A Contextualization Feature to Overcome Intergenerational Language Barriers in Communication Apps

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Abstract: We address existing intergenerational gaps in use of technology and in digital language, and their potential negative consequences for the well-being of older-aged adults. We describe a new contextualization feature which we designed as an addition to existing instant-messaging systems, to overcome misunderstandings and communication breakdowns during synchronic message exchanges. In the current work we focus on intergenerational language gaps within families, but our feature would be beneficial for bridging language gaps between communicators in many different environments (e.g. between employees who use different professional jargons, people from different nationalities and cultures, and so on). We designed a prototype user interface for the feature and demonstrate it in the context of the WhatsApp messaging app.

1 INTRODUCTION

The world's population is aging, as more and more people reach longevity. According to the United Nations Department of Economic and Social Affairs (2017), by 2030, older adults are expected to outnumber children under age ten (1.41 billion versus 1.35 billion). Globally, the number of people aged eighty years or over is projected to increase more than threefold between 2017 and 2050, rising from 137 million to 425 million. This demographic transition poses major challenges in many areas such as health care systems, pension systems, the labor market and life-long education. Longevity must come with quality of life. As part of our vision to expand the access of older-aged adults to a long-term quality of life, we focus on the provision of effective communication via information and communication technologies (ICTs), and on increasing social inclusion for older-aged adults.

The rapid development of technologies raises unparalleled socio-technological challenges and opportunities which call for multidisciplinary solutions in areas related to human-technology interaction. System developers and interface designers must address the demands and challenges of that emerging technologies pose for older users, and strive for better designs that are geared specifically for them.

1.1 ICTs' High Potential for Older Adults

The rapid development of ICTs is leading to a growing dependence of the world's population on them for basic information, social involvement, and the performance of daily tasks. ICT use has a high potential for allowing older adults to maintain independence and social connectedness while offering them a better quality of life (Olphert & Damodaran, 2013). New technologies, especially ICTs, provide many informational and communicational opportunities for older adults and offer a variety of practical, physical, social, and psychological benefits (Nimrod, 2018). Nowadays, with technology supporting almost every activity, there are numerous opportunities for technology to assist older people in everyday tasks such as gaining quick access to information, financial planning, making bank transactions from home, finding health-related information and on-line assistance, booking for entertainment and leisure venues and shopping. Furthermore, by helping to overcome geographic and

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transportation constraints, ICTs are particularly beneficial to older adults who are isolated and/or home bound (Choi & DiNitto, 2013). Valentine (2006) has demonstrated the potential value of ICTs as a new way to maintain and support the intimacy between family members who live or spend large amounts of time apart. ICTs offer a means to be separate and together; they let family members maintain intimacy by allowing information exchange and opportunities for loving and caring for one another online. By connecting family members and friends, ICTs may decrease the isolation which is more common among the elderly (Cornwell and Waite, 2009) and facilitate the social inclusion of this population. Adoption of technology by older adults can improve their quality of life and well-being and may increase their ability to live independently (Orpwood et al., 2010).

1.2 Intergenerational Technology Adoption and Use Gap

Although it might seem that older adults are open to using new technologies, and there is evidence of wider use and growing positive attitudes toward technology among older adults over time (Wolfson et al., 2014), there is still an inter-generational technological gap in the use of ICTs (Bailey and Ngwenyama, 2010). Age is an important factor in determining levels of engagement with information and communication technologies (Selwyn et al., 2003). The terms "digital immigrants" and "digital natives" were coined by Prensky (2001) to describe the difference in experiences, capabilities, comprehension and attitudes towards new digital technologies between two age-groups. "Digital natives" are people born in the digital era (usually also called Generation X and younger), while "digital immigrants" refers to people born before 1964. Though the terms portray a dichotomy, this generational digital divide is not strict since each group is highly diverse in terms of its members' experiences, capabilities, and attitudes toward technologies (Zur & Zur, 2011). Older adults are themselves a digitally diverse demographic group (Ball et al., 2019), and the digital divide within this sector is actually a "grey divide", with significant differences in technology use within this population (Nimrod, 2018). Although the immigrants-natives distinction is not restricted to age differences, it can often explain generational gaps that create misunderstandings, misperceptions and communication breakdowns. Technology adoption is associated with a higher cognitive ability and self-efficacy in computer use, while higher computer anxiety is associated with lower use of technology (Czaja et al., 2006). The challenges and barriers that older people face can lead to a digital exclusion that may in turn lead to a social exclusion. ICTs have a very important role for individual participation in the common activities of the societies in which they live. Consequently, there is an increasing need to design age-friendly ICTs that let aging individuals adopt newer technologies and become part of the digital culture.

