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ORIGINAL PAPER

The Interplay Between Face-to-Face Contact and Feedback on Cooperation During Real-Life Interactions

Friederike Behrens[1] · **Mariska E. Kret**[1,2]

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Abstract

Cooperation forms the basis of our society and becomes increasingly essential during times of globalization. However, despite technological developments people still prefer to meet face-to-face, which has been shown to foster cooperation. However, what is still unclear is how this beneficial effect depends on what people know about their interaction partner. To examine this question, 58 dyads played an iterated Prisoner's Dilemma game, sometimes facing each other, sometimes without face contact. Additionally, explicit feedback regarding their decisions was manipulated between dyads. The results revealed that participants were more cooperative when they saw each other compared to when they could not, and when receiving reliable compared to unreliable or no feedback. Contradicting our hypothesis that participants would rely more on nonverbal communication in the absence of explicit information, we observed that the two sources of information operated independently on cooperative behavior. Interestingly, although individuals mostly relied on explicit information if available, participants still cooperated more after their partner defected with face-to-face contact compared to no face-to-face contact. The results of our study have implications for real-life interactions, suggesting that face-to-face contact has beneficial effects on prosocial behavior even if people cannot verify whether their selfless acts are being reciprocated.

Keywords Cooperation · Face-to-face contact · Feedback · Dyadic interaction · Nonverbal communication · Social dilemmas

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✉ Mariska E. Kret
m.e.kret@fsw.leidenuniv.nl
http://www.mariskakret.com

Friederike Behrens
f.behrens@fsw.leidenuniv.nl

[1] The Faculty of Social and Behavioral Sciences, Cognitive Psychology Unit, Institute of Psychology, Leiden University, Wassenaarseweg 52, 2333 AK Leiden, The Netherlands

[2] Leiden Institute of Brain and Cognition (LIBC), Leiden, The Netherlands

Introduction

Cooperation is an important foundation of social group life and essential in diverse activities ranging from riding a tandem to raising a child. On the one hand, relatively recent technological developments such as the Internet, social media and Skype, allow cooperation on a heretofore unknown scale; researchers separated by an ocean can conduct research together and discuss findings via video chat. On the other hand, more and more people express their concerns; in public transport, travelers hardly interact anymore, but are sucked up by their phones. The big question is whether and to what extent face-to-face contact fosters cooperative endeavors and helps society flourish. To that extent, the current study investigates people's cooperative tendencies towards others when partners can see each other or not, and when they have true, unreliable, or no information about their partners' previous cooperative decisions.

Face-to-face contact may be an important predictor for cooperation. Indeed, using economic games, previous research has shown that with the introduction of more artificial forms of communication, cooperation declines. For instance, cooperation drops in the context of writing messages, having telephone conversations and interacting with human-like avatars compared to face-to-face encounters with real people (Balliet 2010; Bohnet and Frey 1999; Drolet and Morris 2000; Frohlich and Oppenheimer 1998; Kiesler et al. 1996). Possibly, during face-to-face interactions, social information including body language, facial expressions, and eye gaze, shape our expectations about the partner's intentions and therewith decreases the risk of being exploited (Balliet 2010; Boone and Buck 2003). Furthermore, face-to-face contact makes social norms more salient, and hence, boosts cooperation (Bohnet and Frey 1999). While these studies have often investigated the effect of face-to-face contact by looking at "communication" in a broader sense including both verbal and nonverbal communication (Balliet 2010; Bicchieri and Lev-on 2007; Brosig et al. 2003; Jorgenson and Papciak 1981; Sprecher 2014), the current study focussed on nonverbal communication only, refining its contribution to the overall beneficial effect of face-to-face contact. Verbal communication allows people to explicitly exchange information, discuss strategies and agree on future steps in the game. Nonverbal information, such as facial expressions, eye gaze, and pupil dilation, on the other hand, are more subtle, but still carry rich and genuine information that we use to express and interpret other's intentions, which consequently influences our (prosocial) behavior (Adolphs and Tusche 2017; Boone and Buck 2003; Brambilla et al. 2019; Frank et al. 1993b; Jahng et al. 2017; Kret 2015; Kret et al. 2015; Myllyneva and Hietanen 2015; Prochazkova and Kret 2017). Until now, studying the effect of dynamic nonverbal communication on cooperation in natural dyadic interactions has been largely neglected. Only one study conducted by Jahng et al. (2017) used a similar set-up where people were restricted to use nonverbal communication only. The authors reported that seeing each other increased mutual cooperation compared to when participants could not see each other. In sum, the literature shows that face-to-face contact is likely to be important for cooperation in different contexts.

