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Investigating therapists' intention to use serious games for acquired brain injury cognitive rehabilitation

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Abstract   Acquired brain injury is one cause of long-term disability. Serious games can assist in cognitive rehabilitation. However, therapists' perception and feedback will determine game adoption. The objective of this study is to investigate therapists' intention to use serious games for cognitive rehabilitation and identify underlying factors that may affect their acceptance. The respondents are 41 therapists who evaluated a "Ship Game" prototype. Data were collected using survey questionnaire and interview. A seven-point Likert scale was used for items in the questionnaire ranging from (1) "strongly disagree" to (7) "strongly agree". Results indicate that the game is easy to use (Mean = 5.83), useful (Mean = 5.62), and enjoyable (Mean = 5.90). However intention to use is slightly low (Mean = 4.60). Significant factors that can affect therapists' intention to use the game were gathered from interviews. Game-based intervention should reflect therapists' needs in order to achieve various rehabilitation goals, providing suitable and meaningful training. Hence, facilities to tailor the game to the patient's ability, needs and constraints are important factors that can increase therapists' intention to use and help to deliver game experience that can motivate patients to undergo the practices needed. Moreover, therapists' supervision, database functionality and quantitative measures regarding a patient's progress also represent crucial factors.
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1. Introduction

Acquired brain injury (ABI) is one of the main causes of long-term disability in most countries. ABI refers to brain damage after birth resulting from traumatic or non-traumatic brain injury. Traumatic brain injury (TBI) results from trauma to the brain through various ways including traffic accidents, assaults etc., whereas non-traumatic brain injury stems from medical conditions like stroke, brain tumor or poisoning

(Ciuffreda et al., 2012). TBI and stroke (Cerebrovascular Accident) are the two major sources of acquired brain injuries that result in disabilities in adults (Cicerone et al., 2000). The category of abilities impacted depends on the location, type and size of the brain damage. Hence, patients have their own specific impairment ranging from cognitive dysfunction to motor disability that adversely impacts the patients' daily lives and confine their ability to go through their daily activities (Wlodarczyk, 2012).

Patients suffering from brain damage often claim that conventional rehabilitation exercises entail boring activities that are repetitive in nature and hence lead them to ignore these exercises. Today, most patients are familiar with the digital environment characterized by computers and handheld technology. According to studies, most patients (75%) with brain injuries are younger than 35 years of age (Tagliaferri et al., 2006), are relatively skillful in using computers and handheld devices. This resulted in a significant interest among health professionals concerning the use of computer games for the purpose of rehabilitation, where motivation is fostered during rehabilitation and hence the rehabilitation outcomes are ascertained (Maclean et al., 2002).

Additionally, conventional rehabilitation is not sufficient to facilitate the required level of therapy to meet patient's rehabilitation needs (Burdea, 2003). There is an increasing number of patients suffering from brain damage (Langlois et al., 2006; Aditya Widjana, 2011), particularly those who are involved in serious accidents. This led to the limitation in human resources, facilities and the burdening of health-care systems wherein the popular treatment is the conventional rehabilitation system that is monitored and controlled by the therapists in one-on-one patient sessions (Burdea, 2003). Moreover, the location of the rehabilitation centers are more in cities so patients living in rural areas have to travel far and spend a significant amount of money in order to get treatment. This is especially challenging for those with restricted mobility who eventually fail to get the rehabilitation treatment (Burdea, 2003). This explains why the delivery of rehabilitation programs, their scenarios and organization should be designed keeping the patient's needs and expectations in consideration.

Information and Communication Technologies (ICT) can play a crucial role in supporting rehabilitation for individuals with disabilities (Laabidi et al., 2014). For example, the use of serious games in cognitive and/or physical rehabilitation would be invaluable to the rehabilitation process and provides advantages that are lacking in conventional techniques, and more importantly it would increase the effectiveness and efficiency of rehabilitation.

A serious game is used for training and education purposes as compared with traditional (off-the-shelf) games, whose primary purpose is to entertain. Rego et al. (2010), define serious games as "computer games that allow the player to achieve a specific non entertainment purpose using the entertainment and engagement component provided by the experience of the game".

Research on serious games for cognitive rehabilitation is still in its infancy, compared to other types of disabilities (Torrente et al., 2012). Review of the current literature on the use of games for rehabilitation indicates some shortcomings, such as small sample size, limited time invested in usability and acceptance testing done on volunteers, able-bodied and healthy users, and lack of regard for the therapist who is one of the principal end-users of the technology intervention (Fok, 2009; Burke et al., 2010; Jaeggi et al., 2011; Broeren et al., 2008; Rego et al., 2011). For example, Fok (2009) developed an Internet-enabled exercise program which integrates virtual telephone as well as computer-interfaced prosthesis allowing people with memory impairment to exercise at home. However, the testing was carried out on 40 healthy adults between the ages of 20–30. In addition, Rego et al. (2011) highlighted the impact of using new forms of interaction in serious games for cognitive rehabilitation and proposed a game prototype that players can play in three interaction inputs namely mouse, sound or motion. However, a small sample sized usability study was conducted involving 20 healthy users to evaluate the game. Furthermore, Broeren et al. (2008) studied the effects of virtual reality and games on patients with cognitive and physical deficiencies and the intervention involved only five brain-damaged patients.

