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PLAYFUL AND SOCIAL INTERACTION IN PHYSICAL GAME: A QUANTITATIVE AND QUALITATIVE STUDY OF REAL-LIFE ESCAPE ROOM

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Abstract. This study investigated the player experience, playful design factors, and player behaviors of real-life escape room games. A questionnaire survey, group interviews, and behavioral observation were conducted to gather players' demographic information, game experience, social presence, game behaviors, and social interactions while playing a real-life escape room game. Results indicate that a player's background and the theme of the escape room affect game performance and game experience. The playful design factors are sorted into five categories: story, clue, puzzle, mechanism, and interior design. The player behaviors include individual and team behaviors: searching, thinking, monitoring, physical activity, communication, information sharing, decision making, and cooperation.

Keywords: player experience, player behavior, social interaction, escape game, real-life escape room

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1. Introduction

The real-life escape room is a new genre of game. In this game, players must work together as a team to discover clues, solve puzzles, and accomplish tasks to escape a locked room in a limited time. The origins of escape rooms are live-action role playing games, point-and-click adventures, puzzle and treasure hunts, interactive theater and haunted houses, adventure game shows and movies, and

the themed entertainment industry (Nicholson 2015). Technology and mechanical equipment such as sensors, displays, lasers, and radio signals are the key elements of many real-life escape rooms. Therefore, during gameplay, a player interacts not only with other team members but also with physical objects.

Games provide a broad range of player experience (PX) resulting from active participation. PX includes involvement, immersion, presence, engagement, flow, and fun (Takatalo et al. 2015). As the game market expands rapidly and competition intensifies, game designers have identified the significance of player experience assessment in the acceptance and success of games.Some researchers have reached consensus that the psychological dimensions compose the overall player experience in the real-life escape room game (Wong 2015). However, little is known about what kinds of player experiences are generated when playing the real-life escape room games and which design elements of the escape room can induce such experiences in players.

Social interaction is an important issue in the game design as well. An escape game is a real-life interactive game consisting of a team of players; hence, PX is considered to be strongly affected by both the interactions between game facilities and players and the game elements that shape the interactions between the persons participating in the play session. Lo et al. (2017) attempted to discover the collaborative roles that the team members assume and the communication methods that the team uses to facilitate interaction. Nevertheless, connections between the sense of social presence, the sociability of the environment, and PX have not yet been sufficiently investigated.

This study applied a questionnaire survey, group interviews, and behavioral observation to investigate the player experience and social interactions among players in a real-life escape room game. In the questionnaire survey, the core game experience and social presence were examined. In the group interview, the design factors of the real-life escape room were identified. In the group interview and behavioral observation, the individual and team behaviors were explored.

2. Literature review

2.1. Real-life escape rooms

Real-life escape rooms, which are themed physical adventure games, are growing in popularity worldwide. Nicholson (2015) conducted a survey of 175 escape rooms around the world and categorized the diverse theme of escape rooms. Though the themes and settings differ the games typically involve two or more players, who have generally an hour to solve a room full of puzzles in order to escape. Currently, there are more than 7,000 real-life escape rooms of different types in 100 countries (Egnor 2014).

Escape rooms require collaboration and communication, and they encourage players to engage in critical thinking. Because escape rooms are live-action games taking place in the physical world, players collaborate to share clues and solve

puzzles through both verbal and non-verbal communication (Pan et al. 2017). In the escape room, which is filled with various forms and styles of puzzles, the players have to think creatively and use different mechanical skills to decipher the puzzles (Wiemker et al. 2015). Hence, solving puzzles and ultimately escaping will require that the players work on the puzzles using multiple approaches to knowledge.

2.2. Scope of player experience

PX has been approached from a variety of perspectives on game play. Poels et al. (2007) identified nine main dimensions of player experience in digital games: enjoyment, flow, imaginative immersion, sensory immersion, suspense, competence, negative affect, control, and social presence. The dimensions of immersion, fun, and playability are often critical to game motivation and enjoyment (Ghumanand Griffiths 2012, Brown and Cairns 2004, Nacke et al. 2009). Furthermore, Weibel et al (2008) found positive correlations between presence, flow, and enjoyment in game play. Some research has showed that, for most players, immersion equals the degree of involvement within a game and makes them lose track of time and outside concerns (Wiemker et al. 2015, Brown and Cairns 2004, Jennettet al. 2008).

