Less-talk-is-more-play:An Experimental Study on Multiplayer Mobile Games for Casual Gamers

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In this paper, we experimentally study a new type of multiplayer mobile game for casual gamers by introducing the concept of online team-based strategy forming via visual-only in-game communication. The game is deployed to twelve users, formed as three teams (four players per team), in order to study team-based cooperation and competition that they can develop over time and explore new game design concepts. By analyzing both subjective and objective data collected through online logs, questionnaires, and post-game interviews, we find a number of implications and insights that could be used to guide design of similar types of mobile casual games in the future. In addition, how various gaming elements (e.g., ideal number for team-based game play, user interfaces) can be utilized to design better mobile casual games is also discussed.

Categories and Subject Descriptors: K.8 **[Personal Computing]**: Games; H.5.2 **[Information Interfaces and Presentation]**: User Interfaces
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1. INTRODUCTION

Recent technological advances on mobile communication and smartphone devices have led to increased interests in gaming applications specifically developed for such devices. Compared with console or PC based games, games specifically developed for smartphones have a distinct set of characteristics such as simplistic design, usually accompanied by a simple rule set, intuitive interfaces and a *play-as-you-get-it* philosophy. As a result, in general smartphone users, as mobile game players, are more like casual gamers rather than hardcore gamers.

In contrast to hardcore gamers, casual gamers are profiled as less committed, less competitive, and more relaxed users. Casual gamers tend to be less devoted (regarding time, pursue of goal, competition) and less attracted to sophisticated or complex games (relative to game play, goals, environment, graphics, characters, etc.). They are less attentive towards

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game details and more interested in simple, yet addictive game scenario, friendly game plays, intuitive interfaces, and fitting of the application with everyday activities. In general, casual players advert a *less-is-more* gaming philosophy [Juul 2009].

With networking and multiuser interaction becoming omnipresent, multiplayer games have gained increasing popularity recently (for instance, [Barkhuus et al. 2005, Bell et al. 2006, Debeauvais and Nardi 2010]), where the notion of multiple players is not merely a feature but a requirement and a design constraint. In these games, players communicate in real-time during game-play and can interact with both each other and the game environment. Early casual multiplayer games were primarily based on previously successful single-player games (e.g., Chuzzle) in order to control or reduce the commercial risk due to the uncertainty of multiplayer extension. To introduce the multiplayer element, such games were typically extended by providing common boards for posting scores and tracking progresses. Such practices, though fostering a certain perception of a community among players, cannot nevertheless be characterized as *multiplayer* in a strict sense.

The goal of this work is to identify and evaluate design principles of mobile multiplayer games specifically for casual gamers. We look into practices to introduce elements from hardcore gaming to casual games and the ways that casual gamers respond to such elements and gaming scenario. In the spirit of this direction, we develop an experimental mobile multiplayer game for casual gamers called *MosoPlants*. This game involves competing teams of players without previous real-life or online interaction. In addition, a simple set of gaming rules and goals are delicately designed in this game, which enables us to focus on the interaction practices that are preferred and/or developed intentionally or unintentionally by casual gamers.

The novelty of our study lies in the key elements we explicitly include in the design process: intuitive gameplay, *play-as-soon-as-you-get-it* philosophy (without a large body of rules or training beforehand), and limited time commitment. At the same time, we incorporate elements for enhanced gaming experience such as online play and multi-group/multi-user play. In contrast to conventional casual games characterized with simple short-term goals, our experimental game involves with a spanning-several-days goal that multiple users have to fulfill collectively.

In addition, we devise and evaluate a new challenging gaming scenario compared to existing game studies. Specifically, we explicitly exclude any form of verbal or written communication between players in the game, which gives us the opportunity to analyze the effect of creating interesting in-game interactions and the need of judgments and inferences regarding the playmates' intentions and strategies, either on a cooperative basis or on a competing basis. In existing multiplayer mobile games, the players often do not need to focus on learning the strategy of opponents and more importantly of teammates via visual inspection of the changes in the game environment.

The remainder of this article is organized as follows. Section 2 reviews the background and previous work related to this study. Section 3 provides a detailed description of the developed experimental game. Section 4 describes the experimental design and procedure. In Section 5, we present analysis of the user study results, and in Section 6 we describe game design implications learned from this study. Finally, in Section 7, we discuss and conclude this work.

2. RELATED WORK

In this section, we briefly review background and previous work related to the two aspects of mobile gaming (multiplayer gaming and in-game communication).

