Exploring Interpersonal Interaction Through the Design, Evaluation, and Enhancement of a Mobile Game





# AALBORG UNIVERSITY

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### Synopsis:

This master thesis describes the design, evaluation, and enhancement of a mobile game to encourage interpersonal interaction.

The design was created based on a design workshop for creating design ideas for this type of game and a study in communication theories. The design ideas from the design workshop was used together with a pragmatic approach of the communication theories to create the puzzle game, Jiggy-Time.

JiggyTime was evaluated as a means to encourage interpersonal interaction between people who did not know each other beforehand. This was done by continuously enhancing the design through the evaluation. The results showed that it was possible to make people interact on an interpersonal level by playing the game, although, it required the interaction to be forced through the game design.

## Preface

This master thesis is written by project group d611a at the Department of Computer Science, Aalborg University in the spring of 2009.

This report gives an overview of the master thesis as a whole and connects the different aspects of the research. The result of the thesis is two papers which are included in the appendix of the report. Since this report is based on the papers, it will have repetitions of some parts.

When external sources are used in the report, the reference for the source is written in square brackets, for example [1], which then corresponds to a description in the bibliography.

When the words we and our are used it refers to the authors.

We would like to thank the participants at the design workshop and the field study tests for their help and interest in this research. Furthermore, we would like to thank Café Nordkraft and the walk-ons for letting us conduct the tests in a realistic environment. And lastly, we would like to thank Jan Stage for supervising this thesis.

Project group d611a

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## Contents

1	Intr	roduction	1
<b>2</b>	Pap	per Summary	3
	2.1	JiggyTime: Designing a Mobile Game to Encourage Interper- sonal Interaction	3
	2.2	JiggyTime: Evaluating and Enhancing a Mobile Game Design to Encourage Interpersonal Interaction	5
3	$\mathbf{Res}$	earch Method	9
	3.1	Categorizing "JiggyTime: Designing a Mobile Game to Encourage Interpersonal Interaction"	9
	3.2	Categorizing "JiggyTime: Evaluating and Enhancing a Mobile Game Design to Encourage Interpersonal Interaction"	11
4	Cor	nclusion	13
Bi	bliog	graphy	15
A	Des	ign Paper	16
в	Eva	luation Paper	26

## Chapter 1

## Introduction

The gaming industry has the last couple of years reacted to a trend of its consumers and taken different social aspects into concern when designing their products. This can be seen in the increase of social functions in games and especially in the increase of multiplayer games. Also, as the newest trends, we see cooperative gameplay and interweaving of other social networks (Facebook, YouTube) into the games.

The total global market for mobile games was in 2007 \$4.4 billion with a yearover-year growth of 23% [1]. This makes the mobile game market one of the fastest growing markets in the world. Simultaneously, the technology incorporated in mobile devices is in a rapid pace and every year introducing new technologies that alter peoples use of the medium (WiFi, GPS, Accelerometer). All these factors make mobile devices an interesting and constantly evolving medium, especially in the context of human-computer interaction and socialization.

In association to this, several newer studies have expressed concerns of how people are becoming alienated from each other as an effect of the increased technology in our everyday life, specifically amongst online game players [4]. Online games are virtual communities where players can assume any role they desire and choose to either cooperate with or play against other players. These games are characterized by anonymity, real-time interaction, lack of boundaries, and offer the ability to socialize in clans and through online chats, i.e., mediated social interaction.

Over the past ten years the popularity of online games have massively increased and have become the primary reason why many gamers spend hours each day online. This has caused several researchers to examine the addiction these games can have on people and the accompanying social problems which arises from online games and Internet over-usage [2] [5].

In this research we wanted to explore alternatives to newer multiplayer games by creating a game which encourages interpersonal interaction rather than mediated interaction. This led us to the overall research question and initial thesis for this study:

**Overall Research Question:** How can we create a system to encourage interpersonal interaction?

We wanted to encourage interpersonal interaction between people that do not know each other in advance. We wanted the tool for this specific interaction to be in the form of a multiplayer game, supporting interaction between two or more players. We did not want the game to be confined to a specific physical location or a specific social context. The game also had to be available and accessible to the vast majority of people disregarding gender, technological experience, or social class. These thoughts lead us to choose a mobile platform for the study, which also lead us to the first sub-question:

**Research Question 1:** How can we design a mobile game to encourage interpersonal interaction between people who do not know each other beforehand?

The game would need to be evaluated as a means to encourage interpersonal interaction in order to check the success of the design. This lead us to the second sub-question:

**Research Question 2:** *How can we evaluate a mobile game which encourages interpersonal interaction between people who do not know each other beforehand?* 

These two research questions define the two phases of the study, i.e., designing a mobile game and evaluating the mobile game. Each of these research questions are answered in two papers which form the basis for this study. The papers can be found in Appendix A and B.

Following this introduction, a chapter presents a summary of the two papers to give an overview of the content of each paper. After that, a chapter describes the research method for this study. Finally, the study is concluded in a chapter describing the answer to the overall research question as well as the limitations and future work.

### Chapter 2

## Paper Summary

This chapter presents and summarizes the two papers which form the basis of the thesis. Each paper provides answers to research question 1 and 2 respectfully, and contributes to the overall research question for the thesis.

The first paper concerns the design of the game, JiggyTime, while the second paper concerns the evaluation and enhancement of the game. The full length of the papers can be found in Appendix A and B.

### 2.1 JiggyTime: Designing a Mobile Game to Encourage Interpersonal Interaction

The goal in this paper was to design a mobile game to encourage interpersonal interaction between people who did not know each other beforehand. This was done by conducting a design workshop with the purpose of creating design ideas for this type of system which we could use as inspiration when creating our own design. Additionally, we studied communication theories which, through a pragmatic approach, was used in the design process to create the final design.

The design workshop was conducted at Aalborg University with nine participants with relevant competences within the areas of Computer Science, Psychology, Informatics, Humanistic Informatics, Software Engineering, and Game Programming. The workshop was created around three main design activities, Sketching, Bodystorming, and Six Thinking Hats, which were performed respectively. The idea was that the participants should create initial ideas during the Sketching design activity and further develop and enhance these during the Bodystorming and Six Thinking Hats design activity. The results from the workshop were analyzed and categorized in to the seven detailed and thorough design ideas.

- Virus: In short, the idea was that each player had a virus of a certain color and needed to infect other players so they became the same color as him.
- **Riddle Game:** The basic principle for the Riddle Game design idea was that each player had a unique clue about the state of the game, and needed to exchange information with other players in order to reach their goals.
- Mimicking Smokers: The Mimicking Smokers idea was to copy the social interaction smokers have by having groups of people performing small assignments in dedicated areas.
- Health Tamagotchi: The idea is that the players are split in groups, which each are responsible to take care of a "tamagotchi" and keep it happy by eating properly and do exercise.
- **Proximity:** In the Proximity idea players continuously gained points from being in close proximity to other players.
- 20 Questions: The 20 Questions idea was a revised version of the TV show of the same name, but instead of the players guessing random items, concepts or similar, they were trying to guess the person they were in contact with.
- **Punishment:** The simple principle of this idea was to "punish" the players instead of rewarding them through points, meaning the winning condition was to be the least "punished" through the game.

The study in communication theories was done in several steps. Firstly, on a superficial level sorting the different areas of communication into relevant or irrelevant importance to our goal. This led us to focusing on communication theories on verbal communication and concentrating our research into the area of conversation and meetings, more specifically, on meetings of strangers and "good" conversations. This further led to the study of the four main communication theories covered in the research; mediated versus interpersonal interaction, "icebreaking", control (power), and context.

The result from combining the design ideas with a pragmatic approach to the communication theories was the game, JiggyTime. JiggyTime was a simple puzzle game, where the goal was to solve a 3x3 puzzle in one of three colors. This was done by continuously getting new pieces to swap in to the puzzle and by trading puzzle pieces with other nearby players. The rough prototype of JiggyTime's design can be seen in Figure 2.1.



Figure 2.1: A rough prototype of the functional design and user interface of JiggyTime.

The paper concludes JiggyTime as an interpersonal, mobile, casual, and collaborative game design and suggests the future work to be the implementation and evaluation of JiggyTime as a means to encourage interpersonal interaction.

### 2.2 JiggyTime: Evaluating and Enhancing a Mobile Game Design to Encourage Interpersonal Interaction

This paper was created as a follow-up to the previous design paper, with the goal of evaluating the game, JiggyTime, as a means to encourage interpersonal interaction between people who do not know each other beforehand. This was done by implementing and testing three versions of JiggyTime, and continuously enhancing the implementation through an iterative process based on the results from the previous tests.

The three tests were conducted on three different days, one day for each version of JiggyTime and each day being the last workday of the week. All three versions were based on the original design as described in the design paper, but with different levels of interpersonal interaction. JiggyTime 1 was implemented to only contain the single-player part of the game and *no* multi-

Participant	Puzzles solved	Reading menu	Looking around	Trading	Interpersonal contact	Maintaining contact
Male 1	2	4	19	Not available	0	No
Male 2	3	1	24	Not available	0	No
Male 3	1	0	15	Not available	0	No
Male 4	3	1	21	Not available	0	No
Female 1	0	5	11	Not available	0	No
Average	1,8	2,2	18		0	0 out of 5

Table 2.1: Table listing results from test 1.

