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Does Playing Cooperative Mobile Games Facilitate Social Interaction and Positive Affect in Middle Childhood?

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ABSTRACT

The current study examined the effect of a cooperative (*vs.* a non-cooperative solitary) mobile game on social behaviors and positive affect during gameplay in middle childhood. In a within-participants experimental design, groups of fifth graders (ages from 10 to 12) played in counterbalanced order cooperative and solitary versions of a cooking game developed for tablets. Our findings showed that children who played the cooperative (*vs.* solitary) mobile game engaged in more positive and neutral conversations during gameplay. They also sought and received more help from peers and displayed greater positive affect during cooperative (*vs.* solitary) gaming. Finally, they preferred the cooperative mobile game to the otherwise identical solitary game after playing both games. Overall, these findings provide the first experimental evidence of the social and affective benefits of cooperative mobile gaming in middle childhood.

1. Introduction

Parents commonly worry that their children do not spend enough time socially engaging with peers but rather spend too much time isolated online or playing computer games. Such concerns mostly stem from the intuitive knowledge about the importance of a rich social life. Although there is increasing recognition that playing video games might provide children with valuable opportunities for social interaction and cooperation (e.g., Granic et al., 2014; Hirsh-Pasek et al., 2015; Kafai, 2021; Passmore & Holder, 2014; Steinkuehler & Squire, 2014; Steinkuehler & Tsaasan, 2020), limited research attention has been devoted to children's behaviors during in-person cooperative gameplay (i.e., cooperative gaming in the same physical space)—with no experimental research on the effects of cooperative gaming on children's positive affective displays. Considering that an overwhelming majority of youth spend their leisure time playing video games (Lenhart et al., 2008), it is important to study children's affect and behavior when playing cooperative video games. Moreover, although most in-person gaming in day-to-day life occurs with friends or acquaintances rather than strangers, the effects of games played with known others have received relatively less research attention (Verheijen et al., 2019). Finally, given that characteristics of mobile gaming environments may not only facilitate but also hinder social interactions (Szentgyorgyi et al., 2008), it is not clear whether the benefits of cooperative games shown in past work extend to mobile gaming environments. The current within-participants experiment addressed these important gaps by asking groups of fifth graders (ages 10–12) to play in counterbalanced order cooperative and solitary versions of a mobile game with their classmates and measuring social behaviors and positive affect during gameplay as well as game preferences after playing both games.

2. Literature review and theoretical background

Cooperation during gameplay might take many different forms and emerge when playing computer games in person (e.g., El-Nasr et al., 2010) or online (e.g., Kahraman & Kazançoğlu, 2022). Even competitive multi-player games might allow players to cooperate—for example, when players have to work together to make progress but compete to determine the winner. Massively multiplayer online role-playing games allow cooperating in various quests and challenges (Cole & Griffiths, 2007; Steinkuehler, 2004). Cooperation might also be observed when scores obtained from solitary games are combined across players. Finally, some games might allow players to work toward a common goal as a team without having to compete against one another (Verheijen et al., 2019)—as in the case of the cooperative mobile game which is the focus of the current research.

How do cooperative video games impact social behaviors in children? This is an important question given the recent debate on the role of gaming in children's social competence. One line of work provided evidence that gaming has

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adverse effects on children's social competence (Hygen et al., 2020), especially when children spend more than 3 hr per day on gaming (Przybylski, 2014). However, these studies did not consider whether children played games cooperatively. Indeed, there is accumulating evidence showing that playing video games, especially those allowing social interaction, prosocial exchanges, and cooperation may help players acquire social skills (e.g., Blanco et al., 2022; for a review see Granic et al., 2014).

Past theorizing also speaks to the potential benefits of cooperative video games. According to the General Learning Model (Buckley & Anderson, 2006), individual differences and situational factors (including game features) shape players' behaviors via effects on their cognition, affect, and arousal. Although this model was initially developed to explain the role of exposure to violent video games in aggression (General Aggression Model; Anderson & Dill, 2000; Anderson et al., 2004), it evolved into a more general framework to also account for the effects of nonviolent games. When applied to cooperative video games, the model suggests that cooperative game features are situational factors that would increase the accessibility of cooperation-related cognitions, such as social interaction and helping-related scripts. These features also have the potential to increase positive affect, given the hedonic benefits of social interaction (e.g., Holder, 2012). The cognitions and affect resulting from cooperative gaming, in turn, would reinforce relevant social behaviors, such as conversations with peers, seeking and receiving help, and outward displays of positive affect. These ideas are supported by empirical evidence on the correlates of cooperative gaming across the lifespan as reviewed below.

