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BASIC PSYCHOLOGICAL NEEDS OF 10–13-YEAR-OLDS IN OFFLINE COOPERATIVE VIDEO GAMES

ABSTRACT

Susanna Haapaniemi: Basic psychological needs of 10–13-year-olds in offline cooperative
video games
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The aim of this study was to examine how two cooperative games with different levels of social interdependence affect players' satisfaction and frustration of basic psychological needs and communication satisfaction. The study is based on Self-Determination Theory (SDT). It was hypothesized that the low interdependence game would better support players' needs for autonomy and competence, while the high interdependence game would increase communication satisfaction and relatedness satisfaction but also increase need frustration.

The study involved 51 children (41 boys, 10 girls) aged 10–13 years. Participants played two cooperative games, one with high and one with low interdependence, and completed questionnaires after each game situation. The questionnaires measured the players' satisfaction and frustration of basic psychological needs and communication satisfaction.

The results showed no statistically significant differences between the games in terms of players' satisfaction of autonomy and competence needs. Only relatedness satisfaction was higher in the high interdependence game, but the effect size was small. There were no significant differences in autonomy frustration or relatedness frustration between the games, but players experienced more competence frustration in the low interdependence game, possibly due to challenges regarding game controller. Communication satisfaction did not differ significantly between the games, but game order influenced satisfaction, with higher satisfaction for the second game played.

The study highlights the important role of easy-to-use game controllers and the potential of cooperative games to support positive peer relationships. Future research should combine more diverse research methods, such as observations and interviews, and larger sample sizes. The study provides valuable insights for game developers and future research, particularly regarding the impact of game controllers and gaming order on players' experiences.

Keywords: digital games, cooperative games, social interdependence, basic psychological needs, communication, children's and adolescents' peer relationships

The originality of this thesis has been checked using the Turnitin Originality Check service.

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Contents

INTRODUCTION

Peer relationships and the experience of belonging to a group play an important role in children's development and well-being. Positive peer relationships can support adolescents' development, learning, and school achievement (Shao & Kang, 2022; Wang et al., 2018), while problems in peer relationships have been found to be a risk for developing internal and external problems (Shin et al., 2016). In addition, lack of peer relationships, social isolation, and ostracism in early adolescence have been found to predispose to a range of physical and mental health problems and can negatively impact cognitive functioning and academic performance (Nida & Williams, 2017). Longitudinal studies have found that socially inactive leisure time during adolescence is a risk factor for later psychiatric morbidity, whereas socially active leisure time is associated with better mental health in adulthood (Timonen et al., 2023). Compatibly, an increase in the child's perceived social competence predicted decrease in the ostracism and child's internal problems (Sakız et al., 2021). Therefore, it is important to support the development of children's social skills and positive peer relationships.

Children and adolescents' social interactions are increasingly occurring in the digital world, with many spending a significant portion of their free time playing digital games. For example, in Finland, the Pelaajabarometri 2022 survey found that 76.2 percent of respondents aged 10–19 reported playing some entertainment game at least once a week (Kinnunen et al., 2022). Since shared fun can further develop a sense of commitment (Fine & Corte, 2017), playing together can increase the sense of belonging. Consequently, cooperative offline video games can provide a pleasant environment for children to practice social skills and form positive face-to-face peer relationships. Games requiring high interdependence among players have been found to increase player communication (Depping & Mandryk, 2017). However, these games can also present challenges, such as frustration, performance pressure, or conflicts, especially when players have different skill levels or motivations (Schmierbach et al., 2012; Verheijen et al., 2019).

This study aims to deepen our understanding of how playing cooperative games influences young players' communications and the satisfaction of their basic psychological needs – autonomy, competence, and relatedness – which have been shown to be associated with improved well-being and social relationships (Ryan & Deci, 2017). We use

Self-Determination Theory (SDT, Deci & Ryan, 2000; Ryan & Deci, 2017) as our theoretical framework due to its wide recognition and extensive use in research on motivation and well-being. SDT provides a comprehensive understanding of how basic psychological needs can be supported or thwarted in various contexts, including games.

We study two offline cooperation video games with different levels of social interdependence. Our aim is to explore how high and low interdependence games affect players' experiences and how these games can support or thwart the satisfaction of basic psychological needs. The participants aged 10-13 will play both games, allowing us to account for individual differences and compare the impact of high and low interdependence games on players' basic psychological needs satisfaction. This study provides valuable insights for game designers and educators who aim to harness the potential of cooperative games to support the positive development of children and adolescents.

Basic psychological needs and digital games

Researchers have often used Self-Determination Theory (SDT) and its mini-theories, such as Basic Psychological Needs Theory (BPNT), as a theoretical framework when investigating game experiences and elements that support players' well-being (Tyack & Mekler, 2024). SDT (Deci & Ryan, 2000; Ryan & Deci, 2017) describes humans as inherently active beings and seeks to explain how people are motivated, how various internal and external factors influence people's desire to achieve goals, and how this process can lead to deeper contentment and meaning in life. According to SDT, people have three innate, universal basic psychological needs: autonomy, competence, and relatedness. Autonomy is the experience of being able to make one's own decisions and act according to one's own values and interests. Competence is the sense of being able to influence and achieve one's goals. Relatedness is the feeling of mutual care and respect and the experience of meaningful connections with other people and communities. Activities in which the individual has a sense of autonomy, competence, and relatedness are perceived as more intrinsically motivating. BPNT is one of the six mini-theories of SDT and states that the satisfaction of these basic needs is essential for human flourishing, well-being, and development (Ryan & Deci, 2017). When basic psychological needs are met, individuals experience pleasure and improved well-being, whereas activities and contexts that prevent these needs from being met negatively affect well-being (Ryan & Deci, 2017).

