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The influence of competitive and cooperative video games on behavior during play and friendship quality in adolescence

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ABSTRACT

Many adolescents play video games together with their friends for multiple hours per week. The way in which peers play games may influence their interactions and relationship. Research has shown distinct effects of competitive and cooperative play on aggression, prosocial behavior, and feelings of empathy and trust. The current study investigated the effect of the mode of gaming on adolescents' behavior during gaming, as well as their friendship quality and prosocial behavior afterwards, in a field study with experimental design and naturalistic observations. Adolescent friend dyads played a racing video game either solitary, competitively, or cooperatively. Observers coded participants' behavior during the gaming sessions, while friendship quality and prosocial behavior towards the friend were measured afterwards. Results showed that playing a game competitively lowered friendship quality. Furthermore, the mode of play changed the participants' behavior during game play, with more positive, negative, and hierarchical behavior observed in the cooperative condition. Additionally, positive and prosocial behavior displayed during the gaming session predicted higher friendship quality afterwards. There were no effects on the subsequent prosocial behavior task. This study illustrates that both the mode in which friends play a video game and the behavior displayed during gaming influence friendship quality.

1. Introduction

Playing video games has become one of the primary leisure activities of adolescents (Ofcom, 2015) and its impact on the well-being and social behavior of youth has received substantial attention (Kardefelt-Winther, 2017). Instead of dichotomizing video games as either 'good' or 'bad', researchers have started to recognize that games can be used in a variety of ways, urging for a multidimensional approach to understanding gaming effects (Gentile, 2011; Granic, Lobel, & Engels, 2014). One important dimension to investigate is the social context in which games are played. Video games often allow (or even require) that multiple persons play together, and games seem to play an important role in the development and maintenance of real-life relationships (e.g., De Grove, 2014; Domahidi, Festl, & Quandt, 2014; Schiano, Nardi, Debeauvais, Ducheneaut, & Yee, 2011; Snodgrass, Lacy, Francois Dengah, & Fagan, 2011; Trepte, Reinecke, & Juechems, 2012). Youths name social reasons as one of the main motivations for playing games (Sherry, Lucas, Greenberg, & Lachlan, 2003; Yee, 2007) and 52% of teens spend time playing video games with friends (Lenhart, Smith, Anderson, Duggan, & Perrin, 2015).

Despite these findings, the majority of research still overlooks the importance of the social context in which games are played (Bowman, Kowert, & Cohen, 2015). Barring some recent exceptions (De Grove, 2014; Eklund & Roman, 2017; Verheijen, Burk, Stoltz, van den Berg, & Cillessen, 2018), gaming effects are often isolated at the level of the individual. Furthermore, social gaming studies often use convenience samples of college students who do not know each other beforehand. Yet the frequency of gaming peaks in adolescence (Ream, Elliot, & Dunlap, 2013) and teens play games more often with friends than strangers (Lenhart et al., 2015). Finally, few studies have investigated what actually happens between players *during* game play. While gaming effects on post-test measurements are frequently reported, the actual interaction between players while they play is often treated as a black box.

To address these issues, the present research employed a field study with an experimental manipulation to investigate how mode of play (solitary, competitive, or cooperative) influences 1) adolescents' behavior during a game, 2) the quality of their friendship, and 3) their prosocial behavior towards a friend afterwards. This study extends existing research by including players with an already established friendship and by focusing on the behavior displayed during a gaming session.

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1.1. Competitive and cooperative video games

Studies on gaming effects traditionally have focused on the impact of video game content on youth. Meta-analyses have indicated that exposure to violent content can increase aggression, while prosocial content enhances prosocial behavior (Anderson et al., 2010; Greitemeyer & Mugge, 2014), although others have argued that these effects are minimal (Ferguson, 2015). More recently, attention has been given to the way in which video games are played. For example, it has been suggested that the competitiveness of a game, rather than its violent content, increases aggression (Adachi & Willoughby, 2011; but see; Anderson & Carnagey, 2009). Longitudinal studies have shown that both violent and non-violent competitive game genres predict aggressive affect and behavior over time (Adachi & Willoughby, 2016) and frequent gamers who often play competitively report low levels of prosocial behavior (Lobel, Engels, Stone, Burk, & Granic, 2017).

In a similar vein, playing a cooperative video game may reduce aggression. Experimental studies have shown that cooperation during gaming reduces aggression in cognition (Schmierbach, 2010), affect (Eastin, 2007), and behavior (Jerabeck & Ferguson, 2013; Velez, Greitemeyer, Whitaker, Ewoldsen, & Bushman, 2016). Playing a cooperative game together also has been shown to increase prosocial behavior (Dolgov, Graves, Nearents, Schwark, & Brooks Volkman, 2014; Ewoldsen et al., 2012). Cooperative games were found to increase empathy (Emmerich & Masuch, 2013; Greitemeyer, 2013), feelings of trust and cohesion towards a play partner (Greitemeyer & Cox, 2013; Waddell & Peng, 2014), and a more positive attitude towards outgroup members (Adachi, Hodson, Willoughby, & Zanette, 2014; Stiff & Bowen, 2016; Velez, Mahood, Ewoldsen, & Moyer-Gusé, 2014).