Therefore, the requirements for the design of therapeutic games are not clear. There is a lack of knowledge regarding the actual requirements as most of the studies avoid the true end users. The question arises on whether such interventions will be accepted by the target group (i.e. patient and therapist). Jennifer et al. (2002) argues that users may not tell what they want, but if you show them something which they can see and interact with, they soon realize what they want. Hence, to capture the actual requirements and perception of users, Elaklouk and Zin (2012) determined principles of game design that are critical for brain damage rehabilitation and developed a game prototype called "Ship Game" based on these principles. The "Ship Game" was deployed for four weeks in one of the Palestine rehabilitation centers as intervention for cognitive rehabilitation. Twenty patients were involved in this study. Positive comments were received concerning the playability and usability of the "Ship Game" by the patients.

However, considering the patient as the sole end-user is an aberration as the therapist is the one who primarily motivates, guides, and assesses the patient. Therefore, therapist has a key role in the recovery of the patient and in the development of an effective rehabilitation system. Hence, the objective of this study is to investigate therapists' acceptance and examine the determinants affecting their intention to use serious games for acquired brain injury cognitive rehabilitation. To achieve this objective, we test our game prototype "Ship Game" with a large sample of therapists ($N = 41$). The therapists' acceptance and intention to use the game were measured through a questionnaire and later validated through interviews.

2. Technology acceptance

Technology acceptance refers to the inclination of the user to use the technology and how they perceive, accept and adopt it for the purposes it is designed to support (Louho et al., 2006). In an attempt to predict and explain individual's acceptance and intention to use technology, many theoretical models have been suggested, such as the Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), Innovation Diffusion Theory (IDT) and Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). Moreover, the Technology Acceptance Model (TAM) is among the leading models widely used to bring about the understanding of factors impacting the acceptance

and the intention to use technology that is new. TAM has been employed for various technologies and tested in different contexts. Two constructs assumed by TAM are perceived ease of use and perceived usefulness, which are the basic determinants employed to predict intention of a particular system use, which eventually determines the use of the system (Ajzen, 1985; Yi et al., 2006). However, in a later study, Davis et al. (1992) considered perceived usefulness as extrinsic motivation and proposed perceived enjoyment into the model as its counterpart intrinsic motivation. Similarly, Van der Heijden (2004) proposed an extended TAM model consisting of perceived ease of use, perceived enjoyment, perceived usefulness and intention to use to examine information system users' acceptance and usage intention. The model is adapted and used for this study to explore therapists' perception and intention to use our game prototype "Ship Game" for cognitive rehabilitation.

3. Research model and hypotheses

3.1. Research model

Intention to use is defined as the interest of the individual to use the system in the future (Wu et al., 2008). Fig. 1 illustrates the research model used in this study to understand and explore therapists' intention to use serious games for cognitive rehabilitation in general and our game prototype ("Ship Game") in particular. The research model shows the relationship between the dependent and independent variables. The model suggests that the dependent variable (therapists' intention to use the "Ship Game") is affected by independent variables: (1) perceived usefulness; (2) perceived ease of use; (3) perceived enjoyment. Hence three hypotheses are proposed.

3.2. Hypotheses

3.2.1. Perceived usefulness (PU)
Perceived usefulness can be defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989). If individuals perceive a novel technology to be advantageous to achieving
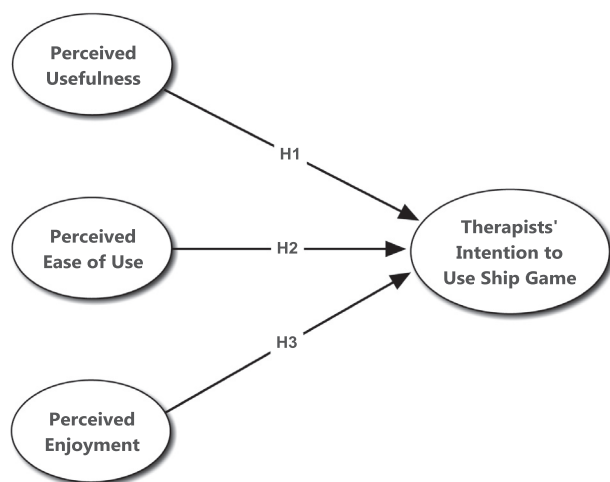

Figure 1   The research model adapted from Van der Heijden (2004).

valued outcomes, and for enhancing their performance, they will be more likely to accept it. Several studies (Davis, 1989; Lee et al., 2005; Chesney, 2006; Parveen and Sulaiman, 2008; Verkasalo et al., 2010; Park et al., 2012) have proven that perceived usefulness is a significant determinant of user acceptance and it positively impacts their intention to use technology. As an example, Parveen and Sulaiman (2008) revealed that perceived usefulness significantly and positively impacts intention to use wireless Internet applications on a mobile device. Moreover, Lee et al. (2005) explored the intention of the students to use Internet-based learning and revealed perceived usefulness to significantly impact the use of Internet-based learning. In addition, Verkasalo et al. (2010) showed a strong significant influence of perceived usefulness on the intention to use smartphone applications. Based on these findings that verified the position of perceived usefulness to determine intention and inclination to use technology, it can be argued that the perceived usefulness of the "Ship Game" will have a positive influence on the intention to use the "Ship Game" for cognitive rehabilitation. Hence, the following hypothesis is proposed:

H1. Perceived usefulness has a significant positive influence on the therapists' intention to use the "Ship Game" for cognitive rehabilitation.

