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Effects of different scenarios of game difficulty on player immersion

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ABSTRACT

This study investigates the effects of game difficulty on player's immersion. Key factors in this study are difficulty of direction changes, including three directions (up and down, down and up, and continuously increasing) and difficulty of rate changes, with three rates (slow, medium, and fast). An experiment was conducted with 48 participants, each playing the same experimental games with different difficulty of direction or rate changes. The results indicate that the players have better immersion when the difficulty changes up and down than when it changes down and up or when the difficulty is continuously increased. And the participants have better immersion when the difficulty changes at a medium rate than when it changes slowly or fast.

1. Introduction

Some researchers believe that challenge is a major contributing factor to fun (Malone and Lepper, 1987; Hsu et al., 2005, 2007; Rouse, 2001; Fabricatore et al., 2002). For game designers one of the major tasks is to design a game of challenging difficulty to maintain the interest of a player (Wong et al., 2006). However, the goal of game design is to concentrate on the process of play for players rather than the result of that process (Barr et al., 2007). Therefore, it is important to explore how to design varied difficulties of a section of a game. In addition, a player who is not appropriately challenged during the game may not be fully motivated. Thus, it is of value to discuss how to appropriately manipulate difficulty over the progression of a game.

There are two kinds of researches on game difficulty. One is on algorithms for providing dynamic difficulty. The other is about the guidelines of game difficulty; for example one guideline recommends games to be "easy to learn, hard to master; the level of difficulty in games should be varied" (Desurvire et al., 2004; Federoff, 2002; Pagulayan et al., 2003; Sweetser and Wyeth, 2005). The method of making the players feel immersed is to provide a challenging difficulty level with the development of the game (Wong et al., 2006). However, few studies have focused on the basic quantitative exploration of difficulty design in a section of a game. Therefore, this paper is aimed at exploring and analyzing how to change the difficulty of a round or level in a game. This study focused on two aspects of difficulty change: directions and rate, each with three types of change directions and three types of change rate in a round of games. Then comparisons would be made between these directions and rates.

2. Literature review

2.1. Game difficulty

From the viewpoint of game designers, difficulty can be represented through various factors such as puzzles, uncertainty, the speed of the game, the number of enemies, and the time limit. From the viewpoint of the player, difficulty can be described as the degree of cognitive and/or physical efforts required in completing a task (Orvis et al., 2008). Hsu et al. (2007) also defined difficulty in terms of the mental workload and physical effort. The players will feel being when they encounter a task demanding skills and/or knowledge beyond their current capabilities (Van Velsor and McCauley, 2004).

Wong et al. (2006) considered that "level of difficulty" was an important area in level design for games, which directed the effectiveness of a game in generating engaging experiences for the players. The difficulty level controls various conditions in a game. These conditions include the aggressiveness of the characters, the number of weapons, and other items. Other common game features are the game speed and the time limit in some games.

Currently, there are two types of difficulty level designs: static and dynamic. The static includes two kinds: one does not allow players to adjust the difficulty level; the other allows them to adjust the basic difficulty level, for example, by setting it to easy,

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medium, and hard or more levels. For example, Diablo2 (single version) provides three levels for players with different skill as Normal, Nightmare and Hell. Another type of difficulty level design allows the game to dynamically adjust the difficulty level based on the player's ability. And the aim of studies on dynamic difficulty (Wong et al., 2006; Hunicke and Chapman, 2004; Bailey and Katchabaw, 2005; Kalyuga and Sweller, 2005) was to explore the feasibility of providing customized levels of difficulty to both novices and experts. However, dynamic difficulty adjustment it is not easy to achieve dynamic difficulty adjustment, which few games incorporate while most games provide static adjustment.

Bailey et al. (2005) believed that designing difficulty levels in games must address the problem of how to achieve the "optimal experience" for players. The games should present an optimal level of difficulty to players. If a game is too easy or too difficult, it could reduce the player's motivation and time on a task (Belanich et al., 2004; Orvis et al., 2008).

Danskey (2006) considered that what happens in the game is the heart of the game narrative. Through the players' performance and as designers advance the challenge in the game, players create stories. Qin et al. (2009) described the computer game narrative as the method or style used to tell what happens in a game. For the game players, a game is composed of continual information, increasingly challenging difficulty, fights, puzzles, and compounding rewards. Therefore, game difficulty design is an important part of the game narrative and an important task for game developers.

2.2. Difficulty of direction change

Players would be in optimal experience when the game difficulty they encounter matches with their current capabilities. So, in course of narrative a game, one of the important tasks for designers is to arrange different difficulties in a game. Therefore, for computer games, how to appropriately narrative difficulty over the progression of a game is of value. The difficulty of most games could be adjusted based on their gameplay elements. These elements include player character attributes, non-player character attributes, game world and level attributes, and puzzle and obstacle attributes (Bailey, 2005). Rani et al. (2005) proposed players' affect-based modification of game difficulty to achieve higher challenge, which was detected from physiological signals.