2.1. Cooperative gaming in adulthood

Past research on the social benefits of cooperative gaming has predominantly focused on adult samples. One study showed that participants who played a video game cooperatively with a stranger (*vs.* alone) showed greater trust and cohesion during gameplay and greater cooperative behavior toward another stranger in a subsequent economic game (Greitemeyer & Cox, 2013). Participants also showed higher empathy, behavioral engagement, and lower negative affect (Emmerich & Masuch, 2013), experienced greater motivation and put more effort during the game (Peng & Hsieh, 2012), and reported more favorable impressions of confederates (Roy & Ferguson, 2016) when playing video games cooperatively (*vs.* competitively). Finally, engagement with cooperative game features was associated with acting in line with the shared goals and collective commitments of a group (Morschheuser et al., 2017).

Even video games with violent content, when played cooperatively (*vs.* competitively or alone), resulted in lower accessibility of aggression-related thoughts (Schmierbach, 2010), lower aggressive behavior (Jerabeck & Ferguson, 2013), and greater cooperative behavior (Ewoldsen et al., 2012; Greitemeyer et al., 2012). Finally, playing a violent video game cooperatively with an outgroup (*vs.* ingroup) member was found to reduce prejudice toward members of that outgroup (Adachi et al., 2015).

2.2. Cooperative gaming in middle childhood and adolescence

There are relatively fewer studies investigating the social and affective correlates of cooperative video games in younger populations (El-Nasr et al., 2010; Gentile et al., 2009; Hanghøj et al., 2018; Verheijen et al., 2019). Research focusing on middle childhood and adolescence showed that exposure to games with prosocial content positively predicted self-reported social skills. In a sample of seventh- and eighth-graders in Singapore (mean age = 13), children who reported greater frequency of playing video games involving prosocial scenes (e.g., characters helping those in need) also reported engaging in greater helping behavior (Gentile et al., 2009, Study 1). Similarly, in samples of fifth-, eighth-, and eleventh-graders in Japan (mean ages = 11, 14, and 17, respectively), children whose favorite video games enabled helping other players reported greater helping, sharing, empathy, and emotional awareness in their everyday lives (Gentile et al., 2009, Study 2). Another study with children from grades 3 to 6 in Denmark (age range: 9–12) demonstrated that playing cooperative computer games increased teacher-assessed social participation compared with baseline measures, especially for students who were perceived by their teachers as at-risk due to social or academic difficulties (Hanghøj et al., 2018).

Although these studies speak to the benefits of cooperative gaming in middle childhood and adolescence, they did not investigate players' behaviors *during* gameplay—with two notable exceptions. One study asked groups of elementary school children from Canada (mean age = 10) to play video games varying in the degree of cooperation (El-Nasr et al., 2010). The findings showed that games that were richer in characteristics of cooperative play (such as complementary roles and shared goals) contributed to greater positive affect, joint decision-making, and helping during gameplay. However, the study did not compare cooperative games with their non-cooperative counterparts, leaving open the question of whether the observed effects were solely due to cooperative or some other (possibly unmeasured) game features. Another study used a between-participants experiment and randomly assigned seventh to tenth graders in the Netherlands (mean age = 15) to play either cooperative, competitive, or solitary versions of a racing game in friend dyads (Verheijen et al., 2019). In the cooperative condition, participants within a dyad assumed interdependent roles and competed against others, whereas in the competitive condition, they competed against each other. In the solitary condition, participants played the game independently of each other in isolation and were instructed not to communicate. Although there were no significant differences across conditions in post-game prosocial behavior, participants in the competitive (*vs.* solitary) condition reported lower friendship quality after playing the game. There was no corresponding increase in friendship quality for participants who played the game cooperatively. Importantly, participants gaming cooperatively (*vs.* competitively) demonstrated more positive behaviors during gameplay including helping and thanking, but also more negative behaviors as well as a greater power imbalance.