The satisfaction of basic psychological needs in the context of video games is central to what makes video games enjoyable and appealing (Ryan et al., 2006). Video games are usually played voluntarily, so players have a high degree of autonomy by default, but games vary in how much autonomy they allow, for example, through flexible game features, strategies, and choices (Peng et al., 2012; Ryan et al., 2006). The need for competence in video games is satisfied by the player encountering appropriate levels of challenge, acquiring new skills, and experiencing success (Peng et al., 2012; Ryan et al., 2006). Additionally, Ryan et al. (2006) argue that intuitive and manageable game mechanics are essential for a sense of competence and autonomy, so that the player feels to be in control of the game. Multiplayer games provide opportunities for social interaction and relationship building with other players, which can increase feelings of relatedness, and games with social elements such as competition or teamwork can help satisfy players' need for relatedness (Reer & Krämer, 2020; Ryan et al., 2006).

In the context of video games, several studies have found that the satisfaction of basic psychological needs is associated with positive effects, at least in the short term, such as enjoyment, improved mood, and well-being (e.g. Allen & Anderson, 2018; Fernandez de Henestrosa et al., 2023; Formosa et al., 2022; Liu et al., 2024; Noon et al., 2024). For example, in Italy, during the restrictions associated with the Covid-19 pandemic, online gaming may have alleviated emotional distress by satisfying the need for relatedness during the isolation (Giardina et al., 2021). Furthermore, in a study by Shoshani and Krauskopf (2021), the satisfaction of competence and relatedness needs in Fortnite was positively associated with children's prosocial behavior. By understanding how video games may fulfill the basic psychological needs, game experiences can be designed to support individuals' growth, development, and overall well-being.

BPNT treats need satisfaction and need frustration as separate, asymmetrically related constructs, where frustration involves an active thwarting of psychological needs, creating a more intense and threatening experience than mere absence of need satisfaction (Ryan & Deci, 2017; Vansteenkiste et al., 2020). According to Vansteenkiste et al. (2020), autonomy frustration refers to feeling pressured and controlled, experiencing conflict, and being pushed in an unwanted direction, with actions misaligned with the authentic self. Competence frustration relates to feeling incapable, ineffective, or failing and helpless. Relatedness frustration refers to the experience of social alienation, exclusion, ostracism, and loneliness. Need frustration can undermine an individual's motivation, commitment, and psychosocial well-being (Vansteenkiste et al., 2020).

In video games, need frustration is a salient experience (Allen & Anderson, 2018; Kosa & Uysal, 2022). A study by Phillips et al. (2024) found that specific game mechanics can lead to feelings of autonomy frustration as early as five minutes into a game session. In addition, Ballou and Deterding (2023) found that players could easily recall game situations in which they had experienced frustration of autonomy, competence, or relatedness, and that these experiences influenced their subsequent game behavior and engagement. Experiences of need frustration in games can be associated with strong negative affective reactions such as aggression (Przybylski et al., 2014), the desire to quit the game, and problem gambling (Allen & Anderson, 2018; Kosa & Uysal, 2022; Pusey et al., 2022).

Most game studies based on SDT have focused on single-player games or online multiplayer games. However, it has been suggested that playing together in the same physical space may better fulfill the need for relatedness than playing together online, possibly due to more immediate and richer social interactions (Reer & Krämer, 2020). On the other hand, while multiplayer games can support relatedness, some studies have shown that the presence of others in the game, or physical proximity can negatively affect players' autonomy (Ballou & Deterding, 2023; Vella et al., 2015). However, one of SDT's mini-theories, Relationships Motivation Theory (RMT), emphasizes that although the satisfaction of the need for relatedness predicts people's experiences of relationships satisfaction or social well-being, flourishing relationships also require the satisfaction of the need for autonomy and competence within those relationships (Deci & Ryan, 2014). Furthermore, many studies of offline multiplayer games have focused on pairs (e.g., Depping & Mandryk, 2017; Emmerich & Masuch, 2017; Verheijen et al., 2019), while games involving more than two players have been less studied. This study aims to fill these gaps by examining how offline multiplayer games played in groups of 6-8 players affect 10–13-year-old players' experience of autonomy, competence, and relatedness. Ultimately, this study aims to provide insights into the broader effects on players' well-being and social interactions.

Cooperative games and social interdependence

When the goal is to build group cohesion, teamwork skills, interaction, and prosocial behaviors, cooperative games are frequently suggested as effective game mechanics (Depping et al., 2018; Farah et al., 2022; Zheng et al., 2021). Cooperative games (co-op games)

are often described as games in which two or more players work together to achieve a common goal (Depping & Mandryk, 2017). The term 'collaborative game' is also used in various contexts and often has the same meaning (Gonçalves et al., 2023). In contrast, competitive games are characterized by players having opposing or at least separate goals (Depping & Mandryk, 2017).

