Stand up to Action: The Postural Effect of Moral Dilemma Decision-Making and the Moderating Role of Dual Processes

Authors: Liu Chuanjun, Liao Jiangqun, Liao Jiangqun

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Abstract

Previous studies have demonstrated the possibility that when people are in standing than sitting postures, they have a stronger cognitive control propensity, making them inclined to agree more to sacrificing one innocent and saving more people. Furthermore, this postural effect can be moderated by dual processes. In three studies, participants read dilemma scenarios followed by a proposed behavior to sacrifice one innocent and save five or more people. The participants in sitting or standing postures were asked whether the described action was morally acceptable (moral judgment) and whether they would perform the described action (moral action). The results demonstrated that participants were more approving of the behavioral proposal in the moral action perspective than in the moral judgment perspective across the three studies. The hypothesized postural effect was found in a field study (Study 1) and replicated in a preregistered replication study (Study 2) and further supported in an experimental study (Study 3). Compared with those in sitting postures, participants in standing postures expressed higher approval of the behavioral proposal compared to their sitting counterparts. Furthermore, the postural effect was dismissed when participants made moral decisions with a dual task to increase cognitive load, and it was reversed when they made moral decisions after deliberate consideration of the behavioral proposal (Study 3). The present research supports and extends the dual-process morality theory by demonstrating that body posture can affect moral decision-making; it also offers novel evidence revealing the moderating role of dual process on embodiment effects. It enriches our knowledge that morality is evolutionarily embodied in postures and that the dual process can moderate embodiment effects.

Full Text

Preamble

Stand Up to Action: The Postural Effect of Moral Dilemma Decision-Making and the Moderating Role of Dual Processes

Chuanjun Liu[1],[2] and Jiangqun Liao[2]*

[1]Affiliation 1, [2]Tsinghua University, Beijing, China

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Author Note: Correspondence concerning this article should be addressed to Jiangqun Liao, Department of Psychology, School of Social Sciences, Tsinghua University, Haidian District, Beijing, China, 100084. E-mail: liaojq@tsinghua.edu.cn. Tel & Fax: (86-10) 62787208.

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Abstract

Previous studies have demonstrated that people in standing postures exhibit stronger cognitive control propensities than those in sitting postures, making them more inclined to endorse sacrificing one innocent person to save multiple others. Furthermore, this postural effect can be moderated by dual processes. Across three studies, participants read dilemma scenarios describing a proposed action to sacrifice one innocent person to save five or more people. Participants in either sitting or standing postures were asked whether the described action was morally acceptable (moral judgment) and whether they would perform the described action (moral action). The results demonstrated that participants were more approving of the behavioral proposal from the moral action perspective than from the moral judgment perspective across all three studies. The hypothesized postural effect was observed in a field study (Study 1), replicated in a pre-registered study (Study 2), and further supported in an experimental study (Study 3).

Compared to those in sitting postures, participants in standing postures expressed higher approval of the behavioral proposal. Furthermore, the postural effect was eliminated when participants made moral decisions under a dual task designed to increase cognitive load, and it was reversed when they made moral decisions after deliberate consideration of the behavioral proposal (Study 3). The present research supports and extends dual-process morality theory by demonstrating that body posture can affect moral decision-making; it also offers novel evidence revealing the moderating role of dual processes on embodiment effects. These findings enrich our understanding that morality is evolutionarily embodied in postures and that dual processes can moderate embodiment effects.

Keywords: body posture; moral dilemma; dual process; embodiment; decision-making

Introduction

Standing represents an important evolutionary breakthrough for humankind that empowered bipedal locomotion. Bipedalism freed human hands for tool invention and use, as well as for hunting and warfare, which subsequently contributed to the high levels of intelligence displayed by humans today (Buss, 2016). This breakthrough expanded the range of human social activities and facilitated the evolution of social interaction. For example, power posing can elevate testosterone, decrease cortisol, and increase feelings of power and risk tolerance (Carney, Cuddy, & Yap, 2010). In such stances, athletes express triumph with their torsos extended and chests expanded when receiving medals (Matsumoto & Hwang, 2012), and men who request aid with an expansive posture receive less help (Tracy, Steckler, Randles, & Mercadante, 2018). While posture clearly matters in our social lives, its relationship with behavior and psychology has been neglected in research. For a long time, we assumed we could behave independently of our postures. However, we must now acknowledge that postures continuously support and influence the mind.

