Effect of Playing Factors and Playing History on Game Flow and Companionship Levels for Online Pets

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Abstract. Electronic robots and virtual pets are used for enjoyment and even companionship. Studies have demonstrated that flow experience and companionship can affect whether players continue interacting with their robots and virtual pets. One study also revealed a positive relationship between flow and companionship regarding online pet games. However, the playing factors and elements of playing history (for example game types, playing time, flow factors, or companionship factors) that significantly increase players' flow and companionship levels are unclear. This study used a questionnaire survey to identify playing factors that may affect players' flow and companionship levels. This study utilized two scales (flow and companionship) to evaluate the flow and companionship states of online pet game players. A total of 204 valid questionnaires were collected. The results revealed that (1) time distortion and concentration were the crucial factors for increasing flow experience; (2) attractiveness was the crucial factor for increasing players' sense of companionship with their online pet; (3) spending more playing time with their online pets every day significantly increases players' levels of flow and companionship; and finally, (4) players who thought themselves to have high flow and companionship levels did actually have higher flow and companionship levels, which indicated that self-reporting of flow and companionship levels was a reliable method. These results can serve as a reference for online pet game designers and in relevant research fields.

Keywords: Companionship · Flow · Online game · Virtual pet

1 Introduction

Companion robots can play a crucial role in therapy and care, and one of their key characteristics is to give users a positive interaction experience (Larriba et al. 2016; Lorenz et al. 2016). Bernabei et al. (2013) reported that animal-assisted intervention has a positive effect on people with dementia and improves the quality of their social interactions. This applies to virtual pets as well as to physical companions and pet robots. Tsai and Kaufman (2014) demonstrated that taking care of a virtual pet can increase children's empathy and humane attitude scores. Children bond emotionally with their virtual pets and believe that virtual pets have their own particular personalities (Tsai and Kaufman 2014). Byrne et al. (2010) revealed that a mobile phone game can

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encourage children to practice healthy eating habits through allowing them to care for a virtual pet.

Whether concerning a companion robot or a virtual pet, the aforementioned studies all demonstrated that nonliving pets can have a positive effect on their owners. Crucial to these nonliving pets achieving their design purposes—such as providing therapy, care, health, education, company, or social interaction—is the establishment of a relationship between user and pet and the motivation of the user to continue using the product, software, or game.

Compared with embodied companion robots or electronic pets, virtual pets are cheaper and easier to purchase and thus have more users (Li and Luh 2011). Smart phone development has led to the release of various mobile phone games, of which virtual pet games such as My Boo, Bubbu Cat, and My Virtual Pet Shop are examples (App Store 2016).

Relevant studies have demonstrated that flow experience and companionship are crucial factors that encourage players to continue interacting with their virtual pets (Lawson and Chesney 2007a; Luh and Li 2015; Luh et al. in press). Most online pet games provide a virtual game environment or allow players to freely design their own game scenes. The environment settings in an online role-playing game can affect players' self-presentation, which in turn can enhance players' trust regarding the game content and game community (Park and Chung 2011). Therefore, players may use virtual pet games for self-presentation, and this may affect players' levels of motivation to continue playing the game.

Interaction frequency, game activity diversity, and relationship with game avatars are all factors that can affect the levels of intimacy between players and their game roles (Zhao et al. 2010). Thus, interaction frequency and the relationship with a virtual pet can both affect the intimacy between a player and that player's virtual pet. These discussions demonstrate that various factors affect the relationship between users and their virtual pets. However, what kind of playing experience enhances virtual pet players' flow and companionship levels has not been deeply studied.

We have previously conducted studies evaluating players' flow experiences with online pet games and their feelings of companionship with their online pets. Luh et al. (in press) confirmed that players experienced true flow while playing online pet games. Li and Luh (2015) also revealed that a high flow state enhances a player's feeling of companionship with the online pet, whereas a low flow state results in low level of companionship. Strong feelings of companionship cause a high flow experience, whereas weak feelings of companionship result in a low flow experience (Li and Luh 2015). Furthermore, Li and Luh (in press) determined that players had different flow and companionship levels depending on their motivations for playing the game.

