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Social Ball: An immersive research paradigm to study social ostracism

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The Social Ball app is currently going through final rounds of testing. If you wish to learn more about the app and/or test it, please contact the corresponding author at e.o.meral@uva.nl.
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All data, analysis scripts, pre-registration files and Supplementary Materials can be found at the Open Science Framework (https://osf.io/zfqax/)

Abstract

We introduce "Social Ball," a new research paradigm to study ostracism via an online ball tossing game based on Cyberball (Williams & Jarvis, 2006) designed with both researchers and participants in mind. For researchers, the game incorporates a variety of features which are easily accessible from the software's interface. Some of these features have already been studied with Cyberball (e.g., tossing different objects) but some are novel (e.g., end-game communication or hand-waving during the game). From the participants' perspective, the game was designed to be more visually and socially immersive to create a more video-game-like online environment. We discuss two previous implementations. Study 1 showed that Social Ball successfully induced need threat and negative affect among ostracized (vs included) participants (n = 247). Study 2 empirically demonstrated how a new feature of the game (i.e., hand-waving) can be used to answer various questions. The results suggested that people waved their hands to varying degrees yet the frequency of which was not associated with post game need satisfaction (n = 2578). Besides describing the features of the game, we also provide a configuration manual and an annotated R code (both as online supplementary materials) to make the paradigm and associated analyses more accessible, and in turn, to stimulate further research. In our discussion, we elaborate on the various ways in which Social Ball can contribute to the understanding of belonging and ostracism.

Keywords: social ball, ostracism, exclusion, research paradigm, open access

People have a strong need to belong and thwarting this need is a negative experience (Baumeister et al., 2007; Baumeister & Leary, 1995; Williams, 2007). Ostracism happens when an individual (i.e., the target) is ignored or left out by others (i.e., the sources) (Williams, 2007) and it threatens the needs for belonging, control, self-esteem, and meaningful existence (Baumeister & Leary, 1995; Williams, 2007, 2009). Besides the threatened needs, researchers have identified various negative effects of being ostracized throughout one's lifespan from childhood (Buhs & Ladd, 2001; Hawes et al., 2012) well into adulthood (Abrams et al., 2011; Rudert et al., 2020) including being a risk factor for depression (Riva et al., 2017; Rudert et al., 2021).

Drawing causal conclusions of the impact of ostracism requires experimental methods. And to experimentally induce feelings of ostracism, researchers need effective, valid, and easy-to-implement paradigms. In the current paper, we present such a paradigm. Our experimental paradigm, Social Ball, builds on the widely used paradigm, Cyberball, while addressing its several shortcomings. Social Ball is open-access and freely accessible via a web application. We introduce Social Ball in two steps: first, we describe the features of the program. Second, we present analyses from two data sets to showcase the effectiveness of the paradigm and its potential for investigating the open questions in the field of ostracism. Additionally, to increase the program's accessibility to researchers, we provide a manual for configuration of various scenarios within the game (Supplementary Material 2 [SM2]), and an annotated R script data for formatting and commonly conducted analyses (Supplementary Material 3 [SM3]).

Why is Ostracism Negative

In the past couple decades, researchers identified many negative outcomes of various belonging threats such as ostracism. These threats to belonging can induce social susceptibility (Carter-Sowell et al., 2008); increase conformity (Knapton et al., 2015; Riva et

al., 2014), and openness to extremism (Hales & Williams, 2018); impair self-regulation (Baumeister et al., 2005) and cognitive functioning (e.g., Buelow et al., 2015; Hawes et al., 2012), reduce intelligent thought (Baumeister et al., 2002); and increase financial risk-taking (Duclos et al., 2013). Being ostracized negatively impacts individuals in various contexts, for example at work and in school. For example, organizational researchers showed that being ostracized at work is associated with poor job satisfaction (De Clercq et al., 2019; Ferris et al., 2015), increased job turnover (O'Reilly et al., 2014); increased likelihood to engage in unethical (Kouchaki & Wareham, 2015) and counterproductive behavior (Yang & Treadway, 2018; Zhao et al., 2013). In a similar vein, research in academic contexts show that threats to belonging can lead to poorer academic performance (Cursan et al., 2017), impaired school adjustment (Buhs & Ladd, 2001), and behavioral or emotional problems (Hoglund et al., 2008). Experiencing belonging threats for extended periods of time is generally considered a risk factor for psychological distress (Beeri & Lev-Wiesel, 2012), and can have long-term psychological effects that stretches into later in life (Lev-Wiesel et al., 2006). To sum, threats to belonging can have negative, serious, and long-lasting effects on the targets thus demonstrating the need for understanding the phenomena further.

The Existing Research Paradigms to Study Ostracism

Past research utilized various paradigms to manipulate people's belonging status (for a review, see: Wirth, 2016). Examples include asking participants to recall past incidents of being rejected (e.g., Knowles & Gardner, 2008; Pickett et al., 2004), giving participants bogus feedback about how one will lead a lone life (e.g., Baumeister et al., 2002; Twenge et al., 2001), leaving participants out of conversations in chat rooms (e.g., Rudert et al., 2018; Smith & Williams, 2004), liking participants' posts on social media less (e.g., Ruff et al., 2014), or using hypothetical scenarios where people are asked to imagine being excluded (e.g., Hales et al., 2020; Meral et al., 2021).

To experimentally study and induce belongingness threats, many researchers employ an online ball-tossing paradigm called Cyberball (Williams & Jarvis, 2006). Each person plays the Cyberball game on an individual computer and toss a ball around with others. In most cases the game is presented as a mental-visualization exercise and participants are encouraged to imagine tossing the ball around with other people in real life. This setup is then used to make participants feel included or ostracized based on the number of ball tosses they (do not) receive from the other players. For this purpose, participants – while believing they play the game with other human players – play the game with pre-programed avatars that throw the ball based on the experimental manipulation. In the inclusion version of the game each player receives the ball an equal number of times; and in the exclusion version of the game excluded players receive the ball a few times in the beginning and never after. This paradigm has been used extensively in ostracism research to induce feelings of inclusion or exclusion. A meta-analysis based on 120 Cyberball studies showed that the average effect size for studies comparing the inclusion and ostracism conditions were $|d|= 1.4$ (Hartgerink et al., 2015).