For the narrative of computer game difficulty, this study considers that there are two aspects: level of game difficulty of a section of a game and transformation of different levels of game difficulty. Meanwhile, the transformation between levels of game difficulty relates to two aspects. The first is change directions, which describe how to change from one difficulty level to another. The second aspect is change rate, which is the span of difficulty between two connecting difficulty levels.

For game difficulty of direction changes, some researchers have proposed that the level of difficulty should be varied (Desurvire et al., 2004; Federoff, 2002; Sweetser and Wyeth, 2005). In practice, the level of difficulty in many games is altered. Commonly, each game level is more difficult than the previous level. However, few researchers focus on difficulty of direction change systematically except Orvis et al. (2008). They investigated how two different strategies for modifying difficulty in instructional videogames impact learner performance and motivation; the two strategies were forced adjustment and learner-centered adaptive adjustment. A forced adjustment is that the videogame gradually gets harder regardless of the learner's performance; a learner-centered adaptive adjustment is that the game gets easier when the learner performs poorly and harder when he/she performs well. The two different strategies for modifying difficulty showed two kinds of difficulty of direction changes. But results of the investigation indicated that no single approach to adjusting difficulty level was clearly superior than any other in terms of enhancing these criteria. These are studies focusing on difficulty of direction change in a whole game.

For game difficulty narrative, this study believed that the difficulty of a round has a greater impact on the player's perception than the difficulty of a whole game does. A round, sometimes called a level, wave, stage, course, or map, is a segment of a game world (Zagal et al., 2008). Recursive rounds compose a game. Within a round, a series of smaller-scale conflicts or challenges are found (Lindley, 2003). The difficulty of direction change of a round become more and more difficult in most fighting games like The King of Fighters or early arcade games such as Phoenix, Gorf, and Time Pilot. Commonly, at the end of a round there is a boss challenge representing a capstone. It was reported that the average adult played games about 7 h per week in America (ESA, 2008), so it was estimated that the average adult played no more than 2 h at a time. Commonly, it takes players from a few minutes to a few hours to complete a round in a game. And players could not complete a game in one time. Therefore, the difficulty of a round has a greater impact on the player's perception than that of a whole game does.

In this study, for difficulty of direction changes in a round, three types are proposed: continuous, up and down, and down and up. With the progress of the games, the players' skills increase gradually. To maintain players' motivation and enjoyment, the challenge should increase accordingly (Andrade et al., 2005; Wong et al., 2006). Thus, this study proposed that the first direction was continuous change. From another viewpoint, players perhaps will probably become physically and/or mentally tired after sustained play. Two directions of change up and down, and down and up were designed to minimize player fatigue. The difference between the two types is that at the beginning and the end of a round the down and up direction is more difficult, and in the middle of and at the end of a round the up-and-down direction is more difficult.

2.3. Difficulty of rate change

Difficulty of rate change is the span of difficulty between two connecting difficulty levels. In a section of a game, there are two kinds method to control difficulty of rate change. One method is to set the level of difficulty at the beginning and the end of the section. And different spans of difficulty are distributed at the middle of the section. The other method is to set the level of difficulty of the whole section. And different spans of difficulty are arranged. In this study, playing time of a round game is not so long. So the difficulty of rate change is designed based on the second method. For difficulty of rate change, this study proposes three levels: slow, medium, and fast. The levels are relative measurement. If the span of difficulty between two connecting difficulty levels is larger, it indicates that the difficulty of a section of a game changes faster. Contrarily, it indicates the difficulty changes more slowly.

Um et al. (2007) propose a dynamic difficulty controlling game system (DDCGS) using factor of difficulty control (FDC) and factor of users' adaptation (FUA) to automatically control the game difficulty according to the skill of the player. In this research, FDC is based on game speed and FUA is based on game score. For FDC, the study uses game speed 1–5 to control difficulty, in which the easiest game is speed 1 and the most difficult is speed 5. Therefore, in this study game speed just represents difficulty of a game. And the speed does not indicate difficulty change in detail.

Rani et al. (2005) propose affect-based modification of game difficulty to achieve higher challenge. In the research, the anxiety of the player was detected real-time and employed to alter game difficulty. It was detected from physiological signals. To manipulate the game design, three levels of difficulty, three levels of performance, and three levels of anxiety are defined. However, this

research just tests the relationship between player's perceived challenge and his/her anxiety. And game difficulty is only verified based on three levels. How soon the difficulty is developed with proceeding of the game is not identified.

Commonly, a typical narrative rhythm of movies tends to employ a dramatic arc as well as difficulty rates. Especially for Hollywood films, each act of most 3-Act movies has stated time. In Act I, the movies set up a story so that the film engages the attention of the audience. Act I generally takes up about one quarter of a films total length. In Act II, an increasing sense of urgency is created when the main characters encounter obstacles. Act II generally occupies the middle two-quarters of the film. In Act III, the results of the stories' main conflict come to dramatic confrontation. And the major conflicts, issues, or ideas in the story are resolved. Act III also takes up about one quarter of total length (Parkinson, 1996).

