,

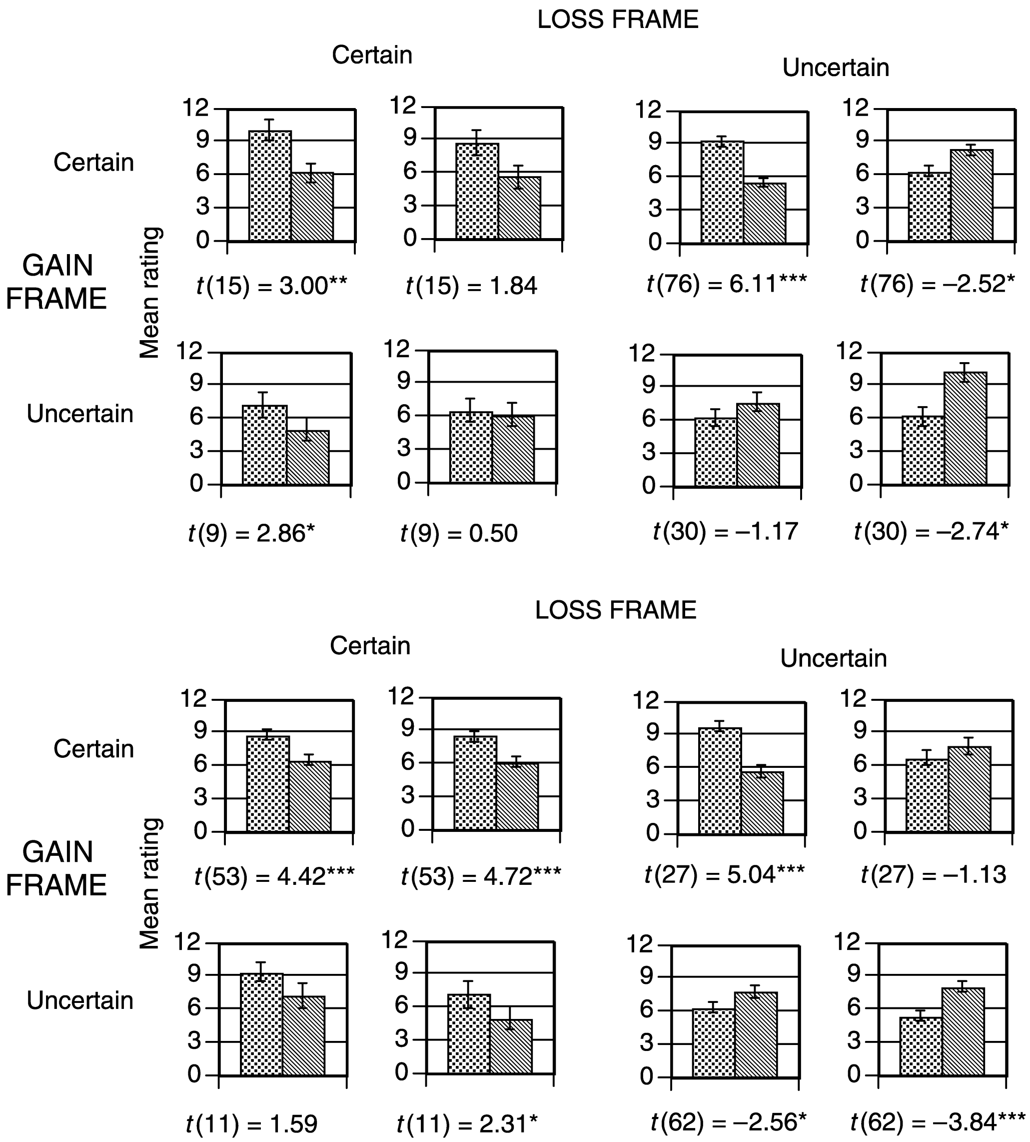

Figure 8. The mean superiority and inferiority ratings for the Cab Problem, framing description (top) and unframing description (bottom). *$p = 0.05$; **$p = 0.01$; ***$p = 0.001$.