All these previous studies revealed that players experience flow and companionship with their online pets, and that a positive relationship exists between flow and companionship levels. However, it is unknown what types of flow and companionship factors significantly enhance players' gaming experiences and whether game model, playing years, and playing time affect players' flow and companionship levels. If a factor is discovered to affect players' flow and companionship levels, it can be used to enhance game experience through appropriate game design.

We previously used flow and companionship scales to evaluate players' flow and companionship levels (Li and Luh 2015); however, there is no standard scale for such an evaluation for players' flow and companionship levels. Therefore, we asked players to evaluate their own flow and companionship levels (as high or low). Whether this classification method is a useful standard is further discussed. The players who considered themselves to experience a high level of flow and a strong feeling of companionship had significantly higher levels in all flow and companionship factors than those who classified themselves as in the low flow and companionship group. This classification method can thus be used to distinguish players' flow and companionship levels in relevant research fields.

This study explored these issues; the purposes were to determine (for online pet games) (1) whether game model affects players' flow and companionship levels; (2) whether playing history (for example, playing years and playing time) affects players' flow and companionship levels; (3) what kinds of flow and companionship factors affects players' flow and companionship levels; and (4) whether players who considered themselves to have high flow and companionship levels did in fact have a significantly higher level of flow experience and companionship. The results are expected to aid in the development of more types of robots, products, and applications that can improve people's quality of life: for example, a robot or application to help manage the health of patients or the elderly by interacting with companion objects; a learning tool or application for students and children through which they interact with virtual pets; or an artificial reality (AR) or virtual reality (VR) product that can help those in the medical field to understand or experience the therapeutic effect of virtual pets.

2 Literature Review

2.1 Online Pet

The National Taiwan University Hospital Yun-Lin Branch cooperated with a Taiwanese university to design an app called Pet Running (Li 2016). With this app, users can raise virtual pets through their own physical exercise: when a user engages in a physical activity, the virtual pet grows. This app demonstrates that virtual pets can not only serve as companions, but can also improve user health. Numerous studies have also revealed that interacting with a virtual pet can benefit users, having health, educational, or psychological effects (Lawson and Chesney 2007a, b; Luh et al. 2015).

This study classified online pet games into four types according to their game models. In some games — for example, in the games Pet Society and Meromero — players can own only one online pet at a time, whereas players can own more than one online pet in other games such as My Fishbowl. Similarly, some games (e.g., My Fishbowl) include only one species of pet, whereas players can raise numerous species and can own pets of more than one species in games such as Neopet and FarmVille. Table 1 summarizes the four types of online pet games and lists examples of each type. In this study, all four types of online pet games were used as samples.

Table 1. Types and examples of online pet games

Types of pet species	Number of pets that a player can raise in a game	
	One	More than one
One	• Dog Sweetie	• My fishbowl • Neko Atsume: Kitty Collector
More than one	• Pet Society • Meromero • Neopet	• FarmVille

2.2 Flow

Bressler and Bodzin (2013) reported that mobile AR science games can increase students' interest in science and help them acquire collaboration skills if the students achieve flow while playing the game. Su et al. (2016) discovered that human–computer interaction, social interactions, skills, and challenges positively affected flow experience and in addition were found to positively affect a player's loyalty to a mobile game. Chang (2013) reported that flow experiences increased users' intentions to continue playing social network games. These studies indicated that flow experiences can have positive effects for users and encourage them to continue using a system or game.

Flow is the state wherein a person is fully immersed in an activity and has an energized focus (Csikszentmihalyi 1975). Flow was previously described to involve three phases (Chen 2000): flow antecedents, flow experience, and flow consequences. In this flow model, the flow antecedents lead to a flow experience, and flow experience then causes various flow consequences.

Different activities require various flow antecedents and can produce different flow consequences (Chen 2000; Choi and Kim 2004; Csikszentmihalyi 1990; Finneran and Zhang 2005; Ghani 1995; Hoffman and Novak 1996; Novak et al. 2000; Skadberg and Kimmel 2004; Sweester and Wyeth 2005). Therefore, flow antecedents and consequences alone cannot be used to confirm whether players experience flow. Compared with its antecedents and consequences, the flow experience is a superior indicator of a player flow state.

