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Design Patterns to Enhance Accessibility and Use of Social Applications for Older Adults

Patrones de diseño para mejorar la accesibilidad y uso de aplicaciones sociales para adultos mayores

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Abstract

The aim of this paper is to present a non-exhaustive set of 36 design patterns for interactive social applications used by older adults. This proposal represents a reliable starting point for designers/developers to easily incorporate usability in interfaces for said technology promoting technology acceptance, use and adoption among older adults. The proposed patterns were based on previous efforts commonly presented as design criteria and guidelines to describe usability issues in this kind of interfaces, reinforcing those alternatives by specifying related usability issues and providing solutions in a pattern-fashion useful for designers/developers. Pertinence of the patterns was analyzed through a usability study implementing «heuristic evaluation» technique (frequently used in Human-Computer Interaction to obtain users' perception on a particular design). The study was conducted from two perspectives: the vantage point from experts, and the perception of a social group of older adults. The analysis revealed the proposed patterns are conducive to create well-designed interfaces able to provide a better user experience, encouraging a positive impact in the quality of life in older adults.

Resumen

El objetivo de este artículo fue proponer una colección no exhaustiva de 36 patrones para el diseño de interacciones en aplicaciones sociales para adultos mayores. La propuesta representa un punto de partida confiable para facilitar, a diseñadores/desarrolladores, la integración de usabilidad en las interfaces de estas tecnologías con el fin de fomentar su aceptación, uso y adopción entre los adultos mayores. Esta propuesta se basa en esfuerzos previos comúnmente expresados como criterios y guías de diseño para definir los posibles problemas de usabilidad en este tipo de interfaces, y se concentra en reforzar estos enfoques mediante la integración de una mayor descripción de tales anomalías y alternativas de solución bajo una estructura de patrones útil para los diseñadores/desarrolladores. Se realizó un estudio de usabilidad con la técnica «evaluación heurística» (comúnmente utilizada en interacción hombre-máquina para obtener la per-



cepción de los usuarios sobre un diseño particular). El trabajo se llevó a cabo desde dos perspectivas: el punto de vista de expertos técnicos y la percepción de un grupo social de adultos mayores. Los resultados reflejaron que los patrones propuestos propician la creación de interfaces bien diseñadas capaces de ofrecer una mejor experiencia de uso y promueven un impacto positivo en la calidad de vida de los adultos mayores.

Keywords / Palabras clave

Accessibility, usability, elder, digital divide, digital inclusion, social interaction, social networks, interaction patterns.

Accesibilidad, usabilidad, adultos, brecha digital, inclusión digital, interacción social, redes sociales, patrones de interacción.

1. Introduction

Social applications such as «Facebook», «Twitter», «Pinterest», or «Google+», allow easy communication, collaboration and social interaction among users and their friends and family and/or with third parties by establishing new relationships (Gomes & al., 2014). These technological tools fortify traditional communication channels by breaking down time and distance barriers. However, these tools have also created an increasing generational digital divide between young people and older adults, revealing different age groups based on their abilities to communicate through Information Technology (IT) tools (Muñoz & al., 2013). In this context, older adults are forced to interact with IT and face multiple obstacles derived from bad designs and aggravated by natural age-changes. In fact, older adults perceive web sites at least 43% more difficult to use than young people (Abad, 2014; Nielsen, 2013; Páez & al., 2011; Zaphiris, Kurniawan & Ghiawadwala, 2007). These barriers or obstacles represent a big challenge, but they also represent opportunities to respond questions such as -how could older adults take advantage from IT to improve their personal and/or social situation?- could these obstacles help identify specific needs, tasks and strategies to ensure user-friendly designs (Abad, 2014; Braun, 2013; Gomes & al., 2014; Patsoule & Koutsabasis, 2012). Easy-to-use designs for social applications are significantly important since these technologies can improve the quality of life of older adults by offering a better communication alternative with their loved ones, and thus reducing their loneliness and isolation (Agudo, Pacual & Fombona, 2012; Lian & Yen, 2014).