3.2.2. Perceived ease of use (PEU)
Perceived ease of use can be defined as "the degree to which a person believes that using a particular system would be free from effort" (Davis, 1989). Technology which is perceived to be easier to use and less complex is more likely to be adopted by users. The effect of perceived ease of use on technology adoption and intention to use has been recognized by many studies, (such as: Davis, 1989; Davis et al., 1992; Ong and Lai, 2006; Amin, 2009; Al-alak and Alnawas, 2011; Park et al., 2012). Most of these studies reported a significant positive association between ease of use and intention to use a new system. For example, Al-alak and Alnawas (2011) measured the acceptance and adoption of an e-learning system by Jordanian academic staff. Findings revealed a positive relationship between ease of use and intention to use the e-learning system by lecturers. Furthermore, Ong and Lai (2006) revealed that perceived ease of use significantly impacts the behavioral intention of students to make use of e-learning. Based on these findings, we argue that the perceived ease of use of the "Ship Game" will have a positive influence on the intention to use the "Ship Game" for cognitive rehabilitation. Hence, the following hypothesis is proposed:

H2. Perceived ease of use has a significant positive influence on the therapists' intention to use the "Ship Game" for cognitive rehabilitation.

3.2.3. Perceived enjoyment (PE)
Perceived enjoyment is defined as "the extent to which the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use" (Davis et al., 1992; Venkatesh et al., 2003). According to Davis et al. (1992), perceived enjoyment is considered as one of the most significant determinants,

having a positive influence on behavioral intention. The use of any technology should entail enjoyment, as without enjoyment, it may not be used in the future. Several studies (Pikkarainen et al., 2004; Lee et al., 2005; Heerink et al., 2008; Lin and Lu, 2011) have proven that perceived enjoyment is a strong determinant and positively influences user acceptance and intention to use technology. For example, Lin and Lu (2011) found a significant positive influence of perceived enjoyment on the intention to use social networking. In addition, Lee et al. (2005) explained students' intention to use Internet-based learning and found that perceived enjoyment significantly influenced the use of Internet-based learning. Furthermore, Heerink et al. (2008) explored the concept of enjoyment as a possible factor influencing the acceptance of robotic technology by elderly people. The findings showed that perceived enjoyment affected intention to use a robotic system. Moreover, Pikkarainen et al. (2004) found that there is a significant positive influence of perceived enjoyment on the frequency of Internet usage. Therefore, when a person finds the activity enjoyable, he will want to repeat it. We argue that the perceived enjoyment of the "Ship Game" will have a strong positive influence on the intention to use the "Ship Game" for cognitive rehabilitation. Hence, the following hypothesis is proposed:

H3. Perceived enjoyment has a significant positive influence on the therapists' intention to use the "Ship Game" for cognitive rehabilitation.

4. Research method

The research uses a questionnaire survey to investigate therapists' acceptance and intention to use serious game for acquired brain injury cognitive rehabilitation. The questionnaires were administered to 41 therapists who were asked to evaluate our game prototype "Ship Game". Furthermore, interviews with therapists were carried out to validate the findings from the survey and to gather therapists' experience of using "Ship Game" and factors that may affect their intention to use serious games for acquired brain injury cognitive rehabilitation.

4.1. The "Ship Game" overview

According to Elaklouk and Zin (2012), the "Ship Game" consists of several mini games as shown in Fig. 2, each with a different challenge designed for brain injury cognitive rehabilitation with special focus on memory, attention, concentration, executive functions and deficiencies concerning eye-hand coordination. Four attributes that are important for brain damage rehabilitation are identified as the design principles of these games: meaningful play, challenge, portability and interaction technology. Meaningful play stems from the link between a player's action and the outcome of the game system, which is created and maintained by both the system's feedback and handling failure positively, specifically in the context of rehabilitation. The challenge lies in the balance between an individual's skills and the challenges faced. Portability is referred to the system's capability to be utilized anywhere (home, hospital or clinic) while interaction

technology is the technology that the patient uses for system interaction.

4.2. Procedure for data collection

After playing the "Ship Game", offline and Web-based surveys are employed in order to test therapists' perception and acceptance regarding our game prototype ("Ship Game") as a cognitive rehabilitation intervention. Offline survey: after obtaining permission from relevant individuals to conduct our research survey, participants were taken to a place where the "Ship Game" was set up. They were not instructed to perform any particular task but were asked to play the "Ship Game" for approximately 20 min. After the session ended, they were requested to fill in the questionnaire. Web-based survey: through electronic mail, the participants were invited to participate in the study. The online participants were employees from different rehabilitation centers distributed across Palestine. They were asked to play the "Ship Game", and then filled in the questionnaires which were both accessible to the participants from our website (www.gamlab.com). We conducted semi-structured interviews with eight therapists. Two of them were from El-Wafa rehabilitation hospital.