In our previous studies (Li and Luh 2015, in press), we identified four main factors in the flow experience of online pet games: concentration, time distortion, loss of self-consciousness, and telepresence. In this study, these four factors were used to evaluate players' flow states.

2.3 Companionship

Real pets such as cats provide companionship that enriches the lives of their owners (Dabritz and Conrad 2010; Wood et al. 2015). Aguiar and Taylor (2015) reported that a virtual pet provides entertainment and companionship to preschool children. Companionship is a crucial relationship based on shared experience and is found in relationships with partners, family, friends, lovers, pets, or others. Companionship can take three relationship forms: one-to-one, one-to-many, and group relationships (Li 1999). In this

study, we focused on the companionship game players felt from their online pets, which reflected a one-to-one or one-to-many (one owner to many online pets) relationship.

Zasloff (1996) developed the Comfort from Companion Animals Scale (CCAS) to measure the companionship between real pets and their owners. Libin and Libin (2003) developed the person–robot complex interactive scale (PRCIS) to assess the interaction between users and newly developed robots and to evaluate the advantages and disadvantages of robots. PRCIS can be used to determine the feasibility of robotic psychology and robotherapy. According to the CCAS, PRCIS, and relevant companionship theory, we developed the companionship scale for artificial pets (CSAP; Luh et al. 2015). This previous study proposed that users establish a companionship with electronic and virtual pets. The CSAP comprises 34 items and includes the three factors of enjoyment, satisfaction, and responsibility, which positively affect the development of companionship. In developing and applying the CSAP, our study demonstrated that some players do feel companionship with their online pets (Luh et al. 2015; Li and Luh 2015).

2.4 Previous Studies

In our previous study (Li and Luh 2015), scales were designed and used to identify the relationship between flow experience and companionship. One scale was used to evaluate participants' flow experiences, and the other was used to evaluate participants' feelings of companionship with their online pet(s).

The previous study used the narrative (survey) method, asking participants to recall their overall flow experiences for an online pet game. The flow experience scale included four factors: concentration, loss of self-consciousness, time distortion, and telepresence. There were 22 items in the flow experience scale, and these 22 flow items were again used to evaluate players' flow states in this study. To evaluate players' flow experience levels, we asked the players to classify their flow levels as high or low. The question asked was: "When I play this online pet game, [option 1] I feel that I am in flow with the game; [option 2] I feel that maintaining a flow in this game is hard (Li and Luh 2015)." We used these two questions again in the present study to determine players' flow levels and divide players into two groups (high and low flow level).

To evaluate companionship, the previous studies used the CSAP, which had 34 items for the evaluation of players' feeling of companionship with their virtual pet(s) (Luh et al. 2015; Li and Luh 2015). The questionnaire also asked the players to evaluate their companionship levels. The question asked was: "What is my attitude toward my pet? [Option 1] It does not matter to me whether I often interact with my pet. [Option 2] My pet is interesting and I often interact with it." In the present study, the CSAP was again used to evaluate players' states of companionship with their online pet(s). The questions were used to distinguish players' companionship levels and divide players into two groups (high and low level of companionship).

3 Data Analysis Method

This study performed statistical analysis on the data collected in our previous study (Li and Luh 2015). The flow and CSAP scales were used to determine whether relevant playing factors and playing history affect players' flow and companionship levels. The analysis items in the flow (22 items) and companionship (34 items) scales were the same as were used in our previous study (Li and Luh 2015). A 7-point Likert scale was used to measure the agreement of the participants, with a high score indicating a high level of agreement.

The present study also analyzed information about the participants, including gender, age, favorite online pet game, playing years (number of years they have played such games), and daily playing time. Furthermore, the items listed in Sect. 2.4 were used to assign players to high and low flow and companionship level groups. The present study aimed to identify what factors and playing history increased players' levels of flow and companionship, and some hypotheses were proposed.

The first hypothesis was based on the four game models defined in Sect. 2.1; it stated that two game models would result in significantly higher levels of flow and companionship: (1) players raise only one pet at one time and there are many pet species in the game and (2) players can raise many pets at one time but there is only one pet species in the game.

