CanTouchThis: Examining the Effect of Physical Contact in a Mobile Multiplayer Game

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Abstract
Smartphones have become ubiquitous and smartphone users have been called anti social because of the high amount of usage they frequently show. In this paper we want to examine if smartphones on the other hand might even be used to bring people. We present *CanTouchThis*, a smartphone game designed around two players physically sharing one smartphone to increase social interaction. We conducted a user study (n=12) examining the effects of physical contact on player experience and emotional benefits of communication. The preliminary analysis shows that playing on a shared device leads to higher valence scores compared to playing on separate devices.

Author Keywords
mobile game; physical interaction; empirical study; player experience

ACM Classification Keywords
K.8.0. [General]: Games; H.5.2. [User Interfaces]: Evaluation/methodology

Introduction
Smartphones became an essential part of our day, storing and offering vast amounts of information and simplifying our lives. On average we access our smartphone approximately 70 times a day [9]. However, the public perception of

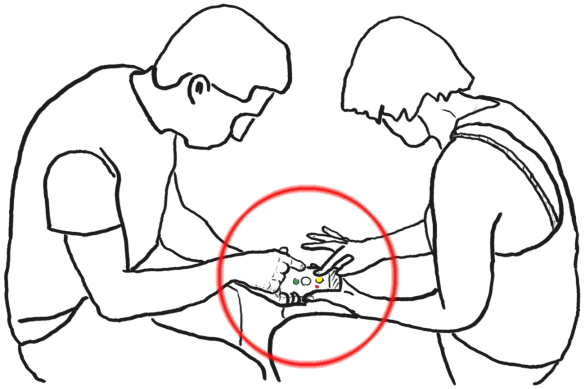

Figure 1: Two players playing *CanTouchThis* on a single shared screen in a typical play setup.

smartphones is that they reduce social interaction and impede face-to-face communication [4]. This results in people often trying to avoid using smartphones during social gatherings. This work presents *CanTouchThis*, a smartphone game designed around two players physically sharing one smartphone to increase social interaction. In particular, our findings highlight the positive impact of physical contact in a mobile multiplayer game on player enjoyment.

Prior work already started to explore the effects on social interaction in co-located handheld gaming [16, 2, 12] and mobile, pervasive games [5]. Xu et al. showed with *BragFish* how to design for a co-located AR gaming experience and found that handheld AR games can foster a strong sense of shared play [16]. Cao et al. further explored the design space of co-located multi-user interactions, but instead of smartphones used two handheld projectors which can be combined to create a single shared projected display for collaboration [2]. Kauko et al. used several smartphones and combined them to a shared surface, showing that local play on shared screens greatly increases the amount of oral communication between the players [12]. Prior work analyzed computer-supported physical games [11] and game design aspects of co-located mobile games [7]. Furthermore, the general concept of sharing one smartphone between two users was already implemented in some apps such as Bounden [15] and Bloop [10]. However, to the best of our knowledge we are the first to investigate the impact this shared device and in particular physical contact has on enjoyment and social interaction.

The main research question of this work is to explore the effects of physical contact on player experience and social interaction. For that purpose we present *CanTouchThis*, a smartphone game designed around two players physically sharing one smartphone to increase social interaction and player experience. The results of a first preliminary user study confirm that physical contact leads to higher valence.

CanTouchThis

We implemented *CanTouchThis* as a casual multiplayer game that can be played on a single shared mobile screen, i.e. a smartphone screen. Players sit opposite of each other and interact with the game via touch (see Fig. 1). In the game both players control an avatar that follows their finger on the screen. The game mechanics are based loosely on air hockey[1] in a way that there is a ball that the players have to guide into a goal to score points. Contrary to air hockey, *CanTouchThis* has only one goal that is situated in the middle of the playing field (see Fig. 2). Further, players do not kick balls, but rather drag them around. When a player avatar touches a free ball, control over the ball is assigned to the player and it starts following them around.

