If it makes you feel bad, don’t do it! Egoistic rather than altruistic empathy modulates neural and behavioral responses in moral dilemmas

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HIGHLIGHTS

• Affective empathy modulates responses at multiple levels when deciding on Footbridge-type dilemmas.
• Egoistic empathy affects both early emotion-related neural activity and behavioral choices in Footbridge-type dilemmas.
• Altruistic empathy affects conscious emotional evaluation in all dilemmas.
• Empathy is unrelated either to neural activity or to behavioral choices in Trolley-type dilemmas.

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ABSTRACT

According to Greene et al.’s dual-process theory, the differential involvement of emotional processes would explain the different patterns of moral judgments people typically produce when faced with Trolley- and Footbridge-type dilemmas. As a relevant factor, dispositional empathy is known to motivate prosocial behaviors, thus playing a central role in moral judgment and behavior. The present study was aimed at investigating how behavioral and neural correlates of moral decision-making are modulated by the cognitive and affective dimensions of empathy. Thirty-seven participants were presented with 30 Footbridge-type and 30 Trolley-type dilemmas. Participants were required to decide between two options: letting some people die (non-utilitarian) vs. killing one person to save more people (utilitarian). Event-related potentials (ERPs) were recorded stimulus-locked to a “decision slide.” Response choices and ratings of valence and arousal were also collected. Trait empathy was measured through the Interpersonal Reactivity Index (IRI), assessing both the cognitive and affective dimensions. Scores on the Empathic Concern affective subscale of the IRI positively predicted unpleasantness experienced during decision-making for all dilemmas. On the other hand, for Footbridge-type dilemmas only, scores on the Personal Distress affective subscale predicted negatively the mean percentages of utilitarian choices and positively the mean amplitudes of the P260, an ERP component reflecting an immediate emotional reaction during decision-making. It is concluded that “self-oriented” feelings of anxiety and unease, rather than “other-oriented” feelings of concern, affect behavioral choices and emotion-related cortical activity in Footbridge-type moral dilemmas.

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1. Introduction

Over the past decade, the relationship between cognitive and emotional processes in moral judgment has increasingly received attention in both the philosophical and psychological domains. Within this research field, the cognitive neuroscience approach has undoubtedly generated new perspectives on the role of emotions in shaping moral judgments, with substantial work being devoted to exploring the neural basis of decision-making in moral dilemmas [1–4].

Among recent research, one of the most influential theoretical contributions has been provided by Greene et al. [2,3,5]. According to their dual-process model, resolutions of moral dilemmas are driven by the interaction between two competing processing systems mediated by partially dissociable neural networks: a fast, automatic emotional system engaging mainly the medial prefrontal cortex, and a slow, controlled cognitive system engaging mainly the dorsolateral prefrontal cortex and the inferior parietal lobe. Specifically, cognitive processes would drive utilitarian choices (e.g., approving of killing one person to save more lives), whereas emotional processes would prompt non-utilitarian choices (e.g., disapproving of killing one person to save
more lives). According to this model, the differential involvement of emotional processes would explain the different patterns of moral judgments people typically produce when faced with Trolley-type and Footbridge-type dilemmas. In the Trolley case, most people judge as morally acceptable the action of pulling a lever redirecting a runaway trolley, which would kill five workmen, onto a sidetrack where it will kill only one person. Despite the same cost/benefit ratio, in the Footbridge case, most people judge as morally inappropriate the action of pushing one person off an overpass onto the tracks to stop the runaway trolley and save the five workmen [3,4,6,7]. This latter dilemma would trigger a stronger aversive reaction that would prevail over controlled cognitive processes and rational cost/benefit computations in determining the resultant moral judgment [8]. Such a powerful emotional response, possibly triggered by harm used as a means to an end and enhanced by direct physical engagement [9–11], might be traced back to the evolutionary benefits of refraining from harm to favor cooperative behavior in social contexts [8,12,13]. But what does this so-called “alarm-bell” emotion really signal? And what is its proximate basis?

