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Accessibility and communicability on Facebook: A case study with Brazilian elderly

by Carolina Sacramento, Simone Bacellar Leal Ferreira, Eliane Pinheiro Capra, and Ana Cristina Bicharra Garcia

Abstract

Given the growth of the elderly population, it is essential that online social networks consider aspects of quality of use to address the unique needs of this audience. Unfortunately, networks, such as Facebook, have been designed largely for younger users, leading to challenges for the elderly in the use of their interfaces.

Some human–computer interaction (HCI) research has explored the usability and accessibility of Facebook and its functionalities, including for the elderly. However, there has not been a great deal of research exploring communicability of this social network Facebook for older users. This paper presents the results of a 2015 case study completed in Brazil, in which Facebook's accessibility and communicability for the elderly were analyzed. As a result of this research, checkpoints are presented to support designers in the construction of virtual spaces for social interaction.

Contents

1. Introduction

The world is aging rapidly. The world's elderly population has been growing at a rate of 3.26 percent a year (United Nations. Department of Economic and Social Affairs. Population Division, 2015). In Brazil, although the last population census conducted in 2010 indicated a population composed largely of young people and adults (Instituto Brasileiro de Geografia e Estatística (IBGE), 2010), it was estimated that the elderly would total 73.5 million people in 2060, representing 33.7 percent of Brazilians (Instituto Brasileiro de Geografia e Estatística (IBGE), 2013).

The possibilities brought about by the Internet have changed the way people relate socially. Online social networking systems facilitate interaction in contemporary society. They are used for various purposes, such as finding and establishing friendship bonds, conversing, sharing photos and videos, exchanging knowledge, among others (Meira, *et al.*, 2012).

Several studies have demonstrated the benefits of online social networks for the elderly (Morton and Genova, 2015; Sundar, *et al.*, 2011; Brunette, *et al.*, 2005). Among these benefits we highlight the reduction of social isolation and contributions to well-being and improvements in cognitive capacity. Particularly in Brazil, whose population is still young and with a large presence in social networks — it ranks fourth in the world in terms of numbers of Facebook users (Statista, 2018a; Facebook, 2015) — the usage of these spaces of interaction by the elderly represents an opportunity of generational integration and reduction of social isolation.

However, social networks systems (SNS) such as Facebook have been designed largely for younger users, so their interfaces bring some interaction challenges for the elderly (Graças, 2013; Sundar, *et al.*, 2011).

These challenges are not restricted to elderly uses of SNS. This audience has difficulties in interacting with technological artifacts in general because they belong to a generation born long before the

widespread dissemination of digital tools. Unlike younger people, the elderly need more time to learn how to manipulate and assimilate the operational aspects of technological devices (Kachar, 2010).

These restrictions often occur as consequence of low digital literacy faced by the elderly. They are caused essentially because of two different aspects: comprehension and operationalization. Comprehension means that the elderly may not interact properly with technologies because they don't understand the purposes of specific interfaces established by designers (communicability issues). Operationalization means that the elderly may have problems due to difficulties such as small font size, low color contrast, non-intuitive design, among others (usability and accessibility issues).

In order for the elderly to completely benefit from SNS, it is important to promote accessibility to these systems. It is also essential to ensure good communicability, allowing messages transmitted by a given designer through the interface (meta-communication) to be understood both in user-system interaction and in interactions between users of a given system (Prates, *et al.*, 2001). Improvements in SNS functionality will reduce potential disruptions in communication; failure to recognize and correct these problems will discourage the use of social networks by the elderly.

This research aimed to explore issues faced by the elderly when interacting with a specific SNS: Facebook, the most popular social network in Brazil (Statcounter, 2018) and the world (Statista, 2018b). Thus study resulted in some specific suggestions to assist interface developers and designers in creating new spaces for social interaction. We conducted evaluations of Facebook under two criteria: accessibility and communicability.

2. The Brazilian elderly and SNS

In Brazil, a person aged 60 or older is considered elderly, according to a law known as Statute of the Elderly (Brasil, 2003).

A survey, led by the Internet Governance Committee in Brazil (CGI.br) (*TIC Domicílios*), aimed at monitoring and evaluating the socioeconomic impact of information and communication technologies (ICTs) in Brazil, found that only 22 percent of people over 60 years old accessed the Internet at least once a day. Only 54 percent have used SNS (CGI.br, 2016). Figure 1 shows the percentages, by age group, of individuals accessing the Internet and Figure 2, individuals using SNS.

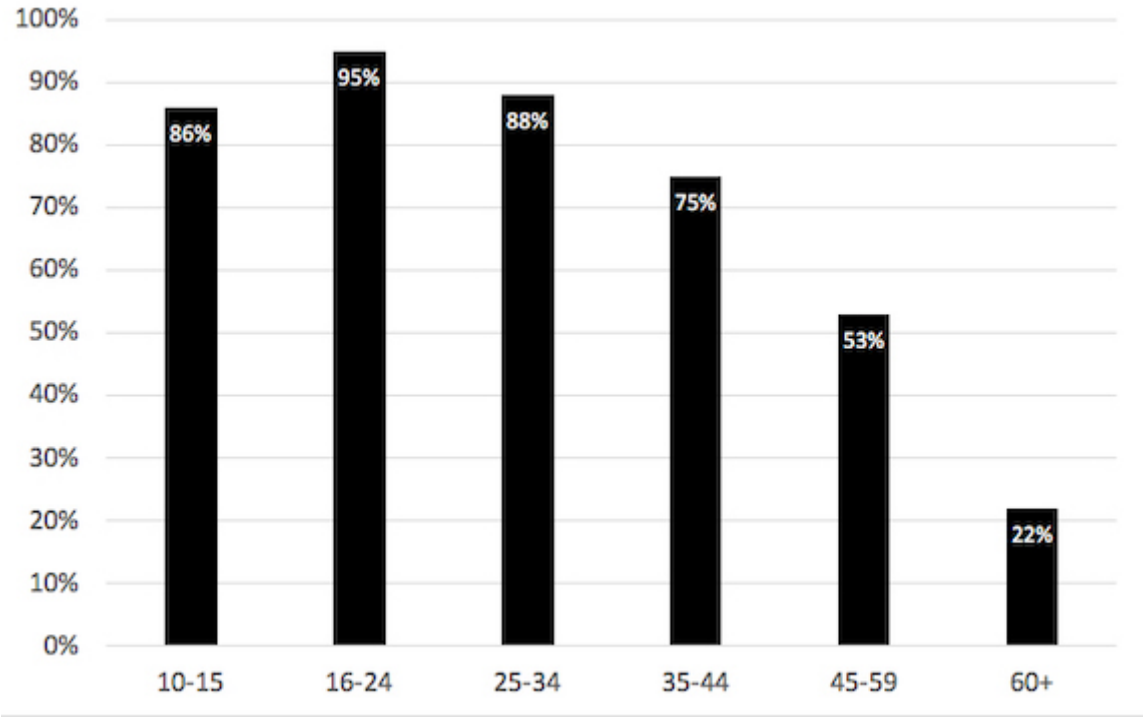

Figure 1: Percent of individuals accessing the Internet by age group. Source: CGI.br, 2016.

