Playing Different Games on Different Phones:
An Empirical Study on Mobile Gaming

Henry Been-Lirn Duh
National University of Singapore
Department of Electrical and
Computer Engineering
4 Engineering Drive 3, Singapore
117576
65-65765859
eledbl@nus.edu.sg

Vivian Hsueh Hua Chen
Nanyang Technological University
Wee Kim Wee School of
Communication and Information
31 Nanyang Link, Singapore 637718
65-67905833
chenhh@ntu.edu.sg

Chee Boon Tan
Nanyang Technological University,
Center for Human Factor Ergonomic
School of Mechanical and Aerospace
Engineering, Singapore
65-67905894
tancheeboon@pmail.ntu.edu.sg

ABSTRACT

With the growing popularity of mobile phone gaming, design issues with mobile phone games have become more important. Given the complexity of designing games for mobile phones, game developers must understand how mobile phone users' gaming experiences are like when using different types of phones. This paper examines users' gaming experiences in playing three types of games on three different types of phones. It is found that users have different preferences when playing different games on certain phones. Some games are more suitable to be played on mobile phone than others. Easy control and fewer levels of difficulties are the two main issues for consideration in designing mobile phone games. It is recommended that game designers design specific types of games for different mobile phone interfaces. Mobile phone manufacturers need to consider gamers' requirements for the type of games they intend to include in the mobile phone.

Categories and Subject Descriptors

K.8.0 [**Personal Computing**]: General--- Games.

General Terms

Design, Experimentation, Human Factors.

Keywords

Mobile Phone Games, User study, Mobile gaming.

1. INTRODUCTION

Mobile phones today are more than just a communication tool. They are packed with features and applications such as games. Mobile phone gaming is one of the features that have gained popularity among users nowadays. Compared to games played on personal computers and game consoles, mobile phone games have certain limitations, such as limited screen size, limited button size for controlling, limited memory storage and limited sound performance. Game developers have to consider such limitations

during the design phase of mobile phones games.

Moreover, the same game may be played on different mobile phone interfaces. Users' experiences in playing the same game on different mobile phones may also differ. The diversity of mobile phones creates challenges for mobile phone game developers. It is difficult to design one game that allows users to have enjoyable experiences when the game is played on different mobile phone interface.

Furthermore, mobile phone manufactures are launching new models with new form factors every other month. Mobile game developers have to consider the newly added phone features as well. Given the complexity of designing games for mobile phones, game developers must understand how mobile phone users' gaming experiences are like when using different types of phones. This study conducted a user study of mobile phone games to understand users' preferences in playing different types of games in different types of phones.

2. LITERATURE REVIEW

Although significant amount of HCI research have been done on mobile devices, literature specifically on mobile games is limited. Current literatures address mobile phone interface design [1][7], particular techniques or models used in designing mobile phone games [6], and evaluation of mobile phone games [4][5].

In terms of evaluating games, one approach is to conduct user studies to understand users' preferences and responses. Koivisto, Suomela and Koivisto [4] employed qualitative research on a particular game Ancient Runes found the game to be very suitable for mobile gaming and female users liked this type of game. Another study looked at players' emotional responses on a game prototype to gain insight on challenges in designing pervasive mobile games [2].

Bucolo, Billnghurst and Sickinger [1] compared three types of input options used for mobile gaming to understand how to better design user interface. They made specific suggestions for designing mobile games. In a study on network games, users were tested on their performances to understand the effects of input and limitations of display. It was found that display is an important gaming factor for first-person view shooting games and the input device is critical for real-time strategy games [3].

Through evaluations, researchers tried to determine the most suitable design of mobile phone game interface as well as the

game itself to enhance gaming experiences. Research has not found any existing game or design model to be most suitable for all mobile phones. Attempts have also been made by phone manufacturers to design mobile phones specifically for gaming purposes (e.g. Nokia N-Gage). However, there is no concluding argument whether such type of phones is most suitable for gaming. Moreover, no studies have done to investigate players' experience in playing different types of games on the same mobile phone or playing the same game on different types of phones. To contribute to this body of literature, this study investigates users' experiences in playing three different types of games on different types of mobile phones. It enhances understanding of the relationship between types of games and mobile phone interface.