Despite aversion to harming others is unanimously acknowledged as a moral obligation, its psychological basis remains unclear [9,13]. Indeed, such prosocial behavior might be ultimately motivated by both other-oriented and self-oriented concerns. In particular, emotionally speaking, the choice of saving five people by pushing one person off the bridge might be rejected because of the empathic concern related to taking the victim’s perspective (i.e., altruistic motivation) or to avoid the personal cost of causing intentional harm to others (i.e., egoistic motivation). In this work, we will suggest that the aversive reaction to Footbridge-type dilemmas might effectively signal the anticipation of the emotional consequences of causing intentional harm (cf. [14]). For example, it should be plausible that at conscious level anticipated guilt plays a significant role in shaping moral judgments, as guilt aversion has proved to strongly motivate people’s choices during decision-making [15]. Indeed, among a number of different emotions to choose from (i.e., anger, sadness, fear, anxiety, disgust, guilt, shame, and surprise), guilt was the primary emotion reported by participants during moral judgment when Footbridge-type dilemmas, drawn from Greene et al.’s [3] set, were presented [16]. On these grounds, it might be emotionally more costly for an individual to kill intentionally one person, even in the service of a greater good, than to let more people die.

Here, it seems particularly relevant to consider the influence of dispositional empathy. It is widely acknowledged that empathy motivates prosocial behaviors and prevents people from harming others, thus playing a central, if not necessary, role in moral judgment and behavior (e.g., [17,18]). This multifaceted phenomenon, broadly defined as the capacity to understand and share other people’s internal states, involves related but partially dissociable classes of processing. Cognitive empathy refers to the ability of intellectually taking the perspective of others and understanding their thoughts, feelings, and actions, whereas affective empathy refers to the capacity to experience emotional reactions toward others’ experiences or expressions of emotions [19–22]. As for affective empathy, two different dimensions have been identified: empathic concern, involving feelings of sympathy, compassion and concern for others’ emotional states, and personal distress, involving aversive emotional reactions and experience evoked by others in distress [19,21]. Relevant to the present study, both empathic dimensions may underlie prosocial behavior, but by triggering different motivations. Other-oriented empathic concern promotes truly altruistic motivation to help, with the final goal of increasing the welfare of another person, while self-oriented personal distress promotes egoistic motivation to help, with the final goal of reducing one’s own aversive empathic arousal [23].

The main goal of this study was to investigate the role played by cognitive empathy and affective empathy in modulating people’s behavior-al choices, neural activity, and emotional experience when facing moral dilemmas. In particular, we aimed at assessing the nature of the motivation underlying the rejection of utilitarian resolutions in Footbridge-type dilemmas and its relation to cortical correlates of cognitive and emotional processing.

Some behavioral studies have demonstrated a clear relationship between dispositional empathy and utilitarian judgments in moral dilemmas. Specifically, a negative correlation between trait altruism, as measured by the Emotional Empathy Tendency Scale [24], and the number of utilitarian judgments was found using Footbridge-type dilemmas [16]. Moreover, by pharmacologically enhancing serotonin function in healthy volunteers, Crockett et al. [25] demonstrated a reduction in utilitarian judgments only for emotionally salient, Footbridge-type dilemmas, suggesting that serotonin motivates prosocial behavior by enhancing aversive emotional reactions to harm. Importantly, this effect was found only in individuals high in trait empathy, as measured by the Interpersonal Reactivity Index [26], indicating that empathy is strongly involved in modulating moral judgment, possibly by supporting a harm-avoidant bias. However, despite the merit of empirically testing the influence of dispositional empathy on judgments related to moral dilemmas, the above-mentioned studies did not distinguish either between cognitive empathy and affective empathy, or between empathic concern and personal distress. The different dimensions of trait empathy were instead measured through the Interpersonal Reactivity Index [26] in a recent study investigating different kinds of moral responders [27]. Participants who were categorized as utilitarian (i.e., who gave utilitarian responses to both moral dilemmas presented in one single pair) showed significantly lower levels of empathic concern as compared to non-utilitarian responders (i.e., who gave non-utilitarian responses to both moral dilemmas), with no difference between the other dimensions of empathy. The authors concluded that reduced other-oriented affective empathy enabled participants to favor harmful acts that maximize aggregate welfare, while highlighting that this only applied to extreme utilitarians.

