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Coping with noise in social dilemmas: Group representatives fare worse than individuals because they lack trust in others' benign intentions

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Abstract

Research on interindividual–intergroup discontinuity has illuminated distinct patterns of cognition, motivation, and behavior in interindividual versus intergroup contexts. However, it has examined these processes in laboratory environments with perfect transparency, whereas real-life interactions are often characterized by noise (i.e., misperceptions and unintended errors). This research compared interindividual and intergroup interactions in the presence or absence of noise. In a laboratory experiment, participants played 35 rounds of a dyadic give-some dilemma, in which they acted as individuals or group representatives. Noise was manipulated, such that players' intentions either were perfectly translated into behavior or could deviate from their intentions in certain rounds (resulting in less cooperative behavior). Noise was more detrimental to cooperation in intergroup contexts than in interindividual contexts, because (a) participants who formed benign impressions of the other player coped better with noise, and (b) participants were less likely to form such benign impressions in intergroup than interindividual interactions.

Keywords

cooperation, discontinuity effect, interdependence, intergroup conflict, noise, social dilemma

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In politics, in collective bargaining, in the international community: interactions between groups fundamentally shape our lives. For this reason, it is important to understand such interactions and to determine what benefits and risks they may entail for our collective welfare. A considerable body of research has revealed that, relative to interactions between isolated individuals, intergroup interactions are more competitive, aggressive, and intractable—a phenomenon called interindividual–intergroup discontinuity (Insko & Schopler, 1998; Wildschut, Pinter, Vevea, Insko, & Schopler, 2003). An important limitation of this research program, however, is that it has studied

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interindividual and intergroup interactions in laboratory contexts with perfect transparency, where decisions match intentions. In real life, however, social interactions are often characterized by misperceptions and unintended errors or *noise*, such that one's actions may produce different outcomes or may be perceived differently than intended (Axelrod & Dion, 1988; Bendor, Kramer, & Stout, 1991; Kollock, 1993; van Lange, Ouwerkerk, & Tazelaar, 2002). Indeed, such noise may be particularly prominent in intergroup interactions, which are often characterized by differences in norms, customs, and language that are conducive to misunderstanding. It is therefore important to gain insight into the difference between interindividual and intergroup interactions in noisy environments.

Our key objective was to examine the impact of noise in interindividual and intergroup settings. We did so by comparing interactions between individuals and between group representatives: individuals who have been appointed to make decisions on behalf of their group (Reinders Folmer, Klapwijk, De Cremer, & van Lange, 2012; also see Aaldering, Greer, van Kleef, & De Dreu, 2013; Milinski, Hilbe, Semmann, Sommerfeld, & Marotzke, 2016; Pinter et al., 2007). In everyday life, groups often interact through group representatives (i.e., through their leaders, representatives, or delegates; Adams, 1976). Hence, by studying interactions between group representatives, we increased mundane realism. Furthermore, dyadic interactions between group representatives resemble closely dyadic interactions between isolated individuals, thus providing a stringent test of the difference between interindividual and intergroup interactions as a function of noise. We examine these processes in a social dilemma where noise is either present or absent.

The Impact of Noise in Interindividual and Intergroup Settings

How does noise affect interindividual and intergroup interactions? Extant research on this question is restricted to interindividual contexts and has distinguished between positive (i.e., own decisions affect others more positively than intended) and negative (i.e., own decisions affect others more negatively than intended) noise (Axelrod & Dion, 1988; Kollock, 1993; Signorino, 1996). Findings indicate that negative noise has a powerful, detrimental impact on interpersonal cooperation, which exceeds the beneficial effect of positive noise (Signorino, 1996). Furthermore, negative noise may be more prevalent in everyday life and has more harmful consequences in social relationships (van Lange et al., 2002). Accordingly, we focused on the impact of negative noise in the context of interindividual and intergroup interactions (cf. Klapwijk & van Lange, 2009; Tazelaar, van Lange, & Ouwerkerk, 2004; van Lange et al., 2002).

Negative noise (henceforth: noise) exerts detrimental effects on cooperation through two possible mechanisms. First, noise affecting one's own decisions (own-noise) results in unintended harm to others and it is costly to repair such unintended negative effects on others' outcomes (Bendor et al., 1991; van Lange et al., 2002). Second, noise affecting others' decisions (other-noise) can lead one to underestimate others' cooperativeness. Noise may make others appear less cooperative than they actually are, which may reduce one's own cooperativeness toward them (Tazelaar et al., 2004; van Lange et al., 2002). What do these processes imply for the impact of noise in the context of intergroup interactions? We hypothesized that noise would be more harmful to cooperation in intergroup contexts than in interpersonal ones, and hence, would accentuate the discontinuity effect. The rationale for this prediction is that the two mechanisms that explain the detrimental impact of noise in the context of interpersonal interactions will be amplified in intergroup contexts.

First, intergroup interactions are characterized by greater greed, such that people display more self-regarding preferences and behavior in intergroup contexts than in interpersonal ones (Insko & Schopler, 1998; Wildschut et al., 2003). Their tendency to do so stems from (a) perceived normative obligations to benefit the ingroup,

(b) the cloak of anonymity that groups provide, and (c) group members' mutual support for competitive initiatives (Wildschut & Insko, 2007). Crucially, these processes imply that own-noise is more detrimental in intergroup contexts: due to their greater greed, groups (relative to individuals) will be less inclined to incur the cost of repairing unintended negative effects of own-noise on others' outcomes.