2.1. Multiplayer Mobile Games

Most of current mobile games are single player games; however, multiplayer mobile games have grown rapidly since the multiplayer functionality benefited significantly from the recent 3G and Wi-Fi technology developments [Doswell 2006, Kloper 2008, Manweiler et al. 2011]. For example, Barkhuus et al. [2005] proposed a multiplayer mobile game that utilizes both network and without-network situations to make inferences about repetitive plays and tactics development, and their importance in delivering enjoyable experiences. Bell et al. [2006] conducted a user study on a mobile multiplayer game to explore integration of mobile games with daily activities. Their work also utilizes GPS (location) based communication, which means that users have to deviate from their daily routines to play the game.

Another category of multiplayer mobile games involves community based gaming. Gamers use their smartphones to access a community website (e.g., Facebook), where they can play browser-based games with thousands of co-players. Such games typically have limited graphical content and are focused on the interaction between a large number of participants [Jarvinen 2009]. However, these community-based games do not usually involve extensive dynamic strategy forming and inference among gamers. On the contrary, our introduced novel multiplayer game is focused on dynamic strategy forming among teammates and among competitors. Specifically, to receive feedback for in-game activities, a player needs to observe the actions and decisions of playmates from the same and different teams and then adapt her/his own actions and strategies accordingly.

2.2. In-Game Gamer Communication

Most of existing online multiplayer games, regardless their platforms, provide a mechanism for inter-player communication. Typically, communication is achieved through written texts, in the form of short messages, or online chat or forums that complement game activities. In some more advanced games, users may be provided with additional communication channels during the game-play in order to familiarize each other, coordinate actions, settle disputes, or form team strategies.

During the past several years, there have been considerable analysis and development efforts on the communicative activities of players in multiplayer games [Mateas 2003, Eladhari and Eindley 2004, Drachen and Smith 2008]. Tychsen [2006] presented his research progress on the communication structure in Pen-and-Paper (PnP) games. Later, Smith [2006] studied collaboration and conflict patterns among gamers in different multiplayer games by using an empirically-based analysis method. Within those different types of Role-Playing (RPG) multiplayer games, much attention has been given to real-time strategy games [Johnson 2010, McClelland et al. 2011]. These research efforts have examined players' tendencies to use different communication ways to pursue game-play objectives, e.g., exploring the game world.

In addition, communication in online virtual environments has been studied extensively [Maher and Simoff 2000]. The communication between groups in such environments is a major research focus, compared with the PnP and RPG multiplayer games. Group-based communication is also considered as one type of social interaction [Ducheneaut et al. 2006]. For example, Li and Counts [2007] developed a rich client multiplayer mobile game and studied the impact of mobile social interactions in a gaming context by examining

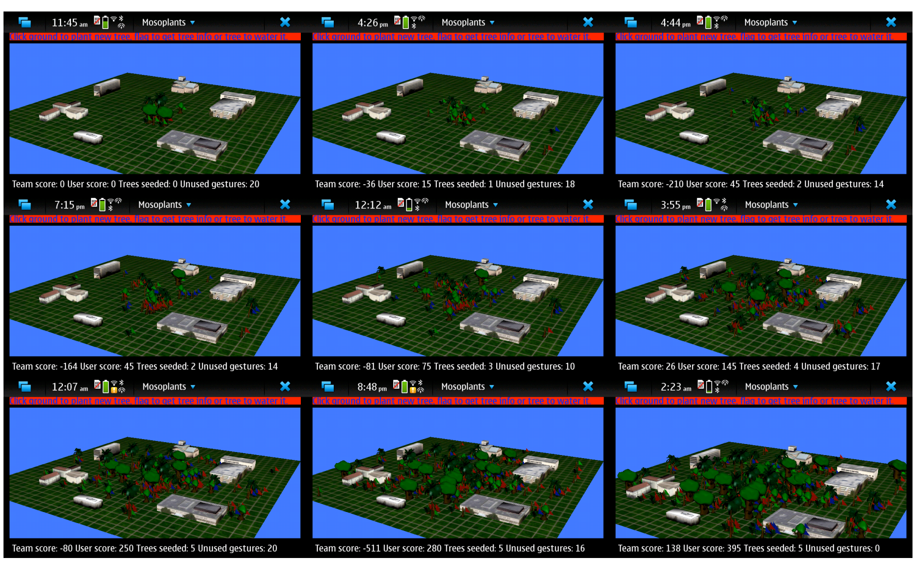

Figure 1: The MosoPlants game is progressively populated and evolved based on the in-game user activities.

social variables such as how strangers get to know their fellow gamers.

In this work, to devise a more challenging gaming scenario while keeping the game-play simple, we explicitly exclude any form of verbal or written communication from players. This has the effect of creating interesting in-game interactions and the need of judgments and inferences regarding the playmates' intentions and strategies, either on a cooperative basis or on a competing basis. The players can infer and learn the strategy of opponents and more importantly of teammates, through visual inspection of the changes in the game environment. To make it explicit we advocate a two-fold, user-id and user-communication masking.