The second hypothesis stated that players with more playing years and playing time would have significantly higher levels of flow and companionship. The third hypothesis stated that the four flow factors (concentration, time distortion, loss of self-consciousness, and telepresence) and three companionship factors (enjoyment, satisfaction, and responsibility) would significantly increase players' levels of flow and companionship. Our final hypothesis stated that players who considered themselves to have a high flow (companionship) level would exhibit significantly higher levels of all flow (companionship) factors than the low flow (companionship) group.

Two items from the CSAP scale were used to test the validity of the questionnaires. If the item responses conflicted (subtracting the two scores ≥ 3), then the completed questionnaire was considered invalid. The completed questionnaires were also considered invalid if the responses to all questions were the same.

The participants in the study were required to be online pet game players. Statistical Package for the Social Sciences (SPSS) 22.0 was used for the statistical analysis. Descriptive statistical analysis was performed on information about the participants: gender, age, game types, playing years, and daily playing time. This study asked participants to complete the questionnaire while considering their favorite online pet games, each of which was classified as one of four game types (Table 1).

Cronbach's α was employed to evaluate the reliability of the flow and companionship scales, and a Cronbach's α of more than 0.7 indicated that a scale had a high coefficient of internal consistency (Chiou 2006). Exploratory factor analysis was conducted to test the validity of the flow and CSAP scales. A principal component method was employed. According to the statistical standard, the factor loading of each item in the three scales had to exceed 0.32 (Chiou 2006) to indicate that it sufficiently contributed to the scale validity. Moreover, the Cronbach's α of each factor in the three scales had to be higher

than 0.7, and the cumulative variance had to be higher than 50%, which indicated that a scale was valid for testing a single concept (Chiou 2006). After factor analysis was performed, the items with the highest factor loadings were selected as the basis for identifying and interpreting factors in this study.

After the factor analysis, we used within-subject analysis of variance (ANOVA) to determine which flow and companionship factors were crucial for increasing players' flow and companionship levels; the significance level α was set at .05, and the Bonferroni method was employed for post hoc tests. Additionally, we used the T-test to identify whether game types, playing years and playing time had any significant positive effects on flow and companionship levels, wherein the significance level α was also set at .05. We also used a T-test to discover whether the high flow and companionship level groups had higher levels of flow and companionship regarding each flow and companionship factor.

4 Results and Discussions

4.1 Results

After invalid questionnaires were removed, there were 204 valid questionnaires for use in the statistical analysis. Of the valid participants, 64.2% were female (n = 131) and 35.8% (n = 73) were male. Regarding age, 56.3% (n = 116) of the participants were young adults (16–24 years old), and 43.7% (n = 88) were adults (25–45 years old). The other playing experience data are presented in Table 2. Fewer than ten participants played games of two of the four types; therefore their data was omitted because further statistical analysis could not be performed. The two game types that were thus disregarded were "players raise only one pet and there is only one pet species in the game" (n = 8) and "players can raise many pets and there are many pet species in the game" (n = 5).

Table 2. Participants' playing history

Variables	Groups	Numbers of participants	Percentages of participants
Game types	Players raise only one pet and there are many pet species in the game (GT1).	94	46.1
	Players can raise many pets at one time but there is only one pet species in the game (GT2).	110	53.9
Playing years	<1 year (PY1)	116	56.9
	≥1 year (PY2)	88	43.1
Playing time	<1 h /day (PT1)	103	50.5
	≥1 h /day (PT2)	101	49.5
Flow level	High (FH)	116	56.9
	Low (FL)	88	43.1
Companionship level	High (CH)	135	66.2
	Low (CL)	69	33.8

The Cronbach's α values of the flow and CSAP scales were 0.906 and 0.961, respectively, indicating that the two scales had high reliability. Factor analysis revealed factor loadings for all items of 0.44–0.87. The total variance of each scale was higher than 61%, further confirming the validity of the two scales. The results of the factor analysis are presented in Table 3. The flow experience scale comprised 22 items, and the first factor analysis revealed that two items ("It was no effort to keep my mind on what was happening" and "I was worried about what others may have been thinking of me") of the flow experience scale were classified as one factor. However, one factor must have at least three items (Chiou 2006); therefore, the two items were deleted, leaving 20 items in the flow experience scale (Table 3). The original CSAP included three factors; however, there were four factors in this study after factor analysis. The companionship factors in this study were based on the factor loadings of each item and its content.

