Domain-specific rationality in human choices: violations of utility axioms and social contexts

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Abstract

This study presents a domain-specific view of human decision rationality. It explores social and ecological domain-specific psychological mechanisms underlying choice biases and violations of utility axioms. Results from both the USA and China revealed a social group domain-specific choice pattern. The irrational preference reversal in a hypothetical life–death decision problem (a classical example of framing effects) was eliminated by providing a small group or family context in which most subjects favored a risky choice option regardless of the positive/negative framing of choice outcomes. The risk preference data also indicate that the subjective scope of small group domain is larger for Chinese subjects, suggesting that human choice mechanisms are sensitive to culturally specific features of group living. A further experiment provided evidence that perceived fairness might be one major factor regulating the choice preferences found in small group (kith-and-kin) contexts. Finally, the violation of the stochastic dominance axiom of the rational theory of choice was predicted and tested. The violations were found only when the “life-death” problem was presented in small group contexts; the strongest violation was found in a family context. These results suggest that human decisions and choices are regulated by domain-specific choice mechanisms designed to solve evolutionary recurrent and adaptively important problems.

1. Introduction

The normative approach to human choices and decision making, represented by utility theory and its many modifications, is characterized by a small set of rational principles, such as the cancellation axiom, the transitivi-
ty axiom, the invariance axiom, and the dominance axiom (for reviews, see Luce, 1992, Luce & Raiffa, 1957; Savage, 1954, Tversky & Kahneman, 1986). Such a definition of rationality reveals the pursuit of an all-purpose and domain-general rationality.

However, over the last few decades, various human reasoning and decision biases have been repeatedly demonstrated in empirical studies (see Kahnemkan, Slovic, & Tversky, 1982; Slovic, Lichtenstein, & Fischhoff, 1988; Tversky & Kahneman, 1986). These findings have challenged the normatively defined domain-general decision rationality and inspired a large number of studies to explore psychological mechanisms underlying human decisions. From these converging studies, a new approach, the cognitive heuristic approach, to human judgment and decision making emerged. Much of the work in line with this approach has contrasted normatively defined rational performance with the use of cognitive heuristics (see Einhorn & Hogarth, 1981; Kahneman et al., 1982). These cognitive heuristics are viewed as information-processing shortcuts which, although normally efficient, can lead to systematic decision biases or errors. Inherent in the heuristic approach is the idea that in coping with uncertainty, human decision makers tend to use some judgmental heuristics as general strategies for simplifying complex decision tasks. From this information-processing simplification viewpoint, emphasis in heuristic analysis of human decision biases has traditionally been on the limited capacity of cognitive processes.

Recently, from different theoretical perspectives and based on a variety of empirical findings on human reasoning and decision making, an increasing number of investigators have drawn research attention to various mechanisms beyond pure computational limitations upon the information-processing capacities and complexity (e.g., Cosmides, 1989; Cosmides & Tooby, 1992; Denes-Raj & Epstein, 1994; Gigerenzer, in press, 1994; Gigerenzer, Hell, & Blank, 1988; Fagley & Miller, 1987; Medin & Edelson, 1988; Schneider, 1992; Schneider & Lopes, 1986; Wagenaar, Keren, & Lichtenshtein, 1988). Some of these studies have provided evidence that the appearance or disappearance of human reasoning errors and decision biases depends on perceived social and ecological context. These studies have opened recent discussions concerning the nature of rationality and raised questions about the extent to which human reasoning mechanisms are domain specific.

The present study takes a domain-specific approach to the psychological mechanisms which underlie human choice behavior and examines how the formally identical decision problems presented in different social and ecological contexts affect human choice behavior. This approach is developed from exploring several key questions. Do human choice preferences deviate from normative rational principles in a social domain-specific pattern? If so, can the irrational choice preferences be eliminated in ecologically more relevant and socially more meaningful contexts? Is such a domain-specific choice pattern also cross-cultural? What proximal (psycho-
logical) mechanisms modulate the domain-specific choices? If human decision rationality is, to some important degree, ecologically and socially domain specific, what specific choice behavior that violates domain-general utility axioms can be further predicted? Finally, what adaptive relationships exist between human decision behaviors and those features of ecological and social environments that pose specific problems for human decision makers?

These questions led to the experiments reported here. Part 1 is an empirical analysis of human choice preference in a life–death decision paradigm. The study was designed to examine how subjects' choice preferences vary in different social group domains by systematically manipulating the context and content variables presented in the life–death decision paradigm. Part 2 compares the choice pattern obtained from US samples with that obtained from Chinese samples in an attempt to uncover some cross-cultural and culturally specific features of human choice strategies. Part 3 explores psychological factors that regulate social domain-sensitive choice behaviors. Part 4 tests the predictive power of a hypothesis of the social group domain-specific choice preferences. The specific violations of a domain-general rational axiom of expected utility theory were proposed and examined. Based on the empirical findings obtained from these experiments, the adaptive nature of a social domain-specific decision rationality and its possible evolutionary origin are reviewed and discussed.

**PART 1: THE EFFECTS OF THE PERCEIVED GROUP SIZE ON RISK PREFERENCE AND CHOICE RESPONSE TO THE FRAMING OF DECISION OUTCOMES**

2. Theoretical considerations

Human decision making occurs in different social contexts. It is conceivably adaptive to evolve a risk preference mechanism that is sensitive to the ecological and social features of different social contexts. From this viewpoint, the perceived social group context of a decision problem would profoundly affect people's risk preference. One important ecological variable for social group living is the size of the group. For over 99% of its evolutionary history, human species had lived in small, simple hunter-gatherer groups or bands with generalized reciprocity. The size of hunter-gatherer groups rarely exceeded 100 people. This is also true, of modern hunter-gatherers and fits with the fossil record (for details, see Dunbar, 1988, 1993; Knauft, 1991; Lee & DeVore, 1968).

Evolutionary analyses also indicate that the defense against hostile out-

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1 The empirical results summarized in Part 1 are presented in details in a paper by Wang and Johnston (1995).
groups is a common survival task for humans and other primate species. Such intergroup hostility might have fostered cooperation among in-groups and animosity toward out-groups (e.g., Alexander, 1974, 1979; Wrangham, 1987).

Recently, Caporael, Dawes, Orbell, and van de Kragt (1989) argued that small group living was essential for individual survival during evolution; it reduces individual risk of predation and starvation. "The maximum number of individuals is limited by the carrying capacity of the environment. Similarly, because groups mediate individual survival, a certain minimum number of group members is required. Under such conditions, the small face-to-face group (15–30 individuals) becomes a primary locus of selection pressures" (p. 694).

The prolonged evolutionary experience in small face-to-face groups might have shaped the human mental mechanisms to be more sensitive to variables characteristic of small group living in human evolution. Thus, group size, bearing significant adaptive weights, might be an important contextual variable regulating human choice preferences.

3. Empirical paradigm

The empirical paradigm used in the present study was similar to that described by Tversky and Kahneman (1981) in their study of framing effects on human choices. In this life–death decision paradigm, the subjects are given a decision problem in which a certain number of people are described as being infected by a fatal disease. Subjects are asked to choose one of two available treatment plans according to their preference for the stated outcomes associated with each plan. The first plan will result in a deterministic outcome whereas the second plan a probabilistic outcome. The deterministic outcome leads to the sure survival for one-third of the patients whereas the probabilistic outcome results in a one-third probability that the entire patient group will survive and a two-thirds probability that no one will survive.