A second reason why noise should be more detrimental in intergroup contexts is that intergroup interactions are characterized by greater fear. According to this explanation, intergroup competitiveness is rooted in learned beliefs that outgroup members are more aggressive, deceitful, and competitive than individuals (i.e., schema-based distrust; Insko & Schopler, 1998; Pemberton, Insko, & Schopler, 1996). This distrust gives rise to defensive, competitive behavior as a means to protect the ingroup against the anticipated competitiveness of other groups. The notion that intergroup interactions are characterized by greater fear has important implications for the impact of other-noise, because people's ability to cope with such incidents is critically dependent on benign partner impressions (Bendor et al., 1991; Tazelaar et al., 2004; van Lange et al., 2002). To overcome other-noise, it is crucial to give the other player the benefit of the doubt when faced with its negative outcomes (Axelrod & Dion, 1988; Klapwijk & van Lange, 2009; Kollock, 1993). The greater fear in intergroup interactions, however, implies that groups will be less likely to respond in this cooperative manner. Thus, other-noise may be more detrimental to cooperation in intergroup contexts because groups (compared to individuals) lack the benign partner impressions (Hoyle, Pinkley, & Insko, 1989) that are necessary to overcome other-noise.

The Present Research

In sum, the present research aimed to examine the differential impact of noise in interindividual and intergroup settings, and to understand how the presence of noise affects the magnitude of interindividual–intergroup discontinuity. To do so, we used a dyadic social dilemma task. Social dilemmas present a conflict between protagonists' immediate self-interest and longer term collective interests (van Lange, Joireman, Parks, & van Dijk, 2013). In situations like these, protagonists choose between competitive (or noncooperative) decisions (which benefit their immediate self-interest, but are harmful for the collective interest) or cooperative decisions (which benefit the collective interest, but are disadvantageous for their immediate self-interest). Social dilemmas are suitable for our present purposes because they provide an environment in which the discontinuity effect emerges (Schopler et al., 2001) and in which the disruptive impact of noise can be studied (Tazelaar et al., 2004; van Lange et al., 2002). Participants played an iterated social dilemma, situated in an interaction between either two individual players or two group representatives (Pinter et al., 2007; Reinders Folmer et al., 2012). The decisions of the other player (or partner) were simulated by a preprogrammed tit-for-tat strategy (consistent with prior noise research; Tazelaar et al., 2004; van Lange et al., 2002). In designated rounds, we manipulated the presence (vs. absence) of noise by altering the decisions of either player to be less cooperative than they intended. Because the preprogrammed tit-for-tat strategy exactly reciprocates participants' own decisions, this paradigm enables us to isolate the impact of noise on participants' decisions independently of their partner's decisions, and to distinguish between participants' responses to own-noise and other-noise.

In this setting, we aimed to test the following hypotheses:

> Hypothesis 1: Levels of cooperation will be lower in intergroup interactions between group representatives than in interpersonal interactions between individuals.

> Hypothesis 2: Levels of cooperation will be lower in interactions where noise is present than in interactions where noise is absent.

> Hypothesis 3: Differences in levels of cooperation between representatives and individuals

will be greater in interactions where noise is present than in interactions where noise is absent.

Method

Participants and Design

Participants were 294 students at Vrije Universiteit (VU) Amsterdam (103 men, 191 women; M_{age} = 20.52, *SD* = 2.91). They were recruited through flyers at the university dining halls and randomly assigned to conditions in a 2 (interaction type: individual vs. representative) × 2 (negative noise: present vs. absent) between-participants design.[1] In light of prior evidence for gender effects in the context of interindividual–intergroup discontinuity (i.e., female groups responding more competitively than male groups when conflict of interest is severe; Schopler et al., 2001), we included gender as an additional predictor. Power analysis with G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) indicated sufficient power (power = .95) for analysis of covariance (ANCOVA) to detect a medium effect (f = .25) at $p < .05$.

Procedure

Up to 15 participants attended each experimental session. They were seated in individual cubicles containing a computer, on which the entire experiment was conducted.

Manipulation of interaction type. In order to examine interactions between group representatives, a context was created in which two meaningful groups could be distinguished, on whose behalf the participants could interact. To do so, we presented the study as a collaborative research project between the VU and the University of Amsterdam (cf. Reinders Folmer et al., 2012). In the representative condition, participants were told that students were attending the experimental session at either institution and would be combined into a VU team and a UvA team. They learned that a single group representative would be selected for each team and that these representatives would interact dyadically on their team's behalf. Participants were further informed that the outcomes of the representatives' interaction would determine the rewards of all the members of their team. A rigged lottery procedure ensured that participants were always assigned to the role of group representative. In the individual condition (where no intergroup context was required), no groups were distinguished and participants interacted dyadically with another participant, with the outcomes of their interaction determining their rewards. The rewards that could be obtained in the task were vouchers for a postexperimental raffle in which a €15.00 ($17.00) book certificate could be won by the participant (individual condition) or all team members (representative condition; see van Lange et al., 2002).[2]

The social dilemma task. The task was a dyadic, iterated, gradual give-some social dilemma adopted from previous noise research (Tazelaar et al., 2004; van Lange et al., 2002). We selected this paradigm rather than the binary social dilemma task that is typically employed in discontinuity research (e.g., Insko et al., 1998; Schopler et al., 2001) because it allows gradual increases and decreases in level of cooperation, which makes it suitable for representing the impact of noise and affords the generous strategies that are necessary to overcome it (Klapwijk & van Lange, 2009).

