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A self-determination theory-based laboratory experiment on social aspects of playing multiplayer first-person shooter games

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ABSTRACT

Addressing gaps in existing research, the current laboratory experiment (n = 139) examined the role that social facets play in the video gaming experience that multiplayer first-person shooter games provide. First, three different social settings of playing were compared concerning the amount of enjoyment and well-being they induced and second, a structural model based on self-determination theory was tested that aimed to investige connections between social facets of playing, game-based satisfaction of competence and relatedness needs, and positive psychological outcomes of playing. The results indicate that also among supposedly unsocial first-person shooter games social interactions among fellow players and the presence of human co-players are important factors that can shape effects of playing positively. Structural equation modeling further indicated that communicating with fellow players and team play can help players of first-person shooter games to satisfy essential psychological needs that, in turn, is connected to increases in well-being and enjoyment.

1. Introduction

While early research on computer and video games was dominated by studies on possible negative consequences of gaming, recent research also covers positive effects of playing, like the potential of games to induce enjoyment and well-being [e.g. 1,2] or to help people to recover and recuperate [3,4]. An often-cited theoretical concept in this context is self-determination theory (SDT).

The main assumption of SDT is that human beings have three innate psychological needs (autonomy, competence, and relatedness) and that fulfilling these needs is tied to positive effects such as pleasure and mental health, while need thwarting is connected with unhappiness and ill-being [5–7]. Concerning games, several laboratory studies have shown that playing offers rich opportunities for satisfying the three needs described in SDT and that in-game need satisfaction is tied to positive short-term effects, such as enjoyment and improvements in players' mood and well-being [1,2,8–10]. However, it is striking that many studies have used more or less casual games as stimulus material in laboratory settings and have concentrated on single-player situations and fulfillment of autonomy and competence needs [8,10,11]. Considering that especially online games and playing multiplayer modes have become increasingly popular in recent years [12,13], more attention should be paid to social aspects of playing and the satisfaction of the need for relatedness. To the best of our knowledge, online games never have been used in laboratory experiments on SDT.

The laboratory study (n = 139) presented in the following sections will address this research gap and investigate need satisfaction experienced while playing a popular multiplayer first-person shooter online game (*Counter-Strike)*. By choosing Counter-Strike as stimulus material, the study not only usefully augments SDT-based research on games, but also provides an interesting new perspective on the effects of shooter games. Some recent works offer first evidence that playing shooter games online can lead to the formation of valuable interpersonal bonds that provide social support and social capital [14–16] and that engaging in a first-person shooter clan can contribute to well-being [17,18]. However, most existing studies on shooter games focus on single player situations and aggression effects, while research on social aspects and possible positive outcomes of playing remains scarce. A more balanced view that also considers social game elements is necessary to deepen the understanding of the players, their motivations and the multifaceted effects connected with playing these games [17].

The current study will focus on the question of how the social context of playing and the presence of human fellow players influence the gaming experience and the psychological outcomes of playing Counter-Strike. Based on the assumptions of SDT, special attention will be paid to possible positive effects and to the question of how far social aspects of playing first-person shooter games (such as the engagement

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in team play and conversations with fellow players) are connected to need satisfaction, game enjoyment, and increases in the players' short-term well-being.

1.1. Social context and need satisfaction

The theoretical background of the following study can be divided into two different sets of works: (1) non-SDT-based studies that investigated how the social setting of playing influences gaming experiences within different types of multiplayer games, and (2) studies with a background in SDT that either focused on first-person shooter games or examined the role that satisfying the need for relatedness plays in gaming outcomes.

1.1.1. Non-SDT-based studies

Quite a few existing laboratory studies investigated the question of how social aspects of playing could shape the gaming experience. Concerning first-person shooter games, existing studies mainly have concentrated on the question of how the social context of playing influences the potentials of these games to trigger aggressiveness [19–21]. However, of more importance for the following considerations are studies on other types of games that investigated how far multiplayer functions and the presence of human fellow players could influence the gaming experience positively [e.g. 22–29].

Theoretical arguments that support the idea that the social context of playing and the presence of human fellow players may exert positive effects on the gaming experience can be found in extant social psychological literature. For example, deKort and Ijsselsteijn [23] referred to research on social facilitation [e.g. 30] and argued that the presence of human fellow players increases arousal, thereby intensifying the gaming experience. Furthermore, winning in front of others may increase pride and, thus, may lead to more game enjoyment [23; based on 31]. Playing together with human fellow players also may appeal to essential human social motivations and may help people satisfy their need to belong [23; based on 31–33]. The last argument, at the very least, indirectly refers to SDT, as Ryan and Deci's [e.g. 5,7] definition of the need for relatedness was inspired partly by Baumeister and Leary's [33] conception of the need to belong; thus the need to belong and the need for relatedness can be viewed as more or less synonymous constructs.

From an empirical perspective, several studies have found evidence that playing against a human fellow player (either co-located or online) is perceived as being more enjoyable than playing against a computer-controlled opponent. For example, Mandryk and Inkpen [22] conducted an experiment in which the participants played the ice hockey game *NHL 2003*. The results showed that the participants had more fun and experienced the game as less boring, more engaging and more exciting when playing co-located with a human opponent than when playing against the computer.

In a similar study on the casual game *Super Monkey Ball Jr.* and the first-person shooter game *Duke Nukem Advance* Ravaja et al. [31] found that playing against a human opponent "elicited higher Spatial Presence, engagement, anticipated threat, post-game challenge appraisals, and physiological arousal, as well as more positively valenced emotional responses" than playing against the computer (p. 381). Furthermore, playing against a friend also led to more engagement, physiological arousal and experiences of spatial presence than playing against a stranger [31].

Weibel et al. [34] chose the role-playing game *Neverwinter Nights* as stimulus material and simulated a (computer-mediated) online playing setting instead of a co-located playing setting. However, the results of their experiment pointed in the same direction: participants who played against the computer reported weaker experiences of flow, presence and enjoyment than participants who played against human opponents [34].

A laboratory study that tested both types of typical multiplayer settings (co-located as well as computer-mediated co-play) was conducted by Gajadhar et al. [24,25]. The results showed that playing the casual game *WoodPong* against a co-located human player was perceived as most enjoyable and elicited the highest scores in outcome variables such as positive affect, challenge, competence, and flow, while computer-mediated co-play was perceived as medium enjoyable, and playing against the computer was perceived as the least enjoyable [24,25]. Even though the study by Gajadhar et al. [24] also has no background in SDT, it is striking that it includes quite similar measurements as they often have been used in SDT-based studies. Thus, the finding that players experienced more positive affect, challenge and competence when playing against human fellow players can be interpreted as a first empirical hint that the social setting of playing could influence game-based need satisfaction and players' mood and short-term well-being.