In one of their original experiments, Tversky and Kahneman (1981) used a life–death decision problem that involved 600 anonymous hypothetical patients. When the choice outcomes were framed (phrased) positively in terms of the number of people who would be saved, 72% of their subjects chose the deterministic outcome. In contrast, when the choice outcomes were framed negatively in terms of the number of people who would die, 78% of subjects chose the probabilistic (risky) outcome.

Most normative decision theories assume that choices revealing underlying utility must be consistent and therefore should not be affected by the way a decision problem is presented. Thus, the finding of a reversal in choice preferences violates the description invariance principle of the
rational theory of choice, in which different descriptions of the same choice outcomes should yield the same preference order.

**Hypothesis 1: Contextual size effects on choice preference**

From a social group domain-specific perspective, it was hypothesized that a subject's choice preference, and the outcome framing effect demonstrated by Tversky and Kahneman (1981) would vary as a function of the contextual size (the size of hypothetical patient group) in the life–death decision problem. The appearance or disappearance of the outcome framing effect may depend on social group context. In addition, choice patterns for the same life–death decision problem described in different social group contexts (e.g., large group context vs. small group context) would be behaviorally distinct whereas choice patterns for the decision problem described in the contexts that are subjectively perceived as to belong to the same context domain would be behaviorally similar.

A recent study (Wang & Johnston, 1995) tested this hypothesis. In this study, 456 subjects (228 males and 228 females) were randomly assigned to one of the subject groups, corresponding to different versions of the life–death problem. Each subject responded to only one version.

The initial experiment consisted of 8 subject groups with 4 groups receiving the life–death decision problem described in terms of saving life, and the rest receiving the problem in terms of losing life. Four hypothetical group sizes (i.e., 6000, 600, 60, and 6) were used: under the saving-life framing condition, the subject groups were designated S6000 (N = 44), S600 (N = 50), S60 (N = 40), and S6 (N = 50); and under the losing-life framing condition, the subject groups were designated L6000 (N = 44), L600 (N = 50), L60 (N = 40), and L6 (N = 50), respectively. N denotes the total number of subjects in each group.

All versions of the life–death problem had the same formal probability structure: the probability of survival always equaled one-third on average. The two options were either sure survival of one-third of people in the patient-group or survival of the whole group with a one-third probability.

The major empirical findings are illustrated in Fig. 1.

To summarize briefly:

1. With large group sizes (6000 and 600), the results replicated Tversky and Kahneman's (1981) outcome framing effect: subjects chose the deterministic outcome when the life–death problem was framed in terms of saving life, and the probabilistic outcome when the problem was framed in terms of losing life.

The comparison between the S6000 and L6000 subject groups showed a significant choice difference ($\chi^2(1) = 3.84$, $p = .05$). A similar result was found in the comparison between S600 and L600 subject groups ($\chi^2(1) =$
Fig. 1. Risk preferences in different hypothetical group contexts. S = saving-life framing; L = losing-life framing; 6000, 600, 60, and 6 = sizes of the patient group in the life-death decision problem.

8.57, p = .003). Outcome framing effects were found between the S6000 and the L6000 groups and between the S600 and the L600 groups.

2. With small group sizes of 6 and 60, the outcome framing effect was absent: framing the outcomes as saving lives or losing lives had no effect.

No significant difference in choice frequencies was found between S60 and L60 or between S6 and L6 subject groups. The outcome framing effect disappeared when the contextual size of the life-death problem was reduced to 60 or 6.

3. Similar choice patterns were found within a large group domain (600–6000) as well as within a small group domain (6–60). However, choice preference patterns in large group contexts and those in small group contexts were significantly different.

Subjects shifted their preference from the deterministic outcome to the probabilistic outcome as the result of the reduced size of social groups. This was revealed in comparisons between the S6000 or S600 group and the S60 or S6 group. For example, whereas 60.0% of subjects in the S600 group preferred the deterministic outcome, the preference was reversed for the S6 group, in which only 36.0% chose the deterministic outcome ($\chi^2(1) = 6.12, p = .01$).

These results showed a clear social context-specific choice pattern con-
sistent within a social group domain but different between social group domains.

A group domain-specific account may also be of help to understanding some otherwise perplexing social phenomena. For example, in the closing part of their systematic review of decision-making studies, Slovic, Lichtenstein, and Fischhoff (1988) claimed a paradox which cannot be explained by existing utility theories. That is, people experience no more grief when hearing the news of a plane crash with 500 fatalities than of one with 300. From a group domain-specific viewpoint, it may not be a paradox if both the 300 and 500 group sizes are perceived as to belong to the same group domain, as suggested by the group context-specific choice patterns found in the current study.

**Hypothesis 2: Indifference point between risk-averse and risk-taking choice preferences as a function of the perceived group context**

The previous findings also suggest a more specific hypothesis that a boundary may exist between large group contexts and small group contexts.

In order to search for such a division between large and small contextual sizes, two additional subjects groups, S120 and L120, were examined. The contextual size of 120 was found to be within a neutral (indifference) zone between the large and small group context. With the group size of 120, subjects were indifferent to the outcome (deterministic or probabilistic) under both framing conditions. No framing effect was found between the S120 and the L120 subject groups, and the choice percentage of both groups was close to a 50–50 distribution. Under the saving-life framing condition, 47.7% of subjects chose the deterministic outcome and 52.3% of subjects chose the probabilistic outcome; and under the losing-life framing condition, 45.5% of subjects chose the deterministic outcome and 54.5% of subjects chose the probabilistic outcome.

The group size of 120 marked a change in subjects' choice behavior from a preference for the deterministic outcome in the S6000 and S600 groups to a preference for the probabilistic outcome in the S60 and S6 groups. At the group size of 120, subjects were indifferent to the outcomes: they are equally likely to choose the probabilistic or deterministic outcome.

Together, these data provide a systematically changing pattern of risk preference that requires to be explained by a theory of human choices. This emerged choice pattern is clearly inconsistent with normative utility theory and any modification which assumes either a uniformly concave (risk-averse) or a uniformly convex (risk-seeking) utility function.

The results are also difficult to interpret from a limited processing capacity perspective. It is unlikely that changes in the size of social groups or changes in the framing of the outcomes of the life–death problem could cause significant variations in cognitive capacity, effort, or the desire for accuracy.

Kahneman and Tversky explained framing effects based on a now well-
known descriptive model of human choices, prospect theory (Kahneman & Tversky 1979; Tversky & Kahneman, 1981, 1986). Under prospect theory, the framing effect is interpreted using the assumption that people code the possible outcomes as gains and losses rather than as final states. Kahneman and Tversky argue that alternative frames for a decision problem are analogous to the alternative perspectives on a visual scene. The preference reversal due to the framing of choice outcomes then are likened to perceptual illusions (Tversky & Kahneman, 1981).

Prospect theory does not fully account for the present findings because the theory is mainly concerned with information-processing domains rather than social domains. Similarly, Wagenaar et al. (1988) found that the scenario described in a cover story of a decision problem had profound effects on subjects’ risk preference. They also conclude that prospect theory of framing is incapable of providing adequate account for such context-dependent choices because all the cognitive operations proposed by the theory are performed on probabilities and outcomes rather than decision contexts.

