benefactor's kind intention from these contextual factors, which enables individuals to recognize high-quality benefactors and build cooperative relationships (i.e., the find-remind-bind theory) (Algoe, 2012). Therefore, the perceived kind intention behind help may be a crucial factor that links other appraisals, such as benefactor's cost and self-benefit, to

decisions under uncertainty. On the one hand, the simulation theory (Gallese and Goldman, 1998; Ondobaka et al., 2017) posits that in-

the cost faced by the co-player; otherwise, it would remain at Level 9. The participants' final monetary bonuses were the average amount of endowment the participants allocated to themselves over the randomly selected trials. The pain stimulation and monetary bonus for each participant were realized at the end of the whole experiment.

There were 6 possible combinations of Agent and Uncertainty level of the cost faced by the co-player during the Help trials, forming a 2 (Agent: Human vs. Computer) × 3 (Uncertainty level of the cost faced by the co-player: Certain vs. Risky vs. Ambiguous) within-subject design.

follow the displayed information. To avoid this situation, we did not execute pain stimulation online for each trial; instead, the participant was told that after the experiment was completed, fi

multiple comparisons with the threshold of peak-level $p < 0.001$ (uncorrected) and cluster-level $p < 0.05$ (FWE-corrected). Statistical neu-

Human_Risky]. Similarly, if a term of psychological component was related to ambiguity-sensitive processing, the similarity between this term

although marginally significant for kind intention:

similar pattern was observed for gratitude ratings, although it did not reach statistical significance (Fig. S4B; $F_{2,\ 188} = 2.63$, $p = 0.074$). Moreover, although we did not find a significant Agent * Uncertainty level * gender interaction, we found a stronger main effect of Agent and a stronger main effect of Uncertainty level in intention ratings in females than in males (Fig. S4C; Agent * gender interaction: $F_{1,\ 93} = 4.80$, $p =$

demonstrate specificity, which is beyond the scope of the current study. Moreover, since the current study aimed to investigate how other's altruistic decisions under uncertainty influence individuals' gratitude, no post-hoc appraisals or emotion ratings were obtained for Nohelp conditions. Therefore, we were unable to build specific hypotheses for the neural analyses of Nohelp conditions based on behavioral observations.

weigh the benefit of altruistic choice against the cost in various circumstances (Penner et al., 2004), in which the cost is usually uncertain. Although a number of studies have investigated how participants make altruistic decisions under uncertainty (e.g., Hu et al., 2017; Vives and Feldmanhall, 2018), it remains largely unknown as to how individuals perceive and respond to others' altruistic behaviors under different uncertain situations (e.g., ambiguity vs. risk). The current study contributes to the understanding of this issue by providing both behavioral and neuroimaging evidence in the context of interpersonal gratitude. Our results suggest that 1) perceived kind intention is a mediating factor for beneficiary's generation of gratitude when faced with other's help under uncertain cost; 2) there are both shared and differential neurocognitive processes of gratitude in response to benefactor's altruistic decisions in risky and ambiguous conditions.

4.1. Perceived kind intention as a mediating factor for the feeling of gratitude

Intention inference is crucial for social interactions (Falk et al., 2008; Falk and Fischbacher, 2006; Sanfey, 2007). According to theories of reciprocity (Fehr and Gächter, 1998; Fehr and Schmidt, 2006; Matthew Rabin, 1993), when an individual perceives the care and benevolence from another person, the utility of acting kindly towards this person increases. In studies of social psychology, individuals are more likely to trust and cooperate with those who engage in altruistic interactions under uncertainty than they do under certainty, as decisions under uncertainty are rarer than decisions under certainty (Hu et al., 2017; Vives and Feldmanhall, 2018) and reflect the concern about others' intention (Capraro and Kuilder, 2016; Jordan et al., 2016; Pérez-Escudero et al., 2016). Consistent with these studies, the current results provide novel evidence demonstrating that, the degree of beneficiary's gratitude varied as a function of the level of uncertaintynovelas a

aversion in both risky and ambiguous situations when individuals make decision under uncertainty (

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