Judgment and Decision Making, Vol. 6, No. 2, February 2011, pp. 156–162

A re-examination of the effect of contextual group size on people's attitude to risk

Kazumi Shimizu*   Daisuke Udagawa†

Abstract

Using Kahneman and Tversky's life-death decision paradigm, Wang and colleagues (e.g., Wang & Johnston, 1995; Wang, 1996a, 1996b, 1996c, 2008; Wang et al., 2001) have shown two characteristic phenomena regarding people's attitude to risk when the contextual group size is manipulated. In both positive and negative frames, people tend to take greater risks in life-death decisions as the contextual group size becomes smaller; this risk-seeking attitude is greater when framed positively than negatively. (This second characteristic often leads to the disappearance of the framing effect in small group contexts comprising of 6 or 60 people.) Their results could shed new light on the effect of contextual group size on people's risk choice. However these results are usually observed in laboratory experiments with university student samples. This study aims to examine the external validity of these results through different ways of experimentation and with a different sample base. The first characteristic was replicated in both a face-to-face interview with a randomly selected sample of the Japanese general public, and a web-based experiment with a non-student sample, but not the second.

Keywords: framing effect, group size effect, attitude to risk, nurture, numeracy.

1 Introduction

Over the last three decades, empirical research on human cognition and decision-making behavior has shown a systematic bias in a number of decision-making areas. One of the pioneering studies in this field was performed by Kahneman and Tversky on the effects of framing in life-death decision problems (e.g., Kahneman & Tversky, 1979; Tversky & Kahneman, 1981). In their study, subjects were presented with a cover story explaining that 600 people were suspected to be infected with a fatal Asian disease for which only two curative plans are available. Specifically, Plan A has a deterministic outcome, while Plan B has a probabilistic outcome. The deterministic outcome ensures the survival of one-third of the patients (i.e., 200 survivors), while the probabilistic outcome results in a one-third probability that all of the patients will survive, and a two-thirds probability that no one will survive. After the subjects read the cover story, they were asked to choose one of the two plans.

The framing effect as demonstrated by Tversky and Kahneman (1981) is as follows: when this problem was represented in terms of saving lives (a "positive frame"), most subjects (72%) were risk-averse; the certain survival of 200 lives was more attractive than the risky choice, in which there was only a one-third chance of saving all 600 lives. In contrast, when this problem was represented in terms of losing lives (a "negative frame"), most subjects (78%) favored the risky choice; the assured death of 400 people was less attractive than the two-thirds probability that 600 could die.

A number of studies have been conducted to test the reliability and generalizability of Tversky and Kahneman's original study. On the one hand, with the standard cover story, strong framing effects have been replicated not only in different kinds of respondents, such as university faculty staff, students, and physicians (McNeil et al., 1982) but also in various applied areas (Burton & Babin, 1989; Kramer, 1989; Travis et al., 1989). On the other hand, some studies have shown little or no framing effect when the context or cover story was manipulated. Apparently, this framing effect is sensitive both to the context in which the problem is described (Fagley & Miller, 1987; Schneider, 1992; Wang & Johnston. 1995; Wang, 1996a, b, c; Wang et al., 2001), and to various cognitive and social variables (Shoorman et al., 1994; Miller & Fagley, 1991; Roszkowski & Snelbecker, 1990).

We would like to thank the participants of the 20th Annual Meeting of the Human Behavior and Evolution Society (2008) for their helpful suggestions. This paper owes much to the thoughtful and helpful comments of Professor X. T. Wang, Professor Jonathan Baron and two anonymous reviewers of Judgment and Decision Making. We gratefully acknowledge financial support from the 21 COE program of Constructing Open Political-Economic System (I-1), the Global COE program of Political Economy and Institutional Construction (I-13) and the Grant-in-Aid for Scientific Research on Priority Areas (19046002). All support was provided by the Japanese Ministry of Education, Culture, Sports, Science and Technology.