Participant	Puzzles solved	Reading menu	Looking around	Trading	Interpersonal contact	Maintaining contact
Male 5	1	1	2	Yes	1	N o
Male 6	1	1	2	Yes	0	No
Male 7	2	0	2	Yes	1	No
Female 2	1	0	3	Yes	0	N o
Male 8	4	0	12	Yes	0	N o
Average	1,8	0,4	4,2	5 out of 5	0,4	0 out of 5

Table 2.2: Table listing results from test 2.

player part. JiggyTime 2 was implemented to contain both the singleplayer and multiplayer part and offer the *possibility* for interpersonal interaction. Finally, JiggyTime 3 was implemented by enhancing the design of JiggyTime 2 and "forcing" the interpersonal interaction.

The procedure for testing the three versions was identical and was build around three tasks which the participants should complete. The most important of these tasks, was the task of playing the actual game situated in a social context in a café with walk-ons acting as other players. During the tests, data was collected through recording the test sessions on video and conducting qualitative interviews with each participant after the tests. Table 2.1, 2.2, and 2.3 show the results gathered from the video recordings from testing JiggyTime 1, 2, and 3 respectively.

Participant	Puzzles solved	Reading menu	Looking around	Trading	Interpersonal contact	Maintaining contact
Female 3	1	0	2	Yes	1	No
Female 4	2	0	9	Yes	5	No
Male 9	0	0	14	Yes	4	No
Female 5	1	0	8	Yes	2	Yes
Male 10	1	0	8	Yes	4	Yes
Average	1	0	8,2	5 out of 5	3,2	2 out of 5

Table 2.3: Table listing results from test 3.

The paper concludes that it was possible to reach the goal of making people initiate interpersonal interaction by playing the mobile game, JiggyTime, although it required the interaction to be "forced" through the game design. Additionally, we noticed the participants changing behavior depending on which version of JiggyTime they were playing. This was not a goal for this paper, but could be used as the basis for a related research of provoking specific behaviors through a game design.

## Chapter 3

## **Research** Method

The following chapter describes the research methods used for answering our research questions. As a means of describing the research methods used in the two papers, we used the research method definitions from the work of Kjeldskov & Graham [3].

Kjeldskov & Graham presented a system of eight different research methods and five different research purposes. These definitions were used to categorize research papers within the field of mobile human-computer-interaction. The following are the listings of the research methods and purposes, finalizing with the categorization of the papers from Appendix A and B.

- The eight research methods: Case Studies, field studies, action research, laboratory experiments, survey research, applied research, basic research, and normative writings.
- The five research purposes: Understanding, engineering, re-engineering, evaluating, and describing.

### 3.1 Categorizing "JiggyTime: Designing a Mobile Game to Encourage Interpersonal Interaction"

Applied research with the purpose of engineering was the research method and purpose used for answering research question 1.

#### 3.1.1 Research Method

According to Kjeldskov & Graham, applied research builds on trial and error on the basis of the researchers' capabilities of reasoning through intuition, experience, deduction and induction. We used the participants from our workshop as the reasoning and academic capabilities together with our own intuition and experience.

Kjeldskov & Graham also pointed out that typically the desired goal or outcome of the research process is known in terms of requirements on some level of abstraction, but methods or techniques for accomplishing this outcome are unknown and thus sought through applying potentially relevant research. We had the abstract goal of designing a mobile game to encourage interpersonal interaction. To accomplish our goal we chose to make a literary research for communicative methods and techniques, and then apply this knowledge to the design.

Kjeldskov & Graham further stated that in mobile human-computer-interaction research, applied research is relevant in relation to design and implementation of systems, interfaces and techniques, which meet certain requirements for performance, user interaction, user satisfaction etc. Again this suits our main goal; to design (design) a mobile game to encourage interpersonal interaction (user interaction).

Advantages: The advantages of applied research is, according to Kjeldskov & Graham, that it is very goal directed and (typically) results in some kind of product being produced, which can be evaluated against the initial goals.

**Disadvantages:** The major disadvantages of applied research are, according to Kjeldskov & Graham, that initial solutions may be very limited and not generalizable and that appropriate solutions for accomplishing the desired outcome may not be produced at all.

#### 3.1.2 Research Purpose

Engineering is defined, by Kjeldskov & Graham, as the purpose of research focused towards developing new systems or parts of systems such as e.g. an interaction technique for mobile phones. Our research pointed in that same direction, with the intention of developing a mobile game as a tool for interpersonal interaction.

### 3.2 Categorizing "JiggyTime: Evaluating and Enhancing a Mobile Game Design to Encourage Interpersonal Interaction"

A field study with the purpose of evaluating was the research method and purpose used for answering research question 2.

#### 3.2.1 Research Method

Kjeldskov & Graham characterized field studies by taking place in "the real world" as opposed to in a laboratory setting. Field studies cover a range of qualitative and quantitative approaches from ethnographic studies of phenomena in their social and cultural context inspired by the discipline of social and cultural anthropology to field experiments. Field experiments are characterized by manipulation of a number of independent variables to observe the influence on dependant variables in a natural setting.

We conducted a series of tests in a "real-life" context, followed by qualitative interviews, in order to evaluate our game design. The game design was tested in three different versions where we, from each test to the other, varied the degree of encouragement to interpersonal interaction among the players; going from no interpersonal interaction, to optional interpersonal interaction, to "forced" interpersonal interaction.

Kjeldskov & Graham stated that in relation to mobile human-computerinteraction research, field studies could be applied for either informing design for or understanding of mobility by ethnographic studies of current practice or for evaluating design or theory by conducting experiments in realistic use settings. We used the field study to evaluate the game design of JiggyTime in three different states, testing them in a realistic environment.

Advantages: The major advantages of field experiments are, according to Kjeldskov & Graham, increased realism and increased control and support for studying complex situated interactions and processes.

**Disadvantages:** According to Kjeldskov & Graham, disadvantages include limited control of experiments and complicated data collection compared to, for example, experiments in laboratory settings. Furthermore, as experimental manipulation increases, realism typically decreases.

### 3.2.2 Research Purpose

Evaluating is defined, by Kjeldskov & Graham, as the purpose of research assessing or validating products, theories or methods, e.g., the usability of a specific mobile device design or a theory of interaction. Again this is pointed in the same direction as our goal of the paper; with the intention of evaluating and enhancing a mobile game design as a tool for encouraging interpersonal interaction.

## Chapter 4

## Conclusion

The overall research question for this study was:

**Overall Research Question:** How can we create a system to encourage interpersonal interaction?

To answer this question we derived the two sub-questions:

**Research Question 1:** How can we design a mobile game to encourage interpersonal interaction between people who do not know each other beforehand?

**Research Question 2:** How can we evaluate a mobile game which encourages interpersonal interaction between people who do not know each other beforehand?

The first sub-question was answered in the design paper by creating the game design, JiggyTime. This was done by conducting a design workshop to create inspirational design ideas and utilizing selected communication theories through a pragmatic approach. The result was the design for the puzzle game, JiggyTime, which encouraged interpersonal interaction with communicative techniques, such as, "icebreaking", absence of symbolic cues etc.

The second sub-question was answered in the evaluation paper. Here, JiggyTime was evaluated through an iterative process of enhancing the design in between the tests. The results showed that it was possible to make people interact on an interpersonal level by playing a mobile game, although, it required the interaction to be "forced" through the game design. Additionally, the results showed that it was possible to change peoples behavior depending on the version of the game they were playing. Based on the results from both sub-questions the overall research questions has been answered, as the papers showed a success in designing a game design for the purpose of evaluating it as a means to encourage interpersonal interaction among the players.

The limitations associated with using applied research meant that the initial study quickly became narrowed and only focused around one solution, whereas, if the broader spectrum was explored more thoroughly, perhaps more effective solutions could be found. Additional limitations existed from using field study for the evaluation of JiggyTime, which relies heavily on the participants being representative and non-biased towards the evaluation.

As a continuation to this study, it could be interesting to evaluate and modify JiggyTime to other social contexts. With the initial barrier solved of making people interact with other people they do not know, there are numerous of social contexts that could be interesting to test, for example, using JiggyTime as a team building tool for companies or as a tool for creating friendships at schools. Furthermore, it could be interesting to evaluate JiggyTime in other parts of the world with a more extrovert social culture than in Northern Europe.

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Appendix A

Design Paper

### JiggyTime: Designing a Mobile Game to Encourage Interpersonal Interaction

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#### ABSTRACT

Interpersonal social interaction is face-to-face interaction through several sensory channels (words, body language, etc.) happening between people who may or may not know each other beforehand. This paper explores how a mobile games can be designed to encourage interpersonal interaction between players who are unknown to each other. To do so, we conducted a design workshop with nine participants, with relevant competences, to create design ideas for this type of game. Additionally, we studied existing theories of interpersonal communication to support the design ideas by examining how dialog is formed between people who do not know each other. Based on the results of the design workshop and existing theory of interpersonal communication between people, a final mobile game design was created. The resulting game design, called JiggyTime, was a simple puzzle game where the player was to gather a 3x3 puzzle in a certain color and where interpersonal interaction was encouraged through the possibility to trade puzzle pieces with other nearby players.

