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Effects of valence and framing in decision making II: Estimating subjective weighting[1]

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Abstract: In comparison between choice options, 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 experiment used the directions of valence effects as a tool to assess the decision maker's interpretation of choice tasks under the "framing effect" (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. This study examined whether preferences for certain options were associated with positive valence effects, whereas preferences for uncertain options were associated with negative valence effects. Moreover, conditions under which preference reversals under the framing manipulations ceased to occur were examined. The effects of valence showed that framing effects ceased to occur when decision makers maintained consistent task interpretations as pertaining to gains or to losses. Most importantly, the pattern of subjective weighting under the valence effects was consistent with previous explanation of valence effects (Yamagishi & Miyamoto, 1996). Possibilities for extending the current findings to understanding related psychological phenomena are discussed.

Key words: valence effect, framing effect, decision making.

The literature 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. Asymmetric judgment is the topic of this paper. A classic example is found in similarity judgment. Tversky's (1977) participants rated North Korea as more similar to China than China was to North Korea. In extension, Holyoak and Gordon's (1983) participants rated their friends as more similar to themselves than they were to their friends. Such asymmetries led researchers to question whether such discrepancies arise due to differences in mental representations of the tasks, or differences between mental processes involved.

This paper extends the line of research set forth by Yamagishi (2002b) by analyzing the cognitive processes of a well-known preferential asymmetry, namely "framing effects" (Tversky & Kahneman, 1981, 1986). First, how the framing manipulation leads to asymmetric

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preferences between the domains of gains and losses is reviewed. The review discusses more recent developments that seek boundary conditions under which the preferential asymmetry ceases to occur. This part of the review will introduce a tool (Yamagishi, 2002b) that can assess a decision maker's task interpretation as pertaining to gains or losses. The next part reviews another asymmetry in strength-of-preference judgments, which was investigated independently of the framing research. It shall be shown that asymmetries in strength of preference, namely "valence effects" (Yamagishi & Miyamoto, 1996; Yamagishi, 1996) was found to be effective as a diagnostic tool to assess decision makers' task interpretation as pertaining to either gains or losses (Yamagishi, 2002b). The current experiment attempts 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, and if those who show the "loss pattern" of preference also show the "loss pattern" of the valence effect. My goal in this paper is to complement Yamagishi's (2002b) analysis by investigating if the pattern of shift in attention to choice options between the valence effects were consistent with the pattern hypothesized by Yamagishi and Miyamoto (1996).

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, viewed as formal abstractions, Options K and K′ represent an identical gamble, whereas Options L and L′ represent another identical gamble, hence these pair-wise 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 & L pair and the K′ & 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 their counterparts. The percentages in the curly 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.[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 the "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 the current argument.

Subsequent research in a laboratory setting showed numerous replications of the framing effect (Takemura, 1992, 1993, 1994; Jou, Shanteau, & Harris, 1996; Yamagishi, 2002b). Moreover, McNeil, Pauker, Sox, and Tversky

[3] It may seem possible to argue that the "uncertain option" would be better described as "risky option", because the probabilities associated with the uncertain options in this paper are known. Yet, I adhere to using "uncertain option" for the following reason. This paper is an extension of the research developed by Yamagishi (2002b), where the term "uncertain option" was used. Because Yamagishi (2002b) and the current manuscript use the same format of Tables and Figures with the label "uncertain option," adhering to using the term may minimize possible confusion of the reader who wants to compare both Yamagishi (2002b) and the current article.

(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 (Jou, Shanteau, & Harris, 1996; Takemura, 1992, 1993, 1994; Yamagishi, 2002b). 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. Studies of unframing typically used the following "Disease Problem" (Tversky & Kahneman, 1981):

> Imagine that the U.S. 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; versus a 1/3 probability that 600 will be saved (otherwise none will be saved). In the loss frame, the choice alternatives consisted of 400 people will die for sure, versus a 1/3 probability that nobody will die (otherwise 600 will die). Regardless of the gain-loss framing, the choices are equivalent because either alternative leads to an identical final asset position; (i.e., letting 200 live (and 400 die) or a 1/3 chance of letting everyone live (and a 2/3 chance that 600 die)).[4]

[4] Notice the subtle difference between the framing effect in the aforementioned gamble problem and in the Disease Problem. The Disease Problem produces the framing effect by the difference in superficial descriptions between the gain and the loss frames, whereas the framing effect in the gamble task is created by making procedural differences (in the decision maker's initial endowment) between the option pairs.

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 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, no indicator variable was obtained regarding the particular "mode" being employed under framing and unframing manipulations. For instance, Takemura (1993) could have reported protocol analysis of his participants' justification of choice, yet no such analysis was reported.

Exceptions include Jou, Shanteau, and Harris (1996) and Yamagishi (2002b). Jou et al. (1996) analyzed the content of the rationale for choice provided by decision makers. They questioned why decision makers under the framing effect fail to recognize the "reciprocal" relationship in choice options, such as 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, such as practical reasoning schemas (Cheng & Holyoak, 1985). Jou et al. (1996) inferred that causal schemas would be relevant in interpreting choice tasks, and provided participants with a 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 a 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. Jou et al.'s (1996) unframing description of the Disease problem was as follows.

