Online Supplemental Materials

Supplemental Table 1. Descriptive statistics and reliabilities

Variables	*Cooperative game*					*Solitary game*				
	M	*SD*	M_{adj}	SD_{adj}	*Reliability*	*M*	*SD*	M_{adj}	SD_{adj}	*Reliability*
Positive affect	32.749	24.551	.066	.049	.868	13.931	24.189	.022	.035	.787
Positive conversation	18.974	14.888	.038	.028	.748	5.048	8.096	.008	.012	.710
Neutral conversation	94.322	63.329	.185	.115	.860	19.352	25.312	.032	.040	.741
Seeking help	14.449	9.933	.029	.019	.711	7.491	12.037	.013	.019	.792
Receiving solicited help	7.941	7.633	.016	.015	.885	8.258	17.844	.014	.030	.882
Receiving unsolicited help	6.237	9.280	.012	.016	.795	1.110	4.846	.002	.010	-
Game evaluation	2.628	.621	-	-	.883	2.422	.758	-	-	.941

Note. Unadjusted means and standard deviations are provided in seconds. M_{adj} and SD_{adj} show means and standard deviations of behaviors adjusted for session duration. Descriptives provided in the table for solicited and unsolicited help are not winsorized; these factors were winsorized before the analyses to decrease skewness. Interrater reliability for behavioral measures was calculated using intraclass correlations. Reliability of the self-reported game evaluation measure was calculated using Cronbach's alpha. Because receiving unsolicited help was observed very infrequently during the solitary game, reliability for this behavior could not be calculated.

Supplemental Table 2. Correlations between measures by game type

Variables	*Gender*	*Game evaluation*	*Game preference*	*Positive affect*	*Positive conversation*	*Neutral conversation*	*Seeking help*	*Receiving solicited help*	*Receiving unsolicited help*
Gender	-	-.211	-.158	.180	.060	.157	.167	.086	-.008
Game evaluation	-.283*	-	.257	-.259*	-.218	-.144	-.291*	-.334**	-.210
Game preference	-.158	.617***	-	.156	.157	.100	.307*	.114	.126
Positive affect	-.161	.203	.248	-	.623***	.271*	.562***	.263*	.294*
Positive conversation	-.192	.159	.267	.679***	-	.241	.415**	.405**	.277*
Neutral conversation	.086	.120	.248	-.013	.069	-	.631***	.662***	.181
Seeking help	.140	-.053	.216	.143	.133	.305*	-	.800***	.545***
Receiving solicited help	.293*	-.098	.032	.157	-.004	.099	.313*	-	.534***
Receiving unsolicited help	.162	.269*	.270	.111	-.033	-.095	-.115	.321*	-

Note. Correlations for the solitary (cooperative) version are above (below) the diagonal. Because receiving solicited and unsolicited help were highly skewed, they were winsorized before calculating correlations. *N*s ranged from 51 to 61 due to missing values on some variables. Gender was coded as 0 = female, 1 = male. *** $p < .001$, ** $p < .01$, * $p < .05$

Statistical Power Analysis

We performed power analysis using PINT 2.1 (Bosker, Snijders, & Guldemond, 2003) to estimate the minimum effect size that our data analytic model could reliably detect with 80% statistical power. Assuming that variances of the residual and random intercept terms (denoted by r_{ij} and u_{0j} in the *Data Analytic Strategy* section below) remain the same as in the present study, a two-level design including 16 groups with 4 participants in each group provided 80% power to detect an unstandardized association of .011 between a dummy variable and a continuous outcome. This effect size corresponds to roughly one-fourth of the association between game version and positive affect and one-third of the association between game version and positive conversation observed in the present study.

Additional participant characteristics

Participants were asked several questions about their everyday gaming habits and interactions with technology. One question asked how much they like playing mobile games in general (0 = *Definitely don't like* to 3 = *Like very much*). On average, participants indicated that they liked playing mobile games (*M* = 2.683, *SD* = .668, *Median* = 3). Another question asked how much time they spend daily on playing games using cell phones, computers, or tablets (0 = *Never* to 4 = *More than five hours in a day*). Most children (39.7%, *n* = 25) reported playing games on these devices between 1-3 hours daily, 33.3% (*n* = 21) reported playing less than an hour or never playing, and 27% (*n* = 17) reported playing more than three hours a day. Children were also asked to indicate members of their family who play mobile games. Majority of children (65.1%, *n* = 41) reported that their siblings play mobile games, whereas 20.6% (*n* = 13) reported that their mother, 31.7% (*n* = 20) reported that their father, and 28.6% (*n* = 18) reported that other relatives play mobile games. Finally, 69.8% of children (*n* = 44) reported playing

mobile games with their family or friends, whereas 30.2% (n = 19) reported not playing mobile games with them.

Data Analytic Strategy

Because children were nested within groups, we analyzed the data using multilevel modeling. All model equations were constructed and estimated using the HLM Software v7 (Raudenbush et al., 2011).