ICT use must overcome a combination of age-related barriers and technology-related barriers. The age-related barriers are mainly normal changes that a person undergoes in cognition and in physical conditions (such as sight impairment), along with affective barriers (age-related perceptions and attitudes towards technology). As to technology, ICTs are usually not designed to be age-friendly. The combination of barriers leads to intergenerational gaps and the negative consequences of such gaps, including deprivation of services and information that the rest of the population benefits from, deterioration of the sense of belonging, and social exclusion.

1.2.1 Normal Aging Changes as Barriers to Adopting and Interacting with Technology

People between the ages of 55 and 75 are typically classified as "young-old" and those 75 years and above are classified as "old-old" (Echt et al., 1998). Aging comes with changes in perception, cognition, control of movements and various physical constraints. It is widely recognized that age-related cognitive impairments and physical changes have negative influences on the performance of various tasks and activities. Aging reduces the speed of cognitive processes, causes a diminution of working memory capacity, and impairs performance of activities such as decision making, comprehension, learning, reasoning, skill acquisition and motor activation (Head et al., 2002; Kennedy, Partridge, & Raz, 2008; Lövdén et al., 2010; Wolfson et al., 2014; Sandberg & Neely, 2016; Czaja, et al., 2019). The various age-related cognitive decline and physical constraints impact many aspects of the human-computer interaction (Ganor, & Te'eni, 2016) and therefore affect the use of ICTs by older-adults.

1.2.2 Affective Barriers to Adopting and Interacting with Technology

In addition to physical and cognitive changes, many older people have affective barriers to adopting and interacting with new technologies. Vaportzis, Clausen and Gow (2017) mention factors such as older peoples' lack of knowledge and confidence, scepticism toward use of technology, perception of technology as much too complex, feelings of inadequacy, and unfavorable comparisons with younger generations. Frustration, physical limitations and usability difficulties are additional inhibitions to using technologies (Heinz et al., 2013). Previous studies also found that older adults experience greater computer anxiety and feel more negative about the effort required to master a technology (Czaja and Lee, 2002; Marquié et al., 2002). Also, many older adults perceive ICTs as having a low value in their lives (Selwyn et al., 2003), and some are simply resistant to changing their existing media and communication habits (Nimrod, 2018). While older-adults acknowledge that ICTs help them preserve social relationships remotely, many feel ostracized or offended when those around them engage with ICTs while they themselves cannot (Ball et al., 2019). A high level of technophobia is mentioned as a factor explaining some age-related digital divides (Czaja et al., 2006, Nimrod, 2018). All these affective barriers constrain online activities for older Internet users and limit the benefits they might otherwise derive from them.

1.2.3 Technology-related Barriers to Adopting and Interacting with Technology

ICT software interface conventions for controls are often less familiar to novice older users, who also lack the knowledge needed to interact effectively with digital systems (Czaja, et al., 2019). In addition, most technological artefacts are not specially designed to meet the physiological and cognitive characteristics of the older population (Selwyn et al., 2003). While adaptation of human-computer interfaces has become an important design principle, there is a paucity of research on adaptation for older users and on age-friendly interfaces (Ganor, & Te'eni, 2016). When technologies are not geared to the unique characteristics of this population, their advantages cannot be fully utilized by it. Along with other considerations, system interface designers need to look at ways to reduce boundaries between the older population and new technologies. Older adults might be willing to use a new technology when its usefulness and usability outweighs negatives feelings about their self-efficacy (Heinz et al., 2013). A previous work has presented principles and guidelines for designing apps and products for older adults, with an overview of the most relevant elements: input devices, visual and auditory displays, and information structured to improve perception and comprehension (Czaja, et al., 2019). Much remains to be done, however, in the realm of age-friendly interfaces, if the aim is to increase the adoption and use of ICTs by older-adults.