Taken together, the aforementioned studies indicate that the presence of human fellow players is an important factor in the enjoyment of playing computer- and videogames and that co-located playing in particular contributes to a positive gaming experience. Notably, only the study by Ravaja et al. [31] used a first-person shooter game as stimulus material. However, since the playing situation (the participants played alone against one single opponent) was rather atypical of modern online first-person shooter games (normally played with teams fighting against eachother), the informative value of the study remains somewhat unclear. Generally, it is striking that none of the studies chose a setting in which the participants played together with others on a team; they all only examined competitive settings in which the participants played alone against a human or computer opponent.

1.1.2. SDT-based studies

SDT is not a genuine gaming theory, but rather a general theory of motivation and well-being that proved to be relevant in very different contexts and life domains [5–7,35]. Autonomy, the first need described in SDT, refers to human beings' desire for self-fulfillment and a life in accordance with one's inner volition. Relatedness refers to the wish to bond with others and feel socially integrated, while competence can be described as the natural urge to be effective and successful [5]. According to SDT, activities that fulfil these needs provide pleasurable experiences and increase well-being. This assumption, for example, was supported by studies on team sports [e.g. 36,37], but also research on the use of social networking sites such as Facebook [e.g. 38–40].

Research by Przybylski et al. [9], to the best of our knowledge, is the only existing series of studies that includes SDT-based laboratory experiments with first-person shooter games. Przybylski et al.'s [9] principal focus lied in investigating violent content's role in players' enjoyment and motivation. In four experimental and two survey studies the authors proved that "enjoyment, value and desire for future play were robustly associated with the experience of autonomy and competence in gameplay" and that "[V]violent content added little unique variance in accounting for these outcomes and was also largely unrelated to need satisfactions" [9,p. 243]. These results show that the general assumptions of SDT concerning the connection between need satisfaction perceived while performing a specific activity and positive effects (such as enjoyment) are also valid for those playing first-person shooter games. However, like most SDT-based laboratory studies on other types of games, the study by Przybylski et al. [9] concentrated solely on single player first-person shooter games and did not address the question of how social aspects of playing and satisfying the need for relatedness influence playing outcomes.

SDT-based studies on gaming that investigated multiplayer games and the satisfaction of relatedness needs were conducted by Ryan et al. [1], Reer and Krämer [17,18], and Tamborini et al. [2].

Ryan et al. [1] surveyed 730 players and proved that satisfying competence, autonomy and relatedness needs in the realms of online gaming is positively connected with time spent playing, the wish to play the game again in the future, perceived game enjoyment, and positive mood experienced after playing. Reer and Krämer [17,18] found that

being member of a first-person shooter clan can help players satisfy all three types of needs described in SDT and that clan-based need satisfaction is connected with increases in well-being and clan engagement. Furthermore, specific behaviors (such as helping administer the group or communicating with clan mates about games, as well as non-game-related topics) were identified as underlying factors tied to need satisfaction in clan life [17]. However, Ryan et al.'s [1] as well as Reer and Krämer's [17,18] results concerning the role of the satisfaction of relatedness needs were based solely on online surveys and were not verified by a laboratory study.

Tamborini's et al.'s [2] study (to our knowledge) is the only existing laboratory experiment that examined the connection between game-based satisfaction of the need for relatedness and positive outcomes of playing. Using the bowling simulation game *Brunswick Pro Bowling*, Tamborini et al. [2] proved that playing the game together with a fellow human player (compared with playing with a computer player) was associated positively with the satisfaction of the need for relatedness, that, in turn, was associated positively with game enjoyment. Considering that Brunswick Pro Bowling is a rather casual game that is typically played co-located, the question of whether Tamborini et al.'s [2] results are transferable to online games, particularly to more complex multiplayer games (such as first-person shooter games) remains unanswered. Furthermore, Tamborini et al. [2] investigated solely connections between game-based need satisfaction and participants' perceived enjoyment after playing, but did not consider other potential outcomes of playing, such as changes in players' moods or short-term well-being.

Against the background of the aforementioned SDT-based and non-SDT-based studies , the current laboratory experiment will investigate the role that social setting plays in outcomes from playing Counter-Strike. First, the study aims to compare different playing situations (as done in the non-SDT-based studies described above), and second, a complex SDT-based model will be tested to further uncover the connections between social aspects of playing, game-based psychological need satisfaction, and positive outcomes from playing. The general hypotheses, as well as the paths of the predicted model, will be described in the following section.

2. Questions and hypotheses

As stated, existing laboratory studies on the question of how the social context of playing influences the gaming experience typically have compared competitive playing scenarios in which participants either played co-located or online against a human or computer opponent. However, playing alone against one single opponent is very atypical in modern multiplayer first-person shooter games. Current first-person shooter games, such as *Counter-Strike: Global Offensive,* usually are played in teams of 2–10 human fellow players that play against equally sized teams of opponents. Three different types of social contexts can be distinguished typically: online *public play*, online *clan play,* and *co-located LAN (local area network) play*.

When playing *public*, players connect to any *public server*, randomly join a team, and try to kill as many opponents as possible. In *online public play*, communication typically is limited to text chat and even though players are part of a team of human players, they usually do not exert much effort coordinating their actions. In *online clan play*, players typically use a voice-communication tool, such as *Teamspeak* or *Ventrilo,* while playing and try to work together as much as possible to achieve the game's goals. *Co-located* play takes place at LAN parties in which the players meet each other face-to-face to play together. In this scenario, anonymity is eliminated, and players can talk to each other directly without the help of any technical tools.

The general idea of the current experiment is to simulate these three typical playing scenarios. In a first analysis step, the scenarios will be compared concerning the gaming experience that they elicit; and in a second step, a structural model will be tested that aims to provide further insights into the interplay between communication, team play, psychological need satisfaction, enjoyment, and pre- to post-play changes in well-being.