Table 3. The results of factor analysis

Scales	Factors	Items	% of Variance	Cumulative %	Cronbach's α
Flow	Telepresence/loss of self-consciousness	12	27.943	27.943	.913
	Concentration	4	18.176	46.119	.863
	Time distortion	4	15.582	61.701	.816
CSAP	Attachment	16	26.888	26.888	.953
	Attractiveness	6	17.248	44.135	.844
	Uniqueness	6	10.146	54.281	.829
	Reality	5	10.049	64.331	.854

Within-subject ANOVA and the post hoc Bonferroni test were performed to determine which flow factors elicited a flow experience and which companionship factors enhanced participants' feelings of companionship with their online pet(s). Tables 4 and 5 present the within-subject ANOVA results based on the methods for testing other factors.

Table 4. Within-subject ANOVA summary of flow factors

Source	*SS*	*df*	*MS*	F	Post hoc test: Bonferroni
Between (A)	147.823	2	73.912	147.044***	Time distortion ($M = 4.63$, $Sd = 0.08$), concentration ($M = 4.53$, $Sd = 0.08$) > telepresence / loss of self-consciousness ($M = 3.54$, $Sd = 0.08$)
Within-Subjects					
Between-Subjects (S)	590.864	203	2.911		
Error (A*S)	204.075	406	.503		
Total	942.762	710			

*** $p < .001$

Regarding the flow experience factors ($p = .000 < .001$, F = 147.044; Table 4), the players experienced significantly higher levels of time distortion ($M = 4.63$, $Sd = 0.08$) and concentration ($M = 4.53$, $Sd = 0.08$) than a sense of telepresence and loss of self-consciousness ($M = 3.54$, $Sd = 0.08$). Regarding the companionship

factors ($p = .000 < .001$, F = 133.660; Table 5), players rated attractiveness as having a much more significantly positive effect on their feelings of companionship ($M = 4.91$, $Sd = 0.07$) than the other factors; thus, attractiveness is a crucial factor in the building of companionship between players and their online pets. A sense of attachment ($M = 3.45$, $Sd = 0.09$) was the factor discovered to have the weakest effect for players.

Table 5. Within-subject ANOVA summary of companionship factors

Source	*SS*	*df*	*MS*	F	Post hoc test: Bonferroni
Between (A)	203.051	2.809	72.278	133.660***	Atractiveness ($M = 4.91$, $Sd = 0.07$) > Reality ($M = 4.47$, $Sd = 0.09$), Uniqueness ($M = 4.44$, $Sd = 0.08$) > Attachment ($M = 3.45$, $Sd = 0.09$)
Within-Subjects					
Between-Subjects (S)	760.866	203	3.748		
Error (A*S)	308.389	570.289	.541		
Total	1272.306	776.098			

*** $p < .001$

The T-test results revealed that playing time had significant effects on flow and companionship levels, but game type and playing years did not (Table 6). Players who spent longer playing with their online pet(s) every day had higher flow and companionship levels. Regarding gender and age, the T-test did not achieve significance (defined as $p < .05$), indicating that neither gender nor age affected the participants' flow and companionship levels.

Table 6. T-test results regarding participants' playing history

Aspects	Factors	Groups	n	*M*	*Sd*	T values
Flow	Game types	GT1	94	4.03	0.89	0.624
		GT2	110	3.95	0.84	
	Playing years	PY1	116	3.98	0.85	−0.078
		PY2	88	3.99	0.89	
	Playing time	PT1	103	3.85	0.80	−2.236*
		PT2	101	4.12	0.91	
Companionship	Game types	GT1	94	4.14	1.03	0.724
		GT2	110	4.03	1.10	
	Playing years	PY1	116	4.00	1.08	−1.157
		PY2	88	4.18	1.04	
	Playing time	PT1	103	3.93	1.04	−1.985*
		PT2	101	4.23	1.07	

* $p < .05$

The T-test also revealed that players who spent longer interacting with their online pets had significantly higher concentration levels, experienced more time distortion and attachment, found their pets more attractive, and felt that their online pet was more unique (Table 7). Therefore, if players can be encouraged to spend more time each day interacting with their pets, their flow experience and feeling of companionship will be enhanced.