> Imagine that the U.S. 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, 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:

Program One: The total resources are applied to 200 people. If this is done, 200 people will be saved or 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.

Given this description, Jou et al.'s (1996) participants exhibited consistent preferences for the uncertain options. 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, which replicated the classic framing effect.

Jou et al.'s (1996) contribution lies in providing an empirical measurement of participants' task interpretation: their work indicated *when* participants' task interpretation 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.

It was Yamagishi (2002b) who attempted to assess decision makers' task interpretation under the framing and unframing manipulations. Yamagishi strengthened the unframing argument that decision makers cease to switch their task interpretations as pertaining to gains or losses by showing that his participants' task interpretations remained constant across the frames. To understand the empirical criterion used by Yamagishi, the reader is now invited to consider the "valence effects."

Valence effects and the focus shift model (Yamagishi & Miyamoto, 1996; Yamagishi, 1996)

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 claimed 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.

Yamagishi (2002b) verified a speculation made by Yamagishi and Miyamoto (1996) as to whether the directions of valence effects may be used as a diagnostic tool to assess the intrinsic pleasantness of particular domains of choice. Yamagishi and Miyamoto entertained this possibility because the direction of valence effects varied depending upon the intrinsic pleasantness of the choice domain. Hence, regarding the framing and unframing, Yamagishi (2002b) investigated whether the two empirical indexes that assess decision makers' task interpretations coincided. His participants who chose the certain option (typically a "gain preference") exhibited positive valence effects (typically a "gain pattern") between subsequent judgments. Conversely, Yamagishi's participants who chose the uncertain option (typically a "loss preference") exhibited negative valence effects (typically a "loss pattern") in subsequent judgments.

It should be noted here that the analysis by Yamagishi (2002b) does not attempt to provide an alternative explanation of the framing effects accounted for by Prospect Theory (Kahneman & Tversky, 1979). Kahneman and Tversky's Prospect Theory postulates that cognitive value function is concave for gains and convex for losses, and is steeper for losses than for gains. It follows from the difference in concavity between gains and losses that decision makers prefer the certain option in the gain frame, but the uncertain option in the loss frame. Yamagishi used the valence effects as a diagnostic tool to analyze the framing effect from a different standpoint than Kahneman and Tversky's original interpretation. Therefore, both Prospect Theory and the valence effects can coexist without producing a logical paradox.

This paper attempts to complement Yamagishi's (2002b) finding by estimating the subjective weight parameters that are supposed to underlie the positive and negative valence effects. In Yamagishi's (2002b) demonstration of the valence effects, it remains to be explored whether the observed results reflect cognitive processes, as shown by Yamagishi and Miyamoto (1996) and Yamagishi (1996). The current experiment was designed to examine the cognitive processes of subjective feature weighting that underlie the valence effects similar to those observed by Yamagishi (2002b). To understand the purpose of the current study, Yamagishi and Miyamoto's (1996) "focus shift model" is now explained in detail.

Yamagishi and Miyamoto's focus shift model postulates that superiority and inferiority judgments are reached by weighting and combining the contribution of features in the preferred and less preferred options. The details outlined below are the reduced models (Yamagishi, 1996) that may be applied to either intrinsically pleasant domains or intrinsically unpleasant domains (see Yamagishi & Miyamoto (1996) for the original model that may be applied to domains where the intrinsic pleasantness is unclear a priori). The focus shift model, as applied to intrinsically pleasant domains, calls the sets of features in the preferred and less preferred options as A_{good} and Z_{good}, respectively; (A and Z represent the idea that Option A is preferred to Option Z). Because they represent intrinsically pleasant choice options, undesirable features in either set are assumed to play minimal roles, hence are set out of concern. The focus shift model in intrinsically pleasant domains was expressed as follows:

$$D_s = \alpha_s f(A_{good}) - \gamma_s f(Z_{good}) \quad \text{and}$$
$$D_i = \alpha_i f(A_{good}) - \gamma_i f(Z_{good}), \tag{1}$$

where subscripts s and i denote superiority and inferiority judgments, respectively, D denotes a difference judgment, α and γ represent subjective weights that are associated with the corresponding feature set, and $f(\bullet)$ represents the contribution of the feature set to judgment. In turn, in intrinsically unpleasant domains, the focus shift model for superiority and inferiority judgments are reached by combining the contributions of undesirable feature sets A_{bad} and Z_{bad} in the following way:

$$D_s = \eta_s f(Z_{bad}) - \beta_s f(A_{bad}) \quad \text{and}$$
$$D_i = \eta_i f(Z_{bad}) - \beta_i f(A_{bad}). \tag{2}$$

Analogous to Formulae (1), β and η denote the subjective weights associated with A_{bad} and Z_{bad}, respectively.