In order to decrease other elements of a game exceeding varied difficulty impacting player experience, this study selected action games to explore the difficulty design. Action games typically have combat as their main interactive feature (Apperley, 2006; Wolf, 2001). Action games were our first choice for exploring game difficulty because they have three distinct characteristics. Firstly, action games commonly have no in-depth storyline. Also, the structure of action games is relatively incompact, which means the two rounds or events are not consequentially successive. Secondly, the challenge of an action game often comes from performance and seldom from the story. Because of these characteristics, it is convenient to test how player experience is impacted by the game difficulty, not other components of the game. In addition, action games, as a basic and broad gaming genre, have characteristics common to all computer games. Therefore, action games became the target for this study to explore difficulty design.

For difficulty of direction or rate change, these are based on quantifying difficulty. Because game difficulty may be from mental workload or physical effort, it is difficult to compute it objectively. However, major difficulty of some action games is from performance like hand-eye coordination. This kind of quantitative method of measuring difficulty is objective. The difficulty could be measured in terms of many kinds of status bar like time bar, quantity of enemies, life bar, weapons, property and so on.

2.4. Measurement of player immersion

Immersion is a metaphorical term derived from the physical experience of being submerged in water (Murray, 1997). Coomans and Timmermanns (1997) defined immersion as a feeling of being engaged deeply into a make-believe world. Ermi and Mäyrä (2005) believed that immersion more clearly refers to the mental processes involved in the game. In the game world, players can see, hear, and manipulate the environment as they do in the real world. This provides the player with a strong visceral and cognitive belief in what is experienced in the virtual context as physical reality. Elements such as the narrative of a game are important for drawing players into a game and keeping them immersed (Sweetser and Johnson, 2004). While experiencing games, players not only are involved in a ready-made game world, but also actively participate in the construction of the experiences; they invest their desires and previous experiences and anticipate outcomes (Blythe and Hassenzahl, 2003).

Although the terms – flow, and immersion have some overlap in studies, they are different in some aspects. Flow is 'the state in which individuals are so involved in an activity that nothing else seems to matter' (Csikszentmihalyi, 1990). Flow is an optimal and extreme experience. However, immersion is not always so extreme. For flow state, Csikszentmihalyi (1990) summarized eight components: clear goals; high degree of concentration; a loss of the feeling of self-consciousness; distorted sense of time; direct and immediate feedback; balance between ability level and challenge; sense of personal control; intrinsically rewarding. Jennet et al. (2008) considered that immersion has the following features: lack of awareness of time; loss of awareness of the real world; involvement and a sense of being in the task environment. Like immersion, the people in the flow state become so absorbed in their activities that irrelevant thoughts are screened out.

Narrative is the framework for computer games. Computer game narrative has its' own unique characteristics, which are interactivity and nonlinear structure. To measure game narrative, Qin et al. (2009) proposed an instrument based on the process of players entering into the immersion experience because the degree of player immersion reflects computer game narrative. The study described three stages including seven dimensions. The primary antecedent conditions are made up of three dimensions: Curiosity, Familiarity, and Challenge and skill. The second stage, experience, includes the players' perception and cognition during immersion including three dimensions: Concentration, Control, and Comprehension. The final stage, effect, represents the players' inner experience after immersion, and consists of one dimension: empathy. The description of the seven dimensions is shown in Table 1. The instrument systematically evaluated the player's perception. Measurements for usability, enjoyment or playability (Federoff, 2002; Sweetser and Wyeth, 2005; Desurvire et al., 2004 and Clanton, 1998) of games can evaluate mechanics, gameplay and performance. However, for computer games, most measurement paid little attention to the new characteristics like interactivity. Therefore, we use the instrument of measuring player immersion instead of other measurements in the computer game narrative to reflect effect of different scenarios of game difficulty.

3. Hypotheses

Hypothesis 1.1. Players playing games in which the difficulty of direction change of one round is up and down will have higher levels of player immersion than those playing games in which the difficulty of direction change of one round is continuously increasing, or down and up.

Hypothesis 1.2. Players playing games in which the difficulty of direction change of one round is up and down will have higher levels of player immersion than those playing games in which the difficulty of direction change of one round is continuously increasing or down and up when the difficulty of rate change becomes faster.

Because the continuous change difficulty direction is a forced difficulty adjustment regardless of player skill, difficulty may increase at a faster rate than that of some participants' skill (Orvis et al., 2008). And if the difficulty at the beginning of the game is harder from down and up direction, it might frustrate the players (Csikszentmihalyi and Csikszentmihalyi, 1988). For up and down direction, at the beginning, the increased difficulty challenges players; however, decreasing the difficulty gives players a feeling that their skill has surpassed the challenge as long as the congruence of skill and challenge hit the "optimal experience" (Bailey et al., 2005). When the difficulty change is faster, the effects of different difficulty of direction changes have a greater impact on players. Therefore, players playing games in which the difficulty changes up and down in one round will have a higher level of player immersion.

Hypothesis 2. Players playing games in which the difficulty change is fast will have higher levels of player immersion than those playing games in which the difficulty change is slow.

Table 1
Dimensions of player immersion in the computer game narrative.

