

# Living Slow and Being Moral

## Life History Predicts the Dual Process of Other-Centered Reasoning and Judgments

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**Abstract** Drawing from the dual process model of morality and life history theory, the present research examined the role of cognitive and emotional processes as bridges between basic environmental challenges (i.e., unpredictability and competition) and other-centered moral orientation (i.e., prioritizing the welfare of others). In two survey studies, cognitive and emotional processes represented by future-oriented planning and emotional attachment, respectively (Study 1,  $N=405$ ), or by perspective taking and empathic concern, respectively (Study 2,  $N=424$ ), positively predicted other-centeredness in prosocial moral reasoning (Study 1) and moral judgment dilemmas based on rationality or intuition (Study 2). Cognitive processes were more closely related to rational aspects of other-centeredness, whereas the emotional processes were more closely related to the intuitive aspects of other-centeredness (Study 2). Finally, the cognitive and emotional processes also mediated negative effects of unpredictability (i.e., negative life events and childhood financial insecurity), as well as positive effects of individual-level, contest competition (i.e., educational and occupational competition) on other-centeredness. Overall, these findings support the view that cognitive and emotional processes do not necessarily contradict each other. Rather, they might work in concert to promote other-centeredness in various circumstances and might be attributed to humans' developmental flexibility in the face of environmental challenges.

**Keywords** Altruism · Dual process model of morality · Empathy · Life history theory · Life history strategy · Morality · Prosociality · Social competition · Unpredictability

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The field of morality has long been divided by the dichotomy between a justice-oriented, “rationalist” approach that grounds individuals’ morality in rule-based cognitive operations (e.g., Gibbs 2003; Kohlberg 1984) and the “intuitionist” approach that grounds morality in empathy- and intuition-based responses (e.g., Eisenberg 1986; Haidt 2001). Different approaches utilize different research paradigms and focus on different facets of morality, thus leading to seemingly inevitable contradictions. In the present study, however, we regard the rational/cognitive and intuitive/emotional aspects of morality as two processes with the shared function of reducing self-centeredness (Gibbs 2003; Piaget 1965). This dual process is explicated from a life history (LH) perspective (Figueredo et al. 2006), which views the reduction of egoistic concerns and the increased concern for others’ needs and welfare (“other-centeredness”) as necessary to enhance future fitness in a competitive society, but also potentially less adaptive in unpredictable environments that threaten present fitness. The present study examines how environmental challenges such as morbidity-mortality, resource scarcity, and competition might explain variations in cognitive and emotional processes, which, in turn, contribute to other-centeredness in moral reasoning and judgments.

### **The Dual Process of Other-Centeredness**

Some researchers have proposed models that aim to account for both cognitive and emotional moral processes, albeit as countervailing forces with contradicting goals (Greene et al. 2001; Paxton and Greene 2010). According to the dual-process model, a cognitive process relies on consequential/utilitarian cost-benefit analyses and logical reasoning to promote the greater good for the greatest number. An emotional process, in contrast, prompts concerns for others’ welfare and rights through deontological moral rules that are backed by emotional responses (Nichols and Mallon 2006; Paxton and Greene 2010). Although it has been recognized that the two processes do not necessarily conflict with each other in real life (Paxton and Greene 2010), the moral dilemmas typically designed to examine the dual-process model preclude a test of this possibility by pitting the utilitarian solutions against the deontological ones.

At the same time, it is clear that both cognitive and emotional processes can prompt either other-centeredness or self-centeredness. Cognitive processes help one to surpass egoistic concerns and take others’ perspective in social interactions, which serves to facilitate cooperation and reduce conflicts (Krebs 2008). However, they can also be used to deliberately manipulate others for personal gain. Emotional processes help to boost sympathy for others’ distress and prompt altruistic support for those in need (Gibbs 2003; Hoffman 2000). However, they might also contribute to nepotism, bigotry, and xenophobia (e.g., Prinz 2011). In our view, then, the dual process of morality is not necessarily a model of countervailing forces but rather comprises two routes that can both lead to other-centeredness (or self-centeredness).

### **The Life History “Trade-Off” and Other-Centeredness**

Whether out of intuitive concern or rational consideration, helping others and thinking about others’ welfare (instead of one’s own) likely involve some immediate fitness costs. This might be the main reason for selfish behaviors and self-centered reasoning.

Despite these potential fitness costs, research has found examples of other-centeredness, or “benefiting others at a cost to oneself,” in both human infants and closely related species such as chimpanzees (e.g., Warneken et al. 2007). Moreover, theoretical models have been proposed to show that other-centeredness is evolutionarily viable in certain environmental conditions (e.g., Wolf et al. 1999). According to “social selection” models, other-centered behaviors are highly preferred in interpersonal interactions and are often rewarded with social resources (e.g., reputation, social support) that enhance the future fitness of the benefactors (Nesse 2007). Thus, one evolutionary account for morality might be that the present-fitness costs of other-centeredness can be offset by future-fitness rewards in many circumstances (Kurzban et al. 2015).

Such a trade-off between present and future fitness is not specific to the self-versus-other facet of morality. Rather, it is present in a number of physiological and psychological characteristics. According to life history (LH) theory, the covariation among these characteristics reflect human LH strategies, which exist on a continuum from “slow” (prioritizing future fitness) to “fast” (prioritizing present fitness; Del Giudice and Belsky 2011; Figueredo et al. 2006). More importantly, the challenges in the evolutionary and developmental environments can account for this trade-off between future and present (Ellis et al. 2009).

### **The Cognitive and Emotional Manifestations of Slow and Fast LH Strategies**

Human LH strategies are not necessarily inflexible genetic features or proclivities. Instead, they represent the evolved developmental flexibility of a number of psychological characteristics that contribute to morality in various environments (Chisholm 1999; Del Giudice and Belsky 2011). Specifically, both fast and slow LH strategies might manifest as cognitive and emotional processes that are either future-oriented and conducive to other-centeredness or present-oriented and conducive to self-centeredness; the relative strengths of these processes largely depend on the degree of unpredictability and competition experienced in the developmental environment (Chang and Lu 2018). In other words, the dual process of morality might be conceptualized as psychological aspects of LH strategies mediating the relationship between environmental challenges and other-centeredness.

Slow LH strategies, which are generally associated with other-centeredness, involve cognitive processes that suppress one’s egoistic drives and internalize others’ welfare, such as planning and perspective taking (Griskevicius et al. 2011; Wenner et al. 2013). Slow LH strategies also involve emotional processes that prompt individuals to care for others, such as emotional attachment and empathic concern (Chisholm 1999). Conversely, fast LH strategies, which are generally associated with self-centeredness, are likely to manifest as impulsivity and weaker cognitive control skills, on the one hand (Griskevicius et al. 2011; Wenner et al. 2013), and insecure emotional attachment and reduced sympathy, on the other hand (Chisholm 1999; Olderbak and Figueredo 2010). Indeed, empirical evidence has shown that both problem-focused coping (representing cognitive processes) and empathy (representing emotional processes) positively predicted prosocial behavior, whereas less-organized kinds of coping (e.g., avoidance) and emotional instability were found to positively predict physical aggression (Carlo et al. 2012).