Over the years, researchers have applied variations to this online ball-tossing game to adopt it to their research questions. For instance, researchers have used a version where getting the ball costs money to see if participants still feel hurt when inclusion is costly and ostracism is rewarding (€yberball, van Beest & Williams, 2006). In other variations the ball that was tossed around was visually depicted as a bomb to investigate the impact of exclusion when being included in the game implied survival threats (van Beest et al., 2011), or as a virus to examine the effect of ostracism when cues of infectious disease were present (Ren et al., 2022). Yet another version enabled participants to claim the ball by clicking on other player's avatars, which allowed the researchers to study the effects of claimed (vs granted) inclusion (de Waal-Andrews & van Beest, 2012). Additionally, researchers have used

versions in which they manipulated the social information participants received about the other players in the game, allowing them to study the effects of group membership or stigmatization on belonging (e.g., Goodwin et al., 2010; Sacco et al., 2014). Taken together, these studies illustrate how variations to this online ball-tossing game can help researchers study a broad range of variables that may impact the processes involved in ostracism and inclusion.

However, there are only limited features that users could quickly implement using Cyberball such as the number of players, the tossing schedule, changing character names and so on. Beyond these features, users are required to take some extra steps to modify the game to meet their needs. To illustrate, to incorporate different objects or avatars to the game, the user would need to have a picture of the objects or six different avatar pictures (to be used for the different positions of the avatar such as throwing, catching etc.). This method could offer more flexibility to the user who has access to such pictures (e.g., six different pictures for the potential avatar). That said, if a user wants to incorporate multiple different avatars, the number of different pictures the user needs would quickly increase. Moreover, adopting some of the features that were used in previous versions of Cyberball would require the researcher to program these features into the software themselves (e.g., throwing multiple objects).

Introducing Social Ball

Here, we introduce a novel paradigm to study social ostracism: Social Ball. Social Ball builds on the structure of Cyberball (i.e., an online ball-tossing game), but emulates Cyberball in two important ways. First, from the perspective of researchers, Social Ball is designed to provide researchers with great accessibility and flexibility with user-specific modifications. Researchers who do not have any programming skills are able to easily implement a range of features simply using the software's interface. These features include the small variations which have been implemented in past studies. For instance, researchers

can select to create a group of avatars (or let participants choose their avatars) from the set of available 12 avatars to study group membership (e.g., Goodwin et al., 2010; Sacco et al., 2014). Alternatively, researchers can select from three available objects (a bomb, a banana, or a ball) to be thrown around to study the effects of inclusion or exclusion from different objects (van Beest et al., 2011). Importantly, besides incorporating some variations studied in prior research, Social Ball also includes new features that allow researchers to investigate novel research questions. For example, Social Ball enables players to wave their hands during the game and has a post-game communication screen. These features can enable researchers to study the effects of interpersonal communication both during (non-verbal via hand-waving) and after the game (verbal via the communication screen). In brief, the modifications researchers often look for and have yet to implement in Cyberball are straightforward and simple to implement in Social Ball. Thus, Social Ball presents a great potential for exploring new research questions while improving the user experience of the researchers.

Second, from the perspective of participants, Social Ball is designed to improve their experience by creating an immersive, video-game-like online environment. Compared to Cyberball which was purposefully designed to be a minimal paradigm, Social Ball creates an immersive environment both visually and socially. Visually, Social Ball has 3D graphics, different backgrounds to choose from (school yard and beach) and animated character avatars which make it a more visually immersive experience than Cyberball which has 2D graphics. Socially, the software allows researchers to create lobbies in which participants can seemingly play the game together (i.e., see each other's avatars and nicknames in the same game). We believe that this lobby feature makes the game more socially immersive by increasing the credibility of the (simulated) multiplayer aspect of ball-tossing than other versions that solely rely on telling participants that they play the game together. Taken together, with a variety of features and a more immersive experience (both visual and social),

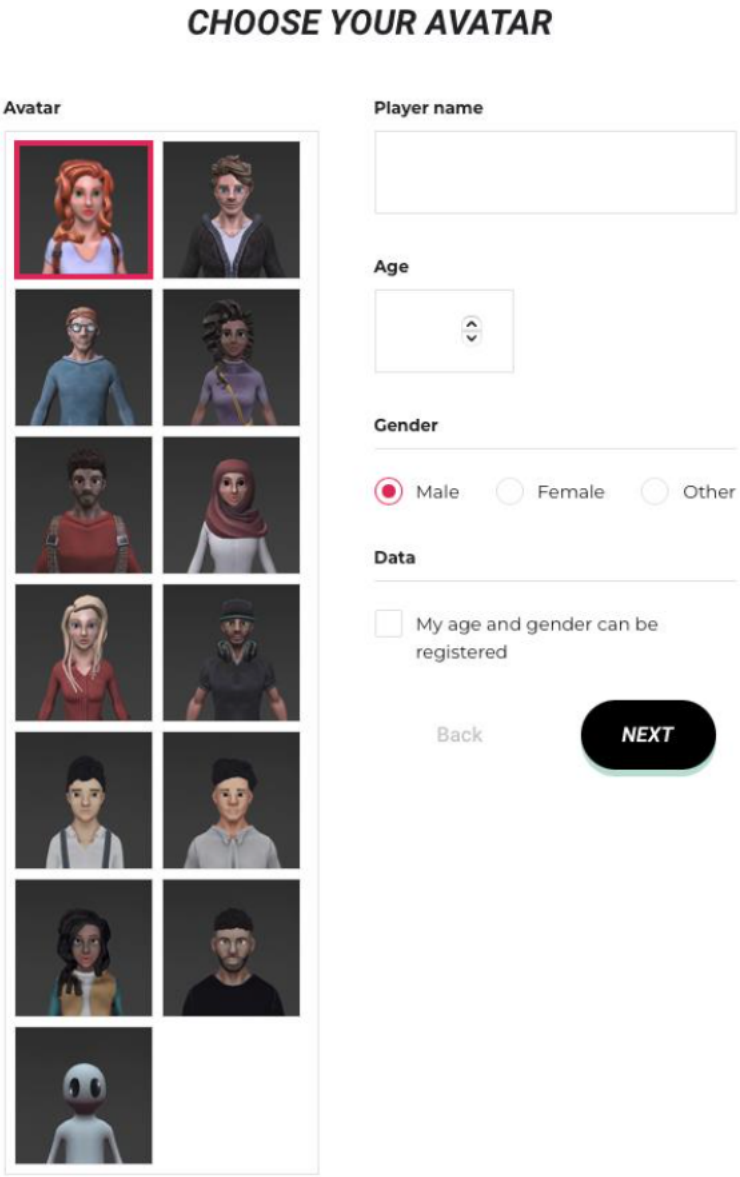
Social Ball can provide participants with a more video-game-like online environment and potentially improve their engagement in studies.