#### **Author Keywords**

Mobile game design, Interpersonal interaction, Ubiquitous computing

#### INTRODUCTION

The gaming industry has the last couple of years reacted to a trend of its consumers and taken different social aspects into concern when designing their products. This can be seen in the increase of social functions in games and especially in the increase of multiplayer games. Also, as the newest trends, we see cooperative gameplay and interweaving of other social networks (Facebook, YouTube) into the games.

The total global market for mobile games was in 2007 \$4.4 billion with a year-over-year growth of 23% [1]. This makes the mobile game market one of the fastest growing markets in the world. Simultaneously the technology incorporated in mobile devices is in a rapid pace and every year introducing new technologies that alter peoples use of the medium (WiFi, GPS, Accelerometer). All these factors make mobile devices an interesting and constantly evolving medium, especially in the context of human-computer interaction and socialization.

Several newer studies have expressed concerns of how peo-

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ple are becoming alienated from each other as an effect of the increased technology in our everyday life, specifically amongst online game players [15]. Online games are virtual communities where players can assume any role they desire and choose to either cooperate with or play against other players. These games are characterized by anonymity, real-time interaction, and lack of boundaries.

Over the past ten years the popularity of online games have massively increased and have become the primary reason why many gamers spend hours each day online. This has caused several researchers to examine the addiction these games can have on people and the accompanying social problems which arises from online games and Internet over-usage [8] [19].

In this study, we wanted to create an alternative to online games by creating a game design which offered possibility for, and encouraged, *interpersonal* interaction rather than *mediated* interaction. By interpersonal interaction we meant face-to-face interaction happening in real-life as opposed to mediated interaction, which is interaction through a medium, for example, text messaging, webcam sessions, phone calls, etc. We designed the game for the mobile platform in order to utilize that mobile phones have become common property, and that the large majority of these phones can be used as a gaming platform and connect to the Internet. This means that the game could be played from anywhere, and ensured that it would have the mobility to meet up with other players in real-life while playing the game.

The overall goal in this research study was to design a game which encouraged interpersonal interaction between the players. To help us with inspiration in the design process we conducted a design workshop for participants with relevant humanistic or computer scientific backgrounds to create design ideas for this type of mobile game. Additionally, we studied existing theories of interpersonal communication to support the design ideas with knowledge of how "good" communication is created.

Following this section, is the presentation of the related work to this study. After that, two sections describe the design workshop and the theories of communication used for the study. Following these two sections, the game design, JiggyTime, is presented as the result for this research study. Lastly, the game design is compared to similar related game designs in a discussion section, followed by a section summarizing and concluding the study.

#### **RELATED WORK**

Several game designs, within the scope of encouraging social interaction, have been made. These attempts we loosely divided into four categories of eight contradicting game design choices:

- Mediated versus Interpersonal (face-to-face): Some games used the medium or technology as the only interaction between the players, these were defined as mediated. Others employed different techniques for encouraging or making the players interact on an interpersonal level.
- **Stationary versus Mobile:** Some games were bound to a physically fixed place or had to be conducted under certain location-based restrictions, these we defined as stationary. Other games had no location-based restrictions and could be conducted wherever, these were defined as mobile.
- **Casual versus Event driven:** This category is of time restrictions. Casual games could be played whenever and as long as the player wanted. A casual game required no long-term or predefined time commitment. Event driven games had a given time, constraining either the start and/or end of a game session, or the time a game session lasted.
- **Collaborative versus Competetive:** The gameplay in some of the games encouraged and/or rewarded cooperative play between players, these are categorized under collaborative. Others focused on rewarding the individual gameplay or the players had to compete for reaching an individual goal, these were categorized under competitive.

These different design choices were, in each category, contradictive. This did not mean that a game design could not contain two contradictive choices, but they would have to be initiated in different states of the game or weighed against each other in some other way. Different combinations of the design choices were observed in related materials and are described in the following.

One example of a game design was FishPong [21] (Interpersonal, stationary, casual, collaborative), which were an interactive table designed to encourage spontaneous social interaction among coffeehouse patrons. FishPong was a casual game on an interactive table where persons situated at the table had to keep one or more virtual fish alive by hindering the fish from falling off the edge of the pond (the table) by using their coffee cups as obstructions. Another example, the game Flaslight Jigsaw [7] ((Interpersonal, stationary, casual, collaborative), was a game situated in a public place where players should solve a jigsaw puzzle projected on a big wall. Three controllers were used as flashlights to move the projected pieces around. FishPong and Flaslight Jigsaw were both stationary and context situated games that offered interpersonal encouragement to the persons sitting at the table or being at the specific public place.

On the mobile front research studies have shown that mobile games can be used as casual or event driven interpersonal activities. One example was Mobslinger [9] (Interpersonal, mobile, event driven, competetive), which was a mobile game that encouraged serendipitous social encounters. The game was inspired by shootouts from the old west, using proximity to always scan for nearby players to engage in an event driven session of "quickdraw". Another research study encouraged players to interact in a casual multiplayer mobile game called MoMENTus [14] (Mediated, mobile, casual, competetive). This game used team play in a brain teasing quiz as the facilitator for social interaction. A stationary and event driven game called Treasure [4] (Interpersonal, stationary, event driven, competetive) explored a mobile game design where the players had to collect virtual coins scattered over a real urban area. In two teams of two players, they should gather as many coins within a given time period. The team with most coins at the end of the time frame won the game. Within a given proximity of each other, the players from one team could also pickpocket coins from the other team.

We also turned our attention to the gaming industry, where several successful projects could be used as inspiration. We found that most newer games offer the ability to socialize in different ways. For example, the Massive Multiplayer Online Role Playing Games (*World of Warcraft, Star Wars Galaxies*) offer the ability to socialize in clans and communities through online chats etc. [11]. Other examples were Party games (*Sing Star, EyeToy, Wii Sports*) that offered the ability to compete/collaborate and socially interact within a physical proximity.

Some studies in the periphery to our research focus, using other technologies than games to mediate social interaction, has proven that their technologies could be used as tools to maintain social relations [3] (*Mediated*, *mobile*, *casual*) or socialize in new ways [10] (*Mediated*, *stationary*, *casual*). These studies could not be categorized in all of the design choices due to their differences from games.

#### **DESIGN WORKSHOP**

The design workshop was conducted with nine participants at Aalborg University. The objective was to create design ideas for a mobile game that encourages interpersonal interaction between the players. The resulting design ideas were used as inspiration for the overall design process of creating the game design for JiggyTime.

#### Participants

The nine participants consisted of nine students (one female, eight males) from Aalborg University within the fields of Psychology, Computer Science, Informatics, Humanistic Informatics, and Game Programming, where eight participants were master's students and one was a third semester student. All participants had a general interest in creative thinking and a basic knowledge of mobile systems and game design. The participants were split in two static groups for the duration of the workshop, in which they should execute each design activity and discuss the results.

#### Setting

The workshop took place in a small conference room at Aalborg University the 5th of November 2008 from 12:30 p.m. to 16.15 p.m. The conference room was arranged with two large groups of tables, one for each group. In the front of the room we had a projected overhead used for our presentation, and in the back there was a table with supplies of various drinks and food. Figure 1 shows a picture of the setting for the design workshop.



Figure 1. A picture of the conference room used as base for the design workshop.

#### Materials and Equipment

The following is the list of equipment and materials used for the design workshop. A projector used together with a laptop, for presenting the tools and exercises. A3 papers used for sketching and notes by the participants. Colored hats used for the Six Thinking Hats design activity. Printed slides containing descriptions of the tools and exercises. Camera for visual documentation.

#### Procedure

The design workshop was conducted over a time span of four hours and created around three main design activities: Sketching, bodystorming, and six thinking hats. Before each design activity, the participants were tutored in the basic principles and theory behind the activity.

#### Sketching

The first design activity, sketching, was based on the theoretic description of sketches developed by Bill Buxton [6]. During this design activity the participants were given 15 minutes to individually sketch as many ideas as possible for the game design in question, and afterwards discuss the ideas in each group.

The purpose of the sketching design activity was to bring out the participants' first impulses, which meant the results would be general ideas with little details. Figure 2 shows one of the sketches created during the sketching design activity.

Bodystorming



Figure 2. One of the sketches from the sketching design activity.

The second design activity, bodystorming, was based on the description by Antti Oulasvirta et al [16]. Each group was given 45 minutes to perform the bodystorming and further develop their ideas from the previous design activity or create new design ideas.

During the bodystorming design activity the participants were asked to write down in details all the design ideas they came up with, so the ideas could be further developed in the last design activity and used by us in our analysis of the workshop.

#### Six Thinking Hats

The third and last design activity was the Six Thinking Hats, developed by Edward de Bono [5]. During this design activity each group should discuss their design ideas from the previous two activities with respect to a predefined thinking strategy we created before the workshop. The design activity was conducted by all the participants in each group wearing the same colored paper hat representing the type of thinking that should be made.