Another factor that people generally take into account when considering cooperation, is knowledge about the person and how cooperative s/he has been in the past. Cooperation is a vulnerable act associated with the risk of being exploited. Knowing that the interaction partner has cooperated before lowers this risk. Research using economic game paradigms clearly shows that this kind of knowledge modulates the outcomes of such games (Bixenstine and Wilson 1963; Jorgenson and Papciak 1981; Monterosso et al. 2002; Tedeschi et al. 1968). What is less clear, is how explicit knowledge about a partner's previous decisions is integrated

with the nonverbal signals that are being transmitted. In other words, how strongly do people rely on face-to-face contact compared to past behavior? The current study addresses this question for the first time by manipulating the visibility of nonverbal information and knowledge about past behavior.

In the current study, two naïve participants played an iterated Prisoner's Dilemma game while they could either see each other or not, and where they received feedback about their partner's decisions that was either true, unreliable or absent (no feedback). We had three main hypotheses. First and foremost, we expected participants to be more willing to cooperate when facing each other, allowing for the implicit transmission of nonverbal signals, compared to when a visual barrier blocked the view of one another. Second, we hypothesized that cooperation would be influenced by the type of feedback participants received. Specifically, we expected individuals to cooperate on the largest scale when receiving correct feedback about the partner's decisions. In this experimental condition, the predictability of the partner's next choice is highest and the risk of being exploited lowest. We further expected that a participant's decision would be influenced by the partner's latest decision, and more likely being the same than different. Third, investigating the possible interplay between feedback and face-to-face contact, we hypothesized that the advantage of face-to-face contact would be most pronounced when participants received no feedback at all, as they would have to rely on nonverbal signals exclusively.

For exploratory reasons, we investigated potential effects of individual differences in social value orientation, emotion recognition ability, social anxiety, and empathy, as previous research suggests that these factors might modulate cooperative decisions (Bogaert et al. 2008; Doesum et al. 2013; Eisenberg and Miller 1987; Sylwester et al. 2012; Wehebrink et al. 2018) or the putative effect of face-to-face contact on cooperation (Adolphs et al. 2001; Emonds et al. 2011; Kret et al. 2017; Pierce 2009).

Methods

Participants

In total, 116 individuals (age: $M=21.05$, $SD=2.49$) participated in the study with 72 (62.1%) females. They were randomly paired to form 58 same-sex dyads, ensuring that they did not know each other before. One dyad was excluded from the analysis due to missing data in more than 50% of the trials in the face-to-face condition. Participants received either course credits or a monetary reward of €7 per hour. In addition, all participants had the chance to win between €0.5 and €2.0 extra based on their performance during the Prisoner's Dilemma game. Participation took two hours, which included completing questionnaires at home and in the lab and playing the Prisoner's Dilemma game. Upon arrival at the lab, participants gave informed consent to participate in the study, which was approved by the Ethics Committee of Leiden University (CEP16-0314/131). They received full debriefing afterwards.

Materials

Two participants played two rounds of 50 Prisoner's Dilemma games, measuring cooperative behavior. This game provides two choice alternatives, where the performance of one player depends on both one's own and the other person's choices. Specifically, both can choose to cooperate (C) or defect (D) during each trial. When both cooperate (CC), the

Table 1 The payoff matrix of the Prisoner's Dilemma game

You	Other	
	C	D
C	3–3	1–4
D	4–1	2–2

The first number refers to the points earned by "You"

incentive is larger compared to when both defect (DD). However, when one player defects whereas the other cooperates (DC), the former gets the highest possible incentive while the latter receives the lowest. In that way, a conflict emerges between self- and collective-interests because the joint outcome is larger when both players cooperate, while the trade-off for each individual is larger when defecting (DC > CC > DD > CD from the perspective of Player 1). The payoff structure for the current study was as follows: DC = 4, CC = 3, DD = 2, CD = 1 (see Table 1; Balliet and Van Lange 2013). Following standard procedures and in order to avoid confounds through suggestive formulations, the game was phrased as choosing between options A or B rather than between cooperation and defection.