The above discussion suggests that cognitive and emotional processes should predict other-centeredness in similar directions. However, cognitive and emotional processes serve different functions, which might lead them to be differentially correlated with different moral tasks. Specifically, cognitive processes mainly serve to justify deliberate decisions rather than to prompt immediate responses (Haidt 2001). Thus, cognitive processes should be positively related to other-centeredness in moral reasoning and moral judgments based on rational cost-benefit evaluations of utilitarian values. Indeed, researchers have found that individuals high in trait reflectiveness or who were exposed to deliberation-inducing manipulations preferred other-centered utilitarian choices in moral dilemmas (Bartels 2008; Paxton et al. 2012). However, cognitive processes might also predispose individuals to be overly cautious about potential losses of personal interests in emotionally charged situations (Griskevicius et al. 2011). This might weaken their correlation with intuition-based moral responses.

In contrast, emotional processes mainly serve to prompt immediate responses based on intuitive comparison of deontological values (Greene et al. 2001). However, when moral decisions or judgments necessitate deliberate considerations for indirect consequences, reliance on emotional processes might not always lead to other-centeredness (Prinz 2011). This might also weaken their correlation with rational moral responses. Overall, the cognitive and emotional aspects of human psyche can be seen as two mutually complementary processes leading to other-centeredness. However, cognitive processes should be more strongly associated with other-centered reasoning and judgments that are based on rationality than those based on intuition (H1). In contrast, emotional processes should be more strongly associated with other-centered reasoning and judgments based on intuition than those based on rationality (H2).

### **Environmental Challenges, LH Strategies and Other-Centeredness**

The cognitive and emotional processes can be better understood when taking into account chronic experiences of the specific environmental challenges that shape them. One aspect of environmental challenge that figure prominently in LH theory is unpredictability. In human society, morbidity-mortality (e.g., wars and violence) and resource scarcity (e.g., famine and economic recession) constitute unpredictable threats to one's present fitness. In such circumstances, it is more adaptive (in evolutionary terms) to prioritize one's own well-being over others' well-being. Indeed, experiences of violence might even "justify" delinquent and aggressive behaviors that, in evolutionary history, tend to increase one's own present fitness at the cost of others (Mishra and Lalumière 2008; Wilson and Daly 1985). Longitudinal studies also showed that chronic experiences of harsh and unpredictable childhood environments (e.g., accidents, frequent changes of caregivers, violence in the community, and financial insecurity) predicted not only higher sexuality in adolescence (Belsky et al. 2012) but also increased social deviance in adolescence and young adulthood (Brumbach et al. 2009; Chang and Lu 2018). Similarly, childhood resource scarcity was associated with poorer functioning in nearly every area of socioeconomic development (Bradley and Corwyn 2002) and was negatively associated with both cognitive and affective empathy (Jolliffe and Farrington 2006). Overall, this led to the hypothesis that unpredictability should be negatively linked to other-centeredness through cognitive and emotional processes (H3).

Another key aspect of environmental challenge implicated by the LH perspective is competition (MacArthur and Wilson 1967), including both within- and between-group competition, in which individuals who outperform others would attain higher future fitness. According to the original theorization of LH theory (e.g., MacArthur and Wilson 1967), density-dependent competition is conducive to a slow LH strategy. This can be interpreted as increased focus on future fitness in a stable, saturated environment. Thus, contrary to the commonsense view that competition tends to stimulate selfish motives, we extrapolate that competition would be positively linked to other-centered moral responses.

Importantly, the concept of competition as an independent environmental challenge should be distinguished from intraspecific violence that constitutes extrinsic risk and mortality (Ellis et al. 2009). Thus, our view of competition is more akin to the concept of “contest competition” (Birch 1957), which involves social interactions characteristic of human society (Alexander 1989). As human society becomes more competitive, future fitness is increasingly gained through accumulating social resources (favors, reputation, and social support) rather than through individual struggle. This necessitates increased sensitivity to others’ needs, perspective taking, and planning and organizational skills (Alexander 1989; Nesse 2007). Contemporary examples include educational and occupational competition, both of which rely on these cognitive and emotional skills in order to be useful to others (and to society), and both kinds of competition are critical for one’s future success in the society (Chang and Lu 2018).

In short, the tendency to benefit others as a way to promote one’s future fitness in competitive environments forms a “trade-off” with the tendency to protect one’s own present fitness from unpredictability. Additionally, such relationships should be mediated by cognitive and emotional processes. The extrapolation that unpredictability and competition are related to other-centeredness has received some empirical support: One study indicated that exposure to war, representing high levels of morbidity-mortality, might change attachment style from secure to insecure and also negatively predicts moral reasoning scores using Rest’s Defining Issues Test (Haskuka et al. 2008). In contrast, researchers have indicated that children living in a safe and stable family environment that buffers them from extrinsic unpredictability tend to have secure emotional attachment and stable social relationships in adulthood (emotional qualities), which are conducive to altruistic attitudes (Chisholm 1999) and authentic forms of prosocial decision-making (Shaver and Mikulincer 2012). Experiments have shown that participants become more other-centered (i.e., contributing more of their own resources) in competitive social dilemma games when their contribution can be recognized by others and rewarded by others’ favors in later interactions (Barclay and Willer 2007; Hardy and Van Vugt 2006).

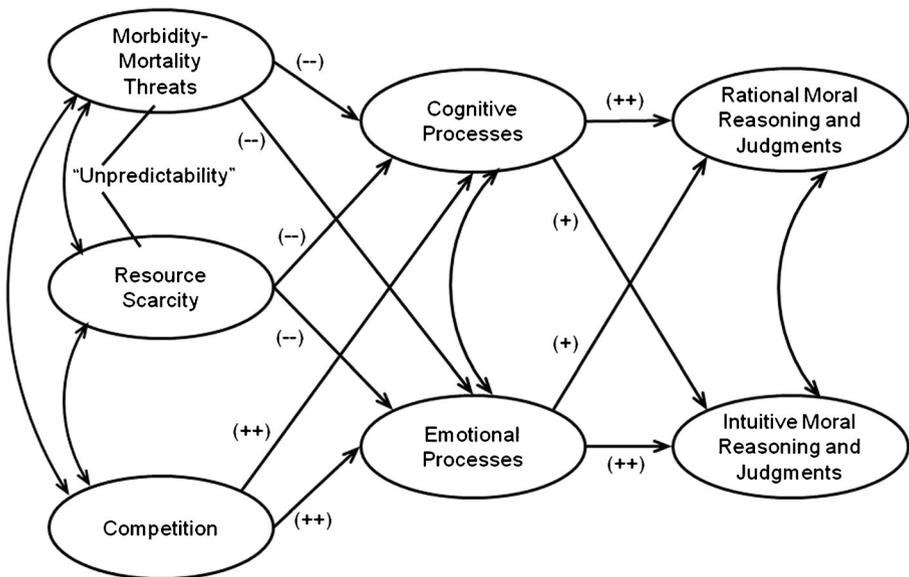
### Summary of the Present Study

The hypothesized relationships among environmental challenges, cognitive and emotional processes, and other-centeredness are summarized in Fig. 1. These hypotheses were tested in two studies. In both studies, we assessed the same three environmental challenges—namely, morbidity-mortality (represented by negative life events), resource scarcity (represented by childhood financial insecurity), and competition (represented by educational and occupational competition). In Study 1, we used self-

developed measures of cognitive and emotional processes (scales of future-oriented planning and emotional attachment, respectively). Other-centeredness was represented by need-based, stereotypic, and, especially, internalized types of justifications in prosocial moral reasoning (Carlo et al. 1992). In Study 2, cognitive and emotional processes were assessed using measures of perspective taking and empathic concern. Other-centeredness was represented by “other-centered” moral judgments in hypothetical dilemmas inducing a “rational” or “intuitive” self-other conflict.