*Corresponding author, Department of Political Science and Economics, Waseda University. Address: 1-6-1 Nishi-Waseda, Shinjuku-ku, Tokyo 169-8050, Japan. Email: skazumi1961@gmail.com.

†Faculty of Intercultural Studies, Tomakomai Komazawa University. Address: Nishikioka 521–293, Tomakomai, Hokkaido 059–1292, Japan; E-mail: udagawa.daisuke@gmail.com.

https://doi.org/10.1017/S1930297500004101 Published online by Cambridge University Press

Table 1: Group Size Effects: Percentages of participants choosing the probabilistic alternative

	Wang and Johnston (1995)			
	Group size = 6000	Group size = 600	Group size = 60	Group size = 6
Positive frame	40.9% (n=44)	40.0% (n=50)	67.5% (n=40)	64.0% (n=50)
Negative frame	61.4% (n=44)	68.0% (n=50)	65.0% (n=40)	70.0% (n=50)
Framing effects	Yes	Yes	No	No
	Wang (1996b)			
	Group size = 6000	Group size = 600	Group size = 60	Group size = 6
Positive frame	38.7% (n=31)	41.9% (n=31)	57.6% (n=33)	66.7% (n=30)
Negative frame	66.3% (n=30)	76.5% (n=34)	66.7% (n=30)	75.6% (n=33)
Framing effects	Yes	Yes	No	No
	Wang et al. (2001)			
	Group size = 6 billion			Group size = 6
Positive frame	36.0% (n=50)			70.0% (n=50)
Negative frame	66.0% (n=50)			70.0% (n=50)
Framing effects	Yes			No

In support for the cognitive/social line of inquiry, a series of studies by Wang and colleagues observed an obvious effect of contextual group size on people's attitude to risk (detailed in the next section). However this effect was usually detected in experiments with university students. Thus, to examine the external validity of the contextual group size effect, it is worth verifying whether this effect can be replicated with a different method of experimentation with different sample types.

Section 2 will explain Wang's effect of contextual group size. Sections 3 and 4 report the results of two experiments that verify the validity of the above effect. In Section 5, we conclude with a summary and discussion of these results.

2 Effect of contextual group size on people's attitude to risk

Table 1 summarizes Wang's previous research, showing how people's attitude to risk changes when the contextual group size is manipulated in the life-death decision problem. These results support two major findings. First, people's risk-seeking tendency was greater in both positive and negative frames when the group affected was small (e.g., 6 or 60 people) than when it was large (e.g., 6000 or 600 people). Second, this tendency was different between the two frames: the rate of risk-seeking increased more drastically in the positive frame than in the negative frame as the contextual group size became smaller. This second characteristic has often led to the disappearance of the framing effect, such that the framing effect is seen only when the decision problem was presented in large group contexts, such as 6000 or 600 people, while such reversals in choice preference were often eliminated when the same life-death problem was described for a small group, such as 6 or 60 people.

Certainly this group size effect, especially the first characteristic, appears similar to the phenomenon known as the "peanuts effect", in which people are more willing to gamble when playing for "peanuts" (small-payouts) (Markowitz,1952; Prelec & Lowenstein 1991). However, we think that it is better to distinguish between them for the following two reasons. The first is related to differences regarding the degree of risk-seeking. For the peanuts effect, "it is not actually necessary to become risk-seeking for very small gains, merely to become less risk-averse for smaller payouts" (Weber & Chapman, 2005, p. 32). Table 2 of Weber and Chapman (2005) showed that, when the probability of winning is 80%, 21% of subjects chose the probabilistic option when playing $1, 14% when playing $10, 14% when playing $100, and 14% when playing $1000. On the other hand, the group size effect reveals that people usually become most risk-seeking in small group contexts, say 6 people, where more than 60% of the participants choose a gambling alternative (see Table 1). The second distinction reflects differences in the context of the problem: the peanuts effect is observed in the context of small monetary payoffs, while the group size effect is posed in the context of a small number of people. When we pick a 10% chance of $1 over $0.10 for sure, we can say "Who cares if I lose? I'm only passing a dime." However, when we give up 4 lives from 6 people, we could not think that it is a small deal. If the psychological motives differ between the two effects, it might be reasonable to consider each effect as separate.[1]

In order to know whether these two patterns can be replicated, we conducted two experiments. The first experiment was done with face-to-face interviews of randomly sampled subjects. The second experiment was conducted on-line with a different sample of subjects.