Study Design

The study used a mixed design with one between-subject (feedback) and one within-subject variable (nonverbal communication). The dependent variables were the willingness to cooperate (0 = defect, 1 = cooperate) and the dyad's joint outcome, i.e., mutual cooperation (CC), mutual defection (DD) and one-sided cooperation (CD/DC).

Feedback was manipulated between dyads with a third of the dyads receiving no feedback about the other person's decision, a third receiving correct feedback, and a third receiving random feedback (50% correct, 50% incorrect). Participants in the latter condition were not informed that the feedback was random. Furthermore, the possibility for participants to use nonverbal communication was manipulated within dyads. Participants played the game twice, once where they faced each other, allowing for nonverbal communication (face-to-face condition), and once while a visual cover was placed in between them, constraining nonverbal communication (face-blocked condition).

Procedure

Before coming to the lab, participants received information about the study and a link to fill out an online questionnaire consisting of the Liebowitz Social Anxiety Scale (LSAS; Beard et al. 2011), the Interpersonal Reactivity Index (IRI; Davis 1980) and nine brief, decomposed games to measure their social value orientation (SVO; Van Lange et al. 1997). When the two participants forming one dyad arrived at the lab, they were immediately separated to avoid interactions before the experiment started. In different rooms, they gave informed consent and filled out the Positive and Negative Affect Schedule (PANAS; Watson et al. 1988) and completed the Reading the Mind in the Eyes task (Baron-Cohen et al. 2001). After filling out these questionnaires, they read the instructions of the Prisoner's Dilemma game and answered verification questions to make sure that they understood the game correctly. The questionnaires were not the main focus of our study, which is the

reason why we included the descriptives and additional analyses regarding their relation with the experiment in the Supplemental Information (see Appendix S1).

When both participants were ready to start the experiment, they were asked to sit at a table facing each other. Participants could not see each other's responses (button presses), as a visual cover was placed in the middle, such that participants could only see each other's faces, but not their bodies. At the beginning of the experiment when participants sat at the table and during the face-blocked condition, there was an extra visual cover on top of the other one, such that participants could not see each other at all (see Fig. 1). The payoff matrix was placed in front of them on the table to reduce mental effort trying to remember the payoff structure (see Table 1; Balliet and Van Lange 2013). The experiment started with five practice trials. When no errors were made, the real experiment began, consisting of 45 testing trials. In order to keep the experiment controlled and standardized, an audio file was played so that participants heard all instructions via their headphones. The sequence of events per trial was as follows: First, both participants were instructed to look at each other ("Look at each other" or: "Look at the cross in front of you"). This interval allowed participants to make a decision and to "read" the other person's mind, and decide whether he/she would cooperate or defect. After 4 s, they were told to look down and make a decision (cooperate or defect), by pressing the corresponding button on the keyboard (the corresponding keys were marked with stickers saying "A" for option A (cooperate) or "B" for option B (defect) ("Look down at the table. After the beep, choose as fast as possible between option A and B. Keep looking down"). Subsequently, they were instructed to indicate what they thought the other person had decided to choose (using the same keys as for their own choice) ("Indicate after the beep what you think the other person chose, option A or B. Keep looking down"). In the correct/random feedback conditions, the points each player earned were subsequently communicated via the headphones (e.g., "Player 1 receives 1 point, player 2 receives 4 points"). In the correct feedback condition, the feedback reflected the actual responses. In the random feedback condition, the points were correct 50% of the time and 50% incorrect. In the "no feedback" condition, they were only informed that both players had made a decision without any information about the points earned ("Both of you have made a decision"). The next trial started when the auditory instruction to look at each other was given. No information was given about the cumulative performance of the players during the experiment.

Before and after the testing trials, participants rated their experience of the interaction regarding their level of connection, awkwardness, and shyness towards the other person on visual analog scales (VAS). After the first session of 50 trials (5 practice, 45 testing trials), participants had to change their sitting position so that they could not (could) face each other (the order of starting in the face-to-face or face-blocked condition was counterbalanced) and played the game again in 50 trials (5 practice, 45 testing trials). After the practice and testing trials, participants filled out the same VAS as in the first session. The descriptives of the VAS at the four time points are provided in the Supplemental Table S4 (see Appendix S4).