Participants received an endowment of 10 grey coins at the start of every round. The other player received an endowment of 10 blue coins. We explained that the value of these coins differed for both players. The participant's grey coins were worth 50 cent each to him/herself, but were worth 100 cents each to the other player. Likewise, the other player's blue coins were worth 50 cent each to him/herself, but 100 cents to the participant. In the task, players would be able to donate coins to each other. Although giving away coins is detrimental to one's individual outcome, it is highly beneficial for the recipient, as one's coins are twice as valuable to the other player. As such, players can collectively earn more by donating coins to each other (i.e., collective rationality). Individually, however, they can earn more by keeping their own coins while receiving coins from the other player (i.e., individual rationality). Therefore, this situation is a social dilemma, in which donations represent a continuous measure of cooperation (with a contribution of zero coins reflecting minimal cooperation, and a contribution of 10 coins maximal cooperation; see van Lange et al., 2002).[3]

Participants played 35 rounds of the social dilemma task (the actual number was unknown to them). In each round, both players simultaneously decided how many coins to give to the other, after which their decisions and outcomes were revealed. Although participants believed they were interacting with another person, we simulated the other player using a preprogrammed tit-for-tat strategy. Tit-for-tat is often considered a "default" strategy in interaction research and players frequently employ reciprocal strategies in social dilemmas (e.g., Parks, Sanna, & Posey, 2003; Tazelaar et al., 2004). As such, this strategy is suitable for simulating the decisions of another player. Consistent with previous research, the other player was programmed to initiate the task with a moderately cooperative contribution of six coins (out of 10) and, thereafter, to reciprocate the participant's contribution in the previous round (Tazelaar et al., 2004; van Lange et al., 2002).

Manipulation of noise. Following the instructions on the social dilemma task, we introduced the noise manipulation. In the no-noise condition, we did not mention noise and participants' decisions always reflected their intended level of cooperation. In the noise condition, participants received additional instructions that explained that players' decisions in the task could be affected by noise. Specifically, participants in the noise condition learned that we were interested in how people make decisions in "situations in which the actual decision(s) by both persons may now and then have different results than they actually intended" (Tazelaar et al., 2004; van Lange et al., 2002). Accordingly, they learned that the computer would change their decisions or those of the other player in some rounds of the interaction, so that the player in question would donate more or fewer coins than he/she had actually intended (in fact, only negative noise occurred; Tazelaar et al., 2004; van Lange et al., 2002). Such changes potentially could occur in any round of the interaction, and whereas the player whose donation was changed would be informed of this, its recipient would not. Therefore, during the task, participants in the noise condition could not determine if the number of coins they received from the other player reflected an intentional choice or a change by the computer, nor would the other player be able to make this distinction in the participant's own donations.[4]

The social dilemma task comprised 35 rounds and we administered noise on every fourth round (i.e., a noise frequency of 25%), with instances alternating between the two players (i.e., affecting the participant's decision in Round 4, the other player's decision in Round 8, etc.). When noise occurred, three coins were subtracted from the number of coins that the player had intended to contribute (i.e., negative noise)—an intensity that was unlikely to go by unnoticed.[5] As noted, a warning was displayed whenever the participant's decision had been affected by noise, but participants received no warning when the other player's decisions had been affected. Upon completion of the task, we administered a postexperimental questionnaire assessing participants' impressions of the other player.

Measuring impressions of benign intent. We assessed participants' global impressions of their partner's benign intent with 10 items (Tazelaar et al., 2004). Participants indicated to what extent their partner was "generous," "nice," "forgiving," "kind," "noble," "selfish," "greedy," "competitive," "stingy," and "vengeful" (1 = *not at all*, 7 = *very much*; negative items reverse-coded; $\alpha = .78$). As a further specification of these impressions, we also assessed participants' perceptions of the specific interaction goals that comprise these global impressions (Kelley & Thibaut, 1978), namely the tendency to maximize joint outcomes (MaxJoint, e.g., "the other person [representative] wanted to get the most outcomes for the both of us [both of our teams]"; $\alpha = .90$); to minimize the difference between each party's outcomes (MinDiff,

Table 1. Means and standard deviations (in parentheses) for mean cooperation, benign impressions, and impressions of specific interaction goals as a function of noise (no noise vs. noise) and interaction type (individuals vs. representatives).

	No noise		Noise	
	Individuals (n = 72)	Representatives (n = 72)	Individuals (n = 74)	Representatives (n = 76)
Cooperation (0–10)				
Round 1	5.83 (3.13)	4.68 (2.92)	5.57 (3.25)	4.93 (3.03)
Rounds 2–35 (mean)	6.13 (2.60)	6.15 (2.49)	5.81 (2.55)	4.96 (2.73)
Partner impressions (1–7)				
Benign impressions	4.26 (0.75)	4.06 (0.85)	4.25 (0.88)	4.03 (0.95)
MinDiff	4.40 (1.27)	4.11 (1.28)	4.28 (1.22)	3.89 (1.42)
MaxJoint	4.50 (1.35)	4.22 (1.38)	4.27 (1.53)	3.96 (1.54)
MaxOther	3.18 (1.08)	2.89 (0.99)	3.11 (0.99)	2.76 (1.03)
MaxOwn	3.81 (1.25)	4.52 (1.17)	4.07 (1.34)	4.47 (1.21)
MaxRel	4.23 (1.27)	4.63 (1.31)	4.12 (1.40)	4.57 (1.20)

Note. MinDiff = partner's tendency to minimize the difference between each party's outcomes; MaxJoint = partner's tendency to maximize joint outcomes; MaxOther = partner's tendency to maximize other's (i.e., participant's) outcomes; MaxOwn = partner's tendency to maximize own outcomes; MaxRel = partner's tendency to maximize relative advantage over the other (i.e., the participant).

e.g., "the other person [representative] wanted to minimize the differences in outcomes between me and him/her [my team and his/her team]"; α = .78); to maximize the participant's outcomes (MaxOther, e.g., "the other person [representative] wanted me [my team] to get the highest outcomes"; α = .68); to maximize the relative advantage over the other party's outcomes (MaxRel, e.g., "the other person [representative] wanted to get higher outcomes than me [my team]"; α = .81); and to maximize outcomes for oneself (MaxOwn, e.g., "the other person [representative] wanted to get the highest possible outcomes for him/herself"; α = .70). We assessed these five perceived interaction goals with three items each (Tazelaar et al., 2004).