3 Experiment 1: Face-to-face interviews

3.1 Subjects

Experiment 1 was incorporated into the public opinion survey conducted by GLOPE (Global Centre for Open Political Economy at Waseda University) in 2005. As a standard public opinion survey, its main agenda was to investigate eligible Japanese voters' socio-political conscience after the 2005 House of Representatives election by remodeling an existing standard social opinion survey. The 2005 survey consisted of 70 questions, one of which was the life-death problem presented in one of three contextual group sizes (600, 60 or 6), and was conducted via face-to-face interviews recorded in a paper and pencil format.[2]

As these data represented participants from a range of ages across multiple geographic locations in Japan, sampling bias was reduced.[3] Experiment 1 included 1397 subjects (725 female, 51.9%) with a mean age of 54.2 years (standard deviation 16.3 years). Also, 1.2% of the sample were students (17 people).[4]

3.2 Design

We used different versions of the life-death decision problem as a means for manipulating the independent variables. The subject's task was to choose between two medical plans. The context of the decision problem was manipulated via the size of the hypothetical patient group presented in the problem: 600, 60, or 6.[5] For each of these contextual group sizes, the life-death decision problem was presented either in terms of saving lives (a positive frame) or losing lives (a negative frame). The subjects were randomly assigned to one of the six experimental groups and were unaware of the experimental manipulation. The frequency of the two choices, the deterministic outcome and the probabilistic outcome, were calculated across subjects as the dependent variable.

Each version of the life-death problem had the same mathematical probability structure: the probability of survival was always one third. The two options were either a sure cure for one-third of the patient group or a cure for the whole group with a one-third probability.

3.3 Results

The results were compared with those from previous research with the following model:[6]

$$\text{Model A}: \quad log(p_i/1-p_i) = \beta_0 + \beta_1 Size_i + \beta_2 Frame_i + \beta_3 Frame_i * Size_i$$

The exponential powered by logit coefficient (β) is intuitively an effect of the independent variable on the "odds ratio". In this case, the odds are the probability of the subject's probabilistic choice divided by the probability of their deterministic choice. In more concrete terms, if exp β_1 is 2, the odds that subjects would choose the risky plan increases two-fold for each unit increase in the log value of contextual group size. That is, people are more risk-seeking for contextual group size 600 than for contextual group size 6.

The results presented in Tables 2 and 3 reveal exp β_1 as 0.767 (p = .002), indicating that the odds with which subjects choose the risky plan increases in both frames when group size decreases. That is, people tend to take

[1] For a review of the peanuts effect, see Du et al. (2002) and Weber & Chapman (2005).

[2] The basic information about this social survey is as follows:
1. geographical area: Japan (all 47 prefectures);
2. population: eligible voters (men and women over 20 years of age);
3. period: November 2005;
4. sampling method: stratified two-stage random sampling;
5. list used for sampling: voter registration list (Senkyonin Meibo) supplemented by a residential register (Jumin Kihon Daicho);
6. number of sample points: 115 locations.
For details and the entire structure of this survey, see Kohno et al. (2008).

[3] The data can be downloaded from http://21coe-glope.com/topics/GLOPE2005EnqueteAbstract.pdf.

[4] The small number of students is due to the fact that the Japanese voting age is 20 years old.

[5] We could not realize the 6000 group size version, due to limited questionnaire space. For the cover story used in our experiment, see the Appendix.