The similar choice patterns that exist within one group context (either large or small), and the marked difference in choice preference between large and small group contexts, suggest a domain-specific reasoning mechanism designed to deal with distinct out-group or in-group social problems.

**Hypothesis 3: Content specification effects on choice preference**

An immediate question concerning these results is why more people preferred the probabilistic outcome when the life–death decision problem was presented in a small group context no matter how the choice outcomes were framed. More specifically asked, do the subjective values of choice options vary as a result of changes in the perceived group context?

From an evolutionary perspective, since the human species has been living in small face-to-face groups for most of its evolutionary history, such species experiences in small group living should have shaped the human choice mechanisms to be sensitive to social group context, since the adaptive consequences may be different when the decision involves the local (kith) group or a large number of strangers.

It follows that the life–death decision problem may become more ecologically valid, biologically meaningful, and emotionally valuable when contextual size is small. In a small group context, the deterministic outcome of losing one-third of group members may be emotionally unacceptable. Saving one-third of group is no longer a sure “gain” but a sure “loss”. This is also why the irrational outcome framing effect disappeared when the decision problem was presented in an ecologically more relevant small group context. The probabilistic outcome provides a “fair” chance (one-third of probability) for all the group members. As a result, more individuals may choose the probabilistic outcome in an attempt to save everyone in the group.
An alternative account of the observed group size specific choice phenomenon can be given under the notion of "diminishing sensitivity". A diminishing sensitivity would result in a utility function in which $\frac{200}{600}$ is greater than $\frac{2}{6}$. In other words, 6 is valued nearly three times as much as 2, whereas 600 is valued less than three times as much as 200. This diminishing sensitivity hypothesis predicts loss aversion for gains and risk seeking for losses in the case of larger numbers but not in the case of the smaller numbers. This hypothesis can explain the outcome framing effect found in a large group context as well as the absence of the outcome framing effect in a small group context. Following the same logic, the hypothesis would predict a linearly diminishing utility curve as the size of the hypothetical group increases. However, instead of a linear function, the present data showed a stepped function with no difference in preferences between either 6000 and 600 groups or 60 and 6 groups. Therefore, the diminishing sensitivity hypothesis fails to account for the finding that the risk preference patterns within a large group domain (600–6000) as well as within a small group domain (6–60) were indistinguishable.

Opposite to the prediction of the diminishing sensitivity hypothesis, the first hypothesis predicts that a life in a small group context would be valued higher than a life in a large group context. This key issue can be experimentally tested. In order to examine the real value functions underlying the group context-dependent choice preferences, an important social group domain, family group, was introduced into the life–death decision problem by specifying identities of the hypothetical patients described in the problem.

This change in the group context was designed to increase utility values of the life–death problem. If the risk-seeking choice pattern found in small group contexts are really due to the increase in life values involving the life–death problem, then a more risk-seeking pattern would be found when the problem is presented in a family context. Conversely, the diminishing sensitivity account would predict an opposite choice pattern. According to this account, the choice pattern in a family context would resemble the one found in a large group context because the utility of 2 family members out of 6 would be greater than 2 anonymous group members out of 6.

Two groups of subjects were used to test the above two rival hypotheses with 50 subjects (25 males and 25 females) in each experimental group. Both subject groups were given the life–death decision problem presented in a family context with 6 hypothetical patients being described as the close relatives of the subjects. Subjects in one group (S$6_r$ group) received the life–death problem framed in terms of saving life whereas subjects in the other group (L$6_r$ group) received the life–death problem framed in terms of losing life.

The results of the experiment were supportive of the prediction of the favored hypothesis. Regardless of how the outcomes were verbally framed, the majority of subjects in both S$6_r$ and L$6_r$ groups (72% and 94%,
respectively) preferred the probabilistic outcome. The preference for the probabilistic outcome was significantly stronger under the losing-life framing than that under saving life condition ($\chi^2(1)=9.38$, $p=.002$). Negative framing augmented the intrinsically negative nature of the life-death problem presented in a family context. However, no irrational preference reversal due to the framing of the outcomes was found. Under both positive and negative framing conditions a clear majority of the subjects favored the probabilistic outcome. Decision rationality appears to be kinship specific. When the loss of lives involved relatives, people became more probabilistic.

In conjunction with the previous results, choice preference data obtained in these experiments showed that the outcome framing effect appeared in large group contexts, but disappeared in small group and family contexts. The choice patterns in the three different social group contexts are behaviorally distinguishable, suggesting a context domain-specific rationality in human choices concerned with large-group, small-group, and family social domains, respectively.

PART 2: A CROSS-CULTURAL STUDY OF CHOICE PREFERENCE

4. Experimental hypotheses and predictions

In order to test the robustness and generality of the observed group context-sensitive choice phenomenon, a cross-cultural study was conducted. A common question arising from any behavioral study is whether the observed behavioral pattern has a cross-cultural validity. If so, how it is manifested in another culture? But, if a behavioral pattern found in a laboratory situation is an artificial phenomenon, that has little or no meaning outside the particular experimental conditions, it is unlikely that such a behavioral phenomenon could be replicated in another culture.

5. Materials

Ten versions of the life-death decision problem was used in experiments reported in Part 1 were translated into Chinese (see Appendix A). The contextual sizes of the hypothetical patient groups used in the different versions of the life-death problem were 6000, 600, 60, and 6, and the problem was presented with either saving-life or losing-life framing. The first eight versions of the decision problem involved strangers in either large group context (the contextual size 6000, or 600) or small group context (the contextual size 60 or 6). For the remaining two versions, one with a saving-life framing and the other with a losing-life framing, the life-death problem was presented in a family context in which six hypothetical patients
were described as close relatives of the subjects. Each version of the life–death problem had the same formal probability structure. That is, for all versions, the probability of survival was always equal to one-third on average: the deterministic choice option led to a sure survival of one-third of the patient group and the probabilistic choice option led to a survival of the whole group with a one-third probability.

As a between-subject design, each subject responded to only one version of the life–death problem. The experimental manipulations were hidden in the sense that subjects were not aware of the experimental manipulations.

The notations for each version of the life–death decision problem used in this study are shown as follows:

- $S6000$: saving life in a group of 6000 anonymous patients
- $L6000$: losing life in a group of 6000 anonymous patients
- $S600$: saving life in a group of 600 anonymous patients
- $L600$: losing life in a group of 600 anonymous patients
- $S60$: saving life in a group of 60 anonymous patients
- $L60$: losing life in a group of 60 anonymous patients
- $S6$: saving life in a group of 6 anonymous patients
- $L6$: losing life in a group of 6 anonymous patients
- $S6r$: saving life in a group of 6 patients described as subjects' relatives
- $L6r$: losing life in a group of 6 patients described as subjects' relatives

6. Subjects and procedure

A total 400 Chinese people took part in this experiment. They were volunteers from universities, research institutes, factories, companies, and government departments in the Beijing area of mainland China. The average age of the subjects was 27.7. Each subject group consisted of 40 subjects (20 males and 20 females). The experiment was run in a group setting with about 10–20 volunteers in each session. Subjects were randomly assigned to one of the 10 experimental groups, corresponding to the different versions of the life–death problem, and made their choices anonymously.

7. Results and discussion

The choice percentage and frequency data obtained from each group are shown in Table 1. The general choice pattern emerged from this study is similar to that found in the US samples, with one exception that no outcome framing effect was found between the $S600$ and $L600$ groups.

