



An e-health platform for the elderly population: The butler system

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ARTICLE INFO

Article history:

Received 17 November 2009

Received in revised form

25 July 2010

Accepted 26 July 2010

Keywords:

Elderly
e-Health system
Telepsychology
Interactive technologies
Virtual reality

ABSTRACT

The Butler system is an e-health platform designed to improve the elderly population's quality of life. The Butler system has three applications diagnostic, therapeutic and playful. The objective of this work is to present the influence of the use of the platform on elderly users' mood states and the degree of acceptance. These measures were assessed through visual analogical scales before and after the platform use, with the outcome measures MANOVAS analyses were performed. Seventeen users (from 58 to 79 years old) completed four sessions with the system; they could choose which technological resources they used in each session. The results showed that after using the system, the participants' insensitive emotions increased and their negative ones decreased. In addition, they obtained high levels of satisfaction, low levels of subjective difficulty and would recommend Butler to other users. Therefore, the results indicate that Butler might be an effective system for improving emotional states in elderly population.

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1. Introduction

Over the last 30 years, worldwide demographic distribution has changed remarkably. The National Institute on Aging's most recent official census (Kinsella & He, 2009) showed that, for the first time, people aged 65 and over will soon outnumber children under 5. Furthermore, the number of people worldwide aged 80 and over is projected to increase 233% between 2008 and 2040, compared to a 160% increase in those aged 65 and over; the total population (including all age groups) is expected to increase 33% during that time.

This demographic shift coincides with the technological revolution that characterizes the twenty-first century, which is dramatically altering and redefining how people communicate and relate to each other. For the elderly population, this technological revolution can widen the generational gap and exacerbate feelings of loneliness, depression and anxiety and contribute to adjustment disorders. However, several studies indicate that bringing information and communication technologies (ICTs) to the elderly can have a significant and positive influence on this population (Marek van de Watering, 2005; Tse, Choi, & Leung, 2008). Some authors have even presented it as the only possibility for alleviating isolation, loneliness and alienation in certain elderly groups (Cody, Dunn, Hoppin, & Wendt, 1999; Karavidas, Lim, & Katsikas, 2005). For example, Wellman and Frank (2001) showed that Internet use by the elderly increases interpersonal connectivity and organizational involvement and also reduces levels of isolation, especially for those with reduced mobility. Similarly, Blit-Cohen and Litwin (2004) also found that elderly people who used ICTs had stronger social networks.

Our research team has developed an e-health platform (the Butler System) for elders and their caregivers (for a more detailed description see Botella et al., 2009 or a video demonstration at <http://www.labpsitec.uji.es/esp/multimedia/videosMYD.php>). The system is designed as a primary intervention to facilitate and optimize caregivers work and to improve elders' quality of life. The Butler System is a multi-user Internet-based platform that serves as a network between users with profiles in the system (including elders as well as their caregivers,

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friends and family members). Each user can have various technological applications in each of the system's three application levels, including: 1. Assessment 2. Therapeutic and 3. Playful. All of the resources available in the Butler System were designed to be self-administered.

From the elderly users' point of view: the assessment application enables early detection, as well as improvement and monitoring, of the users' the emotional states (including anxiety and depression) as well as their physical states. When an elderly person begins using the system, the clinical signs mentioned above are briefly explored. If any alteration in mood state (anxiety or depression) is detected, the system performs a more detailed examination using widely used and validated scales for psychological assessment, such as the GDS-15 (Sheikh & Yesavage, 1986) and STAI-E (Spielberger, Gorsuch, & Lushene, 1970). Depending upon the outcome, the system then offers therapeutic and recreational options best suited to the emotional states detected; additionally, an alert regarding the severity of the outcome (mild, moderate or severe) is sent to the professional.

The therapeutic application offers two tools. One facilitates the training of positive emotions such as relaxation and joy using two virtual reality environments containing different emotional induction procedures that have been validated by the scientific community. The second tool is the Therapeutic Book of Life (TBL) through which the clinician applies the ReVISEP program (for more a more detailed description, see Etchemendy, Baños, Botella, & Castilla, 2010). Additionally, the playful application contains several recreational tools designed to enhance socialization, learning, entertainment and curiosity. For example, users can send and receive e-mail, have videoconferences, create personalized blogs (called Books of Life) or multimedia photo albums, listen to music and meet new people through the network of friends in the system. It's important to note that all of the resources in the Butler System are self-administered.