The effects of playing competitive or cooperative video games on behaviors and attitudes towards a play partner is often explained through the theory of Bounded Generalized Reciprocity (BGR; Yamagishi, Jin, & Kiyonari, 1999). BGR predicts that individuals will behave positively towards those who are expected to reciprocate such behaviors in an effort to protect and further their own interests. Furthermore, individuals expect in-group members to reciprocate positive behaviors more than out-group members (Yamagishi et al., 1999). When co-playing video games, cooperative teammates naturally are categorized as the in-group, while competitors are considered the outgroup. In this way, the mode of the game may affect players' prosocial reciprocity expectations, which then influences their subsequent feelings and behaviors. Thus, cooperative play should promote positive attitudes and prosocial behavior towards a play partner. Similarly, competitive play is expected to decrease affiliation and prosocial behavior towards a play partner. In line with BGR, it has been shown that more interdependence increases helpful behavior during co-playing of games (Velez & Ewoldsen, 2013) and that expectations of reciprocal prosocial behavior increase subsequent positive behavior (Velez, 2015).

BGR was originally proposed as an explanation of the minimal group paradigm, to understand interactions between people who have no established expectations. The theory and previous research examining BGR have focused on strangers. In line with this, social gaming studies typically are based on a convenience sample of college students, where participants do not know each other beforehand. This illustrates a caveat within the existing social gaming research: individuals who do not know each other would rarely play an offline video game together. This is particularly true for adolescents, for whom video games function as a social leisure activity. Video games provide an excuse to ‘hang out’ with friends (Ito et al., 2010) and 78% of teen gamers indicate that games help them feel more connected to friends they already know (Lenhart et al., 2015). Despite this, there is little research on social gaming effects among people with an existing relationship and it is unclear whether previous findings of competitive and cooperative games would replicate in a sample of friends.

According to the BGR, group membership guides (expectations of) reciprocity when previous interactions between individuals are absent. However, BGR also states that group membership cues can activate a heuristic to cooperate with in-group members (Yamagishi et al., 1999). Since group membership cues are more likely to be present in a cooperative gaming session than during solitary or competitive play, cooperative games may influence reciprocity even between existing friends. On the other hand, the simple fact that players know that they will have continued interactions after the gaming session could enhance their reciprocity towards one another, regardless of in- or out-group cues. Given that BGR makes predictions about the effect of gaming between strangers, but not people with an existing relationship, we take an exploratory approach to answer the question: can competitive and cooperative gaming change the behavior and relationship between existing friends?

To our knowledge, only two studies have explicitly tested the differences between playing a cooperative game with friends and strangers, with mixed results. Playing a cooperative video game with friends increased commitment to game goals more than playing with strangers (Peng & Hsieh, 2012), but the relationship type with a play partner did not moderate hostility or cooperative behaviors after playing a cooperative violent game (Waddell & Peng, 2014). More research is needed to investigate the effects of co-playing video games between existing friends. The current study expands the literature by investigating how solitary, competitive, and cooperative gaming influence adolescents' liking, trust, connectedness, and prosocial behavior towards a friend in a naturalistic setting. Based on findings in unacquainted players that show cooperative and competitive games change prosocial behavior (Dolgov et al., 2014; Ewoldsen et al., 2012) and positive feelings towards a play partner (Adachi et al., 2014; Greitemeyer & Cox, 2013; Velez et al., 2014), we explored whether:

H1. Adolescents report higher friendship quality and more prosocial behavior towards a friend after playing a cooperative game together, and lower friendship quality and less prosocial behavior towards a friend after playing a competitive game together.

1.2. Interactions during video game play

Most research has looked at the effects of mode of gaming on behavior; only a few studies have investigated what actually happens during play. These studies found, for instance, that the amount of trash-talking by a confederate during a competitive video game had no effect on aggression (Breuer, Vogelgesang, Quandt, & Festl, 2015). Furthermore, playing a cooperative game with a helpful teammate resulted in more expected reciprocity and prosocial behavior afterwards than playing with an unhelpful teammate (Velez, 2015). In addition, students in competitive or cooperative play settings did not differ in positive and negative verbalizations towards a confederate, but participants in the competitive condition did rate the confederate more negatively (Roy & Ferguson, 2016). Apart from these examples, few studies have examined the interaction during play: actual in-game interactions typically have not been considered in gaming effects research. More research, particularly using observational methods, is needed to understand how the mode of gaming influences interaction during play. Understanding the emotions and actions that occur while a game is being played can provide insight in the exact way competitive and cooperative gaming changes behavior. To our knowledge, no one has tested the underlying assumption that positive and prosocial behavior naturally emerge during cooperative game play. Based on this, we proposed that:

H2. Adolescent friend dyads show more positive and prosocial behavior, as well as less negative, dominant and competitive behavior towards each other while playing a cooperative game than while playing a competitive game.