Features of Social Ball

Number of Players and Avatar Choice

A participant can play the game with two to five more players (i.e., three to six players in one session). Upon following the link to the game, participants first see the entry screen in which they are asked to choose from eight different avatars (see Figure 1). The avatar selection can also be disabled so that the participants play the game with pre-assigned avatars. As opposed to the minimal nature of Cyberball (Williams & Jarvis, 2006), the avatars in Social Ball are fully animated characters that vary in terms of race and gender representation. We also incorporated an avatar that is devoid of such characteristics to allow for researchers to manipulate belonging status without referring to the race or gender of the other players in a method more akin to the traditional use of Cyberball.

Figure 1
The Avatar Selection Screen of Social Ball



Note. The introduction screen of the game in which participants are asked to select their avatar, indicate their name, age, and gender.

These avatars are then displayed within the game in a circle. The participant's avatar is displayed at the bottom of the screen in the center (See Figure 2 for an example configuration). The Admin (e.g., the researcher) can also predetermine the name and the avatars of the other (simulated) players that will be displayed in the game.

Figure 2
Screenshot From an Example Game

Note. A screenshot from an example game. The participant's avatar is at the center of the screen with their back to the camera. Their name ("HumanPlayerName) is displayed within the black rectangle. The other avatars belong to the other (simulated) players with names displayed within white rectangles above their heads. These avatars are created by the admin and are displayed in a counterclockwise manner. The numbers below the avatars are counters, indicating how many times the avatar has received the object. The game depicted here uses the beach background. The red line at the bottom appears after a while if the participant does not throw the object around to alert them that they have the object and can click on a player to throw it.

Lobby Feature

Most paradigms aiming to manipulate belonging status, including various versions of Cyberball, rely on a certain level of deception. In these versions participants are usually led to believe that they are logging into the game with other participants. In the Social Ball game, we added a Lobby feature that can increase the belief of actually playing with other players, thus creating a more socially immersive environment. In this version, participants are first directed into a lobby. In this lobby, participants see the list of other participants that are waiting for the game to start. When there are enough participants in the lobby, the experimenter or the session leader can start the game. Then participants that are in the lobby are randomly matched together to play the game. The participants that are directed into a

game, in turn, see the nicknames and avatar choices of each other. If there is a lack of participants (e.g., there are only four participants for a six-person game), the game automatically fills in those spots with avatars pre-created by the admin. In the lobby version participants see the names and avatars of the other participants but they still play the game configured by the admin (i.e., there is only one actual human player per game). To illustrate, think of a researcher creating an ostracism scenario with four players (i.e., the participant gets the ball only for the first few rounds and never after) using the lobby feature. If the researcher were to recruit four participants to play the game, they would all see the actual avatar choices and nicknames of other participants displayed on their screen. The toss sequence of the objects, however, would follow the schedule set by the admin instead of participants actually playing a multiplayer ball-tossing game. Thus, each participant would play a scenario in which their own avatar is ostracized from the ball tossing game by the other participants in the game. We believe that this setup may increase credibility and involvement, especially when participants already know each other (e.g., students in a classroom) or if they go through a get-to-know paradigm beforehand.

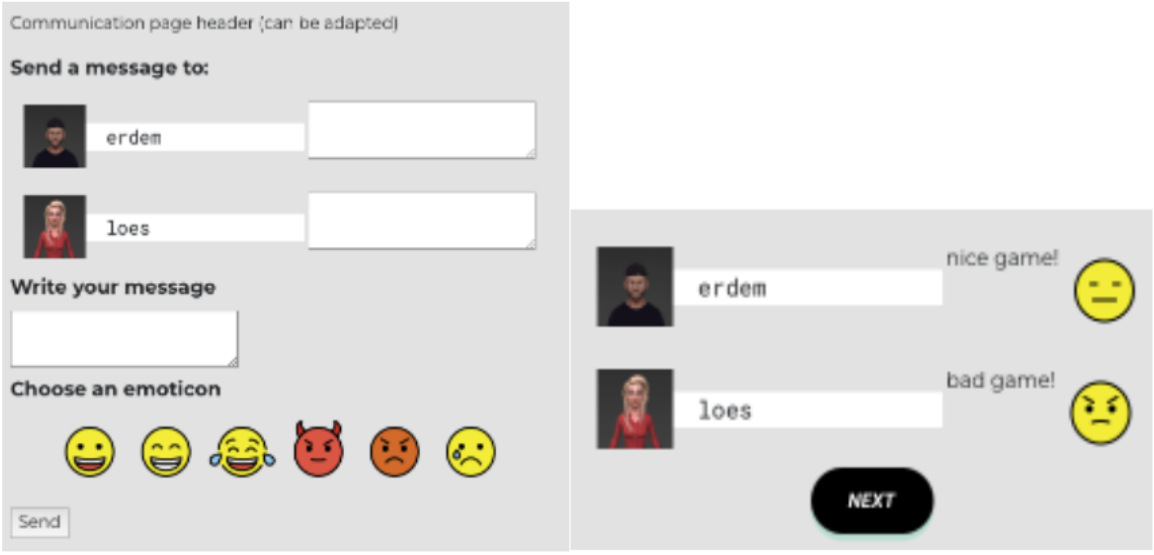
Post-Game Communication Screen

There is a post-game communication screen that simulates a situation in which all players are seemingly allowed to send each other a one-shot text message. In reality, only the participant can send a message but the messages from other players are configured by the admin. After the game, participants first see a screen in which they are asked to send a message either individually to each player or to the whole group as a broadcast (a text message and/or emoticons). Note, however, that there is no actual communication between players because it is not a real multiplayer game. The purpose of this screen is to simulate a post-game communication situation in which the admin can set the features that are enabled in this communication. The instructions in the communication screen can be adjusted. This