3. MosoPlants: an Experimental Mobile Multiplayer Game

To study the above gaming concept, we built an experimental game called "MosoPlants" (Mobile Social Plants). It is an interactive multiplayer mobile strategy game designed and implemented on Nokia N900 smartphones. Since our goal is to use it as the basis and experimental platform for our game study, we opt for a simple graphical environment and an intuitive graphical user interface, and explicitly focus on establishing game-specific rules that shall facilitate inter-player, intra-team and inter-team strategy formation. In this section, we introduce the game architecture and rules in details, followed by description of involved technical development. Figure 1 shows continuous snapshots of a game play of the MosoPlants game.

3.1. Game Description

The MosoPlants game is designed to be played by a number of teams, and each team consists of a group of players, with the players' identities being withheld both from teammates and opposing teams. During the game play, a player needs to collect points for his/her team by strategically planting and maintaining trees in a virtual environment that simulates an outdoor landscape. In order to increase player motivation and commitment to the game, we opt to simulate a familiar environment. For this reason, we model a part of the campus of a university in which all of the game players (i.e., user study participants) are studying. The 3D models in the virtual environment include buildings and ground, and players can select any locations on the ground (except the building area) to plant trees via touch-screen. Trees planted by the players are visually reminiscent models of two types of plants. A plant has three phases (levels), and each of them is simulated with a different visual appearance (i.e., root, small plant, full grown tree). Players can conveniently navigate the dynamic 3D virtual environment through standard 3D navigation operations (e.g., rotation, translation, and zooming).

3.2. Gameplay

Throughout the game, each player has a limited (pre-defined) number of operations that s/he can perform within a game cycle (e.g., one day). A fixed set of possible player actions are pre-defined, including: (1) plant a type A tree (*palm*) at an unoccupied location, (2) plant a type B tree (*baobab*) at an unoccupied location, and (3) water a tree to maintain or increase its age-level. The game is initialized with an unoccupied ground in the form of an empty grid, where players are free to start planting trees by clicking unoccupied locations. Trees are initialized at level 1 and by accumulating a certain number of watering actions (i.e. three watering actions to upgrade one level in our game), they progressively grow to levels 2 and 3. In this process, the players can choose to either water an existing tree or plant a new one. A tree seeded by a player is attributed to both the player and the team that the player belongs to. At any point, a player can access and perform actions on all the trees seeded by his/her teammates. Up-to-date information about team activities and tree states is available in the form of tags on the team-owned trees (refer to Figure 2), which will help decision-making and strategy forming of each player. Note that information about trees owned by opponents cannot be accessed by any players; however, the up-to-date total scores of all the teams are available to all the players all the time.

Gesture Interface: To enhance the user experience and add an additional level of interaction with the game, a gesture-controlled user interface [Lu et al. 2010] is employed. All the game actions except selecting locations and displaying information (that is, seeding a

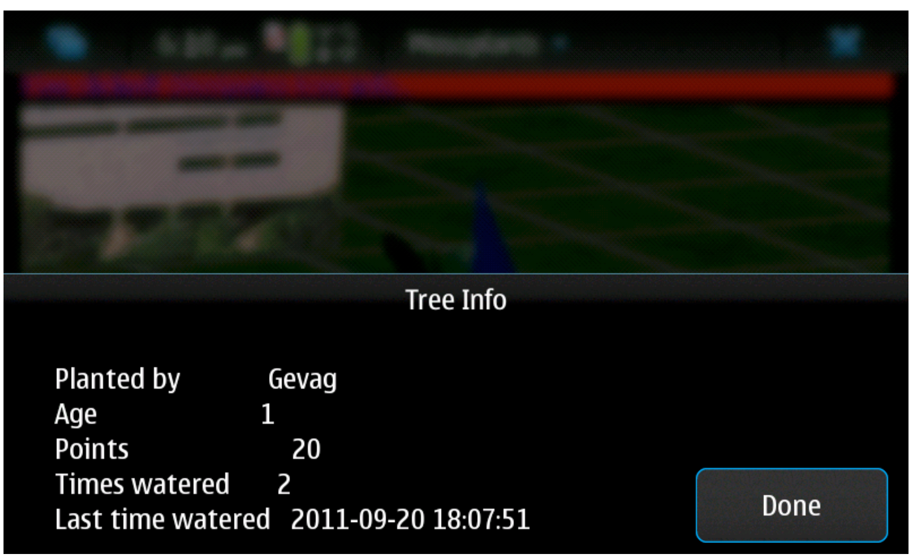

Figure 2: Up-to-date state information of a team-owned tree is available in the form of tags.

type A tree, seeding a type B tree, and tree watering) are performed and trigged via simple gestures (e.g., circling). During the game-play, if a gesture cannot be properly recognized, it will not be counted toward the player's quote and the game system will also give instant feedback about it to the player. The gestures are individual-specific and trained as a priori at the game initialization time.