Furthermore, we expected that:

H3. More positive and prosocial behavior towards a friend while playing a video game promotes friendship quality and prosocial behavior towards this friend after the game.

In order to test these hypotheses, adolescent friend dyads were invited to play a racing game either solitary (separate from one another), competitively, or cooperatively. Friendship quality (measured as liking, trust, and connectedness) and prosocial behavior were assessed immediately afterwards. Behavior during the gaming interaction was video recorded and coded by independent observers at both the individual and dyadic levels. Gender was controlled for in all analyses. Previous research has shown that adolescent boys engage in competitive play more often than girls (Bukowski, Laursen, & Rubin, 2018). Furthermore, competing to win (i.e., to dominate and outperform others) has been associated with having fewer best friends, greater loneliness and less closeness in friendship for female but not male adolescents (Hibbard & Buhrmester, 2010).

2. Method

2.1. Participants and procedure

Two schools for pre-vocational secondary education in the Netherlands were recruited via information letters and follow-up phone calls. The school boards sent out an information letter and consent forms to all parents. Parents were able to opt out of participation of their child by contacting either the researchers or the school. Participants also provided assent at the start of the assessment.

Adolescents were invited to participate in the study together with one same-sex friend from their class during school hours. Oftentimes, this meant that two adolescents who were sitting together during a break or free hour were approached and mutually agreed to participate. If adolescents were by themselves, they were asked to seek out a same-sex friend and return to the classroom where the study was set up. A total of 180 adolescents in 7th to 10th grade were recruited this way (M_{age} = 14.75 years, SD = 1.15), of which 30.8% were female. Power analysis indicated that with an alpha of .05, power of .80 and expected effect size of Cohen's f = 0.42, at least 23 participants per condition were required. The effect size was based on the average effect size across studies with a similar design (Dolgov et al., 2014; Ewoldsen et al., 2012; Greitemeyer, 2013; Greitemeyer & Cox, 2013; Waddell & Peng, 2014).

At the start of the study, friend dyads were seated behind separate laptops. They received information on the general study design and the fact that video recordings would be made while they played a video game. Computerized questionnaires were presented that measured demographic information, friendship quality with their dyad member, and video game play behavior. Next, participants received a brief verbal explanation of the controls and played the video game *Mario Kart: Double Dash!!* (Nintendo, 2003). A video camera recorded the dyad during game play. After 15 min, participants finished their current race and returned to their respective laptops to complete a prosocial behavior task, post-test friendship quality questions, and a manipulation check. At the end of the study, participants were debriefed and instructed not to tell their classmates about the study design until the project was finished. Participants from each school participated in a raffle where they could win a €50 gift card. This procedure was approved by the Institutional Review Board of Radboud University.

2.2. Design

Dyads played Mario Kart Double Dash!!, a cartoon racing game where players control drive on a series of tracks against computer-controlled opponents. Players win through superior driving skills and using various items to hinder their opponents. The game was played on a Nintendo Wii console using GameCube controllers and a 19-inch LCD monitor. Participants played with the same characters, race tracks, and difficulty level.

Friend dyads were randomly assigned to either the solitary, competitive, or cooperative condition, resulting in 30 dyads in each condition. In the *solitary* condition, friends played the game independent of each other. Participants sat behind separate screens and were instructed to refrain from communicating with one another. Each participant controlled two characters sitting on a single kart and raced against computer-controlled opponents. In the *competitive* condition, dyads played the game on a single screen, split in the middle. Both dyad members controlled two characters on their own kart and raced against one another as well as against computer-controlled opponents. In the *cooperative* condition, participants sat behind a single screen and shared a single kart, controlling one character each. One player took care of driving, while the other managed the items. Dyad members in this condition could switch roles at any time by pressing a button on their controller simultaneously. This procedure was based on the study by Greitemeyer and Cox (2013).

2.3. Measures

2.3.1. Manipulation check

Each participant indicated on a 5-point Likert scale "I felt I was playing against < partner > " and "I felt I was playing together with < partner > " at posttest. Answers ranged from 1 (*completely disagree*) to 5 (*completely agree*).

2.3.2. Friendship quality

At both pretest and posttest, adolescents reported on the relationship with their friend using three Visual Analog Scales ranging from 0 (*Not at all*) to 100 (*Very much*). They were asked "How much do you like < partner > ?" (liking), "How much do you trust < partner > ?" (trust), and "How much do you feel connected to < partner > " (connection). Reliability analyses showed good internal consistency between the three items (pretest α = .81; posttest α = .86). Therefore, a composite score of friendship quality was computed by summing the scores on the three questions at pretest and at posttest.

