Peer Influence on Prosocial Behavior in Adolescence

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Adolescence is a time of increased sensitivity to peer influence, which creates vulnerabilities but also opportunities. In this study, we examined the influence of peers on prosocial behavior in 12- to 16-year-old adolescents ($N = 197$). We utilized a public goods game in which participants made decisions about the allocation of coins between themselves and the group. Participants received manipulated peer feedback on a subset of decisions. Results indicate a significant interaction between feedback condition (prosocial, antisocial, or no feedback) and allocation choices: Prosocial behavior increased after prosocial feedback and decreased after antisocial feedback. These findings support the idea that peer influence creates not only vulnerabilities, but also opportunities for healthy prosocial development and social adjustment learning.

Why would a teenager who is usually well behaved agree to vandalize a bus stop with his friends? Although one could think of several reasons, there is most likely some form of peer influence behind such behavior. Puzzled parents try to understand why their teenagers act the way they do, and self-help books for teenagers feature intriguing subjects such as *The Complete Idiot's Guide to Surviving Peer Pressure for Teens* (Chemiss & Sluke, 2002). In general, peer influence has negative connotations in society. Yet a compelling question is whether peer influence may also serve a positive function. Many have argued that adolescence is a sensitive period for adaptive sociocultural development (for a review, see Blakemore & Mills, 2014). This study aims to explore the effect of peer influence by examining feedback on adolescents' prosocial decisions.

Social Relationships in Adolescence

Adolescence is characterized by an increased complexity in social behavior (Lerner & Steinberg, 2004). During this period of sociocultural development, changes take place concerning healthy identity formation, autonomy in decision making, intimacy, and sexuality (Dahl, 2004; Pfeifer & Peake, 2012; Steinberg & Morris, 2001). These changes in the social self also bring about changes in relationships with peers and family (Steinberg, 2011). Frequency of face-to-face contact and digital communication with peers increases, whereas time spent with family decreases (Brown, 2004; Rideout, 2012). In addition, friendships become more intimate and supportive, and peers become more important in decision-making (Berndt, 1992; Larson, Richards, Moneta, Holmbeck, & Duckett, 1996). Within this changing social context, it is important to distinguish between different types of peer relationships (Brechwald & Prinstein, 2011). Besides dyadic bonds with a friend or multiple close friends, adolescents also form relationships with the broader peer group (Klima & Repetti, 2008). That is to say, from middle childhood most interactions with peers occur in groups (Rubin, Bukowski, & Parker, 2006). Previous research has examined a wide variety of peer group types such as cliques, known members of the larger peer group, or an undefined reference group of peers (Prinstein & Dodge, 2008). In this study, we focus on peer influence from the perspective of an unknown peer group. The reason for focusing on peer influence of unknown peers is to make the context comparable to situations in which adolescents do not know everyone in the peer group, such as in larger public settings, or Internet Web sites (Weigard, Chein, Albert, Smith, & Steinberg, 2014).

Through peer influence, peers can encourage both harmful and healthy behaviors (Brown, Bakken, Ameringer, & Mahon, 2008). According to social learning theory, adolescents learn social behaviors from valued peers and their peers' reinforcement of displayed behavior (Bandura, 1986). Behavioral display and reinforcement, common forms of peer influence, are processes through

which adolescents acquire social norms from the peer group (Brown et al., 2008). In turn, these social norms guide approved and accepted behaviors, informing adolescents of what they ought to do in the peer context (Brechwald & Prinstein, 2011; Cialdini & Trost, 1998). Not only are social norms powerful regulators of behavior and attitudes, but the individual's perception of those norms has an impact as well (Berger, 2008; Prinstein & Wang, 2005). Additionally, the group norms that are acquired may be incorporated in subsequent individual decision-making (Berger, 2008).

In line with this theory of social learning, empirical evidence has consistently shown that peers are a powerful source of influence in adolescence (see for reviews: Brechwald & Prinstein, 2011; Veenstra, Dijkstra, Steglich, & Van Zalk, 2013). Ongoing concern about the health risks associated with negative influence of peers has led to research that focuses mainly on risk-taking and antisocial behaviors (Albert, Chein, & Steinberg, 2013; Padilla-Walker & Bean, 2009; Sim & Koh, 2003). Although peer influence and social learning have mostly been linked to these behaviors, they may also be instrumental in prompting adolescents to adopt other types of behavior, such as prosocial behavior (Allen & Antonishak, 2008; Telzer, Fuligni, Lieberman, & Galván, 2013; Wentzel, 2014).

