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Unpredictable and competitive cues affect prosocial behaviors and judgments☆

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ABSTRACT

Why natural selection would favor thoughts or behaviors that benefit others at the cost of oneself (prosociality) in humans is an intriguing question. The present studies explored two kinds of cues representing overarching environmental factors that might affect prosociality: unpredictability, which represents the variability of extrinsic threats, and competition, which represents the relevance of others' performance to one's fitness. In three experiments, we also took into account the interaction between the two environmental factors and two moderators, namely resource availability and prosocial thinking types. In each experiment, participants were exposed to cues of unpredictability and/or competition before assessment of spontaneous prosocial behaviors (Studies 1 and 2) or prosocial judgments in dual-choice dilemmas (Study 3). Results showed that unpredictable cues generally led to lower prosocial behaviors and fewer prosocial judgments (Studies 2 & 3). In contrast, competitive cues led to lower prosocial behaviors among individuals with resource disadvantages (Study 1), and when combined with unpredictable cues (Study 2). However, competition also led to higher prosocial behaviors among individuals with resource advantages (Study 1) and more prosocial judgments in response to rational, utilitarian dilemmas (Study 3). Taken together, these results indicated that human prosociality is affected by environmental factors in predictable ways.

1. Introduction

Researchers have proposed various models accounting for the evolution of prosocial traits, which prompt individuals to help others at a cost to the self (e.g., Nesse, 2007; Nowak & Sigmund, 2005; Trivers, 1971). Importantly, none of the models support the viability of an unconditional "angel gene" that causes prosocial traits to manifest in all environmental conditions. In other words, the human mind is likely sensitized to environmental cues in different situations in order to adaptively adjust one's prosocial behaviors. Although some research has showed that individuals' social behaviors and judgments are influenced by situational cues (e.g., symbol of eyes; Haley & Fessler, 2005; Nettle et al., 2013; darkness; Schaller, Park, & Mueller, 2003), these situational factors are yet to be linked to more general environmental conditions that play a significant role in the evolution of human prosociality.

We propose two overarching environmental factors as candidates that might affect prosociality: whether individuals' fitness depends on uncontrollable aspects of the environment, and whether fitness depends on others' relative performance. The former is captured by the term "unpredictability" (e.g., Ellis, Figueredo, Brumbach, & Schlomer, 2009), which refers to the presence of extrinsic, uncontrollable threats to one's fitness. The latter might be referred to as "competition", which constitutes a major selection pressure that shapes human social psyche (Alexander, 1987; Nesse, 2007; Nowak & Sigmund, 1998). Competition, in particular, might be a double-edged sword: While competition for limited resources tends to undermine one's prosociality, competition for prosocial reputation might increase prosocial behaviors. Thus, the present studies constitute an explorative investigation into the effects of unpredictability and competition on different prosocial behaviors (Studies 1 and 2) and prosocial judgments (Study 3).

1.1. Prosociality in the face of unpredictability

While there might be myriad environmental dimensions affecting human prosociality, one key dimension pertains to unpredictability,

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namely levels and variations of extrinsic, uncontrollable threats in the environment (Chang & Lu, 2018). In unpredictable environments, individuals are more likely to prioritize their own fitness (i.e., reproductive success) over that of others, given that directly investing in one's own fitness is more reliable than expecting others to return one's favors in such environments. Thus, environmental unpredictability should negatively affect individuals' prosocial behaviors and judgments (i.e., behaviors and judgments that are consensually regarded as beneficial to others).

Indeed, research has shown that priming extrinsic threats (e.g., infectious diseases) exaggerated participants' xenophobic attitudes, such that they allocated less budget resources to aid foreign immigrants of a less familiar ethnic group (e.g., Faulkner, Schaller, Park, & Duncan, 2004). Sometimes, simply darkness might serve as a signal of unpredictability, activating negative stereotypes of outgroups among individuals who believe in a dangerous world (Schaller et al., 2003). Other studies have found that individuals who believed in a dangerous world or were primed with violent threats expressed less kindness to unfamiliar others (White et al., 2012). Additionally, research using experimental games showed that individuals are less likely to trust and cooperate with others in unpredictable situations. For instance, participants' contribution to common resources declined when the probability of benefiting from public goods became uncertain (Wit & Wilke, 1998). Similarly, participants tended to harvest more irresponsibly from a common resource pool as the variability of the size of harvestable resources increased (Rapoport, Budescu, Suleiman, & Weg, 1992). Overall, it seems that unpredictability generally undermines prosociality (whether in terms of prejudicial judgments or direct behaviors).

However, evidence also indicates that individuals' decisions in the face of unpredictability might be moderated by their resource advantages/disadvantages. For example, a series of experiments conducted by Griskevicius and colleagues showed that priming unpredictable future lowered delayed gratification and increased risk taking in financial decisions for participants with low childhood socioeconomic status (SES), but not those with high childhood SES (Griskevicius et al., 2013; Griskevicius, Tybur, Delton, & Robertson, 2011). Here, childhood SES might signal resource advantages/disadvantages, rather than absolute levels of resources, that calibrate individuals' behavioral proclivities in the future (e.g., high-SES individuals might act more prudently in the face of unpredictable threats in order to preserve their advantages). These behavioral proclivities might also be applied to the area of prosociality. For example, Piff, Stancato, Martinez, Kraus, and Keltner (2012) found that, in the face of unpredictability, high-SES individuals tended to be less generous in order to preserve their own resources. It appears that the prudency of resource-advantaged individuals might discourage them from acting prosocially in the face of unpredictability. In contrast, low-SES individuals were more community-oriented, and were more willing to engage in prosocial actions. Thus, although unpredictability might be detrimental to prosociality in general, it might not be so among individuals facing resource disadvantages.