the analysis examined the cognitive processes underlying framing and unframing patterns of preference. Two experiments showed that positive valence effects were associated with preferences for the certain options, whereas negative valence effects were associated with preferences for the uncertain options. Such association was observed under both the framing and the unframing descriptions of choice options. Experiment 2 used additional varieties of problems in the framing and the unframing descriptions, and administered each description with the gain versus the loss frames as a within-participant variable. The change in

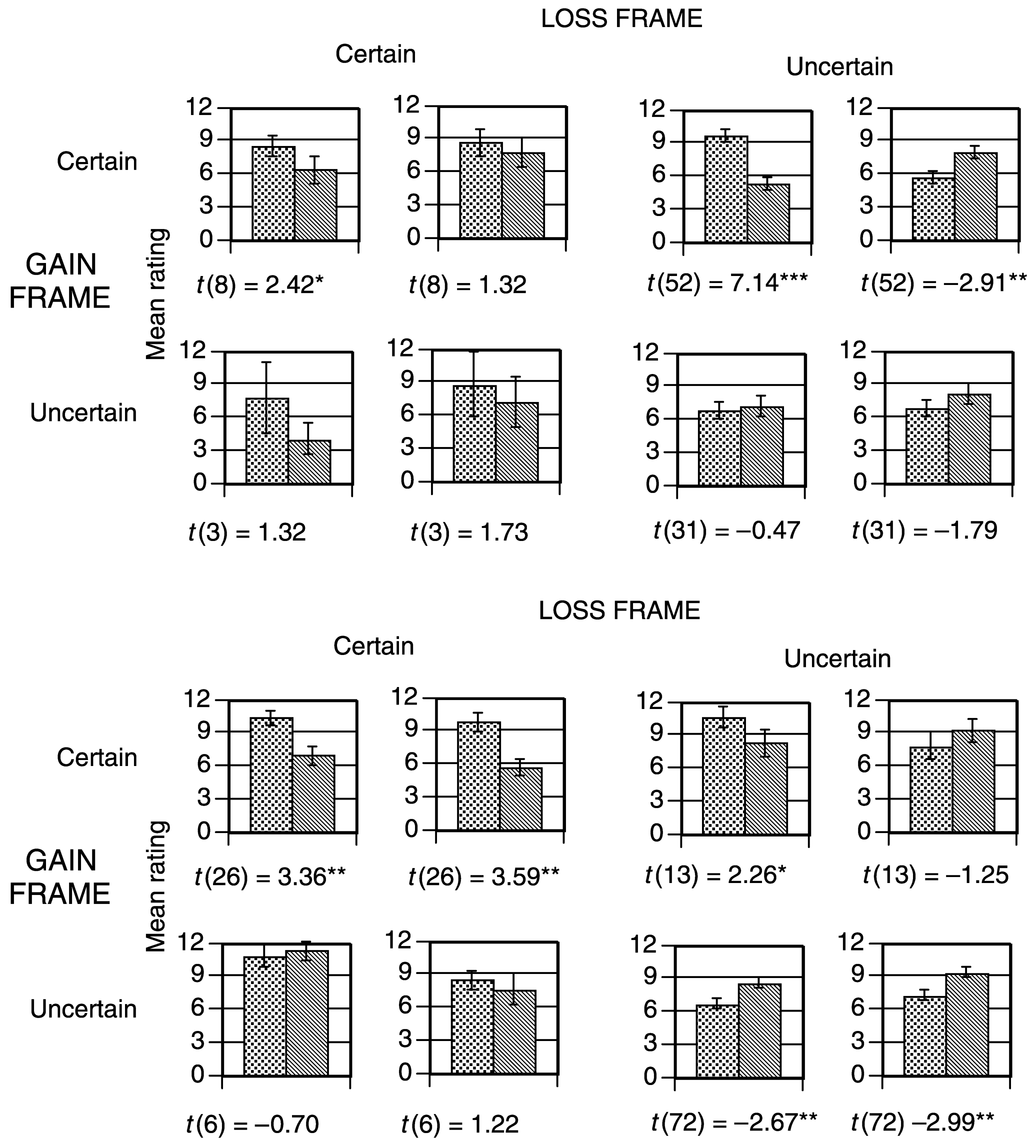

Figure 9. The mean superiority and inferiority ratings for the Crew Problem, framing description (top) and unframing description (bottom). *$p = 0.05$; **$p = 0.01$; ***$p = 0.001$.