In spite of the large number of neuroimaging studies that have assessed the role of empathy disposition on brain responses to the perception of pain in others (for a review, see Ref. [28]), the effects of trait empathy on neural processing underlying moral decision-making have not been systematically investigated to date. In a recent fMRI study [29], cognitive empathy and emotional empathy, as measured by the Questionnaire of Cognitve and Affective Empathy [30], did not predict differences in brain activation between tasks requiring judgments on other people’s actions involving harm to others (moral decision-making) or not (non-moral decision-making). Importantly, no relationship was found between self-reported levels of empathy and behavioral choices.

Further functional neuroimaging studies exploring whether and how empathetic ability modulates neural processing during moral decision-making are needed in order to clarify its relation to the cognitive and emotional processes driving behavioral choices. However, it is also possible that the slow hemodynamic activity measured by fMRI does not allow the detection of the specific decision phases critically modulated by empathy. Indeed, despite its complex and dynamic nature, the decision-making process can be broken down into temporally and functionally distinct phases, each engaging both cognitive and affective processes in various degrees [31,32]. In a previous study [33], we developed a novel paradigm allowing to explore the temporal dynamics of decision-making through event-related potential (ERP) recording in the context of moral dilemmas. We found a larger P260 component, associated with greater unpleasantness ratings, when subjects were deciding on Footbridge- than Trolley-type dilemas. Based

1 In our previous study [33], the Footbridge- and Trolley-type dilemmas were classified as Instrumental and Incidental dilemmas, respectively, based on the intentionality of the proposed actions (killing as an intended means to save others vs. killing as a foreseen but unintended consequence of saving others); however, discussing the specific psychological factors that differentiate the two classes of dilemmas was beyond the aims of the present study. Therefore, for the sake of clarity, we decided to use here the well-known Footbridge/Trolley-type distinction (see Ref. [34] for a comparison between the Instrumental/Incidental distinction and the Personal/Impersonal distinction proposed by Greene et al. [3]).
on the positive correlation obtained between P260 amplitude and unpleasantness experienced during decision-making, this component was interpreted in terms of an immediate affective reaction during the early processing stages. On the other hand, decisions on Trolley-type dilemmas required greater attentional resources during later stages of processing, as reflected in the larger ERP slow wave amplitudes. This effect was interpreted in terms of effortful, controlled cognitive processing required for a cost/benefit computation and/or for the successful regulation of the earlier emotional response. Taken together, these results supported the dual-process model of moral judgment [2,3,5], also providing relevant information on the time course of neural activation during decision-making.

In the present study, we performed new analyses on the dataset from our previous work [33]. By including new variables, we focused on the role played by individual levels of empathy in modulating emotional experience and decision-making at both neural and behavioral levels. Specifically, our aim was threefold: 1) to investigate whether and how cognitive empathy and affective empathy exert moderating influence on cortical activity, behavioral choices, and affective ratings as a function of dilemma type; 2) to disentangle the effects of self-oriented (i.e., egoistic) and other-oriented (i.e., altruistic) underlying motivation, as indexed by measures of personal distress and empathic concern, respectively; and 3) to determine whether empathy affects early emotion-related neural responses, or later controlled processing involving allocation of attentional resources.

We employed a standardized set of moral dilemmas [34], requiring choice of action from a first-person perspective, rather than moral judgment on another person’s action. In our view, this would enhance the identification with the agent and the processes involved in motivating behavior (cf.[35]). We hypothesized that high levels of affective empathy would increase harm aversion, as reflected in lower numbers of utilitarian responses, larger amplitudes of the emotion-related P260 component, and greater unpleasantness during decision-making. We expected these effects to be stronger (or even exclusive) for Footbridge-type dilemmas, in which emotion has already proved to play a relevant role.

2. Methods

2.1. Participants

Thirty-seven healthy, right-handed undergraduates at the University of Padova participated in the study (18 male; mean age 23.7 ± 1.9). They gave informed written consent and were paid €13 for their participation. The study was approved by the local Ethics Committee.

2.2. Stimulus material

We employed 30 Footbridge-type dilemmas, which described killing one individual as an intended means to save others, and 30 Trolley-type dilemmas, which described killing one individual as a foreseen but unintended consequence of saving others. Twelve additional moral dilemmas were used as filler stimuli. They involved no deaths and described other moral issues, such as stealing, lying, and being dishonest. All dilemmas were drawn from the standardized set of Lotto et al. [34]. Detailed information on the criteria used to develop this set of stimuli can be found in Sarlo et al. [33] and in Lotto et al. [34].