Prosocial Behavior and Peer Influence

Prosocial behavior can be defined as "voluntary behavior intended to benefit others" and entails a broad multidimensional domain of behaviors, such as altruistic helping, sharing, and cooperation (Eisenberg, Fabes, & Spinrad, 2006, p. 646; Padilla-Walker & Carlo, 2014). It includes interpersonal helping behavior, but also cooperation that benefits one's group (Batson & Powell, 2003; Penner, Dovidio, Piliavin, & Schroeder, 2005). These different aspects of prosocial behavior all tap into slightly different processes (Wentzel, 2014). In the current study, we specifically focused on cooperation and operationalized prosocial behavior as cooperation choices that result in a benefit for the group, but in a loss for the individual. With regard to developmental patterns of prosocial behavior, studies have found that adolescents typically exhibit more prosocial behavior than younger children (7- to 12-year-olds) in the domain of sharing and donating (Eisenberg et al., 2006).

Previous work that examined peer influence on prosocial behavior has employed various techniques, including self-report or hypothetical situations, and more recently the use of sophisticated quantitative tools such as social network analysis (Brechwald & Prinstein, 2011; Veenstra et al., 2013). Studies that employed self-report or hypothetical situations suggested that friends or acquaintances can influence prosocial behavior either directly (e.g., the urge to perform a prosocial act) or indirectly (e.g., through expectations or closeness with a friend; Barry & Wentzel, 2006; Berndt, 1979; Padilla-Walker, Fraser, Black, & Bean, 2014; Wentzel, Filisetti, & Looney, 2007). Recent work that applied social network analyses to study socialization within friendships in children (10-year-olds) also provided some evidence that friends influence prosociality (Logis, Rodkin, Gest, & Ahn, 2013). Other studies focused on the influence of the peer group on prosocial behaviors and showed that the larger peer group exerts influence on prosocial behavior in early adolescents as well (Berger & Rodkin, 2012; Ellis & Zabartany, 2007). Taken together, these studies led to the hypothesis that peers in dyads and peer groups can influence prosocial behavior in adolescence.

The Present Study

The research aim of this study was to investigate peer influence on prosocial behavior and the process of social learning with an experimental design. We focused on adolescents aged 12–16 years, because prior studies showed that peer influence effects are particularly large in this developmental phase (Chein, Albert, O'Brien, Uckert, & Steinberg, 2011; Gardner & Steinberg, 2005; Steinberg & Monahan, 2007). A well-known and validated experimental approach for studying the process of social decision-making is the use of social dilemmas (for a review, see Van Lange, Joireman, Parks, & Van Dijk, 2013). In the context of developmental psychology, these games are particularly informative in studying the development of core features of social decision-making, such as acting upon social norms and fairness considerations (Crone, Will, Overgaauw, & Güroğlu, 2014).

The public goods game (PGG) is a social dilemma that incorporates self-interest and concern for the group as two key motivational aspects of prosocial behavior when asked to divide tokens in a group (Ledyard, 1995). We adapted the typical PGG so that participants repeatedly made real and anonymous social decisions in a group, while no information was provided about the decisions of the other group members. To test the hypothesis that peers influence

prosocial choices, we introduced peer influence on the decisions in the game. Participants played several rounds of the PGG on the computer in a group of four classmates, while a spectator group of ten same-age peers from another school was supposedly online during half of the rounds. Depending on the between subject condition, these supposed spectators could provide antisocial feedback, prosocial feedback, or no feedback. In the *antisocial feedback* condition, keeping tokens to the self (i.e., maximizing one's own outcome) received many thumbs up from the peer group, whereas in the *prosocial feedback* condition, donations to the group received many thumbs up. In the *no feedback* control condition the spectator group was online, but participants did not receive feedback on their decisions. After the rounds in which the spectator group provided feedback on decisions, the spectator group went offline and participants played several rounds without peer feedback; these anonymous rounds were similar to the first rounds of the PGG.