1.2. Prosociality in the face of competition

Competition can be broadly defined as the covariance between one's fitness with one's relative performance compared with others (similar to "contest competition"; Birch, 1957). Unlike unpredictability, competition necessitates social interactions and comparisons, which are prevalent in primates and most prominently in human society. Although it is difficult to observe an individual's reproductive fitness being influenced by competition, research on social comparison effects has shown that economic behaviors and subjective well-being are often associated with the decisions or income of others (Ferrer-i-Carbonell, 2005; Hodgson, 1988).

Intuitively, competition is often contrasted with cooperation and associated with selfish motives (i.e., people care exclusively about their own self-interests in competition with others; Fehr & Schmidt, 1999). However, theories from a social selection perspective regard competition as a constructive force that has shaped human prosociality. As long as prosocial benefits meet certain conditions (Nowak & Sigmund, 2005), it is in everyone's interest to seek prosocial allies and punish selfish cheaters (Alexander, 1987). Indeed, researchers have shown that chimpanzees exhibited prosocial behaviors with potential allies in the competition for status (De Waal, 2007). Anthropological studies have also shown that the degree of market integration and community size (both are likely associated with competition at the societal level) correlated positively with fairness concerns and altruistic punishment in different experimental games, respectively, across diverse societies (Henrich et al., 2010).

When individuals' fitness depends on mutually beneficial cooperative relationships, individuals have to earn social partners' favors by being more kind and generous than others. This "competitive altruism" constitutes a social selection for increasingly prosocial traits in competitive environments (Nesse, 2007). In support of this, sometimes even an ambiguous cue of others' presence might enhance prosocial responses, indicating individuals' sensitivity to cues of social competition. For instance, research showed that participants were more generous toward partners in various experimental games when being "watched" by eye-like images (Haley & Fessler, 2005; Nettle et al., 2013). However, direct evidence for the effect of competition on prosociality remains largely absent.

Moreover, the constructive effect of competition on prosociality might be contingent on several other factors. First, as with unpredictability, resource availability might also moderate the effect of competition on prosociality. This is because resource availability might be easily converted to competitive advantages/disadvantages in human society. Since prosocial behaviors impose costs on prosocial actors, those with more resources or who are in a better competitive position can afford to be more generous in altruistic competition than those with less. Conversely, those facing resource shortages or competitive disadvantages might show lower degrees of prosociality in competitive situations (to save more resources for themselves). Consistent with this latter prediction, research using an experimentally induced competition pressure showed that poorer performers tended to cheat more in the competition (Schwieren & Weichselbaumer, 2010). Moreover, firms in relatively disadvantaged positions tend to hide more profits for tax evasion in more competitive market conditions (Cai, Liu, & Xiao, 2005). In sum, compared with individuals with resource disadvantages, those with resource advantages are more likely to benefit from competitive altruism and more likely to show prosociality in competitive situations.

Secondly, competition might be intertwined with unpredictability in real environments, leading to interactions of these two factors on prosociality. Unpredictability might weaken the altruistic competition mechanism that promotes prosocial behaviors via increased "errors" in prosocial reciprocal interactions (e.g., individuals might fail to reward others' prosociality because of a lack of information or a lack of resources) or through decreased reliability of one's "reputation score". Indeed, Panchanathan and Boyd (2003) showed in simulation studies that when errors were introduced, reciprocal prosocial responses based on a reputation scoring mechanism can be easily undermined by defectors.

A third potential moderator might be the type of prosocial concerns that individuals bring to bear on their behavior. Specifically, Greene and colleagues proposed a dual-process model of moral judgments, highlighting the conflict between affect-driven, intuitive moral concerns to uphold deontological principles (e.g., one should never harm others), and cognition-driven, rational moral concerns to maximize utilitarian values (i.e., the greatest good for the most people; Greene,

Sommerville, Nystrom, Darley, & Cohen, 2001; Paxton & Greene, 2010). This distinction can also be applied more generally to different prosocial concerns based on affective empathy or perspective taking (Davis, 1983). The former might be related more closely to the intuitive process, while the latter is related more closely to the rational process. Although both of them are deemed conducive to prosocial concerns (De Waal, 2008; Hoffman, 2000), they might function in different environmental conditions. Because competition indicates more frequent and more complex social interactions with others, it can be expected that rational prosocial judgments based on perspective-taking skills that seek to maximize the interests of all parties would be preferred. Thus, we expected competitive cues to be conducive to rational prosocial judgments, but not intuitive prosocial judgments.

Overall, relatively little is known about the effects of competition on prosociality. Contrary to the common understanding that competition is contradictory to prosocial cooperation, the mechanism of altruistic competition might turn it into a constructive force for prosociality. This, however, depends on several important moderators, such as resource advantages/disadvantages, situational unpredictability, and prosocial thinking styles.

1.3. The present studies

The present studies seek to integrate the literature on evolutionary psychological and the social psychological research on prosociality. Our central claim is that both non-social environmental forces (unpredictability) and social environmental forces (competition), together, shape prosocial behaviors and judgments in everyday settings. However, these two environmental forces might be moderated by other factors, such as individuals' resource advantages/disadvantages and type of prosocial thinking, and might also interact with one another. Specifically, we hypothesized that resource-disadvantaged individuals would be less prosocial in the face of competitive cues than in the face of unpredictable cues, whereas the opposite would be true for resource-advantaged individuals (H1). In addition, competition should promote prosociality in combination with predictable cues, but not with unpredictable cues (H2), and promote prosociality in rational judgments, but not in intuitive judgments (H3). Finally, we expected that unpredictability would generally lead to lower prosocial behaviors and judgments (H4). We conducted three experiments to test the aforementioned hypotheses, in which participants were exposed to experimental priming of unpredictability or competition (sentence cues as imagination-based prompts in Study 1 and cues embedded in scenarios in Studies 2 and 3). In Studies 1 and 2, we provided participants with opportunities to exhibit spontaneous prosocial behaviors (monetary donation in Study 1 and volunteering in Study 2) after the environmental priming. In Study 3, we examined participants' intuitive and rational prosocial judgments using different types of dual-choice dilemmas after they were exposed to environmental priming.