preferential patterns from the framing description to the unframing description was associated with the increase of decision-makers in the unframing conditions who adhered to consistent domain perceptions across the gain and loss frames.

It should be noted here that the current analyses of valence effects do not attempt to alternative explanation of the framing effects provided by Prospect Theory. The current attempt uses valence effects as a diagnostic tool to analyze the framing effect from a different standpoint from Kahneman and Tversky's original account. Therefore both Prospect

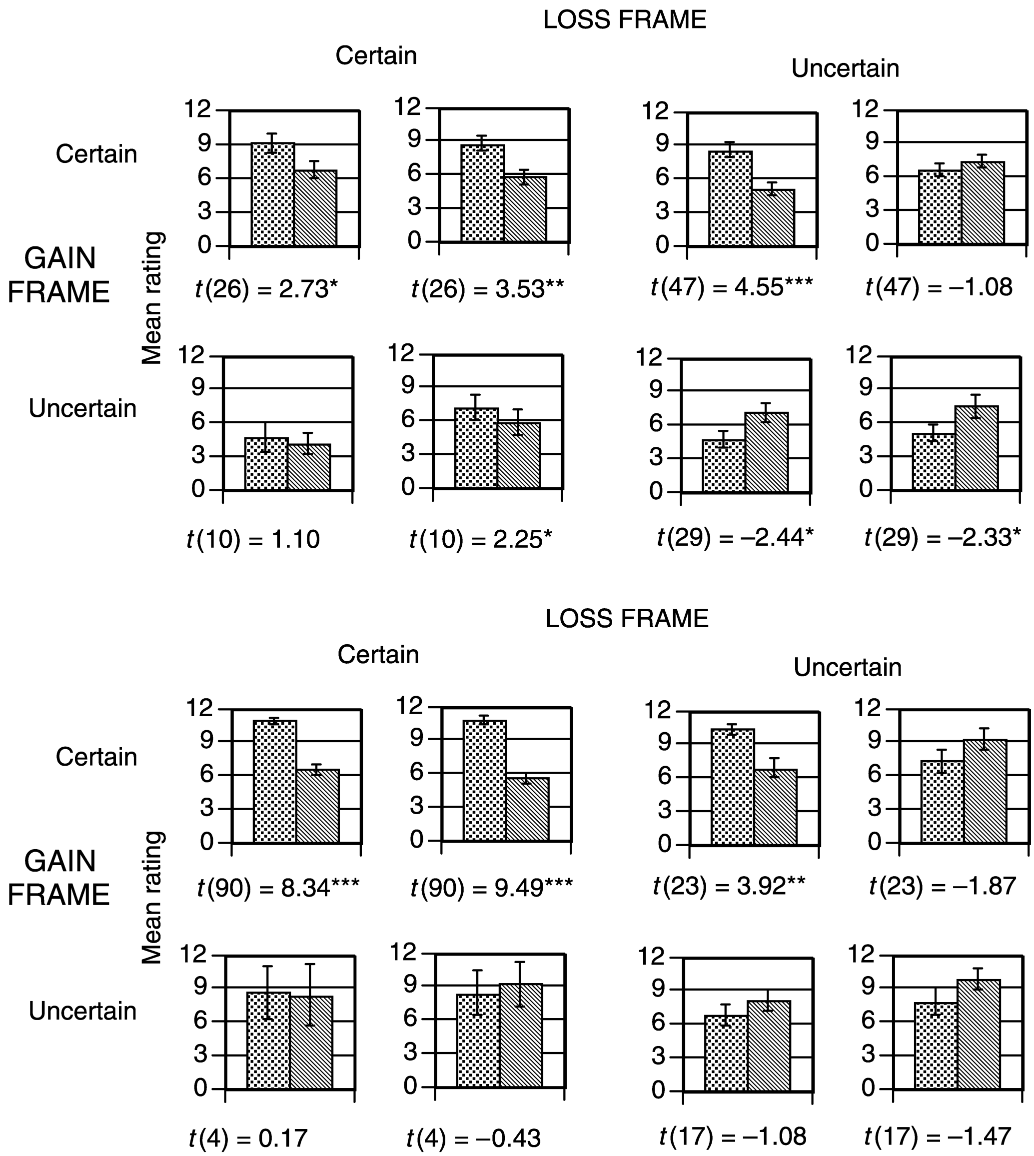

Figure 10. The mean superiority and inferiority ratings for the Metal Problem, framing description (top) and unframing description (bottom). $^{*}p = 0.05$; $^{**}p = 0.01$; $^{***}p = 0.001$.

Theory and valence effect can coexist without logically contradicting each other.

Recent investigations of economic behavior have focused on "loss aversion" (Huber & Puto, 1983; Kahneman, Knetch & Thaler, 1990, 1991; Kahneman & Tversky, 1979; Samuelson & Zeckhauser, 1988). Loss aversion is a preferential tendency that indicates that the disutility of losing \$X is greater than the utility of gaining \$X. Samuelson and Zeckhauser (1988) showed that decision-makers exhibited a strong resistance against changing from their status quo in a variety of choices, such as jobs, automobile colors, and financial plans. They