2.3.3. Prosocial behavior task

Prosocial behavior was measured at posttest using a single trial of the two-person give-some dilemma task (adopted from Van Lange, 1999). Adolescents received 10 tickets and two empty envelopes, one with their own name on it and one with the name of their friend. They were reminded that they would join a raffle to win €50 at the end of the study. It was explained that each ticket increased their chance of winning the raffle. However, they also learned that each ticket donated to their friend had a value of two tickets for that person. Thus, by donating one ticket to their friend, they decreased their own chance of winning by one but increased their friend's chance by two. Using the envelopes, they could anonymously distribute tickets as they saw fit. Adolescents were aware that their friend received the same task, but were not allowed to communicate to ensure that choices were made independently. Prosocial behavior was measured as the number of tickets a participant donated to their partner (0–10).

2.3.4. Observations during gaming interaction

Adolescents' behavior while gaming was videotaped and later scored by four trained observers. The observation scales were derived from the Child-Friend Interaction Rating Scales (Deutz, Lansu, & Cillessen, 2014; Peters, Van den Bosch, & Riksen-Walraven, 2007), an adaptation of the Observed Friendship Quality Scale developed by Flyr, Howe, and Parke (1995). The interactions in the cooperative and competitive condition were coded at both the individual and dyadic levels (Deutz et al., 2014). Because participants in the solitary condition rarely displayed overt behavior during game play, their interactions were not rated. Four dyads did not provide assent for video recordings but completed the rest of the study, resulting in observations of 112 participants in total (28 cooperative and 28 competitive dyads).

Individual behavior was rated on five scales: *positive* (helping, thanking; ICC = 0.79), *negative* (being intrusive, hostile; ICC = 0.84), *dominant* (bossiness, influencing or controlling play; ICC = 0.82), *submissive* (complying with other, seeking direction or approval; ICC = 0.64) and *competitive* (teasing, taunting; ICC = 0.86), using a 5-point format (1 = *not at all*, 5 = *very much*). Observers rated individual behavior on the same 10 recordings (18% of all trials) independently of each other. Interrater reliability was calculated between all possible coder pairs with the consistent two-way random average measures intraclass correlation coefficient (ICC). A composite score for each individual behavior was created as the average of the four coders.

Dyadic behavior was rated on six scales: *positive connectedness* (explicitly pleasant, nice, considerate behavior; ICC = 0.68), *prosocial behavior* (dyadic cooperation, mutual thanking and complimenting; ICC = 0.66), *quantity of communication* (frequency of verbal communication regardless of content or tone; ICC = 0.80), *disharmony* (non-mutual, non-reciprocal interaction, interrupting each other; ICC = 0.66), *conflict* (disagreement, aversive interchanges; ICC = 0.68), and *imbalance of power* (unequal distribution of dominance/leadership; ICC = 0.70), again using a 5-point format. As for individual behavior, four coders rated the 10 reliability recordings (18% of all trials). Interrater reliability was low between two of the four coders, with an ICC = 0.16 on two scales. Therefore, the ratings by these two coders were dropped. A composite score for each dyadic behavior was created as the average of the remaining two coders.

3. Results

3.1. Descriptive statistics

Random assignment of participants was successful; there were no differences between conditions in terms of gender, age, or pretest friendship quality (all $p > .05$). To check whether our manipulation worked, a multivariate analysis of variance (MANOVA) showed that condition (solitary, competitive, cooperative) predicted ratings of playing against the partner, $F(2, 172) = 50.78$, $p < .001$, and ratings of playing together with the partner, $F(2, 172) = 74.01$, $p < .001$. All means were in the expected direction, indicating that our manipulation succeeded in triggering competition and cooperation.

Table 1 shows the means, standard deviations, and bivariate correlations of all study variables. There was a significant positive correlation between prosocial behavior towards the friend and posttest friendship quality, $r = 0.23$, $p < .01$. Posttest friendship quality was significantly correlated with observed individual positive behavior, $r = .26$, $p < .01$, and dyadic positive connectedness, $r = 0.21$, $p < .05$, during the game. There were several other significant correlations between the observation scales (see Table 1). There were no significant correlations between the observation scales and the prosocial behavior task. Even though there were no differences between conditions in gender, we controlled for gender in all subsequent analyses.

3.2. Effect of condition on friendship quality and prosocial behavior

Hypothesis 1 stated that playing a video game solitary, competitively, or cooperatively influences posttest friendship quality and prosocial behavior. Since participants were nested in dyads, we controlled for the variance associated with dyad using multilevel modeling.[1]

To investigate the effect of condition on changes in friendship quality, a linear mixed-effects regression was conducted with condition, gender, and pretest friendship quality predicting posttest friendship quality. A significant effect was found for pretest friendship quality, $b = 46.20$, $t(151) = 21.80$, $p < .001$, indicating a stability effect. Gender did not significantly predict friendship quality. Moreover, a significant difference in posttest friendship quality was found between the competitive and solitary gaming conditions, $b = -10.41$, $t(81) = -2.04$, $p < .05$. Estimated marginal means indicated that adolescents who played competitively reported lower friendship quality than adolescents who played solitary. No significant differences in posttest friendship quality were found between the cooperative and competitive condition, or between the solitary and cooperative condition. Post-hoc tests indicated that adding the interaction between condition and pretest friendship quality to the model did not improve fit, $\chi^2(2) = 5.24$, $p = .073$.

