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

Julian Frommel
Institute of Media Informatics
Ulm University, Ulm, Germany
julian.frommel@uni-ulm.de

Enrico Rukzio
Institute of Media Informatics
Ulm University, Ulm, Germany
enrico.rukzio@uni-ulm.de

Jan Gugenheimer
Institute of Media Informatics
Ulm University, Ulm, Germany
jan.gugenheimer@uni-ulm.de

Michael Weber
Institute of Media Informatics
Ulm University, Ulm, Germany
michael.weber@uni-ulm.de

David Klein
Institute of Media Informatics
Ulm University, Ulm, Germany
david.klein@uni-ulm.de

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
smartphones is that they reduce social interaction and im-
pede face-to-face communication [4]. This results in people 
often trying to avoid using smartphones during social gath-
erings. 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 Brag-
Fish 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 in-
stead of smartphones used two handheld projectors which 
can be combined to create a single shared projected dis-
play for collaboration [2]. Kauko et al. used several smart-
phones 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 smart-
phone 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 con-
tact 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 fin-
ger on the screen. The game mechanics are based loosely 
on air hockey 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, play-
ers 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.

\[1\text{https://en.wikipedia.org/wiki/Air_hockey}\]
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.

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
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,
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 a 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 future 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.

**Acknowledgements**

We thank the study participants; we also thank the Carl-Zeiss Foundation for the partial funding of this work.
References