The models in Formulae (1) and (2), when transformed in the form below, help to explain the cognitive processes that underlie systematic valence effects. It follows from Formulae (1) that a positive valence effect occurs whenever;

$$D_s > D_i \quad iff$$
$$(\alpha_s - \alpha_i)f(A_{good}) - (\gamma_s - \gamma_i)f(Z_{good}) > 0. \qquad (3)$$

Likewise, from Formulae (2), it follows that a negative valence effect occurs whenever;

$$D_s < D_i \quad iff$$
$$(\eta_s - \eta_i)f(Z_{bad}) - (\beta_s - \beta_i)f(A_{bad}) < 0. \qquad (4)$$

By estimating the subjective weight parameters (α, β, γ, and η), Yamagishi (1996) showed that systematic positive valence effects in pleasant domains occurred when $(\alpha_s - \alpha_i) > 0$ and $(\gamma_s - \gamma_i) \approx 0$. Assuming $f(A_{good}) > f(Z_{good})$, this weighting pattern is consistent with the inequality in Formulae (3). Conversely, systematic negative valence effects in unpleasant domains occurred when $(\eta_s - \eta_i)$ was very negative and $(\beta_s - \beta_i)$ were negative yet much closer to zero than $(\eta_s - \eta_i)$. Assuming that $f(Z_{bad}) > f(A_{bad})$, the weighting pattern is consistent with the inequality in Formulae (4). The gist of the focus shift model is to explain valence effects as associated with selective heavy-weighting of particular features as a function of the valence of judgment.

For each participant, Yamagishi (1996) estimated the difference of subjective weights and charted them in boxplots. Figure 1 shows the boxplot pattern with exclusively winning gambles (domain of gains) and exclusively losing gambles (domain of losses). Positive valence effects in the domain of gains were associated with heavy weighting of A_{good} in superiority judgments, whereas negative valence effects in the domain of losses were associated with heavy weighting of Z_{bad} in inferiority judgments.

This paper addresses the following issues. In replication of the study by Yamagishi (2002b), first, would preference for certain options indicate that participants interpret the choice as pertaining to gains? If so, those who prefer certain options would exhibit positive valence effects. Conversely, if preference for uncertain options indicates that participants interpret the choice tasks as pertaining to losses, then those who prefer uncertain options would exhibit negative valence effects. Most importantly, to complement Yamagishi's (2002b) analysis, the new empirical question raised in this paper is whether valence effects under framing and unframing manipulations reflect the same cognitive processes of subjective weighting as documented in Yamagishi and Miyamoto (1996) and Yamagishi (1996). Here, I am attempting to estimate subjective weighting parameters under the valence effects in framing–unframing tasks to determine whether estimated parameters confirm the pattern shown in Figure 1.

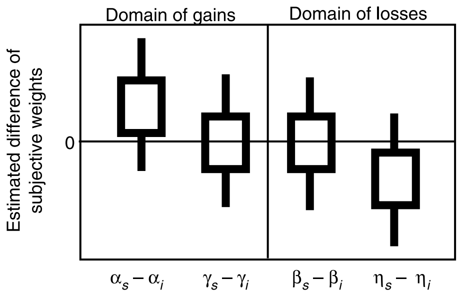

Figure 1. The boxplot pattern of estimated subjective weight differences (Yamagishi, 1996).

Method

The current experiment used the aforementioned unframing variations of the Disease Problem from Jou et al. (1996) and Yamagishi (2002b). After Yamagishi (2002b), the gain and loss frame descriptions were administered as a within-participant manipulation. To satisfy the goal of estimating subjective weight parameters, I modified the task as follows.

Configuration of option pairs

This study used regression analysis to estimate subjective weights. To enable such analysis, it was necessary to vary feature values in the

Table 1. Configuration of choice options

GAINS	
Certain	Uncertain
G1 [+200, 1.0; 0, 0.00]	G5 [+600, 0.33; 0, 0.67]
G2 [+210, 1.0; 0, 0.00]	G6 [+630, 0.33; 0, 0.67]
G3 [+220, 1.0; 0, 0.00]	G7 [+660, 0.33; 0, 0.67]
G4 [+230, 1.0; 0, 0.00]	G8 [+690, 0.33; 0, 0.67]
LOSSES	
Certain	Uncertain
L1 [−400, 1.0; 0, 0.00]	L5 [−600, 0.67; 0, 0.33]
L2 [−420, 1.0; 0, 0.00]	L6 [−630, 0.67; 0, 0.33]
L3 [−440, 1.0; 0, 0.00]	L7 [−660, 0.67; 0, 0.33]
L4 [−460, 1.0; 0, 0.00]	L8 [−690, 0.67; 0, 0.33]

The positive and negative sign in the payoffs indicate "Lives saved" and "Lives lost," respectively.