3. METHOD

The experiment was conducted in a controlled laboratory-based environment ensuring systematic and high quality data collection. The two independent variables were game type (Racing, Adventure and Sports) and phone type (Nokia N-Gage QD, 6610i and 3650). Prior to the actual experiments, a pilot test was conducted with five participants. Any difficulties encountered during the pilot study were noted to modify the actual experimental procedures. Their comments on the pre-test and post-test questionnaires were used to modify the questionnaires.

3.1 Participants

Eighteen experienced mobile phone users were recruited through convenient sampling from Nanyang Technological University. There were three female and fifteen male students participating in the experiment. Their ages ranged from 21 to 30 years old. Participants are frequent users of short messaging services (SMS) and have played mobile phone games. They occasionally play PC games. After completing the study, they were awarded academic marks in their coursework.

3.2 Mobile Phones Selection Process

Three mobile phones, Nokia N-Gage QD, Nokia 6610i and Nokia 3650 were used for evaluation. Both Nokia N-Gage QD and Nokia 3650 have some common features such as large liquid crystal display (LCD) and the depth of colors. Nokia N-Gage QD was chosen in view of its great similarity to gaming console such as SONY PlayStation 2. The phone's styling and keypad layout were intentionally designed for gaming and telecommunication.

Nokia 3650's unique features are its phone size, form factor and the keypad layout. When competitors are designing and developing smaller phones, Nokia launched this big phone with large LCD and built-in camera. The phone's keypads resembled that of the early 1960s landline phones, which are circularly designed. It would be interesting to see how users play games with such keypads interface.

Of the three phones, Nokia 6610i has the smallest LCD screen size. It was chosen because its LCD screen size, stylish form factor and keypad arrangements are similar to most of the phones available on the market.

3.3 Mobile Games Selection Process

Three different genres of games were selected: Adventure, Sports and Racing as shown in Table 1. Criteria of game selection were based on the different levels of attention seeking as well as the variations of gaming interface. All three games required reasonably good mental and hand-eye coordination.

Table 1: Overview of the Game Titles and Genres.

Genres	Adventure	Racing	Sport
Game Title	Rayman3	Motor GP	Bowling2003
Attention Seeking	Low	High	Low
Motor Skill	High	Medium	Low
Game Complexity	High	Medium	Low
Music/Sound effect	High	Low	Low
Good Interface Mapping	Medium	High	Low
Error prone	High	Low	Low

3.4 Procedure

Participants were brought to the laboratory at the Center for Human Factor and Ergonomics. A moderator then briefed them on the objectives, procedures and duration of the test. All participants were then required to sign a consent form before they proceed. Game type is a within-subject design factor and phone type is a between-subject design factor. These participants were randomly assigned to one of the three phone type conditions. The order of games played was balanced among the eighteen participants. Before playing each game, participants were given time to read the gaming scenario and task objectives. They also completed a pre-test questionnaire. During the game, participants were required to do 'think-aloud'. The whole gaming process and verbal comments of each participant were recorded on video. Participants were asked to rank how interesting each game is at the end of the whole experiment and filled out a post-test questionnaire regarding game compatibility and preferences. After all the tasks were done, participants were debriefed. Small video cameras were attached to the mobile devices for recording of the mobile phone screen for later analysis. Users' negative facial expressions or verbal remarks (Confusion, Frown, Frustration and Head Shaking) were coded based on the video.

4. Results

An analysis of variance (ANOVA) on the frequency of negative-expression recorded from all the participants during gaming showed that there was a significant main effect of phone types ($F_{2,45}$ =14.48, p<0.001). Among the three phones, 6610i groups expressed the least amount of negative-expression for all three games, following by N-Gage QD group. Subsequent analysis between the phone types did not reveal any significant differences. No interaction effects were found between phone type and game type.