The purpose of this design activity was to further develop on their existing design ideas rather than creating new ones, and finalize the ideas in to thought through and detailed design ideas. Figure 3 shows three of the participants during the Six Thinking Hats design activity.

To conclude the workshop, each group prepared and presented a short presentation of the design ideas they created during the workshop to the other group.

#### **Data Collection**

Throughout the design workshop we collected data in five different ways.

- **Questionnaire:** At arrival the participants were asked to fill out an questionnaire with demographic information.
- **Pictures:** We took some pictures during the day to illustrate the execution of the design workshop.



Figure 3. Picture of some of the participants during the Six Thinking Hats design activity.

- **Sketches:** At the sketching exercise the produced sketches were collected. Before the collection we asked each participant to write, in a few sentences, what the sketch was representing.
- **Notes:** In the group presentations, discussions, and the design activities we, as the facilitators, each observed our group and took notes in the form of cues; e.g. documenting each participant's presentation of their own sketches and the group's reactions and discussions of them. At the bodystorming session we also asked the participants to take their own notes during the design activity.
- **Presentations:** We asked the groups to write the final presentation of their design ideas on a piece of paper.

#### **Data Analysis**

The design workshop contributed with many different design ideas. Because of the open group discussions in each group, some design ideas ended up being thorough and thought through while others only were discussed for a few moments before they died out. The main data collected from the design workshop was the participants's sketches, notes and presentations which they were asked to make throughout the workshop. This data was analyzed and structured into seven main design ideas, which we thought was the most detailed and thought through.

#### Results

The following is a brief description of the resulting design ideas from the design workshop. Further description of the design workshop and analysis of the results can be found in the associated report [17].

#### Virus

Each player was thought to be infected with a virus of a certain color and needs to infect other players by being in close proximity of them so they become the same color as him/her. The infection would happen by the players grouping up with other players with the same virus, i.e. color, and then approaching other players with different colors and in fewer numbers than themselves, thereby spreading their virus and turning the opposing players into their color. Eventually, one color would win when every other color was eliminated. The interpersonal interaction in this idea would happen when the players tried to find players of their own color and coordinate their infection of other players.

#### Riddle Game

The basic principle for the Riddle Game design idea was that the players each had unique clues about the state of the game, and needed to exchange that information with the other players in order to reach their goal before their opponents. The general idea of the Riddle Game idea was that several types of gameplays could be placed upon the underlying idea. For example, a treasure hunt game where each player would have a piece of information or clue about the location of the treasure, and the players need to trade informations with each other in order to find the treasure and win the game. The interaction in this design idea would happen when the players exchange information with each other, as this communication is the only way to advance in the game.

#### Mimicking Smokers

The Mimicking Smokers idea was to copy the social interaction smokers have by having groups of players performing small assignments in dedicated areas, and thereby creating a common ground for the players, similar to what smokers have. The nature of the assignments could be anything as long as it "forced" the players to be in the same physical location. The interpersonal interaction should then happen by physically placing the players together, where conversation automatically would start after some time because people would break the awkward silence, which would exist otherwise.

#### Health Tamagotchi

This design idea was to split the players in small groups, which each were responsible to take care of a tamagotchi and keep it happy by eating properly and doing exercise. The tamagotchi would either lose or gain happiness depending on what the members of each group ate and what exercise they did, and the groups would compete in having the happiest and healthiest tamagotchi. The social part of this game design lied within each of the participating groups, because each member of the groups would be responsible for the "well-being" of the tamagotchi, and they needed to communicate and encourage each other to keep it happy.

#### Proximity

The Proximity idea was simply that players gained points from being in close proximity of other players. As a variation, the game would have predefined "hotspots" where players would gain even more points from being in close proximity. These spots would be awkward or unexpected places, such as, restrooms, storerooms, or similar. The point of this was, that when people are put in awkward situations they often just start to talk or joke about it to ease the awkward feeling, which would be how interpersonal interaction was encouraged in this design idea.

#### 20 Questions

This idea was a revised version of the TV show of the same name, but instead of the players guessing random items, concepts or similar, they should guess the identity of the players they were in mobile contact with. The social aspect of this idea was that by asking questions about the identity of the other player, the asking player learned more about that player, which would then function as an icebreaker.

#### Punishment

The simple principle of this idea was to "punish" the players instead of rewarding them through points, so the winning condition was to be the least "punished" through the game. As with the Riddle Game design idea, several gameplays could be placed upon this underlying idea. For example, the players could continuously lose points while not interacting with other players which would force the players to be interacting if they did not want to lose.

#### **COMMUNICATION THEORIES**

On the upper level, interpersonal communication could be devided into two areas; verbal and nonverbal. Each of these areas again devided into many different underlying areas of communication. Our research was first done on a superficial level, sorting the different areas of communication into relevant or irrelevant importance to our goal. Cutting of areas of communication theory and then stepping down deeper into the relevant areas, one level at a time. Digging deeper and deeper, we found interesting theories and methods important to our specific design. We started by deselecting the branch of nonverbal communication, focusing on verbal communication. Further down the selection tree we ended up with concentrating our research into the area of conversation and meetings, more specifically on meetings of strangers and "good" conversations.

Note: In this research study we defined dialog as an interpersonal communication between two or more equal participants, where each participant is prepared to share knowledge, dare to question, and care for themselves and the other participants. The definition is a coalition from various theses on dialog, including Alrø & Kristiansen [2], Kristensen & Bloch-Poulsen [12] and the inspiration from work on dialog and interpersonal communication by Martin Buber, Carl Rogers, Hans-Georg Gadamer, and David Bohm.

#### Mediated versus Interpersonal Interaction

For understanding the differences between mediated and interpersonal interaction and the consequences for the communication, we used Thompson's three types of communication [18, p. 94-133] to define the characteristics of interpersonal interaction, see Table 1.

We also used Thompson's derived models, depicting the interacting person's self when communicating in the three different forms, see Figure 4.



Figure 4. A model depicting the organisation of the social interaction in different forms of communication.

In an interpersonal interaction, the persons front region were shared, while in mediated interaction and mediated kvasiinteraction their front regions were separated. This was an important guideline for designing interpersonal interaction. Thompson's third form of communication, mediated kvasiinteraction, only described one-way-communication, and therefore we did not use it in our game design.

#### Icebreaker

Conversations, meetings, events, training sessions, teambuilding sessions, educational seminars and the likes are often started with some sort of structured, or in real life situations unstructured, activity specifically designed to get the participants networking, introduce them to each other or to get them to relax, ease the tension. This activity is in common terms defined as an "icebreaker" [20, p. 11]. In this study we studied different variations of the subject and integrated key elements into the design, by letting the players know as much as possible about each other before an initiating contact.

#### Control (power)

Interpersonal communication and problem solving can be done using communication techniques such as monolog, discussion, debate or dialog. The varying variable in this is the control or power in the communication. We chose our game to incorporate dialog for several reasons that had to do with our definition of a dialog. First of all a dialog is based on two or more participants that in the context of the dialog are equal. We wanted the players in the context of the game to be on an equal social level regarding race, belief, social status, etc. Secondly, the reason for a dialog can be the dialog itself, e.g., participants talk just to talk. This would almost never be the case in our setup, since the game would be the reason for initiating the conversation for most players. But then again, since our main goal was to establish an interpersonal interaction with an initiating dialog between players, it is our belief that a following dialog between the players, if such should occur, would be easy to establish when a preliminary successful dialog had already occurred. Thirdly, participants in a dialog have to communicate in a certain way to find a solution to a problem, using the sharing-, daring- and caring-principles. As every person has differentiating skills in interpersonal communication it is not possible to design a general tool that guarantees a successful dialog. But, ac-

Interaction Types	Interpersonal Interaction	Mediated Interaction	Mediated quasi-interaction
Space/time constitution	Context of co-presence; mutual references to time and space	Seperated contexts; extended use of time and space	Seperated contexts; extended use of time and space
Range of symbolic cues	Multiplicity of symbolic cues	Limited symbolic cues	Limited symbolic cues
Action orientation	Actions oriented towards specific others	Actions oriented towards specific others	Actions oriented towards an indefinite range of potential recipients
Available communication	Two-way-communication	Two-way-communication	One-way-communication

Table 1. Table of the three interaction types and their characteristics.

cording to our definition, some general rules still has to apply for each participants, and the design should strive to support these. First of all the participants has to be willing to enter a dialog. Also the participants in a dialog have to have certain preliminary approaches for a dialog to succeed. Kristensen & Bloch-Poulsen presents three conditions that are essential for a dialog [13]:

Sharing: knowledge and thoughts.

**Daring:** to question your own and others assumptions or epestimology or self-referentiality.

#### Caring: for yourself and others.

Every participant in a dialog has to accept and follow all three of these conditions, and since we cannot force the participants to abide by these conditions without tempering with their free will, we have made the design support the conditions in such a degree that the players will make use of dialog, because the design makes it the obvious choice of communication.