Table 2. Factorial design for the gain and loss conditions

	Uncertain			
Certain	G5/L5	G6/L6	G7/L7	G8/L8
G1/L1	Pair 1	Pair 2	Pair 3	Pair 4
G2/L2	Pair 5	Pair 6	Pair 7	Pair 8
G3/L3	Pair 9	Pair 10	Pair 11	Pair 12
G4/L4	Pair 13	Pair 14	Pair 15	Pair 16

The labels "G1" through "G8" and "L1" through "L8" correspond to the choice options shown in Table 1.

preferred and less preferred options, and examine how superiority and inferiority ratings would be influenced by such changes. Table 1 shows the configuration of choice options. Each choice option is described in the following notation: [x, p; 0 $(1 - p)$], where x and 0 denote the payoff to one outcome and its alternative, and p and $(1 - p)$ denote the probability associated with x and 0, respectively. "Certain" options offered that "x lives are saved/lost for sure." "Uncertain" options offered that "There is a p chance of saving/losing x lives, and a $(1 - p)$ chance of saving/losing 0 lives". Table 1 shows that, in the domains of gains and losses, the "Certain" and the "Uncertain" options had four levels. Table 2 shows a 4 by 4 factorial configuration of 16 choices between the Certain and the Uncertain options in domains of both gains and losses. In every configuration of option pairs in Table 2, the absolute value of x in the Uncertain option was presented as the total number of lives in danger. For instance, in the gain condition, "Pair 16" required a choice between G4 [+230, 1.0; 0, 0.00] and G8 [+690, 0.33; 0, 0.67], where 690 lives were in danger. Every participant was assigned to one of the cell (experimental treatment) in Table 2.

Note that many choice pairs in Table 2 do not classify as "Framing" choice in a strict sense because it is only in pairs in Table 2's diagonal cells that two options provide equal expected values. Thus, only these pairs satisfy the exact definition of choice pairs in the framing study. Contrariwise, in every off-diagonal cell in Table 2, the pair consists of options whose expected values differ slightly. As shown later, even for these quasi-framing pairs, the participants' preferential pattern was comparable to those observed for the Disease Problem in Yamagishi (2002b).

Estimating subjective weighting parameters

Estimating empirical subjective weights. To carry out analyses analogous to Figure 1, the following course was taken. First, participants were classified into four categories depending on the preference they expressed in one of the 16 conditions in Table 2 to which they were assigned for the certain or uncertain option (i.e., gain-certain, gain-uncertain, loss-certain, loss-uncertain). Within each category, the superiority ratings and inferiority ratings were standardized separately across participants whose preferential pattern matched the particular category. These standardized responses served as the dependent variable. For the Certain and Uncertain options, the absolute values of payoff (x in the previous description, see Table 1) were standardized and used as independent variables: These standardized values served as $f(\bullet)$. Standardized values were used because each participant was categorized into one of four categories by their spontaneous preferences. Therefore, the weight estimates cannot be directly compared if the payoffs themselves were used as $f(\bullet)$. For instance, in the gain condition, for those who preferred the Certain option, the payoff candidates are 200, 210, 220, and 230, whereas for those who preferred the Uncertain option, the candidates are 600, 630, 660, and 690, depending on which option pair he/she was assigned to (see Table 2). The regression weights for the standardized predictor and predicted variables were therefore used to make subjective weight estimates comparable across the four categories of preferential pattern.

The standardized superiority rating was regressed upon the standardized absolute payoffs of the preferred and less preferred option to estimate the Option A and Option Z weights in the superiority judgment. Likewise, the standardized inferiority rating was regressed upon the standardized absolute payoffs of the preferred and less preferred option to estimate the Option A and Option Z weights in the inferiority judgment. For the Options A and Z, the inferiority weight was subtracted from the superiority weight.

It should be mentioned that, contrary to traditional analyzes (e.g., Slovic & Lichtenstein, 1968), the current approach does not treat payoffs and probabilities as distinct features, because the payoff of the preferred and less preferred option provided sufficient information for what can be used as $f(\bullet)$, and that probability dimension simply does not vary in the conventional and quasi-framing pairs (see Tables 1 and 2).

Evaluation of empirical weights. The following procedure was taken to assess how likely it would be that the empirical estimates of subjective weights would be obtained by chance alone. The empirical weight difference estimates were compared against the distribution of possible weight estimates generated by the Monte Carlo simulation. Every association between a particular superiority or inferiority rating and particular values in predictor variables was randomized and re-assigned to each other to calculate a set of simulated regression weights. Precisely, every superiority rating was associated with a standard normal random number, and the set of the superiority ratings was sorted by the random number, then the sorted ratings were matched to the predictor variables to be submitted to a simulation regression. Analogous procedures were carried out regarding every inferiority rating. This simulation procedure was repeated for 500 trials, separately for the preferred and less preferred options, thereby generating 500 simulated differences of regression weights. This procedure was carried out, separately for superiority and inferiority ratings, within each preferential pattern. The reader is invited to consult Yamagishi (2002a) for more articulation of the advantage of this simulation method.

This distribution indicates the range of weight differences had they been determined solely by chance. The empirically estimated weight differences could be compared against the distribution of simulated weights to check whether they are likely to be obtained by chance alone. If the focus shift process demonstrated by Yamagishi (1996) were in effect, empirical estimates with positive valence effects would follow the left panel pattern, whereas empirical estimates with negative valence effects would follow the right panel pattern in Figure 1.