3.3. Game Rules

A set of game rules are selected to limit the chance of any team winning out of luck and promote strategy formation. Additional care is taken to facilitate development of different strategies (e.g., create, constrain, expand, maintain, etc.). Specifically, the following game rules are pre-defined in this game:

- The quote of game gestures for each player is 20 per game cycle (24 hours).
- 10 points are credited for seeding a tree at a neutral position (i.e. sufficiently distant from existing trees).

Figure 3: User interface of the MosoPlants game at the client side: the extra function menu (top) and description of the game rules (bottom).

- 10 points are credited for seeding a type A (or B) tree next to an opponent's type A (or B) tree. The opponent team also gains 5 points.
- 5 points are credited for seeding a type A (or B) tree next to an opponent's type B (or A) tree. The opponent team loses 10 points.
- 5 points are credited for watering a tree if the tree does not grow to the next level.
- 10 points are credited for watering a tree if the tree also grows to the next level.
- A team is penalized (i.e., certain points are reduced) based on the number of remaining trees not fully grown (i.e., at level 1 or 2) at the game-ending time.
- A team is penalized based on the extent of unequal contributions from the team members.

The underlying rationale of our game rules is to establish simple in-game principles and set the ground for the associated user-study. For example, the rules are designed to avoid excessive tree planting or overpopulating the environment while at the same time invoke players to plan actions in advance and adapt their strategy during the game play. Moreover, players are guided to pursue a balanced contribution from all the team members, since more penalties will be paid if individual players' contributions are significantly deviated from the average score. Note that the above game rules are clearly explained to the game players beforehand.

3.4. System Architecture

To support the game play of the MosoPlants, we developed client-server architecture, leveraging HTTP as a transport protocol. Each Nokia N900 smartphone is treated as a client, sending and receiving HTTP requests from and to the server. The server uses a MySQL database to store game status, log game information, and collect various experimental data (e.g., each player's actions).

3.5. Game Client

The interactive client of our MosoPlants game is developed in Linux OS environment using C++ with Qt, a cross-platform toolkit for developing applications. The main function of the client is to present the game world to players, interact with players, and send/receive user data to/from the server (Figure 3). The tree models used in the game are created in advance using Blender software, and the 3D building models were acquired from the Google 3D Model Warehouse. The developed interactive client program is deployed to Nokia N900 phones, running Maemo 5 OS. The client program is delicately optimized so that it is able to run at approximately 30 frames per second with 5.6 MB system memory.

3.6. Backend Server

All the backend HTTP requests from clients are handled by a dedicated workstation running Windows XP Professional Edition and Apache 2 Web Server. Database queries are then handled by the web server, and it connects to a MySQL 5 database system running on the same workstation. To communicate with the backend server, clients can send HTTP requests in a predefined format to the web server to notify the clients' tree planting or watering actions, query the game's current status, and perform other operations. The server handles the requests accordingly and updates the database automatically.

It is noteworthy that the main purpose of our study is to investigate certain casual game design patterns, and a small number of players played the game for a short period of time in our study (refer to the follow-up Experiment Section 4); therefore, we did not push every detail of the technical aspects of the game server to limits. Indeed, if this game is deployed for real-world settings with a large number of users, the concurrency of transactions/actions (e.g., conflict of transactions) and other network latency issues need be taken into serious account.

4. Experiment

In this section, we describe the details of our game play experiment and how various game-play data are collected in our study.

4.1. Participants

In the game play, three teams were formed (labeled as “Red”, “Green”, and “Blue”), and each team consisted of four players. For the purpose of identity masking, each player was assigned with an alphanumeric user id upon enrollment. All the 12 players (3 teams x 4 players per team) were recruited from a university. Their demographic information was recorded before the game was started. The average age of the players was 26.3 with a standard deviation of 3.4. Among the 12 players, 7 were male and 5 were female. In terms of their nationalities, 4 were from the United States, 5 from China, 2 from Greece and 1 from India. The educational background of the players was diverse but mainly in Computer Science and Electrical Engineering majors. As far as their gaming habits are concerned, 11 claimed that they were casual gamers, and only one player claimed he was a hardcore gamer.

4.2. Procedure

Each player was provided with a Nokia N900 phone and s/he can take it back home during the game play. The players were not required to be physically present at the same location during the game play, except the starting and ending phase of the game. At the game starting time, we ensured that the players completely had no idea who would be their teammates and who would be in their opponent teams. After the game was over, each of the players was asked to fill in a questionnaire regarding his/her gaming experience and additional usability feedback. The experiment consisted of three phases: starting session, game play session, and ending session, detailed below.