2.1. General hypotheses

As described in Section 1.1, several studies proved that playing together with fellow human players was perceived as more fun than playing against a computer [e.g. 22,24,34]. Furthermore, the studies by Gajadhar et al. [24,25] revealed that enjoyment and fun increased from solo-play to computer-mediated co-play and from computer-mediated co-play to co-located play. These effects were explained by arguing that "[…] the richness of social cues afforded interpersonal dynamics during play, for example, immediacy, reciprocation, mimicry, and via this route enabled social processes such as emotional contagion, reinforcement and affiliation fueling enjoyment of the experience" [25,p. 24]. Even though none of the existing studies investigated playing situations in which the participants played together with human fellow players cooperatively as a team, the general finding that the presence of human fellow players positively influences the gaming experience also should be observable in the current experiment. Based on the findings by Gajadhar et al. [24,25], it is expected that especially playing co-located should increase game enjoyment. Furthermore, due to the limited possibilities that this setting provides in terms of communication and coordination, it is expected that playing in the online public play condition will be experienced as the least enjoyable, while it is expected that the online clan play condition will elicit medium enjoyment levels:

H1. Participants in the online public play condition will experience the lowest levels of enjoyment; participants in the online clan play condition will experience medium levels of enjoyment; and participants in the co-located play condition will experience the highest levels of enjoyment.

Besides enjoyment, the current study will additionally consider indicators of participants' mood and well-being and will investigate how the scores of these measurements change from pre- to post-play. Based on the findings of Gajadhar et al. [24,25], it is expected that *co-located play* elicits the most positive gaming experience, followed by *online clan play*. *Online public play* is expected to elicit the least positive gaming experience and should be accompanied by the slightest positive changes in well-being from pre- to post-play:

H2. Participants in the online public play condition will experience the least pronounced positive pre- to post-play changes in mood and well-being, participants in the online clan play condition will experience medium positive pre- to post-play changes in mood and well-being; and participants in the co-located play condition will experience the most positive pre- to post-play changes in mood and well-being.

2.2. Structural model

Besides examining differences between the three playing conditions concerning the gaming experience that they elicit, the second central aim of the current study lies in (on the basis of SDT) investigating how social aspects of playing influence psychological need satisfaction and how need satisfaction, in turn, is associated with positive outcomes of playing. As stated, it is expected that the three different playing situations described above vary concerning the amount of communication and coordinated team play taking place. With the help of structural equation modeling, it will be examined how these varying levels of communication and team play are connected to game-based satisfaction of the needs for competence and relatedness. In a second step, the model will investigate the relation between need satisfaction, enjoyment and pre- to post-play changes in participants' well-being. The model and corresponding hypotheses are shown in Fig. 1.

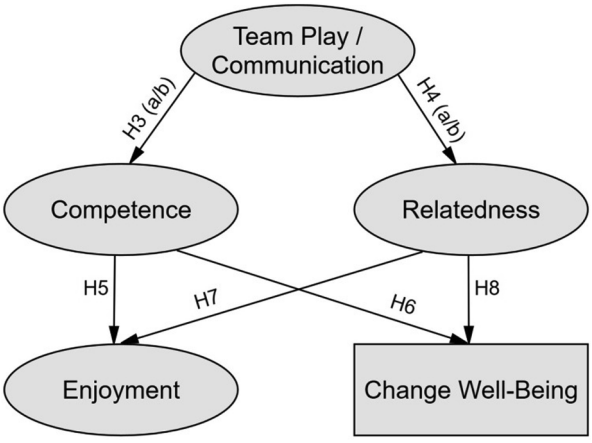

Fig. 1. Predicted model with hypotheses.

The basic level of the model addresses the relationships between coordinated team play and need satisfaction, and between communication with fellow players and need satisfaction.

Concerning communication, it is assumed that conversations with fellow players while playing Counter-Strike, on one hand, have social functions and, thus, should help satify relatedness needs, but on the other hand, they also may have task-related functions (such as coordinating tactical maneuvers or helping inexperienced fellow players learn how to play the game) and, thus, should help satisfy competence needs. Accordingly, it is hypothesized:

H3a. Communication with fellow players is associated positively with the satisfaction of the need for competence.

H4a. Communication with fellow players is associated positively with the satisfaction of the need for relatedness.

Coordinated team play is expected to increase players' chances of achieving the game's goals and experiencing competence. Furthermore, playing cooperatively together with each other also should increase the sense of community experienced while playing and thus should show a positive connection with the satisfaction of the need for relatedness:

H3b. Coordinated team play is associated positively with the satisfaction of the need for competence.

H4b. Coordinated team play is associated positively eith the satisfaction of the need for relatedness.

The second level of the model addresses the central assumptions of SDT that satisfying psychological needs while performing a specific activity makes the activity enjoyable and helps boost well-being [e.g. 5,6]. Concerning games, the study by Tamborini et al. [2] showed that game-based satisfaction of the needs for competence and relatedness increases players' enjoyment levels. The works by Ryan et al. [1] further proved that players who satisfy psychological needs while playing experience positive pre- to post-play changes in their mood and well-being. Accordingly, it is hypothesized:

H5. Satisfaction of the need for competence is associated positively with enjoyment.

H6. Satisfaction of the need for competence is associated positively with positive pre- to post-play changes in participants' well-being.

H7. Satisfaction of the need for relatedness is associated positively with enjoyment.

H8. Satisfaction of the need for relatedness is associated positively with positive pre- to post-play changes in participants' well-being.

The final four hypotheses address the indirect (mediated) effects that coordinated team play and communication with fellow players might exert on enjoyment and well-being. It is expected that both constructs (team play and communication) are indirectly connected to well-being and enjoyment via the satisfaction of the needs for competence and relatedness:

H9a. Communication with fellow players is associated indirectly with enjoyment by satisfying competence and relatedness needs.

H9b. Coordinated team play is associated indirectly with enjoyment by satisfying competence and relatedness needs.

H10a. Communication with fellow players is associated indirectly with positive pre- to post-play changes in participants' well-being by satisfying competence and relatedness needs.

H10b. Coordinated team play is associated indirectly with positive pre- to post-play changes in participants' well-being by satisfying competence and relatedness needs.

Notably, the satisfaction of the need for autonomy was not integrated into the model intentionally. This decision was made because no significant influences of coordinated team play or communication with fellow players on the satisfaction of autonomy needs were expected. Further, there is no theoretical or empirical hint that the social setting of playing could influence a game's potential to satisfy autonomy needs. The study by Tamborini et al. [2] rather showed that co-play and the presence of human fellow players did not exert any significant effect on the autonomy that participants experienced while playing. However, to confirm that autonomy need satisfaction is of minor importance within the present study design, participants' perceived game-based satisfaction of autonomy needs, nevertheless, will be measured, and correlations between autonomy and the other constructs, as well as differences between the three playing conditions concerning the satisfaction of the need for autonomy, will be examined.