Variables

Within-participant independent variables were frame of choice options (gain or loss) and valence of judgment (positive or negative). Between-participant independent variables were preference in either frame (certain or uncertain), payoff levels in the certain and uncertain choice options (the 16 varieties in Table 2), and task description (framing or unframing). Dependent variables were judgments of superiority and inferiority ranging from 0 (no difference) to 15 (maximum difference).

Participants

Eight hundred and twenty-seven undergraduates at University of Washington participated to earn extra credits in an introductory psychology course. Four hundred and two participants were assigned to the framing description, and 425 participants were assigned to the unframing description.

Material and procedure

Data were gathered in a group setting. Each participant worked on a booklet of problems that showed both the gain and loss frames in one of the configuration of the option pairs in Table 2. The booklet contained other filler tasks between the gain and loss task descriptions. Participants first expressed their preferences and provided superiority and inferiority ratings. The orders of administering either the gain or the loss frame, as well as obtaining superiority and inferiority ratings, were counterbalanced across participants.

Prediction

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. For the unframing description of the problems, preferential patterns would not change between the frames. Regarding the valence effects, participants who preferred certain options would exhibit positive valence effects, whereas those who preferred uncertain options would exhibit negative valence effects (see Figure 2; The shaded bars represent superiority ratings whereas the black bars represent inferiority ratings). Finally, empirical subjective weight differences would follow the "gain" and "loss" pattern in Figure 1 under positive and negative valence effects, respectively.

Results and Discussion

Two-tailed tests were used throughout data analyses in this paper.

Framing-unframing effects

Table 3 shows the preferences in the framing and unframing descriptions, collapsing over the 16 variations of option pairs. Between the framing and unframing descriptions, two tests regarding the proportion of participants were performed with a Bonferroni correction. The proportional differences were compared by Goodman's (1964) test statistic,

$$z = \frac{p_x - p_y}{\sqrt{\dfrac{p_x(1-p_x)}{n_x} + \dfrac{p_y(1-p_y)}{n_y}}}.$$

The number of participants in the cell for the certain option in the gain frame and the uncertain option in the loss frame reliably decreased from the framing to the unframing description

$$\left(\frac{195}{105+195+21+81} > \frac{70}{164+70+23+168},\ z = 10.450,\ p < 0.001\right).$$

Furthermore, preferential consistency between the framing and unframing descriptions was tested by comparing the number of participants in the diagonal cells. Goodman's test statistic for the difference between

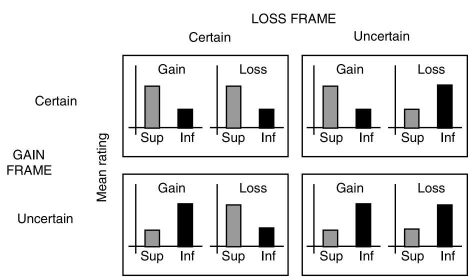

Figure 2. The predicted pattern of valence effects.

Table 3. Participants' preference for the certain and uncertain options

Framing description				Unframing description			
		Loss frame				Loss frame	
		CT	UC			CT	UC
Gain	CT	105	195	*Gain*	CT	164	70
frame	UC	21	81	*frame*	UC	23	168

"CT" and "UC" labels denote the preference for the CerTain and UnCertain option, respectively.

$$\frac{164 + 168}{164 + 70 + 23 + 168} \text{ and } \frac{105 + 81}{105 + 195 + 21 + 81}$$

was 9.737, $p < 0.001$, indicating that more participants in the unframing condition maintained consistent preferences than those in the framing condition.

Valence effects

Figure 3 shows the mean superiority and inferiority ratings, as well as the 95% confidence intervals for the cell mean, for the framing and the unframing descriptions. The top and bottom panels show the results from the framing and unframing descriptions, respectively. The trend in Figure 3 tends to follow Figure 2 that preferences for the certain and uncertain option are associated with positive and negative valence effects, respectively, in replication of Yamagishi (2002b).

Yet, it should be noted that different psychological explanations of the unframing effects may explain these results. One possibility, in agreement with the argument by Jou et al. (1996), would be that decision makers visualize both the gain and the loss consequences simultaneously, then determine their preferences. Another possibility would be that every decision maker commits herself/himself to a particular interpretation (either gains or losses) of choice tasks, while ignoring the "reciprocal"