First, we hypothesized that prosocial behavior would decrease after antisocial feedback from peers (Chein et al., 2011; Gardner & Steinberg, 2005). Prosocial behavior in this task was defined as the number of tokens donated to the group. In accordance with social learning theory, we expected that the social learning process would entail learning about the social norm of the peer group, and consequently, that participants would incorporate this social norm in their decision-making (Bandura, 1986; Berger, 2008). Because the spectator group in the antisocial feedback condition provided many thumbs up when the participant kept tokens to the self, we expected to see a gradual *decrease* in prosocial behavior over trials in which antisocial feedback was provided.

Second, previous studies suggested that peers have a positive influence on prosocial behavior (Barry & Wentzel, 2006; Berger & Rodkin, 2012; Berndt, 1979; Logis et al., 2013). We hypothesized that prosocial behavior would gradually *increase* after prosocial feedback from peers, as large donations to the group were evaluated with many thumbs up and a similar social learning process could be anticipated for this type of feedback.

Third, we hypothesized that prosocial behavior in the no feedback condition would remain in between the levels of prosocial behavior displayed in the feedback conditions over the course of the task. In the absence of feedback, no extrinsic motivation such as a social norm was provided to induce a behavior change.

Fourth, we hypothesized a *carryover effect* of peer feedback in the prosocial and antisocial feedback conditions. In line with social learning theory, social behaviors may be learned through several sources of information, such as social evaluations (Bandura, 1986). Playing several trials with norms of the spectator group in the PGG may provide information about different behavioral alternatives, thereby socializing adolescents through expectations and social reinforcement for their actions (Eisenberg et al., 2006). Thus, we expected that the effects of feedback would be apparent in subsequent individual decisions even if the peer group would no longer be present and watching, because we expected participants to maintain the social norm (Bandura, 1986; Berger, 2008). In the antisocial feedback condition, we predicted that the donations to the group would be smaller in the anonymous rounds after peer feedback relative to baseline trials. In the prosocial feedback condition, we expected to find a higher level of donations to the group in the anonymous rounds after peer feedback relative to baseline trials.

METHOD

Sample and Participant Selection

The sample consisted of 197 adolescents between the age of 12 and 16 years ($M = 14.14$, $SD = 1.09$, range 12.38–16.48), including 110 girls (56%) and 87 boys (44%). The ethnic composition of the sample was 94% Dutch, 5% Moroccan, and 1% classified as "Other". No measure for socioeconomic status (SES) was obtained for this sample. Besides the age range, no other exclusion criteria were applied in this study. We recruited participants from three high schools teaching various academic levels in and around Leiden, the Netherlands. Both parental consent and participant's consent for minors were obtained for all participants. The participation rate was high (94%). Thirteen participants from the original sample ($N = 210$) were excluded due to incomplete data. For a subset of the participants ($N = 120$), a short version of Raven's progressive matrices was obtained as an index for estimated intelligence. Raven data from the remaining participants were unavailable due to technical difficulties. All raw estimated IQ scores were in the normal range ($M = 39.29$, $SD = 4.28$; see Table 1). Analyses indicated no significant differences between feedback conditions in terms of sex, age, and estimated intelligence.

Participants were divided among the three conditions in a semirandom manner, $N = 49$ (25%) in the

TABLE 1
Demographic Variables

	Antisocial Feedback	Prosocial Feedback	No Feedback
Sex (M; %)	23 (47)	41 (42)	23 (46)
Age in years (SD)	13.91 (1.07)	14.20 (1.13)	14.25 (1.01)
Short Raven IQ (SD)	39.29 (3.95)	39.38 (4.03)	39.11 (5.19)

antisocial feedback condition, $N = 50$ (25%) in the no feedback condition, and $N = 98$ (50%; oversampling) in the prosocial feedback condition. The prosocial feedback condition was oversampled to conduct further analyses on positive peer influence in relation to, for example, self-presentational tactics and resistance to peer influence. Supporting information is available upon request from the first author.