2. Study 1

Study 1 focused on the first hypothesis regarding the moderating effects of resource availability (using family income as the proxy) on the effects of environmental cues on prosociality. We assessed participants' spontaneous prosocial behaviors (monetary donation to a charity group) after they were primed with cues eliciting unpredictability (in terms of uncontrollable mortality threats) and competition (in terms of educational and occupational contests). We expected that lower-income participants with lower income would consider themselves disadvantaged and, thus, would donate less money in the face of competitive cues than in other conditions. In contrast, higher-income participants might consider themselves having more to lose in the face of unpredictability, thus would donate less money in the face of unpredictability cues than in other conditions.

2.1. Participants

Participants were 106 undergraduates[1] (77 females and 29 males, $M = 18.87$ years, age range: 18–22 years) recruited from two introductory psychology courses at Fudan University in Shanghai, China. They received 30 RMB (approximately $4.50 USD) for their participation. We used the same standard participation fee in the other three experiments. Four participants were excluded due to suspicion of experimental purpose in a final hypotheses probing.

2.2. Materials and procedure

Participants were randomly assigned to three conditions: unpredictability, competition, and control (*n*s = 35, 35, 32, respectively). Upon arrival at the laboratory, participants were seated in separate cubicles with a desktop computer and input their gender, age, and estimated average family income before conducting a series of tasks within the *E*-Prime 2.0 framework (Schneider, Eschman, & Zuccolotto, 2002). All participants provided informed consent before the start of the experiment (the same informed consent procedure was used for the other two studies, as well). Before the environmental priming task, participants input some demographic information, including gender, age, as well as estimated annual family income for the last five years (on average). All but one participant reported their income. This served as the proxy for resource availability.

2.2.1. Environmental priming task

An imagination task was used to prime environmental unpredictability and competition. In each condition, participants first read nine cue sentences (presented for 45 s each) imagining personally being in the situations described in this sentence. In the unpredictability condition, participants imagined facing unpredictable threats such as disease, unemployment, and social unrest (e.g., “You are unemployed without stable income, live in different places, and are often short of food.”). In the competition condition, participants imagined facing intense competition for career success or educational achievement (e.g., “Every student in your school is studying very hard in order to be successful in the society”). In the control condition, participants imagined facing daily events that cause mild anxiety (e.g., “You forgot where you parked your car in a large underground parking garage”), which might also be elicited by the experimental conditions. This allowed us to examine specific effects of unpredictability and competition beyond a common anxiety baseline in daily life. After separate presentations of the nine sentences, participants had the opportunity to “rehearse their imagination” with all cue sentences presented together. They were told that a memory test of these “imagination prompts” would occur later. See supplementary material for original priming materials and a brief report of a pilot study to validate the effectiveness of the priming.

2.2.2. Prosocial behavior (monetary donation)

After the environmental priming task, participants completed a 30-item social reasoning assessment unrelated to the current purpose of this research. Then, they were asked to reproduce some details of the imagination manipulation, for example: “what was your occupation in

[1] In all studies reported here, sample size was determined before any data analysis. The gender ratios of our samples were similar to the student gender composition of the universities. The sample size of the experiment was comparable to studies with similar design, such as Mittal and Griskevicius (2014). A sensitivity power analysis using the software program G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007) showed that the minimal effect size obtainable for a 3 × 2 ANOVA to test the key hypotheses in this study using the current sample size ($N = 106$) at the two-tailed significance level of $\alpha = 0.05$, with a statistical power of at least 0.80, was $f = 0.31$ (medium, according to conventional standards).

the imaginary situations?" This served to reinforce the effect of the previous imagination priming. After this bogus memory test, participants were told that the experiment has been completed and received the participation fee. The experimenter then offered the participants a non-compulsive opportunity to donate a portion of their participation fee to a fictitious charity organization. Each participant was given a donation form to fill out independently, on which he/she could specify the amount of money to be donated (donated money was returned to participants after debriefing).

2.3. Results

We first conducted two one-way ANOVAs with raw income score and monetary donation as dependent variables, respectively. The results indicated that participants in unpredictable, competitive, and control conditions did not differ in income (*M*s = 149,857, 116,882, 120,937 yuan, *SD*s = 249,259, 129,958, 162,219 yuan, respectively) or the amount of money donated to the fictitious charity (*M*s = 15.00, 15.14, 17.81 yuan, *SD*s = 11.18, 12.22, 7.51 yuan, respectively), *F*s = 0.74, 0.31, *p*s = 0.480, 0.732, respectively. However, these analyses do not take into account the possibility that resource availability might interact with environmental cues, such that higher- and lower-income participants might be influenced by environmental cues differently.