#### Context

Context can have a profound impact on a conversation. It can impact in every step of the communication model, but most often impacting the encoding, channeling, and interpretation area. Therefore, we need to think the use of context into the design. This being both the virtual context of the game but also the real-life context the game is situated in.

#### GAME DESIGN

Based on the experiences and results from the design workshop and the theory of communication described above, a final game design, called JiggyTime, was created together with a prototype of the functional design and user interface. We decided on a simple puzzle game design which was loosely based on the Riddle Game design idea from the design workshop, meaning that each player would have something the other players want/need. Figure 5 shows an early prototype of the functional design and user interface of the game.

The overall goal of JiggyTime was to gather a complete 3x3 puzzle in one of three possible colors, yellow, red, or blue. To do this the player started out with nine randomly colored pieces in a 3x3 puzzle board, depicted under *A* in the figure, and with three extra puzzle pieces *B* to move into the puzzle. The three extra pieces were of random shape and color. The player then swapped the pieces from *B* into *A* depending on what color he wished to gather.

To get new pieces to swap into the 3x3 puzzle the player

had two options. For the first option he could press the button depicted with a C, which would replace the three puzzle pieces in B with three new pieces of random shape and color, however, this button could only be used one time every two minutes. The second option was for the player to press the button depicted with an E, which would switch the view to Screen 2 in the figure. In Screen 2 the game would detect other nearby players who were playing JiggyTime and list them together with a representation of the three extra pieces those players had in B. This list is depicted with a G in the figure. If the player saw another player in the list who had one or more puzzle pieces the player was interested in, (s)he could request a trade by pressing the button depicted with an F, which would bring both players to Screen 3. At Screen 3 each player could choose a puzzle piece they wanted to trade. When each player had done that and accepted the trade by pressing the button depicted with an H the trade would be made.

#### **Encouraging Interpersonal Interaction**

The thoughts we had about this game design was to have a single player part as well as a multiplayer part in the game, so that the player could decide for himself if he wanted to play alone or with other players. The single player part was as shown in *Screen 1* in Figure 5 where the player would gather the colored puzzle by swapping in puzzle pieces from *B* and getting new pieces by pressing the button *C*.

But playing the game solely as a singleplayer game would be dull because of the "once-every-two-minute" time limitation on the button to get the three new random puzzle pieces. However, this limitation functioned as the first step to encourage interpersonal interaction between the players. The idea was that while waiting for the two minutes to pass, the player could access the multiplayer part of the game and trade puzzle pieces with other players.

The trade view, *Screen 3*, was designed to function as the icebreaker and encouragement to start interpersonal interaction with another player. As a means of getting the players to engage in interpersonal interaction, we deliberately removed options for mediating symbolic cues throughout the game design. A good example of this is representative in the trading session where the player does *not* have the option of mediating which piece he/she wants from the other player in the trade. This was meant as a provocative limitation that should encourage the player to use interpersonal symbolic cues instead. The encouragement was therefore found in the absence of mediated cues to communicate with the other player. The principles of "icebreaking", as described earlier, was about easening the tension and creating a common



Figure 5. A rough prototype of the functional design and user interface of JiggyTime.

ground for the interacting players to feel comfortable in. In JiggyTime, the icebreaker was designed in two places in the trade view.

- **Picture:** In the trading sessions two visible profile pictures, depicted with an *I*, were representing the persons trading.
- Name: In same trading session the players' names were depicted.

This meant the players would already know something about the other player before initiating contact. Especially the pictures was thought to have a strong effect as to making the players feel more comfortable about initiating contact, because it would remove the doubt about who the nearby trading player was.

With the design of JiggyTime based on a design workshop and theory of communication, we found some complications as to how these two areas are merged into one game design. The results from the design workshop was easy to use and a good source of inspiration to create the initiating game design. The theory of communication was harder to apply directly to a game design, but was easier to use as guidelines for parts of the game design that should encourage the interpersonal interaction. This meant that it was often easier to make a design choice, which then later could be modified to a communication theory, than to make a design choice directly based on a theory.

#### DISCUSSION

Although some of the game designs described in related work came close to what we wanted to achieve, still some fundamental design differences between the existing attempts and our goal were present. This could also be observed in our final game design, JiggyTime.

#### **Design Choices**

In the beginning of the game design process we made several design choices which are described in the following.

#### Interpersonal

Since we wanted our game design to encourage interpersonal interaction the choice between a mediated or interpersonal game design was obvious. Even though a mediated game design could encourage to interpersonal interaction, many features for encouraging interpersonal interactions would emerge easier, or even by themselves, in an interpersonal game design.

#### Mobile

The stationary games (*FishPong*, *Flaslight Jigsaw*, *World of Warcraft*, *Star Wars Galaxies*) had the restriction of being situated. Even though this restriction properly in some cases can be an advantage in encouraging interpersonal interaction, we had confined our goal to make a mobile game, since this has better opportunities to reach and influence more people. JiggyTime could be implemented on either stationary or mobile platforms, because it did not have the restriction of the stationary games nor did it have to be mobile to play.

#### Casual

Since we also wanted to make a game for use in real life, we chose to make a casual game instead of an event driven (*Mobslinger*, *Treasure*). This choice is rooted in the planning of event driven games. It would take time and effort from the players to coordinate such an event, and compared to the benefits it would accomplish we determined to exclude event driven games in favor of casual game designs. We also

wanted the game to encourage interpersonal interaction between players that did not know each other in advance, and this makes the planning of event driven games even harder. JiggyTime could be played as a casual game since the players could play it alone, anytime, and anywhere. Although, in order to trade puzzles with other players, they had to be in proximity of each other and playing at the same time, the same rules applying to make an interpersonal interaction.

#### Collaborative

As our research into the literature of communication revealed, some core game elements in many of the games were in contradiction to the best communicative design choice for encouraging interpersonal interaction, as mentioned earlier. This meant that according to the success of our goal we had to make our game collaborative, not competitive (*MoMEN-Tus, Sing Star, EyeToy, Wii Sports*). JiggyTime has no competitive gameplay at all. No players are on different levels, has different points, etc. The collaborative element in Jiggy-Time was that you could help others solve their puzzle, and they could help you solve yours.

We wanted the game to be available and accessible to the vast majority of people disregarding gender, technological experience or social class, therefore choosing the mobile phone as the medium/technology for our game due to its commonness and everyday use of a broad audience. Therefore, disregarding other technologies ([3], [10]). It would not be impossible to implement JiggyTime on other technologies, but it was designed to be implemented on a mobile phone.

#### Game Design Process

Creating the game design was an interweaving process of the design ideas from the workshop, the communicative methods, techniques, and guidelines from the research, and our own knowledge and experience as game designers. We discovered that creating design ideas solely based on communicative literature is a difficult task, since most of the literature on communication was intended to describe observed processes and not for designing products. We found it much easier to part the two, first creating design ideas, and then discussing, applying, or molding these in the educated light of the communicative theories, techniques and methods. This process can be imitated using other communication theories or even other fields of study. This paper can serve as a contribution to the development of any social mobile game, giving inspiration to involve knowledge from other academic branches.

#### CONCLUSION

As stated in the introduction, the goal in this research study was to design a game which encouraged interpersonal interaction between the players. In the following we discuss the fulfilling of the goal, the limitations to this and some future work.

For inspiration and research on this problem we studied existing academic projects and commercial solutions, specifically their ability to encourage the players to interact on an interpersonal level. By this study we narrowed our game design in on specific design choices best serving our goal; interpersonal, mobile, casual, and collaborative. We also conducted a design workshop where we invited erudite people from different academic branches to come up with design ideas for our game, again with our specific goal in mind. This led to a series of design ideas. We then made a pragmatic effort to combine the practical design ideas from the workshop with a literary research, trying to define which kind of communicative techniques and methods that could encourage interpersonal interaction. The solution was a design process where we discussed each design idea in the light of the communicative methods and theories. This process helped us to a more obvious decision making, it improved the design ideas to support our overall goal, and it served as a helpful guideline to handle communication in our game design. The final product was a proposing design for a interpersonal, mobile, casual, and collaborative game that encourages interpersonal interaction among the players.

One limitation of this study was the selection of communicative techniques applied to our game design. In this study we only selected communicative techniques and methods from what we covered in our research. There are properly several other communicative theories out of our scope that a game designer could draw knowledge from. Also the selection of the participants or idea-generating sessions conducted at the workshop can have a direct effect of the resulting design ideas, and thereby the final game design. The design process of interweaving practical and theoretical methods and techniques was in our mind a significant benefit when designing for interpersonal interactions, but it was also a time consuming experience. A limitation could also be that the game design needs more work to fulfill the overall goal.

The future work is to implement the final game design on a mobile device and afterwards evaluate the game design's ability to encourage interpersonal interaction.