Several studies have indicated specific features of games that are thought to increase enjoyment. Klimmt et al. (2009) found that suspense was a driver of game enjoyment: A suspenseful version of a game is more enjoyable than a non-suspenseful version. Visual and aural aesthetics are also the keys to creating the desired feeling of immersion. The visual style and fidelity are closely tied to the aspects of immersion and flow (McLaughlin et al. 2010). Music and sound effects not only enrich the game-worlds and assist player navigation but are also important for the semantic operations of games (Whalen 2004). Physical tools or elements also impact the play experience in several manners (Ullmer and Ishii 2000, Buur et al. 2004). Schneider et al. (2004) proposed that players felt a greater sense of presence when a game was structured around a story. Thus, different game design features affect a player's experience of interacting with the game.

2.3. Player experience in social interaction

Social interaction is becoming an increasingly important topic in multiplayer gaming. In multiplayer games, social interaction is inbuilt and direct in the core gameplay. A number of studies have pointed out that playing with other people and friends induces more fun, physiological arousal, engagement, and positive affect (Clarke and Duimering 2006, Mandryk and Inkpen 2004, Ravaja et al. 2006). Experiences of interaction can create feelings of camaraderie and make players feel more connected to each other. In fact, individuals cite social interaction as one of the main reasons why they play multiplayer games (Chou and Tsai 2007, Pagulayan et al. 2003).

Social interaction processes in game play include monitoring, awareness, verbal communication, and nonverbal immediacy behaviors. Monitoring of other players' actions contributes to the maintenance of game awareness (Tseet al. 2007). Xu et

al. (2008) reported that more social presence in awareness of others offered the most opportunities for interpersonal interactions. Since communicating can give players opportunities to express and share emotions and in-game information, social presence also appeared to be highest when people could see and hear each other while communicating (Rettie 1995, Kuoppala and Finnerman 2012). Overall, the social interaction process can occur at different levels of a game and has a clear impact on the player's experience.

2.4. Player Experience Evaluation Questionnaires

Several questionnaires for evaluating player experience have been developed and validated. Some of these questionnaires, such as the Player Experience of Need Satisfaction, the Immersive Experience Questionnaire, and the Game Engagement Questionnaire (Ryan et al. 2006, Sweetser and Wyeth 2005, Jennett et al. 2008), concentrate on the related constructs of motivation, immersion, or engagement. Other scales, such as the Game Flow Questionnaire (Brockmyer et al. 2009), and the Game Enjoyment Instrument (Fang et al. 2008), focus on player enjoyment.

The Game Experience Questionnaire (GEQ), which has been applied in many game research studies of PX (Mahmud et al. 2008, Gajadhar et al. 2008), assesses both player game experience and social presence (Poels et al. 2007). The GEQ contains a multi-dimensional self-report measure of game experience including both a core module and a social presence module. The core module includes seven dimensions: competence, immersion, flow, tension, challenge, negative affect, and positive affect. The social presence module comprises three dimensions: empathy, negative feelings, and behavioral involvement. Each dimension consists of multiple items. In total, the questionnaire includes 50 statements.

3. Research objectives and hypotheses

The objectives of the study were to investigate the kinds of player experiences generated when playing a real-life escape room game, the design elements of an escape room that can induce player experiences, and the social interactions with team members in the game. To carry out the objectives of the study, the following questions were addressed:

1. What are the demographic characteristics of players who play real-life escape room games?
2. What design factors affect players' feelings and perceptions while playing real-life escape room games?
3. What are players' game and social experiences within real-life escape room games?

4. Research methods

This study applied both quantitative (questionnaire survey) and qualitative (group interview and behavioral observation) methods to gather the player experience of real-life escape room games. The game experience questionnaire (GEQ) was used to collect subjective responses from the participants. Observational research provided a reliable measurement of actual participant behavior and the natural context (Smith 1944). The group interview was used to collect additional insights through the interactions of ideas and suggestions from the group (Robson 2000).

The research was conducted in three phases. Phase one was participant recruitment. Phase two was data collection, which included the questionnaire survey, group interview, and behavioral observation. Finally, phase three was data analysis of the player experience, which consisted of both quantitative and qualitative analysis.