4.1 Racing Game

The participants were asked to rank the game and phone compatibility. All three groups had similar responses. All participants from 6610i group and half of the participants from the other two groups felt uncomfortable and that playing the game was an unpleasant experience. The main reason given was having great difficulty controlling their motorcycles.

Both the N-Gage QD and the 3650 groups used the directional keys to control their motorcycles' movements while the 6610i group used the #2, #4, #6 and #8 keys. The left biased directional keys on the N-Gage QD imposed control constraint for the participants, especially for those who are right-handed. It created control difficulty, confusion and frustration. None of the participants in the N-Gage QD group used the right biased number

pads because the keypad arrangement is slightly curved. Prone to pressing the wrong button was the common reason gathered from this group for not using them for such high attention-seeking game.

The keypads on 3650 are arranged in a circle, which provides poor directional mapping. Most participants were observed using their right thumb on the small directional keys right below the LCD to control the bike instead of using keypads. Such small keys made it difficult for participants to control the motorcycle. Hence, it recorded almost three times more negative-expression in this phone group than the other two groups.

For the 6610i, the number pads are orderly arranged giving good directional mapping. However, participants commented that the buttons were too small and too close to one another. All the participants in this group used the number pad to control the motorcycle movement. Although 6610i has a similar type of directional key as the 3650 model, it was not popular among the participants due to its relatively small size. Besides, those users often use keypads for composing SMS. Using number pads is less familiar to them. There were the least number of negative-expressions recorded for 6610i group. Participants in 6610i group commented that the 1.5" screen size was too small for gaming as they had problems looking out for the road sign.

With regards to how interesting the game was, N-Gage QD's special gaming interface and large screen size did not appeal to the users. Half of the participants from 3650 group and 1/3 of participants from the other groups perceived the game to be interesting.

4.2 Adventure Game

Exactly half of the participants from each phone group felt the game and phone compatibility is poor. The reasons gathered from the N-Gage QD group were that the navigation buttons were difficult to control comparing to joystick or keyboard; their fingers feel painful after pressing the button for long period of time; and it was hard to press two buttons at the same time. The N-Gage QD has a storyline narrated every time the gamer arrived at a designated landmark. This feature was considered an annoyance to the participants.

In the 3650 group, the remarks were mainly on the poor mapping of the control keys. Participants recommended the phone should be equipped with nice background music and decent keypad tactile feedback. As for the 6610i group, the general comments were that the limited screen size resulting in poor viewing, and the small control buttons that are too closely spaced. In both phone models, the size of the directional keys is very small and the participants find themselves pressing the wrong button during play. However, observer noticed that 6610i phones seem to have slower responses from gamers' input during game play. It could be due to the lower processing power of the phone model.

Almost all the participants agreed that the game is interesting and exciting with one exception from 3650 group.

4.3 Sports Game

This Sports game is simple to control. Most often than not ?, only one button is required to play the game in all three phone models. Half of the participants from N-Gage QD group and 1/3 of participants from the rest two groups rated the game phone compatibility as poor.

The N-Gage QD and the 3650 groups in particular have problems figuring out how to start the game. All three groups tried the keypad #5 by instinct and only the 6610i group was successful in starting the game. Both the N-Gage and the 3650 group were disappointed and confused because they had to try all the other buttons to start the game. Only one participant made an effort to check out the meaning of the indicator from the gaming instruction.

In this Sports game, bigger LCD phones do not help to enhance the gaming experiences nor raise the level of interests. It was recorded twice as many occurrences of confusion in both the N-Gage QD and the 3650 group than 3610i group. Participants also commented that the control buttons were either too small or confusing in both groups. Six participants felt the game was either boring or a waste of time and they were either from the N-Gage QD or 3650 group.

Gamers in the 6610i group had a more enjoyable time with the game than the other two groups despite the smaller LCD screen. They commented on the bad sound effect and difficulty to see score and game indicator on small screen.