### Study 1

In Study 1, we examined the relationships among chronic environmental challenges (negative life events, childhood financial insecurity, and educational/occupational competition), cognitive and emotional processes, and other-centered moral reasoning. Other-centered moral reasoning was assessed with the Prosocial Reasoning Objective Measure (PROM; Carlo et al. 1992). Prosocial moral reasoning involves considerations of why one should or should not help others at a cost to one’s own interests (Carlo et al. 1992; Eisenberg 1986). According to the framework of Eisenberg (1986) and Carlo (Carlo et al. 1992), prosocial reasoning can be organized into different types, ranging from egoistic/self-centered (e.g., hedonistic and approval-oriented) to internalized/other-centered (needs-based, stereotyped, and internalized). Other-centered or “internalized” types of reasoning are associated with cognitive development and require more rational thinking, which might explain their later appearance in development and



**Fig. 1** Hypothetical relationships among environmental challenges, cognitive and emotional processes, and other-centeredness. Circles represent theoretical concepts instead of latent variables. Notations on the arrows represent numbered hypothetical directions and strengths of the associations: (++) and (--) indicate strong positive and negative associations, respectively; (+) and (-) indicate relatively weaker positive and negative associations

lower prevalence before adolescence (Eisenberg et al. 2014). Meanwhile, self-centered types of reasoning still account for a small portion of reasoning even among adults (Eisenberg et al. 2014).

Cognitive and emotional processes were represented by self-developed measures of future-oriented planning and emotional attachment, respectively. These two qualities were chosen because (1) both of these qualities are integral components of a slow LH strategy and represent long-term investment to future fitness (Figueredo et al. 2006) and (2) planning and attachment have been reliably linked to cognitive and emotional processes, respectively, in prior literature (e.g., Becker et al. 1997; Epstein et al. 1996). The structural and criterion validity of the self-developed scales were assessed and confirmed in a pilot study with a separate sample (see ESM §B).

Based on our general hypotheses, we expected that both future-oriented planning and emotional attachment should predict the composite score of PROM (representing overall other-centeredness in moral reasoning). Moreover, because moral reasoning generally has more to do with the cognitive processing (Paxton and Greene 2010), we expected that future-oriented planning should also positively predict more advanced (rational) types of reasoning (H1) whereas emotional attachment should negatively predict more hedonistic (intuitive) types of reasoning (H2). We also predicted that negative life events and childhood financial insecurity should negatively predict future-oriented planning and emotional attachment, whereas competition should positively predict both processes. These processes should mediate the relationship between environmental challenges and other-centered reasoning (H3 and H4).

## Participants

Participants were 405 adults (221 females,  $M_{\text{age}} = 25.93$  years,  $SD = 2.82$  years, range = 18–39 years) from 27 provinces in China, who provided valid responses through online surveys ([www.sojump.com](http://www.sojump.com)). An electronic version of informed consent was obtained from all individual participants included in the study. All participants completed the entire questionnaire online in one sitting. Fifteen participants (3.7% of the original sample) were excluded due to an unusually short response time (more than 2  $SD$  below the average response time) or invalid responses to multiple items in the questionnaire (indicating potential carelessness).

## Measures

**Other-Centeredness: Prosocial Moral Reasoning** The PROM (Carlo et al. 1992) is an objective measure of prosocial moral reasoning derived from Eisenberg's prosocial moral reasoning interview measure (Eisenberg 1986). The version of PROM included five stories,<sup>1</sup> each followed by three behavioral choices as to what the protagonist in the story should do and nine reasons for why the protagonist should behave as specified. Each story described a situation involving a trade-off between the protagonist's self-interests and others' welfare (e.g., helping an injured girl versus going to a party). After reading the story, participants first made judgments about whether the protagonist

<sup>1</sup> The wording of several stories was slightly changed to fit the Chinese cultural background and to sound more mature for adult participants. These changes did not affect the structure of the story.

should help others (responses were coded 1 = help, 0 = “not sure”, and -1 = not help). Then, they rated on a 7-point scale (1 = *not at all*, 7 = *greatly*) how important each of the nine reasons was in their decision.

Eight of the nine reasons corresponded to a certain level/type of moral reasoning (Eisenberg 1986): two items pertaining to hedonistic or directly reciprocal concerns (e.g., “It depends how much fun Mary expects the party to be”), two pertaining to approval-oriented concerns (e.g., “It depends whether Mary’s parents and friends will think she did the right or wrong thing”), one needs-oriented item (e.g., “It depends whether the girl really needs help or not”), one stereotypic item (e.g., “It depends if Mary thinks it’s the decent thing to do or not”), and two involving internalized reasoning (e.g., “It depends how Mary would feel about herself if she helped or not”; “It depends if Ann would feel guilty if the girl is hurt because she did not help”). The ninth reason was a lie/nonsense item used to screen participants who prefer longer and more abstract reasons.

Scores of PROM subscales (using multiple items per story when appropriate) were calculated by averaging all the items pertaining to the same moral concerns across stories and then transformed to proportion scores (according to the instructions in Carlo et al. 1992). Cronbach’s  $\alpha$  values for the hedonistic, approval-oriented, needs-based, stereotypic, and internalized subscales were .81, .85, .71, .67, and .83, respectively. In accordance with Carlo et al. (1992), a composite score on the PROM reflecting the general level of other-centered reasoning was computed as weighted sums of different reasons (those of hedonistic and approval-oriented reasoning were multiplied by 1; those of needs-based and stereotypic reasoning were multiplied by 2; and the proportion of internalized reasoning was multiplied by 3).<sup>2</sup>

**Cognitive Process: Future-Oriented Planning** Four items were adapted from the “insight, planning, and control” subscale of the Arizona Life History Battery (ALHB, Figueredo 2007; Figueredo et al. 2006) regarding tendencies to make plans, set goals, and prepare for the future (e.g., “I like to make plans for the future”; “I find it helpful to set goals for the near future”). See ESM §A for the full scale. The validity of this scale was assessed in a pilot study (see ESM §B), in which the future-oriented planning scale was shown to be positively associated with the mini-K measure of slow LH strategy and established measures of cognitive processes, but not with most of the emotional processes. Cronbach’s  $\alpha$  for the four-item “future-oriented planning” scale was .67.

**Emotional Process: Emotional Attachment** Another four items were adapted from the mini-K (Figueredo 2007)<sup>3</sup> to assess the degree of interpersonal attachment/trust and emotional warmth of important relationships (e.g., “While growing up, I had a close and warm relationship with my mother”; “I am emotionally attached to my family and my friends, such that their happiness is also my happiness”). See ESM §A for the full scale. The validity of this scale was assessed in a pilot study (see ESM §B), in which the emotional attachment scale was shown to be positively associated with the Mini-K

<sup>2</sup> Consistent with Carlo et al. (1992), the alpha coefficient was not calculated for the composite score because the scores for different types of justifications reflect different directions in prosocial moral reasoning and, thus, cannot be combined.

<sup>3</sup> To avoid an artificial correlation between our measure of LH strategy and morality, none of these items were selected from the religiosity or altruism-related subscales of ALHB (Figueredo 2007).

measure of slow LH strategy and established measures of emotional processes, but not with most of the cognitive processes. Cronbach's  $\alpha$  for the four-item "emotional attachment" scale was .74.

**Morbidity-Mortality: Negative Life Events** We used a 14-item checklist adapted from the Adolescent Self-rating Life Events Checklist (ASLEC; Liu et al. 1997), with slight change of wording in order to fit the assessment of young adults (two items related to school life were not included for this reason). For each item, participants indicated how many times they had encountered/witnessed a certain negative event in their life. Examples of the items were "death of a close family member or friend," "major personal illness/injury," and "parents' divorce." Because the life events on the checklist were assumed to have a cumulative impact on individuals (see Holmes and Rahe 1967), but were not necessarily related to each other, internal consistency measures are not applicable here.