4.1. Participant recruitment phase

This study was carried out at PEACH FUN real-life escape rooms. Hence, the participants were recruited through word-of-mouth advertising and poster advertisements at the PEACH FUN real-life escape room game counter in The Monster Village in Taiwan. Three real-life escape rooms with different themes (Silent Mirror, Hungry Nights, and Nin Ja) were provided by PEACH FUN (PEACHFUN 2015). The teams of players could pick one of the three themed escape room games themselves or follow the recommendation of the staff of PEACH FUN on which themed escape room was suitable for the team. The team was then given 45 minutes to solve the puzzles. In such games, the proper number of team players depends on the varying degrees of difficulty of the escape rooms (i.e., the number of puzzles). Figure 1 shows one such puzzle, which is a meta- and multi-linear puzzle in an escape room designed by PEACH FUN. The suitable team sizes of PEACH FUN real-life escape games proposed by the staff are listed in Table 1. Teams can be composed of friends, family, or even strangers. During the game, each team has two opportunities to ask for hints from the game master of PEACH FUN when they are stumped. At the end of the game, the game master leads the team through a debriefing process, answering questions and explaining the puzzles if the team members have questions. Table 2 lists the groups by theme, team size, and team composition for real-life escape room game challenges.

This study acquired ethical approval from PEACH FUN. Written consent was sought from all participants to ensure their rights and confidentiality. Before the beginning of the game, the researcher explained the purpose of the study, obtained the participants' permission to video and audio record the game playing process, and obtained consent for the group interview. At the same time, the researcher informed the participants that video and audio data would be kept in a secure place during the study and erased afterwards, and that pseudonyms would be used to maintain participant anonymity with regard to the game playing and interview results. After the game finished, the questionnaire survey was administered and the group interview was performed in the counseling room of PEACH FUN. Participants were rewarded NTD 100 (about USD 4) for their participation.

Players have to find eight bottles, paired fragrance bottles, containing a different fragrant essence.

Players smell the bottles and then follow the recipe to find the correct fragrance bottles and arrange them in sequence.

Each fragrance bottle has a number on it. The sequence of numbers is used to open a combination lock on the box. There is another clue in the box.

Figure 1. Example of meta- and multi-linear puzzle

Table 1. The themes and suitable team sizes of PEACH FUN real-life escape games

Theme	Level	Number of puzzles	Team size (persons)
Silent Mirror	Easy	6	2~4
Hungry Nights	Normal	8	4~8
Nin Ja	Hard	10	6~8

4.2. Data collection phase

The data collection phase consisted of three steps: questionnaire survey, group interview, and behavioral observation.

Questionnaire survey: The questionnaire survey comprised a section on the participants' backgrounds and the GEQ. The participants' background information included gender, age, education, and previous experience of real-life escape room games. Given the objectives of our study, which included player game experience and social presence, we collected data on the subjective game experience using Chinese translated versions of the GEQ. The statements of the core module and social presence were respectively 33 and 17. Each statement was rated on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree) to indicate the intensity of the described player experience. Each participant filled out the questionnaire individually. For participants such as elementary school students who

could not recognize the vocabulary in the questionnaire, a researcher (second author) read and explained the vocabulary and statement, and made sure the participant fully understood the question and without misunderstanding.

Group interview: The aims of the group interview were to survey the behaviors of the participants in the real-life escape room game and to elicit implicit issues encountered by the participants while game playing. Questions in the interviews contained general probes to elicit detailed information from the participants. Table 3 shows an example of a participant's responses to questions, subsequent probes, and responses to probes in the group interview. The interview lasted approximately 30 minutes, and the questions were predetermined in a semi-structured questionnaire format (see Table 4). Additionally, all interview questions from the researchers and responses from the participants were audio recorded and later transcribed.

Behavioral observation: The non-participatory observation method was used to observe the activities and collect data on player behaviors, communication, and interaction. The researcher did not engage in or disturb the participants' activities, and one team member volunteered to wear a Go Pro HERO5 on his or her head during the game-play. Hence, the individual behaviors and team interactions were observed by video recording.

Table 2. Group profiles of real-life room escape game challenge for real-life escape room game challenges

Group	Theme	Team size (persons)	Team composition			Ask for hints (number of times)	Performance
			Family	friend	stranger		Results (minutes)
1	SM	3	✓			1	Success (30)
2	HN	8	✓		✓	2	Success (40)
3	NJ	6		✓	✓	2	Failure (–)
4	SM	3	✓			1	Success (29)
5	HN	4		✓	✓	2	Failure (–)
6	HN	4	✓			2	Failure (–)
7	SM	2	✓			2	Success (35)
8	SM	3	✓			1	Failure (–)
9	HN	6	✓		✓	2	Failure (–)
10	SM	3	✓			1	Failure (–)
11	NJ	6		✓	✓	2	Failure (–)
12	HN	4	✓			2	Failure (–)

Note. SM = Silent Mirror; HN = Hungry Nights; NJ = Nin Ja

Table 3. Sample raw data of interview questions, subsequent probes and responses

Interview:	How did you feel about the escape room after you entered it?
Response:	Very excited but scared too.
Probe:	What were you scared about?
Response:	The room is dark and the story…
Interview:	What did you do in the room?
Response:	Pulled out all the drawers and tried to find something.
Probe:	Did you have any idea about the 'something'?
Response:	No, not at all.
Probe:	Did all of the team members operate and move together, or not?
Response:	We acted individually at first. If anyone found anything, he/she shared it with others. Somehow, we began discussions. But we were not always working together or individually.
Probe:	Did you pay attention to the other team members' actions while you acted individually?
Response:	Yes, I was curious about what other team members found. But not always.