Starting session: The selected players were instructed to pick a team (Team *Red*, *Green*, or *Blue*) to join, without any prior knowledge on who were the rest players. The players were also told that a certain amount of monetary prize would be provided for the winning team. The starting session involved a brief, individual meet-up between each player and the game coordinator, where game description and rules were provided. Each player was given a Nokia N900 phone and a password-protected, randomly generated account. In addition, each player was given the option to train a default set of or his/her own selection of gestures for the three game actions (i.e., seeding gesture for type A tree, seeding gesture for type B tree, and watering gesture).

Game play session: The players played the game for a period of three days (three game cycles). They were asked to independently play the game, and they can play it anywhere as long as Wi-Fi network connection was available. In addition, they were free to login in/out and play it at any point during the experiment.

Ending session: At the end of the three game cycles (i.e. three days), the players were asked to fill in a delicately designed questionnaire to report their gaming experience and usability feedback on the game, followed by a short interview for additional free-form feedback and comments.

4.3. Data Collection

Two types of data were collected during the experiment. Objective data included individual player activities and team activities throughout the game play, and subjective data were collected via the post-game questionnaires and player interviews.

4.3.1. Objective Game-Play Data

The collected objective data are gameplay statistics automatically recorded by our program, including (*i*) player activities, (*ii*) tree-object information, and (*iii*) team scores over time. Each player activity data includes the player's log in/out timestamps (used to calculate the play time of each player) and detailed player activities (e.g., which player performs which action at which time instance). The second category, the tree-object information, records all the information relevant to each tree, e.g., the tree's location and current status, which player planted this tree, and at what time which player watered the tree, etc. Each player's score and all the teams' scores were dynamically updated based on the in-game player actions and aforementioned pre-defined game rules, and these scores were recorded every half hour.

4.3.2. Subjective Evaluation Data

Subjective evaluation data were obtained through post-game questionnaires and interviews for all the players. The questions in the survey included not only various aspects of the game (e.g., interface, features, functionality and enjoyability) but also player strategies and tactics development throughout the game play. In addition, general questions on the players' preferences were also included. A short interview was conducted after the questionnaires session. Questions used in the questionnaire can be grouped into the following three main categories:

Social perception: The players were asked to evaluate the intra-team communication and the subjective feeling of playing a game with/against strangers. Suggested by the Likert scaling [Likert 1932], we asked the players to rate the evaluation from 1 to 5, in which 1 denotes the worst and 5 denotes the best.

Game-related: Questions in this category included the user evaluation of game navigation, gesture recognition, scene model/rendering and game difficulty. The players were forced to respond to these questions with a Yes or No answer.

Player expectation: The players were asked to provide feedback on ideal duration of game play, ideal number of team and players, etc.

Each player also performed a web-based Big Five Inventory personality test (*http://www.outofservice.com/bigfive/*) in order to gather quantitative data on various aspects of his/her personality and traits [John and Naumann 2008]. The Big Five Inventory test gives scores for the following five different personality categories: *Openness*, *Conscientiousness*, *Extroversion*, *Agreeableness*, and *Neuroticism*.

5. Results and Discussion

In this section, we present qualitative and quantitative analysis of the collected data and further discuss our findings.

5.1. Strategy Forming via Visual Context

Player strategy development is an important aspect of game design in general. From massive multiplayer games to simple web-based real-time strategy games, much attention has been given to enable players develop their own strategies during the game play. We opted to do that, by carefully choosing the game rules, in order to encourage formation of team strategy through individual player judgment. At the same time we provided an additional challenge to the players, namely, the explicit absence of any form of verbal or written communication (e.g., text messaging and voice chatting). Inter-player communication is implicitly achieved through the visual changes in the game scene.

The distribution of final scores across teams and players is shown in Table 1. A first observation is that the winning team (Blue) was more efficient in member coordination and achieved approximate even contributions from its members. Uniformity of the score distribution correlates to self-organization and formation of an *equal-weight strategy*. Not surprisingly, the same team (Blue) was the one that valued its communication effectiveness with the highest ratings. By contrast, the players in the team (Red) gave the lowest score on their perceived intra-team communication effectiveness.

Team	P #1	P #2	P #3	P #4	*Team Score*
Red	350	390	100	520	551
Green	340	380	465	165	927
Blue	310	430	270	395	1061

Table 1: Final individual player scores and team scores in our experiment.