Results of evaluation indicated that gaming control requirements have greater influence on gaming success and satisfaction than the mobile phone's form factor. Nokia 3650's uncommon keypads design was overshadowed by the large LCD display as well as the provision of a simple directional key. The latter feature was observed to be a good user interface for most games except Adventure Game, which requires multiple buttons to be used at the same time. For Adventure Game, straightforward numbering keypads seem to be the most liked control keys. For 6610i, which has the common form factor and traditional keypads arrangement, seem to be the easiest to adapt for playing new games.

5. DISCUSSION

Sports, Adventure and Racing games were found to be suitable for mobile phone gaming by 67%, 44% and 40% of participants respectively. Almost all participants consider that Strategy, Board and Gambling games more suitable for mobile phones from their past experiences as these games do not require high eye-hand coordination ability.

When designing mobile phone games, easy control and fewer levels of difficulties are the two main issues for consideration. Common problems encountered by gamers in this study are small screens, small keypads, control difficulty and poor button tactile feedback. Gamers will not enjoy a game with complicated operations when playing with mobile phones. Providing more functions usually result in more complex user interface and thus makes a product neither convenient nor easy to use.

The Racing game requires the player to pay sustained attention and the phones to be equipped with good controllability. Although all three phones received poor compatibility verdict, the 3650 group has more favorable replies despite having used an unconventional circular numbering keypad. It is because 3650 has a 5-way directional keys and a big LCD display. It allows users to play the game without using the circular numbering keypads, which give poor directional mapping.

There were mixed reactions when questioned about compatibility of the phone factor and its interface for the Adventure game. Generally, all three groups enjoyed the Adventure game despite the usual gaming interface issues. Adventure games require more

motor skills and number of keypads used, hence more error prone. Many participants were observed to have pressed the wrong buttons during gaming especially when the button spacing is small. Prolonged pressure on the keypads also hurt the finger. Large phones equipped with color screens is useful for adventure games. A joystick type of controller may improve gamers' performance.

The Sports game selected for the evaluation required low level of attention-seeking, game complexity and motor skill. From the survey, it was noted that half the 6610i participants found the simple sports game interesting and almost all enjoy playing it. Coincidently, both the 3650 and N-Gage QD groups encountered difficulty in starting the game. There were no instructions available from the game menu on how to control and play the game.

From the above user study, it is recommended that mobile phone games should have fewer difficult levels than PC games, as users are likely to play the game for a shorter duration. Better animation, sound effects and visual tracks for controlling the device are necessary.

For phone manufacturers, providing an interface for gamers to have vivid experiences and allow good hand-eye coordination is a big challenge. Big screen, good controllability, lively sound effect and simple user interface will be the highest priorities for designing racing games on mobile phones. Although most participants prefer a big LCD screen, there is no relationship between screen size and enjoyment of games.

6. CONCLUSION

The current study discovered that to enhance mobile gaming, designers must consider users' mental model rather than supplying advanced features. Designing a phone specifically for gaming purposes does not guarantee a pleasant gaming experience. N-Gage QD for example, despite having a big display and typical hand-held gaming device interfaces, does not guarantee an enjoyable gaming experience for all three types of games. 6610i, with the most standard mobile phone features received the most positive feedback from users. 6610i has the common form factor the participants are already aware and familiar with. Users apply their usual behaviors in using mobile phones when playing games. Phone manufacturers should carefully consider usability issues of each game in order to modify current user interface to accommodate game play.

To satisfy users' enjoyment in playing games on mobile phones game designers and phone manufacturers are required to work together. It is clear that game design must consider the form factors of mobile phone. Certain types of games are more suitable for certain form factor and interface design. For instance, participants commented that action games may not be suitable for mobile phone.

As mobile phones are moving into the 3G platform, different usability issues may surfaced as both the hardware and the software are getting more powerful and complex. A next step for this research is to evaluate other genres of games with a larger pool of test subjects.

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