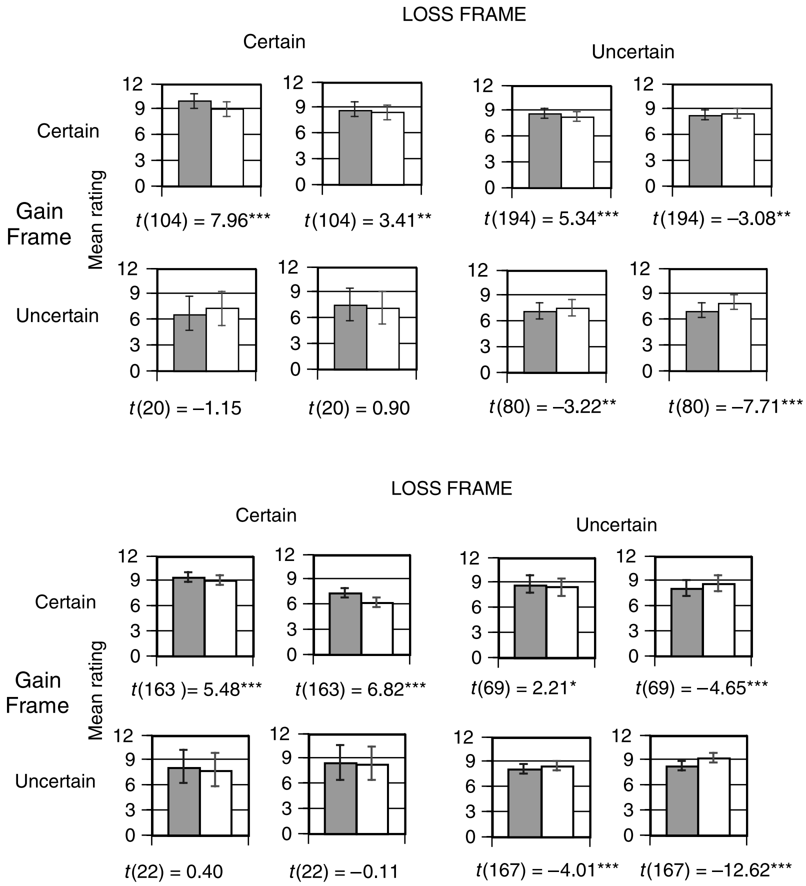

Figure 3. The mean superiority and inferiority ratings, framing description (top) and unframing description (bottom). (■) superiority; (□) inferiority.

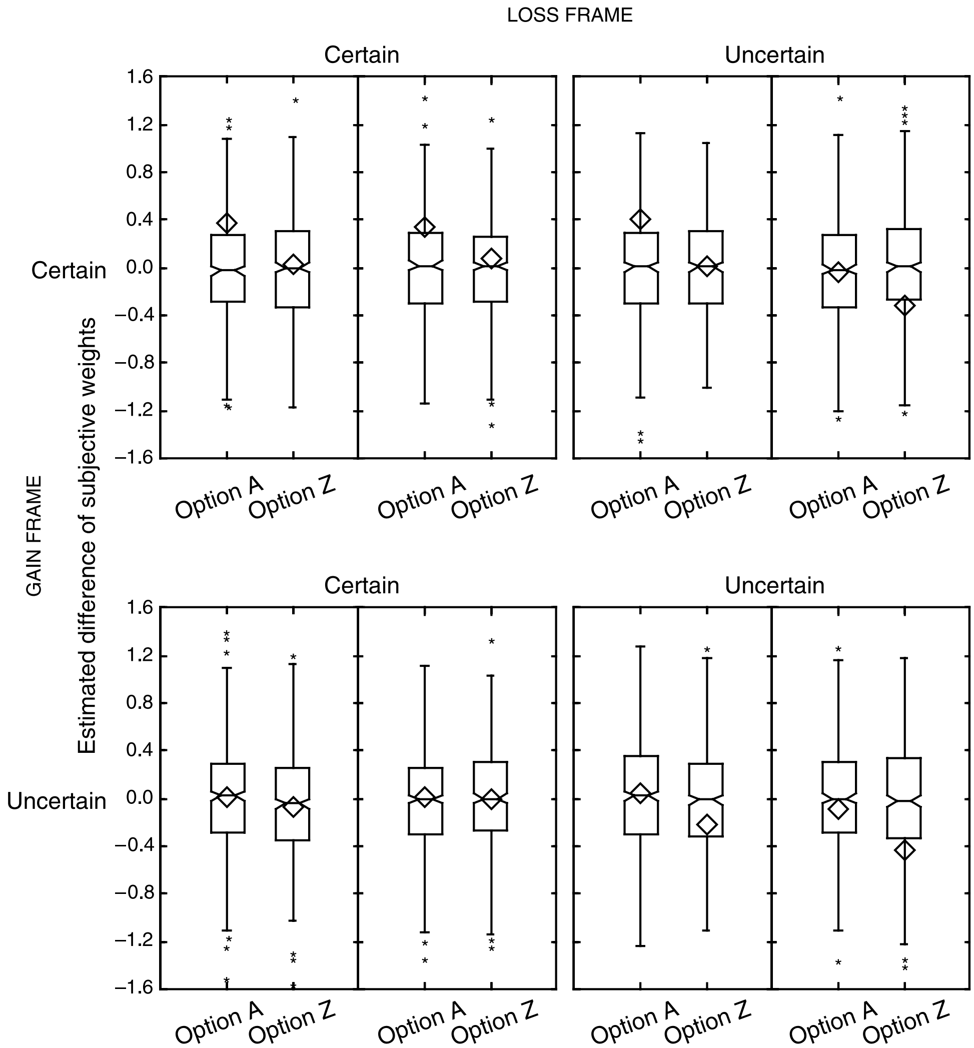

Figure 4. Empirical subjective weight estimates (square symbols) and simulated weights (boxplots) from Framing description.

interpretation. It seems difficult to empirically distinguish these two explanations from the present data. Hence, running a different experimental design would be needed to distinguish between these explanations.

