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Designing Action Games for Appealing to Buyers

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ABSTRACT

This study aims to identify design features for action games that would appeal to game-buyers, rather than game-players. Sixteen frequent-buyers of computer games identified 39 design features that appeal to buyers by contrasting different versions of Pacman games. Twenty-eight versions of Pacman were then evaluated in terms of the identified design features by 45 participants (27 male and 18 female college students). Qnet2000 neural network software was used to determine the relative importance of these design features. The results indicated that the top 10 most important design features could account for more than 50% of "perceived fun" among these 39 design features. The feature of avatar is important to game-buyers, yet not revealed in previous player-oriented studies. Moreover, six design factors underlying the 39 features were identified through factor analysis. These factors included "novelty and powerfulness," "appealing presentation," "interactivity," "challenging," "sense of control," and "rewarding," and could account for 54% of total variance. Among these six factors, appealing presentation has not been emphasized by player-oriented research. Implications of the findings were discussed.

INTRODUCTION

THE MARKET for computer games is growing rapidly. According to a report by the American Entertainment Software Association (ESA), the sales revenue of computer/video games in 2003 accounts for $7 billion. Each household in the United States on average purchases two computer games annually.[1] How to design a "fun" and "appealing" computer game is therefore very important.

Malone and Leppers, after conducting a series of research,[2–6] claimed that a computer game would be fun if the game-players can be intrinsically motivated by the following four factors: challenging, fantasy, curiosity, and control. Some heuristic design guidelines for computer games were accordingly proposed to incorporate these four motivating factors into a game.[2–6] Their studies were based on educational games, with kindergarten-aged children as subjects.

After the pioneer work by Malone and Leppers, the scope of computer games and the population of game-players, have been expanding. Fabricate et al.[7] therefore aimed to identify design guidelines for an action game, a computer game in which the motor-skill of players essentially determines their performance. By analyzing the opinions of experienced game-players based on the ground theory,[8,9] they proposed some design guidelines for action games. Some other relevant work, based on interviews with game-developers and experienced game-players, have also been available.[10–15]

The studies of the aforementioned research are based on an off-line game, which is a game played by one or two players on a particular computer. On-line games, on the other hand, denotes a game that can be played by a large group of players through the internet. Choi and Kim[16] intended to identify the design guidelines for on-line games. They concluded that customer loyalty could be

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enriched if an on-line game could provide good personal and social interaction.

Previous research on identifying the design guidelines for computer games has established significant milestones in how to make a fun game. These studies essentially focus on creating enjoying experience of game-players. That is, they tend to find design guidelines (or design features) of a game that would attract game-players. Yet, can the same design features that make a game fun to game-players make a game appealing to game-buyers?

Game-buyers in this era may not have sufficient time to evaluate each game by their on-hand experiences because thousands of new computer games are introduced to the markets each year. An efficient way to evaluate computer games is by viewing the demonstrations. The evaluation-by-viewing mechanism may extend the traditional scope of design guidelines, which had been dominated by the evaluation-by-playing paradigm. That is, some game design features that appeal to game-buyers may not be revealed or appropriately weighted in the research focusing on game-players.

This study aims to identify design features for action games that would appeal to game-buyers. The relative importance of these design features, in the context of appealing-to-buyers, is determined. Factors underlying these appealing-to-buyers design features are also explored. This research would facilitate game-developers to design marketable computer games, which are not only "fun-to-player" but also "appealing-to-buyer."

METHODS AND RESULTS

This study involves the following three stages: (1) identifying design features that appeal to game-buyers, (2) determining the relative importance of these design features, and (3) exploring factors underlying these design features. Each stage is presented below.

Stage 1. Identifying design features of game demos

An experiment is conducted for identifying the design features that appeal to game-buyers. Experiment materials, subjects, procedures, and results are described below.

Materials. Pacman is used in this study for two reasons. First, Pacman is one of the most popular action games.[17] Second, Pacman has dozens of versions that encompass various design features. This study used 28 versions of Pacman.