Among various postures, the fundamental positions of standing and sitting rarely receive attention, particularly in social interactions. When people make choices—especially moral choices—they are typically either sitting or standing. Recent studies have demonstrated several psychological effects of these postures (Bluedorn, Turban, & Love, 1999; Burns, Forde, & Dockrell, 2017; Knight & Baer, 2014; Mansoubi et al., 2015; Roerdink, Hlavackova, & Vuillerme, 2011; Rosenbaum, Mama, & Algom, 2017; Thorp et al., 2016). For instance, standing compared to sitting has been found to decrease the Stroop effect, a commonly used indicator of cognitive control. Since higher levels of cognitive control are associated with a smaller Stroop effect, these findings suggest that standing enhances cognitive control (Rosenbaum et al., 2017). Compared to sitting, standing can burn more energy and decrease the risk of obesity and cardiovascular disease (Mansoubi et al., 2015; Thorp et al., 2016), while also consuming more attentional resources (Roerdink et al., 2011). Additionally, behavioral research has shown that meetings in which individuals stood were 34% shorter than when they sat, though group decision performance remained comparable regardless of posture (Bluedorn et al., 1999). Overall, these findings demonstrate that standing individuals exhibit greater cognitive control propensity than those who are sitting. Evolutionarily, standing and walking upright also provided humans with more opportunities to access resources and exert greater control over their lives.

Cognitive control plays a crucial role in moral life, as demonstrated by dual-process morality theory (Greene, 2007, 2013; Haidt, 2007, 2013). Cognitive and emotional processes are associated with approval and disapproval, respectively, of proposals that harm others but maximize positive overall consequences. This

type of behavioral proposal aligns with utilitarianism, which advocates for the greatest happiness for the greatest number of people (Bentham, 1996), and is therefore called a utilitarian proposal. More controlled cognitive deliberation results in higher levels of approval for utilitarian proposals (Amit & Greene, 2012; Greene, 2009; Greene, Morelli, Lowenberg, Nystrom, & Cohen, 2008; Greene, Sommerville, Nystrom, Darley, & Cohen, 2001). Given that standing individuals have greater propensity for cognitive control than those who are sitting, we predict that standing individuals will be more approving of utilitarian proposals on average compared to their sitting counterparts (Hypothesis 1).

Nevertheless, it is remarkable that such an abstract moral propensity is directly rooted in body postures. This postural effect may be inconclusive depending on underlying cognitive process mindsets. When cognitive resources are partially occupied, participants may make decisions intuitively without considering internal cues from their body posture, resulting in the elimination of the embodiment effect. This speculation is supported by embodied metaphor studies demonstrating that embodiment effects disappear with increasing cognitive load (Skulmowski & Rey, 2017; Zestcott, Stone, & Landau, 2017). For example, in research on the weight-importance metaphor, participants rated an unrelated topic as more important when holding a moderately heavy clipboard compared to a light one. However, when participants directed attention to the clipboard' s weight while rating the importance of unrelated topics, this embodiment effect was eliminated (Zestcott et al., 2017). Similarly, exerting physical effort by wearing a backpack led participants to provide higher judgments of learning for easy nouns, but this embodiment effect disappeared when participants experienced high cognitive load while learning more difficult nouns (Skulmowski & Rey, 2017). These findings imply that embodiment effects are eliminated when high cognitive load prevents cognitive processes from using bodily cues as a basis for decision-making. Therefore, we expect that the postural effect on moral dilemma decision-making will be eliminated by an additional cognitive load, such as a dual task (Hypothesis 2).

In contrast, what happens when cognitive resource demands are compensated by deliberate thinking? When decision-makers deliberately consider a moral proposal, they have full access to all available resources, including internal cues from body posture. Thus, we expect that the postural effect will be recovered, such that standing increases approval of the utilitarian proposal to a greater extent than sitting due to stronger cognitive control (Hypothesis 3a). However, the opposite pattern is also possible. First, according to dual-process morality theory, deliberating individuals become more utilitarian than non-deliberating control groups (Greene et al., 2008), meaning they become more approving of utilitarian proposals. Second, as implied by Roerdink et al. (2011), standing requires more attentional resources than sitting, which means that standing individuals must invest some cognitive resources to maintain posture control and thus have fewer cognitive resources available overall than sitting individuals. From dual-process morality theory, it follows that standing individuals would be less utilitarian than sitting individuals. In the present study, we therefore

expect that standing individuals will be less approving of utilitarian proposals than sitting individuals, resulting in a reversal of the postural effect on moral dilemma decision-making (Hypothesis 3b).