At the end of the experiment (after the second session), participants filled out the DFI (Desire for Future Interaction Scale, see Table S4) and answered questions about their insight and experience of the interaction with questions including "How much could you "read" the other person's intentions?", "Which information did you use to "read" the other person's intentions?", and "How much did the feedback influence your choices?". In the two feedback conditions, a manipulation check verified that participants believed that they received correct feedback (participants in the random feedback condition were not informed that the feedback was incorrect 50% of the time). Finally, the two individuals

Fig. 1 Set-up of the experiment for the face-to-face condition (left) and the face-blocked condition (right)

were separated again to give them their monetary reward based on their performance on a randomly selected trial (DC = €2, CC = €1.5, DD = €1, CD = €0.5 from the perspective of Player 1).

Data Analyses

We performed two types of analyses, one with the willingness to cooperate (per person) and one with the joint outcome (per dyad) as the dependent variable. We made this distinction because we aimed to understand the effects of nonverbal communication and explicit information on the personal level and how that translates into successful cooperation. For the willingness of cooperation, we performed binary logistic mixed model analyses with cooperation (0 = defect, 1 = cooperate) as the dependent variable. For the joint outcome, we used a multinomial mixed model analysis with mutual defection as the reference. This results in binary estimations of the likelihood of achieving mutual cooperation (CC) over mutual defection (DD) and the likelihood of reaching one-sided cooperation (CD/DC) over mutual defection (DD). To account for the differences between dyads and interdependence within dyads, Dyad and Dyad * Player were added as random intercept effects. As predictor variables, we added face condition (0 = face-blocked, 1 = face-to-face) as a within-dyad factor and feedback type condition (0 = no, 1 = correct [reliable], 2 = random [unreliable]) as a between-dyad factor. On a trial-by-trial basis, we coded the feedback that participants received in the previous trial (previous feedback, 0 = defect, 1 = cooperate). Participants did not directly hear whether the partner defected or cooperated but were informed about the amount of points each player received, from which they could deduce the decision the partner had made (e.g., when player 1 heard "player 1 received 4 points and player 2 received 1 point", s/he knew that the partner [player 2] cooperated). Keep in mind that in the random feedback condition participants sometimes received correct feedback and sometimes incorrect feedback. Both players received either correct or incorrect feedback on the same trials. Given that players knew what they chose themselves, the incorrect feedback had to be tailored to their choice, only changing the feedback about the other player's decision. In the correct feedback condition, both players always heard the same audio clips.

In an exploratory analysis, we investigated the relation between cooperative behavior, face-to-face contact and personality traits. In addition, we appended an analysis investigating whether people were able to predict each other's decisions based on nonverbal cues, an ability that has been reported previously (Lewkowicz et al. 2015; Sparks et al. 2016;

Table 2 Overview of the means and their standard errors of the cooperation rates for the (a) main effects of face and feedback condition and (b) their interaction effect

(a)		
Main effect	Condition	Descriptives
Face condition	Face-to-face	.64 (.03)***
	Face-blocked	.62 (.03)***
Feedback condition	No	.60 (.04)*
	Correct	.79 (.03)***
	Random	.48 (.02)

(b)		
Feedback condition	Face condition	
	Face-to-face	Face-blocked
No	.60 (.06)	.61 (.06)
Correct	.80 (.04) ***	.78 (.05)***
Random	.51 (.03)	.46 (.03)

* $p < .05$; ** $p < .005$, *** $p < .001$, one-sided one-sample t tests ($\mu = 0.5$, level of chance)

Verplaetse et al. 2007). A more detailed description and the results of these analyses can be found in the Supplemental Information Appendix S1 and S2. Given the number of analyses we ran, increasing the chance of Type I errors, we decided to lower the significance level to $\alpha = 0.005$ for the exploratory analysis section. For the confirmatory analyses, the significance level was $\alpha = 0.05$.

Results

The mean cooperation rates and joint outcomes per condition are presented in Tables 2 and 3, respectively. First, our hypothesis that participants would cooperate more in the face-to-face compared to face-blocked condition was confirmed, $B = .17$, $SE = .05$, CI (.06, .27), OR 1.19, $p = .002$. This effect also translated into more successful cooperation considering the joint outcome with people successfully cooperating more (compared to mutually defected) in the face-to-face condition compared to the face-blocked condition, $B = .32$, $SE = .10$, CI (.12, .51), OR 1.38, $p = .001$. Participants also chose one-sided cooperation over mutual defection more in the face-to-face compared to face-blocked condition, $B = .19$, $SE = .08$, CI (.03, .35), OR 1.21, $p = .018$. In Supplemental Information Appendix S3 we describe additional effects regarding the order of the sessions.