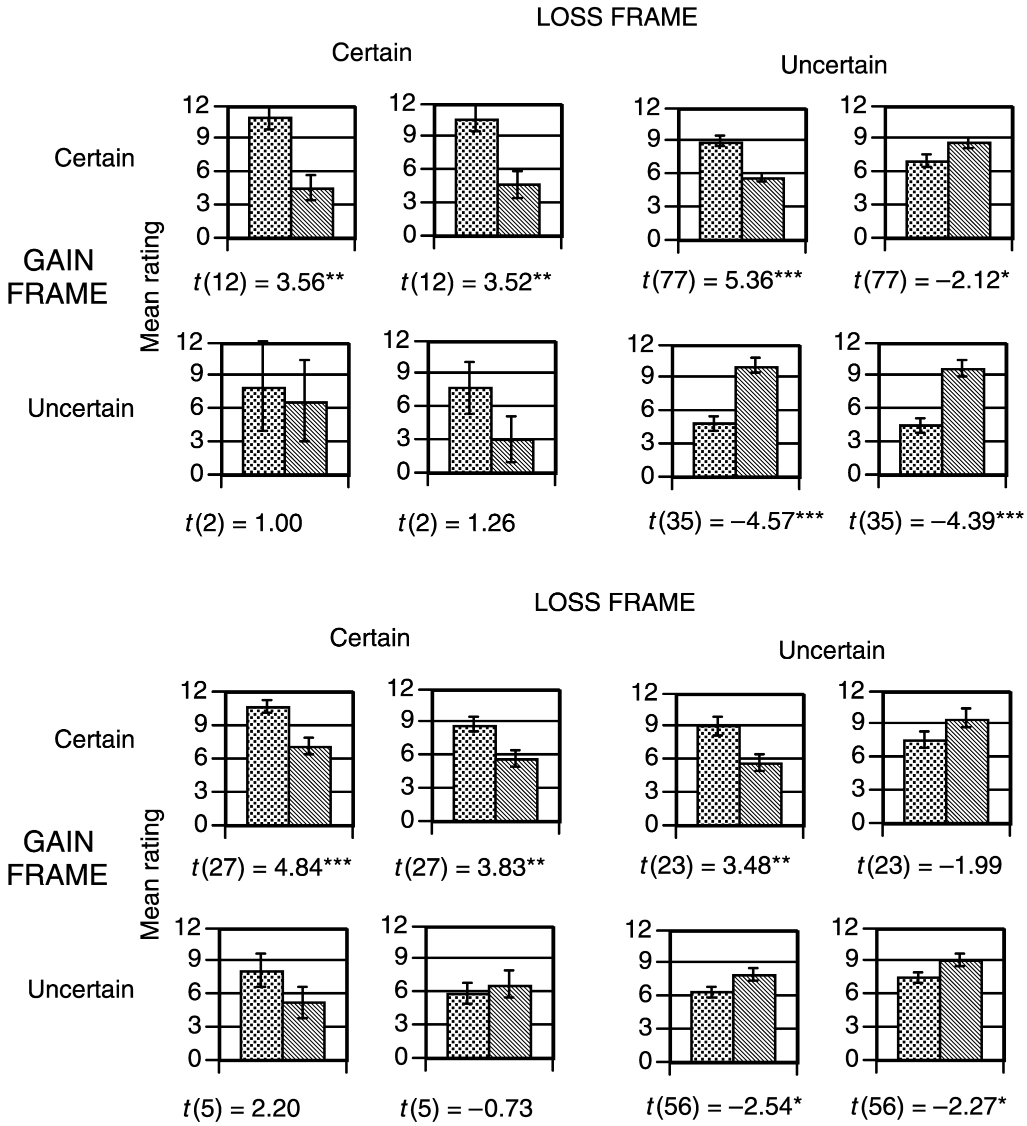

Figure 11. The mean superiority and inferiority ratings for the Pregnancy Problem, framing description (top) and unframing description (bottom). $*p = 0.05$; $**p = 0.01$; $***p = 0.001$.

claimed that a substantial part of such "Status quo bias" reflects loss aversion. The "Endowment effect" (Kahneman et al., 1990; Thaler, 1980) is also considered to be a manifestation of loss aversion. Kahneman et al. implemented an experimental market in their classroom. Some students were instantly endowed with a mug, and were offered an option to sell it. Those who became owners of the mug mostly chose not to trade the mug. Moreover, a "fair price" for the mug showed a notable discrepancy between the mug owners (around $7.00) and non-owners (around $3.00). Kahneman et al. argued that the price difference reflects the compensation for the loss of their endowment.

Such economic anomalies, as explained by loss aversion, may open a possibility for using valence effects to assess the location of such a reference point. In these arguments, empirical indications that assess decision-makers' domain perception were seldom provided. Thus, valence effects may be useful in confirming whether decision-makers perceive the choice as pertaining to gains or losses when such preferential phenomena are observed. For instance, regarding a choice alternative that is inferior to the status quo, would those who exhibit status quo bias also exhibit negative valence effects?