1.3 CMC Language Barriers as a Gap across Generations

Contemporary interpersonal communication has shifted away from traditional modes based on face-to-face interaction to digital social platforms. Social networking, text messaging and instant messaging, are all methods that family, friends, and strangers too now use to communicate (Lenhart, et al 2007). Soffer (2010) claims that computer mediated communications (CMC) has ushered in a new era of "digital orality" with a unique writing culture. Constraints related to the technological medium and difficulties of texting, such as miniature telephone buttons, give rise to a linguistic style that is characterised by a hybrid discourse which combines formal writing and informal speech-like (spoken) features. This new and specialized informal language requires new linguistic skills.

The acquisition of online literacy for digital communication creates a linguistic gap that distinguishes generation Y from the baby boomer generation (Subramaniam & Razak, 2014). The use of nonstandard language and new forms of slang in social networks may lead to misunderstandings and communication barriers. Most of the generation Y communicators attempt to speed up their typing to shorten response time. They are also eager to express themselves. Hence they tend to be creative in using a variety of abbreviated words ("b4" for before; "shud" for should, etc.) compared to baby boomers. Generation Y members also employ syntactical and lexical reduction, language shortening, acronyms and omissions ("BC" for because, "JK" for just kidding), and tolerate misspellings and typos (Soffer, 2010; Thurlow & Poff, 2011). The younger generation tends to make many more spelling innovations, and uses capitalization (e.g. 'STOP'), interjections ('ahah', 'ugghhhhh'), accentuated punctuation ("he did what??!!"), and a variety of emoticons (♥, ;), :/). While members of the younger generation revolt against formal writing rules and seek ways to express their creativity and uniqueness (Soffer, 2010), older users are more careful and restrained in their textual communication, and their writing style is more formalized. The digital writing styles of younger users are sometimes off-putting to older adults (Subramaniam & Razak, 2014).

1.4 Contextualization as a Strategy to Overcome Language across Generation Gaps

In order to increase adoption of ICTs by older-adults, designers must focus both on enhancing motivation and lowering barriers to the use of these technologies. Persuasive interactive designs are those which induce behavioural changes (Fogg, 2009). According to Fogg's behavioural Model (FBM), a person with increased motivation and increased ability has a greater likelihood of performing a target behaviour. Here the target behaviour we wish to encourage is communication among family members via synchronous chat applications, especially cross-generational communication. Effective persuasive technologies boost either motivation or ability. A previous inspirational project named the Story Machine (Marcus, 2012) designed and evaluated powerful ways to improve inter-generational story-sharing behaviour by persuading and motivating people to increase story-sharing with other family members. Our emphasis in the current project is on increasing the *ability* dimension, by making communication simpler. FBM maintains that motivation alone – no matter how high – is not enough to get people to perform a behaviour if they do not have the ability to do it (e.g. if it is not sufficiently "simple").

Even when older adults are highly motivated to communicate with other family members via synchronic chat applications, their ability to do so is low if they cannot figure out the meanings of words and expressions used by the members of the younger generation in the family. "Simplicity" is a function of a person's scarcest resource at any moment a behaviour is triggered. We maintain that the scarcest resources of cross-generational communicators are *time* and *brain cycles*. According to FBM, if a target behaviour requires time, then the behaviour is not simple. With regard to "brain cycles": if performing a target behaviour causes someone to think hard, the behavior might not be a simple one. Thinking deeply or thinking in new ways suggests cognitive difficulty. The contextualization feature that we designed serves in FBM terms as a 'facilitation trigger' to reduce the barriers to performing the target behaviour of communicating whenever there is a language gap. This type of trigger is appropriate for users that have high motivation but lack ability. Our facilitator tells users that understanding a digital text or an emoji is easy to do, and will not require a resource that he or she lacks at that moment. With only one click, the user can get an explanation of the meaning of an expression, abbreviation or emoji.