Regarding our second hypothesis, we observed a significant effect of feedback type, $F(2, 10{,}226) = 8.08$, $p < 0.001$: participants were more willing to cooperate in the correct compared to the unreliable feedback condition, $B = 2.88$, $SE = 0.72$, CI (1.47, 4.29), OR 17.81, $p < .001$, and the no feedback condition, $B = 1.64$, $SE = 0.72$, CI (0.23, 3.04), OR 5.16, $p = .023$. The difference between no and unreliable feedback was not significant ($p = .075$). Focusing on the dyads that did receive feedback about their partner's previous decisions, we investigated whether the feedback they received during the previous trial

Table 3 Proportions (mean and standard errors) of the joint outcomes (CC, DD, CD/DC) per condition

Feedback condition	Face condition	Joint outcome		
		CC	DD	CD/DC
No	Face-to-face	.35 (.009)	.17 (.005)	.48 (.007)
	Face-blocked	.37 (.009)	.19 (.006)	.44 (.007)
Correct	Face-to-face	.72 (.009)	.13 (.005)	.16 (.005)
	Face-blocked	.69 (.009)	.16 (.006)	.15 (.004)
Random	Face-to-face	.25 (.004)	.28 (.004)	.48 (.003)
	Face-blocked	.19 (.003)	.30 (.003)	.51 (.002)

The standard errors of the means are calculated per dyad per face condition

impacted on participant's cooperative behavior during the subsequent trial. As participants did not know whether the feedback they received was correct or not, we only investigated the effect of what they actually heard, independent of whether this was correct or not.[1] The results reveal that participants indeed relied on what they learned from the explicit feedback when deciding on their next choice, with a greater willingness to cooperate after hearing their partner cooperated versus defected in the previous trial, $B = 1.53$, $SE = .07$, CI (1.40, 1.67), OR 4.62, $p < .001$.

With respect to our third hypothesis that people would rely more on nonverbal communication during their decision to cooperate when no explicit information was available (i.e., in the no feedback condition), the interaction between feedback type and face condition, $F(2, 10223) = 3.16$, $p = .043$, was not meaningful as it was entirely driven by dyads with extreme cooperation rates. After excluding the highest cooperation rates (mean cooperation rate of 0.99 or higher), the effect was rendered insignificant, indicating that the interaction was driven by a ceiling effect, $F(2, 7441) = 1.36$, $p = .256$. With respect to the content of the feedback participants received in the previous trial, we observed an interaction effect with face condition, $F(1, 6459) = 14.0$, $p < .001$ (see Fig. 2), with significantly more choices to cooperate in the face-to-face compared to face-blocked condition when participants heard that their partner defected in the previous round, $B = .43$, $SE = .10$, CI (.22, .63), OR 1.54, $p < .001$. However, there was no such difference when participants heard that their partner cooperated during the previous trial ($p = .527$). Disentangling the interaction from another perspective, although participants' willingness to cooperate decreased after hearing that their partner defected in the previous round, this decrease was less pronounced when players saw each other compared to when they did not, as was evident by a smaller beta estimate in the face-to-face condition, $B = 1.17$, $SE = .10$, CI (0.98, 1.36), OR 3.22, $p < .001$, compared to the face-blocked condition, $B = 1.61$, $SE = .10$, CI (1.41, 1.81), OR 5.00, $p < .001$.

Next, we investigated whether the benefits of explicit feedback on partners' willingness to cooperate also translated into greater cooperative success. This was indeed the case, with more mutual cooperation, $B = 1.80$, $SE = .13$, CI (1.54, 2.06), OR 6.05, $p < .001$, and more

[1] There was a significant interaction between feedback type and previous feedback ($p < .001$) driven by extreme cooperation rate values, i.e., by a ceiling effect. After excluding extreme participants with a cooperation rate higher than .95, the interaction became non-significant suggesting that the willingness to cooperate based on what they heard did not differ between the correct and random feedback condition; $p = .120$ (number of excluded trials: 6463–4638 = 1825).