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# **Evaluation Paper**

### JiggyTime: Evaluating and Enhancing a Mobile Game Design to Encourage Interpersonal Interaction

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#### ABSTRACT

Interpersonal social interaction is face-to-face interaction through several sensory channels (words, body language, etc.) happening between people who may or may not know each other beforehand. This paper evaluates a mobile game as a means to encourage interpersonal interaction between players who are unknown to each other. To do so, we conducted tests of the mobile game, JiggyTime, to gather results of peoples willingness to initiate contact with other people. During the tests, JiggyTime was continuously enhanced through an iterative process based on the immediate results from the tests. The results showed it was possible to make the players interact on an interpersonal level with other players, however, they were reluctant to do this unless it was "forced" through the game design. Additionally, the results through the iterative process showed that it was possible to change the participants behavior depending on the version of the game. And lastly, the results showed that the more the players knew about the other players before initiating contact, the more comfortable they felt about doing so.

#### **Author Keywords**

Mobile game design, Interpersonal interaction, Ubiquitous computing

#### INTRODUCTION

The gaming industry has the last couple of years reacted to a trend of its consumers and taken different social aspects into concern when designing their products. This can be seen in the increase of social functions in games and especially in the increase of multiplayer games. Also, as the newest trends, we see cooperative gameplay and interweaving of other social networks (Facebook, YouTube) into the games.

The total global market for mobile games was in 2007 \$4.4 billion with a year-over-year growth of 23% [1]. This makes the mobile game market one of the fastest growing markets in the world. Simultaneously the technology incorporated in mobile devices is in a rapid pace and every year introducing new technologies that alter peoples use of the medium (WiFi, GPS, Accelerometer). All these factors make mobile devices an interesting and constantly evolving medium, especially in the context of human-computer interaction and socialization.

JiggyTime was a game which is designed to encourage in-

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terpersonal interaction through an interpersonal, mobile, casual, and collaborative game design [15]. The game was about solving a puzzle in one of three available colors, which was done by switching extra puzzle pieces in to the puzzle and trading puzzle pieces with other nearby players.

The goal of this research was to evaluate the mobile game, JiggyTime, as a means to encourage interpersonal interaction between people who did not know each other beforehand. To do so, we tested JiggyTime through an iterative process of enhancing the game in between the tests based on the immediate results.

Following this section, is a presentation of the related work to this study. Afterwards, a section describes the empirical study of this research and describes how JiggyTime was evaluated. After that, the design and implementation of JiggyTime is presented together with an evaluation section describing the results and findings from the tests. Lastly, a discussion section compares our findings with previous work, followed by a section concluding the research.

#### **RELATED WORK**

When it comes to evaluating or enhancing mobile systems/games several research methods can be used. Different methods suits different testing purposes. A study of different research methods within the field of mobile human-computerinteraction categorized the different research methods and purposes, as well as their strengths and weaknesses [6]. In the following we have described some academic contributions in the field of evaluating and enhancing mobile systems/games.

#### Evaluation

When evaluating, several studies have compared laboratory and field-study approaches to evaluate mobile systems [14][8] [12][4]; determining strengths, weaknesses, and discussing the ability to compare the research methods. Another study evaluated six techniques for evaluating the usability of mobile computer systems in laboratory settings, with a fieldevaluation as reference [9]. Other studies have tried to make other attempts at evaluating mobile systems. A research study made the users help the researchers in collecting user experience material, by letting the users shoot video clips themselves [11]. Another study used an extensive multimethod evaluation of a mobile guide designed to support the use of public transport [7]. To evaluate the guide, the study applied four different techniques; field-evaluation, laboratory evaluation, heuristic walkthrough and rapid reflection. Also, a method and a supporting environment that allows remote evaluation of mobile applications have been explored [13]. A case study has been used to evaluate the usability of a system involving PDAs, designed to be used in a public museum [18]. The system permitted collaboration of small groups of museum visitors through mobile handheld devices. Another study, evaluating a mobile game called *Treasure*, described the combination of data-logging with video observation [19]. Trying to see things in a different perspective, another study proposed an evaluation framework for networked mobile gaming [16]; consisting of user-, group-, communication-, and environment-models.

#### Enhancement

For enhancing the design of mobile games, a research study presented a method for extracting a product line (mobile game) and evolving it, relying on a strategy that used refactorings expressed in terms of simpler programming laws [2]. Another design approach was studied in [17]. This study developed a mobile game in close collaboration with the field site and iterated between development and evaluation activities. A study, [10], explored the method of designing a pervasive mobile game. The method utilized early user requirements when testing a prototype through a scenariobased player study as the source of requirements for the further game design.

#### **EMPIRICAL STUDY**

For the evaluation of JiggyTime we decided to create three versions of JiggyTime based upon the design seen in Figure 1, which is described in [15]. The first version was a modification of the original design so that it only provided the singleplayer part of the game and no multiplayer part to encourage interaction. The idea behind this version was to examine how people generally act and behave when playing mobile games in a social environment. The second version provided the singleplayer part and the multiplayer part of the original design and offered the possibility for interaction. The idea behind this second version was to see if the players would interact with each other if only encouraged to through the game design. Lastly, the third version was similar to the second version with the single player and multiplayer part, but here the players were "forced" to interact with other players in order to advance in the game. Similarly, the idea behind the third version was to see if the same interaction would happen if the players were forced to interact with each other through the game design. The three versions are henceforth mentioned as JiggyTime 1, 2, and 3 respectfully.

Implementing JiggyTime 1 and 2 were based directly on the design seen in Figure 1, where JiggyTime 1 was a simplified version of this design cutting away the trading part, and the second version was the exact same as shown in the figure. JiggyTime 3, however, was implemented by enhancing the design from JiggyTime 2. This enhancement was made between testing JiggyTime 2 and 3, and based upon the results from the first two tests.

The only difference between the three tests was the version of JiggyTime. This means that the following information regarding how the tests were conducted were common for each test.

#### **Participants**

The three tests were conducted with 15 participants in total, five for each test. The participants consisted of 10 males and 5 females with ages ranging from 15 to 34 year old with an average of 25. The participants were recruited from several different areas, some were fellow students at Aalborg University while others were friends and aquaintances invited from outside the university, and finally, some were recruited through an invitational mail send to a mailinglist for people interested in mobile applications. The variety of participants also meant that they all had different experiences playing mobile games.

#### Setting

The three tests were conducted on three different days, one day for each version of JiggyTime and each day being the last workday of the week. The tests were situated in downtown Aalborg with the base being an office where the test started and ended. Figure 2 shows the start of the test at the office where the participants were explained the formalities of the test and how the game was played. Figure 3 shows a picture of the last part of the test, the interview, also conducted at the office. During the test the participants were given a task to go to a nearby café and play the game which can be seen in Figure 4.



Figure 2. Picture showing the start of a test where the test and game were explained to the participants.

#### Materials and Equipment

The following is the list of materials and equipment used for conducting the three tests.

Camera for visual documentation. Video camera for recording the behavior of the participants while playing the game. Sound recorder to record the interviews. iPhones, being the platform for the game, for both the participants and the walkons.



Figure 1. The early prototype of the functional design and user interface of JiggyTime.



Figure 3. Picture showing the final part of the test where the participants were interviewed.

#### Procedure

The participants were tested individually for one hour, including the interview and formalities. When the participants arrived at the office, the test started by the formalities about the test being read aloud for each participant. After that, they were given an iPhone and briefly described how to operate it, followed by a thorough walkthrough of each aspect of the game.

When the participants felt secure about operating the iPhone and playing the game, the actual test was started. The tests were designed around three tasks, which the participants should complete during the test. Each task were given individually to the participant in the form of a piece of paper, without



Figure 4. Picture showing the café where the participants were playing the game.

him/her knowing what the next task would be and how many there would be. The tasks were formulated in a certain way to make the setting as realistic as possible and were written as follows:

- **Go to a café:** You have had a busy week and feel like relaxing for a while. You decide to go to a café. *Task 1: Go to Café Nordkraft and find a good seat at the upper floor.*
- **Solve one or more puzzles:** You are relaxing and suddenly feel like playing your favorite game. *Task 2: Bring out your iPhone and start "JiggyTime". Use 10-15 minutes to complete one or more puzzles. Give notice after each completed puzzle.*

Leave the café: You feel relaxed for the day and decide to go home. *Task 3: Leave Café Nordkraft and return to the office.* 

As facilitators for the test, one of us would follow the participant and hand out new tasks when they completed their current one. The participants were allowed to ask clarifying questions regarding the test or the tasks, besides that, we did not interact with the participant during the test.

For the second task, being the actual playing of the game, we had placed walk-ons in the café whose job was to sit in the café and play the game on an iPhone. The purpose of the walk-ons was to give the participants a feeling that others were playing games in the café, and to give the opportunity to trade during the playing session (in JiggyTime 2 and 3).

After the last task, when the participants had returned to the office, the actual test session was over and the last part was summarizing the participants' experiences in an interview.

#### **Data Collection**

Throughout the tests we collected data in four different ways.

- **Video with audio:** During the second task, playing Jiggy-Time at the café, a video camera was placed to record video with audio of the participants.
- **Interview recordings:** The sound recorder was used to record the interviews with each of the participants.
- **Questionnaire:** In connection with the interview, the participants were also asked to fill out a questionnaire with demographic information.
- **Pictures:** Throughout the tests pictures were taken as documentation.