Table 4. Select questions used in the group interviews

Question: What made you want to spend time playing the game?
Question: Did you have any plan or strategy to play the game?
Question: How did you feel about the escape room after you entered it?
Question: What did you do in the room?
Question: How did you cooperate with team members?
Question: Do you feel satisfied?
Question: What impressed you most before playing the game?
Question: What impressed you most while playing the game?
Question: What part did you like most while playing the game?
Question: What part did you find difficult while playing the game?
Question: What part did you find interesting while playing the game?
Question: Will you face the challenge of another real-life escape room?

4.3. Data analysis phase

Both quantitative and qualitative methods were adopted in the analysis. Data obtained from the GEQ were entered into IBM SPSS version 22. Prior to the data analysis, the data were checked by a second researcher. In addition, the variables were examined for normality assumptions. Once it was confirmed that the data were normally distributed, analysis of variance (ANOVA) and multivariate analysis of variance (MANOVA) were utilized to determine the gender, age, education of the participants, as well as the way the theme of the escape room (degree of game difficultly) significantly affected the player experience. If dependent variables were found to be significantly affected by main factors, the LSD and Scheffe's post hoc test for multiple comparisons were adopted to determine the levels of the significant main factors. The level of significance was set at $p < 0.05$.

All the data acquired in group interviews were transcribed before being imported into Nvivo 11. The researcher performed the code assignments subjectively. For instance, the second answers to the second question from two participants of group 2 presented in Figure 2 were both coded as 'searching'. Table 5 summarizes the 10 different answers that were coded as 'searching'. After all the data were coded, we grouped the codes into clusters and categorized them into themes based on their attributes.

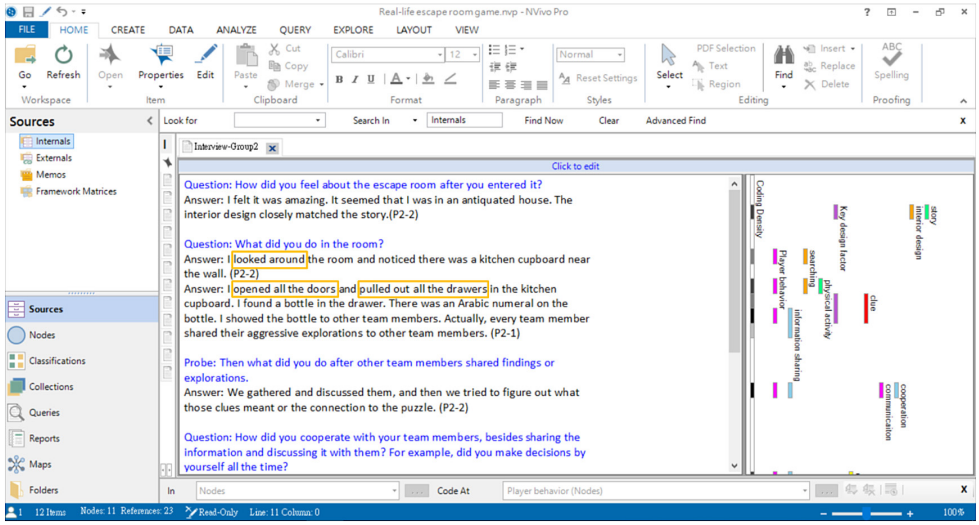

Figure 2. Example of a participant's response and code assign

Table 5. Sample raw data from group interviews supporting the qualitative codes

Qualitative code	*Raw qualitative data*
Searching	1. I looked around to find anything suspicious.
	2. I rummaged around in all the drawers.
	3. Maybe there were clues hidden in the wall, so I touched each wall in the room.
	4. I searched through drawers and closets.
	5. I found a piece of a puzzle under the table.
	6. I opened the lid of the basket.
	7. The container and the box with a cover or lid might hide clues; therefore, I lifted all of the covers and lids.
	8. I turned the pages of a book, and the clues were in the book.
	9. I bent over and examined the space between the floor and the closet.
	10. I drew the curtains open and found a map on the window.