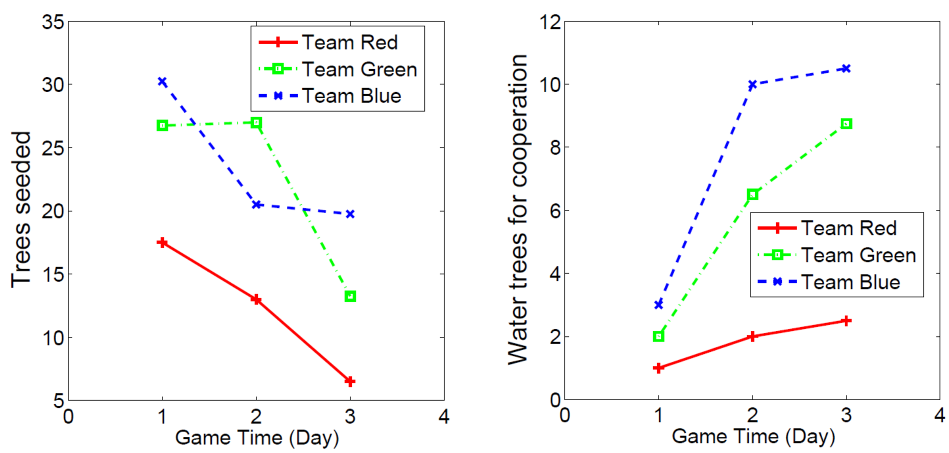

Figure 4: The number of seeded trees and the number of watered trees per day are dynamically adjusted by the players.

Figure 4 plots how the two major game activity measures (i.e., the number of seeded trees and the number of watered trees) of all the teams are changed over time. In this case, the number of seeded trees can be interpreted as individual players' actions while the number of watered trees can be interpreted as cooperative actions (i.e., water trees seeded/owned by other teammates). From the figure, we can observe that the number of seeded trees is significantly more than the number of watered trees in the first day, and then the level of cooperation (i.e., the number of watered trees) was gradually increased in the 2nd and 3rd days.

Figure 5 shows a more detailed breakdown of the game actions (tree seeding and tree watering) in the 3-days game play period, where game actions are plotted every 8 hours. As shown in this figure, among the three competing teams, the blue team employed the most aggressive strategy to handle seeding and watering operations to maximize its team goal, which is, focusing on tree seeding at the beginning of the game and steadily switching to tree watering activities. By contrast, the red team was primarily focused on tree seeding actions and fewer team cooperative interactions were formed until the late stage of the game, which was too late to beat its opponents. Compared with the blue and red teams, the green team used a consistent strategy to balance seeding and watering actions during the whole game play. This is evident in Figure 6, where the green team led the competition at one point. However, by effectively exploiting the game rules, the blue team quickly formed and adjusted an aggressive team strategy, and eventually won the competition (refer to Table 1).

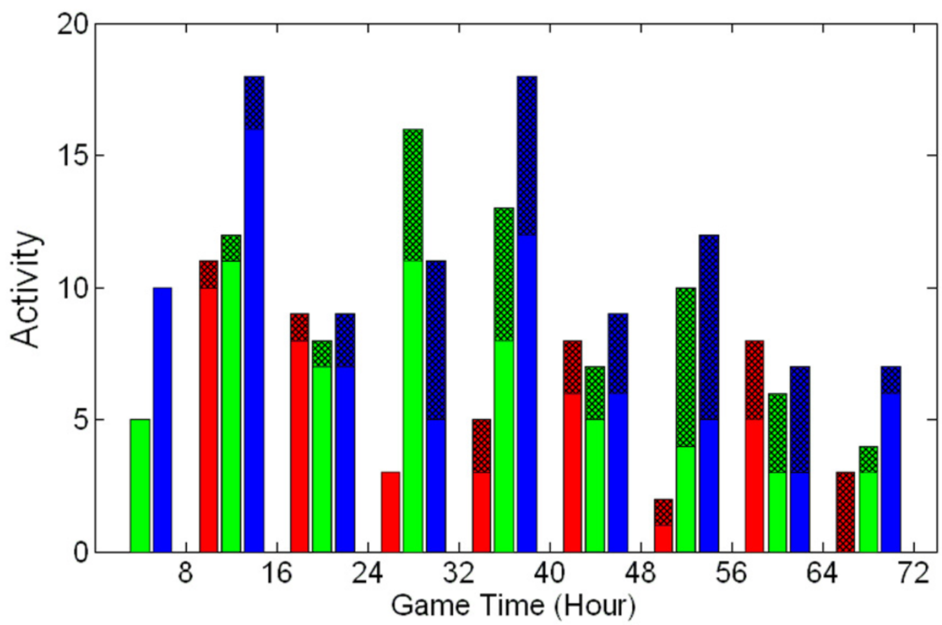

Figure 5: Plotting of in-game team activities (i.e. the sum of the number of the tree-seeding actions and the number of the tree-watering actions) every 8 hours. In this figure, the color of each bar represents the corresponding team (e.g., the red bars represent the activities of the red team). Also, the bars with cross patterns represent the number of tree-watering actions and the bars without patterns represent the number of tree-seeding actions.

The players were additionally asked to comment and express preference on the following three modes of communication if these modes were used in the game to enhance the gaming experience.

- *M1*: Non-written communication (as the case in our game study).
- *M2*: In-game communication in the form of posted messages or chat.
- *M3*: Out-of-game communication using web forums.