The idea of contextualization in CMC to prevent or overcome potential communicational breakdowns and misunderstandings, is not new. Previous research and system design projects implemented contextualization as a central component of efforts to bridge communication gaps and hence achieve effective communication in organizations. KMail, a knowledge-enhanced e-mail product (Schwartz & Te'eni, 2000), is a URL-based email system that allows message senders to convert words and phrases in outgoing emails into hyperlinks to organizational memories. Thus in KMail, contextualization is implemented via embedded links. KMail was designed to achieve successful communication by appropriately adapting messages based on differences between message senders and their addressees. Contextualization was implemented also in an email system designed for customer service representatives (CSRs) to overcome communication breakdowns resulting from differences in perspectives, and especially the lack of a technical background and professional jargon knowledge from the customers' side (Katz and Berman, 2011). In the current design project, we follow the powerful idea of tying knowledge to action with hyperlinks (Schwartz & Te'eni, 2000) and apply it in the synchronic context of instant messaging systems such as WhatsApp. For each task, users need to have the right knowledge at the right time. Just as knowledge-workers in organizations do not have the time to actively seek the organizational knowledge needed for executing their tasks, so do people who communicate through instant messaging systems. In ongoing conversations with multiple participants in synchronic media, communicators are required to reply instantly, and do not have time to look up the meanings of expressions and emoji symbols that are unfamiliar to them. Therefore, it would be far more effective if the missing meanings (the contextual knowledge to understand message components) were able to find *them*.

2 COMPONENTS AND PROTOTYPE DESIGN

2.1 Dictionaries

Our contextualization feature for instant messaging systems links to public and private dictionaries which explain *message components*: expressions, phrases, idioms, concepts, slang, abbreviated words, acronyms, interjections, and emojis. The contextual knowledge retrieved from these dictionaries will explain unfamiliar message components and thus serve as a long-term resource for the message receiver to fully understand incoming messages. The public dictionaries are databases of widely used message components, the meanings of which are known to the general public. Private dictionaries are databases of message components that are group-specific and accessed only by group members. In the current project we are interested in private family dictionaries, which we call “Famictionaries”. Famictionaries include specialized phrases, words, and terminologies that run within the family. Famictionaries have the ability to preserve a family’s private terminology and create a shared family experience, thus strengthening family ties and the sense of belonging and intimacy. The contextualization feature is a participatory tool, since users will be able to expand the dictionaries dynamically by adding dictionary entries to more and more message components. This way, the dictionaries constantly expand and stay up to date with new expressions and evolving terminology. Private dictionaries will be created and updated by authorized members of each group. Meanwhile, the public dictionary will be built and updated by the instant messaging system companies, in the same manner that emojis are added to WhatsApp and updated from time to time.

During message exchange, incoming messages will be parsed to identify message components that appear in both dictionaries, and these components will appear in the message as embedded links. In other words, segments of the dictionaries would link up with the message components.