A linear mixed-effects regression across dyads was conducted to examine the effects of condition, gender, and pretest friendship quality on prosocial behavior. There were no effects of gender on prosocial behavior, but friendship quality significantly predicted prosocial behavior, $b = 0.01$, $t(164) = 2.44$, $p < .05$. No differences were found between the competitive and cooperative conditions, $b = 0.08$, $t(86) = 0.13$, $p > .05$, the competitive and solitary conditions, $b = 0.16$, $t(85) = 0.27$, $p > .05$, or the cooperative and solitary conditions, $b = 0.24$, $t(86) = 0.39$, $p > .05$. Thus, there were no differences in prosocial behavior after adolescents played a video game solitary, competitively, or cooperatively. To explore moderation by friendship quality, the interaction between condition and pretest friendship quality was added to the regression. There was no interaction between friendship and condition on prosocial behavior, $\chi^2(2) = 0.68$, $p > .05$.

3.3. Effects of condition on gaming interaction

Hypothesis 2 stated that playing a game competitively or cooperatively affects behavior during video game play. Differences between conditions on interactions during the gaming session were tested using the five individual behavior scales and the six dyadic behavior scales. All analyses controlled for gender. Results are reported in Table 2.

First, the effect of condition (competitive, cooperative) on the five individual observation scales was examined. Gender and pretest friendship quality were included as covariates. Since participants were nested within dyads, we tested whether there were differences between the null model (not including any predictors) and a model with dyad specified as a random factor to control for their associated intraclass correlation (i.e., random intercept models). Model fit comparisons showed significant dyadic variance in intercepts for negative, dominant, and competitive behavior (all $p < .001$). Thus, we used linear mixed-effect regression in which the intercept was allowed to vary across dyads for these behaviors. Since there was no significant dyadic variance in the intercept of positive behavior, $\chi^2(1) = 2.07$, $p > .05$, and submissive behavior, $\chi^2(1) = 0.00$, $p > .05$, we used simple linear regression for these variables. Differences between conditions for each behavior were tested using Wald's *t*-tests with Satterwhaite approximation of degrees of freedom. Compared to the competitive condition, adolescents in the cooperative condition showed more positive behavior, $t(52) = 2.24$, $p < .05$, more negative behavior, $t(52) = 3.58$, $p < .001$, more dominant behavior, $t(52) = 6.70$, $p < .001$, and more submissive behavior, $t(53) = 3.52$, $p < .001$. No significant differences between conditions were found for competitive behavior. There was no effect of gender or pretest friendship quality on observed individual behavior (all $p > .05$). To explore whether friendship quality moderated the relation between condition and observed behavior, the interaction between condition and pretest friendship quality was added to the regression. There was no interaction between friendship and condition on any of the five individual behavior scales ($\chi^2(2) = 0.70$–3.90, all $p > .05$).

Next, a MANCOVA was conducted with condition (competitive,

[1] Model fit comparisons indicated significant intercept variance across dyads for relationship quality, $\chi^2(1) = 15.36$, $p < .001$, and prosocial behavior, $\chi^2(1) = 6.39$, $p < .05$. Intraclass correlations indicated that the dyad explained 40.7% and 26.2% of the variance, respectively.

Table 1
Means, standard deviations, and bivariate correlations of study variables.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Age	1	.32***	.18*	.19*	.22*	-.07	-.01	.09	-.01	-.05	.02	.12	-.06	.00	.01
2	Prosocial behavior		1	.18*	.23**	.11	.08	-.09	-.06	-.10	-.05	.09	-.10	-.13	.00	-.09
3	Pretest friendship quality			1	.87***	.20*	.16†	.10	.03	-.04	-.02	.16†	.06	.11	-.04	.13
4	Posttest friendship quality				1	.21*	.17†	.06	-.07	-.09	-.01	.26**	.06	.17	-.04	.15
Dyadic observations																
5	Positive connectedness					1	.17	.65***	-.03	-.09	-.01	.20*	.02	.11	-.04	.54***
6	Prosocial behavior						1	.13	-.06	.02	.05	.52**	.02	.12	.03	.17†
7	Quantity of comm.							1	.15	.33*	.25†	.25**	.23*	.38***	.08	.75***
8	Conflict								1	.62***	.30*	-.20*	.59***	.19*	-.02	.13
9	Disharmony									1	.37**	-.01	.49***	.34***	.15	.35***
10	Balance of power										1	.14	.41***	.54***	.39***	.13
Individual observations																
11	Positive behavior											1	-.01	.28**	.14	.22*
12	Negative behavior												1	.68***	.03	.28**
13	Dominant behavior													1	.13	.45***
14	Submissive behavior														1	.05
15	Comp. behavior															1
	M	14.75	5.26	241.02	241.55	2.89	2.27	3.05	1.44	1.95	1.87	2.04	1.33	1.70	1.18	2.69
	SD	1.15	2.97	52.06	52.73	1.08	.85	1.21	0.84	0.91	1.06	.71	0.62	0.90	0.37	1.05
	N	180	180	177	174	55	55	55	55	55	55	110	110	110	110	110

Note. †$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

Table 2
Adjusted means, SE, and Wald t-Tests of Condition on Observed Behavior During Gaming while Controlling for Gender.