#### **Data Analysis**

The data analysis was conducted in two steps. As mentioned, we finished the design of JiggyTime 3 based on the immediate results from the first two versions. This analysis was focused on the collected data to see which part of the design should be enhanced to ensure that the players would be "forced" to interact in JiggyTime 3. The second part of the analysis was based on all the data collected during all three tests.

In order to evaluate JiggyTime's potential as a means to encourage interpersonal interaction, we constructed three criteria of success:

- **Success criteria 1:** The players had to engage in trading puzzle pieces with other players. In order to make the overall game design work, the trading of pieces had to be accepted and used by the players. Therefore, a success would rely on the game designs ability to invoke the players urge to engage in a trading session.
- Success criteria 2: The players had to make an interpersonal contact. If the game design should successfully encourage interpersonal interaction between players, then some

sort of initiating contact would be inevitable. This contact could be momentary verbal or non-verbal.

**Success criteria 3:** The players had to engage in an interpersonal interaction of longer time. This could be a verbal or non-verbal communication between the players, lasting for at least a minute.

#### **DESIGN OF JIGGYTIME 1 AND 2**

We chose to use the iPhone as platform for the implementation of the three versions of JiggyTime. As mentioned, the implementation of JiggyTime 1 and 2 was based directly on the original design as described in [15] and depicted in Figure 1.

JiggyTime 1 was a simplified version of the original design by only implementing the singleplayer part of the design, i.e., the puzzle view as seen in Figure 5. The figure shows the functionality of the 'Get New Pieces' button, with the left figure showing the button as active and ready to be pressed, and the right figure showing the button as inactive with a timer counting down untill the button is ready again. An adjustment was made from the original design regarding the time between the 'Get New Pieces' button could be used. In the original design the time was set to two minutes, but during the ongoing playtesting while implementing the game this time was changed to 45 seconds.



Figure 5. The puzzle window of JiggyTime for the first test showing the functionality of the 'Get New Pieces' button.

JiggyTime 2 was based exactly on the functionality of the original design, although with a few modifications to how elements were placed in the user interface. The implementation was done by adding the trade tab functionality to JiggyTime 1. In Figure 6, the left figure shows the browse view in the trade tab where the player could browse amongst the nearby players and see which pieces they had available for trade, and the right figure shows what happened when the player pressed the 'Request Trade' button. Figure 7 shows the trade view which would appear if the other player accepted the trade. Here the player chose which piece he wanted to trade and when he was satisfied he pressed the accept button, which would indicate to the other player that he was

ready to trade. When both players had accepted, the trade would be completed.

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Figure 6. The browse window of JiggyTime for the second test showing the functionality of the browse view.



Figure 7. The trade window of JiggyTime for the second test showing the functionality of the trade view.

The original idea for the trade tab implementation was that the iPhones would use the existing WiFi network at Café Nordkraft to communicate with each other. However, during the implementation we noticed that this solution would be too extensive and time consuming, so we decided to apply a wizard of oz [3] solution instead. This was done by hard-coding the list of players in the browse view and creating a simple AI for the player to trade with. The picture shown in the trade view was therefore also hard-coded and changed according to who we used as walk-ons for the tests. Additionally, the walk-ons were instructed to pretend to be participating in the trade if one of the participants contacted them about a trade.

#### **EVALUATION OF JIGGYTIME 1 AND 2**

Our evaluation of JiggyTime was centered round the purpose of the game design, derived from the main goal of this paper; how well the game design could encourage interpersonal interaction.

#### **Evaluation of JiggyTime 1**

As described earlier we made three different versions of the initial game design, the first being a stripped JiggyTime 1, with the trading session removed. We wanted to evaluate this design to see how people generally socialize and behave when playing mobile games in a social environment, especially to get a better understanding of how they act when playing JiggyTime in our testing context. JiggyTime 1 served as a reference when we where to evaluate JiggyTime 2 and 3.

The evaluation was a mix of the empirical data collected during the test, a demographic questionnaire, and the exploring follow-up interviews. In Table 1 is a list of the participants empirical result. What is interesting in this table is the interaction with the environment/context. The video observations revealed that the participants, when waiting for new pieces in the game, began to explore the context by reading the menu on the table, looking around, or listening in on conversations. This could also be confirmed in the interviews:

"If I were to go to a café on my own, and if I were to play a game, it should properly be a more active game.. but again, I caught myself looking around from time to time when I had to wait for the game. It wasn't the game that had to wait for me, it was the other way around.. perhaps it (read: the timer) is a good idea, since I noticed myself looking around and watching other things when I was waiting.. the timer ensures that you don't have to play all the time, because the game doesn't go anywhere." - Male 3

"I read the menu and listened to other conversations when waiting for new pieces. I have to admit, that at some time I forgot to get new pieces because I was listening in on another conversation at the bar." - Female 1

The participants did not interact on an interpersonal level with anyone during the test. This was anticipated, since JiggyTime 1 had none of the encouraging elements implemented. It is thought mentionable that *all* of the participants noticed our walk-on:

"I saw someone with an iPhone, but don't know if he was playing (read: JiggyTime)." - Male2

"There was someone sitting behind me, but I don't know if he was playing. I think he had an iPhone." - Female 1

Concluding on the evaluation of JiggyTime 1 we confirmed that the main gameplay of solving puzzles worked and that the players could easily understand and play the game.

#### Evaluation of JiggyTime 2

Participant	Puzzles solved	Reading menu	Looking around	Trading	Interpersonal contact	Maintaining contact
Male 1	2	4	19	Not available	0	No
Male 2	3	1	24	Not available	0	No
Male 3	1	0	15	Not available	0	No
Male 4	3	1	21	Not available	0	No
Female 1	0	5	11	Not available	0	No
Average	1,8	2,2	18		0	0 out of 5

Table 1. Table listing results from test 1.

The analysis of the data observed when testing JiggyTime 2, showed a significant drop in environmental/contextual interaction when compared to JiggyTime 1, see Table 2.

This was properly due to the implementation of the trading session. Since all of the players used the trading session, and that the amount of puzzles solved was the same, we assumed that the time spent on interacting with the environment/context from JiggyTime 1, was instead used on JiggyTime 2's trading session. The interviews supported the assumption:

" The trade was good, I liked that. Without it the timer would have been too long." - Male 5

"Pretty entertaining, good for when you are sitting and waiting for something. I discovered that I, without thinking of it, had played 15 minutes." - Male 7

As discovered in the interviews, we successfully got *all* of the participants to engage in the trading session, meeting success criteria 1:

"When I first heard that it was a puzzle game I thought to myself; crap! But I got caught up in it, because you have to use your wits.. and you can trade.. and how do you get someone to trade the right piece? That's cool." - Male 8

"Trading was fun." "I traded with both. If not the first had a piece, I tried the other one." - Female 2

According to the video observation we got two participants to reach success criteria 2. When leaving the café Male 5 nodded and said "Later." to our placed walk-on. In the interview he said:

" I played with both of them. I didn't think you were allowed to talk with the other players." - Male 5

Further exploration of this revealed that the participant, Male 5, had forgotten that we beforehand had told him: "You may encounter other players during the test, and you are welcome to ignore or interact with them as you please, the choice is yours.". When we in the interview asked him, if he would normally interact with other people in a café, he answered:

"In a café I wouldn't, unless I knew if we were both playing the same game, that would be.. like.. a link.

#### Then I would." - Male 5

Male 7 initiated contact with our walk-on during game play, see Figure 8.



Figure 8. The walk-on (Left) is contacted by Male 7 (Right).

## ".. I could see on the picture that it was him, that I could trade with him." - Male 7

The reason for the contact was due to an urge for a specific piece Male 7 wanted from our walk-on. Missing the symbolic cues to tell him in the game, Male 7 turned to the reallife option, pointing it out on his screen to the walk-on. This was the exact reaction, within the trading session, we had designed the game to encourage in our development of the game design [15]. We had on purpose designed the game with lacking mediated referential cues, so that this might encourage the player to use interpersonal cues instead. In this case it worked.

Concluding on the evaluation of JiggyTime 2, we could see that success criteria 1 was fulfilled by *all* participants and success criteria 2 was fulfilled by 2 out of 5. The test of JiggyTime 2 failed to fulfill success criteria 3. Also we discovered a change in the players interaction with the environment/context.

#### **DESIGN OF JIGGYTIME 3**

As mentioned, JiggyTime 3 was implemented by enhancing the design of JiggyTime 2 through analyzing the results from testing JiggyTime 1 and 2. The most important results from the previous tests were the participants reluctance to initiate

Participant	Puzzles solved	Reading menu	Looking around	Trading	Interpersonal contact	Maintaining contact
Male 5	1	1	2	Yes	1	No
Male 6	1	1	2	Yes	0	No
Male 7	2	0	2	Yes	1	No
Female 2	1	0	3	Yes	0	No
Male 8	4	0	12	Yes	0	No
Average	1,8	0,4	4,2	5 out of 5	0,4	0 out of 5

Table 2. Table listing results from test 2.

contact when only encouraged to. This meant that we had to make sure that the players were "forced" to interact and did not have the possibility to play alone and still advance in the game. Furthermore, the results showed that the players were happy about the picture in the trade view, so they had an idea of who they were trading with. To further support this in JiggyTime 3, we wanted to add more features that also could function as "icebreakers" by letting the players know as much as possible about each other before initiating contact.