[6] If the probability of a respondent i's probabilistic outcome choice is written by p_i, the dependent variable is defined as logit (p_i); that is, log $\frac{p_i}{1-p_i}$. β is a standardized binomial logit regression coefficient. $Size_i$ variable is a log value of contextual group size. For example, if subject i answers to the size 600 problem, its value is $log600$.Framing dummy ($Frame_i$) is coded 1 if subject i answers to the negative-frame problem, and 0 for answers to the positive-frame problem.

https://doi.org/10.1017/S1930297500004101 Published online by Cambridge University Press

Table 2: Percentages of the probabilistic choice in the life-death decision problem across three sizes in a national survey, Experiment 1 (N = 966).

	Group size = 600	Group size = 60	Group size = 6
Positive frame	31.2% (n=173)	32.6% (n=172)	43.4% (n=166)
Negative frame	45.5% (n=156)	58.4% (n=149)	54.0% (n=150)
Framing effects	Yes	Yes	Yes

Note: In group size 600, Pearson's Independence Test: $\chi^2(1) = 7.119$, p value = .008. In group size 60, $\chi^2(1) = 21.565$, p value = .000. In group size 6, $\chi^2(1) = 3.563$, p value = .059; In group size 600, DK/NA (147 people) is excluded from the analysis. In group size 60, DK/NA (140 people) is excluded from the analysis. In group size 6, DK/NA (144 people) is excluded from the analysis.

Table 3: Estimation of model A, Experiment 1.

Coeff.	Estimate	Std. Error	Exp(β)	Pr($>|t|$)
intercept	−0.124	0.220	0.884	0.574
$Size_i$	−0.265*	0.114	0.767	0.020
$Frame_i$	0.535**	0.316	1.707	0.009
$Size_i * Frame_i$	0.092	0.162	1.097	0.569
AIC	1291.4			

† .05 < p < .10, * p < .05, ** p < .01, *** p < .001

more risks with life-death decisions when the contextual group size is small, such as 6 or 60 people than when it is large, (i.e. 600 people). However, although we can say that people are risk-seeking when they are in group contexts of 6 and 60 in the negative frame, where more than half of them choose a probabilistic choice, it is noteworthy that our subjects are generally less risk seeking than those of Wang's previous research (see Tables 1 and 2).

On the other hand, the framing effect is estimated with a exp β_2 of 1.707 (p = .009). This means that the odds that subjects will choose the risky plan in the negative frame are about twice the odds that subjects will choose the risky plan in the positive frame. Table 3 reveals that the framing effect remains significant in group sizes 600 and 60 (p = .008 and .000 respectively), it does not totally disappear in group size 6 (p = .059). Lastly the interaction effect is not significant : p value of β_3 is 0.569. Hence, from these results, we can state that people are more risk-seeking with small group sizes than with large group sizes, but this tendency is not different between positive and negative frames. The first characteristic of the contextual group size effect is replicated, the second one is not.

4 Experiment 2: Web experiment with non-student sample

4.1 Subjects

A private research company was consigned to recruit subjects for the web-based Experiment 2. These subjects voluntarily applied for membership to the research company and can choose to answer survey questions diffused over the Internet in their homes, since the experimental instruction were also presented on the computer screen. After the experiment, the company randomly chooses a part of the respondents and pays them a fee. The survey took place between 18/02/2010 and 26/02/2010 and consisted of over 1893 subjects (860 female, 45.4%), excluding DK (don't know)/NA (no answer) responses. The mean age was 42.4 years (standard deviation: 12.6 years, range: 20-69). The student sample was very small, occupying only 0.5% of the total sample.

4.2 Design of experiment

The same experimental design was used in Experiment 2 as in Experiment 1, except three additional group sizes were included to yield a total of six contexts: 60000, 6000, 600, 150, 60, and 6. These additional group sizes were intended to further explore the group size effect. Subjects were randomly presented with one of the twelve different versions of the life-death problem and asked to choose a medical plan.

4.3 Results

We employed the same model as in the first experiment (model A) on the results shown in Table 4. The estimation of independent variables is shown in Table 5.