5. Quantitative results

5.1. Basic demographics

Twelve groups of players, including a total of fifty-two people (23 males and 29 females) agreed to participant in this study. All participants reported that they were not physically or psychologically disabled, and all were aged between 7 to 55 years old. Over 75% of the participants were under age 30, and 69% of the participants were undergraduate or graduate students. Seven of the fifty-two participants had played in at least one real-life escape room prior to the study. More than 70% of the participants did not know about real-life escape rooms. Over 86% of the participants had never played either real-life or virtual escape room games.

5.2. Reliability and descriptive statistics of the GEQ

The reliability and descriptive statistics for the dimensions of the GEQ are shown in Table 6. In the core module, the two highest scores were immersion and positive affect, and the two lowest scores were tension and negative affect. Both immersion ($t_{(311)} = 28.982$, $p < 0.000$) and positive affect ($t_{(259)} = 33.325$, $p < 0.000$) were rated significantly higher than the scale midpoint. Tension ($t_{(155)} = -13.711$, $p < 0.000$) and negative affect ($t_{(259)} = -7.570$, $p < 0.000$) of the core module were scored significantly lower than the scale midpoint. In the social presence module, the highest and lowest scores were respectively empathy (M = 4.18, SD = 0.76) and negative feelings (M = 2.39, SD = 1.30). The reliability of flow and negative affect of the core module were lower than 0.6.

Table 6. Reliability for the dimensions of the GEQ
(Scale range from 1 to 5 : 1 = strongly disagree, 5 = strongly agree)

Module	Dimension	M	SD	Reliability (Cronbach's α)	95% CI lower	95% CI upper
Core	Com	3.26	1.04	0.736	3.13	3.38
	Imm	4.25	0.76	0.752	4.17	4.33
	Flo	3.83	1.07	0.430	3.70	3.96
	Ten	1.90	1.00	0.748	1.74	2.06
	Cha	3.64	1.08	0.625	3.51	3.77
	NA	1.90	1.10	0.419	1.75	2.05
	PA	4.40	0.68	0.819	4.31	4.48
Social presence	Emp	4.18	0.76	0.797	4.09	4.26
	NF	2.39	1.30	0.602	2.23	2.55
	BI	3.49	1.05	0.719	3.38	3.61

5.3. Game Performance

The results showed that four of the twelve groups succeeded in escaping the locked room. The ANOVA results presented a significant effect of participant experience on game result ($f_{(1,50)} = 11.275$, $p < 0.05$). The LSD post hoc test indicated that game performance was higher for experienced players (M = 1.67, SD = 0.49) than for inexperienced players (M = 1.22, SD = 0.42). There were no significant differences for gender, age, and education on game performance. The theme of the escape room also had a significant effect on game performance ($f_{(2,49)} = 4.655$, $p < 0.05$). The LSD post hoc test indicated that game performance was lower in Nin Ja (M = 1.00, SD = 0.13) than in Hungry Night (M = 1.46, SD = 0.09) and Silent Mirror (M = 1.43, SD = 0.12).

5.4. Core module of GEQ

The MANOVA showed significant differences for participants' backgrounds on the game experiences of the core module: gender ($f_{(28,7767)} = 2.912$, $p < 0.05$) and age ($f_{(28,602)} = 1.690$, $p < 0.05$). Gender ($f_{(1,50)} = 10.801$, $p < 0.05$) and age ($f_{(4,47)} = 6.101$, $p < 0.001$) had significant effects on positive affect (see Figure 3). The Scheffe's post hoc test indicated that positive affect was higher in females (M = 4.54, SD = 0.61) than in males (M = 4.21, SD = 0.71) and in groups of participants aged under 10 yrs. (M = 4.63, SD = 0.63) than in groups of participants aged between 31 yrs. and 40 yrs. (M = 3.80, SD = 0.65).