Upon completion of the questionnaire, participants were debriefed, thanked, and received either course credit or monetary payment of €7.00 ($8.00).

Results

Cooperation

We present relevant means and standard deviations in Table 1.

Round 1. To understand participants' cooperative behavior (i.e., intended number of coins donated to the other player) independently of the influence of partner strategy and noise, decisions in the first round (which were made before participants had encountered noise or the partner strategy) were analyzed separately in a 2 (interaction type) × 2 (noise) × 2 (gender) ANCOVA. Participants' self-reported experience with decision-making tasks involving coins (0 = *no*, 1 = *yes*) was included as a covariate in this analysis to control for possible learning effects due to previous experience with the social dilemma task in other studies in our laboratory.[6] The analysis indicated only main effects for interaction type, $F(1, 285) = 3.82$, $p = .052$, $\eta^2 = .01$; for gender, $F(1, 285) = 6.05$, $p = .009$, $\eta^2 = .02$; and for experience, $F(1, 285) = 22.10$, $p < .001$, $\eta^2 = .06$. Consistent with Hypothesis 1, representatives displayed marginally lower initial cooperation than individuals (i.e., a discontinuity effect). Additionally, women ($M = 4.94$, $SD = 3.01$) displayed significantly lower initial cooperation than men ($M = 5.83$, $SD = 3.23$). Finally, participants with no prior experience of the social dilemma task ($M = 4.48$, $SD = 2.84$) displayed lower initial cooperation than participants with prior experience ($M = 6.18$, $SD = 3.17$).

Rounds 2–35. Participants' cooperative behavior in the remaining 34 rounds of the social dilemma task was averaged into a single index of cooperation. This cooperation index was entered as dependent variable in a 2 (interaction type) × 2 (noise) × 2 (gender) ANCOVA, with prior experience as a covariate.[7] In line with Hypothesis 2, the analysis revealed a significant main effect of noise, $F(1, 285) = 4.92, p = .027, \eta^2 = .01$, indicating that cooperation was lower in the noise condition than in the no-noise condition. Furthermore, the analysis indicated a significant main effect of experience, $F(1, 285) = 21.01, p < .001, \eta^2 = .06$, indicating that participants with no prior task experience ($M = 5.15, SD = 2.40$) cooperated less than those with prior experience ($M = 6.48, SD = 2.72$). The main effect of interaction type was not significant, $F(1, 285) = 0.84, p = .360, \eta^2 = .00$, nor was the effect of gender, $F(1, 285) = 1.94, p = .164, \eta^2 = .00$. As such, the initial differences in cooperation between representatives and individuals in Round 1 did not culminate in significant differences between their subsequent cooperation levels. Hence, the Round 2–35 interval did not provide support for Hypothesis 1.

Crucially, the analysis revealed a marginally significant Interaction Type × Noise interaction effect, $F(1, 285) = 3.62, p = .058, \eta^2 = .01$. Planned follow-up tests of simple effects indicated that, in the representative condition, noise (vs. no noise) significantly reduced cooperation, $F(1, 285) = 8.45, p = .004, \eta^2 = .03$. In the individual condition, however, noise had no significant effect on cooperation, $F(1, 285) = 0.05, p = .827, \eta^2 = .00$. Looked at from a different angle, cooperation between representatives was significantly lower than between individuals (i.e., a discontinuity effect) in the noise condition, $F(1, 285) = 3.93, p = .048, \eta^2 = .01$. In the no-noise condition, however, cooperation between individuals did not differ significantly from cooperation between representatives, $F(1, 285) = 0.50, p = .481, \eta^2 = .00$. The absence of a significant discontinuity effect in this condition may seem surprising, but is consistent with prior research. When individuals and groups interact with a tit-for-tat strategy (as in the present experiment) in the absence of noise, the discontinuity effect is reduced and rendered nonsignificant (Insko et al., 1998; Wildschut et al., 2003). We return to this point in the Discussion section. In sum, results indicate that instances of noise were particularly detrimental in intergroup (compared to interpersonal) contexts, and thereby amplified the discontinuity effect—a finding that supports Hypothesis 3.

Noise trials. Representatives' greater vulnerability to noise (relative to individuals) could reflect both a disinclination to incur the cost of repairing unintended negative effects of own-noise on others' outcomes (i.e., greed) or a reluctance to respond trustingly to other-noise (i.e., fear). To explore these possible explanations, we zoomed in on participants' decisions following instances of noise. In particular, we examined participants' tendency to reinitiate cooperation following own-noise and to maintain cooperation following other-noise. Relevant to greed, if representatives (compared to individuals) are disinclined to incur the cost of repairing unintended detrimental effects of own-noise on the other player's outcomes then they should display lower cooperation levels following own-noise trials. For instance, when own cooperation declines in Round 4 due to noise, representatives should be less inclined than individuals to rebuild cooperation levels in Round 5. Relevant to fear, if representatives (compared to individuals) lack the benign partner impressions that are necessary to overcome other-noise then they should display lower cooperation levels following other-noise trials. For example, when the other player's cooperation declines in Round 8, representatives should be less likely than individuals to respond trustingly, and thus should display lower cooperation in Round 9.