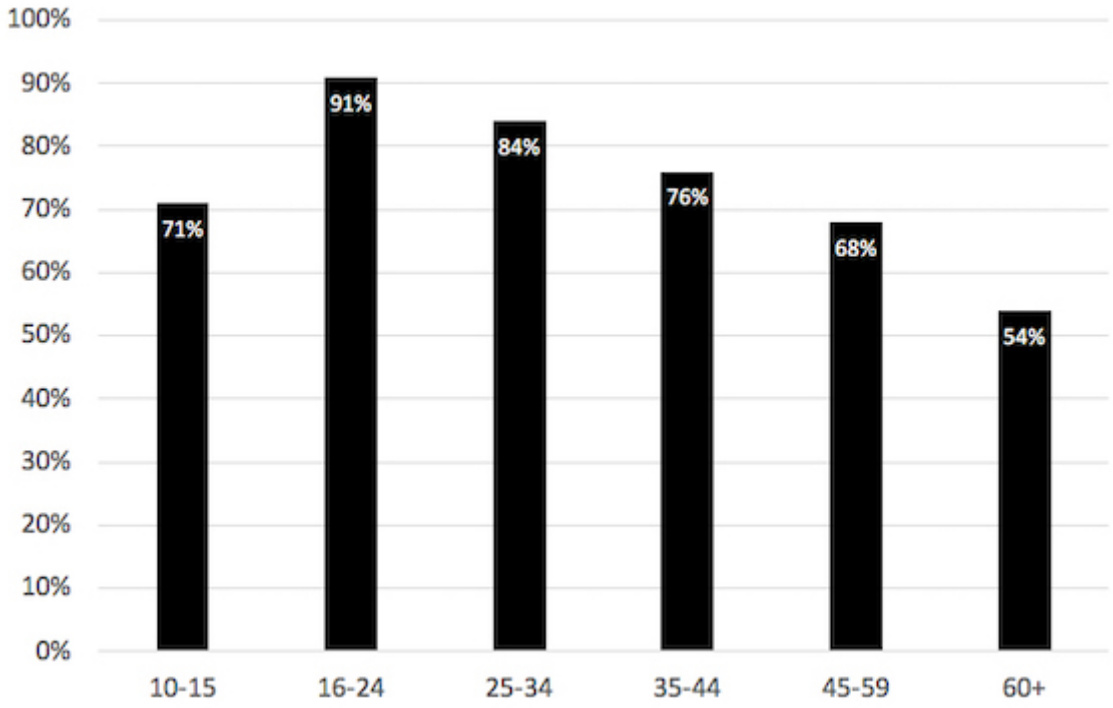

Figure 2: Percent of individuals using SNS by age groups. Source: CGI.br, 2016.

Even though CGI.br did not detail aspects such as frequency of use of SNS by the elderly, types of SNS most used or age range of the elderly (considering all generations over 60), there was an increase of 40 percent of SNS elderly participation compared to the first survey, conducted in 2006.

3. Web accessibility for the elderly

Accessibility is the possibility for anyone, regardless of their physical, motor, perceivable, cultural or social capacities, to enjoy life in society, that is, to participate in all activities, including those involving the use of products, services and information, with minimal restrictions (Associação Brasileira de Normas Técnicas (ABNT), 1994; Ferreira and Nunes, 2008).

The Web content accessibility guidelines (WCAG) are World Wide Web Consortium (W3C) recommendations which guide Web developers and content producers on how to create broadly accessible Web sites. WCAG's most recent version (2.1) is organized along principles, guidelines, success criteria and and advisory techniques (W3C, 2018).

Thinking specifically about the elderly, W3C created the WAI-AGE (Web accessibility initiative: Ageing education and harmonization) project. Among the results of the project is a tool directed to developers, created after an extensive review of the literature on the problems experienced by the elderly on the Web: "Web accessibility and older people: Meeting the needs of aging Web users" (https://www.w3.org/WAI/EO/Drafts/older-users). It is a set of accessibility guidelines for the development of Web sites that are inclusive of the elderly. These guidelines were developed using WCAG 2.0 recommendations and are thematically organized (W3C, 2010a).

Table 1 describes the themes proposed by WAI-AGE and the WCAG 2.0's associated success criteria.

Table 1: WAI-AGE themes. Source: W3C, 2010a.

WCAG principles	Themes	Associated WCAG success criteria
Perceivable information and user interface (*Perceivable*)	Text size	1.4.4
	Text style and text layout	1.4.8
	Color and contrast	1.4.1, 1.4.3, 1.4.6
	Multimedia	1.2.1, 1.2.2, 1.2.3, 1.2.4,

		1.2.5, 1.2.7, 1.2.8, 1.2.9, 1.4.7
	Text-to-speech (speech synthesis)	1.1.1, 1.3.1
	CAPTCHA	1.1.1
Operable user interface and navigation (*Operable*)	Links	2.4.4, 2.4.9, 2.4.7
	Navigation and location	2.4.5, 2.4.8, 2.4.2
	Mouse use	2.4.7, 3.3.2, 1.1.1, 1.4.4
	Keyboard use and tabbing	2.1.1, 2.1.2, 2.1.3, 2.4.1, 2.4.3, 2.4.7
	Distractions	2.2.2, 2.2.4, 1.4.2
	Sufficient time	2.2.1, 2.2.3, 2.2.2
Understandable information and user interface (*Understandable*)	Page organization	2.4.6, 2.4.10, 1.4.8
	Understandable language	3.1.3, 3.1.4, 3.1.5
	Consistent navigation and labeling	3.2.3, 3.2.4
	Pop-ups and new windows	3.2.1, 3.2.5
	Page refresh and updates	3.2.1, 3.2.2, 3.2.5
	Instructions and input assistance	3.3.2, 3.3.5, 3.2.4
	Error prevention and recovery for forms	3.3.4, 3.3.6, 3.3.1, 3.3.3
Robust content and reliable interpretation (*Robust*)	Older equipment/software	4.1.1

4. Communicability in collaborative systems

Semiotic engineering (SemEng) is a HCI theory based on semiotics, a science responsible for studying the phenomena of signification and the communication of signs — anything used by a person to communicate, such as words, images, sounds, etc. (Souza, 2005). This theory focuses on designer-user communication during interaction and considers that the interface of a system communicates to users a designer's vision of who users are, their wants and needs, why they use a given system and their preferences (Souza, 2005; Souza and Leitão, 2009).

Communicability is the main criterion of quality in a system, according to SemEng. It is considered a property that software has to convey to its users, in an efficient and effective way, the intention of a project (Prates and Barbosa, 2007).

In order to evaluate the communicability of an interface with user involvement, SemEng proposed the communicability evaluation method (CEM). It consists of user observations by specialists who analyze user interactions with a system and identify communication disruptions that occur during these activities. CEM was developed to evaluate communication between a design and users, from the specific perspective of the user, providing insights about how users understand messages sent by the designer through an interface (metacommunication).

CEM includes three main stages: 1) preparation, 2) application of tests and 3) analysis/interpretation of interactions (Prates, *et al.*, 2000; Souza, 2005; Souza and Leitão, 2009).

The first two stages are similar to those of other methods that include the participation of users (Bim, 2009), such as usability tests. The third is divided into three steps:

a. tagging, where researchers observe a given user, recording and identify moments in which communication disruptions occur (each disruption being tagged with one of 13 preset labels — "What's this?", "Where is it?", "Oops!", "I can't do it this way.", "Why doesn't it?", "What happened?", "Thanks, but no, thanks.", "I can do otherwise", "Looks fine to me.", "I give up.", "Help!", "What now?", "Where am I?", which represent a researcher's interpretation of behavior in context of an interaction).

b. interpretation: where the meaning of a set of tags is interpreted, based on the presence (or absence) of each of the tags, their frequency and distribution in different interaction contexts (and different user sessions), as well as the theoretical categorization of these tags based on SemEng, and

c. building of the semiotic profile, where the entire process is concluded, with an in-depth characterization of the reception of the meta-communication message (Souza and Leitão, 2009).

In collaborative systems, metacommunication must be expanded, taking into consideration interaction between users of a given system (Prates, *et al.*, 2001). The communicability evaluation method for collaborative systems (CEM-g) (Mattos, 2010) is an extension of the original CEM, considering the utilization of a system in overall interactions between a number of individuals, not just user-system interaction.