Subjects. Sixteen students, eight male and eight female college students, participated in the experiment. All of them are frequent-buyers of computer games. A frequent buyer means that he or she buys at least 1.4 computer games per month.[18]

Procedure

Step 1: Ask subjects to sort the 28 games into three groups in terms of perceived fun.
- Demonstrate the 28 games to subjects.
- Using a three-point Likert scale, subjects were asked to subjectively evaluate the degree of perceived fun for each game.
- Sort the 28 games into three groups based on the average score of each game. These three groups are designated as "fun," "neutral," and "no-fun."

Step 2: Identify design features that make a game fun.
- Select one game from the "fun" group and another one from the "no-fun" group.
- Ask subjects to compare the design features of the two games and identify the design features that make a game fun.
- Iterate the step until no more fun design feature can be extracted.

Thirty-nine design features that appeal to game-buyers were identified in the experiment, as shown in Appendix 1.

Stage 2. Determining the relative importance of fun design features

The relative importance of the fun features is determined by an experiment that used the same 28 versions of Pacman games. Forty-five students, 27 male and 18 female college students, volunteered to participate in the experiment. The experiment procedure is described below.

Step 1: Evaluate the degree of fun of each game.
- Ask subjects to rate the perceived fun of each game by using a five-point Likert scale.

Step 2: Characterize each game in terms of design features.
- Ask subjects to evaluate the extent to which each design feature is implemented in each game, by using another five-point Likert scale.

Step 3. Explore the relationships between the design features and the perceived fun.
- The technique of back-propagation neural network[19] is applied to explore the relationship

between the design features and the perceived fun. The technique is appropriate for such kind of exploration which involves a large number of input variables while with relatively few data sets (28 games).
- Each game is represented by 40 variables, of which 39 design features are input variables and the perceived fun is the output variable.
- Qnet2000[20], a commercially available neural network software, is used to compute the relative importance (known as contribution in the software) of each design features with respect to the perceived fun.

Outcome. Among the 39 fun design features, the top 10 most important design features, listed in Table 1, can account for more than 50% of perceived fun. The top five design features are discussed below.

The top-most fun feature is "Scenario is dramatic." A "dramatic scenario" means that the game scenario is rich, varied, and full of surprise so that game-buyers will be immersed in the demonstration. This finding is consistent with previous studies. An interview with game expert designers, conducted by Rouse,[14] also reveals that a dramatic story and content allows players to become more involved in computer games. In addition, Rollings and Morris[13] argued that the dramatic effects of a computer game story could enhance the entertainment value of computer games.

The second most fun feature is "character's style is similar to mine." This fun feature makes buyers so involved that they identified some characters as their avatars in the game. This finding has not been revealed in previous literature.

The third most fun feature is "opponent is competitive," which means that the player requires more mental effort and motor skill to defeat the opponent in computer game. This finding is consistent with many previous studies,[6,11,14,21] which claimed that the design features that make a player feel challenged are important in a game.

"Character looks like a real person" is the fourth most fun feature. This feature reflects the expectation of game-buyers that a game-world should be close to the real world as possible. Our experiment found that subjects prefer new Pacman versions because of their realism. This finding is consistent with previous studies,[14,22,23] which stated that a high degree of realism was an important characteristic of a computer game.

"Weapons are powerful," the fifth most fun feature, means that players and their opponents can be empowered by being equipped with powerful weapons. This feature tends to make players feel competent while making the game more competitive. This finding is consistent with a design expert's suggestion,[24] which indicated that weapons were extremely important in action games.

Stage 3. Exploring factors underlying these design features

Exploratory factor analysis was employed to identify factors underlying the fun features. The data set includes 1260 data (28 games $\times$ 45 participants), collected from stage 2. The varimax rotation method is used to extract emergent factors.

Outcome. Six factors were identified: "novelty and powerfulness," "appealing presentation," "interactivity," "challenging," "sense of control," and "rewarding" (Table 2). These six factors can account for 54% of total variance.