Dimension	No. of items	Description
Curiosity	6	Arousal of senses and cognition and attraction to explore game narrative
Familiarity	2	Being familiar with the game story
Challenge and skill	3	Some relative difficulty in the game narrative for players and corresponding players' skills
Concentration	4	Ability to concentrate on the game story long-term
Control	3	Ability to exercise a sense of control over game narrative
Comprehension	6	Understanding the structure and content of the storyline
Empathy	3	Mentally entering into the imaginary game world while playing the games

The fast difficulty change will present a greater challenge to the players. High challenge, like high skill, is an important factor for players to enter into the flow experience (Csikszentmihalyi and Csikszentmihalyi, 1988; Pace, 2004). Thus, the players might have higher player immersion when playing games in which the difficulty changes quickly than when it changes slowly.

4. Method

It is known that the difficulty arrangement should give players a feeling of their skill surpassing challenge as long as the congruence of skill and challenge hits the "optimal experience" (Bailey et al., 2005). In terms of this theory, game difficulty of direction changes and difficulty of rate changes proposed in this study were verified based on player immersion. Through playing different difficulty of direction change and/or difficulty of rate change games, players would experience different degrees of immersion.

4.1. Participants

Previous study (Lucas and Sherry, 2004) considered that females are less frequent players than male of games featuring competition. And at the beginning of recruiting participants, few females respond to the message. Compared with male respondents, the responding females' game experiences, including years of playing, playing times per week and playing hours in a time, are widely divergent. Therefore, in order to exclude these differences, young men were chosen as the subjects of this study. Participants were recruited via posting messages on the game forums and part-time job forum on the Tsinghua University BBS. In the experiment, 48 male students were divided into three groups randomly. The same group of participants took part in one kind of experimental game. Ages ranged from 20 to 31 years ($M = 24.50$, SD = 0.42). Approximately 70% of them were graduate students. Among all the participants, 65% indicated they had played video games more than one time per week, and 79% of them had played games no less than 1 h the last time they had played. In addition, the three groups had no significant difference in participants' background information or game experience.

4.2. Task

The experimental games should be adapted from a certain game, so the first task is to select an original game. In order to reduce other elements exceeding difficulty impacting player experience, this study proposed some rules for selecting an original game. The first rule was that the game should have the typical characteristics of action games. The second rule was that it has an incompact structure. The third was simple performance. Furthermore, the game interface should not be complex. Finally, there should not be too many components of the difficulty in a game, so that it would be easy to construct experimental games adapted from the game.

According to these rules, *Warriors of Fate* (WOF) was selected, which is an English adaptation of the Japanese arcade action game *Tenchi wo Kurau II,* released by Capcom in 1992. This game is a horizontal-scrolling beat 'em up game. Common enemies keep popping up from everywhere. In each round there are 3–7 scenes.

After the original game was chosen, the difficulty of each scene in each round of the original game was computed. The difficulty of each scene is determined by the number of diversified enemies, which include spearmen, archers, and bomb-wielding opponents. In the game, the characters' lives represent a level of difficulty, and each kind of enemy has a different length of life bar (top left corner in Fig. 1). If the length of the bar is longer, the enemy is harder to defeat. Therefore, the first step of computing the difficulty of a scene was to measure the length of the life for each kind of enemy. After the number of enemies was counted, the total difficulty of each scene was also worked out.

After computing the difficulty, according to the three types of directions and three types of rate, three games were designed for the experiment on the basis of scenes in the original game. In condition one change rate, there were three types of directions under easy or hard level of game difficulty. For the change rate, about one ninth of the span between the maximum and the minimum of the game difficulty represented a two-connecting-scene difficulty difference of the slow change rate. Similarly, about one sixth represented a two-connecting-scene difficulty difference of the medium change rate and about one third represented two-connecting-scene difficulty difference of the fast change rate. One game represented one type of change rate and one round indicated one type of change direction. Thus, there were three experimental games. Each game included six rounds. Every participant played one experimental game.

Then according to the difficulty of the scenes in the original game and the requirement of the change directions and change rate of a round in the experimental games, scenes in the WOF were recomposed for the experiment. Each game represented a different change rate. The six rounds in a game represented three types of change directions under easy or hard level of game difficulty. Table 2 shows the difficulty design of scenes in each round. Every participant was given two default lives in each scene plus unlimited coins.

The WOF is based on the Chinese novel best known as *Romance of the Three Kingdoms*. In terms of the structure of WOF, *Crossing Five Passes and Slaying Six Warriors* was chosen for the experimental game story, which is another popular story, also based on the *Romance of the Three Kingdoms*. In order to provide the participants with a coherent experience, there was only one character in the experimental game. The back story of the experimental games was designed at the beginning of the game and the title of each pass was inserted at the beginning of each round. The system of the game play was the same as in *Warriors of Fate*. The task of each participant in the experiment was to overcome all enemies in each round.

Fig. 1. A picture of WOF.

4.3. Experimental design

The three independent variables were difficulty of direction changes, change rate, and level of game difficulty. The difficulty of direction changes had three levels, which were up and down, down and up, and continuous. The difficulty of rate change had three levels, which were slow, medium, and fast. The level of game difficulty had two levels, which were easy and hard. The levels of the difficulty of rate change and the level of game difficulty are relative measurement.