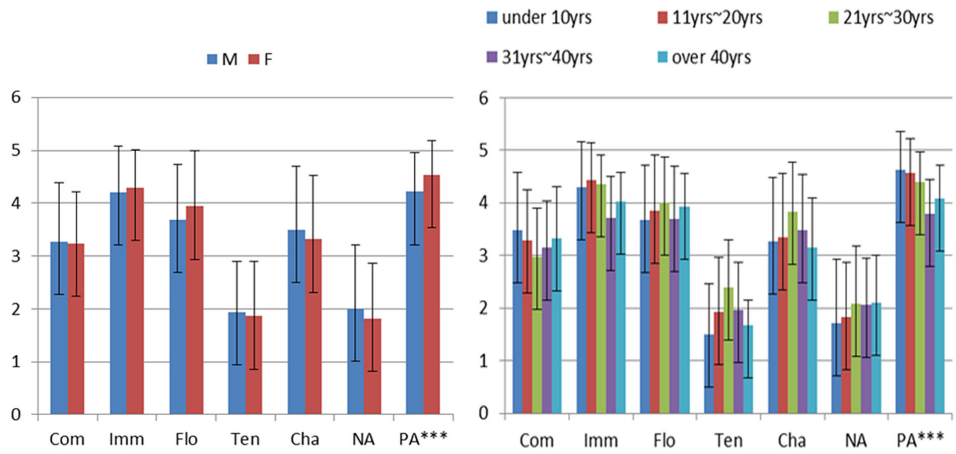

Figure 3. Means of all dimensions of the core module by gender and age groups
(* = p < 0.05; * *= p < 0.01; *** = p < 0.001)

Furthermore, the theme of the escape room ($f_{(56,3609)} = 1.930$, $p < 0.05$) also had a significant effect on the core module. The theme of the escape room had significant effects on competence ($f_{(2,49)} = 9.962$, $p < 0.001$), immersion ($f_{(2,49)} = 3.309$, $p < 0.05$), flow ($f_{(2,49)} = 3.267$, $p < 0.05$), negative affect ($f_{(2,49)} = 3.294$, $p < 0.05$), and positive affect ($f_{(2,49)} = 3.828$, $p < 0.05$) of the core module (see Figure 3). The Scheffe's post hoc test indicated that competence, immersion, flow, and positive affect were lower in the theme of Nin Ja than in the themes of Hungry Night and Silent Mirror. Negative affect was higher in the theme of Nin Ja than in the themes of Hungry Night and Silent Mirror (see Table 7).

Table 7. Means of all dimensions of the core module by room theme

Dimension	Nin Ja	Hungry Night	Silent Mirror
Com***	2.58 (1.11)	3.45 (0.97)	3.43 (0.84)
Imm*	3.90 (0.88)	4.35 (0.72)	4.37 (0.66)
Flo*	3.57 (1.05)	3.99 (1.05)	3.74 (1.07)
Ten	2.36 (0.96)	1.78 (1.03)	1.71 (0.89)
Cha	3.53 (1.20)	3.42 (1.21)	3.24 (1.16)
NA*	2.21 (1.20)	1.83 (1.05)	1.79 (1.07)
PA*	4.07 (0.73)	4.5 (0.64)	4.49 (0.61)

Note. * = p < 0.05; ** = p < 0.

5.5. Social presence module of the GEQ

The results of the social presence module analyzed by MANOVA indicated that neither the participants' backgrounds nor the theme of the escape room had significant effects on any dimensions, including empathy, negative feelings, and behavioral involvement. Both empathy ($t_{(311)} = 27.364$, $p < 0.000$) and behavioral involvement ($t_{(311)} = 8.339$, $p < 0.000$) were rated significantly higher than the scale midpoint. Negative feelings ($t_{(259)} = -7.570$, $p < 0.000$) were rated significantly lower than the scale midpoint.

6. Qualitative results

6.1. Design factors of escape rooms

In the qualitative analysis, the playful design factors of the escape room game were discovered during the group interview. Five groups of codes were identified for playful design factors of the escape room game: story, clue, puzzle, mechanism, and interior design (as shown in Table8). Many escape rooms have themes, and hidden information and physical objects are added to the room to create the clues, puzzles and tasks (Brockmyer 2009).The five playful design factor categories were supported by all groups (sources = 12), and at least 15 references were counted for each of them (see Figure 4). The following example presents participant responses to the theme story, interior design, clue settings, and puzzle and mechanism design, thus demonstrating the relationships among those design factors.

1	Name	Sources	References	Created On	Modified On
2	Key design factor	12	82	2021/3/28	2021/5/26
3	clue	12	33	2021/3/28	2021/5/26
4	interior design	12	18	2021/3/28	2021/5/26
5	mechanism	10	15	2021/3/28	2021/5/26
6	puzzle	12	22	2021/3/28	2021/5/26
7	story	12	16	2021/3/28	2021/5/26
8	Player behavior	12	173	2021/3/28	2021/5/26
9	communicaiton	12	43	2021/3/28	2021/5/26
10	cooperation	12	26	2021/3/28	2021/5/26
11	decision making	12	23	2021/3/28	2021/5/26
12	information sharing	12	38	2021/3/28	2021/5/26
13	monitoring	12	21	2021/3/28	2021/5/26
14	physical activity	12	45	2021/3/28	2021/5/26
15	searching	12	36	2021/3/28	2021/5/26
16	thinking	12	25	2021/3/28	2021/5/26