2.3. Present research

The present research aimed to contribute to the burgeoning literature on children's observed social behaviors during cooperative gameplay. We asked fifth graders in Turkey (age range: 10–12) to play cooperative and solitary versions of an otherwise identical mobile cooking game (in counterbalanced order) in groups consisting of their classmates. We focused on the gaming experience in the company of classmates because most in-person gaming in day-to-day life occurs with friends or acquaintances rather than complete strangers (Verheijen et al., 2019). Given that there is limited research investigating the effects of games played with known others, it is important to study the effects of cooperative games in groups of children who are previously acquainted.

We aimed to test whether the benefits of cooperative games would extend to *mobile* gaming because the relative ease of carrying mobile devices might make mobile games a more convenient tool for engaging in spontaneous cooperative gameplay in larger groups in daily life. A prior study observing and interviewing individuals who played multiplayer games revealed that mobile gaming offered both advantages and disadvantages for social interactions (Szentgyorgyi et al., 2008). On the one hand, mobile devices encouraged face-to-face seating configurations—as opposed to sitting next to one another in front of a screen as is typical of computer games. Mobile gaming also allowed players to move around more freely to interact with their peers—as opposed to sitting in the same spot as is typical of computer games. Face-to-face seating arrangements coupled with greater mobility have the potential to facilitate social exchanges during mobile gaming. On the other hand, in the same study, players also reported that the lack of a shared screen in mobile gaming might undermine the social aspect of the gaming experience. If players concentrate on their own devices and role in the game, "private gaming spheres" might emerge, which in turn might limit social exchanges. Mobile gaming also allowed players to sit at a greater distance from one another—as opposed to players squeezing next to one another in front of a shared computer screen. The cooperative cooking game designed for the present study prevented the emergence of private gaming spheres by creating complementary roles (cutting, mixing, sautéing, and reading aloud recipes) that required interacting with other players. The interdependent nature of cooperative gaming contributes to greater social engagement and game enjoyment, especially when players assume complementary roles (El-Nasr et al., 2010; Harris & Hancock, 2019). Additionally, interactions that required two screens to be in close proximity (e.g., transferring ingredients from one player's cutting board to another player's bowl) ensured physical proximity. Thus, we expected that the potential advantages of mobile gaming would outweigh the disadvantages when playing the cooperative game. The proposition that cooperative gaming allows reaping social-interactive benefits of mobile gaming without incurring its costs is also consistent with the General Learning Model (Buckley & Anderson, 2006) which suggests that playing cooperative games would increase positive social interactions during gameplay by increasing the accessibility of cooperation-related positive cognitions and feelings. Therefore, we predicted that:

Hypothesis 1: Children would engage in more social interactions when playing the cooperative (*vs.* solitary) mobile game.

The link between social interactions and children's positive affect is well-established. For instance, sharing and helping behaviors positively predict observer-rated behavioral displays of positive affect in early childhood (Aknin et al., 2012; Song et al., 2020) and visits with peers positively predict self- and parent-rated feelings of happiness in middle childhood (Holder & Coleman, 2009). However, to our knowledge, the benefits of cooperative gaming on children's positive affect have not been experimentally investigated. The General Learning Model (Buckley & Anderson, 2006) suggests that playing a cooperative game would be conducive to outward displays of positive affect during gameplay via cooperation-related positive cognitions and feelings. Therefore, we expected that:

Hypothesis 2: Children would display greater positive affect when playing the cooperative (*vs.* solitary) mobile game.

The within-participants design allowed us to study the effects of cooperative gaming while controlling for individual differences (as each participant acted as their own control) with high statistical power. But, more importantly, it enabled us to test whether children would prefer a cooperative mobile game over an otherwise identical solitary game. This question is of practical importance because regardless of the benefits of cooperative gameplay if children do not spontaneously prefer such games to their widely available solitary counterparts, potential benefits of cooperative mobile games may not materialize in day-to-day life. Because we asked children to play both game versions, we were able to assess not only how much they liked each game but also whether they preferred one type of game over the other. We predicted that:

Hypothesis 3: After playing both games, children would prefer the cooperative mobile game to the otherwise identical solitary game.

3. Method

Materials (including all questionnaires and behavioral coding instructions) and data are available on the Open Science Framework (OSF): https://osf.io/eap52/?view_only=61f0fe0da6a04dee909477fc9549f564.

3.1. Participants

We recruited 67 fifth-grade students whose parents consented to have their child participate in the study. Four children had to be dropped because they did not consent to participate in study sessions, leaving a final analytic sample of 63 children (23 females) aged 10–12 ($M = 10.951$, $SD = .498$). We focused on this age range because the benefits of cooperative play (outside of a videogaming context) were previously demonstrated for this age group (Garaigordobil, 2008).