The first change we made to JiggyTime 2, was to change the functionality of the 'Get New Pieces' button by removing the timer and making the button always active. Instead, when the button was pressed the player would need to enter a five digit code, which he/she had to receive from another player, in order to get new pieces. As seen in the left view of Figure 9, the puzzle view had a random code listed to the left of the button, which was the code other players needed to get new pieces. The right view of Figure 9 shows the input box which appeared when pressing the button. The codes could not be used by the player themselves but only by other players, which meant that the only way to get new pieces in to the game was to exchange codes with other players, and since there were no text or voice communication in the game, this had to be done through interpersonal interaction.



Figure 9. The puzzle window of JiggyTime for the third test showing the modification of the 'Get New Pieces' functionality.

Figure 10 shows the second change we made to JiggyTime 2. In addition to the three puzzle pieces being visible when browsing the nearby players, the player would also be able

to see an approximate distance to the selected player. This change added to the "icebreaking" aspect of the game, by giving one more possibility for the player to identify who he/she was actually trading with.

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Figure 10. The browse window of JiggyTime for the third test showing the added distance information for the nearby players.

Because the network part of the game was implemented by the wizard of oz method, this meant that the shown distance in the browse view also was hard-coded. We were able to do this because we knew the approximate distance the participants would place themselves to the walk-ons in the café.

#### **EVALUATION OF JIGGYTIME 3**

The collected data from testing JiggyTime 3 showed a drop of puzzles solved, see Table 3. This can be explained by the change of the flow of new pieces introduced in the game. In comparison to JiggyTime 1 and 2 and their timer function, JiggyTime 3 counted on the players' ability to get codes from the other players in order to get new puzzle pieces in play. This affect could easily explain the amount of puzzles solved and according to the video recordings it took the participants several minutes to initiate the code switching. In this inactive time the participants did not get any new pieces, compared to the previous timer function from JiggyTime 1 and 2 where the participants could get new pieces every 45 seconds.

The interaction with the environment/context also changed. We saw that none of the participants interacted with the menu, but instead there was an increase in the participants' desire to look around. This could indicate that the implementation

Participant	Puzzles solved	Reading menu	Looking around	Trading	Interpersonal contact	Maintaining contact
Female 3	1	0	2	Yes	1	No
Female 4	2	0	9	Yes	5	No
Male 9	0	0	14	Yes	4	No
Female 5	1	0	8	Yes	1	Yes
Male 10	1	0	8	Yes	4	Yes
Average	1	0	8,2	5 out of 5	3,0	2 out of 5

Table 3. Table listing results from test 3.

of the code-switching function and the range indicator in JiggyTime 3 encouraged the participants to look more around, since they were the only changes from JiggyTime 2 to Jiggy-Time 3. The assumption was that these game design changes had an effect on the players' behavior. The interviews did not clarify this further, but the video recordings revealed that the players' looking around often ended in them getting up and going over to a walk-on to exchange codes. This confirmed that the looking around was a direct effect of the participants search of other players to exchange codes with.

Concluding on the evaluation of JiggyTime 3, we could, as in JiggyTime 2, see that success criteria 1 was fulfilled by *all* participants. An effect of the enhancement was that success criteria 2 was now fulfilled by *all* of the participants, instead of 2 out of 5 in JiggyTime 2. Figure 11 shows Female 3 initiating interpersonal interaction with one of the walk-ons.



Figure 11. Female 3 (Left) asking the walk-on (Right) to exchange codes.

Also the amount of initiated contacts pr. participant was increased. Furthermore, the enhancement resulted in 2 out of 5 participants fulfilling success criteria 3. Female 5 chose to initiate contact with one of our walk-ons, but she then sat down at the table and stayed there for the rest of the test:

"...when I could see that I couldn't solve a puzzle, and I had seen someone when I came into the café, I could recognize a picture of him in the trade, and that I had traded with him, so I went over to him, the guy I could remember, and said that I could see that he was playing with me and asked if he was interested in exchanging codes. He was into it, so we exchanged codes, but then I was still missing pieces, and I would rather avoid to talk to other strangers, so it was easier to stay with this guy." - Female 5

Male 10 initiated contact with both of the walk-ons and the fourth time he stayed by one, see Figure 12:

"I traded codes with two, and traded pieces with 3. I ended up sitting with one and trading codes." - Male 10



Figure 12. The walk-on (Left) is trading codes with Male 10 (Right).

As a side effect of the evaluation the participants also provided lots of ideas for usability improvements, design suggestions to the game, and overall comments on the test. The wizard of oz solution we created for the network part of JiggyTime proved to be successful. The interviews revealed that none of the participants realized that they were in fact not trading with a real person.

#### DISCUSSION

The different methods for research, evaluation, and design enhancement for mobile systems/games described in are, in the following section, all subject for clarification and comparison to our main goal with this paper. As described in [6], different methods suits different testing purposes. The choices we made for the evaluation and enhancement is described in the following.

#### Evaluation

Since the game design in question was an interpersonal, mobile, casual, and collaborative game, choices of which evaluation method to use, when weighing the strengths against the weaknesses, was obvious in most cases. We chose to conduct a field study, first of all because the main goal of the evaluation was evaluate the game design's abilities to make the players of the game interact on an interpersonal level. This form of interaction could be tested in a laboratory, but referring to the strengths and weaknesses observed in [14][8][12][4][9], a field study with its "natural" setting was the obvious choice for our main goal. The other attempts were in some way conflicting with our main purpose. Making people actively participate in collecting data [11], would in our case conflict with the sense of realism and natural context we were trying to achieve. The extensive multimethod evaluation presented in [7] was simply out of scope for the time period and resources of this research paper. Using only remote evaluation, as in [13], would not provide us with enough data to evaluate or goal. The study of designing and evaluating collaborative learning activities at a museum [18], only concentrated on usability evaluation, seeking out technical limitations of the design. We wanted to evaluate the technical (the game design) impact on human behavior. The evaluation of Treasure [19] had many of the features and strengths that we wanted to incorporate into our evaluation. Since the evaluation of Treasure was mostly focused on location strategies among the players (quantitative data), and that our focus was a little more on the social and human impact (qualitative), we had to centre the evaluation techniques around the human factor.

The evaluation framework for networked mobile gaming presented in [16] is best suited for simulating scenarios, based on prior observations. Since our focus was on interpersonal interaction, and the qualitative experience of this, simulation would be insufficient.

#### Enhancement

The process of enhancing the game design was an iterative process. We chose this work process partially because it suited our time frame, but also because of its benefits; quick feedback, continuous implementation, workload, etc.

The methods presented in [2] were determined for coding and programming enhancements, and as such irrelevant for the main goal of this paper. Even though, some of the proposed methods were of use to us in the iterative production of the different versions of the game. Since our time frame kept the implementation period of each iteration down to a week, some of the methods were of use to constrain inefficient coding. The design approach in [17]. Was very similar, in terms of process, to what we wanted to achieve. However, the focus of enhancing usability was again not reflecting our main goal. The study that explored the method of designing a pervasive mobile game [10], was very much centered around the beginning of a game design. Also scenario-based player studies would be too time consuming to match our iterations.

#### CONCLUSION

This research showed that it was possible to reach the goal of making people interact on an interpersonal level by playing the mobile game, JiggyTime, although it required the interaction to be "forced" in the game design. The iterative process of implementing and enhancing JiggyTime proved to be an effective method of reaching this goal, as it was only during the test of JiggyTime 3 we reached the goal of making the players maintain interpersonal interaction. Finally, the tests resulted in some unexpected and interesting results, which was that the participants changed behaviors depending on which version of JiggyTime they were playing. This was not a goal for this paper, but could be used as the basis for a related research of provoking specific behavior through a game design.

As mentioned, the wizard of oz solution for implementing the network part of JiggyTime was successful as none of the participants realized they actually were not trading with a real person. However, using the wizard of oz method for implementing adds some limitation to the research in that we did not know if the participants' reactions would be different if the trade was done with a real person. During the interviews we noticed several of the participants suggesting improvements to JiggyTime, which would make them initiate interpersonal interaction more easily, however, some of those suggestions were already implemented in the tests and did not work as expected. This could either be an indication that they were unsure of how they would react in this situation themselves, or that they were trying to promote themselves as more social than they really were. This could also be connected to the fact, that people behave differently when they know they are in a test environment [18]. Either way, this added to the limitations for the research.

For future work it could be interesting to conduct the same tests in Southern Europe, since the tests in this paper were situated in Northern Europe. As one of the participants also mentioned, people in Northern Europe have a more reserved social culture than in Southern Europe, for example, when people in the north use public transportation, they usually pick an empty seat rather than one next to an occupied seat. In the south the pattern is opposite, here passengers usually find a seat where other passengers are already seated [5, p. 78]. This indicates a difference in willingness to initiate interaction with other people, and it could prove to require much less work and give completely different results to encourage interpersonal interaction in the south than in the north.

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