In fact, previous studies by the United Nations, such as «The World Population Aging» estimate that in 2050 more than 2 billion older adults will be using Internet, which represents a 300% (UN, 2013).

Inherently, more and more older adults will require social applications that would allow them to better communicate and become active, independent participants in a digital-society. This premise highlights the need to improve the current social applications' design (Agudo, Pacual & Fombona, 2012; Patsoule & Koutsabasis, 2012). The scientific community is also interested in providing older adults with multiple alternatives to increase the acceptance, use and adoption of technologies such as TAM «Technology Acceptance Model» (Davis, 1989; 1993), STAM «Senior Technology Acceptance Model» (Renaud & Van-Biljon, 2008), TRA «Theory of Reasoned Action», TPB «Theory of Planned Behavior» (Lian & Yen, 2014) y UTAUT «Unified Theory of Acceptance and Use of Technology» (Venkatesh & al., 2003). Other research studies analyze the utility, usability, social influence, and the accessibility of social networks in different scenarios and application domains (Lehtinen, Näsänen & Sarva, 2009; Yang & al., 2010).

The findings represent a base for technical approaches in terms of their principles, criteria and requirements to design adequate social applications for older adults (Gomes & al., 2014; Hope, Schwaba & Piper, 2014; Moreno & Martínez, 2012; Moser & al., 2011). Detailed proposals are available on the web as design guides (Ageligh, 2001; Kurniawan & Zaphiris, 2005; Zaphiris, Kurniawan & Ghiawadwala, 2007), and re-design guides for older adults (Patsoule & Koutsabasis,



2012), which integrate Universal Design Principles (Connell & al., 1997), User Centered Design, usability and web-design accessibility (Pernice & Nielsen, 2014), and guides for web-content accessibility such as W3C-WCAG 2.0 (Affonso & al., 2010; W3C, 2008). Several mobile tools have recently emerged to help older adults improve and increase their social relations (Muñoz & al., 2013).

The government, industry and society have been financing strategies in favor of older people by using Information Technology (IT) and social applications in fields like health, digital-literacy, web-services accessibility, among others (Garcia-Vazquez, Rodríguez & Andrade, 2009; Páez & al., 2011). However, most of the existing alternatives are not well specified making it difficult for designers/developers to understand and implement user-friendly designs. This, in turn, creates interfaces that are non-suitable for older adults (Arfaa & Wang, 2014; Gomes & al., 2014; Nesbitt, 2005). These issues could be overcome by providing better specified alternatives to reinforce interactions among users and available web-resources (Affonso & al., 2010). Design patterns represent a good strategy. Alexander cited by (van-Welie, van-der-Veer & Eliëns, 2000:4) defines a pattern as «a three-part rule, which expresses a relation between a certain context, a problem, and a solution», «each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over...». A pattern focuses on the context and can explain developers how, when, and why the solution could be applied (Van-Welie, Van-der-Veer & Eliëns, 2000:1).

This paper proposes 36 patterns to design interface interactions for social applications that are adequate for older adults and that integrate acceptance, usage and adoption factors, following an inclusive-user centered design strategy.

2. Research method

This study started with an extensive literature review of over 100+ related papers. A total of 6 proposals directly related with the objective of this research were selected by considering the advantages, disadvantages and general characteristics of each proposal. Selected proposals were classified into two categories:

a) Social interaction. Group studies that define accessibility barriers, use and adoption of TIC, web interfaces, and social applications for older adults, this category includes the following proposals.

- Study 1 (S1). «A Usability Study on Elder Adults Utilizing Social Networks Sites» (Arfaa & Wang, 2014). In this study were identified several usability, accessibility, design understanding, and navigability problems through a system prototype based on «Facebook».
- Study 2 (S2). «Age and Web Access: The Next Generation» (Hanson, 2009). State of the art work on the impact of aging people in the use of TIC; provides recommendations to reduce various cognitive, perceptual and motor barriers associated with aging and the use of technology.
- Study 3 (S3). «Designing a Facebook Interface for Senior Users» (Gomes & al., 2014). This presents recommendations for interfaces design for older adults after direct observation studies, focus group interviews with older adults after the use of a prototype of mobile social application.