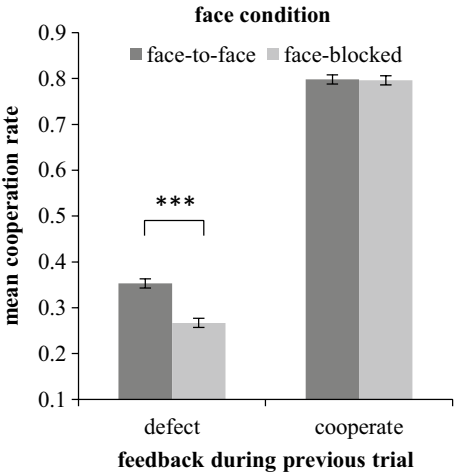

Fig. 2 Predicted mean cooperation rate (±2 SE) in the face-blocked and face-to-face condition moderated by what people heard what their partner chose in the previous trial (***$p < 0.001$)

one-sided cooperation, $B = 0.82$, $SE = 0.11$, CI (0.61, 2.03), OR 2.27, $p < .001$, compared to mutual defection when participants heard their partner cooperated rather than defected in the previous trial. This effect was independent of the face condition the dyads were in ($p = .052$).

Discussion

In the current study, we investigated the joint effects of face-to-face contact and knowledge about partners' previous behavior on the willingness to cooperate and on cooperative success. Our key results are threefold and show that first, face-to-face contact stimulates people's willingness to cooperate, even when their partner defected earlier. This positive effect also translates into more successful cooperation (cooperative decisions in both players). Second, participants are most cooperative when receiving reliable feedback about their partner's behavior compared to unreliable or no feedback, reciprocating their partner's past behavior when that information is available. Third, the benefit of face-to-face contact operates independently of whether people have knowledge about their partner's previous behavior or not. In other words, the positive effects of face-to-face contact and knowledge about a partner's previous behavior on cooperation are additive rather than interdependent. These results, along with other findings, will be discussed in detail in the sections below.

The first key result, that face-to-face contact promotes cooperative behavior and translates into successful joint cooperation, replicates previous studies that have shown the beneficial effects in different contexts (Balliet 2010; Bohnet and Frey 1999; Frohlich and Oppenheimer 1998; Jahng et al. 2017; Sally 1995). One study conducted by Jahng et al. (2017) used a similar set-up as the current study where dyads played multiple rounds of the iterative Prisoner's Dilemma game while looking at each other or not. In line with our findings, their study showed that cooperation was more successful when participants looked at each other compared to when a visual barrier was placed in between them. In their study, participants always received feedback about each other's decisions. Interestingly, in the reliable (correct) feedback condition of our study, mutual cooperation rates

were much higher in both the face-to-face and face-blocked condition (72% and 69%, respectively) compared to their study (around 35% and 20%, respectively). This difference might be attributed to the differences in the sample population: participants in Jahng et al.'s study (2017) were male, Korean students, whereas we tested both male and female, mostly Dutch psychology students. Although males and people from collectivistic cultures have been shown to be more cooperative than females and people from individualistic cultures (Balliet et al. 2011; Parks and Vu 1994), including participants with a broader range of backgrounds might have led participants to be less cooperative in the sample from Jahng et al. (2017) compared to the psychology students of our study (Frank et al. 1993a). Specifically, individuals from a beta-science background [included in Jahng et al.'s study (2017), but not in our study] might be more sensitive to the mathematical advantage of choosing to defect (players will always receive higher rewards when defecting independent of what their partner chooses). The implications of this could be important in different settings, but future studies are needed to directly compare different groups of people and to make valid statements about the effects of sample populations on the cooperative behavior in dynamic social interactions. In sum, the current study replicates previous studies supporting the beneficial effect of face-to-face contact and subsequent nonverbal communication on cooperation in dyadic interactions. Our study extends previous works in various ways, which will be discussed in the next section.