**Resource Scarcity: Childhood Financial Insecurity** The assessment included five items adopted from Griskevicius et al. (2011) measuring the agreement to descriptions of childhood family economic conditions (e.g., "My family did not have stable income," "My family usually had enough money to buy anything we wanted" [reverse scored]), and another five items adopted from Brumbach et al. (2009) measuring the frequency of experiences associated with financial insecurity in their early life (e.g., "Our family relied on government aid" and "Family members could not afford to see a doctor or to go to the hospital"). All items were rated on 6-point Likert scales (for the "agreement to description" items, 1 = strongly disagree, 6 = strongly agree; for the frequency items, 1 = never once, 6 = almost always). A final index of childhood financial insecurity was calculated as the mean of these two sets of questions after standardization. Cronbach's  $\alpha$  for this 10-item scale was .90.

**Competition** Competition was measured by a novel scale consisting of 13 items. Seven items assessed the degree to which the participants' family and friends hold certain views of educational and occupational competition (e.g., "My relatives and friends always want their children to earn better grades at school than other kids"), answered on a 6-point Likert scale (1 = *rarely*, 6 = *mostly*). Another six items tap into the degree of educational and occupational competition in one's social circle (e.g., "People that I know get a highly competitive position through difficult job-seeking process," answered on a 6-point Likert scale (1 = *very uncommon*, 6 = *very common*). The score of the competition variable was calculated by the sum of the 13 items. Cronbach's  $\alpha$  for this 13-item scale was .73.

## Model Estimation

The hypothesized path models were tested with Mplus 6 (Muthén and Muthén 2007) using maximum likelihood estimation. We adopt the model fit criteria of Kline (2011), in which  $RMSEA \leq .05$ ,  $CFI/TLI \geq .95$ , and  $SRMR \leq .05$  indicate a good fit to the data. The indirect effects were estimated using the bootstrap method (Preacher and Hayes 2004) with 10,000 bootstrapped resamples. When the 95% confidence interval of the

standardized indirect effect computed through bootstrapping did not include 0, it is considered statistically significant.

## Results and Discussion

The means and standard deviations of the variables as well as the correlations among variables are shown in Table 1. We found that these two factors were positively and significantly correlated ( $r = .32, p < .001$ ). This is consistent with the expectation that both measures reflect slow LH strategies. Among environmental challenges, the correlation between childhood financial insecurity and negative life events was not significant ( $r = .06, p = .23$ ). However, both childhood financial insecurity and negative life events had negative correlations with competition ( $r = -.20, p < .001$  and  $r = -.09, p = .04$ , respectively).

**Structure of the Dual-Process Measures** To assess the construct validity of the newly devised measures of future-oriented planning and emotional attachment, we conducted a confirmatory factor analysis (CFA) with two correlated factors on the eight items (four related to future-oriented planning and four related to emotional attachment). The resulting model had good fit:  $\chi^2_{19, N=424} = 40.85, p = .003, RMSEA = .05, CI_{95} [.03, .08], CFI = .97, SRMR = .04$ . The loadings for the future-oriented planning factor ranged from .42 to .80. The loadings for the emotional attachment factor ranged from .52 to .74. All the loadings were significant at  $p < .001$ . Future-oriented planning was positively and strongly correlated with emotional attachment ( $r = .61$ ). But this is expected, as both of them reflect slow LH strategies. Combined with ESM §B, these results supported our theoretical predictions of cognitive and emotional processes.

**Path Models** We tested the hypotheses with six path models (Fig. 2). In each model, predictors were negative life events, childhood financial insecurity, and competition; mediators were future-oriented planning and emotional attachment; the dependent variable was one of the proportional scores for the PROM subscales or the PROM composite score.<sup>4</sup> The models with proportional scores demonstrated satisfactory model fit ( $RMSEA \leq .05, CFI/TLI \geq .95$ , and  $SRMR \leq .05$ ), the fit for the composite score model was also acceptable ( $\chi^2_{43} = 103.28, RMSEA = .06, CFI/TLI = .94, SRMR = .04$ ).

The results of the models were consistent with most of our predictions. We found that future-oriented planning negatively predicted self-centered types of justifications (hedonistic and approval-oriented) and positively predicted other-centered types of justifications (needs-based, stereotyped, and internalized). It also positively predicted the composite score of PROM, which represented the overall degree of other-centered reasoning (H1). Similarly, emotional attachment negatively predicted hedonistic justifications and positively predicted internalized justifications and the composite score of

<sup>4</sup> The path models did not include direct links between environmental challenges and PROM scores because (1) we theoretically suggested that cognitive and emotional processes should account for a major proportion of the relationship between environmental challenges and moral judgments; (2) we examined alternative models that additionally included direct links between environmental challenges and moral judgment scores and found mostly nonsignificant or weak direct effects on moral judgment scores; (3) the models without direct links fit reasonably well, thus justifying dropping the direct links for parsimony considerations.

**Table 1** Correlation coefficients, means and standard deviations of the variables in Study 1

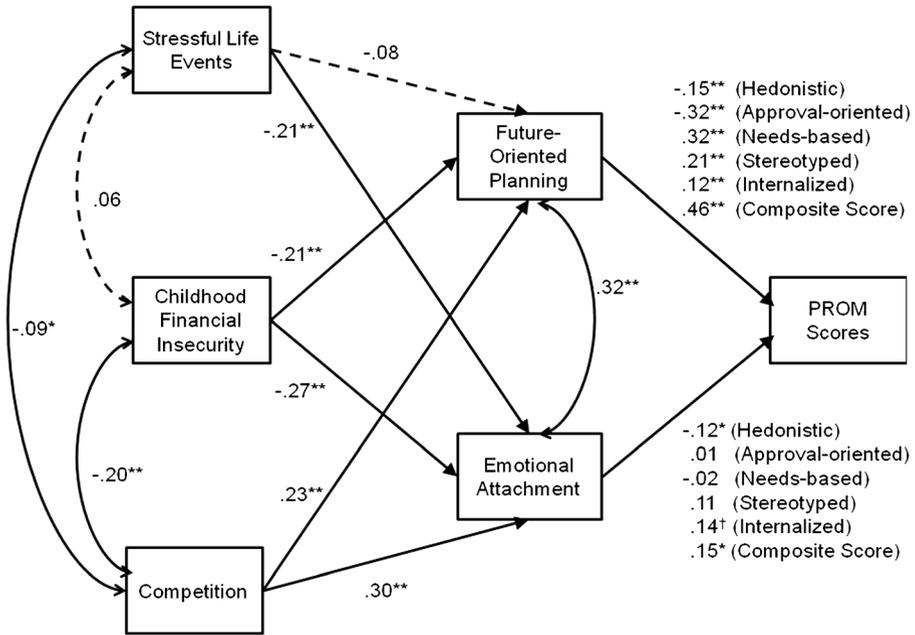
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Negative life events (1)	–										
Childhood financial insecurity (2)	.06	–									
Competition (3)	-.09	-.20**	–								
Future-oriented planning (4)	-.19**	-.31**	.44**	–							
Emotional attachment (5)	-.17**	-.39**	.37**	.73**	–						
Hedonistic (6)	-.01	.15**	-.13**	-.25**	-.32**	–					
Approval-oriented (7)	-.14**	.01	.02	-.18**	-.27**	.21**	–				
Needs-based (8)	.05	-.15**	.09	.23**	.30**	-.61**	-.54**	–			
Stereotypic (9)	.05	-.03	.05	.25**	.28**	-.62**	-.51**	.24**	–		
Internalized (10)	.07	-.05	.05	.16**	.29**	-.69**	-.49**	.33**	.45**	–	
PROM Composite Score (11)	-.13*	-.18**	.20**	.52**	.47**	-.38**	-.04	.23**	.23**	.22**	–
<i>M</i>	0.37	2.93	3.93	4.59	4.40	0.19	0.18	0.21	0.21	0.21	47.53
<i>SD</i>	0.31	0.99	0.57	0.54	0.51	0.03	0.02	0.02	0.02	0.02	5.24