The level-1 model estimating positive conversation was:

$$Positive\ conversation_{ij} = \beta_{0j} + \beta_{1j}(Game\ version_{ij}) + r_{ij}$$

where game version was dummy-coded (0 = solitary, 1 = cooperative) such that β_{0j} (the intercept) referred to mean positive conversation in the solitary version and β_{1j}(the slope) to the difference in positive conversation across cooperative and solitary versions within each group. The level-2 model estimated the average intercept and slope across the entire sample:

$$\beta_{0j} = \gamma_{00} + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

The models estimating other behaviors during gameplay and self-reported game evaluation were identical to the model described above.

Given game preference was a binary measure (0 = *solitary*, 1 = *cooperative*) that was assessed only once after playing both games, an intercept-only multilevel logistic regression was used to assess whether children preferred the cooperative vs. solitary version. Please note that results remained the same as those reported in the main text when the analysis was repeated using a chi-square test of independence in SPSS.

Additional Information on Behavioral Coding

Two independent coders watched video recordings of gaming sessions and calculated the duration with which children engaged in target behaviors by using ELAN (Version 5.8, 2019). ELAN is an annotation software for real-time coding of video recordings and offers a set of media controls that allows coders to pause or adjust the playback speed to enable more precision (Lausberg, & Sloetjes, 2009). Coders were instructed to mark the duration of each behavior as they watched the video. Specifically, independent tiers were created in the software for each behavioral dimension. Coders were instructed to select the beginning and end of each target behavior to annotate the duration of the behavior. In the end, the software automatically calculated the total duration of each behavior by summing up coders' annotations in each tier. Coders watched each video four times. On each sitting, they were instructed to focus on only one of the four children in the group and code behaviors of that specific child.

Additional Coding Dimensions

In addition to coding dimensions reported in the main text, we also coded leadership and negotiation during gameplay. Given that game mechanics allowed these behaviors to emerge only during cooperative gameplay, we report results for these coding dimensions below. Please note that we were unable to code negative behaviors because they were observed very infrequently during both versions of the game.

Leadership. The duration with which children coordinated their peers' behaviors and gave directions to their peers was coded. Leadership behaviors included deciding on the division of labor, guiding other players by reading recipes aloud, and supervising other players' task completion (M = 28.513, SD = 43.111, ICC = .917).

Negotiation. The duration with which children negotiated to share or switch roles was coded. At the beginning of the cooperative game, children could negotiate how to share roles (e.g., cutting, sauteing, reading recipes) or during the game they could re-negotiate to switch roles (M = 6.090, SD = 7.022, ICC = .751).

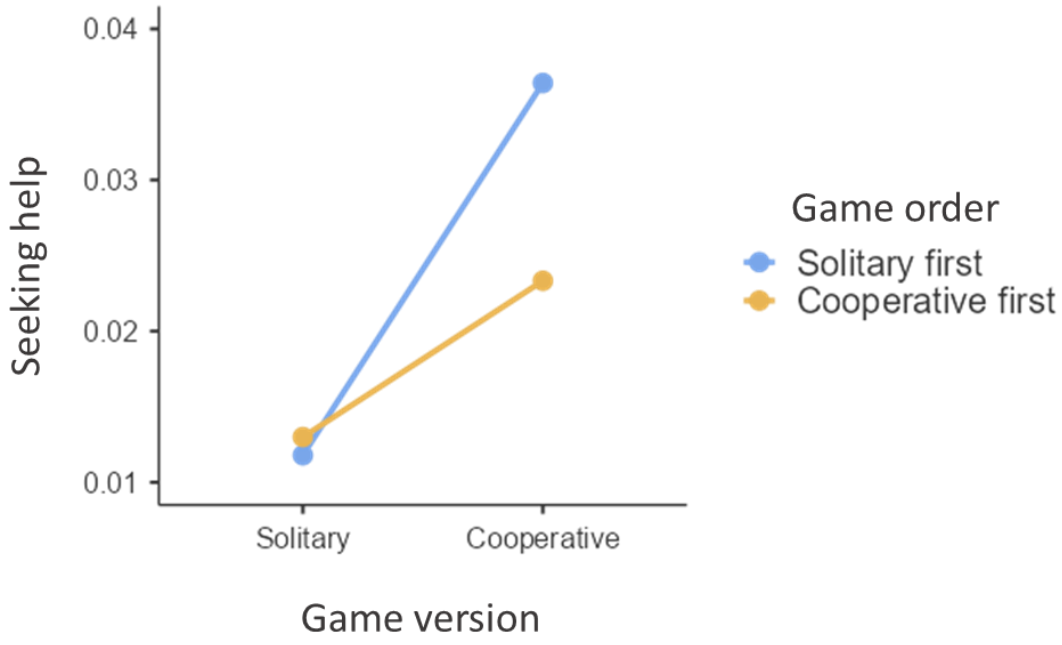
Leadership and negotiation were highly skewed. To reduce skewness, we winsorized values that were 2 SDs above the mean by replacing them with the next highest value before analyzing the data. Results showed that children displayed greater leadership and negotiation behavior during cooperative (vs. solitary) gaming, γ_{10} = .046, SE = .008, p < .001, 95% CI [.030, .062], γ_{10} = .011, SE = .001, p < .001, 95% CI [.009, .013], respectively.