4.3. Instruments

The survey questionnaire consists of three parts. The first part records the respondents' demographic information (see Table 2). The second part of the questionnaire was developed to get information about the level of computer usage, literacy and prior game experience of the respondents (see Table 3). The third part is the constructs of perceived ease of use, perceived usefulness, perceived enjoyment and intention to use to measure respondents' perceptions regarding our game prototype. Items used to measure these constructs were adapted from previous validated instruments and slightly modified to fit our current research context. According to the study of Gupta and Chen (1995), a seven-point Likert scale would provide a normal distribution of observations. Therefore, a seven-point scale was used to answer the questions in the four constructs of the questionnaire ranging from (1) "strongly disagree" to (7) "strongly agree". Table 1 shows the constructs, items used and the sources from where they were adapted.

In order to test the content validity and reliability, three experts (faculty members) specializing in research design, statistical analysis and survey development carefully reviewed the initial draft of the instrument. Furthermore, pretesting on three therapists was conducted to assess the clarity, format and suitability of the wording of the questionnaire. Both of the tests required slight changes in wording, which were carried out accordingly. All participants in Palestine answered the questionnaire in English.

5. Results

5.1. Results of questionnaire survey

A total of 63 (offline and Web-based survey) questionnaires were distributed among respondents but only 41 usable responses were received. According to Glegg (2012), to test
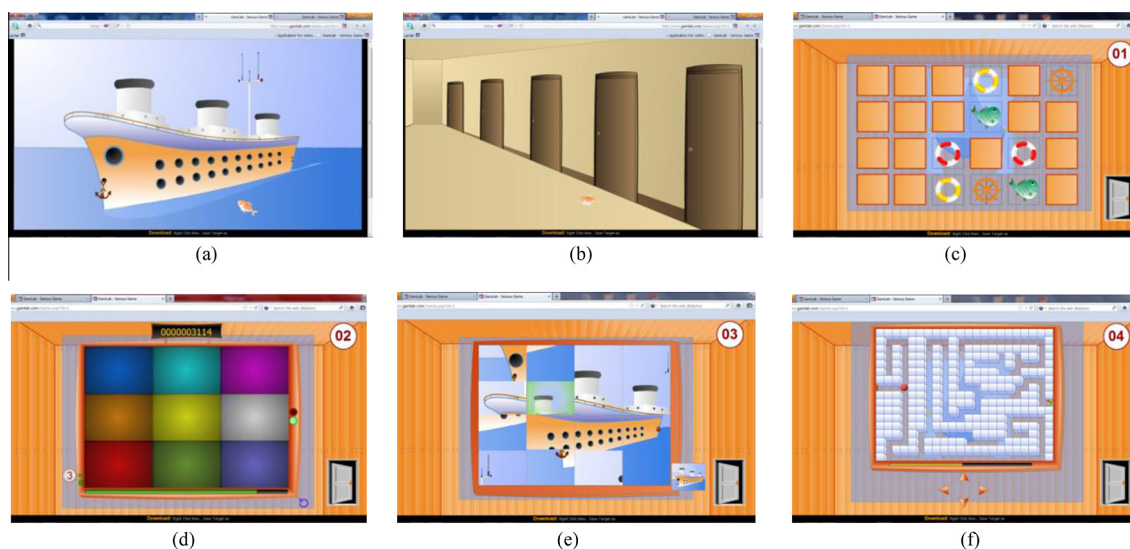
Figure 2 Screenshots of the "Ship Game". (a) The game's main interface; (b) the game menu "on board the ship"; (c) the first door game; (d) the second door game; (e) the third door game; (f) the fourth door game.

Table 1 Question items used in the survey and its resources.

Construct	Item	Measure	Sources
Perceived ease of use (PEU)	PEU1	Learning to operate the "Ship Game" is easy for me.	Davis (1989)
	PEU2	Interacting with the "Ship Game" does not require a lot of mental effort.	
	PEU3	My interaction with the "Ship Game" is clear and understandable.	
	PEU4	It is easy for me to become skillful at using the "Ship Game" system.	
	PEU5	Overall, I find the "Ship Game" easy to use.	
Perceived usefulness (PU)	PU1	Using the "Ship Game" in my job would enable me to provide better support for my patients.	Davis (1989)
	PU2	Using the "Ship Game" for cognitive rehabilitation improves the quality of care that I deliver.	
	PU3	Using the "Ship Game" enhances my effectiveness in work.	
	PU4	Using the "Ship Game" can make my patient care easier.	
	PU5	Using the "Ship Game" provides cognitive training for my patients in more quantity.	
	PU6	Overall, I would find the "Ship Game" useful in my job.	
Perceived enjoyment (PE)	PE1	I had fun using the "Ship Game" system.	Lee et al. (2005)
	PE2	The actual process of using the "Ship Game" was pleasant.	
	PE3	I find the "Ship Game" enjoyable.	
Intention to use (ITU)	ITU1	I intend to use the "Ship Game" on a regular basis for patients' cognitive rehabilitation in the near future.	Aditya Widjana (2011) and Giannakos and Vlamos (2012)
	ITU2	I will strongly recommend other professionals to use the "Ship Game" system for patients' cognitive rehabilitation.	
	ITU3	I prefer to use the "Ship Game" in the future rather than the traditional way for patients' cognitive rehabilitation.	
	ITU4	I feel satisfied with the benefits I can get from the "Ship Game" system.	
	ITU5	I plan to use the "Ship Game" system for patients' cognitive rehabilitation in the future.	
	ITU6	I expect that I would use the "Ship Game" system for cognitive rehabilitation in the future.	

the effect of an intervention, a sample size of up to 25 therapists was thought to be feasible. Data were analyzed using the SPSS version 17.0 and MS Excel.