\*  $p < .05$  \*\*  $p < .001$ 

PROM (H2). Moreover, consistent with the expectation that emotional processes tend to exert weaker effects on rational reasoning, emotional attachment did not significantly predict the remaining four types of justifications (H2). Most relationships between environmental challenges and cognitive and emotional processes were also expected, though not without exceptions: childhood financial insecurity and negative life events were both negatively related to emotional attachment, but only childhood financial insecurity was negatively related to future-oriented planning. Competition was positively linked to both future-oriented planning and emotional attachment.

The pattern of indirect effects was also largely consistent with previous predictions. With regard to self-centered types of justifications, negative life events positively predicted hedonistic justifications through emotional attachment ( $\beta = .03$ ,  $p = .043$ ,  $CI_{95} [.00, .05]$ ). Childhood financial insecurity positively predicted hedonistic justifications through both emotional attachment ( $\beta = .03$ ,  $p = .040$ ,  $CI_{95} [.00, .07]$ ) and future-oriented planning ( $\beta = .03$ ,  $p = .011$ ,  $CI_{95} [.01, .06]$ ). It also positively predicted approval-oriented justifications through future-oriented planning ( $\beta = .07$ ,  $p < .001$ ,  $CI_{95} [.03, .10]$ ). Competition negatively predicted hedonistic justifications ( $\beta = -.04$ ,  $p = .010$ ,  $CI_{95} [-.06, -.01]$ ) and approval-oriented justifications ( $\beta = -.07$ ,  $p < .001$ ,  $CI_{95} [-.11, -.04]$ ) through future-oriented planning and showed a trend of being negatively related to hedonistic justifications through emotional attachment ( $\beta = -.04$ ,  $p = .050$ ,  $CI_{95} [-.07, .00]$ ).

With regard to other-centered types of justifications, childhood financial insecurity negatively predicted needs-based justifications ( $\beta = -.07$ ,  $p < .001$ ,  $CI_{95} [-.10, -.03]$ ), stereotyped justifications ( $\beta = -.04$ ,  $p = .005$ ,  $CI_{95} [-.08, -.01]$ ), and internalized



**Fig. 2** Study 1: Results of the six path models depicting the relationships among measures of environmental challenges, cognitive and emotional processes, and six different PROM scores (five proportional scores for different subscales and one composite score). Because the six models only differ in the dependent variable, most of the paths except two were the same across the six models. The six regression coefficients of the PROM scores on future-oriented planning or emotional attachment in these six models were shown in parallel near the path, with the corresponding dependent variables in parentheses. †  $p = .059$  \*  $p < .05$  \*\*  $p < .001$

justifications ( $\beta = -.03, p = .045, CI_{95} [-.05, .00]$ ) through future-oriented planning. It also tended to be negatively related to internalized justifications through emotional attachment ( $\beta = -.04, p = .053, CI_{95} [-.08, .00]$ ). Competition positively predicted needs-based justifications ( $\beta = .07, p < .001, CI_{95} [.04, .11]$ ), stereotyped justifications ( $\beta = .05, p = .007, CI_{95} [.01, .08]$ ), and internalized justifications ( $\beta = .03, p = .041, CI_{95} [.00, .06]$ ) through future-oriented planning. It also tended to be positively related to internalized justification through emotional attachment ( $\beta = .04, p = .065, CI_{95} [-.002, .08]$ ).

Finally, all three environmental challenges were indirectly related to the overall score of other-centered tendency in prosocial moral reasoning (H3 and H4). Both components of unpredictability negatively predicted the composite score, but through different processes: negative life events through emotional attachment ( $\beta = -.03, p = .019, CI_{95} [-.06, -.01]$ ) and childhood financial insecurity through both emotional attachment ( $\beta = -.04, p = .012, CI_{95} [-.07, -.01]$ ) and future-oriented planning ( $\beta = -.10, p < .001, CI_{95} [-.14, -.05]$ ). Conversely, competition positively predicted the composite score of PROM through both emotional attachment ( $\beta = .04, p = .014, CI_{95} [.01, .08]$ ) and future-oriented planning ( $\beta = .11, p < .001, CI_{95} [.06, .16]$ ). The remaining indirect effects were not significant. In sum, as predicted by the LH theory, unpredictability was indirectly and positively linked to self-centered reasoning through emotional processes and indirectly and

negatively linked to other-centered reasoning through both cognitive and emotional processes. Competition exhibited the reverse pattern of indirect effects. These findings were largely consistent with our predictions.

However, it is noteworthy that the two components of unpredictability exhibited considerably different patterns of indirect effects. Negative life events (reflecting morbidity-mortality) seemed to mainly predict emotional attachment rather than future-oriented planning. Childhood financial insecurity (reflecting resource scarcity) seemed to predict both qualities, with more reliable effects on future-oriented planning. This makes sense in terms of evolutionary function: Individuals exposed to high levels of morbidity-mortality tend to encounter more disturbances in relationships, which might impair their ability to attach to and empathize with others. These same challenges might encourage the development of non-social coping skills (e.g., future-oriented planning) to buffer the threats with accumulated resources, however. In contrast, individuals exposed to high levels of resource scarcity, especially in childhood, might be preoccupied with short-term results in both non-social aspects and relationships so as to overcome the “scarcity.” This might affect future-oriented planning and emotional attachment, both of which necessitate long-term investments. Indeed, research has shown that individuals who experienced low socioeconomic status (SES) in childhood exhibit increased impulsivity in economic decisions and lower persistence in difficult tasks when exposed to cues of unpredictability (Griskevicius et al. 2011; Mittal and Griskevicius 2014). Overall, this indicated that not all cognitive and emotional processes are equally associated with all kinds of environmental challenges.

## Study 2

Although the findings of Study 1 were largely consistent with our predictions, an important remaining issue is that the moral reasoning measure used in Study 1 might favor cognitive processes over emotional processes (Paxton and Greene 2010). To eliminate this potential bias in Study 2, we employed a series of moral dilemmas that elicit both rational and intuitive types of conflicts between self-interests and others' welfare, which were called “rational self-other (RSO) dilemmas” and “intuitive self-other (ISO) dilemmas,” respectively. The RSO dilemmas focused on rational, utilitarian values whereas the ISO dilemmas focused on intuitive, deontological values. Unlike traditional “utilitarian-deontological” moral dilemmas (e.g., Greene et al. 2001), however, the RSO and ISO dilemmas pitted self-centered choices against other-centered choices, rather than pitting utilitarian choices against deontological choices. In this way, dilemma choices would not simply reflect thinking styles but rather would indicate that willingness to benefit others at the cost of one's own self-interests can be either utilitarian or deontological.

Moreover, cognitive and emotional processes were represented by perspective taking and empathic concern, respectively, which are considered major cognitive and emotional components of empathy (Davis 1983). Using a different pair of cognitive and emotional processes than in Study 1 allowed us to examine the generalizability of the mediation effects. The measures of environmental challenges were identical to those in Study 1.