chat simulation is also pre-programmable such that the admin can determine what, if any, text messages and emoticons other players will send (Figure 3). Any message sent by participants will automatically be recorded in the game data.

Figure 3

Screenshots From the Post-Game Communication Screen



Note. The screenshot on the left is the screen in which the participants can send messages to other players. Participants can also choose one emoji to send. After sending, participants see the second screen (on the right) in which they see the messages sent by other players.

Waving and the "Anxiety" Function

During the game participants can wave to other players as a signal that they would like to receive the ball, by clicking on other players (akin to Claimball, de Waal-Andrews & van Beest, 2012). Researchers can also determine the waving frequency of other players in the game by setting the *Anxiety* function to a number between zero (no waving) and one (frequent waving). Participants' waving behavior is recorded in the data and can be utilized to investigate various questions such as whether asking for the ball impacts need satisfaction in post-game measures.

The Exit Button

Previous research shows how some individuals choose to seek solitude after being excluded (Ren et al., 2016, 2020). Such a withdrawal response can be enabled in Social Ball through the exit button. Admin can choose to activate an exit button which then will be

shown on the upper-left corner of the screen (see the upper-left corner of Figure 2). If activated, participants can leave the game before the game ends by clicking this button. The time at which a participant leaves the game is recorded in the dataset. Participants who exit will be directed to whichever is the next stage set by the admin (e.g., the communication screen, questionnaires, etc.).

Object Type, Number, and Counter

Researchers can determine if participants will be throwing around a ball like the Cyberball game (Williams & Jarvis, 2006), a bomb like the Cyberbomb game (van Beest et al., 2011) or a banana. Additionally, researchers can also choose to incorporate two objects to be tossed around simultaneously in the game with various throw schedules. Moreover, researchers can also activate an object counter that will be displayed underneath the avatar of each participant (See Figure 2). This counter will count each object toss that the participant receives.

Linking In-Game Behavior to Post-Game Measures

In Social Ball, researchers can choose to create a unique ID for each participant which is then presented to the participant on screen at the end of the game. In a previous implementation of Social Ball (the study on manipulation effectiveness below), we asked participants to manually enter this code to a survey software after playing the game. This ensured that all participants were playing the game until the end even if they were not getting the ball. This feature also enables researchers to link in-game behavior of participants to any post-game measures. We also share the JavaScript code that would enable researchers to seamlessly pipe this unique ID into a new variable in Qualtrics (a common survey software). This can minimize participant errors that could occur when copy-pasting IDs.

Other Customization Options

The software has some features that would allow further customization. The user can incorporate an intro and an exit page with customizable text. The introduction page would then be the first page that the participants will see upon following the link to a specific scenario. Similarly, if enabled, the exit page can also be customized and would be displayed to the players at the end of the game. Importantly, the object throw sequence can be fully customized. Besides being able to customize the throwing sequence between simulated players (e.g., player 2 throws to player 3, then player 3 throws to the participant), the admin can also change the delay for each toss individually or on average for all tosses within the game. More information about customization and related visuals can be found in the configuration manual.

Accessibility

Social Ball is a web app, and once the game is hosted on a server, researchers can use it simply through a web browser both to create scenarios (e.g., inclusion vs ostracism) but also to start a game or to lead participants to a certain scenario. The version that a participant will see can be embedded in a web page through an iFrame (thus also in a survey software like Qualtrics). To be able to use the game in full capacity, researchers will need to host the game on the servers of their institution or via private hosting companies. Hosting the game gives full control and access to the researchers and enables them to have access to the data that is generated within the game (i.e., the ball tosses and so on).

There are several basic versions of the game that are publicly available. Researchers can go to the OSF page associated with this manuscript (in the configuration manual at https://osf.io/zfqax/) to access a 3- or 4-player version with the minimalistic avatar (i.e., the alien avatar). These versions can be used by researchers who are interested in just manipulating the belonging status (inclusion vs ostracism) in a way that is commonly done so

with Cyberball (Williams, 2009; Williams & Jarvis, 2006). Researchers can use these basic versions to manipulate ostracism/inclusion within their own research without hosting the game on a server.

In our configuration manual (see SM2), we also share information that would helpfully make it easier to (a) host the game on a server, (b) set up an iFrame on Qualtrics, and (c) link the survey with the game to make using the game easier.

Overview of Previous Implementations

In the current paper we discuss two previous implementations of Social Ball. First, we use a data set from a study previously conducted in our lab which used Social Ball to make participants feel ostracized and included for another project. We used this dataset to test the effectiveness of Social Ball and show that the paradigm can be used to induce feelings of ostracism and inclusion reflected by participants' post-game need satisfaction and affect. Second, we report a secondary analysis of data provided to us by a Dutch non-profit organization (Critical Mass) that used Social Ball in a social skills training program. We used this data set to demonstrate how certain features of the paradigm (e.g., hand-waving) can be used to answer various research questions. Additionally, we created the annotated R code based on the formatting and analysis of this data (SM3).

Study 1: Manipulation Effectiveness

Here we presented an implementation of Social Ball in which we compare an ostracism (i.e., only getting the ball a few times in the beginning) and an inclusion condition (i.e., getting the ball a similar amount with the rest of the players). We compared the experiences of participants in these two conditions to see if Social Ball could effectively manipulate ostracism and inclusion.