3. Material and methods

3.1. Study design

The study was realized as a between subjects design with 3 different conditions (1. *online public play* [n = 44], 2. *online clan play* [n = 47], and 3. *co-located play* [n = 48]). The participants were randomly assigned to one of the conditions and played Counter-Strike for approximately 30 min. The participants filled out two questionnaires: one pre-play questionnaire and one post-play questionnaire.

3.1.1. Stimulus material

The game used for this study was *Counter-Strike: Source,* a prototypical multiplayer first-person shooter game. *Counter-Strike: Source* is the second last version of Counter-Strike, but, the differences with the current version (*Counter-Strike: Global Offensive*) mainly concern graphical aspects, while the general gameplay of Counter-Strike has remained the same throughout all game versions: the player either takes the role of a terrorist (who tries to plant a bomb) or the role of a counter-terrorist (who tries to prevent the terrorists from planting the bomb). The game typically is played in teams of 3–10 human fellow players as terrorists or counter-terrorists against an equally sized team of opponents.

Counter-Strike: Source was published in different age rating and language versions that slightly differ from each other (e.g., differing amounts of displayed blood or concerning the way dead bodies are represented). For the present experiment, the German version of the game was used, with the display of blood switched off.

3.1.2. Procedure

The participants were divided randomly into groups of 4 to 5 players and were invited to participate in a laboratory session of

approximately 1 h length. The general procedure was the same for all participants: First, participants were informed about the data privacy policy and the general course of the experiment and signed a participation agreement. They then filled out the pre-play questionnaire before being instructed on how to play Counter-Strike: Source. After playing Counter-Strike: Source for 30 min, the participants filled out the post-play questionnaire. Finally, the participants were debriefed. In all conditions of the experiment, the participants played together as a team of counter-terrorists, while the terrorist fraction comprised an equivalent number of *bots* that were controlled by the computer. The decision to choose bots as opponents instead of human players was made to keep the difficulty constant for all groups and conditions. Considering that the sample mostly comprised inexperienced players, the bots were set to the easiest level and only were allowed to use hand weapons, while the participants were allowed to use all available weapons. The teams of 4–5 participants were assigned randomly to one of three different conditions.

In condition 1, participants played in separate rooms without seeing or hearing each other, but they had the opportunity to write chat messages to each other. This experimental condition aimed to simulate a typical online public play situation, in which players connect via the Internet to a randomly chosen public server. When playing public, players normally play more or less alone for themselves and just try to kill as many opponents as possible. This playing situation is rather anonymous, and players normally do not pay much attention to team play and social interactions with fellow players. If any communication takes place at all, it typically is limited to short comments on gameplay in the chat window. Notably, communication through chat is quite uncomfortable while playing an action-oriented game like Counter-Strike, as you need both hands to control your avatar. Because of its anonymity and the limitation to chat communication, this experimental condition was expected to induce low levels of communication as well as low levels of coordinated team play.

In condition 2, the participants also were sitting in separate rooms, but were given the opportunity to talk to each other and coordinate gameplay by using the voice-communication software Teamspeak. Through this, condition 2 was rather similar to the typical playing situations of clans because using voice-based communication tools while playing online is very common among clans. Clan members typically play together in groups, coordinate their actions and try to achieve the game's goals together. The use of voice-communication makes this playing situation less anonymous than public play and also makes communication and cooperative play much easier. However, players still are separated physically and cannot see with whom they are playing.

In condition 3, the participants were sitting together in one room, with their computers placed on one large table so they could face each other while playing. They were told that they could communicate with each other freely during the session. This condition was rather similar to the typical playing situation that takes place at so called LAN-parties, in which clan players meet each other face-to-face and play together. This condition was considered the most sociable of the three playing conditions, as participants could see each other and communicate face-to-face while playing. It was expected that the termination of anonymity and the possibility to communicate freely and face-to-face would lead to the highest levels of communication and cooperative play compared with the two other experimental conditions.

3.2. Sample

Recruitment of participants took place at a middle-size university in Germany. Most participants were recruited from lecture classes in the undergraduate media studies program. A lottery of online shopping coupons was conducted among participants to make participation in the study more attractive. The first day of the experiment was used to test the server settings, the collection of data, and to optimize procedures. The data collected during these test sessions were not included in the analysis.

For different reasons, the data from a few other sessions also had to be excluded from the analysis: Two participants from two different groups expressed a very negative attitude towards the game Counter-Strike and the experiment in general. Considering that their expression of disapproval might have influenced the other members of their experimental groups negatively, the datasets from both groups were dropped from the final sample. The data from another 2 groups were dropped due to technical issues during the experimental sessions. One group was excluded because only 3 participants appeared in the laboratory.

The final sample comprised 139 participants. Slightly more females (64%; n = 89) than males participated in the study. The mean age was 22.59 years (SD = 3.69), ranging from 18 to 51 years. Nearly all participants were university students (n = 134, 96.4%). Analysis of variance (ANOVA), with age (one missing value) as the dependent variable and the experimental condition as the fixed factor, did not reveal a significant difference between the three experimental conditions, $F(2, 135) = 0.195$, $p = .823$, $\eta_p^2 = 0.003$. The experimental conditions also did not differ significantly concerning the distribution of gender ($X^2(2) = 0.010$, $p = .995$).

3.3. Measurements

Most items used in the questionnaires were adopted from existing scales. English original items were translated into German. If not stated otherwise, scales ranging from 1 "strongly disagree" to 5 "strongly agree" were used.

The items used to measure enjoyment were adopted from the interest/enjoyment subscale of the Intrinsic Motivation Inventory (IMI) [41]. The items were translated from English to German and were modified slightly to fit the context of the current study. We used a 5-point scale to rate the items instead of the original 7-point scale. The 6 items we used read as follows: "I think Counter-Strike is quite enjoyable", "While I was playing Counter-Strike, I was thinking about how much I enjoyed it", "I would describe playing Counter-Strike as an interesting activity.", "I enjoyed playing Counter-Strike very much.", "Counter-Strike is fun.", and "Playing Counter-Strike is boring" (reverse). Cronbach's Alpha for this scale was acceptable, at $\alpha = 0.905$. To allow for group comparisons (hypothesis 1), items scores were summed up and averaged ($M = 2.77$, $SD = 0.999$).