5. Related works

The use of social networks by the elderly has been examined in the literature from different perspectives.

Regarding the benefits of these networks for the elderly, Myhre (2013) pointed out that being part of Facebook can improve the cognitive capacity of those over 65 years of age by 25 percent; this research was based on the hypothesis that both learning new things and social relationships can help maintain the cognitive functions of the elderly. Morton and Genova (2015) concluded that social networks can help reduce the isolation of the elderly in society, stimulating cognition and increasing a sense of self-competence, as well as contributing to overall well-being and social inclusion. Other studies also showed that the use of systems such as Facebook increase well-being and life satisfaction for the elderly (Sundar, *et al.*, 2011), minimizing social isolation (Brunette, *et al.*, 2005).

Regarding the use of these spaces, Hope, *et al.* (2014) investigated how the elderly use social media (digital and physical). The authors completed semi-structured interviews with 22 elderly individuals between 71 and 92 years of age and tried to identify the reasons for non-use or minimal use of these media. They concluding their research with a set of design considerations for the development of future social media technologies that can be used effectively by those of the G.I. generation (also referred to as the World War II generation or the "Greatest generation", those born between 1901 and 1924).

Specifically on the production and sharing of digital content by the elderly, Waycott, *et al.* (2013) conducted a field study with seven participants aged 71 to 92. The participants were encouraged to produce digital content and share it with the remaining participants of the study for about three months. The findings indicated that the production of digital content by the elderly generated new social connections with a small community of peers. It also demonstrated a disposition of participants to share information, in spite of being considered members of the G.I. generation, a group rarely associated with the production and consumption of digital content.

Another work related to the use of social networks by the elderly, more specifically Facebook, was carried by Jung, *et al.* (2017). They addressed questions about how social networks meet the interactive and information-seeking needs of older people. This study focused on 46 elderly individuals with an average age of 80, using Facebook. Six reasons for utilizing this social network were discovered: keeping in contact with others; photo sharing; social interaction; answering family requests; convenience in communication; and curiosity.

As far as the interfaces of these systems is concerned, there have been many works related to the usability and accessibility of Facebook and its functionalities (Hart, *et al.*, 2008; Fox and Naidu, 2009; Boyd, *et al.*, 2012; Almeida and Carvalho, 2012), including for the elderly (Wagner, *et al.*, 2013; Graças, 2013). Among these efforts, we highlight Graças (2013), who developed a prototype version of Facebook for tablets designed for the elderly based on a series of direct observations, interviews and focus groups. Graças identified requirements for privacy, content and functionality as pointed out by the study's participants and designed interface aspects for tablet interactions.

Little research dealt specifically with Facebook's communicability. Carvalho, *et al.* (2012) and Souza, *et al.* (2012) explored the problems of communicability in Facebook's privacy and security settings with young users using CEM. Terto, *et al.* (2012) analyzed privacy settings with a communicability inspection method, emphasizing control and picture tagging removal tools.

Works which explored the application of CEM-g were found in even smaller numbers. Villela, *et al.* (2012) sought to consolidate CEM-g from the results of a case study conducted under the Research Gate social network. Dantas, *et al.* (2014) applied CEM-g in a three-dimensional distance education environment (Sloodle) in order to identify improvements in three-dimensional environments.

6. Methodological procedures

This study was performed during 2015, examining the accessibility of Facebook's interface by observing elderly and non-elderly adults interacting with Facebook, based on communicability evaluation.

The evaluation of the usability criterion was part of the scope of this paper. However this evaluation was not performed due to the existence of reference research in usability, such as Pernice, *et al.* (2013). Aspects that could be related to the social network present in Pernice, *et al.* (2013) and that were not part of the results were integrated into recommendations.

This research was organized in five stages: 1) Definition of the social network system and characteristics to be analyzed; 2) Definition of the accessibility and communicability evaluation methods; 3) Execution of the case study; 4) Triangulation of results obtained in the case study; and, 5) Elaboration of attention points to support the development of interfaces for social networks aimed at the elderly.

6.1. Definition of the social network system and characteristics to be analyzed

Facebook was chosen as the scope of this work, given its popularity in Brazil (Statcounter, 2018) and around the world (Statista, 2018b). Another aspect taken into consideration was the fact that social networks such as Facebook contribute to the health and well-being of elderly, according to Brunette, *et al.* (2005), Sundar, *et al.* (2011) and Myhre (2013).

Characteristics analyzed in this study included synchronous (chat) and asynchronous (sharing of information in another person's timeline) interpersonal communication as well as popular tools of the system ("liking" of a page).

6.2. Aspects of Facebook under study

Facebook's desktop interface was evaluated in this study since it was the most commonly used social network by Brazilian elderly, according to a survey (Comitê Gestor da Internet no Brasil, 2015).

6.3. Evaluation methods definition

The accessibility assessment sought to verify the compliance of Facebook's characteristics to international accessibility standards in a reduced version of WCAG 2.0, targeted the needs of the elderly, available on the WAI AGE project Web site (W3C, 2010a).

The choice of the communicability method took into account the analysis of the interface with user involvement from the point of view of SemEng in a collaborative context. For such, CEM-g (Mattos, 2010) was adopted.

6.4. Definition of target participants in case study

Participants in the case study were between 70 and 85 years old (elderly) and between 30 and 50 years old (non-elderly).

None of the participants had a computer science or information technology background, in order to avoid that any experience with computers and information systems might influence the results.

6.5. Research delimitations

The research was limited to the analysis of Facebook's accessibility and communicability.

The evaluation was restricted to Facebook's characteristics previously noted: synchronous communication (using chat), asynchronous communication (sharing of information in another person's timeline) and popular resources of the system ("liking" of a page).

The accessibility inspections were restricted to the pages and areas used in tasks proposed to a communicability test, utilizing a reduced version of WCAG 2.0 (as proposed in the WAI-AGE project).

The communicability evaluation was done with the participation of people with age range varying between 70 and 85 years old and between 30 and 50 years old. For the elderly, we choose this limit in order to consider only those retired and worked when professional activities relied on few or no digital technologies.

Regarding the choice of the age range of the non-elderly between 30 and 50 years old, this generation was considered transitional, not digital natives. To the contrary, during that generation's educational stage, research was done in libraries and papers were written by hand or with typewriters (Nicolaci-da-Costa and Pimentel, 2012).

6.6. Method limitations

CEM-g proposes that the tests should be conducted in a controlled environment (Mattos, 2010). This research followed this suggestion; however, to make participation of the elderly more flexible, a mobile laboratory was used. This allowed the tests to be performed at the homes or workplaces participants, but with controlled equipment, provided by researchers, with a built-in camera and software to record interaction.

In the accessibility evaluation, a generic checklist was adopted, encompassing Web content problems in general. Only recommendations that had an impact on or relation to the characteristics of Facebook being analyzed in this study were explored.

A limitation to the analysis of quality criteria was the presence of only one researcher during the inspection and observation of users.

7. Case study

The case study was developed from an analysis of both criteria of communicability and accessibility.

7.1. Communicability evaluation

The communicability evaluation was carried out with the application of CEM-g (Mattos, 2010), with the participation of five elderly people (aged 70–85) and five non-elderly adults (aged 30–50).

So as to maintain the anonymity of the volunteers, names have been encoded as I1, I2, I3, I4 and I5 (elderly) and J1, J2, J3, J4 and J5 (non-elderly). Table 2 describes profiles of participants.

Table 2: Profile of test participants.
Note: Experience graded on a Likert scale from 1 (little experience) to 5 (great deal of experience).