Participants were divided into 16 groups to play cooperative and solitary versions of a cooking game in two different sessions. Groups had four members except for one group with three members. All participants completed Session 1, whereas in Session 2 five groups each had one missing member who was absent from school on the day of the session. Additional participant characteristics are provided in the Online Supplemental Materials (OSM). A power analysis using PINT 2.1 (Bosker et al., 2003) revealed that the current sample provided 80% power to detect an unstandardized association of .011, which 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 (see OSM for further details on power analysis).

3.2. Procedure

The study was approved by the Institutional Ethics Review Board of Middle East Technical University (approval number: 2016-SOS-047). To collect data in an elementary school, we obtained permission from the Research Department of the Ministry of Education in Turkey. Experimenters attended parent-teacher conferences and obtained written informed consent from participants' parents.

Participants were tested in the school's study room. Before gaming sessions, they were explained the procedures and provided verbal consent. Children in each classroom were randomly assigned to groups of four (except for one group including three children). Groups were composed of students who were classmates to ensure that all group members were previously acquainted.

Using a within-participants experimental design, each group played both the cooperative and the solitary version of the game using four identical iPad Air 2 tablets. We used a cooking game because cooking is an activity that may be completed either individually or cooperatively—making it possible to develop cooperative and solitary versions of the same game. The gaming sessions were counterbalanced and separated by a week to minimize carry-over effects (Copas et al., 2015). Group members remained the same in both gaming sessions (except for five groups that had a missing member in the second session; see the Participants section). The sessions were recorded using a handheld camera. In both the cooperative and the solitary sessions, children sat in a half-circle facing the camera so that they could see and interact with each other as they played the game (see Figure 1). However, they were allowed to leave their seats or change seating arrangements during the game so that we could observe the effects of game type on social behavior (see the project OSF page for verbatim instructions delivered to children).

3.2.1. Cooking game

Following past work that developed a new game for specific research purposes (e.g., see Chang et al., 2016; Gennari et al., 2017), the cooking game was developed for the present study to investigate the effects of cooperative (*vs.* solitary) mobile gaming on children's social behaviors and positive affect. Unity game engine technology was used due to the wide range of assets available to assist in game development (e.g., the code for cutting 3D ingredients using players' finger movements). The core game mechanics and software development incorporated the phases of creating a game design document, prototyping, Unified Modeling Language (UML) based software architecture design, and agile development. To allow players to interact in real time, Unity's networking technology (a set of code libraries allowing multiple players to connect to a common game from different devices) was modified for transferring the ingredient geometry information across multiple devices. Device-specific libraries were accessed to incorporate additional input types, such as tilting the mobile devices to roll 3D objects. Deployment packages were generated for both Android and iOS devices. The final stage, before deployment on the Android and iOS, was an extensive quality assurance (Q/A) period in which the following elements were tested: (a) User interface and user experience (UI/UX) performance, (b) network stress testing, (c) various player join/quit scenarios, and (d) general playability. These tests were conducted by non-technical personnel who played the game across multiple device configurations (different combinations of mobile phones and tablets) and provided feedback to the development team. Examples of changes following the Q/A period included: (a) fixing timing-related code to ensure all players were accessing the same game state, (b) changing the size and positions of user interface elements (e.g., buttons) to limit accidental presses, and (c) implementing fallback code to keep the game from crashing if a player loses Wi-Fi connection.

The game required players to cut up, combine, mix, and sauté ingredients to complete predefined recipes (restaurant orders) as accurately as possible. To prepare each recipe, children were expected to find the necessary ingredients from the refrigerator and cook them in accordance with the recipe. The game did not use common game interfaces (such as a virtual joystick) in favor of interactions that share a resemblance to real-world food preparation. For example, dragging one finger along the ingredients on the screen without breaking contact translated into precise cuts; tilting the mobile device resulted in prepared ingredients rolling into virtual bowls or pans. Physical movements during gameplay may contribute to greater social interaction and expressiveness without reducing engagement (Lindley et al., 2008). The gameplay did not rely on timing-based challenges but instead on finding the correct ingredients, carrying out

Figure 1. Demonstration of the game setting. *Note.* The game setting was identical in the cooperative and solitary versions.

efficient preparation routines, and representing tactile elements of cooking on a digital platform.