Each dilemma was presented as text, through a series of three screens. The first one described the scenario, in which some kind of threat is going to cause the death of a group of persons, the second one described a hypothetical action in which the main character lets one individual as an intended means to save others, and the third one described an alternative hypothetical action in which the main character kills one individual in order to save these people (option B). Participants had to choose between the two options.

All dilemmas were presented on a 19” computer screen at a viewing distance of 100 cm. Stimulus presentation was accomplished with E-prime software (Psychology Software Tools, Pittsburgh, PA, USA).

2.3. Interpersonal Reactivity Index

The Interpersonal Reactivity Index (IRI [26]) is a 28-item self-report questionnaire assessing both the cognitive and affective dimensions of the empathy construct by means of four subscales. Cognitive empathy is measured by the Perspective Taking (PT) scale, which measures the ability to imagine another person’s point of view in everyday life, and by the Fantasy (FS) scale, which measures the tendency to identify with fictional characters in books or movies. Affective empathy is measured by the Empathic Concern (EC) scale, which measures the tendency to experience feelings of compassion and concern for others (other-oriented empathic response), and by the Personal Distress (PD) scale, which measures the tendency to experience overconcern and discomfort in response to others’ distress (self-oriented empathic response).

2.4. Procedure

Upon arrival, participants were seated in a dimly lit, sound-attenuated room and an elastic cap embedded with 31 electrodes was applied for EEG recording. Then, instructions for the task were given. Each trial (Fig. 1) began with the presentation of the scenario, which participants could read at their own pace. When the participant pressed the spacebar, the option A was presented for 4.5 s. Next, the option B was presented for 6.5 s. After the offset of the option B, a fixation cross appeared in the middle of the screen between the letters A and B defining the respective options (decision slide). Participants were instructed to decide between the two hypothetical actions by pressing one of two computer keys marked A or B. They were explicitly told to wait for the decision slide before evaluating the two options. After their response, participants were required to rate how they felt while they were deciding using a computerized version of the Self-Assessment Manikin (SAM [36]), displaying the 1–9 point scales of Valence (pleasantness/unpleasantness) and Arousal (activation/calm). Then, an inter-trial interval of 1 s elapsed before the next scenario was presented. Dilemmas were presented in three blocks of 24 trials each (10 Footbridge-type, 10 Trolley-type, and 4 filler dilemmas), and in random order within each block.

At the end of the experimental session, participants completed the Italian version of the IRI [37]. They were asked to rate how well each item described them on a 5-point scale, from 1 (not at all) to 5 (extremely). Upon completion of the questionnaire, they were thanked and debriefed.

2.5. Electrophysiological recordings and data analyses

The EEG was recorded from 31 scalp electrodes (Fpz, Fz, Fc2, Cz, CPz, Pz, Oz, Fp1, Fp2, F3, F4, FC3, FC4, C3, C4, CP3, CP4, P3, P4, O1, O2, F7, F8, FT7, FT8, T3, T4, TP7, TP8, T5, T6) and the right mastoid (Electro-Cap system, Electrocap, Inc.). All sites were referenced online to the left mastoid and digitally re-referenced off-line to the algebraic average of the left and right mastoids. For the purpose of artifact scoring, vertical and horizontal electro-oculograms (EOGs) were recorded. The EEG and EOG signals were amplified with Neuroscan Synamps (El Paso, TX), bandpass filtered (DC–70 Hz), digitized at 500 Hz and stored on a Pentium II computer.

In order to compute ERPs, continuous EEG was segmented off-line into 900-ms epochs from 100 ms before to 800 ms after the onset of the decision slide. EEG data were corrected for eyeblinks, and vertical and horizontal eye movements using a regression-based correction algorithm. The EEG epochs were then baseline-corrected against the mean voltage during the 100-ms prestimulus period. All epochs were visually scored for residual artifacts, and each portion of data containing
of events within a trial. ERPs were computed time-locked to a “decision slide” following option B (utilitarian resolution). A prominent positive ERP component peaking at about 260 ms post-stimulus (P260) was observed with this paradigm (Sarlo et al., 2012). Time is not drawn to scale. 