Altogether, 15 translated items taken from two established scales were used to measure well-being. We adopted the 6-item state version [42] of the subjective vitality scale originally developed by Ryan and Frederick [43]. An example item is: "I feel energized right now". Furthermore, the 9-item scale of affect developed by Diener and Emmons [44] was adopted, comprising positive and negative statements about how one feels (e.g. "Pleased", "Happy" or "Unhappy", "Frustrated"). Four of the nine items addressed positive affect, while five addressed negative affect. All items were rated by the participants two times: one time before the playing session and another time afterwards. Both times the participants were asked how they felt at that moment. For economic reasons, no subscale scores were calculated, but the scores of all 15 items were summed up and averaged to build a combined indicator of well-being (negative affect scores were recoded beforehand). This combined indicator of well-being showed a good reliability when measured before playing ($\alpha = 0.890$) as well as when measured afterwards ($\alpha = 0.923$). To calculate the change in well-being induced by playing Counter-Strike, for each participant the pre-play score was subtracted from the post-play score. Thus, values above zero indicated a change in short-term well-being in the positive direction, while values below zero indicated a change in the negative direction. The mean for the change score was $M = 0.244$ ($SD = 0.727$).

3 items were created to measure how much the participants communicated with each other while playing Counter-Strike (e.g. "We

chatted and/or talked a lot with each other"). The Mean for the summed up and averaged items was M = 3.52 (SD = 1.35, α = 0.899). The degree of coordinated team play was measured with 5 items (e.g. "We functioned well as a team"; "We tried to reach the game's goal together"; M = 3.68, SD = 1.00, α = 0.909).

A translated version of the 9-item Player Experience of Need Satisfaction Scale (PENS) by Ryan et al. [1] was used to measure need satisfaction perceived while playing Counter-Strike. 3 items per subdimension addressed each of the needs postulated in SDT: autonomy (e.g. "I experienced a lot of freedom while playing"), competence (e.g. "I felt very capable and effective when playing Counter-Strike"), and relatedness (e.g. "I found the relationships I formed while playing important"). Cronbach's Alpha indicated good reliability (competence: α = 0.884, M = 2.52, SD = 1.15; autonomy: α = 0.759, M = 2.45, SD = 0.952; relatedness: α = 0.802, M = 2.81, SD = 1.07).

The participants' computer game playing skills were considered a covariate that might influence the outcomes of playing. Therefore, 5 items on playing skills were created in close reference to items used by Bracken and Skalski [45] (e.g. "It is easy for me to learn how to play new games", "I am a good computer game player"; α = 0.910, M = 2.52, SD = 0.989).

4. Results

To test the general hypotheses (H1 and H2), several analyses of covariance (ANCOVAs) were performed using IBM SPSS. For all reported ANOVAs and ANCOVAs, Levene's test indicated that the assumption of homogeneity of variance was met for the dependent variables. Additionally, a preliminary correlation analysis of the averaged scale scores was conducted to get an impression of the relationships between the different constructs (see Table 1). The predicted structural model (H3-*H*10) was tested by conducting structural equation modeling using IBM Amos software package.

4.1. General hypotheses

Hypothesis H1 predicted that participants' enjoyment while playing Counter-Strike varies across the 3 experimental conditions with condition 3 (*co-located play*) inducing the highest enjoyment levels, condition 2 (*online clan play*) inducing medium enjoyment levels, and condition 1 (*online public play*) inducing the lowest enjoyment levels. ANCOVA was performed with enjoyment as the dependent variable, the experimental condition as the fixed factor, and playing skill as a covariate. The results revealed a significant effect of the covariate playing skill on the dependent variable game enjoyment, $F(1, 135) = 49.74$, $p < .001$, $\eta_p^2 = 0.269$. Furthermore, the experimental condition also showed a significant effect, $F(2, 135) = 7.22$, $p = .001$, $\eta_p^2 = 0.097$. Taking a closer look at the adjusted means (controlled for the influence of the covariate) for the different groups confirmed the assumptions of hypothesis H1: condition 1 (*online public play*) induced the lowest level of enjoyment (M = 2.45), while condition 3 (*co-located play*) induced the highest level of enjoyment (M = 3.13). Enjoyment for condition 2 (*online clan play*) fell in between, with M = 2.69. Šidák correction for multiple comparisons (as recommended for ANCOVAs; see Field [46]) was used to additionally investigate whether the enjoyment differences between the three experimental conditions were significant. It was found that the difference between condition 1 and 3 ($p < .001$) and the difference between condition 2 and 3 ($p < .05$) were significant, while the difference between condition 1 and 2 did not reach significance ($p = .443$).

Hypothesis H2 assumed that co-located play (condition 3) induces the most positive change in participants' well-being, online clan play (condition 2) induces medium positive changes in well-being, and online public play induces the least positive changes in well-being. ANCOVA with playing skill as a covariate, the experimental condition as the fixed factor, and the pre- to post-play change in participants' well-being as the dependent variable showed a significant effect for playing skill, $F(1, 135) = 6.85$, $p = .01$, $\eta_p^2 = 0.048$, as well as for the experimental condition, $F(2, 135) = 5.15$, $p < .01$, $\eta_p^2 = 0.071$. As predicted, the adjusted mean for the change in well-being was lowest in condition 1 (M = −0.005), followed by condition 2 (M = 0.243) and condition 3 (M = 0.473). Šidák-corrected multiple comparisons revealed a significant difference between condition 1 and condition 3 ($p < .01$); but, neither the difference between condition 1 and condition 2 ($p = .256$) nor the difference between condition 2 and condition 3 ($p = .308$) reached significance.

4.2. Structural models

Besides comparing the three experimental conditions, another study aim lied in investigating relationships between the different constructs, and especially in examining the role that satisfaying competence and relatedness needs play on outcomes from playing Counter-Strike. In the following paragraphs, the results from the structural analysis will be presented (H3-H10).