Game mechanics, recipes, and preparation steps were identical for the cooperative and solitary versions of the game. The only difference was the lack of cooperation in the solitary version like many restaurant games available on app stores. In the solitary version, children prepared orders on their own in the presence of their peers who also played the game in the same room. They could navigate between different segments of the game (e.g., cutting board, cooking station; see Figure 2) to complete the orders. We did not instruct children to refrain from interacting with their peers in this version to increase the ecological validity of the findings. When children play a solitary mobile game on their tablet in the presence of their peers in daily life, they are free to speak with each other and interact. The solitary game in the current research was designed to mimic that experience. This constitutes a conservative control as we did not limit social interactions that might take place during solitary gaming.

In the cooperative version, children had to assume collaborative interdependent roles (cutting, mixing, sautéing, and reading aloud recipes) and division of labor to successfully complete the order. For example, ingredients had to be passed on to other players (i.e., Player 1 cuts the vegetables but transfers them to Player 2 for mixing, who then passes them to Player 3 for sauteing). The infrastructure of the cooperative game allowed mobile devices to communicate so that each tablet served as a particular segment of the gaming environment (see Figure 2). Players could choose any role in the cooking process, such as cutting, sauteing, or reading aloud recipes, and switch roles during gameplay if they wanted to.

All groups received the same number of orders in both conditions. Game duration depended on children's pace in preparing recipes. In the cooperative version, the gaming session was video recorded until children completed all orders as a group. The solitary session was recorded until one child in the group completed all orders, due to two primary reasons: (1) Children who completed the solitary game left the group to complete self-report measures about the game, reducing the size of the group and thereby diminishing social interaction potential. (2) Adopting this decision rule helped keep the duration of cooperative and solitary gaming sessions more similar for coding purposes. Even after we stopped recording, we allowed all children in the solitary session to complete their orders individually so that they had a complete experience of the cooking game before answering questions about it.

After playing each game, children were asked to fill out a questionnaire about their evaluation of the game. At the end of the second session, children were verbally asked which of the two games they preferred. After data collection was completed, two independent coders who were blind to research hypotheses coded children's behaviors during gameplay.

3.3. Measures

Means, standard deviations, and reliability of measures are provided in Supplemental Table 1 in the OSM.

3.3.1. Behaviors during gameplay

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), a video annotation software