b) Design guidelines. This gathers studies with principles, criteria and guidelines for the design and redesign of web interfaces for older adults, which includes the following:

- Study 4 (S4). «A Systematic Approach to the Development of Research-Based Web Design Guidelines for Older People» (Zaphiris & al., 2007). It presents 38 guides for design and evaluation of websites for the friendly aging.
- Study 5 (S5). «Improving WCAG for Elderly Web Accessibility» (Affonso & al., 2010). This proposes 30 criteria for web accessibility for older adults as reinforcing of standard WCAG 2.0 (W3C, 2008).
- Study 6 (S6). «Redesigning Web Sites for Older Adults: A Case Study» (Patsoule & Koutsabasis, 2012). This describes 7 principles and 45 web design guidelines for older adults derived from the redesign of a traditional website through user-centered approach.



From the previous 6 papers, barriers to the acceptance, use and adoption of TIC were identified (including social applications) for older adults, which were associated with the general accessibility criteria for people with physiological constraints (W3C, 2008). We selected 31 «fundamental design criteria for social applications used by older adults» (table 1).

Table 1. Fundamental design criteria for social applications used by older adults

CRITERIA	S1	S2	S3	S4	S5	S6
The interface design must be simple (limited number of options), consistent and predictable regarding how to perform the actions.	✓	✓	✓	✓	✓	✓
Language and textual content must be simple, clear, concise and easily legible.	✓	✓	✓	✓		✓
Information must be concentrated and mainly clustered in the center of the interface.	✓	✓		✓	✓	✓
Provide appropriate space between the interface elements (text lines, images, links, among others).	✓	✓		✓	✓	✓
Highlight specific information and important interface elements, such as: menus, links, and buttons, among others.	✓			✓	✓	✓
Avoid scrollbars if possible.	✓	✓		✓	✓	
Colors, textures, graphics and used contrasts in the user interface must be appropriate and not create distraction.	✓	✓		✓		✓
Appropriate feedback, clear and accurate to any change that occurs in user interface and navigation.				✓	✓	✓
Provide objects, graphics and large links.	✓	✓		✓		
Provide instructions and signals to improve navigation.	✓	✓		✓		
The drop-down menus in the interface must be displayed slowly (to provide enough time) to read information or be activated for users with low cognitive and motors skills.		✓		✓	✓	
Navigation must be simple, clear and consistent.	✓			✓		✓
Icons must be simple, meaningful, and intuitive (associated with real world objects).	✓			✓	✓	
Interactive elements must be perceived and understood without documentation.	✓					✓
Images and icons must be part of the selectable area (clickable) in links.	✓				✓	
The size of all web page elements must be adjustable (resizable) according to user's needs.		✓				✓
It must be possible to return to the homepage from all subpages in the application			✓		✓	
Provide online assistance (tutorial)	✓			✓		
Privacy (content publication)			✓			
Avoid double clicks on the interface.				✓		
Content and group-based functionality (friends and family).			✓			
Give more relevance to photos and images than other content.			✓			
Design must inspire trust.						✓
Interactions must be focused on the family.			✓			
Differentiate between interactive elements and those which are not.					✓	
The general design must be intuitive and aesthetic.	✓					
Avoid irrelevant information on the interface.				✓		
Graphics must be relevant to the displayed information and must not used for decoration purposes only, do not use animated graphics.				✓		
Add an appendix.	✓					
Consistent interface (do not update often).			✓			
Error messages must be simple and easy to understand.				✓		



The criteria presented in table 1 are the basis for identifying patterns, deriving a non-exhaustive collection of 36 patterns to design appropriate interactions for social applications for older adults. The process concludes with an evaluation of these patterns through an empirical study. The following sections describe the proposed classification, participant evaluations, and outcomes.

3. Proposal description

The classification of design patterns focuses on the integration of the design criteria presented in table 1, as well as usability principles, human computer-interaction (HCI), user-centered design; and communication and social interaction aspects. To order the integration of these aspects, the classification incorporates 4 dimensions with 11 design principles each, which in turn focuses on 36 specific patterns, see figure 1. The dimensions, principles and patterns of the proposed classification are described in the next subsections.