We predicted that perspective taking (representing cognitive processes) might be more strongly related to the RSO dilemmas than to the ISO dilemmas (H1), whereas empathic concern (representing emotional processes) might be more strongly related to the ISO dilemmas than to the RSO dilemmas (H2). Additionally, environmental unpredictability should negatively predict both processes of empathy, and competition should positively predict both processes of empathy. We hypothesized that perspective taking and empathic concern should mediate the relationships between environmental challenges and other-centered judgments in response to both ISO and RSO dilemmas (H3 and H4).

## Participants

Participants were 424 adults (193 females,  $M_{\text{age}} = 33.68$ ,  $SD_{\text{age}} = 1.46$ ) from 27 provinces of China who provided valid responses to an online questionnaire. An electronic version of informed consent was obtained from all individual participants included in the study. No participants were excluded due to response time and other issues.

## Measurements

**Moral Dilemmas** Six dilemmas were adapted from materials used by previous researchers (e.g., Greene et al. 2008; see ESM §C for a full list of the moral dilemmas), each requiring participants to make a forced choice between two solutions. They fell into two categories, rational self-other (RSO) dilemmas and intuitive self-other (ISO) dilemmas. Both involve a conflict between the protagonists' self-interests and the interests of others. In the RSO dilemmas, the two choices differed in utilitarian values but neither of them violated any intuitive/deontological rules. The choice with lower utilitarian value was more beneficial to the protagonist (the self-centered choice) whereas the choice with higher utilitarian value required sacrificing the interest of the protagonist (the other-centered choice). In the ISO dilemmas, the two choices were matched in utilitarian outcomes, but one (the self-centered choice) would benefit the self-interest of the protagonist by violating certain intuitive/deontological rules, and the other (the other-centered choice) involved sacrificing the self-interest of the protagonist in order not to violate any moral rule.

Three RSO dilemmas and three ISO dilemmas were selected from eight candidate dilemmas through extensive pilot testing (the procedure and results of the pilot test are summarized in ESM §D). Based on the similarities in the pilot ratings of rationales behind the judgment, responses to the three ISO dilemmas and the three RSO dilemmas were combined in the analyses.

**Cognitive and Emotional Processes: Perspective Taking and Empathic Concern** We used two subscales of the interpersonal reactivity index (IRI, Davis 1983): empathic concern (e.g., "I am often quite touched by things that I see happen") and perspective taking (e.g., "I try to look at everybody's side of a disagreement before I make a decision"). The former was considered relevant to the emotional aspect of empathy, and the latter was considered more relevant to the cognitive aspect of empathy. Each subscale contained seven items (14 items in total). Participants rated how well each item describes them on a 6-point Likert scale (1 = does not describe me well, 6 =

describes me very well). The IRI has established good construct validity, with perspective taking and empathic concern as two independent factors in a variety of cultures (e.g., De Corte et al. 2007). Cronbach's  $\alpha$  values for empathic concern and perspective taking were .87 and .77, respectively.

**Environmental Challenges** Negative life events, childhood financial insecurity, and competition were measured with the same instruments as in Study 1. Cronbach's  $\alpha$  for the childhood financial insecurity measure and the competition measure was .91 and .75, respectively.

### Procedure for the Moral Judgment Task

A practice dilemma not included in the six testing dilemmas was first presented to ensure that participants understood the format of the items to follow. The presenting sequence of the six testing dilemmas was randomized for each participant. Participants were given a maximum of three minutes to make each decision (most participants took less time to respond).

### Model Estimation

The hypothesized path models were tested with Mplus 6 (Muthén and Muthén 2007), using maximum likelihood estimation. We adopted the same criteria for model fit, number of bootstrapped resamples, and criterion for statistical significance as in Study 1. In addition, we used Wald chi-squared tests to compare the relative strength of regression coefficients. A Wald chi-squared test is a parametric test for specific hypotheses regarding one or more parameters estimated in a statistical model (Agresti 2013).

### Results and Discussion

The means and standard deviations of the environmental challenges, different components of empathy, and moral judgment scores, as well as the correlations among them, are presented in Table 2. The path model in Fig. 3 represents the relationships among the environmental challenges, two different components of empathy (empathic concern and perspective taking), and moral judgment scores. The model fit was good:  $\chi^2_{9, N=424} = 16.45, p = .058, RMSEA = .04, CFI = .98, SRMR = .03$ . For reasons similar to those listed in Study 1, we did not include direct paths between environmental challenges and other-centeredness in moral judgments.

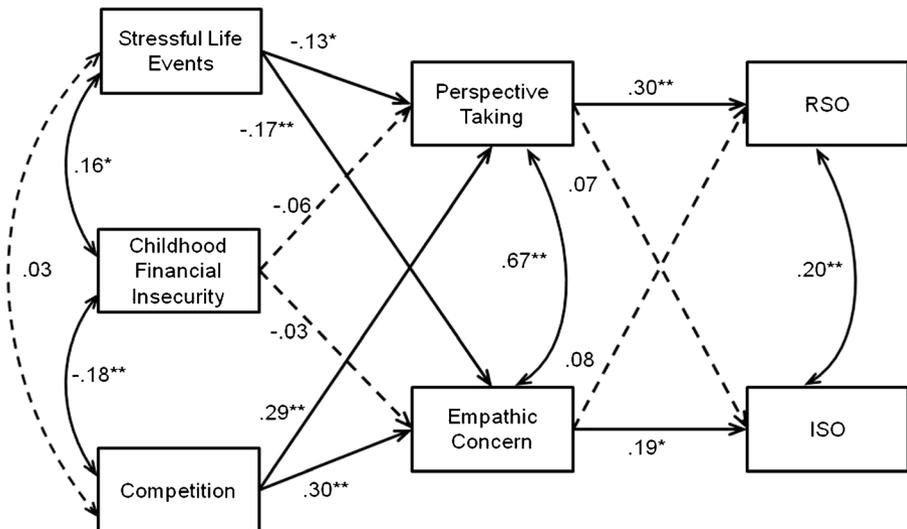
As in Study 1, competition was negatively correlated with childhood financial insecurity ( $r = -.18, p < .001$ ). Negative life events were also modestly positively correlated with childhood financial insecurity ( $r = .16, p = .002$ ) and were not significantly correlated with competition ( $r = .03, p = .50$ ). Also, empathic concern showed a strong positive correlation with perspective taking ( $r = .67, p < .001$ ), which was similar to the pattern obtained in previous studies (e.g., Davis 1983; De Corte et al. 2007). The RSO and ISO scores were positively correlated with each other ( $r = .20, p < .001$ ), which was compatible with the fact that both scores reflect other-centered tendencies.