Table 7. T-test results regarding playing time

Aspects	Factors	Groups	n	*M*	*Sd*	T values
Flow	Telepresence/loss of self-consciousness	PT1	103	3.46	1.01	−1.022
		PT2	101	3.62	1.18	
	Concentration	PT1	103	4.31	1.04	−2.788**
		PT2	101	4.75	1.18	
	Time distortion	PT1	103	4.37	1.07	−3.150**
		PT2	101	4.89	1.27	
Companionship	Attachment	PT1	103	3.36	1.17	−2.102*
		PT2	101	3.72	1.24	
	Attractiveness	PT1	103	4.68	1.02	−3.407***
		PT2	101	5.14	0.91	
	Uniqueness	PT1	103	4.25	1.17	−2.392*
		PT2	101	4.63	1.11	
	Reality	PT1	103	4.37	1.09	−1.251
		PT2	101	4.58	1.33	

* $p < .05$; ** $p < .01$; *** $p < .001$

The T-test results confirmed that the players who believed they had high levels of flow or companionship did actually have significantly higher levels of flow or companionship. Furthermore, the levels of the three flow and four companionship factors were higher for the players in the high flow/companionship groups than for those in the low flow/companionship groups (Tables 8 and 9).

Table 8. Factors affecting flow level

Aspects	Factors	Groups	n	*M*	*Sd*	T values
Flow		FH	116	4.39	0.74	9.167***
		FL	88	3.45	0.72	
Flow factors	Telepresence /loss of self-consciousness	FH	116	4.00	0.99	7.879***
		FL	88	2.93	0.92	
	Concentration	FH	116	5.02	0.95	8.105***
		FL	88	3.89	1.03	
	Time distortion	FH	116	5.09	1.05	7.059***
		FL	88	4.02	1.11	

*** $p < .001$

Table 9. Factors affecting companionship level

Aspects	Factors	Groups	n	*M*	*Sd*	T values
Companionship		CH	135	4.48	0.88	9.440***
		CL	69	3.22	0.91	
Companionship factors	Attachment	CH	135	3.95	1.09	8.263***
		CL	69	2.65	0.97	
	Attractiveness	CH	135	5.24	0.83	7.896***
		CL	69	4.21	0.95	
	Uniqueness	CH	135	4.77	1.04	6.663***
		CL	69	3.73	1.06	
	Reality	CH	135	4.82	1.10	6.654***
		CL	69	3.72	1.13	

*** $p < .001$

Enhancing the effect of flow and companionship factors on a player encourages the player to continue playing a game because the player experiences flow and companionship with the online pet. Furthermore, the T-test results indicated players' self-ratings of flow and companionship levels were reliable and can be used to classify players' levels of flow and companionship.

4.2 Discussions

Regarding the flow factors, concentration ($M = 4.53 > 4.00$, $Sd = 0.08$) and time distortion ($M = 4.63 > 4.00$, $Sd = 0.08$) were discovered to be crucial for increasing players' flow experiences. The results thus indicated that interacting with online pets may help a player to concentrate on the game and distort that player's sense of time (Luh et al. in press).

The telepresence/loss of self-consciousness factor ($M = 3.54 < 4.00$, $Sd = 0.08$), which included 12 items in the flow scale, was not identified as a crucial factor for increasing players' flow experience. According to the content of various online pet games, we concluded that game scenery and online pet appearance are both critical for players' sense of telepresence (Luh et al. in press). However, the appearance factor was not crucial for increasing players' flow experience. Thus, game scenery design and online pet appearance does not help players gain a high level of telepresence or experience a large loss of self-consciousness, so game scenery design and online pet appearance must be further investigated.