In addition to cooperation, social interdependence is another mechanism used to support social relationships, relatedness, and interaction (Depping & Mandryk, 2017). Social interdependence is defined as the condition in which the outcomes of individuals are affected by the actions of others (Johnson & Johnson, 2005). In games with low interdependence, a single player could theoretically finish the game alone. In games with high interdependence, this is not possible because players must interact and cooperate to progress toward their objective. According to Social Interdependence Theory, interdependence is beneficial because it compels people to communicate with each other (Johnson & Johnson, 2005). Research has shown that the positive effect of interdependence on social bonds in games is mediated by increased communication among players (Depping & Mandryk, 2017; Emmerich & Masuch, 2017). In this study, we examine two cooperative multiplayer games that differ in their degree of interdependence and determine whether this affects players' communication satisfaction.

While high interdependence compels players to interact, communicate, and negotiate to achieve their objectives, it can also lead to frustration and performance pressure. Players may feel unable to influence the game when achieving an objective depends on the actions of other players. In a study by Schmierbach et al. (2012), pairs did not find a cooperative game as enjoyable as a competitive one. They suggested that this may be due to the interdependence required in a cooperative game, where the success of one player depends on the performance of another. Players may have felt a lack of control over the game, which could have led to increased conflict (Schmierbach et al., 2012). Similarly, Verheijen et al. (2019) found that while a cooperation game promoted positive interactions, it also increased frustration between players. In particular, high level of interdependence can be frustrating and discouraging when players have different skill levels, and this can subsequently reduce relationship quality and prosocial behavior (Schmierbach et al., 2012; Verheijen et al., 2019).

From the SDT perspective, cooperative multiplayer games with high interdependence may not support the need for autonomy, as they involve pressure to behave in ways expected by others. Multiplayer games with high interdependence may thwart the need

for autonomy and competence if the actions of others prevent the achievement of one's own objectives. Although the BPNT states that support for all basic psychological needs is important for need satisfaction, social contexts that support autonomy have been found to impact all three basic psychological needs (Vansteenkiste et al., 2020). It is important to note that the concept of autonomy within SDT is not incompatible with interdependence, but according to SDT, it is essential that people experience freedom of choice, willingness, and personal approval for their actions (Deci et al., 2006). High-quality relationships, as described by RMT, fulfill the need for relatedness by providing non-contingent care, valuing individuals for their own sake, and supporting their autonomy (Deci & Ryan, 2014). This study examines the impact of offline cooperative multiplayer games on the autonomy, competence, and relatedness needs of 10-13-year-old players.

The current study

This study examines the impact of interdependence in cooperative multiplayer games on players' basic psychological need satisfaction, frustration, and communication satisfaction. We study two cooperative multiplayer games: one with a higher degree of interdependence and one with a lower degree. Both games are played offline, i.e. physically in the same room on the same screen, and in groups of 6-8 players.

In line with Social Interdependence Theory (Johnson & Johnson, 2005), several studies (e.g., Depping & Mandryk, 2017; Emmerich & Masuch, 2017) have confirmed that higher interdependence compels players to communicate more, thereby increasing relatedness between them. We therefore hypothesize that players will experience greater communication satisfaction and relatedness satisfaction in the higher interdependence game than in the lower interdependence game.

We also hypothesize that a game with lower interdependence will better support players' need for autonomy and competence. When a player's performance does not depend on others failing or outperforming them, they may feel freer to choose their actions and game strategy more autonomously. Lower interdependence may also allow players of different skill levels to experience a sense of success and satisfy their need for competence.

Furthermore, we hypothesize that higher interdependence in games may lead to more experiences of need frustration. For example, in a high interdependence game, if one of the group members does not perform as required, the group cannot succeed. If one

player acts against the common objective, it can actively thwart the feeling of autonomy. Similarly, if someone in the group prefers to act alone rather than work toward the common objective, it can lead to negative interactions and blame, such as "Who jumped on the spikes?", which thwarts the sense of relatedness. Likewise, if a player is subjected to commanding or reprimanding comments from others, this can threaten their sense of competence.

We also investigate whether players' gender and previous gaming experience or ease of use of the game controller affect the satisfaction of players' basic psychological needs and communication satisfaction in these games. We do not make specific hypotheses regarding these aspects. We also consider the possibility that the order in which the games are played may have an effect, and therefore examine its potential influence on the gaming experience.

METHOD

Participants

The study was conducted in Tampere, Finland, in May 2024. Participants were recruited through local social media advertisements. Volunteers for the study were sought among 10–13-year-olds. Guardians enrolled their children in the study and provided consent for their participation.

A total of 53 volunteers participated in the study (43 boys, 10 girls). The average age of the participants was 11.97 years (range = 9.92-13.37 years). Responses from two participants were excluded from the analyses due to unreliable response styles, such as unclear entries and multiple responses to the same item. Consequently, the final analysis included 51 participants (41 boys, 10 girls).

Games

In this study, we compared two cooperation games, one with higher interdependence and one with lower interdependence. Previous studies have evaluated the effects of interdependence and cooperation using simple games, specifically created for experiments, allowing researchers to manipulate game mechanics, such as the level of interdependence

(Depping & Mandryk, 2017; Emmerich & Masuch, 2017). Although this approach minimizes confounding factors, it may feel simplistic and artificial to players, potentially affecting the ecological validity of the findings. Verheijen et al. (2019) used the racing game *Mario Kart: Double Dash!!* in both competitive and cooperative modes. While *Mario Kart* was originally developed as a competitive game, and the co-op mode might not fully capture the cooperative experience, it still provides valuable insights. To build on this, we chose to study two cooperative games, each specifically designed with different levels of interdependence. Additionally, we aimed to select nonviolent games suitable for children. We wanted children to play the game in small groups. However, most offline co-op games allow only up to four players. Therefore, we selected two games that could be played by eight players simultaneously on the same screen: *Pico Park* (high interdependence) and *Wondershop games* (low interdependence).