2.2 Prototype Design

We use various techniques known from the field of HCI to develop our prototype contextualization feature. In a preliminary study, we distributed questionnaires using Google Forms via WhatsApp and Facebook platforms to target end-users. The distribution was to acquaintances and family members. A total of 52 old adults (aged 65 and over) and 56 children (aged 10-18) responded. We found that 67.3% of adults and 38.9% of children reported difficulty understanding text messages in family groups. 61.1% of adults and 20.4% of the children reported difficulty understanding emoji; 70.9% of adults and 36.5% of children felt it was difficult for them to keep up with the pace of WhatsApp conversations. In open-ended questions regarding feelings, it emerged that among adults feelings of frustration and embarrassment arose as a result of misunderstanding messages. Repeated comments among the young participants were that grandparents do not know how to use emoji correctly, that it takes them a long time to type, and that grandparents do not always understand jokes and conversation at all. In addition to distributing the questionnaires, we received valuable insights from participatory observations in the correspondence of family WhatsApp groups in which we are active on a daily basis. Follow-up interviews (conducted face to face or via Zoom) with selected subjects, 4 adults and 4 children, further supported the need for a tool to help understand the meaning of message components (e.g. utterances, abbreviations, emoji). In the next stage we created personas (e.g. Grandpa David and grandchild Tamir) and defined user scenarios that address the needs of users, such as reading messages, adding a phrase to a private dictionary, turning on/off a dictionary or a cluster that groups several message components within a dictionary. The interface design follows well-known usability heuristics, principles and guidelines. We conduct this project in YOUsability, which is a usability lab located in the Industrial Engineering and Management department at SCE, the Shamoon College of Engineering in Ashdod, Israel. YOUsability is a research centre for developing and testing interactive technologies. We will conduct usability tests in the lab with 3-4 end users for each one of three family generations, and will continue to develop the interface in an iterative manner. Figures 1-2 show prototype screens that demonstrate WhatsApp message exchanges between Grandpa David and his grandson Tamir. Figure 1 presents Tamir’s view, and Figure 2 presents Grandpa David’s view. The left screenshots in both figures show the view before the user clicks on an embedded link and the right screenshots in both figures show the view after the click, including the contextual knowledge retrieved from the dictionary. The display style can vary according to age, for example the contextual knowledge for the concept that Tamir did not understand (What’s your bag?) is presented in a comic word bubble style that is suitable for children (see Figure 1).

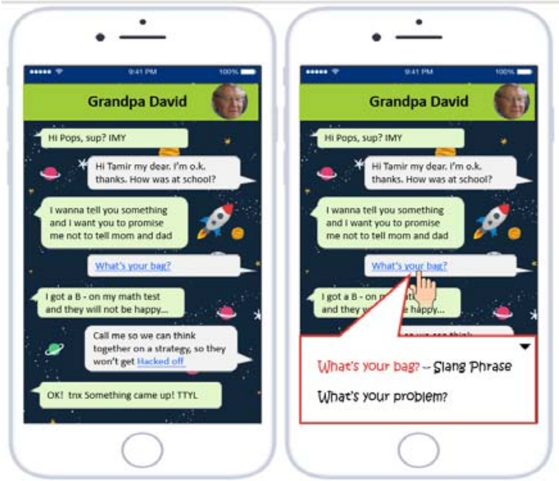

Figure 1: Grandchild's view.

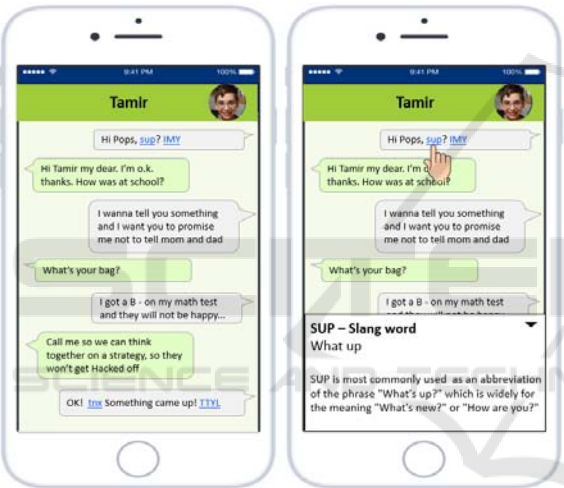

Figure 2: Grandparent's view.

2.3 Applying the Signal Detection Theory

We use signal detection theory (Green & Swets, 1966) to explain the system's decision-making process on whether to link up a message component to its dictionary entry during message parsing. Table 1 shows the application of signal detection theory to the context of contextualization. A message component (stimulus) is either familiar or unfamiliar to a certain user, and the system should display (response) only unfamiliar components as embedded links to dictionary entries. An effective system must have many hits and correct rejections, and very few misses and false alarms. In other words, we need to ensure a nonintrusive user experience (few false alarms but many correct rejections), with useful contextual information whenever there is need to bridge language gaps (many hits and few misses).