Figure 4. Example of users' needs code list generated from the response

'I felt scared when I heard about the theme story (story), but I was still looking forward to it and eager to have a try.'…'The room was dark and just like the scenario of the theme story (interior design). I felt terrible and so scared. But my older brother told me not to be scared, there were no ghosts.'…' I would never have discovered the map drawn on the window and behind the curtain (clue design). It was ingenious.'…'It's very challenging to solve some puzzles (puzzle design), but it's a good opportunity to stimulate my mind and have fun.'…'It was funny that I had to put the steamed stuffed bun on the hand beside the door to release the door lock (gimmick)'.

Table 8. Summary table of key design factors of escape room design (N. of group = 12)

Key design factors	*Statements by participants*
Story	The story can let participants feel the environment and take them into the scenes of the escape room before entering the room.
Clue	To find clues is one of the difficult and interest processes in the game. Participants are adventurous in the escape room.
Puzzle	The puzzle types were various; participants had to think creatively and use multiple approaches to knowledge. It is a great chance to use one's brain to figure out the answer to the puzzle.
Gimmick	The gimmicks set in the room were unexpected and made participants feel surprise.
Interior design	The decoration of escape room was polished and matched the scene of the story.

6.2. Individual and team behaviors in the escape room

The behaviors of the participants in the real-life escape room game were collected from group interviews and behavioral observation. In the game, participants acted both independently and in cooperation with other team members. Hence, the participants' behaviors, comprising both individual and team behaviors, were identified into eight groups of codes: searching, thinking, monitoring, physical activity, communication, information sharing, decision making, and cooperation (see Table 9). The eight categories were supported by all groups (sources = 12), and at least 21 references were counted for each of them (see Figure 4). Real-life escape rooms are physical adventure games; participants have to explore the room and search for clues, think of answers to the puzzles, and accomplish tasks (Wiemker et al. 2015).An escape room game also relies on teamwork, which includes diverse behavioral processes such as communication, information sharing, decision making, and cooperation (Dominick et al. 1997, Janz et al. 1997). At the same time, team members may monitor others' actions and provide different forms of support. For

example, the sample transcript below demonstrates the participants' responses to the relationships among the participants' behaviors.

'*We acted independently after stepping into the room, and we looked around to find clues or anything suspicious. We searched through drawers and closets, and underneath and behind everything.* (*searching/physical activity*)*'… 'They showed us what they had discovered, and then we thought about and discussed the clues to figure out what the clues meant and how to solve the puzzle* (*information sharing/communication/thinking /cooperation*)*'… 'I noticed that she found a few pieces of bricks and I moved to her; then we combined the bricks and tried to figure out the answer to the puzzle. There were more than three possible answers for the puzzle, some from her, some from me, and we decided to try hers first* (*monitoring/cooperation/physical activity/decision making*). *But in the end, our possible answers were all wrong.'*

Table 9. Summary table of participant behaviors of escape room design (N. of group = 12)

Behaviors	*Statements by participants*
Searching	Looking around the room to find anything suspicious. Exploring drawers and closets, and underneath and behind everything, to discover the clues.
Thinking	Participants try to figure out where the clues are, how to assemble the physical materials, and what the answers for the puzzles are. Participants spend a lot of time on the thinking tasks.
Monitoring	Participants observe other team members' actions in the game, not only because they are curious about the other members' behaviors but also because they want to know as soon as another team member might need help.
Physical activity	Physical activity includes pulling, pushing, moving, assembling, climbing, and so on.
Communication	Participants try to communicate in many ways, including verbal and non-verbal (body language, gestures, tone of voice, facial expressions, posture, and non-word sounds).
Information sharing	In active information sharing, a participant takes the initiative to inform other team members about what he/she has discovered. In inactive information sharing, a participant replies to other team members' inquiries about what he/she has discovered.
Decision making	Participants have to decide what answers are correct for the puzzles, what's next, which way to go, and so on.
Cooperation	Participants act together, which includes finding clues, solving puzzles, sharing information, helping each other, etc.

6.3. Social interaction in the escape room

Personal interaction and being physically immersed in the real-life escape room game make a great difference in the way a player might perceive a game. Players have to engage physically and communicate face-to-face with team members such as family, friends, or strangers in the room. The following example shows participant viewpoints for interacting with the physical objects and other players with physical interaction.