The percentage of utilitarian choices was computed for each participant by dividing the number of B choices by the total number of response choices for each dilemma type (n = 30) and multiplying by 100. Mean valence and arousal ratings were also computed separately for each participant and dilemma type.

The four subscales of the IRI (PT, FS, EC, PD) were simultaneously entered as independent variables in separate stepwise regression analyses predicting each of the dependent variables (percentage of utilitarian choices, valence and arousal ratings, P260 peak amplitude, and mean slow wave amplitude) for each dilemma type. Stepwise regression combines forward selection and backward elimination. At each step, a variable was added if its associated significance level was ≤ .05, and was removed if its associated significance level was ≥ .10 (IBM SPSS Statistics 20, Armonk, New York, USA). Tests for multicollinearity between predictors indicated that a low level of multicollinearity was present (tolerance values ranged from .84 to 1.00). It is worth noting that regression designs provide several advantages over factorial designs, such as allowing to determine how large the contribution of each independent variable is and avoiding the loss of information associated with the categorization of continuous variables [38].

For the P260 and slow wave amplitudes, 14 EEG sites covering the whole scalp and equally distributed in the left and right hemisphere were selected for regression analysis (i.e., Fp1, Fp2, F3, F4, FC3, FC4, C3, C4, CP3, CP4, P3, P4, O1, O2). In these cases, in order to minimize the categorization of continuous variables [38].

3. Results

3.1. IRI subscale intercorrelations

Consistent with Davis’ [26] findings, the other-oriented EC subscale was positively correlated with FS (r = .36, p < .03), whereas the self-oriented PD subscale was negatively correlated with PT (r = − .39, p < .02).

3.2. Effects of empathy on behavioral data

In our previous analysis, the percentage of utilitarian choices was largely lower for Footbridge- than Trolley-type dilemmas. No significant correlations were found between behavioral measures and either ERP or self-report measures [33].

In the current analysis, the multiple stepwise regression revealed that for Footbridge-type dilemmas the only final determinant of behavioral choices was PD (β = −.45, B = −2.02, SE (B) = .15, F(1,35) = 9.11, p < .005, R² = .21), in that mean scores on the PD emotional subscale of the IRI were negatively associated with mean percentages of utilitarian choices (Fig. 2). For Trolley-type dilemmas, no variable was significantly associated with behavioral choices (all ps > .33), and no significant model was found.

3.3. Effects of empathy on affective ratings

In our previous analysis, decisions for Footbridge-type dilemmas were rated as significantly more unpleasant than decisions for Trolley-type dilemmas, whereas no significant differences were found in arousal ratings [33].

In the current analysis, the multiple regression showed that the only final determinant of valence ratings was EC for both Footbridge-type (β = −.38, B = −.08, SE (B) = .03, F(1,35) = 6.09, p < .02, R² = .15) and Trolley-type dilemmas (β = −.39, B = −.09, SE (B) = .04, F(1,35) = 6.12, p < .02, R² = .15), in that mean scores on the EC emotional subscale of the IRI were negatively associated with valence ratings (i.e., positively associated with perceived unpleasantness) (Fig. 3). In contrast, no variable was significantly

![Fig. 1. Schematic representation of events within a trial. ERPs were computed time-locked to a “decision slide” following option B (utilitarian resolution). A prominent positive ERP component peaking at about 260 ms post-stimulus (P260) was observed with this paradigm (Sarlo et al., 2012). Time is not drawn to scale.](image)

![Fig. 2. Scatterplot of the relationship between percentages of utilitarian responses to Footbridge-type dilemmas and individual scores on the Personal Distress (PD) scale of the Interpersonal Reactivity Index.](image)
associated with arousal ratings (all ps > .08), and no significant model was found either for Footbridge- or Trolley-type dilemmas.

3.4. Effects of empathy on ERP activity

In our previous analysis, the P260 amplitude was found to be larger for Footbridge- than Trolley-type dilemmas over the frontopolar (i.e., Fp1, Fp2, and Fp2) and frontal (i.e., F3, Fz, F4) sites. Moreover, significant negative correlations were obtained between valence ratings and mean P260 amplitudes specifically over the frontopolar region for both types of dilemmas, indicating that the larger the P260 amplitudes the higher the unpleasantness that was experienced during decision-making. Furthermore, greater cortical positivity was found during decisions on Trolley- than Footbridge-type dilemmas at more posterior locations in the 450–600 ms time window [33].