Id	Gender	Profession (before retirement)	Age	Experience with Facebook (Likert scale 1–5)	Experience with computers and systems (Likert scale 1–5)
I1	F	Housewife	72	3	3
I2	M	Serviceman	75	2	4
I3	F	Pastry chef	72	5	4
I4	F	English teacher	71	4	4
I5	F	Primary school teacher	84	3	3
J1	F	Caretaker for the elderly	35	3	3
J2	M	Public servant	45	2	3
J3	F	Administrator	42	1	4
J4	F	Public servant	33	2	3
J5	M	Economist	36	3	5

The participants performed tasks based on collaborative and popular Facebook actions such as chatting, sharing posts in someone else's timeline, and liking a page, as described in Table 3.

Table 3: Tasks for the communicability test.

Task	Description
1	Begin a chat session with a friend. Conversation ends when the friend says goodbye.
2	Access a friend's profile (it can be a husband/wife, son/daughter, grandchild, acquaintance), choose a publication you like best and share it with another friend.
3	Access the page of a celebrity, politician or public figure you admire and like this page.

The assessment followed steps proposed by CEM-g.

Tests were carried out by two researchers in the home or workplace of volunteers, with a mobile laboratory, consisting of a notebook with a webcam. Prior to the start of tasks, volunteers were oriented on procedures and asked to sign a consent form for ethical reasons. In addition, the participants answered a pre-test questionnaire, in order to identify their user profiles.

Participants performed tasks on their own Facebook profiles. Each task was read aloud by the observer-researcher at the beginning and repeated partially, as the user progressed in the execution of tasks. The partial repetition of the reading was made believing that the participants, especially older ones, would have a better understanding of what should be done if the information was gradually provided. This hypothesis considered the assertion that aging may lead to cognitive decline in short-term memory (W3C, 2010b). The objective of this approach was to ensure that the results were related to interface communication and not related to the test.

In most tests, two researchers were physically present: one in the role of observer and another conducting the chat. The second researcher, when possible, was in another room of the house or workplace of the participant. In four of the 10 sessions (two of each profile: elderly and non-elderly), the researcher responsible for conducting the chat acted remotely, due to incompatibilities in schedules. Because the task was a remote chat, this situation did not impact its execution.

After the test, an interview was conducted to record general impressions and main difficulties of participants.

7.1.1. Communicability evaluation results

The duration of the tasks was greater among the elderly, with an average of 18 minutes, against nine minutes among non-elderly (to conclude all tasks).

An aspect that might have influenced the length of tasks was the fact that the elderly type more slowly, looking at the keyboard. This situation not only affects task completion time, but it also prevents the immediate use of tools provided by the system, such as auto-complete or tagging and looking for friends and pages on the search field. This problem did not occur with any of the non-elderly participants. Although some of them did look at the keyboard while typing, they noticed that, after inserting a few letters, the system suggested friends for tagging.

A lack of dexterity while using the mouse, probably caused by decline in motor function, was also noticed during a test of three of the elderly, resulting in extra clicks of the mouse in order to reach an element on the interface or even to position the mouse cursor over an element. This did not create any ruptures in communication, only usability problems while interacting with the system and affecting task completion time.

As to the ruptures in communication, the elderly exhibited greater numbers: 158 ruptures, against 66 for the non-elderly. Table 4 presents the quantity of CEM tags obtained by elderly and non-elderly participants.

Table 4: Number of communicability disruptions.

	Tags	Elderly total	Non-elderly total
Temporary failures	Where is it?	21	8
	What happened?	27	8
	What now?	14	9
	Where am I?	2	0
	Oops!	6	4
	I can’t do it this way.	10	8
	What’s this?	49	10
	Help!	13	12
	Why doesn’t it?	3	2
Partial failures	Thanks, but no, thanks.	0	1
	I can do otherwise.	2	2
Complete failures	I give up.	4	2

	Looks fine to me.	7	0

To the elderly participants, most of the failures identified in tests were temporary, with the predominance of the "What's this?" tag (49 occurrences). The frequency of this label can indicate a lack of knowledge about the system as created by the designer. During the tests, participants tried to understand the meaning of icons and page elements by hovering the mouse over them, hoping to find clues that could help them. In some cases these tips were not available, denoting a lack of standardization in the interface, leading to disruptions of communicability.

The figures in this same tag among the non-elderly, although less expressive than the elderly, may indicate that even among non-elderly there were conflicts between the symbols adopted by the designer and those recognized by users.

When questioned about improvements that could be made to the social network in the post-test interview, all of the elderly and one non-elderly participant mentioned that Facebook's language doesn't favor intuition during interaction. The non-elderly adult (J2) who took the longest to conclude tasks and who generated the most "What's this?" tags (eight out of ten), declared: "[Facebook] could be more explicit. I'm not sure if it's the vocabulary, the word itself (...) It took me a while because I really had never seen it before and it wasn't very clear." The recognition of this difficulty in language comprehension for the elderly became evident when, during post-test, the researcher explained how the tasks should be done.

The second most frequent tag among the elderly was "What happened?" (27 occurrences), registered when the user seemed not to notice or not to understand what the interface had indicated. The occurrences of this tag were related to a difficulty in recognizing elements of the interface with low contrast and grayscale, which appear frequently.

Another frequent tag with older was "Where is it?" (21 occurrences), related, mostly, to difficulty in finding items on the interface.

Unlike the elderly, ruptures obtained by the non-elderly offered heterogenous results among participants. Participant J1's interaction generated 29 out of 66 ruptures of the non-elderly (about 44 percent of the total), while J5 didn't register any ruptures. Even though J1 had mentioned prior experience using Facebook and information systems as other participants, the fact that she did not use computers in her professional activities (as a caregiver of the elderly), might have influenced the difference in results compared to other participants in this profile, considering that all others utilize computers professionally.

As with the elderly, temporary failures were the most frequent among the non-elderly. However, in this profile, none of the tags reached more than 12 occurrences. The most frequent tags were: "Help!" (12 instances), "What's this?" (10 instances) and "What now?" (nine instances).

The "Help!" tag was used when a participant could not complete a task through the exploration of the interface and asked for clarification from the observing researcher. It is worth mentioning that Facebook's help wasn't used by any participant (elderly or not). Participant J1 was who generated the most "Help!" tags: nine out of 12 occurrences. The "Help!" tags came before or after the "What now?" tags, as the requests for help occurred in situations where participants were unsure of what to do and, as such, would wander the mouse cursor over the interface, trying to discover the next step. J1 was also who registered most "What now?" tags: seven out of nine occurrences. The remaining two tags were registered by participants J2 and J4.

The tags in the "complete failures" category, although in smaller number, are more serious than partial or temporary tags, since they represent a failure of communication (Prates and Barbosa, 2007).

There was a higher incidence of complete failures ("Looks fine to me" than "I give up"). This happened because some of the elderly participants felt they had reached the goal of the task, when in fact it had not happened.

7.2. Accessibility evaluation

In the review of the guidelines that characterized the accessibility evaluation, the pages present in the interaction of the elderly (in the communicability test) were inspected by a specialist regarding their compliance with the guidelines of the WAI-AGE project.

The inspection was carried out in five steps, detailed below.

In the *checklist creation*, the WAI-AGE orientations were filled in an electronic spreadsheet in checklist format, in order to facilitate the inspection of the pages being evaluated.

Definitions of parts of Facebook to be analyzed were limited to identifying those pages or areas in the interface that related to the three tasks proposed in the communicability test (chatting, sharing publications in someone else's timeline and liking a page). It included dynamic resources, allowing the same action to be carried out in different ways, making it necessary to use the CMN-GOMS (Card, Moran and Newell — Goals, operators, methods, and selection rules) (Card, *et al.*, 1983) model of task descriptions to support a process. As a result, a total of seven pages and 10 interface areas (dynamically activated features, example: search results) were identified.