The dependent variables were player immersion, playing time, and hit points.

The player immersion was the score obtained through the instrument of player immersion in the computer game narrative on a scale of 1–7. The reliability and validity of the instrument were tested (Qin et al., 2009) on more than 700 samples. The value of Cronbach's alpha of this instrument was 0.877. The instrument consisted of 27 items addressing seven dimensions, as shown in Table 1.

The playing time was the total time required to overcome enemies in a round. The hit points were measured by the amount of life spent by the player-character in the experimental games to overcome all enemies in one round. It was computed in multiples of the player-character's full life.

This experiment was a repeated-measures design (Table 2). There were two within-subjects factors, the level of game difficulty and difficulty of direction change, and one between-subjects factor, the change rate. Each participant played one game including six rounds, representing one level difficulty of rate change, two level of game difficulties, and three level change directions. In addition, the average playing time for each week was added as a covariate. The reason was that the variable represented the players' previous experience. Some research has found that an individual's prior videogame experience was predictive of his/her future performance (Frey et al., 2007; Orvis et al., 2006). The order of six rounds was designed according to a Latin square design for participants.

4.4. Procedure

For this experiment, the game took participants approximately 1 h and 20 min to complete. Before the experimental game was administered, a practice session was conducted to help the participants become familiar with the game system and the tasks. The participants practiced again until they could surmount the enemies within two lives of Guan Yu in a round. Or they were also permitted to practice again if they did not feel comfortable with the game's controls. The purpose of practice was for participants to develop the skills of gameplay.

Following the practice, each participant played one experimental game composed of six rounds. After playing one round, participants were asked to answer a questionnaire to determine player immersion in the game narrative.

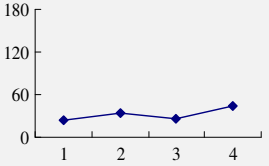
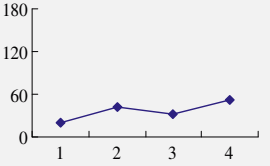
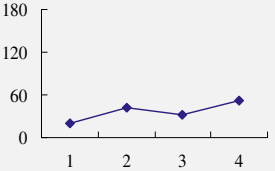
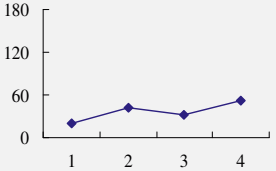
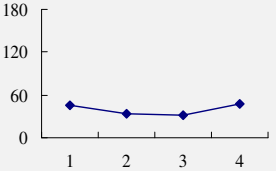
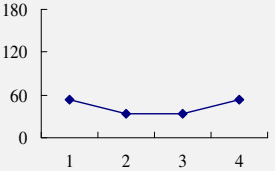
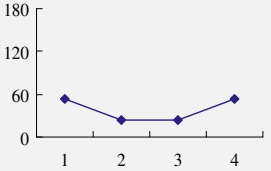
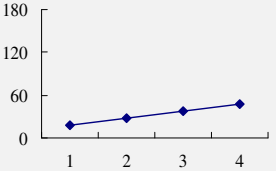
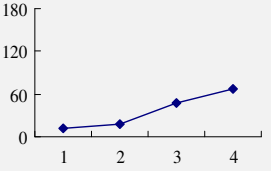
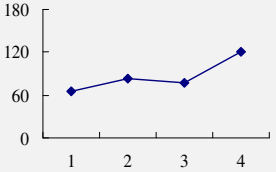
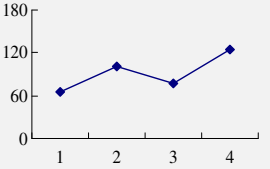
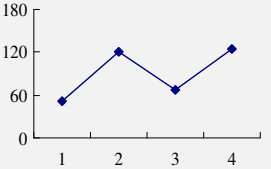
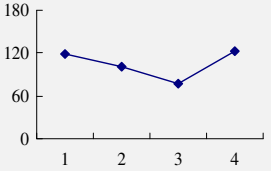
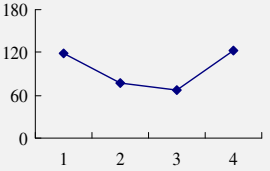
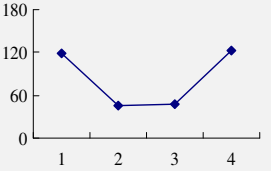
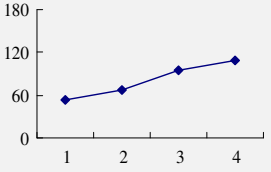
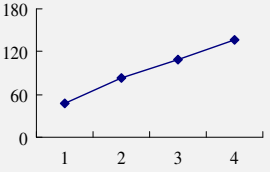
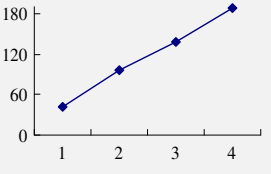
5. Results and discussion

Before testing the hypotheses, the variables' normality and homogeneity were checked. This experiment was a repeated-measures design, so before checking the within-subject test, the sphericity assumption was tested. Except for the playing time, the significances of Mauchly's test of sphericity of change directions and level of game difficulty from the other two dependent variables were not more than 0.05. Therefore, MANOVA was used for the within-subject factors from the two dependent variables, and ANOVA testing was used for the within-subject factors from the playing time. The Cronbach's alpha of the instrument was 0.929.