Measures

Peers public goods game. A linear PGG (Harbaugh & Krause, 2000; Ledyard, 1995) was adapted to meet the goals of this study. Participants were divided into groups of four anonymous classmates to play the PGG online. They were told that the topic of the study was decision-making in groups and that their group would get the opportunity to earn a monetary bonus. At the beginning of each round, participants were given ten tokens with an exchange value of 50 Eurocents per token. No further rationale was provided for the number or value of the tokens. Subsequently, they made a decision whether they wanted to keep the tokens to themselves or contribute to the group by giving any portion of the tokens to the public goods pot. They were informed that after each round, donated tokens were multiplied by two and then divided

equally among the four group members, independent of the individual contributions.

Thus, the individual optimal strategy in this game is to donate nothing, whereas the optimal strategy for the whole group is for all members to donate all tokens (Harbaugh & Krause, 2000). Given that individual contributions are multiplied by two, in this four-person group, the net return of contributing, for example, one token is that one loses 0.50 token (i.e., the net return is negative; the token is multiplied by 2, but then divided equally among all four group members). Donating the token thus constitutes a loss to the individual. However, on the collective level, if all group members would contribute one token, the group would profit (four tokens multiplied by 2, then divided by four group members equals two tokens) and all group members would earn more than if they each kept the tokens to themselves.

To prevent learning from the decisions of the fellow group members, participants did not receive feedback about the payoff after each round. All choices were made individually and anonymously, and participants were told that their fellow group members could not see their respective donations. The peers PGG consisted of twenty trials, divided in three phases. First, participants played five self-paced baseline trials (trials 1–5), in which they made their decisions individually and anonymously. Second, participants learned that a spectator group of ten same-age peers would be online during the consequent rounds (trials 6–15) and that the spectator group could see their decisions on the task (Figure 1a). Additionally, they were told that the peers from the spectator group would evaluate each decision. During this second phase, they played 10 trials with peer feedback, which was displayed within a randomized interval of 3–7 s after the
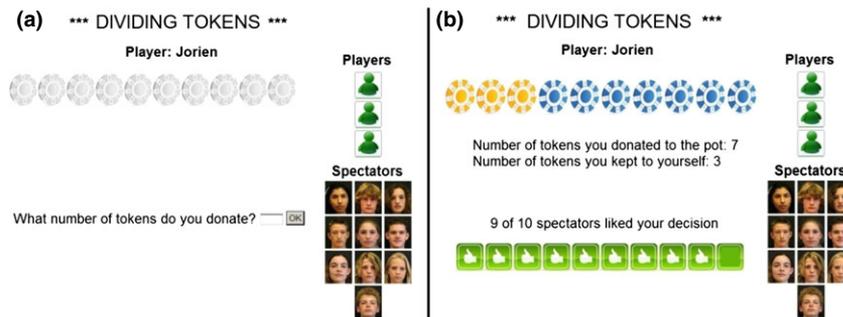

FIGURE 1   (a) Online decision screen. The three players (green) are anonymous classmates, who are not able to see the decisions of the participant. The fictitious spectator group is online, indicated by pictures of same-age peers (five males/five females). These peers can see the decisions of the participant. (b) Online prosocial feedback screen. The participant donated seven tokens to the group of anonymous classmates (blue) and kept three tokens (yellow). The fictitious spectator group provided prosocial feedback on the decision. Nine thumbs up indicate that nine of ten peers liked the allocation of tokens.

participant made a decision (Figure 1b). Third, after these 10 online trials, the spectator group went offline and could not see the participant's decision anymore. Participants played five more trials (trials 16–20), similar to the baseline trials in which they made their decisions individually and anonymously.

We utilized a between-subjects design in which we compared two types of feedback: Antisocial feedback and prosocial feedback, with no feedback as a control condition. In the antisocial feedback condition, keeping tokens to the self (i.e., maximizing one's own outcome) received many thumbs up, whereas in the prosocial feedback condition, donations to the group received many thumbs up. The no feedback control condition was similar to the feedback conditions in the sense that participants were informed that a spectator group would evaluate their decisions, so participants anticipated the possibility of feedback. The only difference in the no feedback control condition was that after making their decisions, participants were not shown any feedback.