"Novelty and powerfulness" involves three elements: novel scenario, vivid visual presentation,

TABLE 1. TOP 10 DESIGN FEATURES FOR APPEALING TO BUYER

Design features	*Contribution (%)*	*Accumulative contribution (%)*
Scenario is dramatic	8.23	8.23
Character's style is similar to mine	6.78	15.01
Opponent is competitive	6.42	21.43
Character looks like a real person	5.31	26.74
Weapons are powerful	5.14	31.88
Beginning levels are easy	4.63	36.51
More than one player can participate	4.38	40.89
Final levels are difficult	3.69	44.58
Sound effect is varying	3.22	47.80
Sound effect varies with events	3.06	50.86

TABLE 2. RESULT OF FACTOR ANALYSIS FOR DESIGN FACTORS

Design features	*Factor 1 (novelty and powerfulness)*	*Factor 2 (appealing presentation)*	*Factor 3 (interactivity)*	*Factor 4 (challenging)*	*Factor 5 (sense of control)*	*Factor 6 (rewarding)*
DF5	0.770					
DF4	0.751					
DF10	0.739					
DF11	0.722					
DF8	0.671					
DF2	0.657					
DF15	0.647					
DF16	0.632					
DF7	0.609					
DF3	0.601					
DF1	0.567					
DF9	0.553					
DF12	0.477					
DF6	0.466					
DF18		0.768				
DF21		0.764				
DF17		0.752				
DF20		0.734				
DF19		0.725				
DF23		0.698				
DF22		0.638				
DF38			0.842			
DF39			0.696			
DF32			0.626			
DF26			0.558			
DF33			0.544			
DF14				0.720		
DF13				0.681		
DF29				0.448		
DF31				0.381		
DF30				0.346		
DF28				0.302		
DF24					0.686	
DF27					0.638	
DF25					0.585	
DF34					0.428	
DF36						0.791
DF37						0.540
DF35						0.422
Percentage variance explained	30.851	8.958	5.213	4.025	2.837	2.243

Factor Extraction Method: Principal Axis Factors; Factor Rotation Method: Varimax Rotation.
Kaiser-Meyer-Olkin measure of sampling adequacy = 0.919.
Bartlett's test of sphericity: $p = 0.000$, $\chi^2 = 30586.161$.

and capability-enhancer. A novel scenario has to be unpredictable, varied and dramatic in order to enhance buyers' curiosity. A vivid visual presentation has to be colorful, looking-real, and varying frequently. Moreover, the transition between scenes has to be smooth. A capability-enhancer has to provide new and powerful weapons for players and their opponents.

"Sensational presentation" indicates that the audio and video presentation has to be compatible with the scene so that emotion can be properly induced by the context. The melody, tempo, and volume of music and sound effect have to be compatible with scenario events and scene.

"Interactivity" involves four components: helpful information, adaptable input setting, progressive difficulty, and play continuity. Helpful information supplies clear instruction and real-time updated information. Adaptable input setting allows players to set up input devices according to their preferences. Progressive difficulty indicates that the game's difficulty increases after the completion of a round. Play continuity allows players to restart from a previous achievement level after the completion of each round.

"Challenging" involves three elements: compatible opponent, fast pace, and effortful play. Compatible opponent denotes that the opponent is compatible with the player in capability. Fast pace requests players respond quickly to opponents' attacks. Effortful play indicates that the player has to be highly devoted in order to master the game.

"Sense of control" results from three design features: free choice, new skill acquisition and player-defined competitiveness. Free choice indicates that players can choose the difficulty level at will. New skill can be acquired at each level so that players' capability can be enhanced. Players define the competition by setting up the type and the number of opponents and partners.

"Rewarding" can be implemented by three methods: cumulative achievement, virtual token, and recognition of achievement. Cumulative achievement indicates that players' scores can be accumulated. Virtual tokens are given according to player's performance. Top performers' names and their records are listed in order to recognize their achievements.