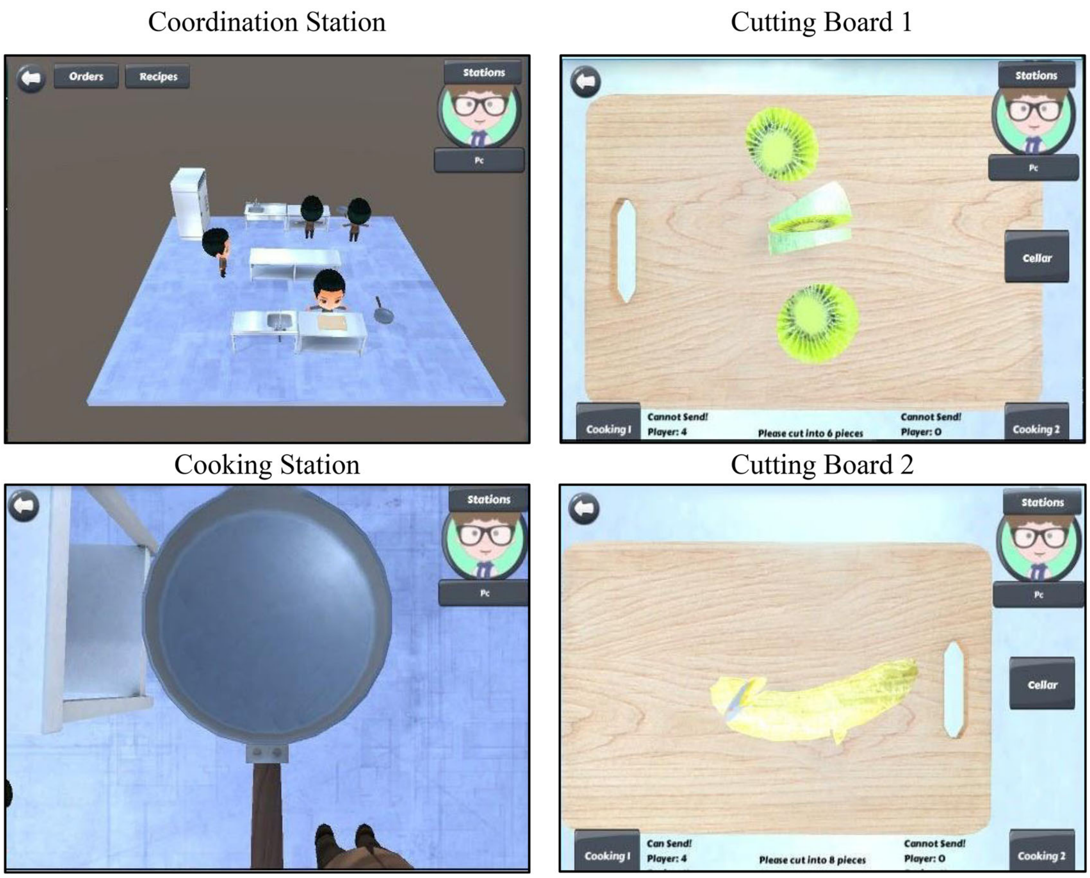

Figure 2. Segments of the gaming environment.

(Lausberg & Sloetjes, 2009). The play literature showed the benefits of cooperative play (outside of a videogaming context) for improving social skills (such as communication and prosocial behavior) and socio-affective relations in children (e.g., Garaigordobil, 2008; Garaigordobil et al., 1996). Based on this work, the present research investigated behaviors that tapped into the social and affective reactions of children. Target behaviors were positive affect, positive and neutral conversation, seeking help, and receiving solicited and unsolicited help.

The duration of recordings ranged from 5.00 to 13.85 min (cooperative version, $M = 8.51$ min, $SD = 2.10$ min; solitary version, $M = 10$ min, $SD = 2.08$ min; $t(15) = 2.328$, $p = .034$, 95% CI for the mean difference [0.121, 2.845]). Given that the solitary version on average took longer than the cooperative version and that the probability of observing a given behavior might increase for longer recordings, we wanted to adjust for the duration of recordings. Therefore, indices of each behavior were calculated by dividing the total duration of the target behavior during each gaming session (cooperative *vs.* solitary) by the duration of the session's video recording. (The pattern of results remained the same when analyses were conducted for each behavioral index without adjusting for the total duration of the session's video recordings.) Receiving solicited and unsolicited help were highly skewed. To reduce skewness, we winsorized values that were 2 *SD*s above the mean by replacing them with the next highest value before analyzing the data.

3.3.1.1. Positive conversation. The duration with which children had conversations of positive valence with other players was coded (e.g., making jokes, commenting on how well their team did).

3.3.1.2. Neutral conversation. The duration with which children had conversations of neutral valence with other players was coded (e.g., commenting on game mechanics).

3.3.1.3. Seeking help. The duration with which children sought help from their peers was coded. Examples include asking peers how to complete game tasks (e.g., asking other players how to open order screens or where the correct ingredients are) and checking with peers before completing certain actions (e.g., asking a peer whether it is the right time to put the tomatoes in the pan).

3.3.1.4. Receiving solicited help. The duration with which children received help from their peers following bids for help was coded (e.g., After a player asks where an ingredient is, another player shows the ingredient's location in the fridge).

3.3.1.5. Receiving unsolicited help. The duration with which children spontaneously received help from their peers despite not actively seeking help was coded (e.g., Although the player did not ask, a peer spontaneously shows the player how to cut vegetables).

3.3.1.6. Positive affect. The duration with which children displayed positive affect (e.g., giggles, smiles, laughs) was coded.

3.3.2. Self-report measures

3.3.2.1. Game preference. After they finished playing both versions of the game, children were asked "*When you consider both games you have played, which one do you prefer?*" The experimenter recorded whether children preferred the cooperative or solitary game. Children who did not indicate a preference for either game were coded as undecided.

3.3.2.2. Game evaluation. Right after each gaming session, children answered five questions assessing how they evaluated the game on a 4-point Likert scale with 0 representing the most negative and 3 representing the most positive evaluation (e.g., 0 = *Disliked very much* to 3 = *Liked very much*). The questions were "*How much did you like the cooking game you have just played?*", "*How fun was the cooking game you have just played?*", "*Would you like to play once again the cooking game you have just played?*", "*If you had free time at home, would you want to play the cooking game you have just played?*", and "*When you meet with your friends, would you want to play the cooking game you have just played?*". The items were averaged for each condition to index evaluation of the cooperative and solitary versions.