A limitation in the current analysis should be pointed out before concluding this article. In their explanation of psychological mechanisms underlying the valence effects, Yamagishi and Miyamoto (1996) developed a "focus shift" explanation. Through the focus shift processes, such asymmetries occur contingent upon task-dependent selective focusing of particular subsets of features in comparison. The positive valence effects in the domain of gains occur because people selectively focus on features that enhance positive consequences, leaving the remaining features ignored. In contrast, the negative valence effects occur when people selectively focus on features that magnify the negativity of choice outcomes. In the absence of data that allow examination of such subjective weighting processes (e.g. Yamagishi (1996) performed such analyses), one may be tempted to rely on alternative explanations to understand the current results. Therefore, further research is needed to determine if the focus shift process were in effect in producing the results in Figures 7–11.

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Appendix

Crew problem

Framing description A ship hit a water mine in the middle of the ocean. There are 600 crewmen on the ship. Their lives are in danger. Two options are proposed. Assume that the estimates of the consequences are as follows:

	Gain frame	Loss frame
Certain	200 crewmen will be saved for sure.	400 crewmen will die for sure.
Uncertain	There is a 1/3 chance that 600 crewmen will be saved, and a 2/3 chance that nobody will be saved.	There is a 1/3 chance that nobody will die, and a 2/3 chance that 600 crewmen will die.