Due to the non-normal distribution of income ($M = 129{,}594$, $SD = 187{,}291$, skewness = 4.89, kurtosis = 30.50), we log-transformed the raw income score. The resulting pattern conformed more closely to normal distribution ($M = 4.87$, $SD = 0.47$, skewness = −0.16, kurtosis = −0.04) and is more suitable for linear regressions. Then, we regressed monetary donation on log-transformed income, as well as dummy variables representing unpredictable cues (1 = unpredictable cues, 0 = other cues) and competitive cues (1 = competitive cues, 0 = other cues). We then entered the interactions between log-transformed income and unpredictable or competitive cues in separate steps, to test the moderation effects of log-transformed income on different environmental cues. When entering only the interaction between unpredictable cues and log-transformed income along with the other predictors, the equation accounted for 10.8% of variance in monetary donation, $F(4, 96) = 2.90$, $p = .026$. Both the log-transformed income ($\beta = 0.37$, $p = .009$) and the interaction between unpredictable cues and log-transformed income ($\beta = -0.33$, $p = .004$) was significant. Simple slope analysis showed that unpredictable cues led to lower monetary donation than in other conditions among resource-advantaged participants (1 SD above the mean of log-transformed income; unstandardized simple slope = −14.35, $p = .005$), but not among resource-disadvantaged participants (1 SD below the mean of log-transformed income; unstandardized simple slope = −2.68, $p = .282$).

Entering the interaction between competitive cues and log-transformed income accounted for an additional 12.7% of variance in monetary donation, $\Delta F(1, 95) = 15.71$, $p < .001$. The only significant predictor was the interaction between competitive cues and log-transformed income ($\beta = 0.56$, $p < .001$). Simple slope analysis showed that among participants with resource disadvantages (at 1 SD below the mean of log-transformed income), competitive cues led to lower monetary donation than other environmental cues (unstandardized simple slope = −12.39, $p = .014$). Conversely, among participants with resource advantages (1 SD above the mean of log-transformed income), competitive cues led to higher monetary donation than other environmental cues (unstandardized simple slope = 7.31, $p = .045$).

2.4. Discussion

Consistent with our expectation (H1), resource availability seemed to moderate the effect of environmental cues on monetary donation. Higher-income participants donated more in the face of competitive cues, thus supporting the effect of competitive altruism (Barclay & Willer, 2007; Nesse, 2007). The opposite was true for lower-income participants, showing the detrimental effect of resource disadvantages in the face of competitive cues. Moreover, higher-income participants donated less in the face of unpredictable cues than in the face of other environmental cues. This is consistent with the finding of Piff et al. (2012), seemingly suggesting that individuals with higher resource-availability tend to deal with extrinsic threat by relying on their own resources, rather than by helping each other out. Although the main effects of environmental cues were not significant, simple slopes for the effect of unpredictable cues on monetary donation among both higher- and lower-income participants was negative (although not significant among lower-income participants). This indicates that in the face of unpredictability, resource availability might be negatively associated with prosocial behaviors, especially for those with resource advantages.

3. Study 2

While Study 1 corroborated our first hypothesis, it manipulated unpredictable and competitive cues separately, which did not allow an interaction between unpredictability and competition on prosocial behaviors. To explore this possibility, we integrated (high versus low) unpredictable and (high versus low) competitive cues in the same scenarios in the manipulation in Study 2, resulting in a two-by-two design of environmental manipulation. In addition, the donation task used in Study 1 did not support a generally detrimental effect of unpredictability (H4). However, it is possible that the monetary donation in such a small amount (about 1/4000 of the mean family annual income of our sample) is not significant enough to be affected by unpredictable cues. We used a different task (volunteering) to assess prosocial behaviors in Study 2, seeking to further test this assertion. Because devoting one's limited time to volunteering works should involve equally significant costs (in amount of time) for individuals with different resource availability, we do not expect a moderating effect of resource availability.

3.1. Participants

Participants were 124 undergraduate students[2] (108 females and 16 males, $M = 21.61$ years, age range: 18–29) attending psychological courses at East China Normal University in Shanghai. Two participants were excluded due to suspicions of the true purpose of experimental tasks in a probed debriefing.

3.2. Materials and procedure

Participants were randomly assigned to four conditions: high unpredictability + high competition (HUHC, $n = 34$), low unpredictability + high competition (LUHC, $n = 32$), high unpredictability + low competition (HULC, $n = 29$), and low unpredictability + low competition (LULC, $n = 29$). The experiment was administered on an individual basis, using questionnaires and a timer.

3.2.1. Manipulation of environmental conditions

Participants read four scenarios (about 200 Chinese words each) with different themes, and to imagine personally being in these situations (see Supplementary material for the full list of scenarios). These

[2] The sample size of each condition was comparable to that of Study 1. A sensitivity power analysis using G*Power 3.1 (Faul et al., 2007) showed that the minimal effect size obtainable for a 2 × 2 ANCOVA with two covariates using the current sample size ($N = 124$) at the two-tailed significance level of $\alpha = 0.05$, with a statistical power of at least 0.80, was $f = 0.25$ (medium, according to conventional standards).

scenarios varied across the four conditions in terms of information about unpredictability and competition. For example, in one scenario about a job application, the HUHC and HULC versions described the job as involving a lot of unpredictable risks, while the LUHC and LULC versions described the job as mostly safe. Meanwhile, the HUHC and LUHC versions emphasized the intense competition regarding the job application, while the HULC and LULC versions emphasized the lack of competition. Participants read each scenario for 2 min.

3.2.2. Situational unpredictability and competitiveness

After reading all four scenarios, the participants responded to two three-item scales assessing situational unpredictability (e.g, "The world is highly unpredictable.") and competitiveness (e.g., "In this world, success or not largely depends one's competitiveness"), respectively, using a six-point scale (1 = *strongly disagree*, 6 = *strongly agree*). These scales served as manipulation checks and were adapted from the uncertainty measure used by Mittal and Griskevicius (2014). The alpha coefficients were 0.64, 0.65, respectively.