Pico Park, developed and published by TECOPARK (2016), is a commercially available local cooperative multiplayer side-scrolling platform action-puzzle game for 2 to 8 players (Figure 1). Pico Park features multiple levels where players must cooperate to obtain a key and exit through a locked door. The game requires the efforts of all players to progress through each level. In this study, a Nintendo Switch console was used, with each player using a wireless controller to control their pixel art cat character. The characters were of different colors, and all played simultaneously on a 65" screen. In this study, Pico Park represents a high-interdependence game, as players must act in a specific way for the group to progress. If one member of the group does not succeed in the required actions, the group cannot progress.
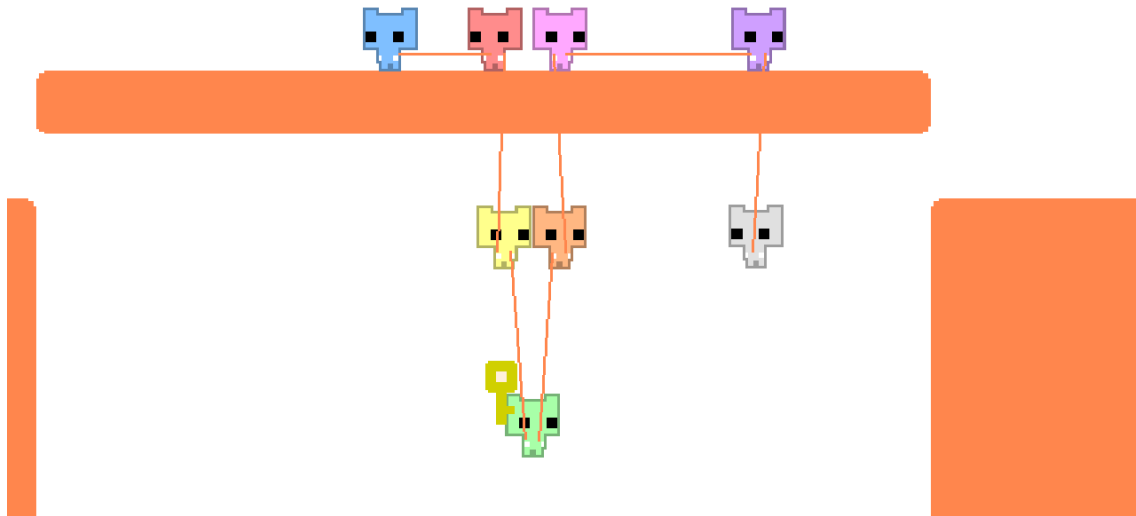
Figure 1. Pico Park represents a high interdependence cooperative game. This figure shows a game level where eight players are playing simultaneously. Each player controls their own cat character, and players must cooperate to obtain a key that allows them to unlock a door and complete the level. In this example, the characters are connected to each other by a stretchy rope, but the tasks vary across different levels. (Figure source: Tecopark, 2025)

Wondershop Games**,** currently in development by Wondershop and played in game clubs in 2024, is a local cooperative multiplayer game for up to 8 players, played simultaneously on a TV screen through a standalone console (Figure 2). Players use a wireless controller, Play-Tag, which has a touchpad for character movement and a single button for actions. Wondershop Games includes several minigames, which players select to play one at a time through a lottery-based voting mechanism. Players play as a team, scoring points in various ways, such as shooting zombies in the Mall of the Zombie minigame, treating injured teammates, or collecting items from the shop. In the Pizza minigame, points are earned by making pizzas for customers, serving customers, cleaning up the restaurant, or catching thieves. Before each minigame starts, the game draws roles for each player (e.g., captain, striker, healer), but players are free to perform any role during the game. To pass a level, the team must complete the specified tasks within a given time (e.g., collecting a certain number of items or stunning zombies), and the tasks become more difficult as the level progresses. After each minigame, the game offers humorous praise to each player in turn, after which players can vote for a new minigame.

Figure 2. Wondershop Games represents a low interdependence cooperative game. This figure shows one of the Wondershop Games minigames: Mall of the Zombie, where eight players are playing simultaneously. Players can name their characters in advance, so instead of "Player 1-8" texts, the character names are displayed. In the "Mall of the Zombie" minigame, players are in a shopping mall, blowing up zombies, collecting items, and healing injured teammates. (Figure source: Wondershop Games, 2024)

In this study, Wondershop Games represents a low-interdependence cooperative game. Although players work together towards the same objective, they have the flexibility to switch roles and choose different strategies. The game rewards helping teammates, but performance is not dependent on any single player. Thus, the game can be played at different skill levels, allowing players to choose between more difficult tasks (e.g., destroying zombies) and easier tasks (e.g., collecting objects). In this study, we used a game version where players first customized their game characters on their computers before moving in front of a shared 65" screen. They were shown a short intro to practice the controls and then had a choice of three minigames: Mall of the Zombie, Pizza, and Gem Raiders.

Procedure

At the time of registration, the participants' guardians selected one of the four possible dates for the study. Upon arrival at the research site, participants were introduced to the study and then randomly assigned to one of two groups (A or B). Over the four days, there were therefore a total of eight groups, each consisting of 6-8 participants, including

0 to 3 girls and 3 to 7 boys. Most participants were unfamiliar with the others in their group.