Methods

Participants and Design

Participants were psychology students at a major Dutch university and were recruited as part of a larger study using Social Ball. Following the preregistration of the original study, we removed participants from the analysis who failed both attention checks that were embedded in the survey (n = 3). The final sample consisted of 247 participants (204 F, 40 M, 3 other; M_{age} = 20.48, SD_{age} = 3.05, range = 18-41). Participants were randomly assigned to an inclusion (n = 130) or an ostracism condition (n = 117) in a four-player version of Social Ball.

Procedure

Participants arrived at the laboratory for the experimental session that they registered for online. When all the registered participants arrived at the lab (group size up to 12), the session leader followed a script to deliver a cover story. Specifically, we told the participants that we developed a new web game (i.e., Social Ball) to be used in a social skills training and that they would be testing it and providing us with feedback. We explained that the game was interactive and that they would be playing it with other participants. We provided each participant with a randomly generated numerical code printed on a small piece of paper (i.e., the matching code) and explained that this would be used to match participants with each other to play the game together[1]. After describing the study, we asked each participant to take a seat in an individual cubicle with a computer in which the informed consent page of the survey was on the screen. After providing their consent, participants needed to enter the matching code that supposedly linked them with another participant. Next, participants played the Social Ball game with three other players and, depending on the condition, they

[1] This process can now easily be carried out by using the lobby feature of the game. At the time of the experiment, the version of the Social Ball did not yet have the lobby feature.

were either included or ostracized by other players. We told them that they were playing with other participants but, in reality, the other (simulated) players were pre-programmed to either include or ostracize the participant. Following the Social Ball game, participants reported their need satisfaction and affect. Next, we asked participants to evaluate the Social Ball game as part of our cover study. Finally, participants answer demographics questions and were debriefed before leaving the lab[2]. Participants were able to take the complete survey either in Dutch (n = 132), or in English (n = 115).

Materials

Manipulation Check. Following previous work (Williams, 2009) we used two sets of items to serve as the manipulation check. First, we used two items to check whether participants felt more ostracized in the ostracism condition than in the inclusion condition (*"I was ignored," "I was excluded;"* 1 [*not at all*] to 5 [extremely], $r_{\text{spearman-brown}}$ = .89). Second, we asked participants to indicate what percentage of the ball tosses they thought they received during the game and participants indicated their answers by writing down the answer in numbers to the provided text box.

Shortened Need Satisfaction Questionnaire. We used the shortened version of the Need Satisfaction Questionnaire (Ren et al., 2016) which contained 12 items in total. The scale consists of three items for each need which were then averaged to a single need score, namely: need for belonging (e.g., "*I felt disconnected* (R)," α = .92), need for self-esteem (e.g., "*I felt liked*," α = .86), need for meaningful existence (e.g., "*I felt invisible* (R)," α = .89) and finally, need for control (e.g., "*I felt powerful*," α = .79). Participants indicated their answers on a rating scale ranging from 1 (*not at all*) to 5 (*extremely*). Finally, we also

[2] As mentioned, Study 1 was part of a larger study for another project. We report all the measures and manipulations relevant for this project here.

calculated the mean score for all responses based on 12 items to a single overall need satisfaction score (α = .93).

Emotions. We asked participants to indicate how they felt during the game with three items. Participants indicated how hurt (*"I felt hurt"*), angry ("*I felt angry*"), and sad ("*I felt sad*") they felt on a rating scale ranging from 1 (*not at all*) to 5 (*extremely*).

Attention Checks. We used two attention check items. One item was asking participants to select a specific answer ("*Please select three*"). The other attention check item was a paragraph explaining participants to ignore the question at the end of the paragraph and select another answer instead, akin to instructional manipulation checks (Oppenheimer et al., 2009).

Results and Discussion

Studies using Cyberball and relying on the Need Satisfaction Questionnaire as a post-game measure (e.g., Bernstein Dr. & Claypool, 2012; de Waal-Andrews & van Beest, 2012; Sleegers et al., 2016; Williams et al., 2000; Zadro et al., 2004) find that, compared to the inclusion condition, participants in the ostracism condition (a) feel more rejected, (b) perceive to have received less ball tosses, (c) experience less need satisfaction in each separate need and (d) experience overall less need satisfaction. Additionally, work on various forms of ostracism and rejection also highlight (e) sadness, anger, and hurt as emotions as a result of being ostracized (e.g., Çelik et al., 2013; Chow et al., 2008; Leary, 2015; Leary et al., 1998).

The results are consistent with these findings and the full set of results, and the descriptive statistics can be found in Table 1. Participants in the ostracism condition (a) felt more rejected and (b) perceived to have received less ball tosses than the participants in the inclusion condition. Importantly, compared to participants in the inclusion condition, participants in the ostracism condition experienced less need satisfaction across all individual needs (c) and on the (d) overall need satisfaction measure, and (e), participants felt more

sadness, hurt, and anger. Taken together, these results support the effectiveness of Social Ball in manipulating ostracism and inclusion in ways similar to traditionally adapted paradigms like Cyberball (Williams & Jarvis, 2006). In previous research, the average effect size on post-game need threat questionnaires was $|d| = 1.4$ (Hartgerink et al., 2015). Here, most of the observed effect sizes are around this size or larger (see Table 1).

Table 1
Descriptive Statistics and t-test Results in Study 1: Manipulation Effectiveness.