4.2.1. Manipulation check

A central assumption of the following structural analysis was that the experimental manipulation leads to differences in the amounts of team play and communication between the three conditions. ANOVA with the experimental condition as the fixed factor and team play as the dependent variable revealed a significant effect, $F(2, 136) = 17.25$, $p < .001$, $\eta_p^2 = 0.202$. Bonferroni-corrected multiple comparisons revealed a significant difference ($p < .001$) in team play between condition 1 (M = 3.02) and condition 2 (M = 4.02). Also, condition 1 and condition 3 (M = 3.96) differed significantly ($p < .001$); however, no significant difference was found between condition 2 and condition 3 ($p = .988$). A second ANOVA with communication entered as the dependent variable showed a significant effect, $F(2, 136) = 84.90$ ($p < .001$, $\eta_p^2 = 0.555$). As for team play, Bonferroni-corrected multiple comparisons revealed a significant difference ($p < .001$) in communication between condition 1 (M = 2.06) and condition 2

Table 1
Means, standard deviations and Pearson-correlations of the averaged scale scores.

	M	SD	1	2	3	4	5	6	7	8
1. Playing skill	2.52	.99	–							
2. Communication	3.52	1.35	.003	–						
3. Team play	3.68	1.00	−.040	.675**	–					
4. Competence	2.52	1.15	.611**	.207*	.161	–				
5. Autonomy	2.45	.95	.364**	.131	.138	.544**	–			
6. Relatedness	2.81	1.07	.147	.656**	.596**	.327**	.313**	–		
7. Enjoyment	2.77	1.00	.463**	.290**	.176*	.562**	.647**	.363**		
8. Change in well-being	.24	.73	.165	.354**	.241**	.343**	.300**	.284**	.557**	–

* $p < .05$.
** $p < .01$.

(M = 4.34), as well as between condition 1 and condition 3 (M = 4.04; $p < .001$). The difference between condition 2 and condition 3 did not reach significance ($p = .305$).

Even though condition 2 (*online clan play*) and condition 3 (*co-located play*) did not differ significantly concerning the amount of communication and team play that they had induced, the purpose to generate variance in team play and communication was regarded, nevertheless, as successful because condition 1 (*online public play*) differed significantly from the other conditions.

4.2.2. Further preliminary analyses

Due to theoretical considerations and to keep the model compact, it was decided not to include autonomy in the structural model. ANOVA and correlation analysis were used to evaluate this decision based on the data. ANOVA with autonomy as the dependent variable and the experimental condition as the fixed factor showed that autonomy did not differ significantly between the three conditions, $F(2, 136) = 0.021$, $p = .979$, $\eta_p^2 = 0.000$. Correlations between the averaged scale scores were calculated to get an impression of the relationships between all measured constructs (see Table 1). We found that autonomy was neither correlated significantly with team play nor with communication (see Table 1). Based on these results, it can be concluded that autonomy indeed was of minor importance within the context and assumptions of this study and that the decision to exclude it from the analysis has data-based justification.

Before estimating the predicted model, the correlations between averaged scale scores were inspected further. Unsurprisingly, communication and team play were found to correlate strongly with each other ($r > 0.650$). To avoid multicollinearity, it was decided not to enter them as predictors into the same model, but to estimate two separate variants of the model. Furthermore, a significant correlation was found between competence and relatedness, thus the corresponding error terms of the latent variables in the structural models were allowed to co-vary. For the same reason, the error terms of enjoyment and change in well-being were allowed to co-vary in the models. Playing skill showed rather strong significant correlations with enjoyment and competence. Considering that it seems logical that especially participants with strong computer game playing skills experience competence while playing and also enjoy playing more than inexperienced participants, it was decided to extend the model by adding playing skill as an additional control variable predicting enjoyment and competence.

4.3. Model 1: communication

Fig. 2 shows the results of the maximum likelihood estimation for model 1 with communication entered as a predictor of competence and relatedness. Communication, playing skill, need satisfaction, and enjoyment were modelled as latent constructs based on manifest indicators. The well-being change score was added as an observed variable. The model explains 51% of the variance in competence ($R^2 = 0.51$), 60% of the variance in relatedness ($R^2 = 0.60$), 42% of the variance in enjoyment ($R^2 = 0.42$), and 15% of the variance in changes to well-being ($R^2 = 0.15$).

4.3.1. Assessment of normality and model fit

Assessment of normality revealed a deviation from multivariate normality (Mardia's normalized coefficient of multivariate kurtosis = 6.285). Following Byrne's [47] recommendation for non-normal distributed data, the significance of all reported path weights was additionally tested with bootstrapping (2000 samples, 90% bias-corrected confidence level). Bootstrapping confirmed the significance of all hereafter reported associations. Model fit was evaluated based on 3 established fit indices: CFI, CMIN/df and RMSEA [48,49]. With CMIN/df = 1.236, CFI = 0.978 and RMSEA = 0.041 (90% confidence interval from 0.019 to 0.058) model 1 fits the data very well.

4.3.2. Direct effects

Hypothesis H3a indicated a positive link between communication and competence and was affirmed with $\beta = 0.23$ ($p < .001$). Furthermore, a strong connection between communication and relatedness was found ($\beta = 0.78$, $p < .001$), thus H4a can also be accepted. Confirming H5 and H6, competence showed a positive association with enjoyment ($\beta = 0.36$, $p < .01$) and changes to well-being ($\beta = 0.23$, $p < .01$). In line with H7 and H8, relatedness also was associated positively with enjoyment ($\beta = 0.26$, $p < .01$) and changes to well-being ($\beta = 0.25$, $p < .01$). Playing skill was entered as an additional control variable and showed significant connections with competence ($\beta = 0.68$, $p < .001$) and enjoyment ($\beta = 0.24$, $p < .05$), indicating that experienced participants with strong playing skills felt more competent when playing Counter-Strike and also enjoyed the game more than inexperienced participants with weaker playing skills.

4.3.3. Indirect effects

To test for indirect effects predicted in H9a and H10a, bootstrapping with 2000 samples and a bias-corrected confidence level of 90% was performed. H9a and H10a both were supported by bootstrapping estimation: communication with fellow players indirectly influenced enjoyment ($\beta = 0.29$; $p < .001$; 90% bias-corrected confidence interval from 0.18 to 0.40) and changes in well-being ($\beta = 0.25$; $p < .01$; 90% bias-corrected confidence interval from 0.12 to 0.39) by satisfying competence and relatedness needs.