Besides manipulating the access to nonverbal information, we also varied the degree or reliability of feedback participants received about their partner's behavior, providing reliable, unreliable, or no feedback after each decision. In line with previous studies (which did not manipulate face contact), our second key finding shows that cooperation is higher when receiving reliable compared to unreliable or no feedback (Jorgenson and Papciak 1981; Monterosso et al. 2002; Pillutla and Chen 1999). In real-life situations, we often have information about the past behavior of our interaction partners from previous experiences or through gossip with a third person. Based on this information we can predict our partner's future behavior and promote cooperation by encouraging others to reciprocate one's own prosocial behavior. Feedback provides a way to control and verify these predictions, infer a partner's strategies directly and unambiguously and eases the adjustment of own behaviors accordingly (Jorgenson and Papciak 1981). One strategy that is often adopted in social dilemma games such as the Prisoner's Dilemma game is that people reciprocate the decisions the partner has made, a finding that is also supported in the current study: people were more willing to cooperate when their partner cooperated, but also tended to reciprocate a selfish decision (Axelrod et al. 1981; Fehr and Fischbacher 2004; Rilling et al. 2008). Given that mutual defection is less favorable than mutual cooperation (in the current study receiving 2 versus 3 points, respectively), the latter becomes more beneficial, resulting in more cooperation. On the other hand, when feedback is not provided, people cannot be "caught" violating the social norm of reciprocating cooperation and consequently decreasing the incentive to make prosocial decisions (Biel and Thøgersen 2007; Fehr and Fischbacher 2004). In a similar vein, when feedback is provided that is sometimes correct and sometimes incorrect (as in the unreliable feedback condition in our study), participants appear overall more selfish, evoking more mutual defection following the reciprocity strategy. This is indeed what we observe: cooperation drops substantially in the unreliable feedback condition and participants reciprocate their partner's decisions independent of whether the feedback is correct or not. Hence, receiving feedback does not stimulate cooperation per se, but rather provokes reciprocity promoting cooperation only if the prosocial effort is returned.

Apart from the independent effects of face-to-face contact and knowledge about the partner on tendencies to cooperate and on cooperative success, we were particularly

interested in their putative combined effect. Both sources of information can be used to predict the partner's next decision, which reduces the risk of being exploited when cooperating. Consequently, one of our predictions was that if only one of these sources is available, people would rely more on information from that source. Specifically, we hypothesized that we would find a greater benefit of face-to-face contact on cooperative behavior when no explicit information was provided compared to when such explicit information was available. In contrast to our hypothesis, the results showed that the "boost" in cooperation when facing each other was independent of whether and what type of explicit feedback participants received (correct or unreliable feedback). In other words, the beneficial effects of implicit and explicit information on cooperative decision-making were additive. On the other hand, the effect of the *content* of the feedback on cooperation was moderated by whether people could face each other or not. Interestingly, specifically when face-to-face contact was allowed, people cooperated more often despite a selfish partner. Cooperation is often seen as the social norm in social dilemma games and it has been suggested that the more intimate the interaction, the stronger social norms are activated (Bohnet and Frey 1999). Hence, people might be more "forgiving" when facing their partner when he/she defects and therefore encourage the defecting partner to return to cooperation by opting for a cooperative decision themselves. Our study, however, does not allow for strong conclusions about the motivation to cooperate in response to a partner's defection. It is possible that these motivations are driven by specific facial expessions or subtle cues in the face of the partner. For instance, in a previous study we demonstrated that the dilating pupils of a partner made people reciprocate more money in a trust game (Kret & De Dreu, 2019). Future studies should be conducted in order to specifically investigate what it is in the partners face, that influences decisions.

To our knowledge, only one other study has investigated the effects of communication and feedback before. In contrast to our findings, Jorgenson and Papciak (1981) observed that whether people were allowed to communicate or not, altered the effect of feedback on cooperation. Specifically, receiving feedback fostered cooperation but only if people could discuss their strategies and outcomes with each other. However, there were three essential methodological differences compared to our study that might explain the discrepancy in findings: First, the authors investigated the effect of *verbal* rather than nonverbal communication, either allowing participants to discuss their strategies for the game or not. Although face-to-face contact was not prohibited, the seating arrangements kept nonverbal communication to a minimum in both conditions (Jorgenson and Papciak 1981). Hence, the type of communication was qualitatively different as nonverbal communication does not allow individuals to discuss strategies and comes with more uncertainty about the prediction of the other's intentions. Research has shown that people are rather good at detecting emotions from nonverbal sources (Ekman and Friesen 1971; Elfenbein and Ambady 2002), but reading another person's intentions is more complex and difficult (Bonnefon et al. 2017). For that reason people might be less likely to form and rely on predictions about the future decisions of a partner. On the other hand, verbal promises are less open to interpretation making predictions easier. The cost of this ease is that promises can easily be broken (i.e., lying), which is why feedback is especially important in these situations. As a consequence, the difference between receiving feedback or not might be more pronounced when communicating verbally compared to nonverbally.