5.1. Testing of Hypothesis 1

Data from these planned comparisons are presented in Table 3. Player immersion results for difficulty change showed significant differences ($F = 6.91$, $p = 0.002$) for up and down, down and up, and continuous directions. An examination of multiple range contrasts indicated that the player immersion from games with the difficulty of up-and-down direction change was higher than the other two directions. Player immersion planned comparison results between difficulty of direction changes interaction with change rate revealed significant differences ($F = 2.81$, $p = 0.030$). An examination of multiple range contrasts indicated that the player immersion from games of difficulty change with the down and up direction was higher than player immersion from games with the up and down direction when the difficulty changed

Table 2
Layout of difficulty design in the experimental games.

Level	Direction	Rate		
		Slow	Medium	Fast
Easy	Up and down			
	Down and up			
	Cont.			
Hard	Up and down			
	Down and up			
	Cont.			

Notes: every ordinate of charts represents difficulty value, and every abscissa of charts represents scenes in the experimental games. Cont. means continuous.

Table 3
Data for testing Hypotheses 1.

Dependent variables	Independent variables	Mean	SD	F	p-Value	Multiple comparisons
Player immersion	Change direction	140.87	21.06	6.91	0.002	Up and down > down and up Up and down > continuous
	Change direction ∗change rate: slow	134.85	21.41			Down and up > up and down
	Change direction ∗change rate: medium	151.13	17.52	2.81	0.030	Up and down > down and up
	Change direction ∗change rate: fast	136.62	20.33			Up and down > down and up
Playing time	Change direction	344.6	111.05	11.55	0	Continuous > up and down Continuous > down and up
	Change direction ∗change rate: slow	331.5	106.03			Up and down > continuous > down and up
	Change direction ∗change rate: medium	332.5	91.95	22.09	0	Down and up > continuous > up and down
	Change direction ∗change rate: fast	339.9	132.35			Continuous > up and down > down and up
Hit points	Change direction	3.80	2.24	15.20	0	Down and up > up and down Down and up > continuous
	Change direction ∗change rate: slow	4.05	2.61			Down and up > up and down > continuous
	Change direction ∗change rate: medium	3.68	1.95	13.23	0	Down and up > up and down > continuous
	Change direction ∗change rate: fast	4.21	2.43			Continuous > up and down Continuous > down and up

slowly. The player immersion was better in games in which the difficulty change was in the up and down direction in the down and up direction when the difficulty of rate change was medium or fast.

For further comparison, seven dimensions of the player immersion were tested. Table 4 lists the effects with significant differences. Curiosity results among difficulty of direction changes of up and down, down and up, and continuous showed significant differences ($F = 3.83$, $p = 0.025$). An examination of multiple range contrasts indicated that Curiosity was better for games with the difficulty of up-and-down direction change than with the down and up direction. Comprehension results between difficulty of direction changes showed significant differences ($F = 6.10$, $p = 0.005$). An examination of multiple range contrasts indicated that Comprehension for games with the difficulty of up-and-down direction change was higher than Comprehension for games with the difficulty of down and up direction change. And Comprehension for games with the difficulty of continuous direction change was higher than Comprehension for games with the difficulty of down and up direction change. Familiarity results between difficulty of direction changes showed significant differences ($F = 9.34$, $p = 0$). An examination of multiple range contrasts indicated that Familiarity for games with the difficulty of up-and-down direction change was higher than Familiarity for games with the difficulty of down and up or continuous direction change. Control results between difficulty of direction changes showed significant differences ($F = 2.72$, $p = 0.035$). An examination of multiple range contrasts indicated that Control in games with the difficulty of down and up direction change was higher than Control in games with the difficulty of up-and-down direction change when the difficulty was changed slowly. And Control was better in games with the up and down direction than the down and up direction when the difficulty of rate change was medium.

For playing time (Table 3), the results between difficulty of direction changes showed significant differences ($F = 11.55$, $p = 0$). An examination of multiple range contrasts indicated that the playing time was longer in games with the difficulty of continuous direction change than with the other two directions. Playing time planned comparison results between difficulty of direction changes interaction with change rate revealed significant differences ($F = 22.09$, $p = 0$). An examination of multiple range contrasts indicated that the playing time for games of difficulty change up and down was longer than the time from the other two directions when the difficulty was changed slowly. The playing time was longer in games with the difficulty of down and up direction change than with the other two directions when the difficulty changes rate was medial. The playing time was longer in games with the difficulty of continuous direction change than with the other two directions when the difficulty of rate change was fast.