To test our hypotheses, we conducted three studies. Study 1 aimed to uncover the postural effect (Hypothesis 1) in a natural setting, with participants completing a moral decision-making task while either standing or sitting on a football field. Study 2 was a pre-registered study designed to replicate the postural effect in an experimental setting. Study 3 further replicated the postural effect and tested whether dual processes moderate it. Study 3 therefore employed three between-subjects conditions: a control condition to replicate the postural effect, an intuitive condition to test whether the postural effect would be eliminated under dual cognitive load, and a rational condition to examine whether deliberate consideration manipulation would recover or reverse the postural effect. In summary, Study 3 predicted an interaction between posture (standing/sitting) and dual process (control/intuitive/rational).

Study 1

Method

Participants. Participants in the field study were 63 university students (33 females, aged 18–29, Mage = 20.54, SDage = 1.70). They were informed about the study without compromising the research question or data collection validity. Participants provided written consent before the study and received a gift as compensation. The study was approved by the Institutional Review Board for Human Participants of Tsinghua University.

As no comparable studies existed to model the research design, we applied the common sampling strategy of 30 participants per condition and aimed to balance participant gender between conditions (see Table 1). All measures and manipulations are reported here, and no participants were excluded from the analysis. During debriefing, no participants reported that their body posture might have influenced their decisions.

Design. We employed a 2 (perspective: moral judgment/moral action; within-subjects) × 2 (posture: standing/sitting; between-subjects) mixed analysis of variance (ANOVA) design. Participants were randomly assigned to groups and maintained either a natural sitting or standing posture while reading the moral dilemmas and answering questions.

For the moral decision questions, we used both moral judgment and moral action questions. Previous research, including our own work, has shown that individuals are more approving of utilitarian proposals when questions are framed around action implementation (i.e., moral action questions) than around moral acceptance of an action (i.e., moral judgment questions; Gawronski, Armstrong, Conway, Friesdorf, & Hutter, 2017; Liu & Liao, under review; Pletti, Lotto, Buodo, & Sarlo, 2017). Therefore, we provided two questions from different

perspectives for each dilemma. Each dilemma concluded with a harmful proposal that maximized positive consequences, such as "push the stranger and save the five workers." Participants then answered the moral decision questions in the following order: (1) moral judgment ("Is it morally acceptable to perform the described action?") and (2) moral action ("Would you perform the described action?"). Both questions used a 9-point scale (1 = completely disapproving; 9 = completely approving) to measure approval extent, with higher scores indicating more utilitarian responses. The former question focused on moral acceptance while the latter focused on moral action implementation, representing important knowledge-based and action-based elements of moral decision-making.

A double-blind design was applied. Experimenters were told that the dilemmas were unrelated filler materials included to increase survey length, and that we were interested in the name-letter effect (Kitayama & Rarasawa, 1997) related to adopting sitting and standing postures. Participants were told they would complete a letter preference evaluation task. Consequently, neither experimenters nor participants knew the true purpose of the study, and none reported guessing it when asked afterward.

Materials. The moral dilemma scenarios were selected from those used by Koenigs et al. (2007) based on their significant moral relevance to the study population (see Part 1 of the supplementary online materials). The scenarios were matched for emotional arousal level and word length. The three dilemma scenarios used were "Ecologists," "Footbridge," and "Vitamins" (see Part 2 of the supplementary online materials).

Procedure. The study was conducted on a football field. Passersby were randomly invited to participate. To reduce potential effects of energy expenditure, we restricted invitations to those who had just walked onto the field and excluded those currently exercising or who had just finished exercising. This ensured participants' energy had not been recently depleted by physical activity, guaranteeing sufficient cognitive resources for the moral decision task.

Participants were asked to complete a letter preference task while either sitting naturally on a chair or standing. All participants were observed within the same zone of the playing field and faced the same direction. The questionnaire was placed on a clipboard with a pencil provided. All participants were right-handed and used their left hand to hold the clipboard and their right hand for writing. They first completed the letter preference evaluation task with the following instructions: "The present research aims to discover how people evaluate the 26 letters of the alphabet. The responses will only be used for scientific research and teaching courses, without any identifying personal information. Therefore, please follow your current state and report your intuitive preference."