From the health workers' point of view: The clinician receives evaluation application reports on the emotional states detected in the elderly users each time they enter the system; they are also aware of the activities the users choose within the system. Furthermore, they are able to administer the ReVISEP treatment program as needed.

Finally, *from the point of view of external contacts, which include users' family members and friends:* the recreational application allows them to interact with users with whom they are linked through e-mails and videoconferences and by reading users' blogs.

One of the main objectives of the Butler System is to help improve older people's quality of life. The purpose of the present study is to test the ability of the system to improve elderly people's mood states and to assess their degree of acceptance of the Butler System. To achieve this goal, mood state variations and degree of acceptance were analyzed throughout four sessions.

2. Material and methods

2.1. Participants

The sample consisted of 17 participants (12 females and 5 males) ranging from 58 to 79 years old with an average age of 68.29 (SD = 5.72). Two people were under 60 years old and two were over 75. All participants were recruited from the Senior Universities of Jaume I University and the University of Valencia, Spain. None of them presented cognitive impairment. All participants were intellectually active; as students at the Senior University, they had to study and read about various subjects. As for their levels of experience with ICTs, eight participants had no experience whatsoever with computers, mobile phones, etc.; seven participants had minimal technology experience: they described themselves as non-computer users who found it difficult to use mobile phones; one participant had intermediate experience: he had difficulty using computers but could use mobile phones; the remaining participant had an advanced expertise level: he had experience using the Internet, sending e-mails, using mobile phones, etc. All participants voluntarily agreed to participate in the study and signed an informed consent. As an exclusion criteria we ensured that no participants had high scores in anxiety or depression, which was measured with the STAI-E questionnaire (>38) (Spielberger et al., 1970) and the GDS-15 questionnaire (>5) (Sheikh & Yesavage, 1986), respectively.

2.2. Measures

- *State-Trait-Anxiety-Inventory (STAI Spanish version Spielberger et al., 1970):* This is a self-administered questionnaire with 40 items divided into two subscales, concerning feelings of anxiety, both general (trait) and situational (state). Only the state subscale is used in this work. Studies with this scale in the geriatric population suggest the following cutoff scores: 39–40 = mild anxiety, moderate anxiety = 41–53 and >54 = severe anxiety (Kvaal, Laake, & Engedal, 2001; Kvaal, Ulstein, Nordhus, & Engedal, 2005).
- *Geriatric Depression Scale-15 (GDS-15) (Sheikh & Yesavage, 1986).* This is a self-administered questionnaire with a yes/no response, which assesses the presence of depressive symptoms in the elderly population. This scale was specifically designed to assess the affective state of the elderly, since other scales tend to overestimate neurovegetative or somatic symptoms. Several studies show the following cutoff scores: 0–5 = no depression, 6–9 = probable depression and 10–15 = depression.
- *Visual Analogic Scale (VAS):* A variant of the Gross and Levenson (1995) measure that our team used in previous studies (Baños et al., 2004, 2005, 2008), was applied. Participants were asked to quantitatively assess (1 = “not at all” to 7 = “totally”) the degree to which they experienced different emotions (joy, sadness, anxiety and relaxation). This scale was applied before and after each Butler session.
- *General Mood State (GMS):* This is a questionnaire designed specifically for this study. It is a visual analogue scale consisting of seven facial expressions, ranked from 0 to 6: 0 is a face expressing maximum sadness and 6 is one expressing maximum happiness. Users had to choose the facial expression that best represented their mood before and after of use Butler system.
- *Level of Satisfaction with the Use of System (LSUS):* Users evaluated their degree of satisfaction with what they experienced in each Butler session using an adaptation of a visual analogue scale consisting of seven facial expressions, from 0 (maximum dissatisfaction) to 6 (maximum satisfaction).
- *Level of Difficulty (LD):* The participants assessed the difficulty of using the system on a scale from 1 (“very easy”) to 5 (“very difficult”).
- Two additional yes/no questions on system acceptability were answered by the users: 1. Would you recommend the Butler system to others? 2. Do you think that what you have learned today in the Butler system can be useful at other times in your life?

Table 1
Statistic descriptives for study variables before and after session.