In the stage of *analysis of Facebook's differences in the two evaluated periods*, we sought to identify changes in the social network's interface, given the seven-month interval between communicability and accessibility evaluations. To ensure compatible results between evaluations, interface areas that had

undergone modifications had their accessibility inspected from recordings made in the communicability test.

In the *checklist application*, each page or interface area was inspected. In this stage, themes were classified as "fully compliant", "partially compliant", "non-compliant" and "not applicable". In order for a theme to be considered "fully compliant", it should have had all success criteria tied to it met in the inspection; to be "partially compliant", it should have at least one criterion of success met; and for "non-compliant" no criteria of success. The "not applicable" classification was attributed to two themes: "CAPTCHA" and "outdated equipment/software" due to the first not being present in the pages/interface areas analyzed and the second not being part of the evaluation scope proposed in this research, since an automated analysis of Facebook's source code was not done.

The last stage was the *analysis of inspection results*, presented in the next section.

7.2.1. Accessibility evaluation results

Twelve of the 20 WAI-AGE themes were not met by Facebook's pages/areas of interface, revealing the social network's reduced accessibility to the elderly. Table 5 presents the results of the inspection organized into themes.

Table 5: Number of communicability disruptions.

WCAG principles	Themes	Results
Perceivable information and user interface	Text size	Non-compliant
	Text style and text layout	Non-compliant
	Color and contrast	Non-compliant
	Multimedia	Partially compliant
	Text-to-speech (speech synthesis)	Non-compliant
	CAPTCHA	Not applicable
Operable user interface and navigation	Links	Partially compliant
	Navigation and location	Non-compliant
	Mouse use	Non-compliant
	Keyboard use and tabbing	Partially compliant
	Distractions	Non-compliant
	Sufficient time	Non-compliant
Understandable information and user interface	Page organization	Non-compliant
	Understandable language	Non-compliant
	Consistent navigation and labeling	Non-compliant
	Pop-ups and new windows	Partially compliant
	Page refresh and updates	Fully compliant
	Instructions and input assistance	Non-compliant
	Error prevention and recovery for forms	Partially compliant

Robust content and reliable interpretation	Older equipment/software	Not applicable

Although some themes had been considered "Partially compliant" due to additional guidelines and accessibility features in Facebook's help center (Facebook, n.d.), the help is not contextual, causing accessibility problems.

Issues related to "comprehensible user interface and information," although present in the inspection, were difficult to identify, since they involved subjective conclusions regarding an understanding of the interface by a given user. In cases in which there were assessments of form requirements, complex sentences, unusual words and technical jargon, the analysis was restricted to aspects related to the lack of information regarding accepted file formats and sizes (in forms) and words in other languages or pertinent to Web features that would be unfamiliar to users in general and not necessarily just the elderly.

Aspects of interface comprehension were better explored in the communicability evaluation, as it analyzes the user's understanding of their interactions with the system and with other users. The triangulation of the results presented in the next section contributes to the connections of results obtained in the two evaluations undertaken in this study.

7.3. Triangulation of evaluation results

The methods used in the evaluations have distinct natures: while the CEM-g is based on semiotic theory, aiming to identify the quality of the system focusing on communicability, the inspection is referenced by practice, and seeks compliance with international standards of accessibility, where quality of use is related to the absence of barriers that prevent the elderly from using a given system.

Triangulation sought to relate the disruptions obtained in the tests with the elderly to the problems of accessibility in the inspection, allowing the identification of ruptures which could potentially have been avoided if the social network had been designed considering the Web accessibility standards of the W3C.

Several disruptions in communicability found in the test with the elderly had no direct association with accessibility problems. In some situations, the association was considered indirect, as the connection was perceived in comments in the post-test interview or analyzed as a possible association in other circumstances.

Ruptures categorized as temporary were those which presented greater convergence with the results of the accessibility inspection, although not all of them were directly related to WAI-AGE themes.

Table 6 illustrates the links (direct and indirect) between communicability tags and WAI-AGE themes. It should be emphasized that there is no intention to present all possible relations between disruptions and themes, only the direct and indirect results of the cross between test and inspection carried out in this research.

Table 6: Associations between WAI-AGE themes and disruptions obtained in tests.

WAI-AGE theme	Direct ruptures	Indirect ruptures
Text size	What happened? Oops!	—
Color and contrast	What happened? Where is it?	—
Links	What happened?	—
Navigation and location	—	I can't do it this way I can do otherwise I give up Looks fine to me What now? Where is it?
Mouse use	What happened?	—
Page organization	—	I can't do it this way I can do otherwise I give up

		Looks fine to me Where is it? What now?
Understandable language	What's this?	Where is it? What happened? What now? Where am I? Oops! I can't do it this way Help! Why doesn't it? Thanks, but no, thanks I can do otherwise I give up Looks fine to me
Consistent navigation and labeling	What's this? Where is it? What now?	I can't do it this way I can do otherwise I give up Looks fine to me
Instructions and input assistance	—	What happened?

8. Checkpoints for designing inclusive social networks for the elderly

The checkpoints were organized according to the WAI-AGE principles:

I. Noticeable information and user interface
II. Operable user interface and navigation
III. Comprehensible information and user interface

In order to facilitate the understanding of which checkpoints were developed from this case study, the following identifications will be presented in Tables 7, 8 and 9:

1. CS: Recommendations obtained in the case study;
2. WAI-AGE: Only WAI-AGE's accessibility recommendations
3. NNG: Nielsen Norman Group's usability recommendations

Table 7: Checkpoints: "Noticeable information and user interface" principle.

Checkpoint	Origin of the checkpoint identification
1. Provide legible texts Ensure that the font size is at least 12 points, using relative units (for example: % — percent) in the encoding and giving preference to non-serif fonts and nonjustified alignment.	NNG WAI-AGE
2. Provide tools for content enlargement The interface should allow the user to enlarge the content (textual or image) by up to 200 percent, without losing focus, content or functionality and in a direct way, that is, without the user knowing in advance the intrinsic resources of the browser or operating system.	CS
3. Avoid color based information Avoid using color as the only visual medium to convey information, indicate a system	CS

action/status, request response or distinguish a visual element.	
4. Use adequate contrast between foreground and background Use foreground and background colors with appropriate contrast in both the texts and symbols of the interface, as well as the focus of the mouse or keyboard. Appropriate contrast ratio values should be at least 4.5:1 for full-size text (up to 18 points without bold letters or up to 14 points in bold letters) and 3:1 for large texts (starting from the sizes indicated above). For a more comfortable reading experience, the WAI-AGE recommends a contrast ratio of 7:1 for normal and 4.5:1 for large texts.	CS
5. Use enlarged spacing between lines and paragraphs Use (main) line spacing of at least one and a half in paragraphs and spacing between paragraphs (where appropriate) of at least 1.5 times larger than line spacing for easier reading.	WAI-AGE
6. Encourage and allow accessible multimedia content to be sent Encourage the uploading of audiovisual content with subtitles and audio description by all users of the social network, providing guidelines on how to do it in the video submission window (contextual help) and provide mechanisms that allow the uploading of this type of resource.	CS
7. Support the use of speech synthesizers Some elderly people can use speech synthesizers when interacting on social networks, so it is essential that the interface meets some basic and fundamental requirements for the access to content through these types of software to be ample, such as to provide (and guide users about the importance of an existing) alternative textual equivalent for nontextual content (*i.e.*, alternative texts in images) and provide keys to access the main features and mechanisms that allow users to ignore blocks of content.	WAI-AGE

Table 8: Checkpoints: "Operable user interface and navigation" principle.