**Table 2** Correlation coefficients, means and standard deviations of the variables in Study 2

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Negative life events (1)	–						
Childhood financial insecurity (2)	.16**	–					
Competition (3)	-.03	-.18**	–				
Perspective taking (4)	-.13**	-.13**	.29**	–			
Empathic concern (5)	-.16**	-.11*	.30**	.70**	–		
RSO (6)	-.06	-.12*	.04	.36**	.30**	–	
ISO (7)	-.10*	.01	.03	.20**	.24**	.26**	–
<i>M</i>	0.40	2.94	3.94	4.43	4.65	0.67	0.65
<i>SD</i>	0.35	1.02	0.58	0.63	0.68	0.29	0.33

\*  $p < .05$  \*\*  $p < .001$

With regard to the relationship between the dual process and other-centered judgments, perspective taking and empathic concern were differentially related to the RSO and ISO scores. Perspective taking, but not empathic concern, positively predicted the RSO judgment score (H1). Empathic concern, but not perspective taking, positively predicted the ISO score (H2). To further test our expectation that different components of empathy would be differentially associated with different types of self-other moral judgments, we used Wald chi-squared tests to examine whether the difference between relevant regression coefficients significantly deviated from zero. The results showed that perspective taking was significantly more strongly related to the RSO score than to the ISO score ( $\beta_{RSO} - \beta_{ISO} = .24$ ,  $Wald_1 = 6.73$ ,  $p = .01$ ). However, although



**Fig. 3** Study 2: Estimates of the path analysis model depicting hypothesized relationships among environmental challenges, different components of empathy, and two moral judgment scores. The numbers adjacent to the arrows represent standardized parameter estimates; those adjacent to the double arrows represent correlation coefficients. Dotted arrows represent non-significant links. \*  $p < .05$  \*\*  $p < .001$

empathic concern was more strongly related to the ISO score than to the RSO score, this comparison was not statistically significant ( $\beta_{\text{ISO}} - \beta_{\text{RSO}} = .11$ ,  $\text{Wald}_1 = 2.19$ ,  $p = .14$ ).

With regard to the relationship between environmental challenges and the dual process, both processes of empathy were negatively related to negative life events (H3) and positively related to competition (H4). Nevertheless, in contrast to prior research (Jolliffe and Farrington 2006), neither of the two processes of empathy was related to childhood financial insecurity. This might indicate that resource scarcity only impairs processes with long-term investments, but not more situation-based cognitive and emotional processes. Alternatively, it might be that the effect of childhood financial insecurity largely overlapped with, or was accounted for, by negative life events, which were not simultaneously investigated in previous studies of empathy.

In terms of indirect effects, most results were also consistent with the anticipated pattern based on life history theory. Negative life events negatively predicted the RSO score through perspective taking ( $\beta = -.04$ ,  $p = .018$ ,  $\text{CI}_{95} [-.07, .00]$ ) and showed a trend of negative indirect effect on the ISO score through empathic concern ( $\beta = -.03$ ,  $p = .05$ ,  $\text{CI}_{95} [-.07, .001]$ ). Competition positively predicted the RSO score through perspective taking ( $\beta = .09$ ,  $p = .001$ ,  $\text{CI}_{95} [.04, .14]$ ) and positively predicted the ISO score through empathic concern ( $\beta = .06$ ,  $p = .022$ ,  $\text{CI}_{95} [.01, .10]$ ). The rest of the indirect paths were not significant. Although childhood financial insecurity did not predict moral judgment scores through either processes of empathy, when the direct paths were added, it had a trend to be negatively related to the RSO score after controlling for empathy and other environmental challenges ( $\beta = -.09$ ,  $p = .064$ ).

Apart from this exception, the results of Study 2 generally replicated the findings in Study 1. In addition, Study 2 also showed that the cognitive and emotional processes mediated the relationship between environmental challenges and other-centered moral judgments in similar ways, but there was a “double separation” of the effects of cognitive and emotional processes of empathy on rational and intuitive judgments. This carries important implications for the dual process account of other-centered morality: Different cognitive and emotional processes, which are linked to environmental challenges in ways predicted by the LH theory, might explain other-centeredness in functionally relevant moral tasks.

## General Discussion

The dichotomy between cognition-based and emotion-based morality has long been a central theme of research in moral psychology. In the present study, we instead propose that both cognitive and emotional processes might contribute to other-centeredness, which is one of the essential features of moral reasoning and judgments (Gibbs 2003). At the same time, these processes were associated with environmental challenges that prompt individuals to focus on either present or future fitness.

From a LH theory perspective (Figueredo et al. 2006), the cognitive and emotional processes examined here can be seen as reflecting slow LH strategies. These processes tend to develop in stable and competitive environments, where other-centered judgments and behaviors tend to promote future fitness. However, these

processes might be less adaptive in the face of unpredictability, which threatens present fitness and activates fast LH strategies (Ellis et al. 2009). Thus, individuals with unpredictable developmental experiences are more prone to self-centeredness in self-other conflicts.

These hypotheses were largely supported in two studies. Study 1 showed that both future-oriented planning and emotional attachment positively predicted other-centered moral reasoning, although emotional attachment was not predictive of specific kinds of other-centered moral reasoning (H1 and H2). These cognitive and emotional processes were also negatively associated with components of unpredictability and positively associated with competition, thus mediating the relationship between environmental challenges and moral reasoning (H3 and H4). Study 2 showed that perspective taking and empathic concern positively predicted rational and intuitive moral judgments, respectively (H1 and H2). Moreover, perspective taking mediated the negative relationship between negative life events and rational moral judgments, as well as the positive relationship between competition and rational moral judgments; empathic concern mediated similar relationships between environmental challenges and intuitive moral judgments (H3 and H4). The strengths of the observed associations were comparable to existing studies employing similar environmental measures (e.g., Belsky et al. 2012; Brumbach et al. 2009).

### **Cognitive and Emotional Processes with Distinct Roles in Other-Centeredness**

Although we found that the cognitive and emotional processes were associated with other-centeredness in similar ways as predicted by the LH theory, the traditional distinction between rationality and intuition are perhaps not without merits in explaining more-nuanced differences between and within moral tasks.

Previous research using neuroimaging methods has shown that rational and intuitive judgments in moral dilemmas recruit brain areas associated with cognitive and emotional functioning, respectively (e.g., Greene et al. 2001, 2008). However, as noted earlier, responses to utilitarian-deontological dilemmas might reflect non-moral thinking styles instead of other-centeredness. In fact, both the utilitarian choice and the deontological choice might be other-centered, thus leading to experienced “high conflict” and prolonged response latencies (e.g., Greene et al. 2001, 2008). Thus, one innovative contribution of Study 2 is that we devised a moral judgment measurement that separated the dual process contributing to thinking styles from the dual process contributing to other-centeredness.

Consistent with this view, we found that perspective taking (representing cognitive processes) was more strongly related to the RSO scores than to the ISO scores, whereas the opposite was true for empathic concern (representing emotional processes). Moreover, the findings might also imply that other-centeredness in various moral functions are affected by various trade-offs between self-interests and others’ welfare. For example, future-oriented planning seemed to be a strong facilitator of other-centered reasoning in long-term trade-offs, where conflicts between self-interests and other’s welfare tend to be more indirect. In contrast, empathic concern seemed to be a strong facilitator of other-centered judgments in situational trade-offs, where individuals tend to take into account immediate costs and benefits and use themselves as a reference to anticipate others’ needs.

## Cognitive and Emotional Processes as Mediators between Environmental Challenges and Other-Centeredness

Another contribution of this research is that we elaborated the distinct associations between different components of environmental challenges and different cognitive and emotional processes, which were subsequently linked to other-centeredness. Although morbidity-mortality is clearly associated with unpredictability (Ellis et al. 2009), the role of resource scarcity is less clear. One possibility is that resource scarcity is positively associated with population density and thus increases competition (Ellis et al. 2009). However, the correlation between financial insecurity and competition in our studies did not support this. Another possibility is that resource scarcity (e.g., famine) constitutes a component of unpredictability. This stance is supported by our research. We found that both negative life events (as proxy for morbidity-mortality) and childhood financial insecurity (as proxy for resource scarcity) were generally negatively related to cognitive and emotional processes and, in turn, negatively related to other-centeredness. This is similar to regarding them as unpredictable. However, morbidity-mortality and resource scarcity did seem to produce different effects on specific cognitive and emotional processes: the former negatively predicted emotional attachment (Study 1) and both empathy processes (Study 2), whereas the latter negatively predicted both future-oriented planning and emotional attachment (Study 1) but neither of the empathy processes (Study 2).