[1] https://en.wikipedia.org/wiki/Air_hockey

Figure 2: Overview of the game interface of *CanTouchThis*. The dark green ball is currently following the green player avatar. The goal of the players is to guide the ball into the goal in the middle of the playing field.

Players score by dragging a ball they control to the goal in the middle of the playing field.

The other player has two ways of getting control over the ball: (1) she has to snatch the ball on its way while it is following the avatar of the player in control or (2) break the link between the player in control and the ball by removing the finger's connection to the touchscreen. The result is game play that frequently involves physical interaction of both players.

Game Modes

There are 3 different game modes in *CanTouchThis*: *competitive*, *cooperative*, and *mixed*. While the core game concept stays the same, i.e. controlling an avatar and scoring by steering the ball into the goal, the modes differ in the more abstract rules of the game. Games in all modes last for 45 seconds. In the *competitive* mode there is just one ball that respawns randomly on the field after a player has scored and the player who has scored more points at the end of the time limit wins the game. In the *cooperative* mode the players' points are added up and their goal is to achieve as much points as possible. In this mode there are several balls on the playing field simultaneously and the balls are pre-assigned to a specific player, i.e. only the yellow player can control a yellow ball. The *mixed* mode was designed in a way that the players were playing against each other but are also highly dependent on the actions of the other player. In this mode players also fight over one ball and their goal is to score more points than their opponent. Compared to the *competitive* mode however, there is a feature that makes the playing field's orientation dependent on the rotation of the smartphone. Tilting the phone in a direction rotates the playing field into that direction and as a result makes the ball roll there as well. This mode leads to even more physical interaction as players can choose to use the rotation of the shared device to their advantage.

Preliminary User Study

A preliminary user study was conducted to explore the effects of physical contact on player experience and social interaction. For that purpose *CanTouchThis* was iteratively designed in two play configurations: (1) *shared screen*, i.e. the regular configuration of *CanTouchThis* in that both players play the game on a single shared screen and (2) *network*, i.e. players playing on separate devices that are connected over network. So both configurations did feature the same basic game mechanics, but in the *shared screen* variant physical contact was frequent as the players' fingers would often touch. This was explicitly designed this way with the constrained space on the smartphone. In both conditions, participants did sit opposite of each other in order to guarantee a fair comparison. Further, we examined the different game modes and their influence on players'

experience.
Two main variables were deemed important for a valuable experience in a game that aims to bring people together. First, emotion was measured using the SAM questionnaire [1]. Second, we wanted to evaluate if the communication of the players was different. So we employed the subscales *emotional expressiveness*, *engagement & playfulness*, *presence-in-absence*, and *opportunity for social support* of the ABCCT [17] questionnaire to measure the emotional benefits of the communication with the game.

Therefore, the present study was conducted with a 2x3 within-subjects design with the independent variables play configuration (*shared screen*, *network*) and game mode (*cooperative*, *competitive*, *mixed*). Play configurations were counterbalanced to avoid order effects. Regarding balancing of game modes, all three game modes were played for a specific play configuration in succession. While *cooperative* and *competitive* were counterbalanced as well, *mixed* was always the last played game mode as it was a mixture of *cooperative* and *competitive* and players did have to know the other mechanics first in order to decently play the *mixed* game mode. This order of modes was also based on the feedback of the participants that played the game during pre-tests in the iterative design.

Participants
We recruited 12 participants (6 female, 6 male) with an average age of 23.92 years (*SD* = 1.782). They were students with a mostly technical background. 6 (50%) reported that they played digital games multiple times per week, while only 2 (16.7%) reported doing so on a smartphone. Participants were recruited in pairs in order to guarantee that only participants played against each other who were familiar enough for the physical game play. Participants were compensated with 5 euros and chocolate.