Checkpoint	Origin of the checkpoint identification
1. Present search results organization criteria The lack of organization criteria on pages with information that can be queried by users (for example, a friend list) can affect the time it takes for the user to complete such a query or even cause him or her to drop the procedure. In this sense, it is essential that the results can be visualized with some type of organization (alphabetical, chronological, degree of kinship, among others).	CS
2. Allow users to research all available content To facilitate the retrieval of information by	CS

users, it is important that all of the social network's content (including all publications) can be searched not only for an annual period, but also for more specific dates, subject, person responsible for the publication, among others.	
3. Provide localization mechanisms which allow users to identify where they are Although social networks are not composed of a large set of pages, such as traditional Web sites, it is important that the pages/areas of the interface are identified by titles that reinforce their functionality and allow the elderly user to easily identify where they are.	CS
4. Visible keyboard or mouse focus Any keyboard-operable interface must have the visible indication of keyboard focus. When the mouse is used, it is critical that links or form controls get highlighted when users mouse over them. The colors used in the focus highlight should meet the specifications of Recommendation 4 of the "Perceivable information and user interface" category.	CS
5. Differentiate between simple text and links In order to facilitate the visual identification of links by the elderly, it is important to distinguish them from simple texts. Suggested specifications are bold, underlined and blue colored text for unvisited links and bold, underlined and purple colored text for visited links.	NNG
6. Create links with larger clickable area and space between them and other clickable items To avoid further "clicks" on the mouse to reach an interface element or even delay to position the cursor on an element, it is important that the links have wider clickable areas. Similarly, to prevent the user from accidentally accessing the wrong link, it is critical to consider a space between the link and other clickable elements positioned next to it.	CS
7. Support keyboard navigation If the user chooses to use the keyboard to navigate the social network, the following premises must be true: • All content functionality must be keyboard operable without requiring specific typing timings; • There should be no keyboard locking situations, that is, the user can enter and exit a page component from the keyboard only; • Mechanisms must be in place to ignore blocks of content that are repeated on several Web pages; • a Web page can be navigated sequentially and navigation sequence affect meaning or operation, the components that can be focused are done so in an order that preserves meaning and operability. The interface should provide shortcut keys to the main system features (as well as clear guidelines on how to use them) to improve the browsing experience.	WAI-AGE
8. Provide labels or instructions in data	CS

entry It is essential that the social network provides labels or instructions to the user when the content requires data entry. This aspect will make it easier for the elderly to see where the cursor should be positioned to start typing texts (when the interaction is done from pointing devices like a mouse or touchpad).	
9. Allow users to turn off notifications which provoke interruptions in the interactions The social network should allow the user to disable visual and sound notifications that can be distracting during the interaction and thus disrupt the metacommunication process.	CS
10. Cautiously provide instant features It is critical that the designer, by providing instant functionality such as tagging features, for example, is careful with the timing and operation of the feature, keeping in mind that a senior user may not interpret the result at the same speed as a younger user.	CS
11. Avoid page refreshing without the consent of the user Prevent content updates from loading automatically, as seniors may lose content that is updated automatically or be confused by the change (this will be detailed in Recommendation 5 in the "Understandable user information and interface" category).	WAI-AGE

Table 9: Checkpoints: "Comprehensible information and user interface" principle.

Recommendation	Origin of the checkpoint identification
1. Avoid the use of unusual words Unusual words such as expressions in other languages, technical jargon, Web terms, slang and neologisms should be avoided. If this is not possible, provide the interface with mechanisms that provide definitions of these words and/or synonyms in objective and educational language. As much of the content in social networks are provided by other users, it is important that the interface has some mechanism that guides users about cultural differences that may exist in these virtual environments in order to allow interactions between a great diversity of generations.	CS
2. Provide and orient users on the importance of providing the meaning of abbreviations The interface should provide the meaning of acronyms and other abbreviations when these are part of its signs and guide users on the importance of providing the meaning of abbreviations in the content created by them.	CS
3. Provide textual information next to non-textual icons and buttons Provide in the interface icons and buttons with clear textual definitions of the meaning of the elements for the users, preferentially arranging them with visible labels. If it is	CS

not possible to provide textual information, the icons and buttons should contain tooltips in objective language (without unusual words — following Recommendation 1 from this category), with clear guidelines of what they do as well as standardization of the texts used on all pages/interface areas (according to the following Recommendation 4 of this category).	
4. Provide consistent navigation and labeling Titles and other headers used in interface pages/areas, as well as element labels (icons, buttons, or data entry) and instructional texts (including guidelines for submitting information on forms) must be consistent throughout the interface to avoid difficulties in establishing connections between the elements during the meta-communication process.	CS
5. Avoid alterations in contexts, page content and automatically opening new tabs when a new element is in focus When an interface component receives focus, context changes, content update, and automatic opening of new windows should be avoided, otherwise the elderly may become confused or distracted during the meta-communication process. Any change must be initiated only at the request of the user, or the interface must provide mechanisms to disable automatic changes.	CS
6. Facilitate access to help features The help resource should be easily accessible to the user, preferably close to the corresponding elements (contextual help).	CS
7. Provide feedback whenever there is Internet connection dropout Elderly people may not realize that Internet connection failures are compromising their communication with the social network, so it is fundamental that the interface provides feedback that guides the user in this sense.	CS
8. Act in the prevention and recovery of mistakes in forms Pages/areas of the interface that require the submission of information must satisfy at least one of the following statements: 1) submissions are reversible; 2) the data entered by the user is checked for input errors and the user is offered an opportunity to correct them; and 3) a mechanism is available to review, confirm and correct information before submission is completed. It is also fundamental to identify the interface elements related to the error, to provide clear descriptions of the problem and to suggest correction, if known. If possible, the designer should develop mechanisms that correct the error for the user.	WAI-AGE NNG

9. Conclusion

This research aimed to reduce the broad scope of accessibility recommendations proposed by WAI-AGE (W3C, 2010a) and usability recommendations in "Senior citizens (ages 65 and older) on the Web" (Pernice, *et al.*, 2013) with results obtained in this case study. The results could facilitate designers of

social networks in the creation of inclusive solutions for the elderly, incorporating aspects of communicability.

The results revealed considerable differences between the elderly and the non-elderly in the amount of communicability disruptions found, incidence of complete failures and task performance time. One of the major differences is related to the language used by these two groups, given the amount of "What's this?" tags present in the elderly interactions, encountering difficulties understanding signs and icons in the interface.

Aspects related to accessibility, such as font size and low contrast, among others, also contributed to many disruptions of communicability for the elderly, which reinforced the importance of accessibility inspection completed in sequential fashion.

The accessibility evaluation, in turn, confirmed some of the findings of the communicability test, since 60 percent of the WAI-AGE themes used as reference in the assessment were not met by Facebook's interface, revealing the need for accessibility improvements for the elderly. The evaluation also revealed a connection between WAI-AGE themes in the problems encountered. In some situations, problems occurring in one theme ended up affecting others, which may suggest that the correction of problems related to some themes may be more urgent than others.

Issues related to WAI-AGE's "comprehensible information and user interface" themes, although present in the accessibility inspection, identify very superficial aspects of user comprehension, being restricted to form requirements, complex sentences, unusual words and technical jargon, but not to an understanding of an interactive system, which reflects the importance of a joint communicability assessment.

Although the proposed assessments had different natures: communicability is based on semiotic theory and accessibility in standards compliance, some results could be contrasted, revealing that not following accessibility guidelines may affect a designer's ability to fully achieve meta-communication with users.

One of the main contributions of this research is to increase knowledge in the HCI community about the accessibility and communicability needs of the elderly in social networks. Thus study is based on the comparison of elderly interactions with those of non-elderly users. The construction of these environments should consider intergenerational aspects, related to behaviors, values and styles of communication.