The following observations were drawn from the obtained user feedback and comments: (1) For *M1,* even though the players found it challenging and motivating, it would be more meaningful if the duration of the game play could be longer. This would give sufficient time for the players to facilitate learning through visual observation and enabling them to adaptively form a common team strategy. (2) Regarding *M2* or *M3* as an alternative, the majority of the players preferred in-game communication (*M2*) over external web forums (*M3*) in order to form an effective team strategy. This observation is closely in accordance with the casual gamer profile we aim to address in this study.

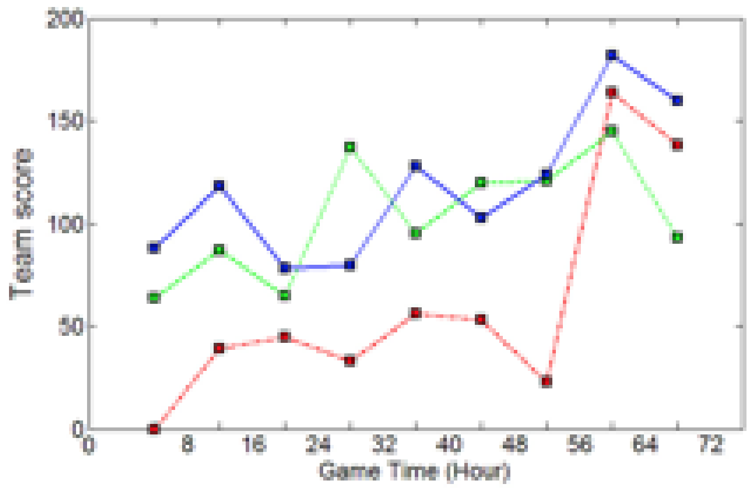

Figure 6: Plotting of change of the team scores every 8 hours in our game play. In this figure, the color of each bar represents the corresponding team (e.g., the red bars represent the activities of the red team).

Actually, the preferred form was in-game message posting (e.g., on the trees, as a part of gaming activities), as suggested by 8 out of the total 12 players. The communication preference outcomes indicate that for a game play with a short period, it would be more helpful for the players to establish a game plan at the beginning and then make necessary adjustment as they go, rather than spend time trying to figure out their teammates' and opponents' actions.

5.2. Correlation Analysis between Players' Personalities and In-Game Actions

Researchers have found that humans' personalities may have certain correlations with their social behaviors in virtual environments [Golbeck et al. 2011]. To exploit this correlation in our experimental game, as mentioned above, we collected the trait scores of the 12 players in our study. Following the correlation analysis method proposed by Golbeck et al. [2011], we performed Canonical Correlation Analysis (CCA) on the players' trait scores and the obtained in-game player action data (refer to Table 2). We can observe that openness (indicating appreciation to others' views and ideas) has a weak correlation with the players' in-game actions in our study. This result is surprising, since it is generally believed that people who are open to other persons' ideas and opinions would be more cooperative in collaborative tasks. In addition, interestingly, we found that more agreeable players who have a tendency to be pleasant and accommodating in social situations more actively performed all the in-game actions (i.e., seeding-A, watering, and seeding-B actions) in our game. In particular, the agreeable players were more competitive in the game play as well (i.e., performed more seeding-B actions to decrease the opponents' scores).

	Openness	Conscientiousness	Extroversion	Agreeableness	Neuroticism
Seeding-A *(P-value)*	0.07 (0.091)	0.08 (0.045)	0.14 (0.091)	**0.50** (0.051)	0.17 (0.033)
Watering *(P-value)*	0.02 (0.031)	0.30 (0.073)	**0.44** (0.041)	**0.52** (0.050)	0.05 (0.042)
Seeding-B *(P-value)*	0.03 (0.035)	**0.54** (0.081)	0.10 (0.051)	**0.60** (0.042)	0.24 (0.043)

Table 2: Summary of the canonical correlation analysis between personality and individual players' in-game actions in our study. Note that here *Seeding-A* denotes tree-seeding for the own team and *Seeding-B* denotes tree-seeding to decrease the opponents' team scores. The P-value in each cell shows the computed statistical significance of the correlation.

5.3. Ideal Numbers for Team-based Game Play

In our study, we formed 3 teams and each team had 4 players. At the game completion time, the players were asked to specify the number of teams and members per team that they would consider ideal or optimal for the game. This is related to factors such as interaction, enjoyment and efficiency in game play and game walk-through.