3.3.2.3. Demographics. Children reported their year of birth and gender (0 = *female*, 1 = *male*) as well as their gaming habits (described in the OSM).

4. Results

Correlations between measures are provided in Supplemental Table 2 in the OSM.

4.1. Behaviors during gameplay

Given children were nested within groups, we conducted our analyses using multilevel modeling (see OSM for further details on the data analytic strategy). Supporting Hypothesis 1, children engaged in greater positive and neutral conversations when playing the cooperative (*vs.* solitary) mobile game, $\gamma_{10} = .030$, $SE = .003$, $p < .001$, 95% CI [.024, .036] and $\gamma_{10} = .154$, $SE = .015$, $p < .001$, 95% CI [.124, .184], respectively. Moreover, children sought greater help from their peers, $\gamma_{10} = .016$, $SE = .003$, $p < .001$, 95% CI [.010, .022], and received greater unsolicited and solicited help during cooperative (*vs.* solitary) gaming, $\gamma_{10} = .008$, $SE = .001$, $p < .001$, 95% CI [.006, .010] and $\gamma_{10} = .006$, $SE = .003$, $p = .034$, 95% CI [.0001, .012].

Supporting Hypothesis 2, children displayed greater positive affect when playing the cooperative (*vs.* solitary) mobile game, $\gamma_{10} = .043$, $SE = .006$, $p < .001$, 95% CI [.031, .055].

4.2. Game preference after playing both games

The majority of children (65%, $n = 41$) preferred the cooperative version, whereas only 16% (n = 10) preferred the solitary version and 11% ($n = 7$) remained undecided. (Five children did not have data on game preference due to not attending the second session.) We first tested for differences in game preferences by excluding undecided children and compared preference for the cooperative game against the preference for the solitary game. In line with Hypothesis 3, this analysis revealed that after playing both games, children had significantly higher odds of preferring the cooperative over the solitary game, $\gamma_{00} = 1.844$, $SE = .606$, $p = .008$, 95% CI [.644, 2.044]. Next, we performed a more conservative test by combining children who preferred the solitary game with those who remained undecided. This analysis yielded the same conclusion: After playing both games, the odds of preferring the cooperative game were greater than those of preferring the solitary game or remaining undecided $\gamma_{00} = .936$, $SE = .364$, $p = .021$, 95% CI [.223, 1.650].

4.3. Self-reports after each session

We examined whether the game version predicted how children evaluated the game that they have just played. Although children evaluated the cooperative (*vs.* solitary) game more positively, this difference failed to reach significance, $\gamma_{10} = .199$, $SE = .113$, $p = .081$, 95% CI [−.025, .423].

In analyses reported in the OSM, we also explored whether the effects of game version on social behaviors, positive affect, game preference, or self-reported game evaluation were moderated by gender, order (playing the solitary game first *vs.* the cooperative game first), or gaming experience (daily time spent playing video games). None of these factors consistently moderated the effects of game version (except a significant interaction between game version and gender in predicting positive affect and a significant interaction between game version and order in predicting seeking help as reported in the OSM).

5. Discussion

The current study examined for the first time how a mobile game that requires cooperation (as opposed to a non-cooperative solitary mobile game) influences social behaviors and positive affect during gameplay in middle childhood. Our design had several strengths: (1) We asked children to engage in cooperative gaming using tablets, enabling us to experimentally test whether the benefits of cooperative gaming generalize to a mobile gaming context. (2) Children played games in groups consisting of their classmates, enabling us to investigate the effects of cooperative mobile games in the context of known others, with whom most in-person gaming in daily life occurs. (3) We focused on player behaviors and affect during cooperative *vs.* solitary gaming, which received relatively less research attention. (4) Our within-participants design enabled us to compare behaviors of the same players as they experienced both cooperative and solitary versions of the same game and to test a question with practical implications—whether children would prefer a cooperative mobile game to an otherwise identical solitary game after playing both.

Consistent with extant empirical work on behaviors of youth during cooperative gameplay (El-Nasr et al., 2010; Verheijen et al., 2019), our observations during gameplay indicated that children who played a cooperative (*vs.* solitary) mobile game in groups engaged in more social interactions (Hypothesis 1) and displayed greater positive affect (Hypothesis 2). These findings suggest that engaging in cooperative mobile gaming might positively contribute to social skills and well-being in middle childhood. We also found that most children preferred a cooperative mobile game to an otherwise identical solitary game after playing both games (Hypothesis 3). Although children's self-reports after each gaming session indicated that they evaluated the cooperative game more positively than the solitary game, this trend failed to reach significance. These findings suggest that fully appreciating the value of cooperative gaming might require contrasting both game versions before arriving at a clear preference.