3.2.3. Prosocial behaviors (volunteering)

Similar to Study 1, participants were asked to complete a 30-item measurement unrelated to the current purpose of the study and thereafter completed a bogus time-management task related to the scenarios (see supplementary material). This bogus task actually served to reinforce the effect of the environmental manipulation. At this point, participants were told that the experiment was over, and given a fictitious opportunity to sign up as a volunteer for charity activities. They indicated the number of days in a month to serve as volunteers (serving as the measure of prosocial behaviors) and any previous volunteering experiences. About half (61) of the participants had volunteering experiences (no differences between conditions). Finally, participants were debriefed.

3.3. Results

Descriptive statistics of manipulation-check measures and dependent variables are presented in Table 1.

3.3.1. Manipulation check

Two 2 (unpredictability: high, low) × 2 (competition: high, low) ANOVAs were conducted with situational unpredictability and competitiveness as the respective dependent variables. The main effect of unpredictability was significant for the score of situational unpredictability, $F(1, 120) = 29.56$, $p < .001$, $\eta_p^2 = 0.20$. Specifically, participants reported higher unpredictability in HUHC and HULC conditions than in LUHC and LULC conditions. The main effect of competition was significant for the score of situational competitiveness, $F(1, 120) = 28.11$, $p < .001$, $\eta_p^2 = 0.19$. Specifically, participants reported higher competitiveness in the HUHC and LUHC conditions than in the HULC and LULC conditions. We did not observe other main effects or an interaction between unpredictability and competition on either measure. Overall, these results showed that the manipulation induced unpredictability and competitiveness in the expected ways.

Table 1
Study 2: Means and standard deviations (in parentheses) for self-reported situational unpredictability and competitiveness, score of the Sentence Completion Task, and volunteering days for each condition.

Conditions	HUHC (n = 34)	LUHC (n = 34)	HULC (n = 29)	LULC (n = 30)
Situational unpredictability	4.34 (0.78)	4.10 (0.84)	4.48 (0.77)	3.30 (0.79)
Situational competitiveness	4.43 (0.54)	4.62 (0.66)	3.87 (0.54)	3.88 (0.88)
Sentence completion task	3.84 (0.30)	4.11 (0.20)	3.70 (0.43)	3.93 (0.29)
Volunteering days	1.63 (1.85)	4.18 (2.78)	2.14 (1.98)	2.86 (2.49)

Note. HUHC = high unpredictability and high competition condition, LUHC = low unpredictability and high competition condition, HULC = high unpredictability and low competition condition, and LULC = low unpredictability and low competition condition.

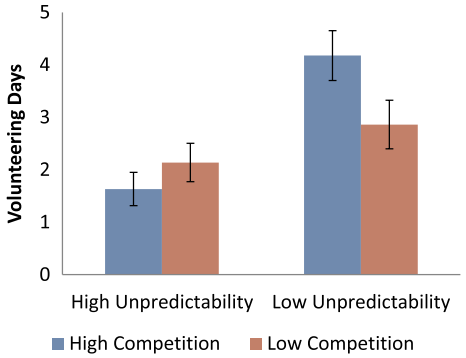

Fig. 1. Study 2: Mean number of days in a month devoted to volunteering in the high unpredictability and high competition (HUHC, n = 34), low unpredictability and high competition (LUHC, n = 34), high unpredictability and low competition (HULC, n = 29), and low unpredictability and low competition (LULC, n = 30) conditions.

3.3.2. Prosocial behaviors (volunteering)

A 2 (unpredictability: high, low) × 2 (competition: high, low) factorial ANOVA (Fig. 1) revealed a main effect of unpredictability, $F(1, 122) = 15.66$, $p < .001$, $\eta_p^2 = 0.11$, indicating fewer volunteering days in high unpredictability conditions than in low unpredictability conditions, but not a main effect of competition, $F(1, 122) = 0.96$, $p = .329$, $\eta_p^2 = 0.01$. Moreover, we found a unpredictability-by-competition interaction on volunteering, $F(1, 122) = 4.86$, $p = .029$, $\eta_p^2 = 0.04$. Specifically, there was a drastic contrast within high competition conditions, as participants in the LUHC condition (M = 4.18, SD = 2.78) contributed more than twice as much time to volunteering as those in the HUHC condition (M = 1.63, SD = 1.85), $t(66) = 4.45$, $p < .001$, $d = 1.10$, CI_{95} [1.40, 3.69]. Volunteering within low competition conditions (the HULC and LULC conditions: Ms = 2.14, 2.86, SDs = 1.98, 2.49) were not significantly different, $t(56) = 1.23$, $p = .225$, $d = 0.85$, CI_{95} [−0.46, 1.91].

3.4. Discussion

The results supported the general prediction that individuals would exhibit less prosocial behavior in the face of unpredictability (H4). Consistent with H2, competition undermined prosocial behaviors when unpredictability was high, but not when unpredictability was low. This, again, suggests a constraint on the mechanism of altruistic competition. In the face of extrinsic threats, it seemed more likely that the temptation to be selfish is greater than the rewards for prosociality.

4. Study 3

The previous two studies explored the effect of environmental cues on two common prosocial behaviors. However, we did not examine their underlying thinking processes and whether the prosocial judgments leading to generous or selfish behaviors were also affected by environmental cues. Consistent with Greene's dual-process model (Greene et al., 2001; Paxton & Greene, 2010), we distinguished between intuitive, deontological judgments and rational, utilitarian judgments. As different thinking processes leading to prosociality, we postulated that intuitive judgments should be associated with affective empathy, whereas rational judgments should be associated with cognitive perspective-taking skills. We expected participants to exhibit

fewer intuitive and rational prosocial judgments in the face of high unpredictability (in accordance with H4). We also expected an interaction between the type of prosocial judgments and competition, such that participants would make more rational prosocial judgments (but not more intuitive prosocial judgments) when facing competitive cues (in accordance with H3).