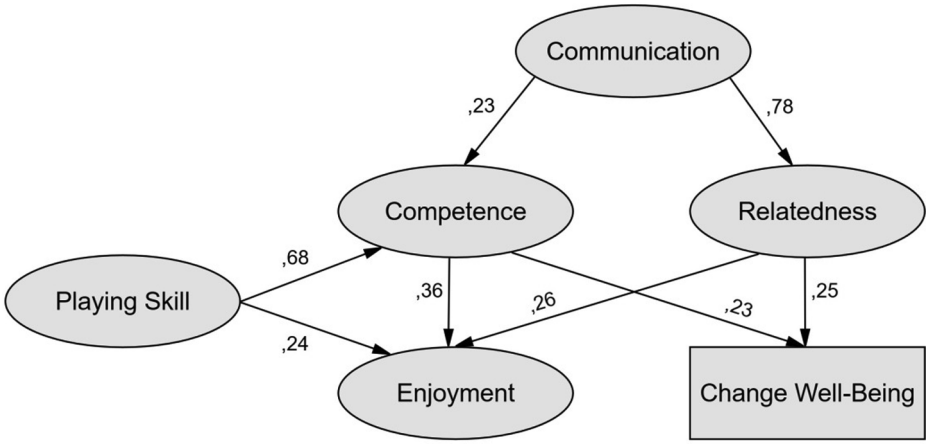

Fig. 2. Estimated model for communication. All reported standardized beta coefficients are significant at least with $p < .05$.

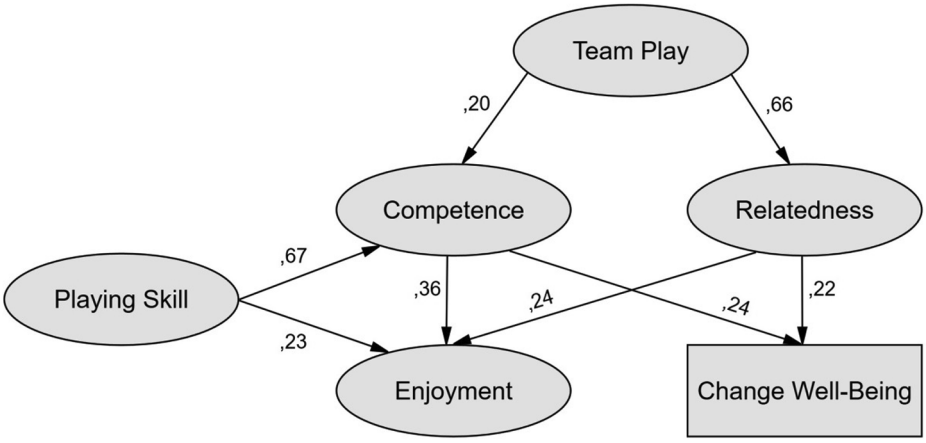

Fig. 3. Estimated model for team play. All reported standardized beta coefficients are significant at least with $p < .05$.

4.4. Model 2: coordinated team play

Fig. 3 shows the model with team play entered as a predictor of competence and relatedness need satisfaction. Model 2 explains 49% of the variance in competence ($R^2 = 0.49$), 44% of the variance in relatedness ($R^2 = 0.44$), 42% of the variance in enjoyment ($R^2 = 0.42$), and 14% of the variance in changes to well-being ($R^2 = 0.14$).

4.4.1. Assessment of normality and model fit

As for model 1, assessment of normality for model 2 revealed a deviation from multivariate normality (Mardia's normalized coefficient of multivariate kurtosis = 6.801). However, evaluating the significance of the path weights with bootstrapping (2000 samples, 90% bias-corrected confidence level) confirmed significance of all reported associations. According to established fit indices, model 2 fits the data very well (CMIN/df = 1.305, CFI = 0.968 and RMSEA = 0.047, 90% confidence interval from 0.030 to 0.061).

4.4.2. Direct effects

Hypothesis H3b predicted a positive relation between team play and competence which the data supported ($\beta = 0.20$; $p < .01$). Team play also was found to be associated positively with relatedness ($\beta = 0.66$; $p < .001$), supporting H4b. The predictions for H5 to H8 already were tested in model 1 and were supported by the results of the estimation of model 2. Considering that the strength of the path weights only changed marginally and that all paths of model 2 were (as in model 1) significant at least with $p < .05$, these results will not be reported in detail again. However, the standardized beta coefficients of the paths can be found in Fig. 3.

4.4.3. Indirect effects

The predicted indirect effects from team play via need satisfaction on enjoyment (H9b) and changes to well-being (H10b) were tested with bootstrapping (2000 samples). Affirming both hypotheses, team play was found to influence enjoyment indirectly ($\beta = 0.23$; $p = .001$; 90% bias-corrected confidence interval from 0.14 to 0.34) as well as changes to well-being ($\beta = 0.20$; $p < .01$; 90% bias-corrected confidence interval from 0.08 to 0.33) by satisfying competence and relatedness needs.

5. Discussion and conclusions

Comparing the three different playing scenarios revealed that the social context of playing significantly influenced participants' playing experience. Participants who played in separate rooms without seeing and hearing their team mates (condition1: *online public play*) experienced the least enjoyment; participants who played in separate rooms but were allowed to use the voice communication tool *Teamspeak* (condition 2: *online clan play*) experienced medium enjoyment levels; and participants who played co-located together in one room (condition 3: *co-located play*) experienced the highest enjoyment levels. Šidák-corrected multiple comparisons revealed significant differences between condition 1 and condition 3 as well as between condition 2 and condition 3. Similar results were found concerning pre- to post-play changes in participants' mood and well-being: participants who played under condition 3 experienced the strongest positive changes in short-term well-being (measured with scales on positive affect, negative affect and vitality), followed by condition 2 and condition 1 (with a significant difference between condition 1 and 3). These results are in line with findings from previous studies on other types of computer- and videogames, indicating that the presence of human fellow players influences the gaming experience positively and leads to increased game enjoyment, improvements in players' mood, and other positive outcomes [e.g. 22,24,25,34]. Similar to studies by Gajadhar et al. [24,25], the current experiment showed that playing co-located (condition 3) is experienced more enjoyable and also leads to stronger improvements in players' short-term well-being than playing in a computer-mediated setting in which players could hear, but not see, each other (condition 2). Furthermore, a playing situation in which players' interactions with fellow players were limited to text chat (condition 1) was experienced the least enjoyable and induced the lowest well-being levels.