After completing the letter preference evaluation task, participants received instructions for the moral dilemma test: "Sometimes during our lifetime, we have to make tough decisions. We are conducting a pre-test to filter materials for use in other decision studies. Here, three scenarios that we might face will be

presented. Please put yourself in each situation and answer the questions that follow each scenario."

Participants were thanked and debriefed upon completion. During debriefing, participants were asked, "Were your decisions influenced by any contextual factors, such as the light, the temperature, your posture, and so on?" No participants reported any influence from their body posture.

Results

Demographic distribution and average moral ratings are shown in Table 1. We conducted a 2 × 2 ANOVA with moral perspective (moral judgment/moral action) as the within-subjects variable and posture (sitting/standing) as the between-subjects variable. The results revealed a main effect of moral perspective, $F(1, 61) = 35.14$, $p < .001$, $p^2 = 0.37$, with moral action ratings significantly higher than moral judgment ratings. A between-subjects effect of posture was also identified, $F(1, 61) = 4.16$, $p = .046$, $p^2 = 0.06$, with moral ratings significantly higher when standing than when sitting. The interaction effect was not significant, $F(1, 61) = 0.33$, $p = .567$, $p^2 = 0.01$. These results confirm previous research on the moral question framing effect, showing that moral action frames elicit more utilitarian inclinations than moral judgment frames (Gawronski et al., 2017; Liu & Liao, under review). The findings also indicate that standing activates more utilitarian inclinations than sitting, thus supporting Hypothesis 1.

Study 2

In response to the replication crisis in psychological research (Open Science Collaboration, 2015), we pre-registered this replication study to test whether the postural effect was robust and to explore possible boundary conditions. The pre-registration can be retrieved from osf.io/b4dg8.

Study 2a

Method Participants. We used G*Power to conduct a power analysis and compute the required sample size. In Study 1, we achieved a power of 0.73 given = .05, an effect size* f* = .26, and a sample size of 63. Our goal was to obtain a power of .80 to detect a medium effect size, $f = .26$ (based on Study 1) at the standard .05 alpha error probability. The analysis indicated we needed to recruit 74 participants. To account for potential exclusions due to failed manipulation checks, we recruited 80 participants (aged 17–23, *M*age = 19.74, *SD*age = 1.20), half of whom were female. Participants received 10 yuan compensation after completing the experiment. The study was approved by the Institutional Review Board for Human Participants of Tsinghua University.

Data were analyzed upon study completion, and all measures and manipulations are reported here.

Design and Materials. The analysis utilized a mixed design with perspective (two levels: moral judgment/moral action) as the within-subjects condition and posture (two levels: standing/sitting) as the between-subjects condition. Variables were manipulated as in Study 1. Participants were randomly assigned to either the sitting or standing condition. In the sitting condition, participants completed the task in a regular seated posture. In the standing condition, they assumed a regular standing posture with the computer screen adjusted to their preferred height using a standing desk. The moral dilemma decision task was preprogrammed with Inquisit 3.0 to record participants' responses.

The moral dilemma scenarios were also selected from those used by Koenigs et al. (2007). The scenarios were matched for emotional arousal level and word length. Five dilemmas were used: "Ecologists," "Footbridge," "Vitamins," "Crying Baby," and "Sacrifice." An answer-check scenario (see Part 2 of the supplementary online materials) was adopted from Gawronski et al. (2017), in which participants were instructed to select "completely approving." By default, we excluded from analyses all participants who did not follow these instructions.

Procedure. To mask the research objective, we created a cover story. Both the experimenter and participants were told that the experiment was a workstation-experience study and that the moral dilemma decision-making task was used to simulate a daily office work task. After providing formal consent, participants were ushered into a separate room and left alone to complete the moral dilemma decision-making task first, followed by workstation ratings. Upon completing all tasks, they were thanked and debriefed.