Table 1: Application of signal detection theory.

Familiarity / User view	No	Yes
Embedded link	Hit	False alarm
No embedded link	Miss	Correct rejection

Effective message views that suit a given user would be produced in several ways: (1) the user regulates information overload by activating or deactivating the contextualization feature, fully or partially (for example, activate the Famictionary and deactivate the public dictionary). Depending on the user's choice, the links associated with the activated dictionary will be filtered. Users will also be able to enter specific dictionary entries and turn them off, or even more efficiently turn off clusters of dictionary entries so that they do not appear as embedded links in incoming messages. (2) In the initial activation of the contextualization feature, the user will be asked to complete a short survey (with questions such as age, country/state, and languages) to create a personal profile. Based on the survey, the system will assess the user's generational affiliation and the words and phrases that are expected to be unfamiliar to him or her. Survey results will guide formation of the embedded links presented to the user as part of incoming messages. (3) The contextualization feature will also employ a machine-learning component that continuously incorporates new data regarding a user's message exchanges. By tracking the usage (and non-usage) of dictionary entries in messages, the system will effectively determine which dictionary entries are useful for a given user as contextualization for comprehension. The idea here is that a user most likely knows the meaning of a message component if that message component was used in previous messages he or she sent, or appears in a sufficient number of incoming messages in various groups to which he or she belongs. It may also be assumed that if a user does not click on an embedded link of a message component several times, then the entry is not useful for that user (4) To overcome situations where the system does not detect a message component which is unfamiliar to the user (miss), the user can select that message component and check whether there is a dictionary entry for it.

An additional option that lets the user control the amount of information linked to a message component, according to the user's momentary (situational) needs, is to choose the amount of contextual information displayed for that component.

Each message component may have several layers of information. A quick and parsimonious display of the meaning which lets incoming messages be understood will appear at the bottom of the screen when the user clicks on an embedded link. This parsimonious display is shown in Figures 1-2. Users who wish to expand their knowledge about a message component that has a dictionary entry can click on the triangle to access the full information for that component (synonyms, example sentences, etc.).

3 LIMITATIONS

A requirement that is vital to the feature's success yet difficult to control, is a sufficient level of user participation in the task of updating the private dictionaries (the 'Famictionary' in the current project). In this respect, our feature suffers from the same shortcomings as any other knowledge-management system (Schwartz & Te'eni, 2000). Our design approach is persuasive, with interface elements that encourage the act of updating. On the one hand, interface elements should increase the *motivation* for updating (e.g. including gamification components such as winning special stickers) and on the other hand the interface design will simplify the *ability* to update (by applying usability principles, focusing on ease of use and efficiency). Of course, there is also a challenge that relates to the creation of appropriate message views. The system's successful use depends on the system's ability to properly define the views relevant to each user. We previously described how signal detection theory explains the system's decision-making process regarding the creation of links to dictionary entries when creating a user's view. As aforementioned, our feature will employ a machine-learning component that continuously incorporates new data regarding a user's message exchanges. Signal detection theory, which is closely related to statistical decision making theories, provides a base for modern machine learning (Sumner & Sumner, 2020). Previous work already employed signal detection theory in the field of machine learning (Hung, Jiang, & Wang, 2020; Demestichas et al., 2021).

4 CONCLUSIONS

Our preliminary user study findings, conducted using questionnaires, participatory observations, and interviews, support the research literature regarding language barriers as a gap across generations, and the difficulties that older adults have in interpersonal communication via ICTs. We offer a solution to reduce the gap and its possible negative consequences for the well-being of adults. Our solution is a contextualization feature which we designed as an addition to existing instant-messaging systems, to overcome misunderstandings and communication failures during synchronous message exchanges. While we focus in the current work on intergenerational language gaps within families, such a contextualization feature can be just as beneficial for bridging any language gaps between communicators in different environments and communicational domains, such as communication between employees who use different professional jargons, people from different nationalities and cultures, and so on.

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