For hit points (Table 3), the results between difficulty of direction changes showed significant differences ($F = 15.20$, $p = 0$). An examination of multiple range contrasts indicated that the hit points were greater for games with the difficulty of down and up direction change than with the other two directions. Hit points planned comparison results between difficulty of direction changes interaction with change rate exhibited significant differences ($F = 13.23$, $p = 0$). An examination of multiple range contrasts indicated that there were more hit points in games with the difficulty of down and up direction change than with the other two directions when the difficulty was changed slowly or medially. There were more hit points in games with the continuous direction than with the other two directions when the difficulty was changed fast.

For difficulty of direction changes, as expected, the player immersion results displayed that the participants had better immersion with the change up and down direction than with the change down and up direction and the continuously increasing direction. The difficulty trend of change up and down was increasing. This maintains the player's feeling of being challenged. Furthermore, decreasing the difficulty after it has been increased gives players a feeling of greater skill. The high skill and challenge provide the "optimal experience" for a player (Bailey et al., 2005; Csikszentmihalyi and Csikszentmihalyi, 1988). Through further analysis, we found that the up and down direction had a better impact on the dimension Familiarity, Curios-

Table 4
Tests of dimensions of player immersion (for change directions).

Dimension	Independent variables	F	p-Value	Multiple comparisons
Curiosity	Change direction	3.83	0.025	Up and down > down and up
Comprehension	Change direction	6.10	0.005	Up and down > down and up Continuous > down and up
Control	Change direction ∗change rate	2.72	0.035	Slow change: down and up > up and down Medial change: up and down > down and up
Familiarity	Change direction	9.34	0	Up and down > down and up; up and down > continuous

ity, and Comprehension of players. So, Hypothesis 1.1 was supported completely.

When the difficulty of rate change was medial and fast, the participants had better immersion in the change up and down direction than in the down and up direction. The reason is that when the difficulty changes faster, it poses a greater challenge. The direction of difficulty increasing continuously might have increased at a faster rate than the participant's skill level (Orvis et al., 2008), and the difficulty at the beginning of the game might have been greater in the difficulty change down and up direction, so the greater challenge frustrated the players (Csikszentmihalyi and Csikszentmihalyi, 1988).

However, when the difficulty was changed slowly, the participants playing with the change up and down direction were less immersed than those playing the down and up direction game. The results implied that slowly decreasing the difficulty gives players a feeling of greater skill and challenge. It also provided players the optimal experience. But for the up and down direction, slowly increasing the difficulty did not maintain the player's feeling of being challenged. Therefore, the participants had less immersion from change up and down. Ghani and Deshpande (1994) considered that skill leads to control, which leads to an optimal experience. Through the dimension Control, we also found that in the condition of slow difficulty change, the participants had less feeling of control with the change up and down direction than with the change down and up direction. Therefore, Hypothesis 1.2 was partially supported.

The results of playing time indicated that it took participants a longer time to play the games when the difficulty was changed up and down than the games in the other two change directions. The results of hit points implied that participants used more of the character's life when playing the games when the difficulty of direction change was down and up compared to the other two change directions.

5.2. Testing of Hypothesis 2

Table 5 presents the tests of between-subjects effects for player immersion. The player immersion results between difficulty of rate changes of slow, medium, and fast showed significant differences ($F = 3.84$, $p = 0.029$). An examination of multiple range contrasts indicated that the player immersion from games with a medium difficulty of rate change was higher than the other two.

For further comparison, seven dimensions of player immersion were tested. Table 6 lists the effects with significant differences. The Curiosity results for difficulty of rate changes of slow, medium, and fast showed a significant difference ($F = 4.24$, $p = 0.021$). An examination of multiple range contrasts indicated that Curiosity was greater in games of with a medium difficulty of rate change than with the other two. Familiarity results for the three difficulty of rate changes showed significant differences ($F = 3.50$, $p = 0.039$).

Table 6
Tests of dimensions of player immersion (for change rate).

Dimension	Independent variables	F	p-value	Multiple comparisons
Curiosity	Change rate	4.24	0.021	Medially > slowly Medially > fast
Familiarity	Change rate	3.50	0.039	Medially > fast

An examination of multiple contrasts indicated that Familiarity was greater for games with medium change rate than with a fast change.

Table 5 presents the tests of between-subjects effects for playing time. Playing time results showed no significant differences ($F = 0.65$, $p = 0.525$) between the three rates of difficulty change.

Table 5 also shows the tests of between-subjects effects for hit points; there were significant differences ($F = 3.64$, $p = 0.034$) for the three rates. An examination of multiple range contrasts indicated that there were more hit points for games with the fast difficulty of rate change than with the medium difficulty of rate change.

The participants had better immersion in games with a medium rate of difficulty change than with the other rates. There was no significant difference in player immersion between slow and fast rates. The results indicated that if the increasing rate of difficulty exceeded the increasing rate of player skill, the player immersion would decrease. So Hypothesis 2 was partially supported. The participants used less of the character's life in games with a medium change rate than with the other two rates.