Subjective weight estimation

Figures 4 and 5 display notched boxplots[5] (McGill, Tukey, & Larsen, 1978) of 500 simulated regression weight differences from the framing and unframing conditions, respectively.

[5] In notched boxplots, the top and bottom ends of the "whiskers" extend to the maximum and minimum observations excluding outliers. Outliers appear as asterisks. The upper and lower ends of the box represent the 75th and 25th percentiles, whereas the horizontal bar inside the box denotes the median. The oblique lines from the median stretch to the 95% confidence bounds for the median.

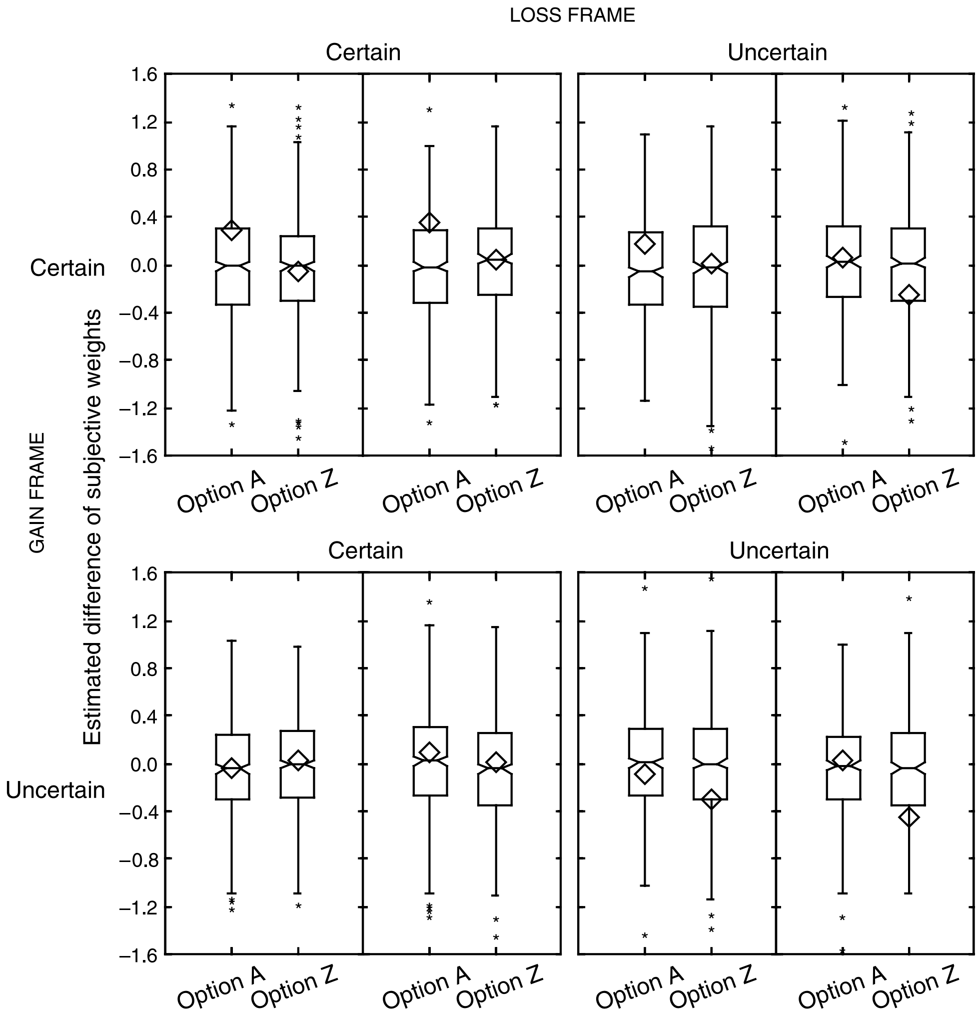

Figure 5. Empirical subjective weight estimates (square symbols) and simulated weights (boxplots) from Unframing description.

The empirically estimated weight differences appear in square symbols. The principle of coordinating the quadrants in Figures 4 and 5 are the same as Figure 3 (pre-ferential pattern under the gain and the loss frame). A comparison of Figures 4 and 5 to Figure 3 shows the following tendencies: When participants choose the certain option, positive valence effects are observed and the estimated differences of Option A weights lie above the confidence intervals, whereas the differences of Option Z weights are closer to zero. When participants prefer the uncertain option, negative valence effects are observed and the estimated differences of Option Z weights lie below the confidence intervals, whereas the differences of Option A weights are closer to zero. In comparison to Figure 1, it may be summarized that the empirical weights followed the "gain pattern" under positive valence effects and the "loss pattern" under negative valence effects. Thus, it may be claimed from the empirical weight estimates that positive and negative valence effects under framing and unframing task descriptions were produced through the focus shift process demonstrated by Yamagishi and Miyamoto (1996) and Yamagishi (1996).