4.1. Participants

Participants were 213 university students[3] (155 females and 58 males, $M = 21.20$ years, age range: 18–34) attending introductory psychology courses at Fudan University and East China Normal University in Shanghai. Seven participants (3.29% of the original sample) with two or more missing/excluded responses were excluded from all analyses.[5]

4.2. Materials and procedure

Similar to Study 2, participants were randomly assigned to four between-subjects conditions: HUHC ($n = 50$), LUHC ($n = 59$), HULC ($n = 50$), and LULC ($n = 54$). Participants were seated in separate cubicles and completed all the tasks on a computer. They first completed a computerized version of the manipulation of environmental conditions used in Study 2. After the manipulation, they completed the measures of situational unpredictability ($\alpha = 0.67$) and competitiveness ($\alpha = 0.75$) used in Study 2.

4.2.1. Prosociality in moral judgments

Participants responded to three intuitive self-other (ISO) dilemmas and three rational self-other (RSO) dilemmas developed in a previously published study (Zhu, Hawk, & Chang, 2018). The full list of dilemmas is included in the supplementary material. They were presented in random sequence. The format of the task was similar to the forced-choice dilemmas used by Greene et al. (2001). However, instead of asking participants to choose between an intuitive, deontological solution and a rational, utilitarian solution, our dilemmas asked participants to choose between a pro-self-solution (maximizing the self-interests of the protagonist) and a prosocial solution (serving the interests of others at the expense of the protagonist). In the ISO dilemmas, the two solutions were matched in utilitarian outcomes, but the pro-self-solution violated deontological rules. Thus, they assessed prosocial judgments based on intuitive, deontological concerns. In the rational self-other (RSO) dilemmas, neither of the two solutions violated deontological rules, but the pro-self-solution promoted self-interests of the protagonist, whereas the prosocial solution maximized the utilitarian value for most people in the scenario. Thus, they assessed prosocial judgments based on rational, utilitarian concerns. The dilemmas were presented one at a time, with no time limit for response. Participants' choices and response latency were recorded using *E*-prime 2 programming software. Responses to each type of dilemmas were averaged to form an ISO score and a RSO score, respectively.

4.2.2. Additional measures

To confirm that the ISO and RSO dilemmas involve different prosocial thinking processes, we incorporated an manipulation check in which participants completed additional measures assessing empathic concern (related to intuitive prosocial judgments) and perspective taking (related to rational prosocial judgments), using the corresponding subscales of the interpersonal reactivity index (IRI; Davis, 1983). Because these are trait measures, we did not expect between-condition differences. The alpha coefficients for them were 0.84 and.78, respectively.

4.3. Results

Before data analysis, we excluded extremely short responses (shorter than 10 s, including reading time) to the dilemmas. Descriptive statistics for all variables are presented in Table 2.

4.3.1. Manipulation check

The manipulation of unpredictability and competition corresponded to our expectations. For situational unpredictability, participants in the high unpredictability conditions reported significantly higher unpredictability than participants in the low unpredictability conditions, $F(1, 202) = 49.63$, $p < .001$,$\eta_p^2 = 0.20$. For situational competitiveness, participants in the high competition conditions reported significantly higher competitiveness than participants in the low competition conditions, $F(1, 202) = 17.97$, $p < .001$, $\eta_p^2 = 0.08$. All other effects were not significant, $Fs < 1.5$, $ps > 0.10$.

Perspective taking and empathic concern were not influenced by unpredictability, competition, or their interaction, $Fs < 2$, $ps > 0.10$. However, examination of partial correlations showed that empathic concern correlated positively with the ISO score ($r_p = 0.19$, $p = .006$), but not the RSO score ($r_p = 0.08$, $p = .288$), with perspective taking being controlled. In contrast, perspective taking correlated positively with the RSO score ($r_p = 0.28$, $p < .001$), but not the ISO score ($r_p = 0.08$, $p = .247$), with empathic concern being controlled. This is compatible with our distinction between intuitive and rational prosocial judgments as based on different thinking processes.

4.3.2. Prosocial judgments

A 2 (dilemma type: ISO, RSO) × 2 (unpredictability: high, low) × 2 (competition: high, low) mixed ANOVA was conducted (Fig. 2). This revealed a main effect of unpredictability, $F(1, 202) = 14.39$, $p < .001$, $\eta_p^2 = 0.07$. Overall, participants in high unpredictability conditions ($M = 0.59$, $SD = 0.32$) made fewer prosocial judgments than participants in low unpredictability conditions ($M = 0.71$, $SD = 0.32$), supporting H4. Additionally, we found an interaction between dilemma type and competition, $F(1, 202) = 14.92$, $p < .001$, $\eta_p^2 = 0.07$. Specifically, there was a trend for participants in high competition conditions ($Ms = 0.48, 0.72$, $SDs = 0.35, 0.32$ for HUHC and LUHC conditions, respectively) to make fewer prosocial judgments in ISO dilemmas than participants in low competition conditions ($Ms = 0.66, 0.72$, $SDs = 0.32, 0.31$ for HULC and LULC conditions, respectively), $t(204) = -1.77$, $p = .077$, $d = -0.25$, CI_{95} [−0.18, 0.01], whereas participants in high competition conditions ($Ms = 0.65, 0.77$, $SDs = 0.32, 0.20$ for HUHC and LUHC conditions, respectively) made more prosocial judgments in RSO dilemmas than participants in low competition conditions ($Ms = 0.55, 0.63$, $SDs = 0.32, 0.33$ for HULC and LULC conditions, respectively), $t(204) = 3.00$, $p = .003$, $d = 0.42$, CI_{95} [0.04, 0.21]. No other main effects or interactions were significant, $Fs < 2$, $ps > 0.10$.