5.1. Theoretical contributions

Our findings are consistent with the General Learning Model (Buckley & Anderson, 2006), which suggests that cooperative gaming would reinforce cooperation-relevant behavior and affect—in our case social interaction and positive affective displays. The present study extends empirical work testing this framework in two different ways: First, we demonstrated the wide range of social behaviors that might transpire during cooperative gaming. Specifically, children engaged in more positive and neutral conversations, sought more help, and received more solicited and unsolicited help from peers during cooperative (*vs.* solitary) gaming. Second, our study addressed the lack of empirical work in children testing the General Learning Model prediction that playing a cooperative (*vs.* solitary) mobile game would result in greater positive affective displays. Specifically, we showed that children giggled, laughed, and smiled more when playing a cooperative (*vs.* solitary) mobile game. This finding is also consistent with the known role of social interactions and prosocial behavior in well-being of adults (e.g., Gunaydin et al., 2021) and children (e.g., Aknin et al., 2012).

The General Learning Model also suggests that repeated engagement with cooperative gaming might reinforce relevant cognitions, affect, and behaviors, which in turn might give rise to lasting positive behavioral changes in the long-run. Therefore, one interesting avenue for future research is to investigate how long the benefits of cooperative mobile gaming demonstrated in the current study would last and whether playing cooperative mobile games repeatedly might lead to lasting positive changes in children's social behavior and affect.

5.3. Practical implications

Our findings suggest that designing mobile games that children can play cooperatively with their peers in the same physical space has the potential to increase social interaction and positive affect during gameplay. Such games might be used in schools to facilitate social interactions between classmates or might be made commercially available for use during children's leisure time. Given our findings showed that children preferred the cooperative game to the solitary game after playing both, children might be willing to play these games in their everyday lives, which might make it easier to see lasting benefits of cooperative mobile gaming in the long-run.

Although the game designed for the current research did not have an educational component, our findings might have implications for educational apps. A crucial component of educational apps that supports children's learning has been identified as social interaction (Hirsh-Pasek et al., 2015). Our findings imply that incorporating collaborative features in educational apps might help support learning by facilitating social interaction. Future work should experimentally compare cooperative *vs.* solitary educational apps to see if the social and affective benefits observed in the current study generalize to educational games.

6. Limitations and conclusions

A limitation of the current study is the lack of repeated assessments of children's cooperative gameplay. If children play cooperative games repeatedly, this might contribute to long-term improvement in their social skills and well-being. Future studies should employ longitudinal designs in which children play cooperative games and report their gaming experience in multiple sessions over time. Including follow-up assessments of social skills and subjective well-being in these studies might help understand whether cooperative gaming has lasting benefits.

Although it is an important contribution of the current work to show the social and affective benefits of cooperative games played with known others, we did not measure how emotionally close children felt to other players in their group. Given the known role of close relationships in well-being across the lifespan (e.g., Holder & Coleman, 2009; Selcuk et al., 2016; Tasfiliz et al., 2018; Yang et al., 2016), cooperative gaming might yield even greater benefits in groups consisting of close others. Future work can test this possibility by measuring the emotional closeness of children who play cooperative games together.

Given that the current study focused on children aged between 10 and 12 years, it remains an open question whether our findings generalize to younger populations. Children in this age range have the necessary skills to readily engage in social interaction and cooperative play (Manning, 2021), which might have made it easier to observe the benefits of cooperative gaming in our sample. Therefore, an important direction for future work is to study the consequences of cooperative gaming in younger children.

Despite these limitations, the current investigation is the first to show in a mobile gaming context that playing cooperative games is conducive to social interactions and positive affective displays in middle childhood. Our findings contribute to the burgeoning literature examining how cooperative gaming influences children's behavior during gameplay.

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Disclosure statement

We declare one conflict of interest that did not affect the content of the article or authorship order: Yavuz Eren owns shares in JeoIT, which developed the infrastructure of the cooperative game that allowed mobile devices to communicate. JeoIT may use a similar infrastructure in future commercial apps.

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