In the current analysis, the multiple regression revealed that for Footbridge-type dilemmas PD was the only final determinant of P260 amplitudes over several EEG sites specifically located in the right hemisphere (i.e., F4, FC4, C4, and CP4), in that the higher the reported personal distress the larger the P260 amplitudes during decision-making (Fig. 4; see Table 1 for regression statistics). In contrast, for Trolley-type dilemmas none of the regressors was retained in the final model after Bonferroni corrections (see Table 2 for regression statistics). As for the slow wave activity, no variable was significantly associated with mean amplitudes (all ps > .09), and no significant model emerged for any of the EEG sites, either for Trolley- or Footbridge-type dilemmas.

4. Discussion

The present study had two main purposes. First, we aimed at investigating whether and how the cognitive and affective dimensions of dispositional empathy could affect decision-making in classic moral dilemmas, at subjective, behavioral, and neural levels. Second, within the framework of the dual-process model of moral judgment [2,3,5], we aimed at unveiling the motivational bases underlying the emotion-driven rejection of utilitarian resolutions in Footbridge-type dilemmas.

We used a novel paradigm allowing the measurement of ERPs during decision-making, thus providing reliable information on both early and late processing stages. Self-report ratings of affective valence and arousal were also collected, as they represent the core affective components of emotional experience (e.g., [36,39]). Trait empathy was assessed through the Interpersonal Reactivity Index (IRI [26]), including cognitive (perspective taking and fantasy) and affective (empathic concern and personal distress) subscales, with the latter representing the

![Fig. 3. Scatterplot of the relationship between valence ratings and individual scores on the Empathic Concern (EC) scale of the Interpersonal Reactivity Index, for Footbridge-type (top) and Trolley-type (bottom) dilemmas.](image1)

![Fig. 4. Scatterplot of the relationship between P260 amplitudes recorded at a representative EEG scalp site (C4) for Footbridge-type dilemmas and individual scores on the Personal Distress (PD) scale of the Interpersonal Reactivity Index.](image2)

Table 1

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For the F4 EEG site, only the PD effect survived Bonferroni correction (t = 3.17, p = .003).

* Variables with significant β values at a level of p < .0036 (.05/14) Bonferroni corrected.
other- and self-oriented motivational sides of helping behavior, respectively.

While sharing the main dataset, the current study importantly extends our prior work [33] by providing strong overall evidence that dispositional empathy plays a relevant and direct role in shaping decision-making on moral dilemmas, by affecting subjective, behavioral, and neural responses.

The first relevant result to be noticed is that affective, but not cognitive, empathy was able to modulate responses at multiple levels. While the deliberate cognitive process of adopting the perspective of others might be necessary for affective empathy to occur (see Ref. [17]), it did not directly predict choice of action or the respective cortical activity in any of the examined processing stages, either for Footbridge- or Trolley-type dilemmas. In contrast, individual differences in affective empathy were found to be reliably associated with percentages of utilitarian responses, early cortical processing, and levels of unpleasantness experienced during decision-making. Therefore, our data support a dissociation between cognitive empathy and affective empathy in modulating decision-making in moral dilemmas, in line with the evidence of a functional distinction between these two dimensions, which appear to involve different processes and to rely on partly distinct neural networks [40,41].

The most striking findings in this study concern the role played by personal distress. This affective dimension of empathy, dealing with self-focused feelings of anxiety and discomfort prompted by others in need (e.g., [18]), was found to significantly impact decision choices and early cortical processing during decision-making. Importantly, these effects held for Footbridge-type dilemmas only, showing that the higher the personal distress reported by participants, the lower the number of utilitarian responses they gave. In other terms, personal distress strongly promoted a harm-avoidant bias when the proposed resolution involved the death of one individual as an intended means to save others. Critically, such prosocial behavior appears to be motivated by egoistic rather than altruistic concerns, such as reducing one’s own aversive emotional state rather than caring for the welfare of the other person. This is consistent with the finding of our previous analysis [33] indicating that decisions on Footbridge-type dilemmas were significantly more unpleasant than those on Trolley-type dilemmas. In the latter condition, indeed, no relationship was found in the present study between affective empathy, either self- or other-oriented, and behavioral choices, which were driven by a different (possibly more complex) interplay between cognitive and emotional processes.