The odds that subjects will choose the risky plan increases in both frames when group size decreases (exp β_1 = 0.815, p = .000). However, similar to Experiment 1, the subjects also show generally less risk-seekingness than those in previous research (see Table 1 and 4). The

https://doi.org/10.1017/S1930297500004101 Published online by Cambridge University Press

Table 4: Percentages of the probabilistic choice in the life-death decision problem across six sizes in a web survey, Experiment 2 (N = 1893).

Group size	60000	6000	600	150	60	6
Positive frame	26.1% (n=165)	24.8% (n=161)	29.6% (n=169)	33.1% (n=163)	34.3% (n=169)	43.6% (n=156)
Negative frame	43.0% (n=172)	43.1% (n=144)	46.8% (n=141)	48.4% (n=157)	47.5% (n=158)	63.8% (n=138)
Framing effects	Yes	Yes	Yes	Yes	Yes	Yes

Note: In group size 60000, Pearson's Independence Test: $\chi^2(1) = 10.691$, p value $=$ .001. In group size 6000, $\chi^2(1) = 11.325$, p value $=$ .001. In group size 600, $\chi^2(1) = 9.737$, p value $=$ .002. In group size 150, $\chi^2(1) = 7.740$, p value $=$ .005. In group size 60, $\chi^2(1) = 5.851$, p value $=$ .016. In group size 6, $\chi^2(1) = 11.971$, p value $=$ .000. DK/NA (446 people) is excluded from the analysis.

Table 5: Estimation of model A with the results of experiment two

Coeff.	Estimate	Std. Error	Exp(β)	Pr($>|t|$)
intercept	−0.223	0.155	0.800	0.150
$Size_i$	−0.205***	0.054	0.815	0.000
$Frame_i$	0.624**	0.218	1.867	0.004
$Size_i * Frame_i$	0.035	0.074	1.036	0.634
AIC		2368.7		

† .05 < p < .10, * p < .05, ** p < .01, *** p < .001

framing effect is significant (exp β_2 = 1.867, p = .004), suggesting that the odds subjects in the negative frame will choose the risky plan are about twice the odds that subjects will choose the risky plan in the positive frame. And the interaction effect is not significant: p value of β_3 is 0.634. This affirms the results of the first experiment, the first characteristic of the contextual group size effect was replicated, the second one was not.

5 Conclusion and discussion

Considering the results of previous research (e.g., Wang & Johnston, 1995; Wang, 1996a, 1996b, 1996c, 2008; Wang et al., 2001) and those of our experiments above, we could conclude that the increase in risk-seeking decisions when the contextual group size is small is stable. The first characteristic of the effect of contextual group size on people's risk choice may exist. However it is worth noting that the subjects in our experiments were generally less risk-seeking. Actually if we compare the percentages of the subjects who chose the probabilistic choice in our sample with those found in previous research, we see that our sample is consistently less risk-seeking than those in the literature by 10%$\sim$30% across every contextual group size. In terms of the framing effect, our results show that this change in attitude to risk does not differ across either frame and it does not lead to the disappearance of the framing effect in smaller group sizes, such as 6 or 60 people. The second characteristic of this effect may not generally exist. We conclude this paper with some hypotheses or ideas that might explain why the second characteristic was not observed in our experiments. They also concern the generally reduced risk-seeking in our subjects.

First, we will begin by considering Wang's hypothesis, which proposes the disappearance of the framing effect with small group sizes: the ambiguity-ambivalence hypothesis. This hypothesis proposes the following assumptions: "(1) Decision cues are selected and used in accordance to their priorities. (2) Cue priority reflects the evolutionary and ecological validity of a cue in predicting specific risks. (3) Primary cues in risk communication carry evolutionary, ecological, and social significance and anchor decision reference points, while secondary cues of verbal communication fine-tune the settings of reference points. (4) Inconsistent decision biases tend to occur as a result of secondary cue use when primary cues are absent in risk communication (i.e., an ambiguity condition) or when primary cues elicit conflicting preferences (i.e., an ambivalence condition)" (Wang, 2008, p. 82).