4.4. Discussion

Overall, these results supported our predictions. As in Study 2, unpredictability generally undermined prosocial judgments. Although there was no significant interaction between unpredictability and competition, there was a qualitative pattern in which the ISO score (but not the RSO score) was lower in the HUHC condition than the HULC condition, but higher in the LUHC condition than the LULC condition. In other words, competitive cues seemed more detrimental to intuitive

[3] The sample size of the experiment was determined based on the estimated effect size (based on Study 2), a statistical power of 0.80, and a two-tailed alpha value of 0.05 and were calculated using G*Power 3.1 software (Faul et al., 2007). A sensitivity power analysis using G*Power 3.1 (Faul et al., 2007) showed that the minimal effect size obtainable for a 2 × 2 ANCOVA with two covariates using the current sample size ($N = 213$) at the two-tailed significance level of $\alpha = 0.05$, with a statistical power of at least 0.80, was $f = 0.19$ (small, according to conventional standards).

Table 2
Study 3: Means and standard deviations (in parentheses) for self-reported situational unpredictability and competitiveness, empathic concern, perspective taking, and judgment scores in each condition.

Conditions	HUHC (n = 48)	LUHC (n = 59)	HULC (n = 47)	LULC (n = 52)
Situational unpredictability	4.24 (0.99)	3.36 (0.95)	4.16 (0.81)	3.24 (0.89)
Situational competitiveness	4.23 (0.87)	4.40 (1.00)	3.67 (0.89)	3.82 (1.05)
Empathic concern	4.65 (0.64)	4.60 (0.70)	4.64 (0.67)	4.51 (0.60)
Perspective taking	4.08 (0.73)	4.19 (0.62)	3.99 (0.66)	4.07 (0.58)
Intuitive Self-Other (ISO) score	0.48 (0.35)	0.72 (0.31)	0.66 (0.32)	0.72 (0.31)
Rational Self-Other (RSO) score	0.65 (0.32)	0.77 (0.20)	0.55 (0.32)	0.63 (0.33)

Note. HUHC = high unpredictability and high competition condition, LUHC = low unpredictability and high competition condition, HULC = high unpredictability and low competition condition, and LULC = low unpredictability and low competition condition.

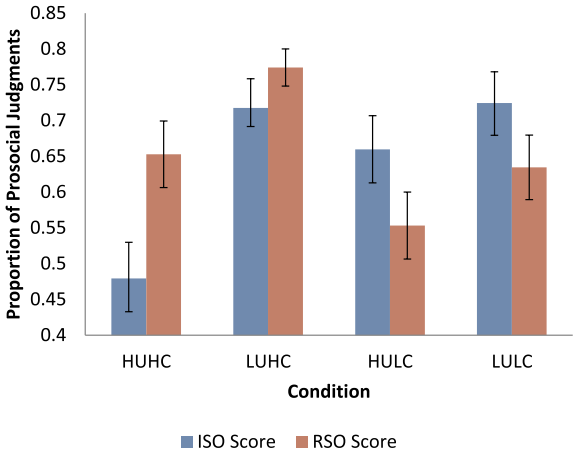

Fig. 2. Study 3: Mean proportions of prosocial judgments in intuitive self-other (ISO) and rational self-other (RSO) dilemmas in high unpredictability and high competition (HUHC, n = 48), low unpredictability and high competition (LUHC, n = 59), high unpredictability and low competition (HULC, n = 47), and low unpredictability and low competition (LULC, n = 52) conditions.

prosocial judgments when combined with unpredictable cues than when combined with predictable cues. Finally, given the interaction between competition and dilemma type, competition seemed to favor rational prosociality rather than intuitive prosociality. This might indicate a third constraint for altruistic competition: when facing the social pressure to show prosociality, individuals are more likely to act on their rational analyses of others' needs rather than on intuitive, empathic responses.

5. General discussion

Evolutionary research has long established that human prosociality is conditional (Axelrod, 1984; Nowak & Sigmund, 2005), but has rarely tested whether prosocial behaviors and judgments are influenced by overarching environmental factors, such as unpredictability (i.e., individuals' fitness influenced by uncontrollable environmental threats) and competition (i.e., individuals' fitness influenced by others' relative performance). Our studies explored the possibility that (1) cues of unpredictability and competition influence individuals' prosocial behaviors and judgments in predictable ways, (2) these two kinds of cues would interact with each other, and be moderated by individual differences (e.g., resource advantages/disadvantages). Using different designs and various measures of prosociality, we found partial support for our hypotheses. Specifically, resource-advantaged individuals were more prosocial in the face of competitive cues, whereas the opposite was true for resource-disadvantaged individuals. Competitive cues promoted rational prosocial judgments but undermined prosocial behaviors and intuitive prosocial judgments in the face of unpredictable cues. Except for in Study 1, results supported the hypothesis that unpredictability generally undermines prosociality. Overall, these results indicated that human prosociality responds to environmental conditions in predictable ways. Our research thus contributes to the literature on the mechanisms of prosociality (e.g., competitive altruism; Nesse, 2007) by specifying the moderators that might come into play when assessing prosocial behaviors and judgments in concrete contexts.