A multiple comparison across the 10 groups revealed a significant difference in subjects' choices over the experimental groups, $\chi^2(7) = 17.46,$
Table 1
Choice percentages and frequencies for subject groups in the Chinese study

<table>
<thead>
<tr>
<th>Group</th>
<th>Deterministic Outcome</th>
<th>Probabilistic Outcome</th>
<th>Total (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentage</td>
<td>Frequency</td>
<td>Percentage</td>
</tr>
<tr>
<td>$6000</td>
<td>50.0</td>
<td>20</td>
<td>50.0</td>
</tr>
<tr>
<td>L600</td>
<td>20.0</td>
<td>8</td>
<td>80.0</td>
</tr>
<tr>
<td>$600</td>
<td>37.5</td>
<td>15</td>
<td>62.5</td>
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<tr>
<td>L600</td>
<td>40.0</td>
<td>16</td>
<td>60.0</td>
</tr>
<tr>
<td>$60</td>
<td>37.5</td>
<td>15</td>
<td>62.5</td>
</tr>
<tr>
<td>L60</td>
<td>32.5</td>
<td>13</td>
<td>67.5</td>
</tr>
<tr>
<td>$6</td>
<td>37.5</td>
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<td>$6r</td>
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<td>62.5</td>
</tr>
<tr>
<td>L6r</td>
<td>17.5</td>
<td>7</td>
<td>82.5</td>
</tr>
</tbody>
</table>

Note: S = saving-life framing; L = losing-life framing; 6000, 600, 120, 60, and 6 = the sizes of the patient group in the life-death decision problem, 6r = size of the patient group in which the patients were described as subjects' relatives.

$p = .015$. No significant gender difference was found. This general analysis suggests that subjects' choice preferences varied with the group context manipulation.

A series of comparisons between subject groups receiving identical decision problems but with different verbal framings was performed. The results revealed that the outcome framing effect appeared in a group context-dependent manner. Although no framing effect was found between the $S600$ and the $L600$ subject groups, an outcome framing effect appeared when the hypothetical group size was increased to 6000, $\chi^2(1) = 8.78$, $p = .003$. Similar to what was found in the US samples, there was no framing effect when the decision problem was presented in small group contexts (i.e., between the $S60$ and the $L60$, and between the $S6$ and the $L6$ subject groups). Also similar to the results from the US samples, subjects became more risk taking when the decision problem was presented in a family context regardless of the framing of the choice outcomes. Under losing-life framing condition such preference was even more significant: the probabilistic choice frequency was significantly higher in the $L6r$ subject group than that in the $S6r$ group, $\chi^2(1) = 4.22$, $p = .04$.

In summary, the only major difference in choice preference between the US data and the Chinese data is the absence of the outcome framing effect, in Chinese subjects, at the contextual size of 600. Both overall and separate comparisons between the Chinese subject groups and their corresponding US groups (from the choice data reported in Part 1) showed no significant choice differences except for a single case: the chi-square analysis between
the two S600 groups showed a significant difference, \( \chi^2(1) = 4.75, p = .03 \). This difference suggests an upward shift in the boundary point between the perceived large group context and small group context along the group size dimension in Chinese subjects. If the contextual sizes 6000 and 6 are used to represent large group and small group respectively, the choice patterns of US subjects and Chinese subjects are quite similar. This comparison of choice preference between the US and Chinese subjects across the three social context domains (large group, small group, and family group contexts) is shown in Fig. 2.

It is also interesting to note that if the cross-cultural comparison was limited on the data obtained only from the S600 and L600 subject groups, the results would be misleading. Such results could be reliable, but the conclusion would be invalid.

The present results suggest that the subjective scope of a small group might be larger for Chinese subjects. Considering the demographic characteristic of the Chinese population, including a large overall population, extended family size, enduring social interactions within a local society over generations, and low mobility of social groups, the present findings indicate that the conceptual scope of small versus large group has been adjusted to the specific statistical features inherent in the social structures of Chinese society. Given the above demographics, the observed difference in choice behavior between US samples and Chinese samples may reflect a broader intuitive definition of kith group in the Chinese culture.

Because the size of a social group may vary over generations in hostile environments, it is conceivably dangerous for humans to evolve a fixed conceptual size for a group instead of a relative concept of large or small group. Therefore, it would be adaptive to have an ontogenetic mechanism that can construct a conceptual domain (a range) for the size of a "kith-and-kin" group contingent upon a specific living environment. Although the conceptual size of a group may vary from society to society and from culture to culture, the contexts of large group, small group and family group would still be perceived by individuals as important social domains.

The empirical evidence gleaned from both the US and Chinese samples has revealed a context-domain specific choice pattern that violates normative rationality principles of human decision making. The contextual size and content effects found in these experiments suggest that small group living was a major factor in shaping human decision rationality. Decision rationality appears to be adapted to the enduring ecological features of social environments. An important question then is: what is the adaptive significance of the observed group-context sensitive risk choices?

7.1. An evolutionary analysis of group-context sensitive risk preference

The results found in both the US study and the Chinese study suggest that people’s risk-proneness increases as the perceived losses become psychologically more severe. These results are consistent with a general choice
Fig. 2. Risk preferences as a function of the group context of the life–death decision problem from US samples from the experiments reported in Part 1 (top) and Chinese samples (bottom). The meaning of each label is as follows: S6000 or L6000 = saving life or losing life in a large group context involving 6000 anonymous patients; S600 or L600 = saving life or losing life in a large group context involving 600 anonymous patients; S60 or L60 = saving life or losing life in a small group context involving 60 anonymous patients; S6 or L6 = saving life or losing life in a small group context involving 6 anonymous patients; S6r or L6r = saving life or losing life in a family group context involving 6 patients described as subjects' relatives.
pattern: people are more likely to be risk-averse when choosing among alternatives with positive outcomes, and to be risk-taking when choosing among alternatives with negative outcomes (see, for example, Eraker & Sox, 1981; Fishburn & Kochenberger, 1979; Galanter & Pliner, 1974; Kahneman & Tversky, 1979; Payne, Laugh unn, & Crum, 1980; Kahneman & Tversky, 1979; Tversky & Kahneman, 1986). It is commonly believed that no normative theory of rational choice could predict such gain-loss-sensitive risk preferences. However, normative mathematical models in the evolutionary ecology literature do predict these choices (e.g., Stephens & Krebs, 1986, Real & Caraco, 1986).

In recent years, studies of foraging have enriched our understanding of ecological and biological attributes of decision-making strategies. Decision makers confront problems conceptually similar to those facing foraging animals. Most theories of risk-sensitive foraging address the interaction between the mean and variance of some important environmental variables, such as the food consumed or the time spent acquiring energy (e.g., Caraco, 1981; Houston, Kacelnik, & McNamara, 1982; Real, 1991; Real & Caraco, 1986). The central idea embodied in these foraging models is that foraging choice preference is contingent on the biological conditions facing a forager. For example, if total energy intake follows a normal distribution, the probability of starvation depends on the combined effects of both mean and variance.