- Perceivable dimension: According to (W3C, 2008), «Information and user interface components must be presentable to users in ways they can perceive», this means, must be sorted properly and offer some form of feedback e.g. proper visual and auditory services for users. This dimension includes patterns related to: general arrangement of the interface elements; and perceivable feedback from environmental elements.
- Operable dimension: The (W3C, 2008) indicates that «user interface components and navigation must be operable for the user», that is, the user can do the tasks properly. This dimension includes criteria related to: suitable operation of the environment elements, simple, clear and consistent navigation; and operable feedback.
- Understandable dimension: In the same way (W3C, 2008) indicates that «information and the operation of user interface must be understandable», that is, interface elements must be accessible and easy to use. To achieve this, specific criteria and patterns must be included and related to: interface content and information; and understandable feedback of the environment elements.
- Social dimension: This dimension focuses on criteria and patterns related to: contact management; interaction with other people across the application; related content with social group and visualization of the activities to be performed by the social group.

3.1. Structure and definition of the interaction patterns proposed

The essence of the pattern concept is to «express knowledge in an orderly, accurate and complete manner » (Rodríguez, 2005). To keep this vision, the structure of the proposed patterns is based on the recommendations of (Van-Welie, Van-der-Veer & Eliëns, 2000:7) under the following headings: name, problem, usability principle; context; solution; example; and related patterns. In order to clarify the formal structure, the following section describes a fragment of the classification, including the pattern «Centering elements» of «Perceivable dimension», and the pattern «Group-based functionality» of «Social dimension». It is important to mention that the complete description of the classification (36 patterns) is available at (<http://goo.gl/KGsWjj>).

a) Pattern 1. Perceivable dimension: Environment conditioning.

- Name: Centering elements.

- Problem: What can be done for the information displayed in the interface to be presented properly and within an appropriate visual field to older adults?

- Usability principle: Consistency and standards.

- Context: The location and content quantity in a user interface is important for older adults; they prefer pooled information with few options as it prevents a cognitive barrier. According to Affonso and & (2010), adults focus their attention on the center of the screen and disregard the information provided in the lateral header and footer areas.