To explore these possibilities, we computed mean cooperation scores for participants' decisions in the four rounds that followed own-noise (i.e., Rounds 5, 13, 21, and 29) and for their decisions in the four rounds that followed other-noise (i.e., Rounds 9, 17, 25, and 33). These scores were analyzed in 2 (interaction type) × 2 (noise) × 2 (gender) ANCOVAs. The predicted Interaction

Table 2. Means and standard deviations (in parentheses) for mean cooperation in rounds following noise as a function of noise (no noise vs. noise) and interaction type (individuals vs. representatives).

	Individuals		Representatives	
	No noise	Noise	No noise	Noise
Following other-noise	6.07 (3.03)	5.39 (2.77)	6.15 (2.97)	4.29 (2.88)
Following own-noise	6.33 (2.73)	5.82 (2.86)	6.33 (2.60)	4.98 (2.94)

Type × Noise effect was significant for responses to other-noise, $F(1, 285) = 5.74$, $p = .017$, $\eta^2 = .02$, but not for responses to own-noise, $F(1, 285) = 2.40$, $p = .122$, $\eta^2 = .01$ (see Table 2).

Next, we probed the significant Interaction Type × Noise effect for responses to other-noise. Representatives displayed significantly lower cooperation than individuals following other-noise, $F(1, 285) = 6.38$, $p = .012$, $\eta^2 = .02$. In the no-noise condition, the simple effect of interaction type was not significant in these rounds, $F(1, 285) = 0.73$, $p = .393$, $\eta^2 = .00$. Viewed from a different angle, representatives displayed significantly lower cooperation following other-noise than in the same rounds in the no-noise condition, $F(1, 285) = 15.82$, $p < .001$, $\eta^2 = .05$. For individuals, the simple effect of noise was not significant in these rounds, $F(1, 285) = 0.36$, $p = .551$, $\eta^2 = .00$. Whereas we observed similar patterns for responses to own-noise, the Interaction Type × Noise interaction effect was not significant here, suggesting no reliable differences between representatives and individuals in their responses to own-noise.[8, 9]

Impressions of Benign Intent

We analyzed participants' impressions of their partner's global benign intent and of his/her specific interaction goals in 2 (interaction type) × 2 (noise) × 2 (gender) ANCOVAs (with prior experience as covariate). We present relevant means in Table 1. For global impressions of benign intent, the results revealed a significant main effect of interaction type only, $F(1, 285) = 3.93$, $p = .048$, $\eta^2 = .01$. As predicted, individuals reported more benign partner impressions than did representatives. For the specific interaction goals, we obtained significant main effects of interaction type on MinDiff, $F(1, 285) = 4.39$, $p = .037$, $\eta^2 = .01$; MaxOther, $F(1, 285) = 5.83$, $p = .016$, $\eta^2 = .02$; MaxRel, $F(1, 285) = 4.77$, $p = .030$, $\eta^2 = .02$; and MaxOwn, $F(1, 285) = 13.46$, $p < .001$, $\eta^2 = .04$; but not on MaxJoint, $F(1, 285) = 1.87$, $p = .173$, $\eta^2 = .01$. Individuals (compared to representatives) attributed to the other player greater concern for minimizing differences and maximizing others' (i.e., the participant's) outcomes, and lesser concern for maximizing relative advantage and own (i.e., the other player's) outcomes.[10]

Conditional Process Analyses

Compared with individuals, representatives displayed less favorable impressions of their partner's benign intent, and attributed to him/her less other-regarding (i.e., MinDiff and MaxOther) and more self-regarding (i.e., MaxOwn and MaxRel) interaction goals. We examined whether these potential mediating mechanisms explained why the discontinuity effect was more pronounced when noise was present (compared to absent). Specifically, we tested a "direct effect and second stage moderation model" (Edwards & Lambert, 2007). This model specifies that the moderator (noise) affects the magnitude of the mediators' (benign impressions, perceived interaction goals) partial association with the outcome (cooperation), and that this occurs in conjunction with a main effect of the independent variable (interaction type) on the mediators (see Figure 1). This model is appropriate because interaction type influenced the potential mediators irrespective of noise, but influenced cooperation only in the noise condition. We therefore tested the mediated effects of interaction type on cooperation, conditional upon noise.

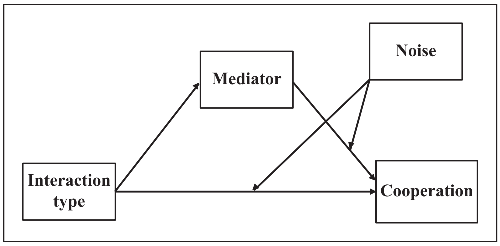

Figure 1. The conditional process model tested in this experiment.