Results After filtering out participants who failed manipulation check items, we conducted a 2×2 ANOVA with moral perspective (moral judgment/moral action) as the within-subjects variable and posture (sitting/standing) as the between-subjects variable. The results revealed a main effect of moral perspective, $F(1, 69) = 6.93$, $p = .010$, $\mathrm{p}^2 = 0.09$, with moral action ratings significantly higher than moral judgment ratings. The between-subjects effect of posture was not significant, $F(1, 69) = 0.16$, $p = .690$, $\mathrm{p}^2 = 0.00$. The interaction effect was not significant, $F(1, 69) = 2.55$, $p = .115$, $\mathrm{p}^2 = 0.04$. These results support previous research on the moral question framing effect, showing that moral action frames elicit stronger utilitarian inclinations than moral judgment frames (Gawronski et al., 2017; Liu & Liao, under review). However, the postural effect was not found.

We carefully reviewed the experimental procedure and identified two important issues. First, five participants reported during debriefing that the standing desk was somewhat rickety or wobbly. We also confirmed after the experiment that the standing desk was unstable. Second, we speculated that the cover story might have led participants to adjust their postures to better experience the standing desk. These two factors could have drawn participants' attention to their postures, thereby eliminating the postural effect based on recent relevant evidence (Noah, Schul, & Mayo, 2018; Zestcott et al., 2017). For example, Noah

et al. (2018) found that participants rated cartoons as funnier when holding a pen with their teeth versus their lips, but this facial-feedback effect disappeared when a camera was present to record their reactions. This demonstrates that embodiment effects can be eliminated when participants attend to the embodied variable. We reasoned that the instability of the standing desk and the content of the cover story may have drawn participants'attention to their posture, resulting in the elimination of the postural effect. We therefore modified the experimental settings and conducted Study 2b. First, we replaced the wobbly standing desk with a new stable one. Second, we adjusted the cover story. The experimenter was told that participants might pay too much attention to the workstation, which would confound workstation-experience ratings. Therefore, participants were simply told that the study was a common psychological experiment. The remaining procedure was identical to Study 2a.

Study 2b

Method Participants. We recruited 80 participants aged 18-23 (Mage = 19.59, SDage = 0.96), half of whom were female. Participants received 10 yuan compensation after completing the experiment. The study was approved by the Institutional Review Board for Human Participants of Tsinghua University. Data were analyzed upon study completion, and all measures and manipulations are reported here.

Design, Materials, and Procedure. The design, materials, and procedure were almost identical to those of Study 2a, except that the standing desk was replaced with a stable one and the cover story was altered as described above.

Results After filtering participants who failed manipulation check instructions, we conducted a 2 × 2 ANOVA with moral perspective (moral judgment/moral action) as the within-subjects variable and posture (sitting/standing) as the between-subjects variable. The results revealed a main effect of moral perspective, $F(1,\ 68) = 16.95$, $p < .001$, $\mathrm{p}^2 = 0.20$, with moral action ratings significantly higher than moral judgment ratings. The between-subjects effect of posture was significant, $F(1,\ 68) = 5.70$, $p = .020$, $\mathrm{p}^2 = 0.08$, with participants in the standing condition giving significantly higher ratings than those in the sitting condition. The interaction effect was not significant, $F(1,\ 68) = 0.28$, $p = .598$, $\mathrm{p}^2 = 0.00$. These results support previous research on the moral question framing effect (Gawronski et al., 2017; Liu & Liao, under review), and the postural effect was again observed.

Overall, Study 2 replicated the postural effect after we altered the cover story and replaced the unstable standing desk with a stable one. This demonstrated that the postural effect might be moderated by dual processes, which we assessed in Study 3.

Study 3

Method

Participants. We recruited 220 university students, and 180 of them (93 females, aged 18–23, Mage = 20.14, SDage = 1.12) passed the manipulation check scenario (described below). Participants were informed about the study without compromising the research question or data collection validity. Participants provided written consent before the study and received either a gift or course credit according to their preference. The study was approved by the Institutional Review Board for Human Participants of Tsinghua University. Data were analyzed upon study completion, and all measures and manipulations are reported here.

Design and Materials. To test our hypotheses, we conducted a 3 (dual process: control/intuitive/rational; between-subjects) × 2 (posture: sitting/standing; between-subjects) × 2 (perspective: moral judgment/moral action; within-subjects) mixed ANOVA design. The control condition was used to replicate the postural effect. The intuitive condition tested whether dual cognitive load would eliminate the postural effect (Hypothesis 2), and the rational condition tested whether deliberate consideration would recover or reverse the postural effect (Hypothesis 3a/3b). Thus, dual process (control/intuitive/rational) might moderate the postural effect, potentially producing an interaction between dual process and posture.