Another important evidence for the role played by self-oriented affective empathy in Footbridge-type moral dilemmas comes from the effects of personal distress on early, but not late, cortical activity during decision-making. The levels of reported personal distress were found to positively modulate the amplitude of the P260, occurring soon after the onset of the decision slide. In our previous analyses [33], this early ERP component was found to be larger in the frontopolar and frontal areas when participants were deciding on Footbridge- than on Trolley-type dilemmas. Crucially, its amplitude was found to positively correlate with the unpleasantness experienced during decision-making specifically over the frontopolar region. Taken together, these results made us interpret the P260 component in this context as reflecting an immediate affective reaction during the first phase of decision-making, mainly involving automatic processing stages. Indeed, no relationship was found between valence ratings and cortical slow wave activity developing at later, more controlled, processing stages. On the basis of the focal topographical distribution of the P260 effects, we speculated that this neural response was mediated by the activation of the orbitofrontal/ventromedial prefrontal cortex, whose role in emotion-based decision-making is widely acknowledged (e.g., [42]). This speculation was further strengthened by previous demonstration of medial prefrontal involvement during the resolution of Footbridge-type moral dilemmas [1–3].

It is noteworthy that the moderating effects of personal distress on P260 amplitude found in the present study for Footbridge-type dilemmas were significant at several EEG sites, ranging from frontopolar to centro-parietal areas, specifically located in the right hemisphere. This result nicely fits with previous neuroimaging and lesion research demonstrating a key role of the right hemisphere in the mediation of empathy. In particular, the right inferior parietal cortex and prefrontal cortex were found to be involved in the ability to identify with others and to share representations with others [43], while the right anterior insula and dorsal anterior cingulate cortex appeared to be more specifically involved in affective-perceptual empathy [40]. Moreover, lesions to the right hemisphere, either in the prefrontal or parietal regions, were found to impair patients’ empathic abilities [44].

Taken together, our results indicate that in Footbridge-type dilemmas the egoistic motivation to alleviate one’s own distress was directly associated with the neural impact of the aversive emotional state in the early stages of cortical processing, thus driving behavioral choices toward non-utilitarian resolutions. These effects, in line with what predicted by the dual-process theory [2,3,5], importantly complement and extend previous research by unveiling the motivation underlying the prepotent “alarm-bell” emotion saying “Don’t do it!” (see Ref. [8]) and by clarifying the nature of its prosocial effects. According to our data, indeed, such immediate affective reaction would rather mean “Don’t do it, because it makes you feel bad!”.

It remains to be determined whether in this context people reject the utilitarian resolution to avoid immediate or delayed emotional consequences. In other words, do people try to minimize the negative affect elicited at the time of decision, or the negative affect expected to result from the consequences of their decisions? Both immediate and anticipated emotions are known to influence decision-making through different processes and neural networks [45]. Besides of contextual influences, immediate emotions result from anticipation of the outcome of one’s decision. They provide useful information to decision-making as well as the motivation to perform the chosen action [46]. On the other hand, anticipated emotions (including guilt, regret, or disappointment) arise from counterfactual comparisons across alternatives. They can be effectively used as inputs in the decision process [47] and are an integral part of the expected consequences of the decision [45]. On these bases, the immediate emotion we recorded at the moment of decision-making at both neural and subjective levels might alert the individual on the aversive consequences of choosing the utilitarian resolution, which, at conscious level, might be represented as an unbearable feeling of guilt for having caused intentional harm to others. This anticipatory emotional information, supported by an egoistic motivation, might then drive people to turn to the non-utilitarian resolution despite the cost/benefit

Table 2

<table>
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<tr>
<th>EEG sites</th>
<th>Variables retained in the final model</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>R²</th>
<th>F</th>
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</table>