First, we assessed whether the moderator (noise) affected the magnitude of the mediators' (global benign impressions, perceived interaction goals) associations with the outcome (cooperation) by testing, for each mediator, the Noise × Mediator interaction. This tested whether global benign impressions and perceived interaction goals were stronger predictors of cooperation when noise was present (compared to absent). We found significant interaction effects between noise and, respectively, MinDiff and MaxRel. Results further revealed marginal interactions between noise and, respectively, benign impressions and MaxOwn (see Table 3, A × C). Global benign impressions and partners' greater (compared to lesser) perceived concern for minimizing differences in outcomes predicted increased cooperation in the noise condition, benign impressions: $F(1, 277) = 17.39, p < .001, \eta^2 = .05$; MinDiff: $F(1, 277) = 35.03, p < .001, \eta^2 = .09$; but these associations were not significant in the no-noise condition, benign impressions: $F(1, 277) = 2.24, p = .136, \eta^2 = .01$; MinDiff: $F(1, 277) = 1.61, p = .205, \eta^2 = .00$. Partners' greater (compared to lesser) perceived concern for maximizing own outcomes and relative advantage in outcomes, conversely, predicted decreased cooperation in the noise condition, MaxOwn: $F(1, 277) = 7.13, p = .008, \eta^2 = .02$; MaxRel, noise: $F(1, 277) = 8.67, p = .004, \eta^2 = .03$; but did not in the no-noise condition, MaxOwn: $F(1, 277) = 0.00, p = .977, \eta^2 = .00$; MaxRel, no noise: $F(1, 277) = 0.05, p = .822, \eta^2 = .00$. Furthermore, the previously significant Noise × Interaction Type interaction on cooperation (see Table 3, A × B) became nonsignificant or marginal when we controlled for the interaction between noise and, respectively, benign impressions, MaxRel, MinDiff, and MaxOwn.

Next, we used the PROCESS macro to test the conditional process model shown in Figure 1 (Model 15; 10,000 resamples; Hayes, 2013). The mediator was, in turn, benign impressions, MinDiff, MaxOwn, or MaxRel. PROCESS calculates bootstrap confidence intervals (CIs) for the indirect effect (denoted as *ab*) of interaction type on cooperation via each of the mediators, conditional upon noise. In the noise condition, this indirect effect was significant (i.e., the 95% CI did not include 0) for benign impressions ($ab = -.09$, $SE = 0.05$, 95% CI [−0.21, −0.01]), MinDiff ($ab = -.16$, $SE = 0.08$, 95% CI [−0.33, −0.02]), MaxOwn ($ab = -.10$, $SE = 0.06$, 95% CI [−0.24, −0.02]), and MaxRel ($ab = -.09$, $SE = 0.05$, 95% CI [−0.21, −0.01]). In the no-noise condition, this indirect effect was not significant for benign impressions ($ab = -.03$, $SE = 0.03$, 95% CI [−0.13, 0.01]), MinDiff ($ab = -.04$, $SE = 0.03$, 95% CI [−0.14, 0.01]), MaxOwn ($ab = -.00$, $SE = 0.05$, 95% CI [−0.11, 0.11]), or MaxRel ($ab = .01$, $SE = 0.03$, 95% CI [−0.03, 0.08]). When the four mediators were entered simultaneously as parallel mediators, the indirect effect in the noise condition remained significant only for MinDiff ($ab = -.17$, $SE = 0.09$, 95% CI [−0.36, −0.03]), and was not significant for benign impressions ($ab = -.02$, $SE = 0.02$, 95% CI [−0.11, 0.04]), MaxOwn ($ab = -.00$, $SE = 0.05$, 95% CI [−0.10, 0.09]), or MaxRel ($ab = .04$, $SE = 0.04$, 95% CI [−0.01, 0.15]). In the no-noise condition, the indirect effect was not significant for benign impressions ($ab = -.02$, $SE = 0.04$, 95% CI [−0.12, 0.03]), MinDiff ($ab = -.06$, $SE = 0.05$, 95% CI [−0.20, 0.01]), MaxOwn ($ab = .00$, $SE = 0.07$, 95% CI [−0.13, 0.15]), or MaxRel ($ab = .05$, $SE = 0.05$, 95% CI [−0.01, 0.19]).

The mediational analyses yielded practically identical results when zooming in on responses to other-noise (Rounds 9, 17, 25, and 33). Here too, the interaction-type effect in the noise condition was mediated by benign impressions ($ab = -.11$, $SE = 0.06$, 95% CI [−0.26, −0.01]),

Table 3. Conditional process analyses: Testing the effect of noise on the magnitude of the mediators' association with cooperation (Effect A × C).

	Mediator									
	Benign impressions		MinDiff		MaxOther		MaxOwn		MaxRel	
	F	*p*	*F*	*p*	*F*	*p*	*F*	*p*	*F*	*p*
Noise (A)	5.63	.018	3.49	.063	3.96	.047	2.59	.109	4.93	.027
Interaction type (B)	0.46	.498	0.54	.816	0.05	.830	0.25	.618	0.50	.480
A × B	1.68	.196	2.78	.097	3.74	.054	3.22	.074	2.42	.121
Mediator (C)	15.15	< .001	26.26	< .001	23.66	< .001	3.24	.073	3.66	.057
A × C	2.77	.097	11.23	.001	0.00	.987	3.09	.080	5.04	.026

Note. The dependent variable in each analysis is mean cooperation. Denominator degrees of freedom equal 277. MinDiff = partner's tendency to minimize the difference between each party's outcomes; MaxOther = partner's tendency to maximize other's (i.e., participant's) outcomes; MaxOwn = partner's tendency to maximize own outcomes; MaxRel = partner's tendency to maximize relative advantage over the other (i.e., the participant).

MinDiff (ab = −.18, SE = 0.09, 95% CI [−0.38, −0.02]), MaxOwn (ab = −.15, SE = 0.07, 95% CI [−0.32, −0.05]), and MaxRel (ab = −.12, SE = 0.06, 95% CI [−0.26, −0.02]). Only the indirect effect through MinDiff remained significant (ab = −.17, SE = 0.09, 95% CI [−0.37, −0.02]) when testing all mediators in parallel.