	Condition				*t*
	Cooperation		Competition		
	M	*SE*	*M*	*SE*	
Individual observations					
Positive behavior	2.18	0.10	1.89	0.10	2.09*
Negative behavior	1.55	0.09	1.09	0.10	3.42**
Dominant behavior	2.17	0.11	1.17	0.11	6.22***
Submissive behavior	1.31	0.05	1.05	0.05	3.75***
Competitive behavior	2.51	0.18	2.87	0.19	−1.39
Dyadic observations					
Prosocial behavior	2.41	0.79	2.13	0.89	1.21
Positive connectedness	2.73	0.99	3.06	1.14	−1.14
Quantity of communication	3.02	1.24	3.07	1.17	−0.17
Conflict	1.54	1.04	1.33	0.55	0.87
Disharmony	2.05	1.04	1.85	0.75	0.79
Imbalance of power	2.41	1.10	1.31	0.66	4.38***

Note. Intercept was allowed to vary across dyads for negative, dominant, and competitive behavior. Pretest friendship quality was included as a covariate for individual observations.
*$p < .05$, **$p < .01$, ***$p < .001$.

cooperative) as the predictor variable, gender as a covariate, and the six dyadic behaviors as the outcome variables, with dyad as the unit of analysis. There was a significant multivariate effect of condition, $F(6, 47) = 3.91$, $p < .01$, Wilk's $\Lambda = 0.667$, partial $\eta^2 = 0.33$. Univariate testing indicated a difference between conditions for balance of power, $F(1, 52) = 19.20$, $p < .001$, partial $\eta^2 = 0.27$. Estimated means indicated more imbalance of power in the cooperative condition ($M = 2.41$) than in the competitive condition ($M = 1.31$). None of the other univariate effects reached statistical significance. There were no gender differences for observed individual and dyadic behavior.

3.4. Effects of the gaming interaction on friendship quality and prosocial behavior

Finally, we examined Hypothesis 3 by testing whether behavior displayed during the gaming session influenced friendship quality and prosocial behavior towards the friend at posttest. This was tested using a series of hierarchical (two-step) linear mixed-effects regressions in which the intercept was allowed to vary across dyads. Gender was included as a covariate, but did not predict prosocial behavior or friendship quality.

For friendship quality, all analyses included one of the behavior scales, gender, and pretest friendship quality as predictors in Step 1. In Step 2, the main effect of condition and the interaction between observed behavior and condition were added as predictors. Results indicated a stability effect of pretest friendship quality on posttest friendship quality for all models ($p < .001$). Results are reported in Table 3.

For the observed individual behaviors, positive behavior during the game predicted higher friendship quality after the game, $t(98) = 2.00$, $p < .05$. No other individual behaviors showed a significant main effect on friendship quality, although there was a marginal effect of dominant behavior, $t(98) = 1.70$, $p = .092$. Adding the main effect and interaction of condition in Step 2 did not improve fit for any of the models using the individual behaviors.

For the dyadic behaviors, there was a significant effect of prosocial behavior on posttest friendship quality, $t(46) = 2.26$, $p < .05$. Dyads who displayed more prosocial behavior during the game scored higher on friendship quality after the game. There was a significant interaction

Table 3
Linear mixed-effects regression of observed behavior during gaming on posttest friendship quality, controlling for gender and pretest friendship quality.

	Estimate	*SE*	*t*	*p-value*
Individual observations				
Positive behavior	5.15	2.57	2.00	.048*
Negative behavior	1.79	2.63	0.68	.498
Dominant behavior	4.56	2.68	1.70	.092†
Submissive behavior	−0.81	2.53	−0.32	.750
Competitive behavior	0.75	2.71	0.28	.782
Dyadic observations				
Prosocial behavior	7.84	3.47	2.26	.029*
Prosocial behavior x Condition	−14.46	5.16	−2.81	.007**
Positive connectedness	−1.63	2.89	−0.57	.574
Quantity of Communication	−2.69	2.75	−0.98	.333
Conflict	−4.58	2.63	−1.74	.089†
Disharmony	−2.58	2.69	−0.96	.343
Imbalance of Power	0.99	2.69	0.37	.715

Note. Intercept was allowed to vary across dyads. Reports are resulted for Step 1, except for prosocial behavior, where Step 2 explained a significant change in proportion of variance.
†$p < .10$, *$p < .05$, **$p < .01$.

between condition and prosocial behavior on friendship quality, $t(46) = -2.81$, $p < .01$. Means indicated that observed prosocial behavior was related to friendship quality in the competitive condition, but not in the cooperative condition. No other dyadic behavior was a significant predictor, although there was a marginally significant negative effect of conflict on friendship quality, $t(47) = -1.73$, $p = .089$.