According to this hypothesis, the framing effect was evident in both the 6000 people and 600 people groups because the life-death problem was presented in a large, anonymous, and hence ambiguous context. Because of this, group size variables (6000 and 600) cannot function as primary cues and people resort to secondary cues such as verbal framing. On the other hand, the framing effect was absent in the groups of 60 and 6 people, because these group sizes indicate a high level of interdependency, and is likely to have evoked familial, kinship relationships in the subjects. In this sense, size variables (60 and 6) can function as primary cues. Generally speaking, this hypothesis states that verbal framing as a secondary cue has the most obvious effect only when a choice is presented in an evolutionarily novel and ambiguous context, in which primary cues are absent or alternatively produce

https://doi.org/10.1017/S1930297500004101 Published online by Cambridge University Press

conflicting risk preferences in people. Taking this into account, we think there is still room for further investigation as to how people prioritise particular cues.

Recall that while most of the research mentioned above used a sample of university students, our experiments used a non-student sample, specifically the general public. This leads us to suppose that the general public may have a different cue priority from students. For example, on the one hand, groups of 6 and 60 can serve as valid cues for university students, due to the fact that 6 corresponds to the size of families, and 60 is not far from the group sizes in their school lives. On the other hand, it is possible that the general public does not focus on small group sizes such as those of 6 or 60 people as closely as students, since the general public is more varied than university students in terms of group experience. Although the family remains an important group, we may assume that some of them are living independently from the families in which they were born/raised and that they may have important experiences such as working for a company, or union activities, in which group sizes can be larger than 6 or 60. In short, compared to university students, their various experiences can prevent them from giving immediate priority to smaller group sizes. If so, it is possible that in our experiments, risk-seekingness might be harder to reinforce and the framing effect would not disappear with smaller group sizes.

The second point is also related to the sample difference, but pays attention to individual differences in cognitive abilities, such as numeracy. Peters & Levin (2008) reveals that the less numerate showed a more direct effect of framing, compared to the highly numerate. Assuming that the general public is lower than university students in terms of numeracy, this result seems to be consistent with the appearance of the framing effect in our sample. In a similar vein, Frederick (2005) stated that people with lower cognitive ability generally tend to prefer the deterministic choice to the probabilistic choice. Risk-averseness, due to low cognitive ability, might prevent our sample from being risk-seeking in both frames when contextual group size becomes small, and as a result the framing effect remains. Since these studies (i.e., Peters & Levin, 2008; Frederick, 2005) do not focus on the manipulation of contextual group size in the life-death paradigm, it is premature to attribute the existence of the framing effect in small group sizes to differences in the sample's cognitive ability. Still, this seems to be an interesting point.

The final possibility is that differences in results between previous research and our present study is due to differences in experimental procedures. While previous research experiments have usually been conducted in the laboratory, ours were face-to-face interviews or online surveys. However it seems hard for us to construct a reasonable argument that is able to explain the disappearance of the framing effect in laboratory experiments but not in other types of experiments.

References

Burton, S., & Babin, L. A. (1989). Decision-framing Helps Make the Sale. *Journal of Consumer Marketing, 6*, 15–24.

Du, W., Green, L., & Myerson, J. (2002). Cross-cultural comparisons of discounting delayed and probabilistic rewards. *Psychological Record, 52*, 479–492.

Fagley, N. S., & Miller, P. M. (1987). The effects of decision framing on choice of risky vs. certain options. *Organizational Behavior and Human Decision Processes, 39*, 264–277.

Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic Perspectives, 19 (fall),* 24–42.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decisions under risk. *Econometrica, 47*, 313–327.

Kohno, M., Kuriyama, K., Morimoto, Y., Tanaka, A., & Watabe, M. (2008), The making of making casi possible in japan. Working paper no.4, G-COE GLOPE II Working Paper Series, from http://globalcoe-glope2.jp/modules/mydownloads/ [18 March 2010]

Kramer, R. M. (1989). Windows of vulnerability or cognitive illusions? Cognitive processes and the nuclear arms race. *Journal of Experimental Social Psychology, 25*, 79–100.

