RESEARCH IN PROGRESS

BRIDGING THE DIGITAL DIVIDE FOR OLDER ADULTS: AN INVESTIGATION OF BARRIERS AND FACILITATORS

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As Information and Communication Technologies (ICT) become increasingly pervasive, older adults often face significant barriers to digital inclusion. This research-in-progress paper investigates the multi-faceted barriers and facilitators affecting ICT use and embracement among older adults. Barriers include cognitive decline, physical limitations, lack of digital skills, and psychosocial factors such as low confidence and distrust. Facilitators encompass inclusive interface design and motivational support tailored to older adults' needs. The study employs a mixed-methods approach, combining behavioral surveys, interviews, and neurophysiological measures to capture comprehensive insights into older adults' ICT experiences. By involving older adults in the co-design of ICT interfaces and identifying effective motivational strategies, this research aims to develop empirically driven tools and guidelines to enhance digital inclusion and well-being for older adults, ultimately bridging the digital divide.

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1 Introduction

As Information and Communication Technologies (ICT) become increasingly pervasive, those that are left behind in technology access and use are highly disadvantaged (Wei et al. 2011). The COVID-19 pandemic highlighted the vital importance of increasing digital inclusion as migration to digital life rapidly accelerated. Older adults have frequently been excluded and marginalized with respect to technology (Weil et al. 2021) and this reality became even more vivid due to the pandemic. This digital exclusion gap is deeply widened when we intersect lower socioeconomic factors such as race, gender and new immigrant status with the older adults' segment (Yoon et al. 2020).

2 Digital Divides for Older Adults

When one thinks of a digital divide, not having access to technologies is what typically comes to mind (Compaine 2001). However, more recently, there has been an appreciation that digital divides exist at different levels, which are successive and interrelated (Loh & Chib 2021; Wei et al. 2011). The first level, Digital Access Divide (*access*), refers to inequities in access of hardware, software and connectivity. The second level, Digital Capabilities Divide (*use*), refers to inequities in ability (i.e., skills and/or access to training) and attitude (e.g., self-efficacy, trust, motivation) to use ICT. The third level, Digital Outcome Divide (*embracement*), refers to inequities of benefits derived from ICT use. Equality in ICT access and capabilities may not necessarily result in equivalent outcomes, as certain groups of people derive greater benefits from ICT than others (Van Deursen & Helsper 2015). In this research the focus is on how ICT is embraced and integrated in one's life in order to achieve positive tangible outcomes that can result in offline benefits to social, emotional, physical and intellectual wellness (Wilson et al. 2023; Van Deursen & Helsper 2015). With increased ICT and Internet penetration within developed countries, the issue of the digital access divide has waned (Loh & Chib 2021). As such, this research focuses on the digital divides of ICT use and embracement among older adults.

2.1 Barriers for Older Adult ICT Use and Embracement

Older adults may encounter various barriers when it comes to using and embracing ICT. Cognitive barriers emerge due to natural cognitive decline associated with neurocognitive, structural, or functional changes in the brain as people age (Harada et al. 2013). For example, age-related decreases in fluid cognitive abilities such as reasoning, pattern recognition and problem solving as well as decline in memory and attention can impact effective learning and use of new technologies (de Bruin et al. 2012). Physical barriers such as diminished motor control, vision, hearing, hand-eye coordination, flexibility of joints, touch sensation, among others, can impact performance (errors and efficiency) of ICT use and, ultimately, older adults' willingness to continue using technologies for their potential benefits (Wildenbos et al. 2018). Knowledge-based barriers arise from a lack of digital skills and training, further impacting older adults' cognitive ability to navigate websites, use applications, and resolve common issues, often stemming from limited exposure to technology in earlier years (Wilson et al. 2023; Wilson et al. 2021). Older adults need more time to learn new ICT-related skills (Wildenbos et al. 2018), emphasizing the importance of training and support (Marston et al. 2019). Finally, psychosocial barriers also play a substantial role in ICT use and embracement among older adults. These barriers encompass issues like low confidence (Horst et al. 2021), distrust and anxiety of ICT (Gomez-Hernandez et al. 2022), lack of interest (Nymberg et al. 2019), insufficient support (Nymberg et al. 2019), and concerns about privacy and online scams (Gomez-Hernandez et al. 2022). Particularly for older adults, self-stereotyping may become a self-fulfilling prophecy that impacts ICT use and embracement (Wagner et al. 2010; Wilson et al. 2023).

Extant research has tended to examine the impact of these barriers on ICT use in isolation rather than holistically understanding how these multi-faceted barriers may interact to not only reduce overall use of ICT and exacerbate digital exclusion but limit the opportunity to use these technologies for positive tangible outcomes for older adults (Wilson et al. 2021; Lu et al. 2023). Such barriers become more pronounced when considering the intersections of age with factors such as race, ethnicity, socioeconomic status, sex, disabilty, etc. (Loh & Chib 2021).

2.2 Facilitators for Older Adult ICT Use and Embracement

2.2.1 Interface Design

The interface design of ICT can either create a barrier to use, which can be insurmountable especially for marginalized users, or facilitate effective use and embracement of technologies. In an effort to accommodate the broad diversity of users who may face multiple individual barriers (such as older adults), ICT designers have employed universal design (also described as accessible design) approaches (Nussbaumer 2011). However, this "one size fits all" approach focuses on designing with the average user in mind where needs and preferences of some individuals are prioritized over others and it ignores the fact that these needs may change over time (Patrick & Hollenbeck 2021). A more inclusive approach to ICT interface design should take into account personal identifiers such as age, race, economic status, gender, etc., where design is done for groups that are typically underrepresented or ignored (also known as equity-based design) (Patrick & Hollenbeck 2021). For the underrepresented group of older adults, equity-based interface designs have tended to focus on overcoming visual and cognitive load barriers through larger font sizes, high-contrast colours and simplified navigation, instructions, and other design elements (Wilson et al. 2023).