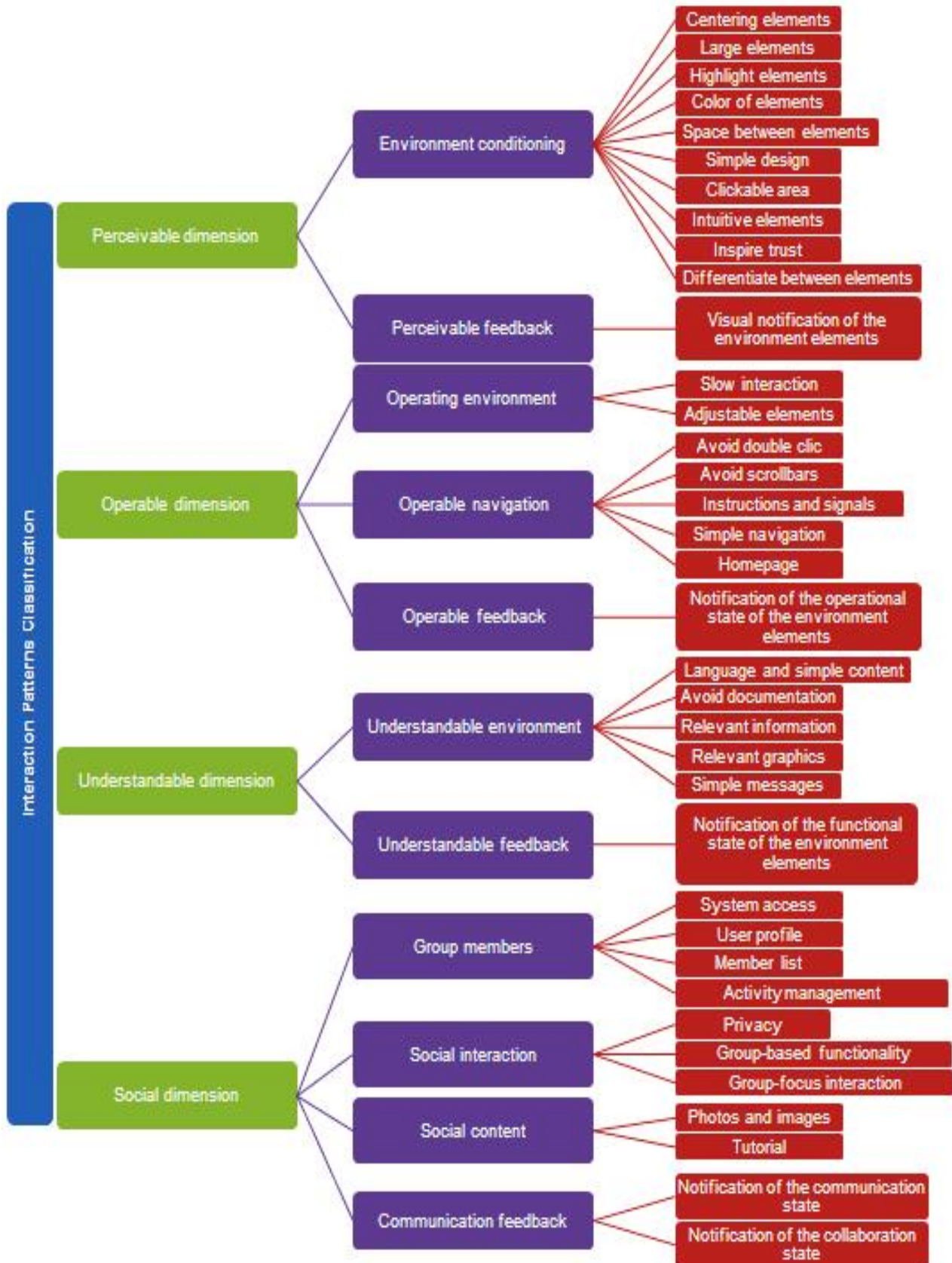


Figure 1. Interaction pattern classification.



- Solution: The user interface of social application for older adults must contain the essential elements needed and grouped in center of the screen; this will allow the older adult to visualize in a better way the area of interaction in the interface.
- Example: Figure 2a shows an example of web interface with information located in the center of the screen and figure 2b shows a mobile device interface with the interaction elements located in the central part of the screen.
- Related patterns: Simple design, simple navigation.
- a) Pattern 2. Social dimension - Social interaction
- Name: Group-based functionality.
- Problem: The functionality of current social networking services has a wide range of integrated services to interact between users, which represent an accessibility and use barrier for older adults.
- Usability principle: Mental models and metaphors.
- Context: Family is an essential factor for the older adults since it creates the communication and social interaction base group; social network services must provide the necessary tools for effective communication within this social group.
- Solution: The interaction elements of the interface must focus on the activities and tasks related to the circle of social interaction of older adult.
- Example: Figure 2c shows a desktop interface application with group-based functionality and figure 2d shows a mobile device interface, where the application elements target the communication and interaction needs of older adults.
- Related patterns: Privacy, group-focus interaction