	Session 1 (Mean (SD))		Session 2 (Mean (SD))		Session 3 (Mean (SD))		Session 4 (Mean (SD))	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
STAI-S	14.96 (6.7)	8.56 (5.5)	14.61 (9.3)	8.93 (4.6)	13.82 (7.7)	8.93 (5.2)	15.12 (8.7)	8.87 (6.0)
VAS								
Joy	4.94 (1.0)	5.47 (1.0)	4.41 (1.5)	5.24 (0.9)	4.71 (1.2)	5.35 (0.8)	4.82 (1.1)	5.29 (1.0)
Sadness	2.29 (1.3)	1.35 (0.6)	2.35 (1.6)	1.59 (0.9)	2.00 (1.3)	1.59 (1.0)	1.76 (1.2)	1.35 (0.8)
Relaxation	4.59 (1.2)	5.65 (1.1)	4.41 (1.5)	5.59 (0.8)	4.59 (1.1)	5.41 (1.0)	4.47 (1.5)	5.29 (1.1)
Anxiety	1.82 (1.1)	1.00 (0.0)	1.65 (0.9)	1.12 (0.3)	1.53 (1.1)	1.18 (0.7)	1.29 (0.7)	1.12 (0.4)
GMS	4.70 (0.6)	5.10 (0.7)	4.30 (1.1)	5.00 (0.9)	4.50 (0.9)	5.10 (0.9)	4.30 (0.8)	4.90 (0.9)
LSUS	4.40 (0.7)	4.80 (1.0)	4.40 (1.0)	4.80 (1.0)	4.50 (0.9)	5.00 (0.9)	4.30 (0.8)	4.90 (0.9)
LD		1.65 (0.7)		2.24 (0.7)		2.35 (0.8)		2.53 (0.9)

2.3. Procedure

People older than 58 who were attending courses for senior students at University Jaume I and the University of Valencia were invited to participate in the study. Subsequently, interested students attended a meeting where a researcher explained the system's applications and mode of operation. Users who voluntarily agreed to participate were then given the state version of the State-Trait Anxiety Inventory Scale questionnaire (STAI-S) (Spielberger et al., 1970) and the Yesavage-15 questionnaire (Sheikh & Yesavage, 1986), in order to identify clinical indicators of anxiety and/or depression, which had been established as exclusion criteria. In addition, a short interview was conducted to collect sociodemographic information and to assess users' levels of experience with computers. Once they had signed the consent form, participants were given a password for accessing the Butler system; next, they attended both Universities once a week at their convenience to use the system. Users completed the VAS, STAI-S, EAG and LSUS questionnaires before and after each Butler session, and completed the LD and the two additional questions at the end of each session. At each session, they were received by a researcher who was then available in an adjoining room for any questions that the participants might have, while encouraging users to follow the instructions presented at each step by the Butler system.

3. Results

Repeated measured MANOVAs were applied to STAI-S, VAS, GMS and LSUS with two intra-subject factors: "time" (pre-post session) and "session" (first, second, third and fourth). A comparison of means and percentages was applied for the variables "level of difficulty" and the two additional questions, respectively. Descriptive statistics are shown in Table 1. MANOVAs results are shown in Table 2. Percentages are presented in Tables 3 and 4.

Regarding STAI-S, results show that, for all sessions, anxiety levels were significantly reduced after using the Butler system "time" effect was statistically significant. No significant differences for "sessions" or interaction effects between "time" and "session" were observed. (See Tables 1 and 2).

Regarding VAS, results show that levels of happiness and relaxation increased significantly in all sessions after the use of the Butler system (see Tables 1 and 2), and levels of sadness and anxiety decreased significantly in all sessions after using the Butler System (see Tables 1 and 2). In no case were significant differences between sessions or interaction effects observed.

Regarding GSM, results show that after using the Butler system, participants' positive mood levels increased significantly in all sessions (see Table 1). As in the above measures, no significant differences between sessions or interaction effects between the factors "time" × "session" were observed (see Table 1).

Concerning LSUS, results show that users' level of satisfaction with the system increased significantly in all sessions after using Butler system. There were no significant differences between sessions or interaction effects between the factors "time" × "session".

Concerning LD, results show that throughout the sessions the difficulty level was between "very easy" and "normal".

Regarding the question "Would you recommend the Butler system to others?", 100% of users (see Table 3) answered yes for all sessions; as for the question "Do you think that what you have learned today in the Butler system can be useful at other times in your life?", between 87.5% and 100% answered yes for all sessions (see Table 4).

4. Discussion

As mentioned above, an increase in life expectancy has transformed the world's demographics. Additionally, several studies show a high prevalence of depressive and anxious symptoms in this population; these symptoms are exacerbated by frequent feelings of isolation and

Table 2
Manovas results.