The feedback participants received was dependent on the condition and contingent on the decision that was made. An example of the feedback is presented in Figure 1b. More specifically, participants were told that the peers from the spectator group would judge their decision with a *like* if they liked the decision and would leave the box empty if the decision was not liked. If a participant in the prosocial feedback condition donated zero, one, two, or three tokens to the group, they received one or two thumbs up from the spectator group (randomly varied). When participants donated four, five, or six tokens to the group, they received four, five, or six thumbs up, and finally, they received nine or ten thumbs up if they donated seven, eight, nine, or ten tokens to the group. The exact reverse feedback pattern was used in the antisocial feedback condition, such that high donations to the group received only one or two thumbs up, and low donations to the group resulted in nine or ten thumbs up. A written statement indicating the number of peers that liked the participant's choice accompanied the likes. For example, in Figure 1b, nine likes indicate feedback that nine of ten peers liked the decision of the participant.

Pictures of the 10 peers in the spectator group (previously validated in Gunther Moor, Van Leijenhorst, Rombouts, Crone, & Van der Molen, 2010) were presented on the screen when participants made their decision in these online trials. The spectator group pictures were semirandomly drawn from a database (age matched; five males/five females), and the same peer group was present during all trials.

Procedure

The study was conducted in a regular computer room or media library at school, with adolescents who were enrolled together in class. If possible, participants were separated by an empty seat. The experimenter explained the procedure to the class. The study was composed of three different online elements: A task in which they were asked to divide coins (PGG), a computer game with puzzle pieces (Raven), and finally several questionnaires. These questionnaires were used to provide additional information for future studies. After the procedure was explained to the class, all participants agreed to the procedure and started at the same time during the PGG to ensure the credibility that they were playing with their classmates. Three research assistants were present at all times to provide help. After the online individual instruction, we included three quiz questions to ensure that all participants understood the PGG; they could not start with the game unless the right answer to these questions was provided. During the subsequent debriefing, participants were informed about the exact setup of our study, after all participating classes on a school were tested. Afterward, the participants were given a small present for their participation in the study.

Data Analysis

To control for possible confounding effects of estimated intelligence and gender, we conducted two separate analyses on prosocial behavior in the PGG in which we included these variables. Neither gender nor estimated intelligence appeared significant and these variables were excluded from further analyses. Additionally, participants were asked whether they fully understood the instructions of the PGG and, indirectly, whether they believed the spectator group was real. We performed additional analyses in which we excluded participants of whom we suspected did not fully understand or believe the task ($N = 9$) and found no changes in the results. Hence, we included all participants ($N = 197$) in the final analyses.

RESULTS

Peers Public Goods Game

To analyze the temporal pattern of donations in the PGG, the trials were split into four blocks of five trials: (1) offline trials 1–5, (2) online trials

6–10, (3) online trials 11–15, and (4) offline trials 16–20. The donations to the group were assessed by a 3 (Feedback: Antisocial feedback, prosocial feedback, no feedback) × 4 (Block: 1, 2, 3, 4) ANOVA with repeated measures of the last factor. Means for the number of tokens donated to the group in block and feedback condition are displayed in Figure 2.

The analysis showed a main effect of feedback, $F(2, 193) = 3.68$, $p = .027$, $partial$ $\eta^2 = .047$. Donations to the group in the antisocial feedback condition, M $(SD) = 3.64$ (0.26), were lower than in the prosocial feedback condition, M $(SD) = 4.44$ (0.18), $p = .039$. Donations to the group in the no feedback condition, M $(SD) = 3.87$ (0.18), were in between the prosocial and antisocial feedback condition and did not differ from either, both $ps = ns$.

This main effect of feedback was qualified by a feedback × block interaction, $F(6, 579) = 30.23$, $p < .001$ (Greenhouse-Geiser corrected), $partial$ $\eta^2 = .239$. Further analyses were performed to examine the pattern of donations over trials for each feedback type separately. In the antisocial feedback condition, we found that adolescents donated significantly fewer tokens to the group over trials after feedback from their peers; donations were lower in block 2 after antisocial feedback from peers than in block 1, $p < .001$. A further decrease was found in block 3 compared to block 2, $p = .008$. During the offline trials in block 4, the donations to the group were significantly higher than in block 3, $p = .011$.