Imagine, for example, the minimum daily intake for a bird is $M$. In deciding where to forage, the bird must choose between two patches: the mean expected daily intake ($X$) on both patches is equal, but their variances differ. The variance ($V_1$) in patch one is high whereas the variance ($V_2$) for patch two is low. If the mean value $X$ is below the minimum requirement $M$, the rational decision is to forage on the high variance patch. As a result of this choice, the bird will have a better chance of survival. The chance of $(X + V_1 > M)$ is higher than the chance of $(X + V_2 > M)$ because $V_1$ is greater than $V_2$. In contrast, if the mean intake $X$ is greater than $M$, the bird is better off foraging on the low variance patch, as this decreases the chance of death. That is, for gains above the minimum requirement, the choices should be risk-averse; but to avoid potentially disastrous losses, the choices should be risk seeking.

A body of recent empirical findings on foraging choices with various animals is consistent with the above theoretical analysis. The basic paradigm of these animal studies is similar to the life-death problem of the present study and therefore provides an interesting comparison. In these animal studies, risk sensitivity and associated choice strategies are tested by observing the animals' choice preference between two food resources (e.g., Caraco, 1981, 1982, 1983, Caraco & Brown, 1986). For example, Caraco, Martindale, and Whittam's (1980) study with yellow-eyed juncos found that the juncos preferred a constant reward when their energy budget was positive but preferred a variable reward with an equal mean value when their energy budget was negative.
The findings from the studies on risk-sensitive foraging closely parallel the results of human choice behavior. Risk sensitivity appears to be a selected property of choice mechanisms that take account of both means and variances associated with choice outcomes.

In this light, the observed risk-seeking attitude in small group and family contexts is consistent with an evolutionary strategy (Wilson & Sober, 1989) where members of a species start to function as a group rather than as a set of individuals, thereby improving the chance of individuals surviving in such cooperating groups. The smaller a social group is the more interdependent the group members are. Therefore, a sure survival of one-third group members might be tolerable for a large group but disastrous for a small group. Compared to a large group, it is more likely, for a highly interdependent small group, that the survival of one-third of its group members is below the minimum requirement for maintaining the function of the group in the future. When facing a potentially disastrous life-death decision problem in a small social group context, people then should be risk seeking.

PART 3: EFFECTS OF A SELECTION PROCEDURE AND THE SENSE OF FAIRNESS ON CHOICE PREFERENCE

8. Experimental hypotheses and predictions

In the previous experiments of the present study, it was revealed from post-experiment interviews that the most common reason given by subjects who chose the probabilistic outcome is that they wanted to give everybody an equal chance to survive; this suggests that considerations of fairness may be the major determinant directing the subjects' preference towards the probabilistic outcome.

The reason for many "irrational" behaviors may not be that people miscalculate, but that they are guided by their sense of fairness (Frank, 1988). In recent years, several studies have drawn attention to the role of fairness as an important influence on choice preference. Messick and Sentis (1979, 1983) have argued that considerations of fairness play an important role in interpersonal decision making. Choices made on the basis of fairness will be different from those that reflect preference without fairness considerations.

In a series of experiments, Kahneman, Knetsch, and Thaler (1986) examined the question of whether the consideration of fairness can help explain decision behaviors by firms and consumers that could not be easily explained by standard economic analyses based on utility theory. One experiment was designed to explore the motivation for making a fair offer. It was found that in allocating money to unknown people in an anonymous experimental condition, the majority of the subjects chose a fair solution
(the 50–50 split). Since the design of the experiment eliminated both fear of detection and any threat of retaliation, Kahneman et al. concluded that an intrinsic concern about fairness itself was the primary motive for these allocations. In a follow-up study, Kahneman et al. found that the majority (74%) of their subjects preferred to divide $10 evenly with a fair allocator rather than divide $12 with an unfair allocator. Most people, in other words, were willing to incur a cost of $1 in order to punish an unfair allocator and reward a fair allocator. These results suggest that fairness is not an abstract concept in social interactions, but a powerful factor that affects people's decisions.

In the following experiment, it is hypothesized that fairness may be one of the important psychological components underlying the observed group context-dependent choice patterns. Given the high reciprocity and interdependence among the members of a small social group (e.g., Knauft, 1991; Wilson & Sober, 1989), the sense of fairness may serve as an adaptive psychological factor regulating choice preferences in small group contexts. It follows that the intensity of the sense of fairness may be group context dependent. That is, the sense of fairness is stronger when a decision problem is presented in a small group context or in a family context, but weaker in a large anonymous group context. This differentiation in the sense of fairness then will lead to the group context-dependent choice preferences.

The central to the current fairness hypothesis is the idea that the sense of fairness stems from the face-to-face social interactions in small group living to deal with various interpersonal problems. When it is applied to a large anonymous group setting, its intensity may decrease as a result of the change in social context.

To manipulate the sense of fairness, two statistically identical deterministic outcomes were used in the life–death paradigm. One of the two deterministic outcomes involved a less fair procedure whereby one-third of hypothetical group members described in the life–death problem would be selected to be saved. The deterministic outcome with selected survivors, compared to the original one with equal number but non-selected survivors, was considered less fair for the hypothetical patients at risk.

According to the fairness hypothesis, it is predicted that more subjects will choose the deterministic outcome with non-selected survivors when the life–death problem is presented in a small group context than when the problem is presented in a large group context.

9. Materials

There were two versions of the life–death problem used in this experiment: one with a contextual size of 600, and one with a contextual size of 6. For both versions of the life–death problem, two deterministic outcomes were presented. One deterministic outcome led to a sure survival of one-
third of the group members. The other deterministic outcome resulted in a sure survival of a selected one-third of the group members. The hypothetical patients in both versions of the choice problem were anonymous. Since the main purpose of the present experiment was to examine if the manipulation of fairness would affect subjects' choice preference in a group context-dependent manner rather than to study framing effects, both versions of the choice problem were presented in terms of saving life only.

The questionnaires are reproduced in Appendix A.

10. Subjects and procedure

Eight New Mexico State University students, with an average age of 20.4 years, participated in the experiment. Each subject group consisted of 40 subjects (20 males and 20 females). The sampling and experimental procedures used in this experiment were identical to those used in the previous studies.

Subjects were asked to make their choice between the deterministic outcome with selected survivors and the deterministic outcome with non-selected survivors described in either a large group context (contextual size = 600) or a small group context (contextual size = 6). The subject group receiving the problem described in the large group context was denoted Size600 group whereas the subject group receiving the problem described in the small group context was denoted Size6 group.

11. Results and discussion

As predicted, more subjects chose the deterministic outcome with non-selected survivors in both group contexts (60% of subjects in the Size600 group and 80% of subjects in the Size6 group).

Of greater interest, a significant effect of contextual size was found; a chi-square analysis showed a reliable difference in choice preference between the Size600 subject group and the Size6 subject group, $\chi^2(1) = 4.00$, $p = .05$ (see Fig. 3). No gender effect was found.

A separate chi-square analysis was also performed on the choice frequency data within each subject group. The results showed that the observed choice frequency in the Size600 group was not significantly different from the expected frequency of indifference (50%), but a significant difference between the observed frequency and indifference was found for the Size6 group, $\chi^2(1) = 8.78$, $p = .003$. This result indicated that the effects of the fairness manipulation were much more significant when the choice problem was presented in a small group context.

Concerns about fairness appears to be a driving force behind group context-sensitive choice behavior. The choice patterns observed in the
Choice of the plan with non-selected survivors

Choice of the plan with selected survivors

Fig. 3. Effect of fairness manipulation on the subjects' choice preference.