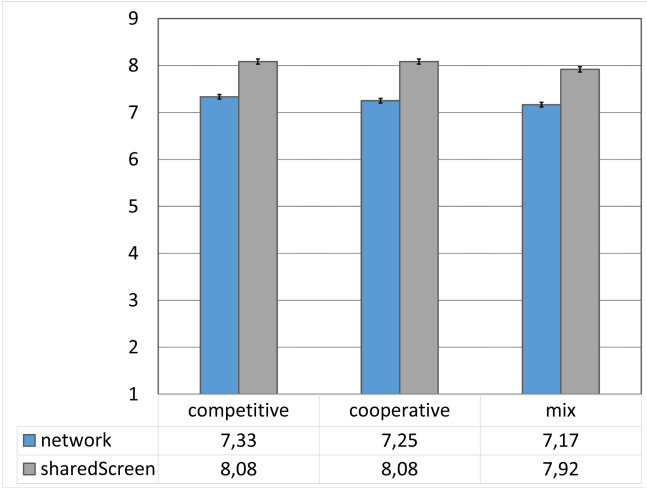

Figure 3: Valence scores for the different play configurations and game modes.

Procedure
Participants were invited into a university lab in pairs. They were placed on chairs opposite of each other in short distance (see Fig. 1) for all conditions. A video camera was placed on a table next to the participants to record their interaction. First, they were introduced to the general topic of the study. Subsequently, they stated their consent to the study and then completed a demographic questionnaire. Then, they played a match of *CanTouchThis* for each of the 6 conditions. In the *shared screen* variant the participants played on a shared smartphone, while they were given a separate device each in the *network* variant. Every match consisted of a preparation phase (15 seconds) and 3 rounds (45 seconds). Subsequently, the participants completed the SAM and the ABCCT subscales. After every

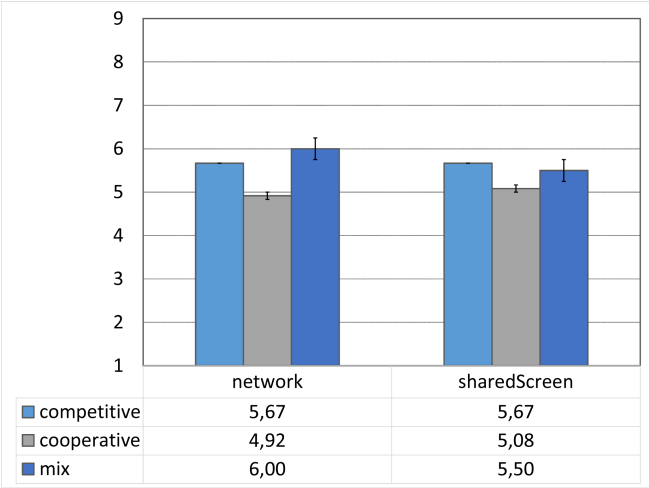

Figure 4: Arousal scores for the different play configurations and game modes.

play configuration, i.e. *shared screen* or *network*, participants completed another questionnaire containing further questions about their experience and behavior.

Results

Repeated measures ANOVAs were conducted to analyze the effects of play configuration and game mode on emotion and social interaction. The results show that the valence scores were significantly affected by the play configuration, $F(1, 11) = 9.625$, $p = .01$, $partial\ \eta^2 = .467$ (see Fig. 3). Participants reported higher valence for the *shared screen* variant ($M = 8.028$) compared to the *network* configuration ($M = 7.250$). The game mode, however, did not significantly influence valence scores, $F(2, 10) = 0.196$, $p > .05$. Arousal scores were not influenced by the play configuration, $F(1, 11) = 0.423$, $p > .05$, but by the game mode, $F(2, 10) = 4.486$, $p = .02$, $partial\ \eta^2 = .29$ (see Fig. 4). Pairwise comparisons revealed that the *cooperative* mode ($M = 5.000$) did elicit lower arousal than the *mixed* game mode ($M = 5.750$), $p = .021$ (Bonferroni adjusted significance). The other pairwise comparisons did not show any significant differences. Regarding the reported dominance there were no significant effects of play configuration, $F(1, 11) = 1.405$, $p > .05$, and game mode, $F(2, 10) = 0.560$, $p > .05$.