The moral dilemma materials were identical to those used in Study 2.

Procedure. Participants completed the task on a computer. The computer screen was elevated in the standing condition using a standing desk and placed on the desk as usual in the sitting condition. After providing informed consent, participants were randomly assigned to one of the between-subjects conditions. Participants completed the letter preference evaluation task using the same instructions as in Study 1. The moral dilemma scenarios were then presented in random order using Inquisit 3.0, and participants read each dilemma and answered the moral decision questions.

The control condition procedure was identical to Study 1. The only difference between the intuitive condition and the control condition was that participants in the intuitive condition needed to remember a meaningless five-letter string (e.g., “bukps”) presented with each scenario before answering the moral decision-making questions. Since previous research has demonstrated that working memory is limited to approximately seven chunks (Miller, 1956), we used five characters in the dual task to avoid completely overloading working memory. Furthermore, to avoid any anchoring effects following moral decisions, we did not use Arabic numerals in the dual task because participants might otherwise select the same number that appeared in the dual task when making moral decisions. To prevent this possibility, we used only letter strings in the dual task. The only difference between the rational condition and the control condition was that participants in the rational condition were required to answer a deliberate

question (“Regardless of whether you agree or disagree with the above proposal, what is your reason for this?”) without any time limit before completing the moral decision questions. Participants freely answered this question and then made their moral decisions.

Participants were thanked and debriefed upon completion using the same procedure as Study 1. No participant reported any influence of posture on their decision-making.

Results

First, we conducted a 2 × 2 ANOVA using data from the control condition, as in Study 1. The results showed a main effect of moral perspective, $F(1, 62) = 57.40$, $p < .001$, $p^2 = 0.48$, with moral action ratings significantly higher than moral judgment ratings. There was also a between-subjects effect of posture, $F(1, 62) = 5.32$, $p = .024$, $p^2 = 0.08$, with moral ratings significantly higher when standing than when sitting. The interaction effect was not significant, $F(1, 62) = 0.02$, $p = .894$, $p^2 = 0.00$. These findings replicated those from Study 1 and further supported Hypothesis 1, demonstrating that the postural effect on moral decisions is robust in both field and laboratory settings.

Next, we conducted a 3 (dual process: control/intuitive/rational; between-subjects) × 2 (posture: sitting/standing; between-subjects) × 2 (perspective: moral judgment/moral action; within-subjects) mixed ANOVA to further test our hypotheses. The results revealed a main effect for moral perspective, $F(1, 174) = 137.02$, $p < .001$, $p^2 = 0.44$, with moral action ratings significantly higher than moral judgment ratings, confirming the moral question framing effect (Gawronski et al., 2017; Liu & Liao, under review).

The between-subjects effect for dual process was significant, $F(2, 174) = 31.25$, $p < .001$, $p^2 = 0.26$. Multiple comparisons using the least significant difference (LSD) test demonstrated that moral ratings in the intuitive condition were significantly higher than in the control condition (95% CI of the difference [0.36, 1.41]), and that moral ratings in the rational condition were significantly higher than in both the control condition (95% CI of the difference [1.61, 2.68]) and the intuitive condition (95% CI of the difference [0.71, 1.80]). These results support intuitive utilitarianism theory (Bago & De Neys, 2019; Bialek & De Neys, 2017), demonstrating that individuals might intuitively be more approving of harmful proposals that maximize benefits. The results also partially support dual-process morality theory, suggesting that deliberate thinking increases approval of utilitarian proposals (Greene et al., 2008).

The results did not demonstrate a between-subjects effect of posture, $F(1, 174) = 0.07$, $p = .788$, $p^2 = 0.00$, but the interaction between posture and dual process was significant, $F(2, 174) = 3.98$, $p = .020$, $p^2 = 0.04$. Specifically, as shown in Fig. 1 [Figure 1: see original paper], the simple effects of dual process were significant for both sitting, $F(2, 174) = 27.76$, $p < .001$, $p^2 = 0.24$, and standing, $F(2, 174) = 6.77$, $p = .001$, $p^2 = 0.07$. Furthermore, the simple effect

of posture was marginally significant in the control condition, $F(1, 174) = 3.71$, $p = .056$, $p^2 = 0.03$; non-significant in the intuitive condition, $F(1, 174) = 0.04$, $p = .837$, $p^2 = 0.00$; and reversed in the rational condition, $F(1, 174) = 4.22$, $p = .041$, $p^2 = 0.02$. No other interactions were found.