5.3. General discussion

In this study, the game difficulty was computed based on a status bar indicating the length of the character's life. The major reason is that the length of the life bar can imply the difficulty of defeating the character. The aim of the game player is to defeat enemies through controlling the character's actions, such as jumping, dodging or blocking an attack, and striking. The major difficulty of action games is from performance like hand-eye coordination and/or mental dexterity. This kind of quantitative method of measuring difficulty is objective. For many games, there are many kinds of status bars measuring things like time, weapons, or property. These also could be used to compute the difficulty. However, for some games, there is another kind of difficulty such as a maze. There is no status bar representing its difficulty. Solving this kind of problem mainly computes the player's mental load. Therefore, for this situation, in addition to a status bar for computing difficulty, mental resource costs are also computed.

For all the sections of a game, difficulty of direction changes also could be applied. As mentioned above, if difficulty gives players a feeling of their skill surpassing the challenge at a high level, players

Table 5
Data for testing Hypotheses 2.

Dependent variables	Change rate	Mean	SD	F	p-Value	Multiple comparisons
Player immersion	Slowly	134.9	21.42			Medially > slowly Medially > fast
	Medially	151.1	17.52	3.84	0.029	
	Fast	136.6	20.33			
Playing time	Slowly	331.5	106.03			
	Medially	332.5	91.95	0.65	0.525	
	Fast	339.9	132.35			
Hit points	Slowly	4.05	2.609			Fast > medially
	Medially	3.68	1.945	3.64	0.034	
	Fast	4.21	2.431			

will enter the "flow zone" (Csikszentmihalyi, 1990). If the challenge is greater than the skill, the players will feel anxious. If the challenge is lower than the skill, it provokes boredom. Fortunately, human beings have tolerance, so there is a fuzzy safe zone of flow. The description of flow is identical to what a player experiences when totally immersed in a game. Therefore, for the whole game, with the progression of the game, the skill of the players is improved. This means that the trend of the whole game's difficulty should be increasing continuously. Considering physical and mental fatigue, the difficulty of the whole game should increase up and down. If the game difficulty mainly comes from play or performance, as in action games, the rate of the increase of difficulty should be quicker than for games with a more complex narrative. This is because games with complex stories have suspense to maintain tension.

By completing tasks in games, players complete a pre-designed difficulty. It is important to emphasize that the game difficulty of direction and rate changes indicate those perceived by players in the course of playing. Generally, the structures of the computer games may not be linear, but the course of the player playing the games is linear and continuous. Therefore, the designers should know that the difficulty is designed according to the possibility of the course of playing.

Besides computer games, the rules of designing game difficulty also could be applied in other areas, for example, for instructional games or educational software. These applications require strategies for modifying the difficulty to improve learners' performance and motivation. Tasks that are too easy or too difficult will lead to reduced effect of learning for learners. Therefore, appropriate difficulty design is important for users and designers. Changing the difficulty level up and down and changing it at medium rate will increase involvement in the course of learning, motivate learners, and result in a positive learning outcome.

For other entertainment like movies, a typical narrative tends to employ a dramatic arc. At the beginning, the background of the story is unfolded. With the story development the tension rises at the sub-climax. Then the tension decreases, and the movie introduces some related events. After that, more and more problems arise and the tension rises to a critical state. At the climax, tension is relieved by way of the most important problems being solved. The tension then decreases rapidly after this moment. This procedure implies that the movies narrate the challenge up and down to maintain the interest and tension of audience.

By comparing the results from three dependent variables (player immersion, playing time, and hit points), this study found that measuring player immersion had effective results, and better reflected the change in the game than objective variables such as playing time or hit points. This was because player immersion represents user experience in the process of playing the game. And playing time or hit points do not indicate the process of playing games. In addition, Petre et al. (2006) considered that it is the total user experience that impacts the users' perceptions of value and service quality, and consequently affects user loyalty. Therefore, for developers and designers of computer games, measuring player immersion is an effective way to reflect the process of playing a game.

Before experiments, the researchers have discussed with two expert players on difficulty of direction change and difficulty rate change. They thought intuitively that games with difficulty changing fast or continuously would make them immersed. Nothing else could arouse their sense of being challenged. However, immersion comes not only from challenge, but also from other factors. And the dimension challenge did not indicate significant difference. In addition, when participants were asked which round impressed them most after the experiments, commonly, they could not recall the situation of a round, yet many of them remembered the difficult Boss at the end of a round.

6. Conclusion

The purpose of this study was to investigate the impacts of different difficulty of direction and rate changes of one round on player immersion. As expected, Hypothesis 1.1 was supported completely. This study did find the up and down direction had a better effect on players than the down and up or continuous directions. However, Hypotheses 1.2 and 2 were partially supported. If the change rate was slow, the down and up change direction had a better effect on players. Medium change rate results in better player immersion.

From the results presented in the previous section, this study suggested that the difficulty in a section of a game should increase up and down generally. And the change rate should not be slow or fast. However, if the change rate is slow, the difficulty of a section of a game should change down and up.

The current research was the first step in exploring the difficulty of a game to enhance player immersion. In the future, the rules of the difficulty of direction and rate changes in the other genres and how to design the difficulty in the whole game should be researched.

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