The results did not reveal any significant effect of play configuration or game mode on any of the examined subscales of the ABCCT. Participants stated their agreement to several statements regarding their experience and behavior independent of the game mode on 5-point Likert scales. Results were analyzed via dependent t-tests. Players ratings indicate that they felt they played more offensively in the *network* condition ($M = 3.75$) than in *shared screen* ($M = 2.75$), $t(11) = -2.708$, $p = .02$, while they felt that they played more defensively in *shared screen* ($M = 3.00$) than in *network* ($M = 2.17$), $t(11) = 2.590$, $p = .025$. Further, participants ratings if they would play *CanTouchThis* with a stranger were significantly higher for *network* ($M = 3.75$) than for *shared screen* ($M = 3.17$), $t(11) = -2.244$, $p = .046$.

Discussion

The preliminary analysis shows that the physical contact through playing on one shared device elicits a more positive play experience than playing the same game in a networked version on separate phones. Players overall reported significantly higher valence for *shared screen* than *network*, confirming the main hypothesis that physical contact leads to a better experience. This is also in line with previous work that linked physical interaction with increased enjoyment, social interaction, and cognitive benefits [13,

6, 14, 8]. Thus, this first evaluation confirms the findings of previous research in the mobile multiplayer gaming context. Further, we expected that the physical contact through playing with one device would also lead to more communication of players. However, the results showed no significant differences for the examined ABCCT subscales. While it is possible that there is indeed no difference in communication, it might also be that the ABCCT was not the correct instrument for detecting such differences in a game context. As sharing a screen did lead to increased oral communication in previous related research [12], we plan to further examine the video recordings of the game sessions in order to evaluate if a similar effect might be present in our work.

Although it was not the main focus of the present study, the influence of the different game modes on players' experience was examined as well. Arousal was highest for the *mixed* game mode. This might be indicative that the integration of interdependence into an competitive mode was interesting for players. However, it has to be noted, that game modes were not fully counter balanced and the *mixed* game mode was always the last played game mode. This might have influenced ratings as it was kind of a final showdown and effects might come from learning effects as well.

Recent research has shown that games are useful as ice breakers for distributed teams [3]. Similarly, *CanTouchThis* was designed to bring people together and improve communication of the players and could thus be used as an ice breaker game as well. However, the results of this study show that people would prefer playing *network* play configuration over the *shared screen* game variant, when playing with a stranger. This might be indicative that although physical contact leads to positive effects on the players' experience, this effect might not be true for playing with strangers. So in order to guide design of games as ice breakers it is necessary to further examine if the positive effects of physical contact are generally existent. In this study, however, we only examined pairs of participants that did already know each other well. Further, the participants stated that they played differently, i.e. defensively vs. offensively, depending on the play configuration. Thus, in further analyses as well as future work we plan to explore the question further what aspects of the design, e.g. game mode, as well as the play circumstances, e.g. the specific dyadic social relationship of players (friends, strangers, romantic partners), influence the experience and behavior of players.

Conclusion and Future Work

In this work we presented *CanTouchThis*, a smartphone game designed around two players physically sharing one device, to investigate the effect of physical contact on players' experience and social interaction in mobile multiplayer games. A preliminary user study was conducted to examine the effects of two players playing *CanTouchThis* on a single shared screen or on two separate screens. The results show that playing on a shared device leads to higher valence, but did not affect their impression of the game as a communication tool. In future work we plan to examine the video recordings of the participants' communication during the user study in order to confirm the preliminary findings regarding the positive effects of physical contact on positive emotions and examine if communication can be improved as well. Further, there is more research necessary to study what aspects of the design as well as what play circumstances are important when employing a game like *CanTouchThis* in order to improve the players' experience and social interaction.

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