	Time			Session			Time × session		
	F	Sig.	μ	F	Sig.	μ	F	Sig.	μ
STAI-S	19.74	0.00	0.57	0.13	0.94	0.01	0.43	0.74	0.03
VAS									
Joy	11.35	0.00	0.42	1.41	0.25	0.08	0.61	0.61	0.04
Sadness	13.57	0.00	0.46	1.30	0.29	0.08	2.37	0.08	0.13
Relaxation	21.84	0.00	0.58	0.59	0.63	0.36	0.48	0.70	0.03
Anxiety	10.06	0.00	0.39	0.58	0.63	0.04	2.47	0.07	0.13
GMS	16.94	0.00	0.65	1.00	0.41	0.10	0.52	0.68	0.05
LSUS	19.23	0.00	0.68	0.23	0.87	0.03	0.16	0.92	0.02

Table 3
Responses to question #1 on system acceptability.

Would you recommend the Butler system to others?			
S1	S2	S3	S4
YES	YES	YES	YES
100%	100%	100%	100%

Table 4
Responses to question #2 on system acceptability.

Do you think that what you have learned today in the Butler system can be useful at other times in your life?							
S1		S2		S3		S4	
YES	NO	YES	NO	YES	NO	YES	NO
87.5%	12.5%	100%		94.1%	5.9%	100%	

loneliness. Several studies stress the advantages of bringing ICTs to the elderly: through them, the elderly can strengthen their social networks and feelings of self-efficacy while decreasing their feelings of isolation and loneliness (Karavidas et al., 2005; Marek van de Watering, 2005; Savolainen, Hanson, Magnusson, & Gustavsson, 2008.) ICTs can enable elderly people to participate more widely in society, and make it possible for them to connect with people who are similar to or different from them in experience and concerns (Blit-Cohen & Litwin, 2004). The Butler system was designed to promote key components for optimal aging, such as integration, communication, learning, socioemotional networks, and training in positive emotions (the last being the most critical for the mental health of elderly people, Avia & Vázquez, 1998), in order to improve their quality of life.

Regarding the system's efficacy at improving mood states and degree of acceptance, results from the present study show that the use of Butler system increases positive emotions (joy and relaxation) significantly, and satisfaction with the system in each session. Simultaneously, the STAI-S and negative emotion scores (sadness and anxiety) were significantly reduced every time participants used the system. Furthermore, this increase was maintained throughout subsequent sessions. Thus, as the Butler system is used, its efficacy does not decrease. On the contrary, users like and enjoy the system, and return for additional sessions.

Limitations of the study include sample size, the users' absence of anxiety disorders, depression or cognitive impairments and the fact that their profiles are not typical for the elderly population, as they were senior University students. For these reasons, the results should be carefully considered. It is necessary to extend the analysis to a larger number of sessions with more users. On the other hand, it is important to highlight that although the majority of our users were not familiar with computers nor with Butler's applications, they reported difficulty levels of very easy to normal throughout the sessions, no matter how many activities they performed. Additionally, all participants would recommend Butler to others and stated that what they had learned from the system could be useful at other times in their lives.

The Butler system was designed to improve the quality of life of the elderly population and to facilitate caregivers work. This study focused on the first goal. The first step in learning whether the system meets this goal was to assess it in a reduced sample and to explore its efficacy in improving mood state and acceptability in elder users. Next, it is necessary to explore the frequency and duration of the sessions that are required to improve quality of life. This study presents preliminary data, but further studies are needed that include more variables and will therefore determine if the system can improve elders' quality of life.

In summary, a system such as Butler can help reduce the technology gap between ICTs and the elderly population, and can be a useful resource for improving elderly mental health and preventing depression. Furthermore, such systems can facilitate protective activities, such as strengthening social networks, exercising emotional capabilities, learning new communication skills, strengthening the desire to keep learning new activities, and encouraging curiosity through developing new skills. Hence, further research is necessary to explore the efficacy of the Butler system at achieving its goals.

A video demonstration of the Butler system is available at: <http://www.labpsitec.uji.es/esp/multimedia/videosMYD.php>

Acknowledgements

This study was funded in part by Ministerio de Educación y Ciencia Spain, Projects Consolider-C (SEJ2006-14301/PSIC), "CIBER of Physiopathology of Obesity and Nutrition, an initiative of ISCIII" and Excellence Research Program PROMETEO (Generalitat Valenciana, Conselleria de Educación, 2008-157).

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