Overall, the results replicated the moral question framing effect (Gawronski et al., 2017; Liu & Liao, under review) and the hypothesized postural effect on moral dilemma decision-making (Hypothesis 1). The results also support Hypothesis 2, demonstrating that the postural effect is eliminated when cognitive resources are burdened and participants must make moral decisions intuitively. Furthermore, the postural effect was reversed after deliberate thinking, supporting Hypothesis 3b and rejecting Hypothesis 3a.

General Discussion

The findings demonstrate that standing compared to sitting increases people' s approval of harmful utilitarian proposals when the underlying cognitive process is not artificially manipulated. The pre-registered replication demonstrated that the postural effect can be replicated, but the effect is highly sensitive to contextual factors. When experimental settings or environmental variables draw participants' attention to their postures, the postural effect is eliminated. Furthermore, the postural effect was moderated by dual processes; it was not apparent under intuitive processing but was reversed under rational processing. These findings indicate that body posture can influence moral decision-making and that the wide range of social-psychological effects observed in seated participants should be revalidated for standing participants. Additionally, replication failures for many embodiment effects may be due to uncontrolled underlying cognitive processes or contextual covariates.

The present studies uncovered the moderating role of dual processes on postural effects in moral decision-making. Specifically, the results suggest three findings related to the postural effect. First, posture control as a background task induces co-varying cognitive inclination that influences the immediate task when the cognitive process is not artificially manipulated. Second, posture cues cannot access cognitive processes and influence the immediate task when cognitive processes are occupied by dual immediate tasks. Finally, posture control impairs cognitive resources and influences the immediate task when cognitive inclination is intensified by deliberate thinking.

These findings can be understood from an evolutionary perspective. Human thoughts are constrained by the body and its surroundings. Standing enables humans to reach out into their environment and care more about behavioral consequences in the competition for survival. Consequently, standing participants cared more about whether the consequences of their decisions would be beneficial compared to their seated counterparts. As humans evolved to stand, posture control became a background task; whatever we do, we are always in some posture. Although evolution enabled multitasking for survival, conducting

multiple immediate tasks expends cognitive resources so that cognitive processes cannot access bodily background cues, thus eliminating postural effects. However, cognitive resources are compensated through deliberate thinking, and even more so when sitting than when standing, thereby reversing the postural effect. Evolutionarily, these processes facilitate better adaptation to the world and enhance human survival.

Contributions and Limitations

The present research contributes to the embodied cognition literature by identifying a novel postural effect on moral decision-making and establishing dual processes as a boundary condition. It expands dual-process morality theory to explain embodied moral decision-making and provides new evidence for psychological differences between sitting and standing postures (Bluedorn et al., 1999; Burns et al., 2017; Knight & Baer, 2014; Mansoubi et al., 2015; Roerdink et al., 2011; Rosenbaum et al., 2017; Thorp et al., 2016). Three main theoretical contributions emerge from this work.

First, the findings have important implications for the replication crisis and embodiment effects. Many failures to replicate embodiment effects may be due to uncontrolled underlying cognitive processes or contextual covariates. As discussed above, if participants complete an experimental task hastily, they primarily respond using intuition and do not utilize bodily and environmental cues to support their decisions, causing embodiment effects to disappear (Skulmowski & Rey, 2017; Zestcott et al., 2017). Additionally, if experimental settings or contextual covariates draw participants' attention to embodied variables, the target embodiment effect may be eliminated, as observed in our Study 2 replication and in Noah et al. (2018). Conversely, as shown in the rational condition of Study 3, if some participants silently reverse postural effects through deliberate thinking while others retain the original postural effects, the postural effects of moral decisions will cancel out overall. Such a possibility could account for many failed replications, such as with the power pose effect (Carney et al., 2010; Cuddy, Schultz, & Fosse, 2018). In summary, many replication failures in psychological research should be treated cautiously because other covariates could be interfering with the target effect.

Second, experimental findings from seated participants may differ from those obtained from standing participants (Rosenbaum et al., 2017). As standing increases cognitive control propensity and readiness-for-action states, it leads to different behavioral effects. The present study demonstrated that the cognitive control inclination enhancement from standing could influence downstream moral decisions, rather than merely affecting attention distribution. Therefore, postural effects might exist across diverse domains. Further consideration of differential effects resulting from standing versus sitting will enrich and enhance associated psychological theories.