Group A began by playing Pico Park for 35-40 minutes. All participants sat in front of a 65" screen, playing the game on a Nintendo Switch console. The researcher initiated the game and passively observed the gameplay. After the game, the participants filled out a paper questionnaire. A break of approximately 15 minutes followed.

After the break, group A played Wondershop Games. Initially, the participants used computers to modify their characters (less than 5 minutes), then the game was played on a 65" screen simultaneously for about 35-40 minutes, including a brief introduction to practice the controls. The researcher translated the game texts and instructions into Finnish and answered questions, if necessary, otherwise passively observed the game. After the game, the participants filled out a paper questionnaire. At the end of the study, participants received a 10 € gift card.

At the same time, group B played the games in the opposite order: first Wondershop Games and then Pico Park. After each game, the participants in group B also filled out a paper questionnaire.

Measures

All constructs were measured on a 7-point Likert scale (1 = Strongly Disagree, 7 = Strongly Agree). All items were translated from English to Finnish, and the questionnaires were presented on paper, which participants completed after each game.

The basic psychological needs were measured using the Basic Needs in Games Scale (BANGS) (Ballou et al., 2024). This scale consists of six subscales, each containing three items, for a total of 18 items: autonomy satisfaction (e.g. *"I could play the game in the way I wanted."*), competence satisfaction (e.g. *"I felt a sense of achievement while playing the game."*), relatedness satisfaction (e.g. *"I felt I formed relationships with other players in the game."*), autonomy frustration (e.g. *"Many actions in the game were boring"*), competence frustration (e.g. *"I often felt that I lacked the skills necessary for the game."*) and relatedness frustration (e.g. *"Others in the game made me feel unwelcome."*). The items were pre-randomized so that all subscale items were intermixed, and this same randomized order was used for all participants.

Reliability was assessed using Cronbach's alpha for each subscale in two different games, with varying degrees of reliability. Generally, higher reliability was observed in

Wondershop Games. In Wondershop Games, Cronbach's alpha ranged from questionable to good (autonomy satisfaction: α = .78, autonomy frustration: α = .69, competence satisfaction: α = .83, competence frustration: α = .81, relatedness satisfaction: α = .71, relatedness frustration: α = .69). In Pico Park, Cronbach's alpha was acceptable for three subscales, but not for autonomy satisfaction, competence frustration, and relatedness satisfaction (autonomy satisfaction: α = .49, autonomy frustration: α = .72, competence satisfaction: α = .71, competence frustration: α = .58, relatedness satisfaction: α = .63, relatedness frustration: α = .71).

In addition, we measured participants' satisfaction with the communication using eight items from the 19-item Interpersonal Communication Satisfaction Inventory (ICSI) (Hecht, 1978), some of which were slightly modified. The items were used to assess the extent to which participants enjoyed their group interaction, e.g., *"I felt that we could laugh easily together."* and *"I would like to have another interaction like this one."*. Two items were reverse-coded, e.g., *"I did not enjoy the interaction."*. Internal reliability was good in both games (Wondershop Games: α = .83, Pico Park: α = .82).

Additionally, participants were asked for background information regarding their age and gaming experience. After both games, they were also asked to rate (on a scale of 1-5) whether they found the game amusing, interesting, and difficult, as well as whether they found the game controller easy to use.

Statistical analysis

All analyses were conducted using R software (v4.4.2; R Core Team, 2024). Data preparation and visualization were performed using the tidyverse package (Wickham et al., 2019) and the psych package (Revelle, 2024), and the ggplot2 package (Wickham, 2016) was used to create the graphs. Internal reliability of the measures was examined using the ltm package (Rizopoulos, 2006). The linear mixed model was implemented using the lmerTest package (Kuznetsova et al., 2017) and effect sizes were calculated using effsize package (Torchiano, 2020).

A composite variable was created from the ICSI questionnaire (8 items), and separate composite variables were formed for each subscale of the BANGS questionnaire, with each composite variable consisting of three items. Reliability coefficients were then calculated separately for each game. In addition to the two excluded participants, there

were occasional missing observations in the dataset, which were imputed using the respective respondents' mean scores for the other items in the corresponding subscales. One participant's responses to the ICSI questionnaire were missing for both games, so their responses were only considered for the BANGS questionnaire, to which they responded after each game.

Mean scores and descriptive statistics were first computed. The normality of distributions was checked using histograms, QQ plots, and the Shapiro-Wilk test. Most of the distributions were skewed, with only relatedness satisfaction and communication satisfaction being normally distributed. For normally distributed variables, a paired samples t-test was used to compare the mean scores of the variables. Since the other distributions were skewed, the non-parametric Wilcoxon Signed-Rank test was used to compare differences in participants' responses related to the Pico Park and Wondershop Games.

Finally, we constructed statistical models to investigate whether players' gender, prior gaming experience, and ease of use of the game controller influenced their responses regarding the satisfaction and frustration of basic psychological needs as well as communication satisfaction. We also examined whether the order in which the games were played had an effect on the outcomes. Given that most variable distributions deviated from normality, we employed linear mixed models for the analysis. These models are less sensitive to the assumption of normality and effectively account for the dependency of measurements.