Although unpredictability and competition constitute important environmental factors that affect individuals' prosocial behaviors and judgments, there might be individual differences in the sensitivity to these pressures. For example, previous research showed that pre-classified egoists, compared with pre-classified altruists, were less sensitive toward the incentives in a competition for reputation (Simpson & Willer, 2008). Bereczkei and Czibor (2014) found that individuals high in Machiavellianism may be more sensitive to situations when participating in a social dilemma game. Rather than classifying individuals into egoists and altruists, or low and high Machiavellianists (such individual differences potentially confound with what we intend to assess), we focused on individual differences in resource availability, which relates more closely to the environment. Our finding that individuals with lower income donated less in the competition condition (Study 1) is consistent with other findings in the literature regarding the effects of competitive disadvantages (e.g., Cai et al., 2005; Schwieren & Weichselbaumer, 2010).

This does not mean that advantaged individuals are more prosocial than disadvantaged individuals, however. Since spontaneous donation behaviors impose costs on the self, they necessitate some prosocial courage (impulse) and risk-taking, just like other financial decisions. Thus, advantaged individuals in Study 1, just like high childhood-SES participants in the studies of Griskevicius et al. (2011, 2013), seemed to be more prudent in the face of unpredictability than disadvantaged individuals. As a result, our findings corroborated the existing findings of Griskevicius and colleagues in the area of prosocial financial decisions. Moreover, whereas Griskevicius and colleagues only focused on unpredictability, we contrasted unpredictability against competition, showing that different environmental conditions may have different (even opposite) effects on prosocial behaviors.

Studies 2 and 3 also explored the potential interaction between unpredictability and competition, and resulted in somewhat mixed findings. On the one hand, competitive cues were conducive to prosocial behaviors only in the presence of predictable cues (Study 2). On the other hand, competitive cues seemed conducive to rational prosocial judgments, regardless of the presence of predictable or unpredictable cues (Study 3). Both findings are tentative, given the exploratory nature of the current research, and need future replications. However, this should inspire future studies to examine interactions between different situational factors on prosocial behaviors, rather than a single factor.

Finally, Study 3 also connected the environmental effects on prosociality to the dual-process model proposed by Greene and colleagues (Greene et al., 2001; Paxton & Greene, 2010), highlighting the distinctive thinking processes contributing to prosocial behaviors that are often overlooked in evolutionary models of prosociality. Results in Study 3 showed that thinking process matters when individuals are exposed to competitive cues. Specifically, rational prosocial judgments (linked to cognitive perspective taking), but not intuitive prosocial judgments (linked to empathic concern) increased in the face of competitive cues (compared with the absence of competitive cues). Alexander (1987) argued that competition might be responsible for social intelligence or even general intelligence in the evolution of human mentality. The prolonged presence of competitive pressure in human society might select for rational thinking that prompts

individuals to take others' perspectives and show “calculated” prosociality for fame and reputation, which might explain the aforementioned results. Indeed, there is a literature on the positive effect of accountability on prosocial cooperation in social dilemmas (e.g., De Cremer & Barker, 2003; Wang et al., 2017) and the reputation concerns in experimental games (e.g., Barclay & Willer, 2007; Engelmann & Fischbacher, 2009; Sylwester & Roberts, 2013). All of these reputation concerns might depend on “theory of mind” abilities or perspective-taking skills (Nowak & Sigmund, 2005). Future research, however, can further examine if the accountability effects and reputation concerns exaggerate in the face of competitive cues or actual competition.

Admittedly, the present research still faced several methodological limitations. One challenge lies in the experimental manipulation of unpredictability and competition. The effects of imagining hypothetical situations are likely to be much weaker than real-life experiences. To facilitate personal engagement in the manipulations, we required participants to identify themselves with the protagonist in the priming materials. Additionally, our manipulation always presented participants with several cue sentences or scenarios to maximize the generalizability of the manipulation. Still, we cannot rule out the possibility that some participants might not fully engage with the manipulation materials in expected ways. To overcome these limitations, future studies can employ other techniques (e.g., virtual reality techniques) to enhance participants' engagement in the situational manipulations and control relevant personality aspects.

Another issue has to do with the generalizability of our findings. Although our tasks allow a relatively objective and context-based assessment of prosocial behaviors and judgments, we cannot rule out the possibility that individuals' prosocial behaviors and judgments in laboratories might differ from those in real life. In laboratories, prosocial behaviors usually involve costs of lesser significance, compared with those in real life. It might also be argued that, since our participants were exclusively university students living in a large city (although they may come from different regions of China, including underdeveloped, rural regions), the generalizability of our findings might be limited. Indeed, the interaction between income and environmental cues in Study 1 indicated that individual differences in family background might affect how individuals' prosociality manifests in different situations. However, these possibilities do not contradict our central assumption that human prosociality is adaptive for the environments in which it evolves and manifests.

A related issue is that females were over-represented in our samples. Previous research has shown that gender and gender roles are relevant for prosocial behaviors, but the overall differences between females and males in various prosocial behaviors are typically small (Eagly, 2009), and thus are unlikely to lead to biased findings. Moreover, the present studies were mainly concerned with the effects of environmental cues on prosocial behaviors, which is likely to be equivalent between genders. Indeed, in all three studies, the qualitative pattern of the findings held for both females and males.

To conclude, the key message of this research is that human prosociality is susceptible to the influences of situational unpredictability and competition. Thus, instead of treating prosociality as a stable personality trait that is insensitive to environments, it is advisable for parents, educators, and policy-makers to create environments that bring out different kinds of prosociality. As our results implied, a competitive and stable society might naturally foster prosocial judgments and behaviors supported by rational, utilitarian reasoning via a self-reinforcing circle of altruistic competition. However, we should avoid elevating competition in unpredictable situations (e.g., during political chaos or after a natural disaster) or within resource-disadvantaged communities, as this is likely to undermine prosociality.

AcknowledgementsData availability

The data associated with this research are available at [link].

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2018.10.006.

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