For the scores on the prosocial behavior task, a series of hierarchical (two-step) linear mixed-effects regressions was conducted with one observed behavior and gender as predictors in Step 1 and the main effect of condition and the interaction between condition and the behavior added as predictors in Step 2. No significant effects were found of individual or dyadic behaviors during the game on prosocial behavior after the game. There were also no significant interactions between condition and behavior during the game session on prosocial behavior. Thus, behavior during the game did not predict prosocial behavior after the game.

4. Discussion

Existing research has shown that the mode of play in a video game (i.e., solitary, competitive and cooperative) influences aggression (Adachi & Willoughby, 2011, 2016; Greitemeyer, Traut-Mattausch, & Osswald, 2012; Jerabeck & Ferguson, 2013; Velez et al., 2016) and prosocial behavior (Dolgov et al., 2014; Ewoldsen et al., 2012; Greitemeyer & Cox, 2013; Lobel, Engels, Stone, Burk, et al., 2017). However, most experimental studies have used a sample of unacquainted college students, and no research has investigated behavior displayed *during* game play that might explain these findings. In order to understand what happens between players while they engage in competitive or cooperative play, the present research used naturalistic observations of adolescent friend dyads in a field study with an experimental design.

First, we found lower friendship quality between adolescents after they played a video game competitively, compared to playing the same game solitary. We did not find evidence that playing a game cooperatively promoted friendship quality. Second, whether a video game was played cooperatively or competitively changed adolescents' individual behavior during the game session. As expected, more positive behavior was observed during cooperative gaming. However, there was also more negative, dominant, and submissive behavior and a greater imbalance of power between friends in the cooperative condition. Third, the behavior displayed during the gaming interaction predicted friendship quality afterwards. Both prosocial behavior and positive behavior during gaming enhanced friendship quality. The effect of observed positive behavior on friendship quality was found across all conditions, while prosocial behavior enhanced friendship quality particularly in the competitive condition. The amount of observed prosocial behavior did not predict friendship quality in the cooperative condition, perhaps because prosocial behavior is expected in this game mode.

Our findings indicated that cooperative or competitive games can change positive behavior during the gaming interaction. Furthermore, positive and prosocial behavior during gaming influenced friendship quality afterwards. These results are in line with the BGR, which posits that expectations of reciprocal positive behavior during gaming increase subsequent positive behavior. While BGR typically is used to explain interactions between strangers, our results show that similar processes might occur in existing friend dyads. Besides the changes in friendship quality, we expected that both mode of play and the observed interaction during gaming would also influence posttest prosocial behavior. Yet we did not find an effect on prosocial behavior after the game. This is in contrast with studies in which cooperative games were shown to increase prosocial behavior (e.g., Ewoldsen et al., 2012; Velez et al., 2014, but see Jerabeck & Ferguson, 2013, for a similar null result).

There are several possible explanations for this result. It could be that the effect of play mode and behavior during gaming results in changes on an affective level, but not in actual behavior towards a friend. Based on the BGR, we expected that cues in the cooperative and competitive condition would influence reciprocity (Yamagishi et al., 1999). However, our results may differ from previous studies because participants were friends instead of strangers. Our sample has had a plethora of previous interactions to base their expectations of reciprocity on. The history of interactions and established expectations may have a stronger effect on friendship quality and prosocial behavior than the manipulation of the game mode. This is supported by the consistent effect of pretest friendship quality on posttest friendship and prosocial behavior. Furthermore, participants knew that they would have continued interactions after the gaming session. This could have inhibited them from changing their behavior on the prosocial task.

Another possible explanation is that some participants in the cooperative condition became frustrated with the way their friend played. This is evidenced by the fact that not only positive behavior, but also negative and dominant behavior was more present during cooperative play than during competitive play. This frustration could be the reason why positive findings of cooperative gaming on prosocial behavior were not replicated. Alternatively, our assessment may not have been sensitive enough to detect differences as we used a single trial of the two-person give-some dilemma. This measure has been used successfully before, but in unacquainted college students (Greitemeyer & Cox, 2013). Regardless, our findings suggest that future research of competitive and cooperative gaming should take both relational attitudes and behavior into account.

Cooperative games seem to provide an opportunity to promote friendship quality between adolescent friends. However, we emphasize the importance of the interaction during gaming more so than the mode of play. We found no direct association between cooperative gaming and later friendship quality, and cooperation in games did not always lead to more affable interactions. While there was more positive behavior in the cooperative condition, we also observed an increase in negative, dominant, and submissive behaviors, and a greater imbalance of power. Perhaps cooperation encouraged positive interactions, but also increased frustration between friends.