In line with our predictions, the findings of the prosocial feedback condition revealed a positive effect of peer influence. Adolescents in the prosocial feedback condition donated significantly more to the group after feedback from their peers; more tokens were donated to the group in block 2, in which participants received prosocial feedback from peers, than in block 1, $p < .001$. We found a further increase in donations in block 3 compared to block 2, $p < .001$. In block 4, the donations to the group were lower than in block 3, $p < .001$. However, adolescents who received prosocial feedback showed significantly higher donations in block 4 than block 1, $p < .001$.

The donations to the group in the no feedback condition did not change during the online trial blocks by the presence of peers (without feedback), all $p's = ns$. Levene's test indicated equal variances, $F(1, 98) = 0.10$, $p = ns$) in the online trial blocks (block 2 and 3) compared to block 1.

Finally, we examined the hypothesized carry-over effect in the antisocial feedback and prosocial feedback conditions. We expected that the feedback provided in online block 2 and 3 would still influence decisions during the offline trials in block 4, where feedback was no longer provided. This effect, indicated by a significant difference between donations to the group in block 4 and baseline block 1, was found in both antisocial and prosocial feedback conditions. Thus, even though the peer effects diminished from block 3 to 4 in both the antisocial and prosocial conditions, adolescents in the antisocial feedback condition showed significantly lower donations in block 4 relative to block 1, $p = .004$. Similarly, adolescents who received prosocial feedback showed significantly higher donations in block 4 than in block 1, $p < .001$.

DISCUSSION

The goal of the present study was to examine peer influence on prosocial behavior and the process of
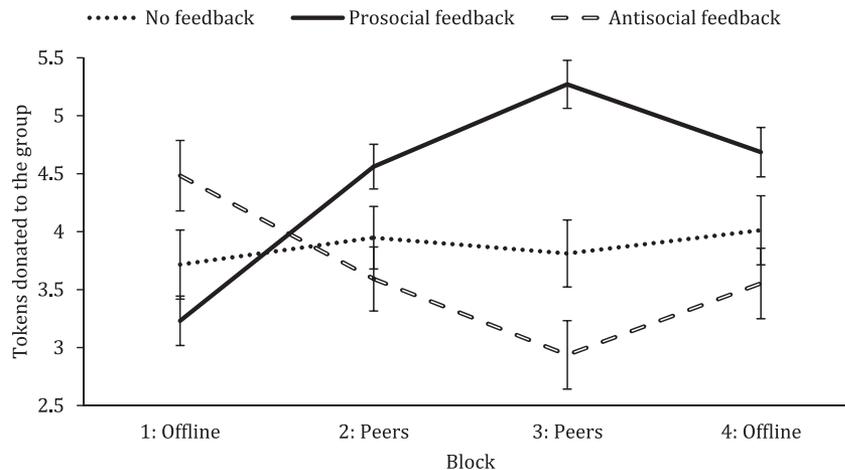

FIGURE 2   Mean number of tokens (SE) donated to the group over the course of the public goods game task.

social learning. The key finding in our study was that changes in prosocial behavior depended on the behavior that was liked by the peer group. Prosocial behavior decreased when peers liked the decision to keep tokens to the self, and similarly, prosocial behavior increased when peers liked decisions to donate the tokens. When no feedback was provided, prosocial behavior remained stable and did not change over multiple consecutive decisions. As expected, the level of prosocial behavior in the no feedback condition remained in between the levels of prosocial behavior displayed in the feedback conditions over the course of the task.

Peer Influence on Prosocial Behavior

Our findings build on a large body of research indicating that peers are a major influence in adolescent decision-making (Albert et al., 2013; Brechwald & Prinstein, 2011). We showed that peers can have a direct *negative* influence on prosocial behavior. Moreover, we demonstrated that peers may also have a direct *positive* influence on prosocial behavior in adolescence. These findings provide support for the theoretical viewpoint of adolescence being a period that creates not only vulnerabilities, but also opportunities for healthy prosocial development and social adjustment learning (Blakemore & Mills, 2014; Crone & Dahl, 2012).