As far as the ideal number of players in one team is concerned, 7 out of the total 12 players specified 3 to be an ideal number of players per team, and the maximum number (of members in a team) specified the players is 5. On the other hand, regarding the ideal number of competing teams, 6 out of the 12 players declared they would prefer more than 4 teams to participate in and compete each other, 5 players felt that 3 was a good number for this game, and one player preferred 2 teams. An interesting observation is that although the multiplayer nature of the game is appreciated, most of the players still prefer a small group of cooperative teammates (i.e., number of players per team). This conforms to casual players' standards in the sense that although a certain level of engagement and team coordination need to be put on the game, it should not be too high so that the coordination overhead is still manageable. The players enjoyed the sense of being in an active virtual community with many members, but they preferred the number of teammates is small enough and thus more efficient and enjoyable.

5.4. Expected User Interfaces

In our game, we followed a minimalistic user interface design approach, given that more complex interfaces would discourage or fail to engage casual game players who are typically not willing to invest significant gaming time to figure out the flow of the gameplay. As an example, the main screen of our game only displays all the team scores and the player's score, along with the number of remaining gestures in the current day for this particular player (refer to Figure 3). Navigation through the 3D game environment is achieved through use of the keyboard arrows, which is relatively intuitive and straightforward.

Consistent with the casual gamer profile, it comes as no surprise that all the players preferred the minimal interface design. They commented that the interface was more appealing compared with using a more cluttered and confusing display. On the other hand, the integrated gesture-based actions did not seem to enhance the overall gaming experience. 5 out of the total 12 players indicated dislike towards the gesture-based action design (i.e. tree seeding and watering actions can only be trigged via gestures) and a clear preference towards simply clicking or touching screen control, while other 4 players commented they found no additional merit or interest in gesture-based actions after they got used to gestures. All the players preferred the 3D aspect of navigation and inspection of the game environment, noting that it added a level of excitement. This is in accordance with a current tendency in mobile game design towards increasingly complex graphical design.

6. Recommendations and Design Implications

In this work, we used three teams (total 12 players) to conduct our user study. By analyzing both subjective and objective data collected through online logs, questionnaires, and post-game interviews, we found many interesting observations that could be used to guide future design of similar types of mobile casual games.

- A form of *less-is-more* intra-team communication design could make the game more challenging.
- *3D games* are in general preferred over 2D game by majority of the players, although this is somewhat unexpected and in contrast to the *less-is-more* philosophy that casual gamers typically follow. However, *minimalistic user interfaces* are expected for such games so that the players do not need to spend significant time to learn game play beforehand.
- *Multi-player gaming* mode is essential, compared with single-player gaming mode, for mobile casual gamers.
- Gamers are able to easily adapt to handle cooperation and competition in multiplayer game if the game is designed in an *asynchronous mode*. Under the asynchronous gaming mode, players do not feel negatively committed, e.g., being required to be online at specific time or for certain durations; instead, they can manage their own game time, irrespective of the other players.
- Such type of multi-player games would be even more appealing for gamers if the game play can be much longer (i.e., longer than three days such as one month) so that they are able to better improve their in-game learning and make the game more fun and interesting.

One major limitation of the current study is that it suffers from a limited scale. With more participants and a longitudinal study, we could provide a clearer and more comprehensive assessment of players' behaviors, preferences, and actions in-game. Therefore, we would be able to derive more solid game design guidelines and implications. However, despite the relative small scale of the current study, we believe that the main implications and findings drawn from it can be used to guide future design of mobile casual games, to a certain extent.

7. Discussion and Conclusions

In this work we proposed, developed and tested a novel multiplayer mobile game aimed at casual gamers. The game utilizes the main concepts of casual gaming, while at the same time it incorporates some "hardcore-game" elements such as online player coordination, and dynamic strategy forming and inference through visual context. An important factor that makes casual games appealing is that they allow players to incorporate the game play into daily activities, e.g., taking a break or riding a bus. Thus, the goal of this study is to identify how casual mobile gamers would react to a game that is specifically designed to deviate from majority single-player oriented mobile games. In addition, we explored a form of "less-is-more" intra-team communication in order to make strategy forming more challenging, by connecting the players visually through a shared virtual world and restricting any other forms of communication.

Certain limitations exist in the current study. For example, most of the participants were recruited from college students, so that the participants' backgrounds were not sufficiently diverse. This fact may affect the analyzed results in terms of in-game multiplayer communication. As studied by previous researchers [Juul 2009], the non-verbal communication in casual games tends to be influenced by gamers' ages, culture, or even genders. On the other hand, the participants' background certainly affected our personality analysis against in-game actions [Golbeck et al. 2011], which may limit our analysis to the certain extent.

Future research includes modification of our experimental game and design choices according to the findings of our current study. We plan to conduct a comparative study between mobile and traditional multiplayer games in order to identify and quantify the game design differences that game developers need to be aware of. Also, we plan to conduct a longitudinal study (e.g., one month) on the improved game with a large number of involved participants (game players). In this way, we hope to further refine and identify emerging game design patterns that can increase player engagement and the game enjoyability.

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