Third, previous research has demonstrated intuitive utilitarian sensitivity in

moral dilemma decision-making (Bago & De Neys, 2019; Bialek & De Neys, 2017), and the present research provides novel support for this theory. As shown in Study 2, moral ratings in the intuitive condition were significantly higher than in the control condition. This indicates that although participants responded intuitively to the dilemmas, they did not become less utilitarian or more averse to harmful proposals, as implied by dual-process morality theory. Instead, they became more approving of harmful proposals. In other words, they intuitively held more utilitarian moral attitudes than the control group.

Finally, the moral question framing effect was consistently replicated across all three studies, regardless of whether cognitive processes were artificially manipulated. This demonstrates that the moral question framing effect is not affected by cognitive process differences between the two questions. Liu and Liao (under review) argue that this effect is primarily due to motivational rather than emotional processes, which can be explained by the action-based model of cognitive dissonance (Harmon-Jones & Harmon-Jones, 2002; Harmon-Jones, Harmon-Jones, & Levy, 2015; Harmon-Jones, Price, & Harmon-Jones, 2015; Harmon-Jones, Amodio, & Harmon-Jones, 2009). The present research further provides evidence that cognitive processing discrepancies do not impact the moral question framing effect.

Two limitations and future research directions should be noted. First, the mechanism underlying the postural effect could be further explored. Physiologically, many biological markers differ between sitting and standing postures, including center-of-pressure regularity (Roerdink et al., 2011) and energy expenditure (Burns et al., 2017). Future research could investigate which physiological changes account for the postural effect on moral decision-making. Another possible mechanism involves language metaphors. The Chinese saying, "Rise up to action," might link standing posture to approving proposed actions. Future studies could assess whether an embodied metaphor mechanism underlies the postural effect.

Second, supine posture should also be considered for its psychological effects. Some researchers have found that supine posture reduces neural response to anger evocation (Harmon-Jones & Peterson, 2009), decreases approach motivation, and further reduces rationalization (Harmon-Jones, Price, & Harmon-Jones, 2015) compared to upright posture. Moreover, another study demonstrated that supine posture inhibits cortical activity to a greater extent than seated posture (Spironelli, Busenello, & Angrilli, 2016). This evidence suggests that supine posture is another specific stance that might produce various psychological effects. Evolutionarily, supine posture is also more primitive in human development. Future research should therefore examine supine posture' s effects on morality and other social-psychological factors.

Conclusion

Standing enhances cognitive control compared to sitting and makes people more approving of utilitarian behavior. This postural effect can be eliminated when individuals make moral decisions intuitively and reversed when they engage in deliberate thinking before making moral decisions. As an evolutionary outcome, standing motivates us to care more about beneficial consequences in moral life than does sitting, and this postural effect depends on the cognitive process mindset. The evidence obtained in the present study also suggests that many replication failures may be due to uncontrolled cognitive processes.

Disclosure of conflict of interest. The authors declare no conflicts of interest.

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Tables

Table 1. Demographic distribution of valid participants and description of moral ratings ($M \pm SD$)

Between-subject condition	nfemale	nmale	Mage	SDage	moral rating (M ± SD) judgment	moral rating (M ± SD) action
Study 1						
Sitting					2.98±1.47	4.16±1.88
Standing					3.65±1.87	5.08±1.84
Study 2						
Study 2a: sitting					5.04±1.41	5.21±1.30

Between-subject condition	nfemalenmale Mage SDage	moral rating (M ± SD) judgment	moral rating (M ± SD) action
Study 2a: standing		4.89±1.57	5.59±1.38
Study 2b: sitting		4.27±1.15	5.11±1.29
Study 2b: standing		5.07±1.66	5.72±1.64
Study 3			
Control: sitting		2.69±1.41	4.09±1.54
Control: standing		3.43±1.27	4.78±1.52
Intuitive: sitting		4.20±1.45	5.15±1.48
Intuitive: standing		4.00±1.72	5.19±1.74
Rational: sitting		5.54±2.16	7.06±1.49
Rational: standing		4.69±2.16	6.28±1.94

Figure Captions

Fig. 1. The postural effect of moral ratings was moderated by dual process. The error bars represent ± 1 standard error.

Note: Figure translations are in progress. See original paper for figures.