The change in level of prosocial behavior over the course of the task suggests that the process of social learning is a key mechanism for adapting to the social norms of the peer group (Bandura, 1986). In both feedback conditions, the patterns of prosocial behavior imply that adolescents first learned the social norms from the spectator group of peers and consequently incorporated those norms in their decision-making (Berger, 2008; Harbaugh & Krause, 2000). Thus, peer influence appears crucial in the transmission of group norms (Clasen & Brown, 1985). As one of our participants nicely put it:

> I thought it was useful to be able to see what peers thought about my decisions. That way you know whether you don't make really crazy decisions. Even though the decisions are for yourself, it is nice to see what others think of them [decisions].

Because social acceptance and approval are highly salient in adolescence, a time period of social reorientation in which peers' opinions become more important, social reward is likely an important guide for social behavior (Berger, 2008;

Somerville, 2013; Steinberg & Morris, 2001; Wentzel, 2014). An intriguing follow-up question that we tested was whether the peer effects of prosocial and antisocial feedback would be apparent in consequent individual decisions, with peers no longer present. As expected, this carryover effect was present after both prosocial and antisocial peer feedback. A higher level of prosocial behavior was displayed in consequent individual decisions after prosocial feedback compared to baseline, and a lower level of prosocial behavior was found in consequent decisions when antisocial feedback was provided. It may be noted that there was an initial difference in the level of prosocial behavior between the prosocial and antisocial feedback conditions on the baseline trials. We believe that this difference can be attributed to chance, because the participants were randomly assigned to conditions, and there were no significant differences between groups on measures of age, sex ratio, and estimated IQ. Interestingly, both prosocial and antisocial peer feedback seem to override these initial differences in the level of prosocial behavior.

These findings may imply that social norms provided by the group are to some extent maintained in subsequent individual decision making. Even though there was a small trend toward the baseline from block 3 (peer presence) to block 4 (alone), prosocial behavior in the prosocial and antisocial feedback conditions was clearly different between the first and last alone blocks. Note, however, that this design only allows us to draw conclusions about short-term effects. The observed change in the trajectory of prosocial behavior in both conditions may indicate that participants eventually return to the initial level of prosocial behavior. Previous work suggests that the extent to which social norms truly guide social decision-making and behavior depends on whether those norms are internalized, rather than just learned by the individual (Staub, 1972). For future research, it would be interesting to add additional rounds of the PGG, to further examine to what extent the social norms provided by peer feedback are internalized and continue to guide individual decisions over time. Ideally, a longitudinal design could be implemented to study the sustainability of a causal relation between peer effects and prosocial behavior.

Peer Presence Effects on Prosocial Behavior

Prosocial behavior did not change over the course of the task by the mere presence of peers when no feedback was provided. These findings suggest that

feedback provided by peers is crucial in actuating change in prosocial behavior. In contrast, in other domains of behavior the presence of friends and acquaintances has previously been linked to change in behavior. For example, an increase has been observed in risk-taking behavior by the mere presence of peers (Chein et al., 2011; Gardner & Steinberg, 2005). Although social influence theories suggest that the relationship between the adolescent and source of the influence (e.g., friendship quality) may relate to consequent behavior change, the question remains whether friends exert more influence on behavior than unfamiliar peers from the larger peer group (Berndt, 2002; Hartup, 2005).

A recent study illustrated that the belief that an anonymous peer is watching an adolescent participant in the MRI-scanner induces self-conscious emotions and autonomic arousal, even when there is no decision-making process involved (Somerville et al., 2013). Thus, it seems that the mere presence of unknown peers already elicits strong neurophysiological responses. In addition, this feeling of being observed by an anonymous peer has also been linked to a change in reward-related behavior: Adolescents who believe unknown peers are observing them show a preference for immediate rewards as opposed to long-term rewards (Weigard et al., 2014). Interestingly, those findings illustrate effects of peer presence on behavioral and neurophysiological measures (Somerville et al., 2013; Weigard et al., 2014); however, in the present study, we did not find an effect of peer presence on prosocial behavior. This disparity suggests that the effects of peer presence may depend on the domain of behavior (i.e., risk-taking behavior or prosocial behavior; Sim & Koh, 2003).