5.1.1. Demographic profiles
The demographic profile presented in Table 2 depicts a clear picture of the characteristics of the respondents; majority are males (90.2%) while the remaining (9.8%) are females. In terms of age, most respondents (41.5%) are between the ages of 30 and 40 years old, followed by 26.8% between 41 and 50 years old, while 22.0% were less than 30 years old and only 9.8% exceeded the age of 50. With regard to respondents' educational level, majority (58.5%) have a bachelor's degree, while 26.8% have a post-graduate's degree and the remaining 14.6%

Table 2 Descriptive statistics of respondents' profile (N = 41).

Characteristics	Frequency	Percent (%)
Gender		
Male	37	90.2
Female	4	9.8
Age (Year)		
Less than 30	9	22.0
30–40	17	41.5
41–50	11	26.8
Over 50	4	9.8
Qualification		
Certificate/Diploma 1–3 years of college	6	14.6
Bachelor's degree	24	58.5
Master's degree or higher	11	26.8
Occupation		
OT	19	46.3
COTA	11	26.8
PT	2	4.9
Educator	5	12.2
Others	4	9.8
Work experience (Years)		
Less than 1	2	4.9
1–5	14	34.2
6–10	19	46.3
Over 10	6	14.6
Most frequent patient group they work with		
Pediatrics	3	7.3
Adolescents	13	31.7
Middle Adults	18	43.9
Older Adults	5	12.2
Others	2	4.9

Abbreviations: OT = occupational therapist; COTA = certified occupational therapy assistant; PT = physiotherapist.

Table 3 Computer skills and use (N = 41).

Characteristics	Frequency	Percent (%)
Computer literacy		
Very good	19	46.3
Good	13	31.7
Medium	6	14.6
Poor	3	7.3
Frequency of computer use		
Every day or continuously	36	87.8
Only when needed	5	12.2
Idea/knowledge about use of games for CR		
Yes	28	68.3
No	13	31.7
Prior game use experience for CR		
Never used	19	46.3
Commercial games	6	14.6
Free online games	5	12.2
Customizable games	9	22.0
Handheld/mobile phone games	2	4.9
Other	0	0
Use of the game could be an effective intervention activity for		
Pediatrics	4	9.8
Adolescents	7	17.1
Middle adults	6	14.6
Older adults	0	0
All	24	58.5

Abbreviations: CR = cognitive rehabilitation.

have a diploma. Responses in the occupation category show that the majority of respondents (46.3%) are occupational therapists (OT), 26.8% are certified occupational therapy assistant (COTA) and 12.2% are educators. Only 9.8% had other occupations involving cognitive rehabilitation. Physical therapists are the smallest group (4.9%). Regarding job experience, majority of respondents (46.3%) have 6–10 years' job experience while 34.2% have 1–5 years' experience. 14.6% have more than ten years of experience and only 4.9% have less than a year's experience. Additionally, therapists reported that most frequent patients they received and worked with in rehabilitation centers are middle adults (43.9%), followed by adolescents (31.7%) and older adults (12.2%), while pediatrics constituted 7.3% and others (4.9%).

5.1.2. Participants' skills and prior game experience

In terms of the participants' computer literacy, the responses (Table 3) reveal that the majority of respondents (46.3%) had "very good" computer skills while 31.7% had a "good" level of computer skills. The rest of the respondents (14.6%) revealed a "medium" level of computer skills with a minimal (7.3%) number who had poor level computer skills. Table 3

also shows frequency of computer use; most (87.8%) worked on a computer daily, while 12.2% worked on computers when required. The respondents were asked in general whether they had any idea about the use of computer games in the cognitive rehabilitation context. The results in Table 3 confirm that majority (68.3%) of them are familiar with the concepts of game-based intervention. However, about 32% respondents are not informed of using games in cognitive rehabilitation. They were asked concerning their game experience in terms of cognitive rehabilitation purposes. The findings in Table 3 reveal that the majority (46.3%) has never used games for cognitive rehabilitation purposes. However, 22.0% used customizable games for certain cognitive purposes, followed by 14.6% who used commercial games for cognitive rehabilitation, and 12.2% of the participants used free online games. Only 4.9% used handheld and/or mobile phone games for rehabilitation. Table 3 also shows the responses regarding the willingness to use games for cognitive rehabilitation. The respondents were also asked about suitable patients group regarding which the use of games could be an effective intervention activity. Majority (58.5%) of respondents reported that the game could be an effective intervention for all groups. Others (17.1%) agreed that the game could be effective for adolescents, while 14.6% agreed that it could be effective with middle adults, and the remaining responses (9.8%) agreed that the game could be effective for use with pediatrics.