Previous experiments are also consistent with the fairness hypothesis. Compared to the deterministic outcome, the probabilistic outcome should be viewed as a fairer solution since it gives all group members in the life–death problem an equal chance of survival. The fairest way for the hypothetical patients to be treated is to leave the selection to nature: an option which is reflected by the probabilistic choice. Moreover, the probabilistic choice pattern was more significant when the problem was presented in a small group or a family context.

Alternatively to the fairness hypothesis, another possible account of the risk-seeking preferences observed in the small group and family contexts involves the notion of conflict avoidance. It is conceivable, in a hypothetical family context, that subjects might imagine that they were choosing which member of the family was to be condemned to die. To avoid such a conflict, the subjects would prefer the probabilistic outcome over the deterministic outcome. Similarly, they would choose the deterministic outcome with non-selected survivors over the one with a selection procedure. This conflict avoidance account is also consistent with Bell's (1982) argument that the anticipation of regret will influence decisions. According to him, when a
choice option is followed by an adverse event regret may be especially intense if an alternative option is available that might have avoided the undesired outcome. To avoid a conflict and to pursue the fair solution are distinct motives. However, to examine the relative validity of these two accounts, the current data do not suffice. Further studies are needed to identify the motivational factors underlying the group context-dependent choices.

PART 4: VIOLATIONS OF THE DOMINANCE AXIOM IN LARGE GROUP, SMALL GROUP AND FAMILY CONTEXTS

12. Experimental hypotheses and predictions

Among a small number of rational axioms of utility theory, the dominance principle is considered to be one of the most compelling principles of normative decision making. The dominance principle, sometimes called monotonicity, can be stated as follows: if one choice option is better than another in one aspect of its outcome and at least as good in all other aspects of the outcome, then the dominant option should be chosen. A stochastic version of the axiom, called stochastic dominance, states that A is preferred to B if the cumulative distribution of the payoffs produced by A is to the right of the cumulative distribution for B. The dominance axiom is both simple and compelling for the rational analysis of choice behaviors; it serves as the cornerstone of the normative theory of choice.

According to Tversky and Kahneman (1986), the axiomatic analysis of the foundations of expected utility theory reveals four substantive assumptions (axioms): cancellation, transitivity, dominance and invariance. The four assumptions can be ordered by their normative appeal. Invariance and dominance are essential, transitivity could be questioned, and cancellation has been rejected by many researchers. Most of normative utility models assume transitivity, dominance and invariance. Others relax the model by taking out transitivity but retain invariance and dominance (for reviews, see Allais, 1979; Fishburn, 1989; Luce, 1992; Tversky & Kahneman, 1986; Wakker, 1989).

However, empirical evidence of violations of dominance principle have been provided by a number of studies (e.g., Birnbaum, 1992; Birnbaum, Coffey, Mellers, & Weiss, 1992; Kahneman & Tversky, 1979; Mellers, Weiss, & Birnbaum, 1992).

For example, let \((x, p, y)\) represent the binary gamble to receive \(x\) with probability \(p\); otherwise to receive \(y\). Dominance requires that \((x, p, y)\) is preferred to \((z, p, y)\) if and only if \(x\) is preferred to \(z\). However, Birnbaum et al. (1992) found that when \(p \leq .2\), \((0, p, 96)\) receives a higher ranking than \((24, p, 96)\), even though 24 is higher than 0.
Similarly, Tversky and Kahneman (1986) reported that when asked to choose between a sure gain of $240 and a probabilistic option with 25% chance to gain $1000 and 75% chance to gain nothing, the majority of their subjects chose the sure gain. However, the preferred deterministic outcome is actually dominated by the rejected probabilistic outcome.

Nevertheless, violations of dominance can be reduced by manipulating the way that gambles are presented. Keller (1985) has shown that a matrix-like graphic display significantly reduced the violation. Similarly, Mellers et al. (1992) found that when the key gambles were printed on the same page, there were fewer violations. These results are consistent with Tversky and Kahneman's (1986) idea concerning the transparency of dominance. According to them, when the relation of dominance is transparent, the dominated prospect gets rejected without further processing. However, if no dominated prospect is detected, the method of presentation begins to affect the choice. For example, a dominated option with two positive and one negative outcomes can be preferred to a dominant option with two negative and one positive outcomes when no dominance is detected (Tversky & Kahneman, 1986).

However, it is still not clear if deviations from the dominance principle are possible when the relation between options is transparent. An examination of whether the violation of dominance occurs even when the decision options are presented transparently appears to be not only critical for testing the validity of the dominance axiom of utility theory but also important for understanding the nature of behavioral violations or decision biases from normative rationality.

Based on the observed social group domain-specific choice preferences and the results from the fairness hypothesis testing, it might be possible to demonstrate a systematic violation of the stochastic dominance even when the questions are transparent.

To evaluate this possibility, stochastic dominance was tested by increasing the number of lives saved in the deterministic outcome of the life-death problem while keeping the one-third chance of survival unchanged in the probabilistic outcome. This manipulation makes the deterministic outcome a dominant option and the probabilistic outcome a dominated option. For instance, according to the stochastic dominance axiom, a probabilistic outcome with a one-third chance of saving 600 lives is dominated by a deterministic outcome of saving 400 lives. This stochastic dominance implies the following:

\[ .33u(600) < 1.0u(400) \]

Alternatively, this normative inequality can be expressed as

\[ .50u(400) < .50u(400) + .50(400) \]

However, this normatively defined dominance may not hold in a content- and context-free manner. In a small group or family context, the preference
to the probabilistic outcome may persist even when the deterministic outcome is transparently dominant. Whether or not a violation of the stochastic dominance occurs would depend upon the content and context of the decision problem. It is predicted that subjects' choice preference would agree with stochastic dominance axiom when the contextual size of a choice problem is large, but violate the axiom when the contextual size is small, particularly when genetic relatives are involved.

13. Materials

Four versions of the life-death choice problem were used in this experiment. Within each version, two alternative outcomes were presented in terms of saving life. The deterministic outcome led to a sure survival of two-thirds of the hypothetical patients (the dominant option) and the probabilistic outcome resulted in a survival of the entire patient group with a one-third probability. Each subject received one version of the choice problem. In the first three versions of the life-death problem, the problem was presented in a group context involving 600, 6, or 3 hypothetical patients, respectively. The subject groups receiving the first three versions of the life-death problem were denoted by $400/600$, $4/6$, and $2/3$ respectively. In the fourth version of the problem, 6 hypothetical patients were described as close relatives of the subject. The subject group receiving this version of the problem was denoted by $4/6r$.

Examples of the questionnaires are shown in Appendix A.

14. Subjects and procedure

A total of 160 students from New Mexico State University, with an average age of 23.2, participated in the current experiment. Each subject group consisted of 40 subjects (20 males and 20 females). The sampling and experimental procedures used in this experiment were identical to those used in the previous studies.

15. Results and discussion

The choice frequency and percentage data are presented in Table 2.