In sum, the discontinuity effect in the noise condition was mediated by benign impressions of the partner and by perceptions of the partner's concern for maximizing own outcomes, relative advantage in outcomes, and (particularly) minimizing differences in outcomes. These results are consistent with the idea that (a) benign partner impressions help to cope with the detrimental effects of noise on cooperation and (b) group representatives (compared to individuals) are less likely to form such benign partner impressions, and thereby are less able to overcome the deleterious effects of noise. Accordingly, the discontinuity effect is accentuated when noise is present (compared to absent).

Discussion

We examined the impact of unintended errors, or noise, in interindividual and intergroup contexts. To this end, we compared social dilemma interactions between group representatives with interactions between isolated individuals in the presence or absence of noise. Noise exerted detrimental effects on cooperation between group representatives but had no significant impact on cooperation between individuals. Viewed from a different angle, representatives were less cooperative than individuals in the presence of noise, but did not differ significantly from individuals when noise was absent (in line with previous evidence involving tit-for-tat strategies; see Insko et al., 1998; Wildschut et al., 2003). Accordingly, the presence (vs. absence) of noise accentuated the discontinuity effect. These findings provide important insight into how interindividual–intergroup discontinuity may unfold in realistic, noisy environments, and show that these environments are less conducive to intergroup cooperation than the non-noisy environments in which this contrast has previously been studied. This offers important insights into the origins and potential resolution of intergroup conflict. We discuss these contributions next.

The Impact of Noise in Intergroup Contexts

The literature on the discontinuity effect indicates two major mechanisms whereby the impact of noise might be magnified in intergroup settings:

greed and fear. People's greater greed in intergroup contexts could make them reluctant to incur the cost of repairing unintended detrimental effects of own-noise on others' outcomes. However, the discontinuity effect was not significantly larger in rounds following own-noise than in the same rounds with no noise. Thus, results did not support the own-noise explanation. People's greater fear in intergroup contexts could reduce their willingness to give others the benefit of the doubt and to respond cooperatively to other-noise. Indeed, the discontinuity effect was significantly larger in rounds following other-noise than in the same rounds with no noise. This finding suggests that the stronger impact of noise in the context of interactions between representatives may be rooted in people's greater fear of interdependent others in intergroup contexts. This conclusion is further supported by the notion that the discontinuity effect in the noise condition was mediated by partner impressions and particularly, by perceptions of the partner's concern for minimizing differences in outcomes. Whereas individuals' positive partner impressions limited the deleterious effect of noise, representatives' negative partner impressions obstructed the trusting interpretations and generous behaviors that are necessary to overcome noise (Axelrod & Dion, 1988; Klapwijk & van Lange, 2009; Kollock, 1993). To further identify how fear and greed contribute to the impact of noise in intergroup contexts, a valuable avenue for future research would be to test directly these processes and the mechanisms through which they may operate (e.g., examining people's tendency to interpret partner noise as intentional and to remedy the deleterious consequences of own-noise for others), as well as alternative processes that may contribute to this relationship (e.g., tendencies to employ noise deceptively for personal gain, willingness to sustain the costs associated with responding generously).

It is noteworthy that when noise was absent, representatives achieved the same high levels of cooperation as individuals, even though their initial cooperation levels had been lower (see Round 1 results). This finding is encouraging, as it suggests that group representatives are capable of developing cooperative relations between groups if instances of noise can be avoided. However, the absence of a discontinuity effect within this environment does contrast with prior research. How can this discrepancy be understood, and what does this imply for the present conclusions? As noted, our method differed in several respects from prior discontinuity research, which may have impacted participants' level of cooperation. We outline two major differences and their implications for the present conclusions next.

The first major difference is that we examined interactions between group representatives, whereas prior research on the discontinuity effect has mostly examined interactions between groups of participants who followed a consensus decision rule. Representatives interact one-on-one (similar to individuals) and thus lack the anonymity and mutual support that group members enjoy (Wildschut & Insko, 2007). Accordingly, interactions between representatives may be less competitive than interactions between entire groups and this could have contributed to the absence of a discontinuity effect in the no-noise condition. The second major difference is that we used a reciprocal strategy to simulate the other player, whereas prior research has mostly examined interactions between two individuals or groups whose strategies were unconstrained. The discontinuity effect is attenuated by reciprocal strategies (Insko et al., 1998; Wildschut et al., 2003) and, hence, this second methodological difference could also have contributed to the absence of a discontinuity effect in the no-noise condition. To address these issues, future research would do well to examine the impact of noise on the discontinuity effect in a context where groups follow a consensus rule and players' strategies are unconstrained. Whereas the overall rate of intergroup competition should be higher in that context, our key finding that noise accentuates the discontinuity effect should replicate because (a) groups (relative to individuals) lack benign partner impressions (Hoyle et al., 1989; Insko & Schopler, 1998; Pemberton et al., 1996) and (b) benign partner impressions are particularly important in the context of noise (relative to no noise), as the present findings showed.

Broader Implications

The concept of noise has been largely absent from the literature on intergroup relations. This is surprising because, in everyday life, intergroup interactions are often characterized by differences in norms, culture, and ideology, which may increase the likelihood of misunderstandings (Choi & Nisbett, 1998; Gelfand & Christakopoulou, 1999; Morris & Peng, 1994). The present research provides evidence that noise is particularly harmful in intergroup settings and accentuates the discontinuity effect. Indeed, past research may have underestimated the competitiveness of intergroup relations: in environments without noise, the competitive impressions and interaction goals that characterize intergroup interactions may be less detrimental to cooperation. The present research thus underlines the importance of considering noise in future theorizing and research on intergroup relations. In doing so, such initiatives should consider not only negative noise, as in the present contribution, but also positive noise, or combinations of the two (i.e., neutral noise; Signorino, 1996).