In a second analysis step, an SDT-based structural model was tested to offer additional insights into the question of how social aspects of playing and interactions with fellow players influence outcomes from playing first-person shooter games. A preliminary analysis showed that the three different experimental conditions significantly differed from each other concerning the amount of communication that had taken place during the gaming sessions and concerning the amount of coordinated team play the participants had engaged in: participants who played under condition 1 (public online play) were less likely to communicate with fellow players and less likely to engage in coordinated team play than participants who played under condition 2 (online clan play) or condition 3 (co-located play). Within the structural model, communication with fellow players and coordinated team play were used as independent variables predicting competence need satisfaction and relatedness need satisfaction. Performing maximum likelihood estimation showed that communication and team play both were assocaited positively with satisfying competence and relatedness needs. Furthermore, competence and relatedness need satisfaction showed positive assocaitions with enjoyment and positive pre- to post-play changes in participants' mood and short-term well-being. Testing indirect links from team play and communication via psychological need satisfaction to enjoyment and change in well-being revealed a

significant positive effect; indicating that participants who communicated more often with fellow players and engaged more strongly in coordinated team play improved their chances of satisfying essential psychological needs while playing, and as a consequence, gained more positive outcomes from playing than participants who were less engaged in social interactions with fellow players.

Generally, the results of the structural analysis confirm the theoretical assumptions of SDT and the findings of previous studies on other types of games that have shown that game-based psychological need satisfaction leads to increases in players' well-being and enjoyment [e.g. 1,2,8,9,11]. However, in contrast to most existing studies, the current experiment did not use a single player game as stimulus material and did not focus solely on the underlying factors and effects of satisfying the needs for competence and autonomy, but rather used a popular multiplayer first-person shooter game as stimulus material and gave special attention to social aspects of playing. Coordinated team play and communication with fellow players were identified as two important factors that positively contribute to the satisfaction of competence and relatedness needs. In this, the study offers a plausible explanation for the increasing popularity of multiplayer online games. Social interactions that take place while playing together with human fellow players and the possibilities that modern multiplayer games provide in terms of collaborative play offer a fruitful ground for the satisfaction of essential psychological needs, making these games enjoyable and leading to improvements in players' short-term well-being. Notably, playing together with human fellow players is obviously not only helpful in terms of satisfying relatedness needs (as also previously shown by Tamborini et al. [2]), but also bears the potential to satisfy the need for competence. A plausible explanation for this finding might be that coordinating maneuvers and talking about playing tactics and other game-related topics could improve a player's chances of achieving the game's goals and, thus, experiencing success [17]. Additionally, interacting with fellow players and playing together as a team also may provide one with the feeling of being socially skilled [17]; an assumption that should be examined further in future studies.

By investigating social aspects of playing and the potentials of first-person shooter games to fulfil basic psychological needs, the study augments the few existing works that previously addressed violent video games' positive psychosocial potentials [14–17]. As noted by Reer and Krämer [17], regarding their study on need satisfaction in clans, the results from the current experiment should not be misinterpreted in a way that suggests playing multiplayer first-person shooter games primarily is connected with positive psychological outcomes and that concerns about negative effects from playing these kinds of games generally are negligible. However, the results at the very least provide further evidence that concentrating solely on the negative effects that these kinds of games might elicit is too one-sided and that playing first-person shooter games cooperatively together with human fellow players can elicit the same positive social and psychological effects as playing any other kind of computer/video game together with others [15–17].

Taken together the results of the current study show that social aspects and the social context of playing exert a significant influence on the gaming experience modern first-person shooter games provide. Contrary to the negative public perception tied to first-person shooter games, (multiplayer) first-person shooter games should be considered social games that offer opportunities for joint activities, may serve as starting points for social interactions with others, can satisfy basic psychological needs, and, thus, can foster enjoyment and well-being. Furthermore, the results generally emphasize the importance the social component has for the gaming experience modern multiplayer games provide. Previous findings stemming from studies in which participants played rather casual games competitively against human or computer-controlled opponents provided early evidence that the presence of human fellow players can influence the gaming experiences positively and lead to positive psychological effects [e.g. 24,25,31,34]. The current study affirmed these findings for collaborative play, using a more complex multiplayer game.

Based on social-psychological theories, scholars have argued that the positive effects from the presence of fellow players likely could be based on diverse psychological processes that the shared gaming experience might elicit; such as the triggering of affiliation and emotional contagion, pride experienced when winning in front of others, or the possibilities that collective play provides in terms of satisfying the need to belong [23,25]. However, empirical evidence on these mechanisms' relevance mostly remained a research gap. The SDT-based model tested in the current study uncovers some of the psychological processes underlying the positive gaming experience that collaborative play can evoke by indicating that interacting with fellow players and playing together as a team help players satisfy competence and relatedness needs, which is connected to positive psychological outcomes, such as enjoyment and well-being. It seems very plausible that these mechanisms are of general importance and also should be relevant in the context of other multiplayer games that typically are played cooperatively. To prove this assumption and to test the model with games of other genres, such as roleplaying games or strategy games, would be an interesting direction for future research. The current study intentionally focused on a shooter game because investigating social aspects of this type of game aimed to fill a research gap. However, providing a systematic comparison between different types of games concerning social components' role in game enjoyment and well-being outcomes would be another worthwhile direction for future research.

5.1. Limitations

The present study's laboratory experiment is subject to several limitations. For example, most participants were rather inexperienced players; therefore playing skill was used as a control variable in the statistical analyses. However, the findings should be confirmed through samples comprising more experienced players. Furthermore, only one specific multiplayer first-person shooter game was used in the experiment. Even though Counter-Strike is a very prototypical online first-person shooter game and has been one of the most popular games of its genre for several years, the results of the study may not be transferable to all other multiplayer first-person shooter games.

Concerning the measurements used in this study, another possible critcism concerns the fact that the amount of team play and communication that took place during the playing sessions was measured through self-reports of the participants. Future studies may use more valid observational data to increase reliability. Furthermore, we measured communication frequency, but did not consider the content of the conversations. Violent and rude conversations may elicit other effects on reed satisfaction and the gaming experience than friendly and cooperative forms of interactions between players.

In the current study, the 139 participants played together in teams of 4 to 5 players to simulate a more realistic playing situation than previous studies that only investigated playing situations in which participants played alone against a human or computer-controlled participant. However, this approach is problematic in that the observed cases are not independent of each other, which should be kept in mind when interpreting the results of the analyses. Future studies may avoid this problem by recruiting a larger number of participants to enable more complex analyses.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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