	Exclusion	**Inclusion**				
Outcome Variables	***M (SD)***	***M (SD)***	***t***	***df***	***d***	**95%CI**
Belonging	2.32 (0.80)	4.56 (0.57)	-25.15	206.19	-3.26	[-4.18, -2.88]
Self-Esteem	2.31 (0.67)	3.40 (0.71)	-12.47	244.45	-1.58	[-1.87, -1.30]
Meaningful Existence	2.62 (0.87)	4.54 (0.66)	-19.35	214.96	-2.50	[-3.83, -2.17]
Control	1.32 (0.41)	2.25 (0.74)	-12.27	206.65	-1.52	[-1.80, -1.24]
Need Satisfaction	2.14 (0.50)	3.69 (0.43)	-25.96	230.97	-3.33	[-3.72, -2.95]
Sadness	2.21 (1.12)	1.10 (0.30)	10.42	131.07	1.39	[1.11, 1.67]
Hurt	2.48 (1.23)	1.18 (0.42)	10.90	140.46	1.45	[1.17, 1.73]
Anger	2.03 (1.09)	1.17 (0.47)	7.95	153.89	1.05	[0.78, 1.32]
M.C. Rejection	4.04 (0.81)	1.35 (0.57)	29.97	205.08	3.89	[3.46, 4.31]
M.C. Ball Tosses	10.13 (4.87)	24.94 (6.21)	-20.87	238.73	-2.64	[-2.97, -2.29]

Note. M.C. stands for manipulation check. All results reported were statistically significant at $p < .001$.

Study 2: Empirical Demonstration of New Features

Here we use a data set provided to us by the Dutch non-profit organization (Critical Mass) to demonstrate how a specific feature of the game can be used to answer certain research questions. Critical Mass used the Social Ball game as part of a training program that relies on experiential learning principles. Programs relying on experiential learning usually use a combination of first-hand experience and follow-up discussions to encourage developing new perspectives on various subjects (Kolb, 2014; Lewis & Williams, 1994). The non-profit organization used Social Ball to let students experience how it feels to be ostracized. This initial experience was then used as a basis for learning in the debriefing and

discussion sessions[3]. This data set only contains participants who were ostracized because the non-profit organization's goal use case did not require them to make people feel included.

We use this data set to explore how hand-waving in the game can be utilized by researchers to understand the effect of an in-game behavior on post-game need satisfaction. To that end, we describe the hand-waving behavior of the participants in this data set and we conduct some analyses to showcase how it can be used to test various questions. We corroborate these analyses with an annotated R code (see SM3) to make conducting these analyses more accessible.

Methods

Participants and Design

The data set consisted of 4415 participants. We cleaned the data in several ways (such as applying an age restriction and limiting the analysis to data between certain dates) to ensure that we did not incorporate test runs of the paradigm (see the Rmarkdown [SM3] file for detailed explanations on this procedure). The remaining sample consisted of 2578 participants (female = 418, male = 498, no response = 1623, other = 39, M_{age} = 13.47, SD_{age} = 1.44). Because this was a training program that was focused on the experience of being ostracized, the participants were all assigned to the ostracism condition (i.e., receiving the ball only a few times throughout the whole game).

Procedure

The non-profit organization conducted their training program in classrooms. All students were provided with tablet computers to participate in the training. After a brief introduction, participants were all given a lobby code that led them to the online lobby version of the game. This meant that when the session started, Social Ball automatically

[3] For a more detailed explanation of how similar online ball-tossing paradigms can be utilized in experiential learning programs, see Meral et al., (2022).

connected students with each other in teams of six. After choosing their game name and avatar, these six students saw each other's names and avatar choices on the game screen in a display. Even though each student was seemingly playing with a peer, the actual ball-tossing schedule was preprogrammed to ostracize each participant. To each participant it looked like they received the ball only a few times throughout the game. Participants were able to wave to other players to ask for the ball, but this had no actual effect on the ball-tossing schedule (i.e., the behavior of the other players). The ball-tossing part of the game finished after about a total of 30 tosses. Next, each participant answered the post-game questions about need satisfaction, emotions, and two open-ended questions about potential behavioral reactions[4]. Afterwards, the training program continued with the discussion that focused on the experience of being ostracized in the Social Ball game. Note that the non-profit organization provided us a data set that did not contain any personally identifying information, or data pertaining to the training program. What we are reporting here solely focuses on the use of Social Ball.

Measures and Materials

Need Satisfaction Questions. Participants answered a shortened version of the Need Threat/Satisfaction Questionnaire (Williams, 2009) that included one-item per need. Such single-item versions of the questionnaire have been used in previous work with younger populations (Abrams et al., 2011). Participants read "I felt like I belonged to the group during the game," for belonging; "I felt visible during the game," for meaningful existence; "I had the feeling that other players liked me" for self-esteem; "I felt that I had control during the game," for control. Participants indicated their answers on a 5-point scale (1 = *not at all*, 5 =

[4] We only discuss the questions about need satisfaction and emotions. For the text of the open ended questions, see SM1.

very much). We created a need satisfaction index by calculating the mean score of the four individual needs (α = .83).

Sadness and Anger. Participants reported their level of anger with the item "I felt angry during the game," and sadness with the item "I felt sad during the game"[5] (1 = *not at all,* 5 = very much).

Demographics. Demographics questions were posed at the opening page of the game (Figure 1). Participants were asked to report their gender and age but could opt out and/or ask for their demographics data not to be saved.

Results and Discussion

How Did the Participants Feel After Playing the Game?

The summary statistics with regards to the need satisfaction and emotional reactions can be found in Table 2. Note that in this study all participants of the training program were ostracized and, thus, we cannot compare this experience to an inclusion condition.

Table 2
Summary Statistics of All the Outcome Variables in Study 2.

Outcome Variables	*M (SD)*
Belonging	1.88 (1.17)
Self-Esteem	2.24 (1.33)
Meaningful Existence	1.83 (1.21)
Control	1.99 (1.27)
Need Satisfaction	1.99 (1.02)
Sadness	2.08 (1.50)
Anger	2.25 (1.55)

Do People Wave in the Game?