5.1.3. Constructs reliability analysis

Reliability analysis is utilized to measure the scale items' internal consistency to make sure that the scale is stable and

Table 4 Constructs reliability using Cronbach's alpha (N = 41).

Construct	No. of items	Cronbach's alpha
Perceived ease of use (PEU)	5	0.88
Perceived usefulness (PU)	6	0.85
Perceived enjoyment (PE)	3	0.81
Intention to use (ITU)	6	0.76

Table 5 Descriptive analysis (N = 41).

Construct	M	SD
Perceived ease of use (PEU)	5.83	0.68
Perceived usefulness (PU)	5.62	0.61
Perceived enjoyment (PE)	5.90	0.63
Intention to use (ITU)	4.60	0.58

Note: M = mean, SD = standard deviation.

consistently measured the constructs. Cronbach's alpha is the most common measure of scale reliability and it is used in the present research. Gliem and Gliem (2003) states that Cronbach's alpha reliability coefficient accepts values ranging from 0.0 to 1.0. When Cronbach's alpha coefficient is closer to 1.0, the greater will be the internal consistency of the items in the Likert scale. Measures with reliability score of above 0.70 as determined by Cronbach's alpha are viewed as reliable (George and Mallery, 2003).[1] The reliability analysis of the present study is shown in Table 4, which shows that the survey instrument is a reliable measure of the constructs.

Table 5 shows the descriptive analysis of the four constructs used in our research model. All mean scores of perceived ease of use, perceived usefulness, perceived enjoyment and intention to use are above the midpoints of their respective scale and indicated an overall positive response to the constructs. Moreover, the mean scores range from as low as 4.60 for intention to use to as high as 5.90 for perceived enjoyment, indicating that intention to use got the lowest average rate compared with the other three constructs.

5.1.4. Correlation analysis (hypothesis testing)

The next step was to determine whether the perceived ease of use, perceived usefulness and perceived enjoyment are correlated to an intention to use the "Ship Game" for cognitive rehabilitation. According to the study by Lewis et al. (2009), the correlation coefficient is suitable in determining relationships and significance. Therefore, in this study, the Pearson correlation coefficient (r), is used to evaluate the correlation with a coefficient value between -1 and $+1$, with the latter ($+1$) representing a perfect positive correlation and the former (-1) representing a perfect negative correlation. Moreover, when r is close to 0, a weak relationship is considered to exist between the variables. According to Collis and Hussey (2009), correlations between 0.1 and 0.4 depict a weak positive correlation whereas those between 0.4 and 0.7 depict a medium

positive correlation. Finally, correlations greater than 0.7 depict strong positive correlations.

The present study's analysis of results is provided in Table 6. At a 0.05 level of significance, perceived ease of use ($r = 0.366$, $p = 0.019$), perceived usefulness ($r = 0.315$, $p = 0.045$) and perceived enjoyment ($r = 0.295$, $p = 0.017$) have a significant, but weak, positive correlation with intention to use. Hence, all hypotheses are supported but the association between therapists' intention to use and the PU, PEU and PE constructs are weak.

As mentioned earlier, the results of the first three determinants, i.e. perceived ease of use, perceived usefulness and perceived enjoyment, were high in the light of acceptance. Hence, it was imperative that the fourth determinant should be at an equal level to that of the other three, although data analysis is not the same as it should be, judging from the results of the first three. In addition, the weak relationship between the first three determinants and intention to use may be attributed to some internal and external factors playing a major role in the respondents' opinion and attitude toward the game technology when they were rating it.

If cases of outlier arise from the quantitative analysis, the qualitative interview could shed light on the respondents' divergence from the questionnaire (Creswell, 2008). Thus, the analysis from the semi-structured interview contributed to the research study to validate the quantitative data and confirm the results obtained from the therapists prior to the interview (Sandelowski, 2000).

Hence, semi-structured interviews were conducted with therapists to identify factors determining users' acceptance and the potential of serious games for cognitive rehabilitation. A set of questions were designed using the constructs perceived ease of use (PE), perceived usefulness (PU) and perceived enjoyment (PE). The objective is to investigate the relationship between these three determinants and therapists' intention to use "Ship Game" for cognitive rehabilitation. We discussed the analysis of the interview data in the following subsections.

5.2. Results of the interviews

5.2.1. Usefulness, ease of use and enjoyment

In general, the respondents agreed that game-based rehabilitation combines several advantages and benefits in comparison to traditional rehabilitation methods. It can be less time-consuming and provide a safe low-cost environment for practicing, heighten the element of fun, decrease performance-related stress and encourage patients to engage and

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[1] George and Mallery (2003) recommended the rule of thumb which states that Cronbach's alpha = ">0.9 = Excellent, >0.8 = Good, >0.7 = Acceptable, >0.6 = Questionable, >0.5 = Poor, and <0.5 = Unacceptable".

Table 6 Pearson's correlations (N = 41).