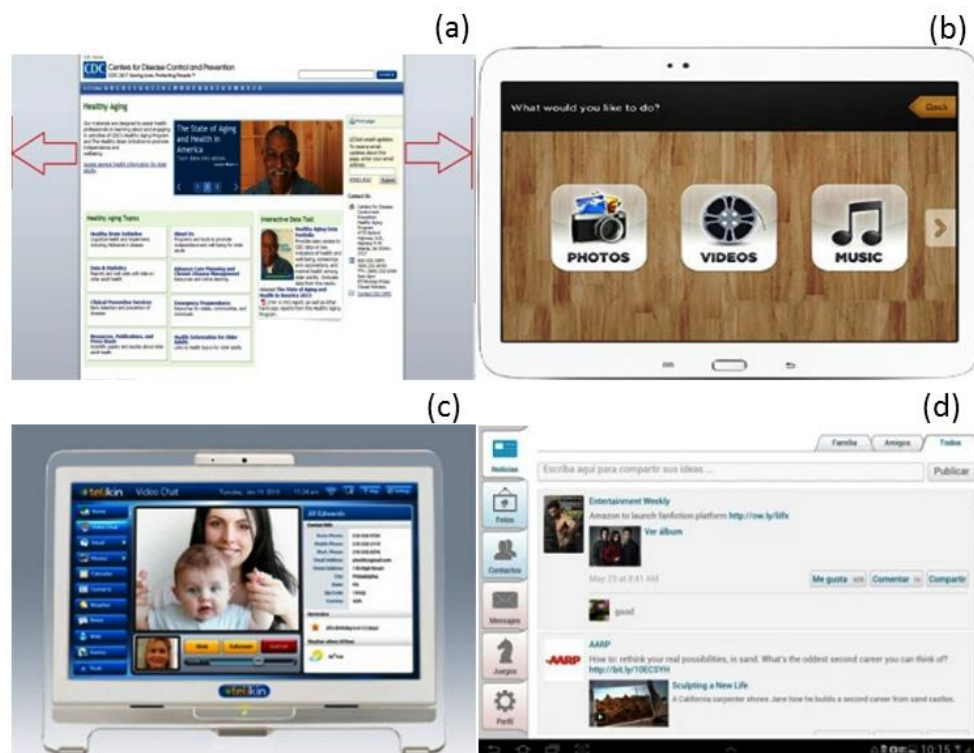


Figure 2. Ejemplos de interfaces de usuario, cortesía de: a) CDC, 2014; b) Kwido, 2014; c) Telikin, 2014; y d) EFA, 2013.

4. Test environment: Heuristic evaluation

Heuristic Evaluation (HE) is an inspection method commonly used in usability engineering to find usability problems in hardware and/or software user interfaces. HE could be performed by a small group (2-5 evaluators), and analyzes the level of accomplishment of specific usability/good-design



principles which are called «Heuristics» (Nielsen, 1993). This proposal was analyzed through a specific scenario using HE and considering the following case study:

a) Description: This proposal was evaluated from two perspectives «technical aspects» and «user experience» in order to obtain a representative starting point for developers to design social applications that provide a good user-experience for older adults. «Facebook for Older Adults, EF Social v.1.0» was selected as the mobile social application due to its popularity (Over 10,000 downloads reported), which is available at: (<http://goo.gl/ZkwKjR>).

b) Participants: A total of 70 individuals participated in the study, including 5 Research Professors or technical experts, internationally recognized for IHC and user experience (UX) (1 female and 4 males); 65 elders (54 mexican women and 11 men between the ages of 60 and 98), who are members of the «Golden Age» social group in the rural community Tlachichila, Nochistlán de Mejía (Zacatecas, México). This group was established in 2000 by the «Golden Age» members themselves with the purpose of promoting social integration and recreational activities, taking courses and workshops in diverse topics (including basic digital literacy), among other activities.

c) Methodology: Technical experts were provided with an overview of the study purpose and they were given a set of proposed patterns expressed in Heuristic fashion. The experts then individually evaluated the mobile social application «Facebook for Older Adults, EF Social v.1.0». The obtained feedback helped determinate the technical pertinence of the proposed technique. Subsequently 5 tasks and 9 sub-tasks were defined for the elders to complete. The results helped determine the level of experience of each user. The following list shows the set of tasks users were asked to perform.

- 1) Start the application: Click on the application icon to start (EF Social).
- 2) Identify the active elements of the User Interface (Interpreting Home page): Click on the option «Pictures»; Click on any photograph album.
- 3) Add a contact to the contact-list «Family»: Click on the option «Contacts»; Identify the «Assign group» button; Select the group «Family».
- 4) Write a comment to any family contact: Select a contact; Write a message.
- 5) Exit the application: Find the «Exit» button.