One possible interpretation is that the differential effect of peer presence for risk-taking behavior and prosocial behavior is related to the social norms associated with behaviors in each domain. In experimental risk-taking paradigms, such as the Stoplight game (Chein et al., 2011), the injunctive norm for risk-taking behavior in the presence of peers originates from the individual's perception of risk-taking behaviors of those peers (Cialdini & Trost, 1998). In general, adolescents tend to overestimate the degree to which their peers engage in risk-taking behavior (Prinstein & Wang, 2005). Subsequently, an individual may engage in risk-taking behavior as frequently as perceived in the peer group. These overestimated risk-taking behaviors are then expected to elicit approval and positive social reward from the peer group. Peer presence may thus reinforce the perceived social norm and thereby lead to increased risk-taking behaviors (Prinstein & Wang, 2005).

The present study adopted the social dilemma approach to study prosocial behavior. It may be less evident which of the two dilemmatic options (i.e., further the self-interest or the collective interest of the group) peers will accept in the PGG. We suggest that peer presence did not lead to a change in prosocial behavior, because the norms related to prosocial behavior are more ambiguous than in the risk-taking paradigm and are not reinforced by the mere presence of peers.

Limitations and Conclusions

This study had several limitations. First, we used an age group of adolescents ranging from 12- to 16-year-olds. This narrow age range limits our ability to make developmental comparisons with other age groups such as children or adults. The *direction* of this peer effect could be similar in other age groups such as adults and children. An expectation derived from this study is that the *strength* of the effect might differ between age groups based on the hypothesis of increased social sensitivity in adolescence (Blakemore & Mills, 2014; Wentzel, 2014). One could argue that this increased social sensitivity might result in stronger effects of peer influence on prosocial behavior in adolescence. Developmental comparisons would be an informative extension of the present study that should be addressed in future research. Additionally, this paradigm included only peers to provide feedback on the decisions. An interesting direction for future research is to introduce different actors, such as adults or family members, in the paradigm, as it creates a possibility to examine whose feedback is most influential.

Second, our paradigm was designed to measure peer influence and the social learning process during the task and consequently only conclusions about short-term effects can be drawn. At present, it is unclear to what extent the social norms provided by peer feedback are internalized and continue to guide individual decisions over time.

Third, a person's expectation about the behavior of others is another major factor that has been shown to affect prosocial behavior in the PGG (Dijkstra, 2012; Fishbacher, Gächter, & Fehr, 2001; Gächter & Fehr, 2000). That is, participants may expect other group members to adapt their

behavior in line with the social norms of the peer group. Consequently, it is possible that participants adjusted their own behavior because they thought that other group members would adapt to the peer norms. Our design does not allow us to disentangle the direct effects of peer feedback and possibly indirect effects of peer feedback on the other group members, because feedback was consistent across trials. In future research, it will be interesting to apply the paradigm to real social interactions to examine the complex interplay between prosocial choices and expectations about prosocial choices.

Despite these limitations, this was the first study that utilized an experimental design in which real, on-the-spot, prosocial behavior was measured. The current study focused on one aspect of prosocial behavior: Cooperation. The findings from our new paradigm are consistent with previous work in which other developmental measures were utilized, suggesting that the experimental paradigm is a valid measure that taps into a similar process (Barry & Wentzel, 2006; Berger & Rodkin, 2012; Berndt, 1979; Ellis & Zabartany, 2007; Logis et al., 2013; Padilla-Walker et al., 2014; Wentzel et al., 2007). In future studies, it will be important to study peer effects on other aspects of prosocial behavior as well, for example sharing and altruistic helping. In addition, it will be valuable to relate these effects to real-life behavior, such as donating behavior.

Moreover, we attempted to address a gap in current knowledge by providing insights about the process of social learning in peer influence. For these purposes, we aimed to show that useful results about the process of prosocial behavior in adolescence can be obtained with the novel peers public goods paradigm. Thus, in the present study, we provided a social context that admittedly may be less complex than social situations in everyday life. Future studies using the basics of this experimental paradigm may include several variations in social context to provide an even better match of day-to-day social situations. For example, an interesting suggestion for future research would be to examine the effects of peer influence and peer presence of a spectator group that includes actual friends.

In conclusion, our study provides support for the view of adolescence as a period of vulnerabilities, but also a period of opportunities for social learning and adaptation. Teenagers who vandalize a bus stop with their friends could instead be encouraged by their peers to be prosocial.

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