Testing the Interactions between Game Order and Game Version

We explored whether game order (0 = playing the solitary game first, 1 = playing the cooperative game first) moderated any of the effects reported in the main text. Game order did not change the odds of preferring the cooperative game over the solitary game (γ = -2.170, SE = 1.457, p = .158 in the model comparing the odds of preferring the cooperative game over the solitary game only; γ = -1.240, SE = .761, p = .125 in the model comparing the odds of preferring the cooperative game over the solitary game or remaining undecided combined). Similarly, game order did not moderate the effects of game version on game evaluation, positive affect or social behaviors except seeking help (for game evaluation, γ =.189, SE = .229, p = .410; for positive affect, γ = .005, SE = .012, p = .669; for leading, γ = -.006, SE = .015, p = .719; for receiving unsolicited help, γ = -.002, SE = .003, p = .572; for receiving solicited help, γ = .008, SE = .006, p = .154; for negotiation, γ = -.004, SE = .002, p = .074; for positive conversation, γ = .006, SE = .007, p = .371; for neutral conversation, γ = -.019, SE = .029, p = .518). The only significant interaction between game order and game version emerged in the model predicting seeking help,

γ = -.014, *SE* = .006, *p* = .019. We estimated simple effects of game version at each level of order using the GAMLj module in jamovi (Galucci, 2019; The jamovi project, 2021). Children sought more help during the cooperative (vs. solitary) game regardless of whether they played the solitary game first (γ = .025, *SE* = .005, *p* < .001, 95% CI [.016, .034]) or the cooperative game first (γ = .010, *SE* = .004, *p* = .010, [.003, .018]). However, the difference between game versions was greater when children played the solitary game first (Supplemental Figure 1). We should note that this effect should be interpreted with caution given that game order did not play a similar moderating role in other outcomes and the sample sizes were small for testing interaction effects.

Supplemental Figure 1. *Seeking help as a function of game version and game order*



Testing the Interactions between Gender and Game Version

We also explored whether gender (0 = female, 1 = male) moderated any of the effects reported in the main text. Gender did not change the odds of preferring the cooperative game

over the solitary game (γ = -1.929, *SE* = 1.098, *p* = .088 in the model comparing the odds of preferring the cooperative game over the solitary game only; γ = -0.657, *SE* = .701, *p* = .354 in the model comparing the odds of preferring the cooperative game over the solitary game or remaining undecided combined). Similarly, gender did not moderate the effect of game version on game evaluation or social behaviors (for game evaluation, γ =-.008, *SE* = .233, *p* = .974; for leading, γ = -.020, *SE* = .016, *p* = .198; for seeking help, γ = -.002, *SE* = .006, *p* = .774; for receiving unsolicited help, γ = .003, *SE* = .003, *p* = .248; for receiving solicited help, γ = .006, *SE* = .006, *p* = .338; for negotiation, γ = .001, *SE* = .002, *p* = .562; for positive conversation, γ = -.013, *SE* = .006, *p* = .057; for neutral conversation, γ =.007, *SE* = .030, *p* = .823). Gender significantly interacted with game version only in predicting positive affect (γ = -.030, *SE* = .012, *p* = .015). Greater positive affect when playing the cooperative (vs. solitary) game was evident for both females (γ = .062, *SE* = .010, *p* < .001) and males (γ = .032, *SE* = .007, *p* < .001). However, the difference was greater for female (vs. male) participants (Supplemental Figure 2). This finding is in line with the literature that during middle childhood, females (vs. males) are more likely to show positive affect when engaging in social interactions (Chaplin, 2015). However, we should note that this effect should be interpreted with caution given that gender did not play a similar moderating role in other outcomes and the sample sizes were small for gender comparisons (23 females, 40 males).

Supplemental Figure 2. *Positive affect as a function of game version and gender*

Testing the Interactions between Gaming Experience and Game Version

Finally, we explored whether gaming experience (daily time spent playing video games) moderated any of the effects reported in the main text. Gaming experience did not change the odds of preferring the cooperative game over the solitary game (γ = .039, *SE* = .386, *p* = .919 in the model comparing the odds of preferring the cooperative game over the solitary game only; γ = -.056, *SE* = .288, *p* = .846 in the model comparing the odds of preferring the cooperative game over the solitary game or remaining undecided combined). Similarly, gaming experience did not moderate the effect of game version on game evaluation, positive affect, or social behaviors (for game evaluation, γ =.006, *SE* = .109, *p* = .960; for positive affect, γ = -.002, *SE* = .006, *p* = .684; for leading, γ = -.006, *SE* = .007, *p* = .407; for seeking help, γ = -.0002, *SE* = .003, *p* = .946; for receiving unsolicited help, γ = -.0004, *SE* = .001, *p* = .784; for receiving solicited help, γ = .001, *SE* = .003, *p* = .680; for negotiation, γ = -.0002, *SE* = .001, *p* = .850; for positive conversation, γ = -.002, *SE* = .003, *p* = .625; for neutral conversation, γ =-.002, *SE* = .014, *p* = .912).

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