'*In our family, everyone is generally busy doing their own thing, and we don't spend a lot of time together. This game allowed the four of us to interact face-to-face and work toward the same goal. Even though we didn't win the challenge, it was really a special experience.'…'In the beginning, I thought it would not work to play the game with strangers. But we worked closely and escaped from the locked room successfully. Actually, I just added them to my Line friends list.'...'I was so excited since this was my first time to play an escape room game. Unfortunately, we ran out of time, but it was quite fun to explore and solve the puzzles with my friends. We will face the challenge of another real-life escape room together soon.'*

7. Discussion

The quantitative results showed that the experience of the participants and the theme of the escape room had significant effects on game performance. Consistent with cognitive psychology research, the players were sorted and acted based on their relative experiences to accommodate insights into the circumstances (Graham et al. 2006). Therefore, experienced participants performed better than inexperienced participants. Meanwhile, game levels that are too easy and or too hard will leave players bored or frustrated (Klimmt et al. 2009). Consequently, the competence and positive affect of players was lower for the escape room that contained a higher number of puzzles. In contrast, the negative affect and feelings were higher for that room.

The participants' backgrounds, including gender and age, had a significant effect on the core game experience. Females thought the game was more fun than females. Younger children felt happier than adults. Usually, children played game with more pure joy than did adults. On the other hand, adults performed more mental exploration tasks in the environment (Piccone 1999).

This study found that neither participants' backgrounds nor theme of the escape room had significant effects on the social presence module of the GEQ. But participants did experience higher levels of empathic and behavioral involvement with others. The qualitative results described below also support this point of view.

In terms of qualitative results, the coded playful design factors of the escape room game were sorted into five categories: story, clue, puzzle, mechanism, and interior design. Many escape rooms have a collection of puzzles, physical objects, and tasks with a theme or a narrative, all of which can immerse players in the game (Nicholson 2015). Participants reported that the interior design and decorations of the escape

room matched the theme or story, which added to the ambience. The clue exploration and puzzle-solving process were not easy but still fun. The unexpected mechanisms of clues, puzzles, or other tasks in the room surprised participants. Designers of real-life escape room games have to consider all of the design factors in the design process.

The participants' behaviors were composed of individual and team behaviors, which were identified into eight groups: searching, thinking, monitoring, physical activity, communication, information sharing, decision making, and cooperation. Participants had to perform various physical activities while they searching for clues and solving the puzzles in the escape room. Communication and information sharing can help teams make decisions and cooperate effectively (Rousseau et al. 2006). Moreover, participants thought physically communicating face-to-face and interacting with team members were more impressive than success in escaping. The social interactions were discovered both during and after the game.

The results also indicated that the reliabilities of a few dimensions of the GEQ were too low. A Cronbach's Alpha value should be greater than 0.6, which indicates that the internal consistency of all facets is good (Fornell and Larcker 1981). There are five questions in the flow dimension, including "I forgot everything around me" and "I lost track of time". However, players had to look around to discover the clues and pay attention to the time limit during the real-life escape room game. This difference in gameplay settings can potentially explain the differences in the feelings of the flow dimension. Regarding the negative affect, players might use multiple approaches to think about and solve the puzzles. That could contravene other players' thoughts about other things, which is one of the questions on negative affect. Also, the results of the positive affect and focus group indicated that participants were entertained (had fun) and were interested, which were not negative feelings.

8. Conclusion

Player experience is an important area of research in games. This study applied quantitative and qualitative research approaches to investigate the player experience in real-life escape rooms. The GEQ was adopted to explore the feelings and social presence of the players while playing the game. The results showed that players' backgrounds and the theme of the escape room (game level) affected the player experience. The design factors (story, clue, puzzle, mechanism, and interior design) were discovered through the group interview. Both group interviews and task-observation were conducted to understand the deeper behaviors (searching, thinking, monitoring, physical activity, communication, information sharing, decision making, and cooperation) and social interactions of players during the game. The findings may allow developers and game designers to better understand the player experience whilst playing real-life escape room games, and they also shed light on the fundamentals of real-life escape room design.

This study focused on the player experiences and social interactions of the players in the real-life escape room game. However, further testing and designs are

necessary to provide support in the development of design guidelines for physical games. At the same time, real-life escape rooms are a new genre of games, and they are growing in popularity worldwide. The absence of a coherent and complete set of methods and tools that enable the measurement of entertainment experiences is one of the major challenges facing the gaming research community. Appropriate questionnaire items and descriptions would assist in the collection of accurate responses from the participants (Richardson 1999). Thus, future work on developing a validated methodology for assessing physical adventure games is necessary.

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