Another important difference is that in Jorgenson and Papciak's study (1981) participants played in groups of four players, while our interactions consisted of only two players. Research has shown that trust, a premise of cooperative behavior, is enhanced among dyadic interactions compared to larger groups (Lev-on et al. 2010). On the other hand,

in a meta-analysis, Balliet (2010) reported a positive effect of group size on the relation between *verbal* communication and cooperation suggesting that the effect of communication becomes stronger in larger groups. These studies suggest that people might generally be more willing to cooperate in dyadic interactions, but that face-to-face interaction has a larger beneficial effect on cooperation when playing in larger groups. It might be that verbal communication is more important to coordinate the behavior and discuss strategies among members of a larger group (Jorgenson and Papciak 1981), whereas nonverbal communication becomes more important in smaller groups because the transmission of nonverbal signals is a back-and-forth interplay between two people (Kret 2015; Prochazkova and Kret 2017). The exact consequences of group size on cooperative behavior are hence unclear and future studies would need to investigate the relation between group size, (nonverbal and verbal) communication and cooperation. In sum, the fact that Jorgenson and Papciak (1981) observed an interplay between communication and feedback, while we did not, might be explained by methodological differences, in particular, the type of communication and the group size. Future studies are needed to address these differences and scrutinize their impact on the relation between communication, feedback, and cooperation.

There are a few limitations in this study that should be considered. First, due to very high cooperation rates in the reliable feedback condition, we found a ceiling effect for the interaction effect between the feedback and face conditions. Future studies using a different payoff structure might want to investigate whether an interaction effect can be detected without such a ceiling effect and therefore show that the two sources of information might influence each other. Second, our results revealed that the order of the face condition influenced the effect of face-to-face contact on cooperative behavior (see Supplemental Information Appendix S3). Future studies should investigate whether this is a true finding and if so, what can explain such an effect. It might be that the "social connection" between the two participants can only be established when the initial contact is face-to-face and that cooperation declines as face-to-face contact is not possible anymore. However, this order effect is confounded by a general "time" effect. Research has shown that cooperation declines with an increasing number of trials (Bó 2005) and therefore the decrease in cooperation might have occurred with or without face-to-face contact. Future studies should include conditions where dyads play only in the face-to-face or in the face-blocked condition over the two sessions to disentangle the order effect of the manipulation and a general time effect.

The current study has been the first to investigate the interplay between nonverbal and explicit information, raising many open questions for future studies to investigate. First, although various studies have provided evidence for the beneficial effect of face-to-face contact on prosocial behavior, the motivation and underlying mechanisms are less known. What exactly is it that we rely on when making our decisions and what is it about the face that makes us behave more socially? Which nonverbal signals do we pick up and take into account when making our social decisions? Although more and more studies address these questions, it is still an understudied topic and future studies using eye-tracking and physiological measures are highly needed to address these questions. Second, in an exploratory analysis (see Supplemental Information Appendix S1 for details) we observed that the way face-to-face contact affects a person's cooperative behavior depends on that person's level of empathy, prosociality, social anxiety and emotion recognition skills. Future studies are needed to verify these findings and draw stronger conclusions about such effects. Related to this, we observed different levels of cooperation rates compared to another study with a similar set-up. One explanation might be that differences in the sample population might have caused such deviations. Future studies are needed to investigate whether the strength

of the effect of face-to-face contact might differ between cultures, work disciplines, and other contexts. This might be particularly interesting in light of globalization as people are more and more often asked to work with people from different backgrounds who might benefit from different environments.

In conclusion, the findings of the current study emphasize the need to study social phenomena during real-life interactions and investigate the interaction and complexity of information derived from different sources. Fortunately, real-life interaction studies using realistic, ecologically valid contexts are on the rise and scientists increasingly realize that knowledge about social cognition cannot be merely based on studies lacking in actual social interactions. In the current study, we highlight the power face-to-face contact has on social decision-making and the remarkable willingness of people to cooperate with strangers even though they have no previous experiences or knowledge of that person.

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Data Availability Statement The data set and additional information that is associated with this paper and used to conduct the analyses will be uploaded and accessible on the Leiden University archiving platform DataverseNL when published.

Compliance with Ethical Standards

Conflict of interest The authors have no conflict of interest to report.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (CEP16-0314/131) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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