Unframing description A ship hits a water mine, and is sinking in the middle of the ocean. There is a total of 600 crewmen aboard, but only enough lifeboats for a maximum of 200 people. You know that, when the lifeboats are overloaded, there is a chance that the boats will capsize. Two alternatives are proposed. Each alternative and its consequence are as follows:

	Gain frame	Loss frame
Certain	200 of the crewmen go aboard the lifeboats so that 200 people will be saved.	400 of the crewmen will not go aboard the lifeboats so that 400 people will be die.
Uncertain	All 600 crewmen go aboard the lifeboats, so that there is a 1/3 probability of saving all the crewmen, and a 2/3 probability of saving none of the crewmen should the lifeboats capsize.	All 600 crewmen go aboard the lifeboats, so that there is a 1/3 probability that nobody will die, and a 2/3 probability that all the crewmen die should the lifeboats capsize.

Metal problem

Framing description A ship hit a water mine. Six hundred boxes of precious metal on board are in danger. Two options are proposed. Assume that the estimates of the consequences are as follows:

	Gain frame	Loss frame
Certain	200 boxes of the precious metal will be saved.	400 boxes of the precious metal will be lost.
Uncertain	There is a 1/3 chance that 600 boxes of the precious metal will be saved, and a 2/3 chance that none of the precious metal will be saved.	There is a 1/3 chance that none the precious metal will be lost, and a 2/3 chance that all 600 boxes of the precious metal will be lost.

Unframing description A ship hit a water mine accidentally, and is sinking in the middle of ocean. There are 600 boxes of precious metal on the ship. But, there are only enough spare lifeboats to carry a maximum of 200 boxes of the precious metal. It is known that when the lifeboats are overloaded, there is a chance that the boats will capsize. Two alternatives are proposed. Each alternative and its estimated consequences are as follows:

	Gain frame	Loss frame
Certain	200 boxes of the precious metal are loaded on the spare lifeboats so that 200 boxes of the precious metal will be saved.	400 boxes of the precious metal will not be loaded on the spare lifeboats so that 400 boxes of the precious metal will be lost.
Uncertain	All 600 boxes of the precious metal are loaded on the spare lifeboats, so that there is a 1/3 chance that all the boxes of the precious metal will be saved, and a 2/3 chance of saving none of them should the lifeboats capsize.	All 600 boxes of the precious metal are loaded on the spare lifeboats, so that there is a 1/3 chance of losing none of the boxes of the precious metal, and a 2/3 chance of losing all of them should the lifeboats capsize.

Pregnancy problem

Framing description Suppose that you are in charge of a medical program. Six lives are in danger. Choose between:

	Gain frame	Loss frame
Certain	Two people will be saved for sure.	Four people will die for sure.
Uncertain	There is a 2/3 chance that nobody will be saved, and a 1/3 chance that six people will be saved.	There is a 1/3 chance that nobody will die, and a 2/3 chance that six people will die.

Unframing description Suppose that you are in charge of medical research at a large urban hospital. Your team has found a chemical substance that inhibits allergic reactions of pregnant mothers with a specific genetic pattern. It is known that women with this genetic pattern usually suffer miscarriages. Currently, six inpatients (pregnant mothers) at your hospital are diagnosed as having this pattern. Unfortunately, the chemical substance is very difficult to synthesize. Consequently, you do not have enough to distribute to all the patients:

	Gain frame	Loss frame
Certain	Two mothers will be treated with a full dosage of the substance, that two babies will be born for sure.	Four mothers will not be treated with the substance, so that four babies will die of miscarriage for sure.
Uncertain	All the mothers will be treated with a partial dosage of the substance, so that there is a 1/3 chance that all babies will be born successfully, and a 2/3 chance that no baby will be born.	All the mothers will be treated with a partial dosage of the substance, so that there is a 1/3 chance that no baby dies of miscarriage, and a 2/3 chance that all babies die of miscarriage.