To assess the influence of in-game waving behavior on post-game need satisfaction and emotions, we first looked at the frequency of waving during the game. This analysis was

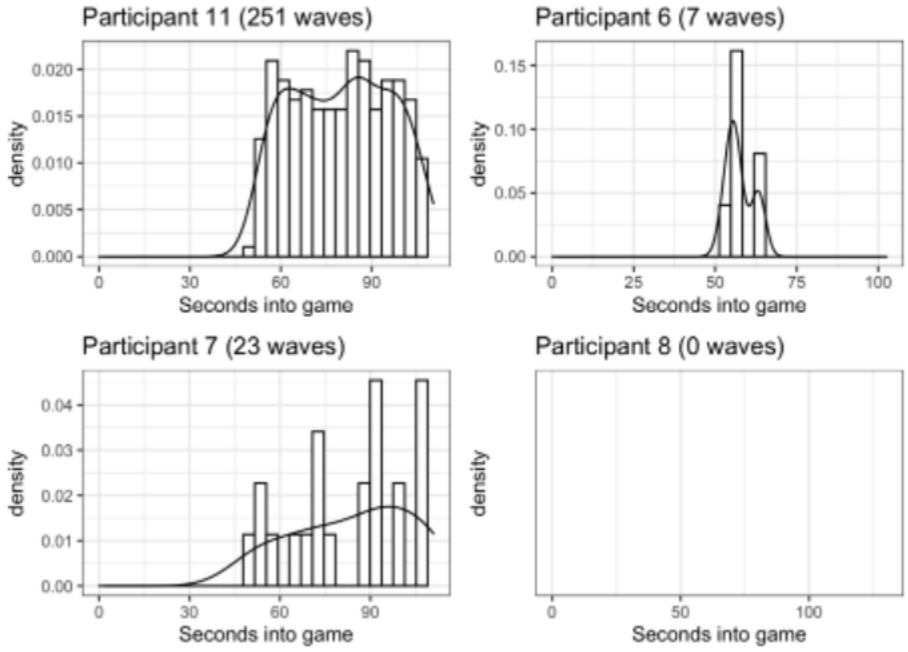
[5] For the original versions in Dutch, see Supplementary Materials 1 (SM1).

based on participants with at least some data points for in-game behaviors such as tosses and waves (n = 2,037). There was a large spread in the number of times people waved (IQR = 101, $Q1$ = 4, $Q3$ = 104), ranging from not waving at all (min = 0) to waving 319 times (max) in one game. On average, people waved about 70 times ($Mean$ = 71.52, $Median$ = 40).

There is also a difference in terms of when people wave. To illustrate, we present a visual depiction of waving behavior across time for four participants (see Figure 4). These participants not only waved in different amounts, but also at different time points. For instance, both participant 7 and 11 waved in the second half of the game with participant 11 waving at a much higher frequency (251 waves) than participant 7 (23 waves). Participant 6 only waved a few times around half-way through their game and participant 8 did not wave at all.

Figure 4

Visual Depiction of the Waving Behavior Across Time for four Participants in Study 2



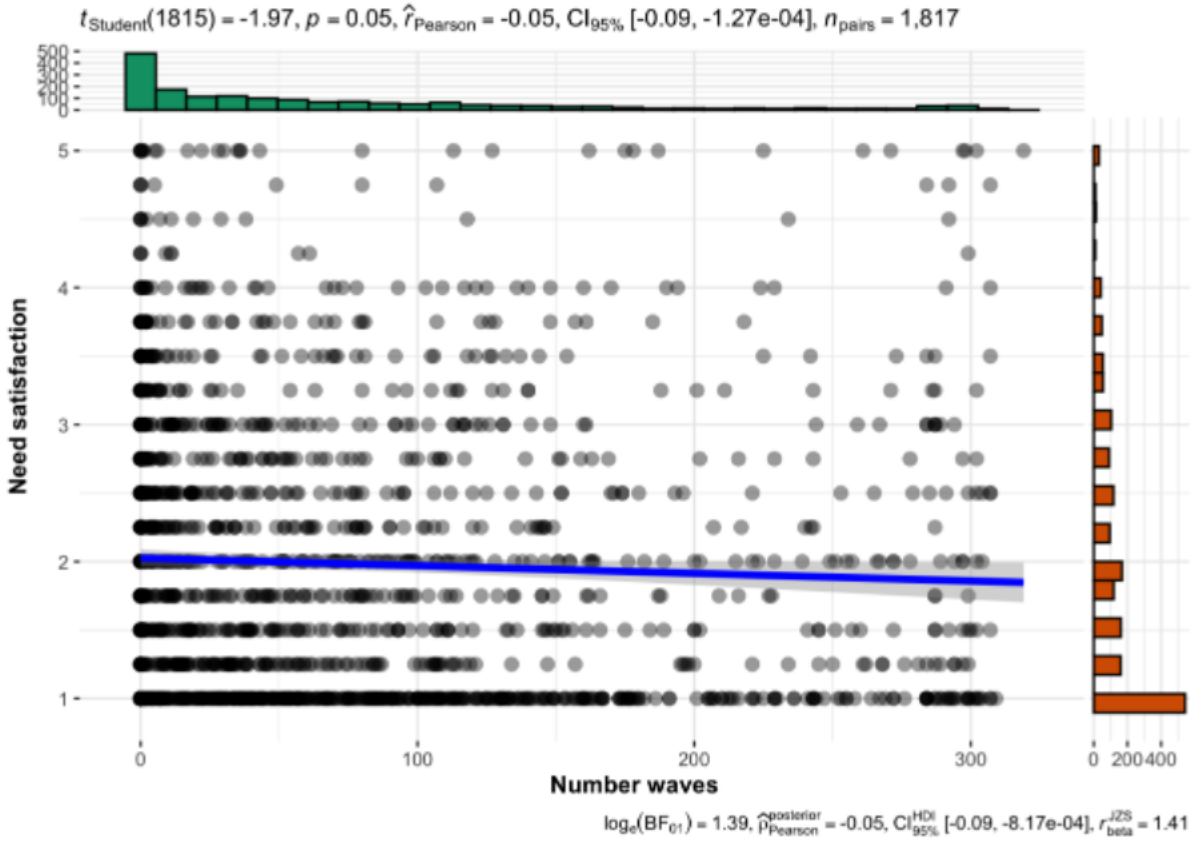
Does In-game Behavior Relate to Need Satisfaction?