RESULTS

The mean scores for need satisfaction, need frustration, and communication satisfaction in the game situations are presented in Table 1. Regarding need satisfaction, only relatedness satisfaction differed significantly between the games ($t(50) = 2.65$, $p = .011$), with higher satisfaction in the high interdependence game Pico Park ($M = 4.73$) compared to the low interdependence game Wondershop Games ($M = 4.33$). The effect size was small ($d = 0.35$). There was no significant difference in autonomy satisfaction and competence satisfaction between the games. Regarding need frustration, a statistically significant difference between the games was observed only in competence frustration ($V = 231$, $p =$

.016). Players felt less competence frustration in Pico Park ($M = 2.20$) compared to Won-dershop Games ($M = 2.59$). The effect size indicated a small effect ($d = -0.30$). Autonomy frustration and relatedness frustration did not show statistically significant differences between the games. Communication satisfaction also did not differ statistically signifi-cantly between the games (Pico Park: $M = 5.33$, Wondershop Games: $M = 5.25$; $t(41) = 0.34$, $p = .735$).

TABLE 1. Descriptive statistics for need satisfaction, need frustration, and communica-tion satisfaction in the games.

Game						t	V	Cohen's d
Pico Park			Wondershop Games					
M	(SD)	Md	M	(SD)	Md			
Need satisfaction								
Autonomy satisfaction	5.34	(1.07)	5.33	5.20	(1.35)	5.33		535	0.12
Competence satisfaction	5.27	(1.45)	5.67	5.22	(1.35)	5.50		459	0.03
Relatedness satisfaction	4.73	(1.29)	5.00	4.26	(1.36)	4.33	2.65**		0.35
Need frustration								
Autonomy frustration	3.02	(1.45)	2.67	3.13	(1.34)	3.00		465.5	-0.08
Competence frustration	2.20	(1.14)	2.00	2.59	(1.41)	2.33		231*	-0.30
Relatedness frustration	1.97	(1.16)	1.67	1.88	(0.98)	1.33		273.5	0.09
Communication satisfaction	5.33	(1.01)	5.38	5.25	(0.96)	5.25	0.34		0.06

7-point Likert scale (1 = Strongly Disagree, 7 = Strongly Agree)

Relatedness satisfaction and Communication satisfaction: Paired t-test

Others: Wilcoxon Signed-Rank Test

*p < .05, **p < .01, ***p < .001.

The descriptive statistics for participants' responses regarding the amusement of the game, how interesting the game was, the difficulty of the game, and the ease of use of the game controllers are presented in Table 2. The games differed significantly in terms of reported amusement, difficulty, and ease of use of the game controllers. The results showed that participants found Pico Park to be more amusing ($M = 4.33$) compared to Wondershop Games ($M = 3.65$; $V = 601.5$, $p < .001$). The effect size for amusement was

medium (d = 0.74). The difficulty of the games also differed significantly ($V = 223$, $p = .031$), with participants finding Wondershop Games more difficult ($M = 3.28$) than Pico Park ($M = 2.80$). The effect size for game difficulty was small ($d = -0.41$). Additionally, the ease of use of the game controllers was rated higher for Pico Park ($M = 4.26$) compared to Wondershop Games ($M = 2.81$; $V = 520$, $p < .001$). The effect size for ease of use of the game controllers was large ($d = -1.12$), indicating a substantial difference in participants' perceptions of the controller usability.

TABLE 2. Descriptive statistics for game amusement, interest, difficulty, and ease of use of game controllers in the games

	Game						V	Cohen's d
	Pico Park			Wondershop Games				
	M	(SD)	Md	M	(SD)	Md		
Game was amusing	4.33	(0.91)	5.00	3.65	(0.96)	4.00	601.5***	0.74
Game was interesting	3.90	(1.07)	4.00	3.50	(1.02)	4.00	466	0.35
Game was difficult	2.80	(1.39)	3.00	3.28	(1.23)	3.00	223*	-0.41
Using the game controller was easy	4.26	(1.10)	5.00	2.81	(1.35)	3.00	520***	-1.12

5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree)

Wilcoxon Signed-Rank Test

*p < .05, **p < .01, ***p < .001.

Several linear mixed models were constructed to examine the effects of player gender, previous game experience, ease of use of game controls, and game order. In these models, the participant was treated as a random effect, while game type (Pico Park or Wondershop Games), ease of use of game controls, and game order were treated as fixed effects. The random effects showed significant variation across participants. The variance of the residuals and goodness of fit indices, such as REML criteria, supported a good fit for the models. Additionally, we tested the inclusion of gender and previous gaming experience as fixed effects, but these did not improve the model fit.

The linear mixed model analysis for autonomy satisfaction indicated that the ease of use of the game controller ($\beta = 0.19$, $t(92.27) = 2.02$, $p = .047$) and the game order (β

= 0.54, $t(49.25) = 2.20$, $p = .033$) had statistically significant effects. However, the game type did not have a significant effect ($\beta = 0.24$, $t(66.29) = 0.99$, $p = .325$). For competence satisfaction, the game order had a significant effect ($\beta = 0.93$, $t(46.63) = 3.12$, $p = .003$), while the game type ($\beta = 0.12$, $t(60.52) = 0.50$, $p = .617$) and controller ease of use ($\beta = 0.12$, $t(92.16) = 1.19$, $p = .238$) were not significant predictors. In terms of relatedness satisfaction, the game type had a significant effect ($\beta = -0.55$, $t(61.71) = -2.37$, $p = .021$), but the ease of use of the controller ($\beta = -0.06$, $t(87.40) = -0.59$, $p = .556$) and game order ($\beta = -0.07$, $t(50.67) = -0.22$, $p = .830$) did not show significant effects.