The proposed checkpoints could support designers in the creation of new spaces for social interaction, as even if this research was focused on a specific social network.

About the authors

Carolina Sacramento is a Ph.D. student in informatics at the Federal University of Rio de Janeiro State (UNIRIO). She holds a Master's in informatics, and is a researcher at the Accessibility and Usability Center (NAU — UNIRIO) and also works as Web developer at the Oswaldo Cruz Foundation (Fiocruz). Her areas of interest include human-computer interaction, accessibility and information systems.
E-mail: carolina [dot] sacramento [at] fiocruz [dot] br

Simone Bacellar Leal Ferreira is Associate Professor of Information Systems in the Department of Applied Informatics of the Federal University of Rio de Janeiro State (UNIRIO); She is the founder and coordinator of the Accessibility and Usability Center (NAU — UNIRIO). She holds a Ph.D. in computer science and a Master's in computer science from the Pontifical Catholic University of Rio de Janeiro (PUC Rio) as well as Bachelor's in oceanography, from the University of Rio de Janeiro State — UERJ. Her areas of work and interest include human-computer interaction, information systems and use of colors.
E-mail: simone [at] uniriotec [dot] br

Eliane Pinheiro Capra is a Ph.D. student in informatics at the Federal University of Rio de Janeiro State (UNIRIO). She holds a Master's in informatics, and is a researcher at the Accessibility and Usability Center (NAU — UNIRIO) and a reviewer for the Brazilian Symposium on Information Technology (SBTI) and the Brazilian Symposium on Information Systems (SBSI). She is an IT analyst at the Social Security Information and Technology Company (DATAPREV) in Rio de Janeiro. Her areas of interest include accessibility, usability and functional illiteracy.
E-mail: eliane.capra [at] uniriotec [dot] br

Ana Cristina Bicharra Garcia is Professor of Information Systems in the Department of Applied Informatics of the Federal University of Rio de Janeiro State (UNIRIO). She completed postdoctoral fellowships in 2002 at Stanford University and in 2013 at the MIT Sloan School of Management. She holds a Ph.D. in computer-aided civil engineering and a Master's in computer-aided civil engineering from Stanford University as well as a Bachelor's in civil engineering from the Federal University of Rio de Janeiro. Her areas of work and interest include artificial intelligence, collective intelligence, environmental intelligence, and human-computer interaction.
E-mail: cristina [dot] bicharra [at] uniriotec [dot] br

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References

Rosana Coelho de Almeida and Alan Henrique Pardo de Carvalho, 2012. "Análise sobre o Website Facebook do Ponto de Vista da Acessibilidade," *FaSCi-Tech*, volume 1, number 6, at https://www.fatecsaocaetano.edu.br/fascitech/index.php/fascitech/article/view/69, accessed 23 December 2018.

Associação Brasileira de Normas Técnicas (ABNT), 1994. *NBR 9050: Acessibilidade de pessoas portadoras de deficiências a edificações, espaço, mobiliário e equipamentos urbanos*. Rio de Janeiro: ABNT.

Silvia Amélia Bim, 2009. "Obstáculos ao ensino dos métodos de avaliação da Engenharia Semiótica," Tese de Doutorado, Pontifica Catholic University of Rio de Janeiro (PUC-Rio) (13 August).
doi: https://doi.org/10.17771/PUCRio.acad.15340, accessed 23 December 2018.

Kyle Boyd, Chris Nugent, Mark Donnelly, Roy Sterritt and Raymond Bond, 2012. "A usability protocol for evaluating online social networks," In: Mark Donnelly, Cristiano Paggetti, Chris Nugent and Mounir Mokhtari (editors). *Impact analysis of solutions for chronic disease prevention and management*. *Lecture Notes in Computer Science* , volume 7251. Berlin: Springer, pp. 222–l225.
doi: https://doi.org/10.1007/978-3-642-30779-9_30, accessed 25 July 2016.

Brasil, 2003. "Estatuto do Idoso. Lei n° 10.741, de 1 de outubro de 2003," at http://www.planalto.gov.br/ccivil_03/LEIS/2003/L10.741.htm, accessed 23 December 2016.

Kynthia Brunette, Matthew Eisenstadt, Erik Pukinskis and William Ryan, 2005. "Meeteetse: Social well-being through place attachment," *CHI EA '05: CHI '05 Extended Abstracts on Human Factors in Computing Systems*, pp. 2,065–2,069.
doi: https://doi.org/10.1145/1056808.1057100, accessed 7 October 2017.

Stuart K. Card, Thomas P. Moran and Allen Newell, 1983. *The psychology of human-computer interaction*. Hillsdale, N.J.: L. Erlbaum Associates.

Juliano De Carvalho, Felipe Lammel, Janaína Da Silva, Lucélia Chipeaux and Milene Silveira, 2012. "Inspeção semiótica e avaliação de comunicabilidade: Identificando falhas de comunicabilidade sobre as configurações de privacidade do Facebook," *IHC '12: Companion Proceedings of the 11th Brazilian Symposium on Human Factors in Computing Systems*, pp. 73–74.

CGI.br, 2016. "TIC Domicílios," at http://cetic.br/pesquisa/domicilios/, accessed 2 January 2018.

Comitê Gestor da Internet no Brasil, 2015. "TIC Domicílios 2014," at http://cetic.br/media/docs/publicacoes/2/TIC_Domicilios_2014_livro_eletronico.pdf, accessed 7 July 2017.

Adriana Dantas, David Lima, Thais Castro, Lucilene Maciel, Isomar Lima and Antônio Neto, 2014. "Avaliação de comunicabilidade em ambientes colaborativos Tridimensionais: Estudo de caso no Sloodle," *Eleventh Brazilian Symposium of Collaborative Systems*, pp. 85–93.

Facebook, 2015. "45% da população brasileira acessa o Facebook mensalmente" (20 March), at https://www.facebook.com/business/news/BR-45-da-populacao-brasileira-acessa-o-Facebook-pelo-menos-uma-vez-ao-mes, accessed 25 July 2017.

Facebook, n.d. "Accessibility for people with disabilities," at https://www.facebook.com/help/141636465971794/, accessed 7 July 2017.

Simone Bacellar Leal Ferreira and Ricardo Rodrigues Nunes, 2008. *E-Usabilidade*. Rio de Janeiro: LTC.

Doug Fox and Shiva Naidu, 2009. "Usability evaluation of three social networking sites," *Usability News*, volume 11, number 1.

Gonçalo Gomes da Silva Santos das Graças, 2013. "3G Facebook: social networks for the elderly," *Dissertações de Mestrado, Universidade de Lisboa*, at http://hdl.handle.net/10451/9457, accessed 23 December 2018.

Jennefer Hart, Charlene Ridley, Faisal Taher, Corina Sas and Alan Dix, 2008. "Exploring the Facebook experience: A new approach to usability," *NordiCHI '08: Proceedings of the Fifth Nordic Conference on Human-Computer Interaction: Building Bridges*, pp. 471–474.
doi: https://doi.org/10.1145/1463160.1463222, accessed 25 July 2017.

Alexis Hope, Ted Schwaba and Anne Marie Piper, 2014. "Understanding digital and material social communications for older adults," *CHI '14: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pp. 3,903–3,912.
doi: https://doi.org/10.1145/2556288.2557133, accessed 6 August 2017.

Instituto Brasileiro de Geografia e Estatística (IBGE), 2013. "Projeção da População do Brasil por sexo e idade: 2000–2060," at https://ww2.ibge.gov.br/home/estatistica/populacao/projecao_da_populacao/2013/, accessed 7 July 2017.