In contrast to a content- and context-free normative analysis which relies on stochastic dominance, a significant number of subjects favored the normatively dominated probabilistic outcome (saving one-third of group members on average) over the dominant deterministic outcome (saving two-thirds of group members certainly) when and only when the life-death
Table 2  
Choice percentages and frequencies for subject groups in the experiment in Part 4

<table>
<thead>
<tr>
<th>Group</th>
<th>Choice of deterministic outcome</th>
<th>Choice of probabilistic outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentage</td>
<td>Frequency</td>
</tr>
<tr>
<td>S400/600</td>
<td>90.0</td>
<td>36</td>
</tr>
<tr>
<td>S4/6</td>
<td>75.0</td>
<td>30</td>
</tr>
<tr>
<td>S2/3</td>
<td>67.5</td>
<td>27</td>
</tr>
<tr>
<td>S4/6r</td>
<td>45.0</td>
<td>18</td>
</tr>
</tbody>
</table>

Note: Numerators = the number of lives which can be saved by the dominant deterministic outcome; denominators = size of the hypothetical patient group in the life-death decision problem; r = hypothetical patients were described as subjects’ relatives.

Problem was presented in small group contexts; the strongest violation was found in a family context.

A multiple comparison across the four groups revealed a significant difference in subjects’ choices preference, $\chi^2(3) = 26.34$, $p < .0001$. No significant gender difference was found. This overall analysis reveals that the choice pattern for each subject group was significantly different from the choice patterns obtained from other subject groups.

In the large context, with 600 anonymous people involved, the subjects’ choice preference conformed to stochastic dominance; 90% of the subjects chose the dominant deterministic outcome. As the group context of the choice problem was reduced from 600 to 6, to 3, the choice percentage of the deterministic outcome declined from 90% to 75% to 67.5% respectively. The general choice pattern revealed an increase in the choice percentage of the dominated probabilistic outcome from the S400/600 to the S4/6 to the S2/3 to the S4/6r subject group. The subjects became more “irrational” when the social context of the life-death problem changed from a large anonymous group (600 members) to a small unspecified group (6 or 3 members) to a family group (6 relatives).

A pooled comparison also revealed a significant contextual size effect. The choice frequency of the probabilistic outcome in a large hypothetical group context (S400/600) differed significantly from the average choice frequency of the probabilistic outcome in a small group context (S4/6 + S2/3), $\chi^2(1) = 7.33$, $p = .007$. When the problem was presented in a family context, the choice of the probabilistic outcome went up to 55% – significantly higher than the average choice of the probabilistic outcome when presented in a small group context (S4/6 + S2/3), $\chi^2(1) = 7.89$, $p = .05$.

A chi-square analysis showed that choice frequency was not significantly different between the S400/600 subject group and the S4/6 subject group; $\chi^2(1) = 3.24$, $p = .07$, but was significantly different between the S400/600 group and the S2/3 group, $\chi^2(1) = 6.55$, $p = .01$. When the content of the choice problem involved genetic relatives, an even stronger violation of the
dominance axiom was found. The choice frequency of the probabilistic outcome in the S4/6r subject group was significantly higher than that of every other subject group. Comparisons between the S4/6r group and the other three groups (S400/600, S4/6, and S2/3) all showed significant differences in choice frequencies; $\chi^2(1) = 24.00$, $p < .0001$, $\chi^2(1) = 8.28$, $p = .04$, and $\chi^2(1) = 4.34$, $p = .04$, respectively. These results suggested that subjects' choice preferences were not a linear function of contextual size but they were, instead a function of contextual domains. If the structure of social environment is not linearly related to the number of individuals in a social group, then the mental functions of human beings, living in such a group, would not be expected to operate linearly with group size either.

These sizable choice differences are illustrated in Fig. 4.

The current results argue strongly against a social domain-general viewpoint of decision rationality. The degree of the violation of stochastic dominance varied as a function of the hypothetical social group contexts (i.e., large-group, small-group, and family-group contexts) of the choice problem. It appears that this violation of stochastic dominance is not a choice bias due to cognitive illusions but is a persistent and systematic choice phenomenon contingent upon the social context of a decision problem.

![Choice of Probabilistic Outcome (Dominated)](Choice of Deterministic Outcome (Dominant))

Fig. 4. Violations of stochastic dominance in choice preference as a function of the group context of the life-death decision problem. Numerators of labels = the number of lives which can be saved by the dominant deterministic outcome; denominators of labels = size of the hypothetical patient group in the life-death decision problem; r = hypothetical patients were described as subjects' relatives.
GENERAL DISCUSSION

Theories about human rationality and reasoning have played a central role in the social sciences. Explanations and predictions of people's choices in everyday life are also often founded on the assumption of human rationality. The definition of rationality has been much debated and the concept is overloaded with connotations. The normatively defined decision rationality derives from the use of the principles of the utility theory. It is assumed that a small set of rational principles governing utility maximization ensures that decisions are logically coherent and consistent. One significant implication of this notion is that the mechanisms that direct rational choice operate uniformly across all domains: they are not affected by content; they are not sensitive to context; and they have no specialized features for processing particular kinds of tasks.

However, over the years, this long-standing viewpoint has been strongly challenged on both theoretical and empirical grounds. Despite the differences in their theoretical viewpoints, many investigators have converged to the notion that human cognition consists of a rich array of domain-specific mechanisms.

Chomsky (1980) described the cognitive structure of knowledge representations as "mental organs". Under the assumption that intrinsic (psychological) structure is rich and diverse, Chomsky argued that "these mental structures serve as vehicles for the exercise of various capacities... It is argued that the mind is modular in character, with a diversity of cognitive structures, each with its specific properties and principles" (p. 1).

Shepard (1984) discussed the necessity of domain-specific brain mechanisms in terms of ecological constraints on human behavior. He argued that humans' exploration of their environment is not just random but is guided by internal schemes that allow individuals to anticipate and notice events. This ability to develop appropriate expectations may be vital when there is little information or little time available before an organism must act.

Wason and Johnson-Laird (1972), based upon their research findings, note that: "For some considerable time we cherished the illusion... that only the structural characteristics of the problem mattered. Only gradually did we realize first that there was no existing formal calculus which correctly modeled our subjects' inferences" (p. 244).

In the area of human choice and decision making, an increasing number of investigators has called research attention to the ecological validity of a task, and the content and context of decision problems. Hogarth (1981) claimed that in most decision-making studies the external validity has not been adequately demonstrated. He also drew attention to the adaptive nature of the judgmental processes in coping with a complex, changing environment.

Anderson (1990) argued that many cases of demonstrated human irrationality are only irrational normatively, not adaptively. Anderson's view of rationality holds that rationality is goal oriented, and human goals are
defined by environmental structures. Anderson (1990, 1991) recently proposed a functional account of rationality that emphasizes the demands of the environmental structure imposed onto human cognition. According to him, in order to achieve human goals, people do not need logical calculation. Logical calculations are only needed for theorists to make their predictions. This view takes environmental tasks as the driving force in shaping human rationality.

Cooper (1987) asserted that the notion of rationality as used, for instance, in the phrase "rational man" is species-specific for humans. A rational man is in the first instance a "biological man". Moreover, rational man and biological man are related concepts: the former is assumed to behave to maximize his expected utility; the latter is assumed to act to maximize his evolutionary fitness. Cooper (1987) further suggested that rational man is in some sense logically reducible to biological man. That is, individual decision making could be viewed biologically as a special form of evolutionary reasoning; and the rational principles that constrain decision behaviors are ultimately derivable from evolutionary laws.