Markowitz, H. (1952). The utility of wealth. *Journal of Political Economy, 60*, 151–158

McNeil, B. J., Pauker, S. G., Sox, H. C. Jr., & Tversky, A. (1982). On the elicitation of preferences for alternative therapies. *New England Journal of Medicine, 306*, 1259–1262.

Miller, P. M., & Fagley, N. S. (1991). The effects of framing, problem variations, and providing rationale on choice. *Personality and Social Psychology Bulletin, 17*, 517–522.

Prelec, D., & Loewenstein, L. (1991). Decision making over time and under uncertainty: A common approach. *Management Science, 37*, 770–786.

Peters, E. & Levin I. P. (2008). Dissecting the risky-choice framing effect: Numeracy as an individual-difference factor in weighting risky and riskless options. *Judgment and Decision Making, 3*, 435-448.

Roszkowski, M. J., & Snelbecker, G. E. (1990). Effects of "framing" on measures of risk tolerance: Financial planners are not immune, *Journal of Behavioral Economics, 19*, 237–246.

Schneider, S. L. (1992). Framing and conflict: aspiration level contingency, the status quo, and current theories of risky choice. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 18*,1040–1057.

Shoorman, F. D., Mayer, R. C., Douglas, C. A., & Hetrick, C. T. (1994). Escalation of commitment and the framing effect: An empirical investigation. *Journal of Applied Social Psychology, 24*, 509–528.

Travis, C. B., Phillippi, R. H., & Tonn, B. E. (1989). Judgment heuristics and medical decisions. *Patient Education and Counseling, 13*, 211–220.

Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science, 211*, 452–458.

Wang, X. T. (1996a). Evolutionary hypotheses of risk-sensitive choice: Age differences and perspective change. *Ethology and Sociobiology, 17*, 1–15.

Wang, X. T. (1996b). Framing effects: Dynamics and task domains. *Organizational Behavior and Human Decision Processes, 68*, 145–157.

Wang, X. T. (1996c). Domain-specific rationality in human choices: Violations of utility axioms and social contexts. *Cognition, 60*, 31–63.

Wang, X. T. (2008). Risk communication and risky choice in context ambiguity and ambivalence hypothesis, *Annals of the New York Academy of Sciences, 1128*, 78–89.

Wang, X. T., & Johnston, V. S. (1995). Perceived social context and risk preference: A re-examination of framing effects in a life-death decision problem. *Journal of Behavioral Decision Making, 8*, 279–293.

Wang, X. T., Simons, F., & Bredart, S. (2001). Social cues and verbal framing in risky choice. *Journal of Behavioral Decision Making, 14*, 1–15.

Weber, B. J., & Chapman, G. B. (2005). Playing for peanuts: Why is risk seeking more common for low-stakes gambles?. *Organizational Behavior and Human Decision Processes, 97*, 31–46.

Appendix: Versions of the life-death decision problem used in experiments

Positive Frame Version

Imagine that 6 (60, 150, 600, 6000 or 60000) people are infected by a fatal disease. Two alternative medical plans to treat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the plans are as follows:

- If plan A is adopted, 2 (20, 50, 200, 2000 or 20000) people will be saved.
- If plan B is adopted, there is a one-third probability that all 6 (60, 150, 600, 6000 or 60000) people will be saved, and a two-thirds probability that none of them will be saved.

Which of the two plans would you favor?

Negative Frame Version

Imagine that 6 (60, 150, 600, 6000 or 60000) people are infected by a fatal disease. Two alternative medical plans to treat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the plans are as follows:

- If plan A is adopted, 4 (40, 100, 400, 4000 or 40000) people will die.
- If plan B is adopted, there is a one-third probability that none of them will die, and a two-thirds probability that all 6 (60, 150, 600, 6000 or 60000) will die.

Which of the two plans would you favor?