We investigated whether the frequency of waving within the game was related to post-game need satisfaction. For the full set of results and the graph, see Figure 5. Both the

frequentist and the Bayesian analyses indicated that the size of the correlation ($|r|$) was smaller than .09. This suggests that amount of waving and need satisfaction only correlate to a negligible degree (Akoglu, 2018; Schober et al., 2018). The amount of waving within the game thus did not significantly relate to how participants felt after the game. In the Rmarkdown file (SM3), we present another operationalization of waving by exploring the effect of giving up (i.e., the time between the last wave and the end of the game) on post-game measures.

Figure 5

Results of the Analysis Testing Whether Waving Influences Post-Game Need Satisfaction.



General Discussion

In this article we introduced Social Ball – an immersive online ball-tossing game. We argue that Social Ball is an easy to implement and effective paradigm for ostracism research for several reasons. First, the test with respect to the effectiveness of ostracism manipulation suggested that Social Ball can successfully induce feelings of ostracism in ways similar to the

established paradigm Cyberball (Williams & Jarvis, 2006). Second, researchers have full control over the social interactions within the game (via pre-programmed actions). This allows for exploring the impact of very specific group compositions and behavior patterns within and after the game – via the communication screen. Additionally, the lobby feature allows researchers to introduce some ecological validity by showing the selected avatars and nicknames of a group of participants to each other. Third, after hosting, the software functions as a point-and-click web app and does not require any programming knowledge. We believe that this makes the software easily accessible and easy to implement. We present additional instructions and tips in the configuration document to make the process easier on potential users (also includes instructions on hosting).

Additionally, we presented a previous implementation of Social Ball in an educational context (data based on social skills training). Participants in this data set were primary and secondary school age children. Here we focused on how the hand-waving feature in the game can be used to explore various questions. The results showed that participants differed in the extent of waving to receive the ball, which may be an interesting feature to include in future research (e.g., to tap attempts that may signal one's need for control or attempts to be included).

Prospects and Possible Avenues

Social Ball allows researchers to configure group settings in which the gender and the race representation can be varied. Researchers can easily alter the composition of the group in terms of race and gender to investigate questions pertaining to differences in group membership and their influence on feelings of belonging. By doing so, Social Ball can help contribute to the ongoing research on how group membership in terms of race (Aureli et al., 2020; Gonsalkorale & Williams, 2007; Goodwin et al., 2010; Mulvey et al., 2016) or gender

(e.g., Bolling, 2016; Bolling et al., 2012; Hawes et al., 2012; Wirth & Williams, 2009) influences or is influenced by belonging threats.

Users can program two objects to be tossed in the game with various throw schedules. We have not yet used this feature in our research, but it allows designing games in which the participants are excluded from the toss of both objects, one object; or are included in the tossing of both objects. Such designs would enable researchers to test the effect of more complex situations that were not possible in previous versions of the ball-tossing game. Would being included in tossing one ball but not the other be better than being excluded from both tosses? How would people feel if they get a bomb thrown to them but not the ball? Additionally, the object counter – another property of the objects within the game, can be utilized for various purposes. By relying on instructions, researchers can use this counter to either strengthen the manipulation (i.e., the excluded participant received clearly less ball tosses than the others) or can potentially attach other meanings to the number of ball tosses (e.g., for each ball toss you receive you will get 10 cents).

Previous work on behavioral responses to ostracism shows that some individuals choose solitude after being ostracized (Ren et al., 2016, 2020). In Social Ball, researchers can activate an exit button and allow participants to leave the game sooner than the programmed duration. Such a setting would allow researchers to investigate factors predicting withdrawing from a situation in which one is ostracized by others. For instance, researchers can investigate whether people tend to withdraw by exiting the game quicker if they are ostracized by in-group or out-group players. Additionally researchers can also investigate whether factors that relate to solitude-seeking such as introversion (Ren et al., 2016) also predict quicker or more frequent exit behavior. Such studies would contribute to the overall understanding of how people respond to being ostracized by specifically zooming on withdrawal behaviors.

Besides a few recent exceptions (e.g., Meral et al., 2021; Zimmerman et al., 2021) interpersonal communication following ostracism has received little empirical attention. By using Social Ball, researchers can ask questions about if and how targets communicate with the sources following ostracism. For example, researchers can investigate whether the targets tend to confront the sources or what kind of emotions are being communicated by the targets. Alternatively, researchers can also study the participants' reaction to messages sent by other players. Does receiving an apology from the sources restore threatened needs? The post-game communication feature can easily be implemented to contribute to the understanding of this under-researched response following ostracism.

In addition to various research-focused uses, Social Ball can be utilized for educational purposes. As we briefly touched upon in the second implementation of the paradigm, the data in that study were from a training program a Dutch non-profit organization carried out in schools across the Netherlands. The non-profit used Social Ball as part of an experiential learning program in which the participants (students) were first asked to play Social Ball. This phase served as the first-hand experience of exclusion which then was used as a starting point in the discussions about exclusion and inclusion in general. Such experiential learning programs are used in schools (e.g., Healey & Jenkins, 2000) or workplaces (Heath et al., 2021) to raise awareness about various issues such as sexism or bullying (e.g., Cundiff et al., 2014; Hall et al., 2009). We think Social Ball is a feasible education tool for two main reasons. First, it can be easily implemented if there is internet access. It also does not require computers and can be played on tablets that have a touchscreen. Second, the lobby feature can increase the credibility of the game and involvement in cases where a group of individuals who already know each other are playing the game together. For instance, if the game is being used in a classroom the lobby feature would enable each participant to see the name/nickname of another peer from that classroom.

Conclusion

In this article we introduce Social Ball, a new, immersive online ball-tossing game that can be used as a research paradigm to study ostracism. Besides describing the features of Social Ball, we also share a configuration manual and an annotated R code to help format the data and carry out some common analyses. Moreover, we also reported findings from two use cases of the software. First, we verify the effectiveness of the paradigm by showing that ostracized (vs included) participants experienced less need satisfaction and more negative affect. This suggests that Social Ball can be used to induce feelings of ostracism. Second, we show that people used the hand-waving function within the game but that this behavior did not relate to need satisfaction following ostracism. To summarize, we argue that Social Ball is a promising, feasible and effective research paradigm to introduce variations in belonging.

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