		PEU	PU	PE	ITU
PEU	Pearson correlation r Sig. (2-tailed)	1.00			
PU	Pearson correlation r Sig. (2-tailed)	0.480 0.001	1.00		
PE	Pearson correlation r Sig. (2-tailed)	0.372[*] 0.017	0.436 0.004	1.00	
ITU	Pearson correlation r Sig. (2-tailed)	0.366[*] 0.019	0.315[*] 0.045	0.295[*] 0.017	1.00

[*] Correlation is significant at the 0.05 level (2-tailed).

immerse themselves in rehabilitation exercises. It is also good for many patients because it increases the intensity of exercises.

The head of the occupational therapy department mentioned that the options of the "Ship Game" to be accessed online and/or offline; played on the PC using a mouse or hand-held devices through touch screen functionality make it suitable for quite a large group of patients. He further explained that, it is important to cover as many patients as possible because not all of them are equally competent at playing certain games owing to their physical and/or cognitive limitations. In other words, while some patients can play games on the computer using a mouse, others have little or no control over their hands and fingers and can only manage to play through touch screen mobile phones. In addition, those who are confined to wheelchairs may find it difficult to visit rehabilitation centres and hence they may play online or through their mobile phones at home. Other respondents also supported the statement and reported that, developing serious games with flexible input methods allows them to be used for different purposes; for instance, physiotherapists may use the game as a pain distraction tool with patients suffering from motor impairment. The therapists expressed their opinion in comparison to other customizable games created to handle specific deficits, which are expensive, accessible and playable only by a small group of brain-damaged people.

On the other hand, they further mentioned that occupational and physical therapy in Palestine set a heavy emphasis on patients' active treatments. The ability of the "Ship Game" to be used at home or in a hospital or clinic is crucial in the rehabilitation context, enabling patients to practice and hence their impairment can be improved more because training can be conducted every day. Patients can be trained individually ten times a day and in this way they can improve more easily. Others supported the statement and said that they always recommend different kinds of home exercises to their patients due to lack of professionals with increasing number of patients. Hence, the "Ship Game" will be useful for home-based rehabilitation, offering the outpatient a chance to practice at home as everyone back home can have a laptop, computer and/or mobile phone and can be trained on their own. This can reduce the workload of professionals involved in the therapy sessions.

Participants who used the commercial games before in rehabilitation stated that, the games that are commercially available are in general too fast, created for able-bodied game player and provide negative feedback upon losing, thus rendering them unsuitable for brain-damaged people. However, they are very comfortable with uncomplicated rules and found the "Ship Game" simple, more fun and more enjoyable, as it has the least number of rules, using text-less game interfaces which made it more suitable for the rehabilitation context. Moreover, by making the mini-games of the "Ship Game" accessible from one main interface can smooth patient's access and navigation, making the "Ship Game" easy to use and easy to interact with. Furthermore, elements such as progress and time interval bars, sound effects, graphics and numerical scores are used in most mini-game prototypes as feedback mechanisms as well as players' performance indicators – all these make the "Ship Game" enjoyable as well as useful by helping to sustain the attention of the patient and to motivate him, which is critical for experiencing the practices required.

Respondents further mentioned that, the "Ship Game" handled failure positively and it has the facility to make the player replay the failed game task without beginning from the initial level. This makes the game enjoyable and can help to maintain the patient's attention and his motivation more than commercial games that provide only one to three chances to go through the task without failing. But once they fail, they have to begin from the initial level. This aspect leads to patients' boredom, and makes commercial games unsuitable in the rehabilitation context. Additionally, the "Ship Game", specifically in the second door game prototype, provides the patient with the suitable level of challenge through its automatic settings that enable gradual modification of the difficulty level based on the progress of the patient. This can also maintain patient's motivation and keep him engaged in the game experience where game activities can be reasonably accomplished without having to experience frustration (too difficult) or boredom (too easy).

5.2.2. Intention to use

The interviewees unanimously exhibited their optimism and conviction in the potential of serious games and some suggested that the focus should be concentrated on understanding the technology used for the purpose of viability.

When asked whether tasks involved in the "Ship Game" can improve cognitive impairment, most of them replied that it depends on the nature of a patient's disability. In other words, certain features factor in including location, type and size of the damage to the brain basically pinpoints the type of impacted abilities and as a result, every patient has a specific impairment and hence each should be treated based on that type of impairment. They further mentioned that the "Ship Game" is an access to another way of training, and therapists could use it based on the patients they have. Others also supported the statement and said that the "Ship Game" could be added as a complement to conventional therapy in order to sustain patient motivation and bring improvement to cognitive relearning.

When asked about their opinion concerning acceptance of the "Ship Game" in cognitive rehabilitation, the head of the occupational therapy department said, "If more rehabilitation goals are achieved, high acceptance will be realized." He explained that therapists need a variety of game exercises with different levels of challenge to meet the diversity of patients' impairments. He further mentioned that it is very good if such games are developed together with the therapist toward achieving the right goal, as then there are many opportunities for increasing its usage in the health-care area.