Among the four companionship factors, game or pet attractiveness ($M = 4.91$, $Sd = 0.07$) was crucial if players were to feel companionship for their online pet. Therefore, continuing to increase attractiveness for players will help them feel companionship with their online pet.

Compared to pet's attractiveness, reality, and uniqueness factors, sense of attachment ($M = 3.45 < 4.00$, $Sd = 0.09$), which included 16 items in the CSAP scale, was not discovered to be crucial for companionship. We inferred two possible reasons for this: (1) players expect to feel attached to their online pet, but the studied online pet games

cannot fulfill this expectation effectively; or (2) players did not originally expect to feel attached to their online pets and did not subsequently gain any such attachment.

Only 13 participants played the games wherein (1) players could raise only one pet and only one species was available or (2) players could raise many pets and numerous pet species were available. This may indicate that these two types of games find it difficult to attract players. The other two game types, GT1 and GT2, had a total of 204 players (Table 2), indicating that these game types attracted more players. No significant differences were found in the flow and companionship levels of players of game types GT1 and GT2 (Table 6). Therefore, both types of game enabled players to achieve flow and feel companionship with their online pets.

T-test results revealed that how many years the participants had been playing online pet games did not affect players' flow and companionship levels, the reason for which should be discussed in the future. The T-test also demonstrated, however, that when players spend longer interacting with their online pet each day, they experience more flow and companionship. This was especially true regarding the following factors: concentration, time distortion, sense of attachment, pet's attractiveness, and pet's uniqueness.

Game designers wanting to increase players' flow and companionship levels should focus on encouraging players to spend more time interacting with their online pets daily, but game designers may need not emphasize involving players in online pet games over long periods (such as one or two years). The players' levels of flow and companionship did not differ considerably between the genders, with results similar to those of Lawson and Chesney (2007b), which focused on the effect of gender on sense of companionship with Nintendogs.

According to the T-test (Tables 8 and 9), players who believed they had high flow and companionship levels were confirmed to actually have high flow and companionship levels. Thus, the players' feelings are a reliable indicator. Nonetheless, we suggest that scales should include additional two or three items to identify players' flow and companionship levels; for example, "Compared with other players, I believe I have high levels of flow/companionship when playing the game." Using multiple items to determine whether a player belongs to high or low flow/companionship groups is more objective than relying on self-reporting.

This study used data collected in our previous study (Li and Luh 2015), and most of the games played by the participants were PC games. Currently, there are more than one hundred mobile games, and whether the results of this study are applicable for mobile pet games requires further investigation and discussion. Furthermore, the playing history factors discussed in this study only included gender, age, game type, playing years, and daily playing time. Other relevant factors, such as individual online pet games, playing days per week, and lifestyle can also be studied in the future.

5 Conclusions

This study evaluated what types of playing factors and playing history factors affect players' flow and companionship levels. The results revealed that concentration and time distortion were crucial for increasing players' feelings of flow. Pet attractiveness, reality, and uniqueness were discovered to be the crucial factors for building players' sense of companionship with their online pets. Furthermore, more time spent playing with online pets each day resulted in significantly higher flow and companionship levels. Finally, players who self-rated themselves as having high flow and companionship levels were confirmed to actually have higher flow and companionship levels than those who self-rated their levels as low.

The results of our previous studies (Li and Luh 2015, in press; Luh et al. 2015, in press) and this study collectively demonstrated that players truly achieve flow while interacting with their online pets and that some players feel companionship with their online pets. In addition, flow and companionship were revealed to have a positive relationship when considering online pet games. Different game motivations were discovered to result in different flow and companionship levels in players. Finally, game designers can enhance players' flow and companionship levels by strengthening some crucial playing factors and playing history factors.

The results of these studies can serve as a developmental reference for designers of games in which players own a virtual pet, such as online, VR, and AR games. Moreover, these results will also be useful in the development of companion robots, robot pets, and virtual pets for company functions, health management, and e-learning. Product, system, and game designers can utilize the relevant flow and companionship factors to enhance users' motivation and help them build more intimate relationships with their companion products or virtual pets.

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