5. Results

The 5 technical experts analyzed «Facebook for Older Adults, EF Social v.1.0» by looking for potential interaction/usability issues and used the proposed 36-set of patterns/heuristics. They found several design flaws specifically related to the way that older adults could perceive the applications' interface. For example, inconsistencies with colors and shapes, as well as a lack of feedback were observed (section 3.1). In addition, experts observed some operability problems like the absence and/or limited accessibility of returning-option, cancel-option, and important options (like exit-option) (section 3.2). On the other hand, the application's feedback, on most of the interface elements, is limited and difficult to understand (section 3.3). Finally, expert participants found inconsistencies related to interaction-presentation, such as the double zone «clickable» to select a contact (section 3.4). Table 3 shows a fragment from the experts' perceptions including a brief description of the detected problem and the description of related pattern(s) that need to be solved.

PROBLEM	PATTERN/SOLUTION
1. The text «Please wait while loading...» is static, that is, the interface does not provide feedback that shows an activity in progress; and creates uncertainty to the user. This issue is aggravated by the length of time it may take to load the homepage.	Notification of the operational state of the environment elements.
2. The lighted color in the tabs does not allow to identify which of them is the entry/attention focus.	Color of elements. Intuitive elements. Differentiate between elements.



3. Using the text below each photo album creates two clickable areas for the same item.	Clickable area.
4. In most application interfaces, the data input box «Post something on the wall of my friend» uses a smaller «font» size than the rest of the App.	Large elements.
5. The button «publish» does not provide visual or auditory feedback when it is pressed, this happens with most buttons in different sections.	Visual notification of the environment elements.
6. The popup window to add a contact to a predetermined list, e.g. «Friends/Family», does not allow setbacks or cancellation action, forcing to select one of two options in the popup window to continue.	Simple navigation. Instructions and signal.
7. To exit the application the user must find the button «exit», which is located inside the tab «profile», leading to a higher cost of interaction for the user.	Simple design. Simple navigation.

Table 3 summarizes the findings from the perception of older adults after completion of scheduled tasks.

Table 3. Task list completed by older adults		
TASKS	%OF PARTICIPANTS WHO COMPLETED TASKS	
	YES	NO
1. Start the application.	72%	28%
2. Identify the active elements of the User Interface (Interpreting Home Page).	55%	45%
3. Add a contact to the contact-list «Family».	35%	65%
4. Write a comment to any family contact.	40%	60%
5. Exit the application.	15%	85%
*For a task to be considered «complete» all associated subtasks had to be completed.		

As shown in table 1, most tasks were not successfully completed and the current design of the App «EF Social» does not provide an adequate experience of use. Participants corroborated this finding during the final comment session.

«It was difficult for me to know what was happening when the application started, nothing moved, everything was blue; and it was difficult to read the white text », Mrs. Chávez, 75 year old (figure 3a).

«The color used in the tabs confused me because they were three colors: white, blue and gray; when I was able to access the photos I did not know if I should choose the image or text to enter to an album» Mr. Esparza, 67 year old (figure 3b).

«I wanted to add my nephew to my contacts but I could not read the text and the buttons were very small», Mrs. Pasillas, 81 years old (figure 3c).

«The text in the box was gray and I could not see it. I did not know if the message was sent», Mrs. Olmos 60 years old (figure 3c).

«I did not find the exit button» Mrs. Juárez 74 years old (figure 3d).