Other respondents also supported the statement and said that the potential of serious games as a training method will be ascertained by the synergy practices of the agents involved in the field. They further mentioned that, in the process of developing a serious game, a series of issues must be taken into account; for example, the goal of rehabilitation should be reflected in the game architecture and this is why off-the-shelf games are unsuitable for rehabilitation. Therapists' fear of losing control over a game's therapeutic activities entails that the game tasks should be designed in such a way that the patient can focus on goal achievement as opposed to playing the game. In addition they mentioned that before referring the game to patients, they should experience and control the exercises themselves so that patients can actively practice the game

exercises that are closely linked to their abilities, which is very important for their cognitive improvement.

Therapists' also mentioned that it is important that they have specific functions in games so that patients can get well-tailored treatment. They stated, "Patients have to be trained based on what their therapists want to achieve." Therapists who have prior game experience suggest improving the functionality of the system in terms of bringing a greater number of games into one platform with each possessing specific goals, for every level and kind of impairment, to eventually result in the achievement of rehabilitation goals and the maximization of intention to use the system. Therefore, a balance should be achieved between complexity and the functionality of the game-based system and its acceptance by therapists regarding their ability to manage and control it. This calls for extensive investigation and this is why an interdisciplinary synergy should be established.

In order to map the main inhibitors preventing or reducing intention to use serious games and to identify the needs and challenges, we asked therapists about what they consider to be the main obstacles and needs required to close the gap in the "Ship Game". The therapists argue that at the moment, the degree of intention to use the "Ship Game" is low. They have highlighted several aspects that limit the acceptability and dissemination of game-based cognitive intervention – among them is the difficulty to translate a rehabilitation goal into a game process. Most therapists are of the consensus that the difficulty lies in adjusting the rehabilitation goals to the game concept or vice versa, while providing a proper game structure to best meet those goals.

In addition, the head of the occupational therapy department said that as they always recommend home exercises to their patients, "Ship Game"-based training will be useful for home-based rehabilitation when patients get back home but it requires the therapist's supervision. He thinks that supervision by therapists must be compulsory along with this technology to get the right treatment. Otherwise, without the supervision of therapists, the game technology might not be useful.

From the practical viewpoint, therapists claimed that our game prototype led to mismatches and miscommunication among rehabilitation units, thus reducing their effectiveness. They proceeded to state that the process of rehabilitation might be viewed as a multidisciplinary process covering differing rehabilitation units and involving professionals from diverse disciplines who are responsible for taking care of some aspects of the patients' rehabilitation process. For example, physical therapists focus on motor impairments while occupational therapists focus on cognitive deficiencies. Their individual concerns of areas of rehabilitation are different although overlapping. An effective recovery plan for patients suffering from brain injury would entail the knowledge of physical and occupational therapists along with other professionals to discuss the patient's motor and cognitive systems, the recovery plans and methods used and the patient's improvement and progress. This requires the need for integration between the gaming system and the rehab center's information system.

Therapists also asked for data concerning the activities involved in playing games. They claimed that having records of the patient's progress would enable the monitoring of their progress and may help them in a more effective manner, particularly when the sessions are not one on one. Additionally, others mentioned that, while meaningful play, providing appropriate game challenge and positive handling of failure are significant, in order for the therapist to be really convinced of the games as rehabilitation intervention, there should be a tracking and a statistical representation of the patient's improvement. Therapist requires presentation of patients' performances over time in order to keep track of the time they spend on playing games as well as their progress and how much these games help them in recovery, particularly when they are not in one-on-one rehabilitation sessions. With a visual presentation of improvement over time through graphs and other visual statistical operations, therapists will be more motivated to adopt and continue using the game treatment in the future.

6. Conclusions

Serious game usage for rehabilitation is becoming increasingly popular; it contributes to increasing the motivation of patients to train and improve their rate of recovery. Therapists' perceptions are important, and the role they play is crucial in the development of any game-based intervention. Therefore, to understand and explore therapists' intention to use serious games for acquired brain injury cognitive rehabilitation, 41 therapists tested the "Ship Game" prototype and the data were collected through a survey and interviews.

Results showed that the "Ship Game" is useful, easy to use and enjoyable. However, the degree of therapists' intention to use is slightly low. Furthermore, a weak association was found between independent variables (perceived usefulness, perceived ease of use and perceived enjoyment) and the dependent variable (therapists' intention to use). Significant factors were noted to be missing that can affect therapists' intention to use game-based rehabilitation. Therapists agreed that, while "Ship Game" can be invaluable for achieving simple rehabilitation goals, it can only be used as a complement to conventional rehabilitation.

Tasks should be more meaningful to provide suitable rehabilitation since different patients have different levels of impairment. Therefore, Game-based rehabilitation should be designed to incorporate therapists' suggestions in order to achieve the goals of complex rehabilitation. Hence, facilities to tailor the game to the patient's ability, needs and constraints are important factors that can increase intention to use and help to motivate patients to undergo the practices needed. Furthermore, a study reported that for any games-based intervention to be successful and effective, it should be incorporated by the therapist into his/her daily clinical practices, providing facilities to track patient's activities and progress. By taking these factors into account when developing serious game intervention for rehabilitation, user acceptance can be increased. Future study will address the issue, by taking these factors into consideration, in developing a framework to be used as a basis to design an effective and motivating rehabilitation gaming system for acquired brain injury cognitive rehabilitation.

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