It presents the final models for stepwise regressions of Perspective Taking (PT), Fantasy (FS), Empathic Concern (EC), and Personal Distress (PD) on P260 amplitude at each EEG site for Trolley-type dilemmas.
tradeoff. This would be consistent with the theoretical framework according to which anticipatory affective signals at the time of decision allow the encoding of the emotional value of the consequences of alternative choices through the activity of the ventromedial prefrontal cortex [42,48] (see also Ref. [45]). Of course, our results do not provide direct support to this explanation, as no measures of anticipated emotions have been taken in the present study. However, the lack of correlations between behavioral responses and either the P260 amplitude or valence ratings suggests that immediate emotion did not directly predict decision. Decision, in contrast, was directly modulated by the disposition to reduce one’s own distress, possibly in relation to anticipating aversive emotions.

Of particular relevance is the dissociation observed between other- and self-oriented affective empathy in modulating conscious and unconscious processing of emotional information. Scores on the empathic concern subscale of the IRI significantly predicted self-reported unpleasantness when deciding on both Footbridge- and Trolley-type dilemmas. Thus, independent of dilemma type, the tendency to experience feelings of sympathy and compassion toward others determined participants’ conscious emotional evaluation. Interestingly, this was found to be unrelated to decision or to cortical processing preceding decision. On these bases, we can infer that in the context of moral dilemmas altruistic prosocial motivation appears to underlie self-reported emotional experience, but neither drives actual action choices nor emotion-related neural activity.

Overall, our behavioral results are consistent with those of the few relevant studies [16,25,27] in demonstrating that high levels of dispositional empathy are significantly associated with a reduced number of utilitarian responses to Footbridge-type dilemmas. However, when separately testing the different dimensions of empathy, either no significant effects were detected on behavioral and hemodynamic responses [29], or only the empathic concern dimension of empathy proved to significantly affect utilitarian responses [27]. In contrast, in our study, it was the personal distress dimension which strongly affected both behavioral choices and neural activity during decision-making. There are important methodological differences between ours and the above-mentioned studies that could account for these inconsistencies. For instance, Reniers et al. [29] recruited only male participants and used moral/non-moral scenarios involving human actions in social situations rather than classic moral dilemmas. Gleichgerrcht and Young [27] employed a very restricted number of classic dilemmas (i.e., a single pair) to categorize participants as utilitarian vs. non-utilitarian and used empathy as dependent variable, thus reversing our perspective. Moreover, in our paradigm participants were explicitly required to choose between two possible resolutions (i.e., utilitarian vs. non-utilitarian) of each moral dilemma, rather than being provided with the utilitarian resolution only (to be accepted or rejected). This could have further emphasized the dilemma conflict by explicitly depicting both undesirable outcomes, thus increasing the emotional impact of the task and producing a greater engagement of the processes involved in egoistic, distress-related, motivation.

One final consideration might deal with the question of why people faced with Footbridge-type dilemmas empathize with the single individual to be sacrificed, rather than with the higher number of persons who are about to die. Several concurring factors can be taken into account. Here, we provide only few remarks, which future studies might want to consider. First, the sense of agency, which plays a crucial role in empathy [49], is enhanced by performing rather than witnessing harm, thus largely contributing to the sense of personal responsibility and related moral emotions (cf. [9,50]). Second, physical or sensory proximity (e.g., to the person standing on the footbridge) tends to increase empathy toward victims, whereas distance (e.g., from the five men working on the track) tends to decrease it [51]. Lastly, it is well-established that affective sensitivity diminishes as the number of victims grows, a general phenomenon termed “collapse of compassion” [52–54].

To summarize, this study provided new evidence for the crucial role of empathy in moral behavior and new relevant information on the motivational bases of prosocial choices in moral dilemmas. Our results demonstrated that 1) affective rather than cognitive dispositional empathy modulates responses at multiple levels when deciding on Footbridge-type dilemmas only; 2) within the affective dimension, self-oriented (egoistic) empathy affects both early emotion-related neural activity and behavioral choices in Footbridge-type dilemmas, whereas other-oriented (altruistic) empathy affects conscious emotional evaluation in all dilemmas; 3) empathy is unrelated either to neural activity or to behavioral choices in Trolley-type dilemmas, suggesting that the underlying neural, cognitive, and emotional processes rely on different mechanisms.

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