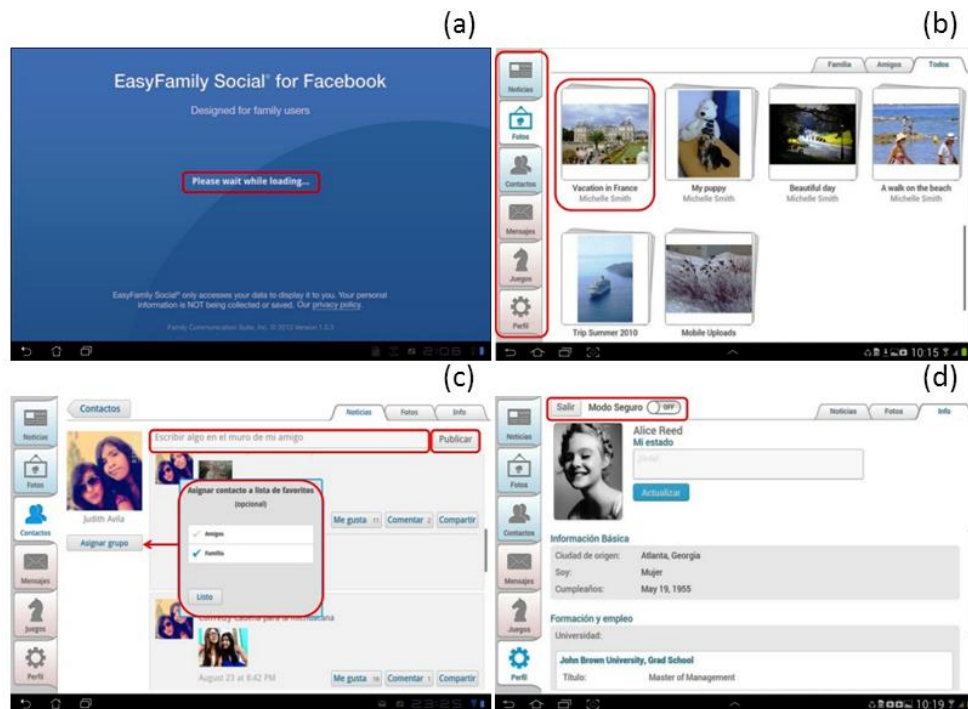


Figure 3 a), b), c), d). User interfaces of EF Social Application, courtesy (EFA, 2013).

6. Conclusions

This study reveals several design anomalies and controversies from the interaction offered by the application «Facebook for Older Adults, EF Social v.1.0» (<http://goo.gl/ZkwKjR>). Issues like design inconsistencies, small font sizes, low-fluent navigability, and low levels of control, were common barriers that participants face when interacting with EF Social. This situation prevented participants to adequately completing the assigned tasks (table 3).

It is important to mention that older adults' perception agrees with the experts' point of view (table 2). Table 3 shows that task 5 «Exit the application» had the biggest discrepancy between those participants who did not complete the task and those who did, 15% V.S. 85%, respectively. Additionally, experts pointed out that users needed to literally «guess» the location of the «Exit» bottom, which is hidden in the last option tab and, according to them, it should be visible at all times.

Undoubtedly, the identified issues reduce and/or prevent older adults' accessibility, use and adoption of this technology. Consequently, it is necessary to develop the necessary tools to close this technology-usability gap. As mentioned before, there are several available approaches to reduce this generational gap; however, they are barely applied by developers due to their poor specification that does not facilitates their implementation/development.

In this context, the proposed patterns could provide a basic but reliable starting-point for developers to create well-designed social applications for older adults that promote a better quality of life by facilitating interface communication with their loved ones.

Implementing the proposed patterns would improve the design of the interaction offered by social applications for older adults. Well-designed interaction could assist older adults in doing the things they care about, such as easily communicating with their loved ones, increasing their digital-society acceptance and integration by utilizing these technologies, and becoming independent from people to use information technology. Furthermore, the proposed strategy could also be implemented in a heuristic fashion not only to identify usability issues in current applications, but also to design/create new social applications. In addition, the study suggests that the proposed patterns could be suitable for other age-groups provided that potential adjustments to specific scenarios are considered. Existing literature on alternative patterns has not explore these aspects. As such, this



study contributes to academia by presenting a starting point to continue to develop the proposed patterns and subsequently improve technology usability among older adults.

Even though the results are promising, this research project is not intended to propose an alternative that accounts for all interaction preferences from older adults. It is important that future research understands and takes into account the heterogeneity of this age group that has multiple contextual-factors such as economic status, access to technology in their communities, among other aspects.

Several venues for future research have been unveiled, such as the materialization of the patterns through a digital mockup to be evaluated by means of the diary-study technique where would participate other older adults groups. New data could help to corroborate findings from current study.

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