The frustration-aggression hypothesis states that thwarting or threatening an individual's goals increases aggression (Berkowitz, 1989). The frustration-aggression hypothesis has been used to explain the effects of competitive games on aggression (Adachi & Willoughby, 2016; Breuer et al., 2015), but frustration during gaming is not necessarily inherent to competitive settings. If there is a difference in skill level between partners playing cooperatively, individuals might feel that the other player hinders them from winning. This may lead to more negative interactions. The feelings of frustration may subsequently lower friendship quality and prosocial behavior. Indeed, research has shown that liking of a teammate increases after receiving positive performance feedback, but decreases when a team learns they failed an objective (McGloin, Hull, & Christensen, 2016). Future research should investigate whether factors such as players' individual competence or their success together moderate the effects of cooperative gaming on friendship quality. Furthermore, in contrast to expectations, we did not find a difference between conditions on observations of competitive behavior. Perhaps there was competitive behavior in both conditions but directed at different targets. Whereas the competitive condition consisted of a contest between two adolescents, in the cooperative condition players competed as a team against the computer-controlled characters. Furthermore, there was no difference between conditions in the amount of communication observed. Thus, it was not the case that there was simply more interaction in the cooperative condition. Rather, the valence of the interaction in the cooperative condition differed from the competitive condition, which was both more positive and negative as well as more hierarchical.

Together, these findings help us to gain insight in the effects of different modes of game play on adolescent friendship. The exact ways

in which cooperation and competition change behavior help us to understand the impact of games on youths' social behavior, and provides game designers with tools to enhance positive social experiences through games. Based on our findings, game designers looking to create a bonding experience through multiplayer games should incorporate mechanisms that elicit positive behaviors towards a play partner. In addition, encouraging prosocial behavior towards a peer could increase friendship quality, particularly if the game is competitive. This means that designers who want to promote affiliation between players do not necessarily have to limit themselves to cooperative games. Furthermore, it appears that players' roles in a game do not necessarily have to be equal, as observations of submission, dominance, and power imbalance did not predict friendship quality afterwards.

4.1. Strengths and limitations

A strength of this study was that we used a strong, ecologically valid sample by inviting friend dyads in school. Dyad members knew each other well and were aware that they would continue interacting with each other after the study ended. Some of them may regularly experience the competitive or cooperative gaming interaction that we simulated, as 52% of teens play games with their friends (Lenhart et al., 2015). Thus, the procedure should have been familiar to participants outside of the research context.

While ecological validity was high, the existing friendship between adolescents may have influenced effect sizes. Our analyses controlled for the highly significant stability of friendship quality between pretest and posttest, which may have reduced the effects of the other predictors. Indeed, it is ambitious to expect that a 15-min gaming session can change the quality of an existing friendship. Thus, the particular sample of the present study might explain why no support was found for the expected effect on later prosocial behavior. The fact that changes in friendship quality did emerge even after controlling for pretest friendship quality speaks to the strength of the effects on friendship quality. To move forward, we recommend that future studies directly compare effects of competitive and cooperative gaming between strangers and friends. The field would benefit from experimental studies where participants are paired with either a stranger or a friend in both competitive and cooperative gaming sessions. Longitudinal surveys among classmates would also help us understand how often friends play competitive and cooperative video games together and whether this relates to their friendship quality over time.

Another limitation is that the present study used a short-term experimental design, with a single gaming session. However, adolescents frequently play games with one another. Cumulative experiences of either competition or cooperation may lead to long-term effects, but more research is needed to investigate these claims. We encourage future researchers to look at the effects of friends playing competitively or cooperatively on relationship quality over a longer period. Based on our results, it can be expected that friends who often play competitively have lower friendship quality than friends who play solitary. However, many variables could impact this association. Future research could investigate differences between friends playing offline or online, in dyads or in larger groups, and those playing exclusively competitively versus in a mix of solitary, competitive, and cooperative modes.

The chosen measures also place some limits on the contributions of this paper. For instance, reciprocity expectations for prosocial behaviors between dyads were not measured. Besides actual prosocial behavior, more information on expected reciprocity might have helped to further clarify the mechanisms behind BGR between friend dyads. Positive behavior during gaming increased friendship quality, but we cannot know for sure whether this was due to increased expectations of reciprocity. We encourage future research to measure expectations of reciprocity directly.

Finally, we do not wish to argue that competitive play is inherently harmful and should be prevented in youth. Playful competition in video games may actually be a standard occurrence in typically developing children, and has been linked to beneficial effects such as a decrease in conduct problems and improvement in peer relations (Lobel, Engels, Stone, & Granic, 2017). While our results indicate that cooperation in video games is a promising tool to influence adolescents' peer relationships, we emphasize that the actual interactions during a gaming session are more important than the mode of play.

5. Conclusion

Multiple studies have investigated how competitive and cooperative gaming impact youth, but this study is the first to show how behavior during a gaming interaction influences the players' friendship afterwards. Overall, findings indicated that both the way in which a game is played and the behavior that is displayed during a gaming session can change adolescents' relationship with a friend at least temporarily. Furthermore, the behavior displayed during gaming is dependent on whether a game is played competitively or cooperatively. Our findings illustrate the importance of examining what actually happens during play in order to further understand the effects of video games on youth.

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