The linear mixed model analysis revealed significant effects on need frustration. For autonomy frustration, the ease of use of the game controller ($\beta = -0.23$, $t(89.89) = -2.19$, $p = .031$) and the game order ($\beta = -0.85$, $t(49.92) = -2.65$, $p = .011$) had statistically significant negative effects, while the game type did not have a significant effect ($\beta = -0.16$, $t(62.16) = -0.67$, $p = .503$). In terms of competence frustration, the game order ($\beta = -0.63$, t(49.38) = -2.42, p = .019) and the ease of use of the controller ($\beta = -0.24$, t(93.98) = -2.56, $p = .012$) were significant predictors, but the game type was not ($\beta = 0.05$, $t(64.68) = 0.22$, $p = .830$). For relatedness frustration, the game order ($\beta = -0.55$, $t(47.11)$ = -2.32, $p = .025$) had a significant effect, whereas the game type ($\beta = -0.12$, $t(62.40) = -0.62$, $p = .540$) and the ease of use of the controller ($\beta = -0.08$, $t(93.85) = -0.97$, $p = .336$) did not show significant effects.

Communication satisfaction was significantly influenced by the game order ($\beta = 0.52$, $t(45.26) = 2.03$, $p = .049$). However, the game type ($\beta = -0.04$, $t(59.59) = -0.19$, $p = .849$) and the ease of use of the controller ($\beta = 0.08$, $t(90.94) = 0.93$, $p = .353$) did not show significant effects. Figure 3 illustrates the impact of game order on communication satisfaction, highlighting the observed differences in satisfaction based on the sequence in which the games were played. Regardless of which game was played first, participants reported higher communication satisfaction during the second game.
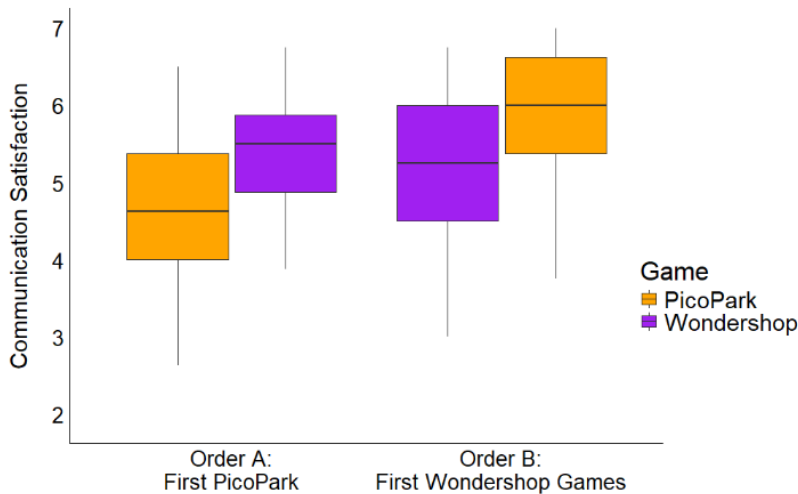
Figure 3. Effect of gaming order on communication satisfaction. In the box plots, the height of the box shows the range within which the middle 50 percent of the scores fall. The horizontal line inside the box represents the median score. The lines (whiskers) above and below the boxes indicate the range of scores, beyond which values are considered outliers. Outliers have been omitted from the figure for clarity.

DISCUSSION

The aim of this study was to examine differences in the players' satisfaction and frustration of basic psychological needs and communication satisfaction, between two cooperative games with different levels of social interdependence. We hypothesized that the less interdependent game (Wondershop Games) would better support players' needs for autonomy and competence. Additionally, we hypothesized that participants would experience higher relatedness satisfaction and communication satisfaction but also greater need frustration in the higher interdependent game (Pico Park).

Our hypotheses were partially supported by the study. Despite the different cooperation mechanics and levels of social interdependence required by Pico Park and Wondershop Games, there were no statistically significant differences in players' satisfaction of autonomy and competence needs. Participants reported that their needs for autonomy and competence were equally well met in both game situations. However, in terms of relatedness satisfaction, participants reported higher satisfaction in Pico Park, but the effect size was small. This finding aligns with previous research suggesting that higher interdependence in games can enhance feelings of relatedness (Depping & Mandryk, 2017; Emmerich & Masuch, 2017). However, our study found no significant differences in

communication satisfaction between the games. Participants experienced communication as equally satisfying in both game situations, indicating that the level of social interdependence in the game did not impact their communication satisfaction.

The experiences of autonomy frustration and relatedness frustration did not differ significantly between the games. However, contrary to our hypothesis, players experienced more competence frustration in Wondershop Games than in Pico Park. This may have been influenced by some players' challenges in controlling their characters in Wondershop Games, as well as a few bugs present in this still-developing game. Studies have identified hardware and character control challenges as one of the key factors affecting the sense of competence. The intuitive controls of a game have been described as the game's "price of admission", meaning they are necessary but not sufficient conditions for experiences of competence, autonomy, and immersion (Ryan et al., 2006). In our study, the challenges in game control affected not only competence frustration but also autonomy satisfaction and autonomy frustration, with a large effect size. This finding reinforces previous research emphasizing the importance for game developers to focus on game controllability and usability.