DISCUSSION

This study aims to identify design features for computer games that would appeal to game-buyers. We have proposed an empirical method to identify 39 fun features of action games. Of these 39 fun features, the feature of avatar is important to game-buyers, yet not revealed in previous player-oriented studies. A plausible explanation may be that buyers, not physically engaging in the game, tend to be attracted to the game if their representative characters are similar to them.

Six factors were extracted from these 39 design features. These six factors include "novelty and powerfulness," "appealing presentation," "interactivity," "challenging," "sense of control," and "rewarding." Of these six factors, appealing presentation has not been emphasized by other researchers. Appealing presentation becomes quite important in a demo-environment due to the inaccessibility of buyers to the game.

The findings of this study have several implications in planning game-demos. First, game-buyers and game-players may have different key criteria on the definition of a fun game. Therefore, planning a game-demo should be considered from buyers' perspectives. Second, the relative importance of fun features allows demo-planners to make trade-off decisions. Third, the avatar feature indicates the importance of personalizing a game-demo by incorporating buyers' preferences into the demo-design.

Appendix 1. Action Game Design Features for Appealing to Buyers

Design features
DF1: Scenario is unpredictable
DF2: Scenario is varying
DF3: Scenario is dramatic
DF4: Scene is creative
DF5: Scene is looking-real
DF6: Scene is colorful
DF7: Scene is complex
DF8: Scene is varying
DF9: Scene transmits smoothly
DF10: Character is creative
DF11: Character looks like a real person
DF12: Character's style is similar to mine
DF13: Opponent is competitive
DF14: Opponent is unpredictable
DF15: Weapons are creative
DF16: Weapons are powerful
DF17: Background music suits the scene
DF18: Background music is varying
DF19: Music tempo suits the plot
DF20: Sound effect varies with events
DF21: Sound effect suits the event

(continued)

Appendix 1. Continued

Design features
DF22: Sound effect is loud enough
DF23: Sound effect is varying
DF24: Level difficulty is flexible to choose
DF25: New skills are acquired at every level
DF26: Level difficulty increases progressively
DF27: Levels can be skipped
DF28: Beginning levels are easy
DF29: Final levels are difficult
DF30: Pace is fast enough
DF31: Pace is varying
DF32: Input device is easy to control
DF33: Game can be saved for continuity
DF34: More than one player can participate
DF35: High score board can be viewed
DF36: Game scores can be accumulated
DF37: Virtual token can be won
DF38: Instruction is clear
DF39: Real-time information is updated

Appendix 2. Contribution of Design Features for Appealing to Buyer

Design features	*Contribution (%)*	*Accumulative contribution (%)*
DF3	8.23	8.23
DF12	6.78	15.01
DF13	6.42	21.43
DF11	5.31	26.74
DF16	5.14	31.88
DF28	4.63	36.51
DF34	4.38	40.89
DF29	3.69	44.58
DF23	3.22	47.80
DF20	3.06	50.86
DF25	2.84	53.70
DF10	2.72	56.42
DF15	2.59	59.01
DF4	2.55	61.56
DF24	2.48	64.04
DF32	2.35	66.39
DF36	2.29	68.68
DF21	2.20	70.88
DF8	2.18	73.06
DF30	2.17	75.23
DF2	2.12	77.35
DF14	2.06	79.41
DF7	2.03	81.44
DF5	1.95	83.39
DF33	1.74	85.13
DF6	1.71	86.84
DF35	1.58	88.42
DF39	1.50	89.92
DF31	1.43	91.35
DF9	1.41	92.76
DF19	1.30	94.06
DF27	1.24	95.30
DF1	0.97	96.27
DF37	0.95	97.22
DF26	0.85	98.07
DF17	0.69	98.76
DF38	0.59	99.35
DF22	0.39	99.74
DF18	0.26	100.00

Network information: BPN (39–10–1); RMS: 0.018674; Correlation: 0.99461.

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