A drawback of the traditional ICT design approaches is that they do not capture or address the impact of digital designs beyond the immediate use of the design. For example, they do not consider impacts on users' offline well-being (Sin et al. 2021). Additionally, they tend to follow a "top-down" approach where the design process is based on technologists' or geriatricians' preconceptions of the needs of older adults (White et al. 2022). To create ICT interfaces that are truly useful, reduce barriers and have positive online and offline impact, older adults must be meaningfully engaged in the design process. Not involving older adults in the design of ICT has been recognized as a significant barrier to their use and embracement of these technologies (Wilson et al. 2023). As such, older adults still largely remain a 'relevant but absent' group in the design/development of ICT (Xie et al. 2012).

2.2.2 Motivation

ICT interfaces that are tailored to the unique needs of older adults are essential to remove obstacles for use. However, technology design alone is not sufficient to bridge digital divides. Alongside effective interface design, motivational facilitators need to inspire and support older adults in their journey towards ICT embracement for positive online and offline outcomes (Tyler et al. 2020). Self-efficacy theory, with foundations in social cognitive theory (Bandura 1997), is a well-established motivational theory that has been posited to positively influence older adults' learning and adoption of technology (Tyler et al. 2020). According to this theory, one's self-belief in one's competence (for example with ICT) is shaped by: (1) mastery experiences (experienced previous success or failure); (2) vicarious experiences (observation of success); (3) verbal persuasion (feedback from influential people) and (4) social ties and support networks (social milieu). The appropriateness and effectiveness of motivational facilitators may differ by individuals (varied backgrounds and barriers) and by stages of ICT use and embracement (Loh & Chib 2021).

3 Proposed Methodology

An initial model for this proposed research is shown in Figure 1. A combination of methods will be employed – from behavioural surveys and interviews to neurophysiological measures, ensuring a complete grasp of older adults' ICT experiences while capturing conscious and subconscious interactions.

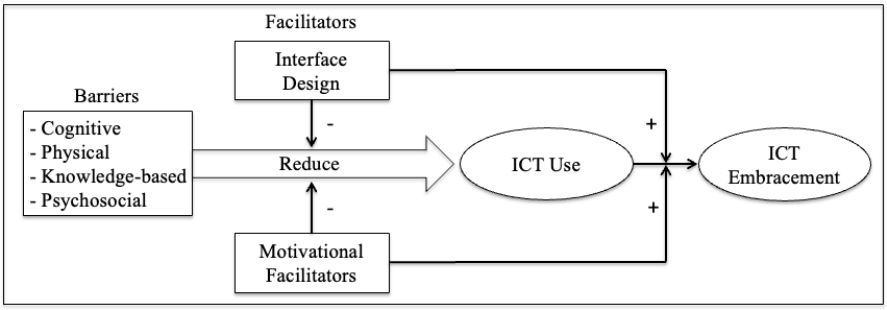

Figure 1: Barriers and Facilitators of ICT Use and Embracement
Source: Own

An exploratory study will be conducted to gain a holistic understanding of how different barriers may interact in their effects on ICT use and embracement by older adults. This investigation will also explore facilitators that motivate older adults to effectively engage with ICT. Interviews (n=15), focus groups (4 x 5 older adults each, n=20) and surveys (n=200) will be conducted across a diverse range of older adults, capturing the nuances of their ICT barriers and facilitators.

Based on the findings from the above exploratory study and in consultation with the older adult community, three interface designs will be developed to attenuate the negative impacts of multi-faceted barriers (examples may include attentional enhancement and social cue designs). Similarly, three most salient motivational facilitators will be identified, drawing from the above findings and self-efficacy theory (Bandura 1997). A controlled experiment will follow a three-by-three balanced analysis of variance design (3 interface designs x 3 motivational facilitators) with 270 older adults (30 replications per cell). To ensure generalizability, the sample will be drawn across a diverse range of older adults. Using the selected motivational facilitator, participants will be asked to interact with the selected interface design during several (approximately 4) one-hour sessions over the span of three to six months. At the end of each session, participants will be asked to complete a survey to express their views on the manipulated interface design.

While traditional self-reported human computer interaction methods may yield significant insights, such methods can suffer from shortcomings due to inherent biases (e.g.; retrospective, subjectivity, etc.). As such, each session will be conducted at the Digital Transformation Reserach Centre of a major Canadian university where neurophysiological equipment will allow for additional unobtrusive measurement of behavioural (e.g., eye movements), physiological (e.g., Electrocardiogram (EKG), Electromyography (EMG), Galvanic Skin Response (GSR)), and cognitive (e.g., Electroencephalography (EEG)) activities of diverse older adults engaged with ICT. Triangulating these methods with traditional self-reported methods will allow for a much deeper understanding of true older adult experiences by analyzing their underlying cognitive, biological, affective and attitudinal correlates.

3 Expected Contributions

The proposed research will provide: (1) An in-depth understanding of multi-faceted barriers and motivational facilitators for effective ICT use among older adults. Behavioural methods as well as neurophysiological measures will be utilized to provide rich insights into conscious and subconscious processes. (2) An examination of the efficacy of various interface designs and motivational facilitators via experimental comparisons across older adults with diverse subsets of multi-faceted barriers. (3) The development of empirically driven interface tools and guidelines to support diverse older adults across various ICT contexts. Overall, this research promises to help older adults remain connected, informed, and engaged in an increasingly digital world, ultimately promoting digital inclusion and well-being.

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