Recently, Cosmides and Tooby (Cosmides, 1989; Cosmides & Tooby, 1992; Tooby & Cosmides, 1992) have proposed a domain-specific theory of social cognition within an evolutionary framework. According to them, human cognition consists of a large collection of functionally specialized, interrelated modules that collectively guide thought and behavior with respect to the evolutionarily recurrent and persistent problems posed by ecological and social environments. In their words, "different adaptive problems frequently have different optimal solutions, and can therefore be solved more efficiently by the application of different problem-solving procedures. When two adaptive problems have different optimal solutions, a single general solution will be inferior to two specialized solutions" (Cosmides & Tooby, 1992, p. 179). They further argue that a general-purpose mind is, in principle, an impossible outcome of the evolutionary process. In other words, it is not just that domain-specific mechanisms are better at solving adaptive problems; rather, the kind of mind that advocates of content-independent rationality envision is impossible.

Recently, discussing domain-specific reasoning, Gigerenzer and Hug (1992) raised a challenging research question: what would a theoretical framework that starts with content as a primary concept, rather than a modifier of logical reasoning, look like?

In line with the attempt to search for domain-specific mechanisms underlying human reasoning and decision making, a central claim of the present study holds that decision rationality should be defined by not only the formal probability and pay-off structure of a choice problem but also by content and context as primary concerns, rather than mere intervening factors.

In this light, the present study examined human choice strategies as the content and context variables of a life–death decision paradigm were systematically manipulated. As a result of these manipulations, a social
group domain-specific choice pattern emerged. This choice pattern served as a map for uncovering the reasons behind the violations of the rationality axioms of utility theory, and provided an empirical approach for examining the social context domain-specific mechanisms underlying decision biases. Briefly summarized:

1. Significant changes in choice preference were found as a result of the experimental manipulation along the group size dimension; the risk-seeking choice preference became more dominant when the size of a hypothetical social group decreased. Moreover, the content manipulation of the life-death problem resulted in a kinship-specific choice pattern. When the hypothetical patients of the life-death problem was described as subjects' close relatives, subjects became extremely risk seeking in favor of the probabilistic outcome. These results can not be easily explained by either normative utility theory or cognitive (heuristic) decision models.

2. The irrational preference reversal seen in the outcome framing effect (a violation of the invariance axiom of utility theory) was eliminated by providing ecologically more valid small group and family contexts. The risk preference data obtained from both American and Chinese samples demonstrated a behaviorally distinguishable large group, small group, and family group social context domain-specific choice pattern.

3. The results from the Chinese study also indicate that the subject scope of small group domain is larger for Chinese subjects, suggesting that human choice mechanisms are sensitive to the culturally specific features of group living. It appears that a universal sensitivity to group size may be modulated culturally.

4. Psychological factors, particularly those regulating the sense of fairness, appeared to be the major determinants of choice preference in a small or family (kith-and-kin) group context.

5. The accordance and violation of the stochastic dominance axiom of utility theory were predicted and tested. The observed violations of the dominance axiom varied as a function of social context domains presented in the life-death decision problem.

Together, these findings support a social domain-specific rationality viewpoint and have important implications for contemporary approaches to human reasoning and decision making. In the present study both the traditional example of irrational choice biases (framing effects) and predicted violations of stochastic dominance were examined in an interdisciplinary context where human choices were lined with socially and ecologically important variables, such as, kinship and the size of social groups. The results depict a kith-and-kin relationship-sensitive rationality resulting in different choice attitudes in different group contexts.

Wherever humans live, their cultural events and social activities occur in group contexts. Different group contexts should embody different adaptive significance. The contextual size of a social group appears to serve as an
important cue for activating specific cognitive and emotional mechanisms designed to deal with social domain-specific decision problems. Irrational choices may occur in performing a decision task in an evolutionarily novel and ecologically irrelevant context. Analogously, testing color vision at night will inevitably lead to errors in performance, simply because color vision is designed for daytime activities. In this case, any biases found in performance in such a functionally irrelevant context should not be viewed as errors; what is erroneous is the lack of consideration of the validity of the context in which the performance is tested.

A contingent relationship between social contexts and social decisions suggests a domain-specific decision rationality that can reflect the consistency between environmental regularity (recursive, domain-specific tasks imposed by ecological and social environments) and behavioral regularity (behavioral responses governed by specialized cognitive and emotional mechanisms).

The empirical findings of the present study also suggest that a search for reasons behind irrational decision biases be directed along adaptive dimensions. The focus of such an approach is not on unlimited possible cognitive mechanisms but possible cognitive adaptations tailored for solving specific adaptive problems. From this viewpoint, domain specificity of human reasoning and decision making involves not only computational domains in which decision-relevant information is processed but also social domains in which decision problems occur. The content and context of a decision problem may be powerful determinants of how the input information is to be processed.

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Appendix A

A.1. English translation of the versions of the life–death decision problem used in the Chinese study

A.1.1. The questionnaire used for the $6000 ($600, $60, or $6) subject group

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

Which of the two plans would you favor?

A.1.2. The questionnaire used for the L6000 (L600, L60, or L6) subject group
Imagine that 6000 (600, 60, or 6) 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, 4000 (400, 40, or 4) people will die.
If plan B is adopted, there is a one-third probability that none of them will die, and two-thirds probability that all 6000 (600, 60, 6) people will die.

Which of the two plans would you favor?

Note. Each item in parentheses represents the corresponding number used for a different subject group.

A.1.3. The questionnaire used for the S6r subject group
Imagine that 6 people in your family, including both of your parents, your brothers and your sisters, 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 of them will be saved.
If plan B is adopted, there is a one-third probability that all 6 of them will be saved, and two-thirds probability that none of them will be saved.

Which of the two plans would you favor?

A.1.4. The questionnaire used for the L6r subject group
Imagine that 6 people in your family, including both of your parents, your brothers and your sisters, 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 of them will die.
If plan B is adopted, there is a one-third probability that none of them will die, and two-thirds probability that all six of them will die.

Which of the two plans would you favor?

Note. A copy of the original Chinese version of the questionnaires can be obtained by asking the author.

A.2. Versions of the life-death decision problem used in the experiment in Part 3

A.2.1. The questionnaire used for the Size600 and Size6 subject groups

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

If plan A is adopted, 200 (2) people will be saved.
If plan B is adopted, 200 (2) people will be selected to be saved.

Which of the two plans would you favor?

Note. Each item in parentheses represents the corresponding number used for a different subject group.

A.3. Versions of the life-death decision problem used in the experiment in Part 4

A.3.1. The questionnaire used for the $400/600$ ($4/6$ or $2/3$) subject group

Imagine that 600 (6, or 3) 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, 400 (4 or 2) people will be saved.
If plan B is adopted, there is a one-third probability that all 600 (6 or 3) people will be saved, and two-thirds probability than none of them will be saved.

Which of the two plans would you favor?

A.3.2. The questionnaire used for the $S4/6r$ subject group

Imagine that 6 people in your family, including both of your parents, your brothers and your sisters, 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 people will be saved.
If plan B is adopted, there is a one-third probability that all 6 people will be saved, and two-thirds probability that none of them will be saved.

Which of the two plans would you favor?

Note. Each item in parentheses represents the corresponding number used for a different subject group.

References


Gigerenzer, G. (1994). Why the distinction between single-event probabilities and frequencies is important for psychology. In G. Wright & P. Ayton (Eds.), Subjective probability. Chichester: Wiley.