In addition, our findings also shed light on how to reduce the discontinuity effect by increasing intergroup cooperation. Prior perspectives have proposed a range of initiatives to increase intergroup cooperation, including reciprocal strategies and the pursuit of long-term goals (Cohen & Insko, 2008). As the present findings suggest, such strategies may be compromised by instances of noise. We propose that generosity, or returning greater cooperativeness than that received from another individual or group, is necessary to counter the negative impact of noise (Klapwijk & van Lange, 2009). The question of how to promote such generosity in the context of competitive groups is an important challenge for future research. One promising idea is based on prior evidence that representatives who received sufficient autonomy to conduct the group's interactions at their own discretion, without fear of being penalized by their constituents, employed more cooperative strategies to maximize long-term gain and collective interests (Pinter et al., 2007; also see Milinski et al., 2016). This orientation would seem more conducive to the generous strategies that are necessary to overcome noise. For these reasons, we suggest that autonomous (i.e., unaccountable) representatives may hold the key to overcoming the impact of noise and enhancing cooperation in intergroup contexts.

Coda

Although intergroup interactions may be particularly prone to noise in everyday life, little is known about the impact of unintended errors on decision making in intergroup contexts. The present research addressed this by comparing interindividual and intergroup interactions in social dilemma environments with or without noise. Results indicated that noise was more detrimental to intergroup than interindividual cooperation and, hence, accentuated the discontinuity effect. In light of the far-reaching implications of intergroup interactions (in politics, collective bargaining, and international relations), the present research underscores the importance of considering noise in theorizing about intergroup conflict and in initiatives to resolve it.

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Notes

1. The original sample included two nonadult individuals (aged 14 and 10). In light of the study's framing (i.e., in terms of rivaling universities), we excluded them from data analysis.
2. In fact, participants' chances of winning in a postexperimental raffle were not contingent on task outcomes.

3. This paradigm is more suitable for examining coping with noise than the dichotomous decisions that have been used in some previous research (e.g., Axelrod & Dion, 1988; Kollock, 1993), as people can communicate intentions and goals more profoundly through increases and decreases of their gradual level of cooperation.
4. We informed participants about the possibility of noise because they are unlikely to expect unintended errors in an experiment and, hence, would assume all of their partner's decisions to be intentional.
5. If participants intended to give no coins, then, an incidence of noise could reduce this no further and, hence, would go by unnoticed. However, previous research has indicated that typically a high percentage of noise comes through (over 90%; see Tazelaar et al., 2004; van Lange et al., 2002). Here, of the eight instances of noise, on average 86.8% came through. This rate did not differ between interpersonal and intergroup interactions ($p = .62$).
6. Experience in social dilemma tasks is strongly predictive of cooperation, as it promotes understanding that cooperative strategies afford higher outcomes in repeated interaction (Allison & Messick, 1985). Around the time when we conducted the present study, other studies in the same laboratory also used the coin paradigm (van Lange, Klapwijk, & van Munster, 2011; Vuolevi & van Lange, 2012). As a precaution, we made the a priori decision to assess participants' prior experience with the paradigm. Of the 294 participants, 134 indicated having played the coin paradigm before, and these participants displayed significantly higher levels of cooperation than those without prior experience (see main text). To control for this, we included experience in all analyses. Doing so increased the statistical power to detect effects of our manipulations (by reducing the within-group error variance), both for the main effect of interaction type in Round 1, with covariate: $F(1, 285) = 3.82$, $p = .052$, $\eta^2 = .01$; without covariate: $F(1, 286) = 3.19$, $p = .075$, $\eta^2 = .01$; and for the interaction effect between Interaction Type × Noise in Rounds 2–35, with covariate: $F(1, 285) = 3.62$, $p = .058$, $\eta^2 = .01$; without covariate: $F(1, 286) = 2.19$, $p = .140$, $\eta^2 = .01$.
7. A repeated measures ANCOVA on cooperation in Rounds 2–35 indicated only a single significant interaction effect involving rounds and noise, $F(18.31, 5219.88) = 3.83$, $p < .001$, $\eta^2 = .01$ (indicating a modest increase in cooperation in interactions without noise and a gradual decline and slight recovery in noisy interactions). Accordingly, we only present the (more parsimonious) analysis on average cooperation here.
8. Additionally, these analyses indicated significant main effects of noise for both, responses to other-noise, $F(1, 285) = 10.53$, $p = .001$, $\eta^2 = .04$, and responses to own-noise, $F(1, 285) = 7.73$, $p = .006$, $\eta^2 = .03$.
9. The interaction (as well as simple effects tests) remained significant when we controlled for participants' level of cooperation in the preceding round (i.e., prior to the occurrence of noise).
10. Additionally, the analyses revealed isolated effects involving gender, indicating that men attributed greater concern for maximizing own outcomes to their partner than women, $F(1, 285) = 5.72$, $p = .017$, $\eta^2 = .02$; that women, but not men attributed greater concern for relative advantage to their partner in intergroup contexts than in interpersonal contexts, $F(1, 285) = 2.88$, $p = .091$, $\eta^2 = .01$; and that women displayed more benign impressions than men in interactions without noise, but not in noisy interactions, $F(1, 285) = 3.61$, $p = .058$, $\eta^2 = .01$.

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