General Discussion

The current experiment extended Yamagishi (2002b) by showing that the subjective weight estimates followed the "gain pattern" under the positive valence effects when the certain option was preferred and the "loss pattern" under the negative valence effects when the uncertain option was preferred. This finding was consistent with previous research that positive and negative valence effects are found in the domains of gains and losses, respectively (Yamagishi & Miyamoto, 1996; Yamagishi, 1996). In doing so, I used the positive and negative valence effects to assess decision makers' task interpretations as pertaining to gains or losses, as conjectured by Yamagishi and Miyamoto (1996). Yamagishi (2002b) was replicated by showing 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 framing and unframing descriptions of choice options. The change in 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 task interpretations across the gain and loss frames. It should be mentioned here though, that the valence effects are judgmental effects that are observed after the decision maker committed to a particular choice alternative. From the literature on preference reversals (Tversky, Sattath, & Slovic, 1988; Tversky, Slovic, & Kahneman, 1990), it has been shown that choice and judgment may differ in their cognitive processes. Therefore, questions may be raised as to what extent the valence effects may be considered as explaining the framing effect.

It seems beneficial to characterize theories of asymmetries in two classes. The first class may be labeled as weight shift theories. Weight shift theories, including the focus shift model, assume task-dependent subjective weighting as a primary explanatory mechanism. Well-known examples include theories of preference reversals (Tversky, Sattath, & Slovic, 1988; Houston, Sherman, & Baker, 1989; Shafir, Osherson, & Smith, 1989; Tversky, Slovic, & Kahneman, 1990; Shafir, 1993). In Tversky, Sattath, and Slovic's (1988) contingent weighting theory, subjective weights associated with payoffs and probabilities vary between choice and pricing, depending on whether preference is observed via pairwise choice or bidding of options. Subjective weights shift from emphasis on probabilities in choice to emphasis on payoffs in bidding. The advantage model by Shafir et al. states that, given a pair of gambles, people assess one gamble's advantage (or disadvantage) over the other in payoff and in probability and assign subjective weight onto these attributes. Choice is guided by the weights that function as an adjustment parameter between two attributes. Also, Takemura and Fujii provided another account for the framing effect by a weight shift theory (Fujii & Takemura, 2001; Takemura, 1994b). They argued that the framing effect occurs contingent upon shifts in psychological weights associated with payoffs and probabilities in choice alternatives. I remark here that some weight shift theories share common mathematical properties. Concretely, both the focus shift model and Takemura and associate's Contingent Focus Model may be formulated in an Additive Conjoint Measurement framework (see Chapter 6 in Krantz, Luce, Suppes, & Tversky (1971)).

The second class, namely, reference-point shift theories, claim that asymmetries occur in task-dependent shifts in cognitive reference points, upon which decision makers form their judgmental responses. Research on "loss aversion" tends to fall in this class (Kahneman & Tversky, 1979; Huber & Puto, 1983; Samuelson & Zeckhauser, 1988; Kahneman, Knetch, & Thaler, 1990; Kahneman, Knetch, & Thaler, 1991). 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, financial plans, etc. They claimed that a substantial part of such "Status quo bias" reflects loss aversion. The "Endowment effect" (Thaler, 1980; Kahneman et al., 1990) is also considered to be a manifestation of loss aversion. Kahneman et al. (1990) 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. (1990) argued that the price difference reflects the compensation for the loss of their endowment.

This classification helps understand how seemingly analogous asymmetries between gains and losses may require different theories to explain such phenomena. For instance, regarding asymmetric strength of preference, the focus shift model provides a weight shift argument, postulating that strength of preference is formed by weighting feature contributions. In contrast, the standard explanation for the framing effects (Kahneman & Tversky, 1979), as previously introduced, may be regarded as a typical example of reference-point shift theories.

Finally, the framework of feature representation and response-compatible subjective weighting may produce models for a wider variety of psychological phenomena. Tversky's (1977) analysis on similarity judgment was previously discussed. In self-evaluation of happiness, Kunda, Fong, Santioso, and Reber (1993) asked a group of participants to rate how happy they were with their social life. Another group rated how unhappy they were, and both groups listed their thoughts. Subsequently, both groups evaluated their overall happiness level. Kunda et al. found that the former group reported themselves happier than the latter. Kunda et al. argued that the discrepancy was due to participants' use of a "positive test strategy" (Klayman & Ha, 1987) in their memory search for confirmatory examples. Such search processes led the "happy" group to selectively sample happy evidence, whereas the "unhappy" group sampled unhappy evidence. Although Kunda et al. did not explicitly formalize any model, a feature-weighting theory is implicit in their argument. Let each piece of evidence in memory constitute a feature, associated with a digital, inactive–active weight. The binary weights can turn on and off in a response-compatible manner. Thus, the "happy" question turns weights for happy features on, leaving the rest off. The "unhappy" question turns weights for unhappy features on, leaving the rest off. This state of mind is what Kunda et al. characterized as the use of positive test strategy.

One might criticize that the widespread applicability of the feature-weighting approach may indicate that such an approach internalizes a grand theory that lacks constraints in its limitation. The value of the feature-weighting framework for producing theories, for better or worse, could be evaluated by characterizing the boundary conditions of the applicability of such approaches.

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