To account for potential order effects, we balanced the game order by having half of the participants play the games in reverse order compared to the others. Using this balancing, order effects were observed in autonomy satisfaction, autonomy frustration, competence frustration, relatedness frustration, and communication satisfaction. Specifically, for communication satisfaction, regardless of which game participants played first, they gave higher communication satisfaction scores to the second game. This is an important finding to consider in future studies, as pre-post scores for a single game may reflect the impact of the act of playing itself or other external factors rather than the specific game mechanics or content. Our study, where the same participants played two different games, showed that factors such as game control and game order can influence participants' experiences more than the game type.

Most of our participants did not know each other beforehand; however, by the second game situation, the group members had become more familiar with each other. Possibly for this reason, regardless of the game, players found the second game more enjoyable. Playing together can thus support the positive development of the group, even if the players do not know each other beforehand. In addition, Emmerich and Masuch (2017) found that in short offline gaming sessions with friends, the gaming partner was rated as more competent, sympathetic, and trustworthy after the gaming session. Consistent with

previous studies, playing together seems to offer a good opportunity to promote positive interpersonal relationships.

Additionally, there were significant differences between the groups, reflected in both the questionnaire responses and the researcher's observations. Our study included eight groups, some of which were very active in interaction, sometimes boisterous, while others were very quiet. In accordance with the Bounded Generalized Reciprocity (BGR) theory, each member of the group influences the behavior of other group members (Velez, 2015). Because a group consists of many members, several factors influence group interaction, such as each child's individual characteristics, personality and temperament, social skills, interest, enthusiasm, and previous gaming experience. These other factors can be at least as important for an individual's group interaction experience as the game mechanics and contents.

Some studies have examined individual differences, such as gender differences (e.g. Noon et al., 2024). In this study, as in many game studies recruiting volunteer children, more boys participated (81% boys, 19% girls). However, gender did not affect need satisfaction, frustration, or communication satisfaction in this study. It is worth noting that the lack of observed differences may be due to the small proportion of girls in this study, as only 10 girls participated.

A strength of this study is that the participants acted as their own controls. Given the significant individual differences between players, comparing each player's results across the two game situations provided a more accurate comparison of the games.

Limitations and further agenda

This study has several limitations. First, the questionnaires used were not validated for children, which may have affected the reliability of the responses. Participants were offered additional help in completing the questionnaires, if needed. Two participants had challenges completing the questionnaires, and their responses had to be removed from the analyses.

The BANGS questionnaire we used has recently been validated for adults (Ballou et al., 2024). However, in our study, the autonomy satisfaction subscale showed poor internal reliability for Pico Park. While this weakens the reliability of the results, it is an interesting finding, as it only appeared in Pico Park (high social interdependence game), and not in Wondershop Games. It is worth noting that we balanced the order, so the order

effect does not explain the problem with the reliability of the autonomy satisfaction sub-scale in Pico Park. This may be related to the fact that the experience of autonomy in a high interdependence multiplayer game is not as straightforward, and the BANGS questionnaire's autonomy subscale may not capture this well.

It should also be noted that Pico Park is a released game, while Wondershop Games is still in the development phase, and not all the objectives of the game were enabled during the research phase. Therefore, the bugs and control challenges experienced by some players in Wondershop Games had a greater impact than if two released games had been compared.

A small sample size of our study is also a limitation. A larger sample size would allow for the consideration of multiple potentially influential factors, such as different skill levels among players. This study examined only two game situations. It is not possible to determine from this study how group interaction and children's social skills would develop in these games over time. Although no statistical differences were observed between the games, over a longer period, the game experiences may differ more.

Additionally, our study relied solely on self-report methods from children. More diverse research methods, such as observations and interviews, would provide more comprehensive and nuanced information about the effects of games. Nonetheless, it is useful to include self-report methods in research, as children's internal experiences do not always match what an external observer might perceive. For example, silence in a multiplayer game can indicate a high level of concentration and serious engagement. While it may appear that there was little interaction, the players' internal experience may be that everyone was deeply involved, and the interaction was perceived as intense and positive. Conversely, a group situation that appears to be highly communicative may correspond to internally experienced interaction, but it may also be that only some individuals stand out, and for some reason, others remain in the background and may even feel excluded.

Relationships Motivation Theory (RMT) emphasizes that both giving and receiving autonomy support are important factors for the quality of close friendships and individual well-being (Deci & Ryan, 2014). Autonomy support is illustrated by considering the other person's perspective, offering choices, encouraging independent initiative, and responding to the other's needs. To support friendships, games that not only support autonomy but also provide players with the opportunity to offer autonomy support could be benefi-

cial. A game that allows players to make their own choices and encourages them to recognize and support others' successes and insights could be particularly effective. More research is needed on the effects and mechanisms of different types of games.

Conclusions

Supporting children in developing and strengthening their social skills and peer relationships is important. Game-based interventions can be an intrinsically motivating and engaging way for children to strengthen their social skills.

In this study, our hypotheses were partially supported. The high and low interdependence cooperation offline multiplayer games did not differ in terms of autonomy and competence satisfaction or communication satisfaction. However, participants reported higher relatedness satisfaction in the high interdependence game, aligning with previous research. Contrary to our hypothesis, players experienced greater competence frustration in the low interdependence game, likely due to challenges in controlling their characters and bugs in the game.

Our study provided valuable insights for game developers and future research. Given the significant individual differences among players, comparing each player's responses in two different game situations allowed for a more accurate assessment of the games. The order of the games and the difficulty of the game controllers had an impact on the participants' gaming experience. Regardless of the game, communication in the second game situation was perceived as more enjoyable. This may suggest that locally played digital multiplayer games can be effective in developing children's peer relationships.

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