These differences can be explained with different considerations of self-other trade-offs in the face of different environmental challenges. For individuals with chronic experiences of morbidity-mortality, the benefits of future-fitness-enhancing relationships are likely to be negated by extrinsic threats. This might discourage them from forming stable, non-instrumental types of relationships. Indeed, there is evidence that unstable life experiences and witnessed violence contribute to increased aggression and social deviance (Brumbach et al. 2009). However, morbidity-mortality did not seem to impair future-oriented planning, which could serve as a useful coping skill in both predictable and unpredictable environments (Epstein et al. 1996), nor did it seem to prevent the internalization of other-centered moral values in reasoning (Study 1).

According to our previous reasoning, for individuals with chronic experiences of resource scarcity, the benefits of long-term investment in relationships (future-oriented planning and secure attachments) are likely to be negated by more urgent short-term needs, which are associated with self-centeredness. This seemed to be the case given the findings of Study 1. However, we also found that childhood financial insecurity did not predict empathy and, thus, did not contribute negatively to other-centered judgments (Study 2). This seemed to suggest that accurately gauging others' feelings and empathizing with others' distress are not sensitive to resource scarcity. Indeed, from the view of adaptiveness, especially in the face of unpredictable threats, individuals with few resources need to band together to survive. This is consistent with extant findings that low SES individuals are more accurate in judging others' emotions (Kraus et al. 2010) and tend to be more prosocial when facing uncertainties in the future (Piff et al. 2012). Therefore, we should not draw the oversimplified conclusion that poverty would necessarily lead to selfishness in all cases. Like morbidity-mortality threats, resource scarcity might

negatively predict certain cognitive and emotional processes, but not others. In addition, it might even interact with morbidity-mortality, which was not examined in the present study. In sum, the precise psychological mechanisms between different components of unpredictability and other-centeredness warrant further examination.

Compared with morbidity-mortality and resource scarcity, competition is rarely assessed as an environmental challenge independent of unpredictability in LH-theory-inspired psychological research (Chang and Lu 2018). Competition is conceptualized as contests for future fitness in the present study, in order to distinguish it from unpredictability in the social domain. We found that educational and occupational competition positively predicted all of the cognitive and emotional processes we examined here, and it indirectly contributed to other-centeredness in reasoning and judgments. This is consistent with the general prediction of life history theory—that within-species competition resulting from stable and predictable living environments should facilitate slow LH strategies (Ellis et al. 2009; MacArthur and Wilson 1967). This implies that not all kinds of environmental challenges impose negative effects on cognitive and emotional processes that lead to other-centeredness.

### Limitations and Future Directions

We note several limitations in our studies that might inspire future investigations. First, our assessment of other-centeredness was indirect—in other words, requiring participants to identify with the protagonist in moral reasoning scenarios or moral dilemmas. However, some might identify more with the protagonist than others and thus are more invested in the “self-interests” of the protagonist. Although “high-identified” and “low-identified” participants might cancel each other out, the inclusion of low-identified participants could reduce the effect sizes. Future studies can employ more ecologically valid assessments of other-centeredness, such as “real” moral decisions in self-other conflicts in daily life or in laboratory settings, to more closely reflect other-centeredness.

Additionally, the present research did not directly examine present-oriented processes pertaining to fast LH strategies. We reasoned that present-oriented processes that promote present fitness in unpredictable environments (e.g., risk-taking propensity and manipulative and Machiavellian personalities; Griskevicius et al. 2011; Wenner et al. 2013) should lead to self-centeredness. However, as mentioned earlier, individuals facing existential threats would also help each other out (White et al. 2012). Thus, it is possible that fast strategists might respond to immediate environmental challenges in different ways compared with slow strategists. They might tend to be other-centered in a different situation (which is not the typical, predictable situation when they respond to a questionnaire). Future research can examine this possibility using experimental manipulation of immediate environmental challenges as well as trait measures of future- or present-oriented cognitive and emotional processes.

A third issue has to do with the reliance on retrospective report of environmental challenges. Individuals’ current environment could “color” their memory of the past environment, leading to inaccurate assessment of environmental challenges. This issue can be addressed by a longitudinal design that assesses current environmental challenges and uses it to predict the dual process and other-centered judgments and reasoning later

on. Another approach could be to examine the causal effects of experimentally manipulated “environmental challenges” and associated tasks of cognitive and emotional processes and other-centeredness.

More generally, there are some inherent limitations when employing self-report surveys to examine psychological variables. Some might argue that the observed associations might be attributed to undetected semantic overlaps among different measurements, leading to artificial correlations (Arnulf et al. 2014). To minimize this possibility, we took great care in defining and operationalizing key variables and devised measurements accordingly (see also note 3). We also employed factor analyses to ensure the distinctiveness of the cognitive and emotional processes (Study 1) and used established measures with considerable discriminative validity. Admittedly, these precautions might not eliminate all possible semantic overlaps, especially between items measuring psychological processes and morality that rely more heavily on subjective judgments and interpretations. Thus, we have included self-developed measurements in sections A and C of the ESM for readers’ reference.

Finally, the present studies highlighted unpredictability and competition as key environmental challenges that predict other-centeredness in ways compatible with the LH perspective. However, we recognize that they are unlikely to be the only factors contributing to other-centeredness. Sociocultural factors such as socialization, culture, and religion have been traditionally linked to morality (Gladden et al. 2009; Hoffman 2000; Shweder et al. 1987) and might account for considerable variance in other-centeredness. Sociocultural factors such as religiosity might moderate the relationship between environmental challenges and other-centeredness.<sup>5</sup> For instance, although morbidity-mortality threats might prompt selfish motives in non-religious individuals, they seemed to increase other-centeredness among religious individuals (Norris and Inglehart 2004). Additionally, while religiosity might contribute to higher moral standards, these standards might be overly rigid, such that religious individuals might intuitively oppose deontological transgressions even if these transgressions are for the greater good (Piazza and Sousa 2013). This seems to suggest that religiosity might have greater moderation effects on the intuitive aspect of other-centeredness, which might also constitute a promising future direction for research.

## Conclusion

Morality is supported by an intricate combination of cognitive and emotional processes serving to reduce concern for one’s self-interests and to enhance concern for others’ welfare. The present research suggests that other-centeredness is facilitated by various cognitive and emotional processes that are conducive to future fitness. Our findings support the view that cognitive and emotional processes do not necessarily contradict each other. Rather, they might work in concert to promote other-centeredness in various circumstances, and they might contribute to the developmental flexibility of human

<sup>5</sup> This indicates a potential confounding effect of religiosity. However, the results of the present research were unlikely to be affected by participants’ religiosity since our samples consisted solely of educated adults in China. The Chinese population is among the least religious according to the World Values Survey—only 3% of Chinese respondents consider religion to be very important in their lives (Inglehart et al. 2004). Given this, we did not take extra measures to statistically assess and control religiosity.

morality in the face of such environmental challenges as morbidity-mortality, resource scarcity, and competition as mediators. Overall, these intricate relationships can be unified by the general explanation provided by LH theory.

### Compliance with Ethical Standards

**Conflict of Interest** Nan Zhu, Skyler T. Hawk, and Lei Chang declare they have no conflict of interest.

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

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