Instituto Brasileiro de Geografia e Estatística (IBGE), 2010. "Distribuição da população por sexo, segundo os grupos de idade," at https://censo2010.ibge.gov.br/sinopse/index.php?dados=12, accessed 23 December 2018.

Eun Hwa Jung, Justin Walden, Ariel Celeste Johnson and S. Shyam Sundar, 2017. "Social networking in the aging context: Why older adults use or avoid Facebook," *Telematics and Informatics*, volume 34,

number 7, pp. 1,071–1,080.
doi: https://doi.org/10.1016/j.tele.2017.04.015, accessed 6 August 2017.

Vitória Kachar, 2010. "Envelhecimento e perspectivas de inclusão digital," *Revista Kairós Gerontologia*, volume 13, number 2, pp. 131–147, and at https://revistas.pucsp.br/index.php/kairos/article/view/5371/3851, accessed 2 January 2018.

Bernardo Augusto Maciel Mattos, 2010. "Uma Extensão do Método de Avaliação de Comunicabilidade para Sistemas Colaborativos," dissertação, Universidade Federal de Minas Gerais, at https://www.dcc.ufmg.br/pos/cursos/defesas/1204M.PDF, accessed 23 December 2018.

Silvio Romero de Lemos Meira, Ricardo de Araújo Costa, Paulyne Matthews Jucá and Edeilson Milhomem da Silva, 2012. "Redes sociais," In: Mariano Pimentel and Hugo Fuks (editors). *Sistemas colaborativos*. Rio de Janeiro: Elsevier, pp. 69–80.

Thomas Morton and Angela Genova, 2015. "Ages 2.0: Activating and guiding the engagement of seniors through social media. Final report," at http://ages2.eu/sites/default/files/page/Ages-final-report-EN.pdf, accessed 23 December 2018.

Janelle Wohltmann Myhre, 2013. "Effects of online social networking on the cognitive, social, and emotional health of older adults," Ph.D. dissertation, University of Arizona, at http://hdl.handle.net/10150/332671, accessed 23 December 2018.

Ana Maria Nicolaci-da-Costa and Mariano Pimentel, 2012. "Sistemas colaborativos para uma nova sociedade e um novo ser humano," In: Mariano Pimentel and Hugo Fuks (editors). *Sistemas colaborativos*. Rio de Janeiro: Elsevier; version at http://sistemascolaborativos.uniriotec.br/wp-content/uploads/sites/18/2017/09/SC01-SociedadeHumano.pdf, accessed 23 December 2018.

Kara Pernice, Janelle Estes and Jakob Nielsen, 2013. *Senior citizens (Ages 65 and older) on the Web*. Second edition. Fremont, Calif.: Nielsen Norman Group, and at https://www.nngroup.com/reports/senior-citizens-on-the-web/, accessed 23 December 2018.

Raquel Oliveira Prates and Simone Diniz Junqueira Barbosa, 2007. "Introdução à Teoria e Pr&accute;tica da Interação Humano Computador fundamentada na Engenharia Semiótica," *XXVII Congresso da Sociedade Brasileira de Computação. Jornadas de Atualizaç˜o em Informática JAI/SBC*, pp. 263–326, and at http://www3.serg.inf.puc-rio.br/index.php/published-work/206-introducao-a-teoria-e-pratica-da-interacao-humano-computador-fundamentada-na-engenharia-semiotica, accessed 23 December 2018.

Raquel Oliveira Prates, Clarisse Sieckenius de Souza and Patricia Seefelder de Assis, 2001. "Categorizing communicability evaluation breakdowns in groupware applications," *CHI-SA 2001: Second South African Human-Computer Interaction Conference*.

Raquel Oliveira Prates, Clarisse Sieckenius de Souza and Simone Barbosa, 2000. "Methods and tools: A method for evaluating the communicability of user interfaces," *Interactions*, volume 7, number 1, pp. 31–38, and at http://interactions.acm.org/archive/view/jan.-feb.-2000/methods-and-tools-a-method-for-evaluating-the-communicability-of-user-, accessed 25 July 2016.

Clarisse Sieckenius de Souza, 2005. *The semiotic engineering of human-computer interaction*. Cambridge, Mass.: MIT Press.

Clarisse Sieckenius de Souza and Carla Faria Leitão, 2009. *Semiotic engineering methods for scientific research in HCI*. Williston, Vt.: Morgan & Claypool.
doi: https://doi.org/10.2200/S00173ED1V01Y200901HCI002, accessed 23 December 2018.

Luiz Gustavo de Souza, André Specian Cardoso, Tiago Alexandre Schulz Sippert and Clodis Boscarioli, 2012. "Análise da percepção e interação de usuários sobre privacidade e segurança no Facebook," *IHC '12: Companion Proceedings of the 11th Brazilian Symposium on Human Factors in Computing Systems*, pp. 67–68.

Statcounter, 2018. "Social media stats Brazil: June 2017 — June 2018," at http://gs.statcounter.com/social-media-stats/all/brazil, accessed 29 June 2018.

Statista, 2018a. "Leading countries based on number of Facebook users as of April 2018 (in millions)," at https://www.statista.com/statistics/268136/top-15-countries-based-on-number-of-facebook-users/, accessed 23 December 2018.

Statista, 2018b. "Most famous social network sites worldwide as of April 2018, ranked by number of active users (in millions)," at https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/, accessed 29 June 2018.

S. Shyam Sundar, Anne Oeldorf-Hirsch, Jon Nussbaum and Richard Behr, 2011. "Retirees on Facebook: Can online social networking enhance their health and wellness?" *CHI EA '11: CHI '11 Extended Abstracts on Human Factors in Computing Systems*, pp. 2,287–2,292.
doi: https://doi.org/10.1145/1979742.1979931, accessed 23 December 2018.

Ana Terto, Cláudio Alves, Janicy Rocha and Raquel Prates, 2012. "Imagem e privacidade: Contradições no Facebook," *IHC '12: Companion Proceedings of the Eleventh Brazilian Symposium on Human Factors in Computing Systems*, pp. 71–72.

United Nations. Department of Economic and Social Affairs. Population Division, 2015. "World population prospects. Key findings and advance tables," at http://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf, accessed 24 July 2017.

Maria Lúcia Bento Villela, Simone Xavier and Raquel Oliveira Prates, 2012. "Método de avaliação de comunicabilidade para sistemas colaborativos: Um estudo de caso," *IHC '12: Proceedings of the Eleventh Brazilian Symposium on Human Factors in Computing Systems*, pp. 277–286.

Rosana Wagner, Sandra Dutra Piovesan and Lisete Rodrigues, 2013. "Acessibilidade em redes sociais: Em busca da inclusão digital no Facebook," *Informática na educação: Teoria & prática*, volume 16, number 2, at https://seer.ufrgs.br/InfEducTeoriaPratica/article/view/43422/28000, accessed 23 December 2018.

Jenny Waycott, Frank Vetere, Sonja Pedell, Lars Kulik, Elizabeth Ozanne, Alan Gruner and John Downs, 2013. "Older adults as digital content producers," CHI '13: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 39–48.
doi: https://doi.org/10.1145/2470654.2470662, accessed 23 December 2018.

World Wide Web Consortium (W3C), 2018. "Web content accessibility guidelines (WCAG) 2.1," at https://www.w3.org/TR/WCAG21/, accessed 4 July 2018.

World Wide Web Consortium (W3C), 2010a. "WAI-AGE project," at https://www.w3.org/WAI/WAI-AGE/, accessed 7 July 2017.

World Wide Web Consortium (W3C), 2010b. "Web accessibility and older people: Meeting the needs of ageing Web users," at https://www.w3.org/WAI/older-users/, accessed 25 July 2017.

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