Help! I'm Stuck, and there's no F1 Key on My Tablet!

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ABSTRACT

Older adults are often considered to be less frequent adopters of new technologies, in part due to increased efforts required to learn new interaction paradigms, especially if these need to overcome long-established mental models of technology use. Many current interfaces such as mobile devices often do not incorporate elements that align with older adults' models of use: explicit help menus, user manuals, navigation affordances. The lack of such reassuring elements may cause anxiety to those trying to learn interaction paradigms that are new to them. This paper details the help and support paradigms behind the design of a contextual support interface for tablet devices and describes the results of a usability evaluation with older adult participants.

CCS CONCEPTS

• Human-centred computing → **Human computer interaction (HCI);** *HCI design and evaluation methods*

KEYWORDS

Older adults; tactile interaction; learning; mobile devices;

INTRODUCTION

Contemporary user interfaces often do not accommodate the needs of the ageing population [15], and too often assume that older adult users will have the necessary technological proficiency in using an application effectively. The number of older adults in industrialized countries is projected to double within the next two decades [29] Significant contributions to older adults' quality of life in the coming decades will arise from applications that are built to help manage their health [26]; however, implementations of these technologies will be ineffective if older adult users fail to adopt these products. Drawing upon theoretical frameworks of understanding technology acceptance (TAM, UTAUT), this paper evaluates new ways to provide useful and usable support for older, novice users of technology.

Research suggests that up to 45% of older adults are uncomfortable when attempting to learn new technologies and are hesitant to independently explore new user interfaces in order to learn their functions [25]. Age-related complications in cognition and physical ability aside, many current older adult users developed their skills and education during a time when digital technology was not widespread, and it should not be assumed that their mental models and expectations for technical devices would align with the interaction design models of modern mobile interfaces [1][37]. Additionally, digital literacy among older adults is highly dependent on the prior need to learn new technologies in the workplace [16] and thus decreases post-retirement, especially as new technologies emerge that will pose learning and adaptation challenges to newer generations of older adults [1]. Digital literacy is accentuated by the lack of peer (family) support for learning new technologies, especially for socially-isolated older adults [30]. However, the notion that older adults actively avoid adoption of new technologies is often a misconception, as research reveals that older adults exhibit a strong desire to adopt new technologies in order to stem the social isolation and loss of independence commonly associated with aging [25].

Older adults are motivated by a psychosocial need to stay independent [18], and technologies that enable them to do so may be better adopted. Ensuring that older adults feel confident about their use of technology is essential, as it is required for older adults to perceive the benefits and satisfaction of adopting new technology. However, older

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adults generally suffer from low self-confidence and high anxiety when using technology [8], despite evidence suggesting that older and younger users generally have a comparable knowledge of computers [19], with self-confidence and perceived self-efficacy being the primary differentiators.

The Technology Acceptance Model – TAM [34] by Venkatesh indicates several factors that affect the adoption of (potentially beneficial) technologies, particularly by older adults [33]. TAM is a widely used theoretical framework that examines how people accept and use a specific technology. While not without its shortcomings [28], TAM is successfully used in the (scant) work studying the factors affecting the adoption of technologies by older adults [22]. Two of the critical adoption factors identified by TAM are usability and perceived value (usefulness/utility). Within this context, TAM is typically interpreted to indicate that in order for older adults to adopt a software system (or more broadly, digital technology), such an interface must be highly usable by them.

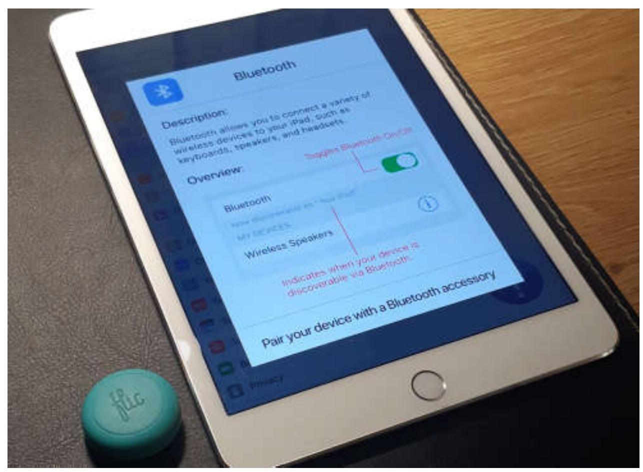
Furthermore, the Unified Theory of Technology Acceptance Model (UTAUT) is an extension and evolution of TAM, that identifies four additional concepts as determinants of technology usage intention: Performance expectancy, effort expectancy, social influences, and facilitating conditions [34]. We apply principles from TAM and UTAUT to articulate how and why improvements designed to facilitate conditions for learning new interfaces may reduce perceived effort expectancy. UTAUT thus provides useful and actionable heuristics in designing for user acceptance and adoption.

Effective use of mobile technology still requires a baseline understanding of how and when to interact with a device [37]. For older adult users without prior knowledge in the use of digital interfaces, this presents a significant problem. Training programs are often cognitively and emotionally demanding [35], which is antithetical to the requirements of older learners. At the same time, a commonly observed behaviour in technologically inexperienced older adults when 'stuck' is to stare at the interface without interaction for several seconds [9], often leading up to abandoning the task [25].

We posit that if users are provided with quick and easy access to relevant help information when they become stuck, we can reaffirm their confidence and self-efficacy, and overcome negative technology adoption factors. Additionally, a design that accounts for acceptance and use of technology factors would be expected to yield measurable improvements to usability.

In this paper, we argue that older adults can be supported while learning new interfaces by a system that provides users with contextually pertinent support through a single-step interface. We contribute the design and prototype implementation (Figure 1) of such a system for tablet devices. The prototype is designed to assist older adults' adoption of mobile technology, by providing them with contextually relevant information when they become 'stuck'. The design of the interface is based on our understanding of older adults' learning preferences and informed by related work in this space. We contribute an empirical evaluation of the prototype and discuss comparisons between the physical instantiations of the help button (tactile vs digital) with the on-screen help modalities (documentation vs overlay), to determine which combination of the above conditions best serves as learning support for older adults.

Fig. 1: Tactile Button and Documentation Modal Prototype, presenting Bluetooth settings help.



BACKGROUND

The foundational work for this project derives from a qualitative auto-ethnography conducted by the first author during their work as a volunteer iPad tutor of older adults. The autoethnography retrospectively describes 'epiphanies' [10] based on the first-person experience of supporting the adoption of technology by older users. We generalize these findings to the design of improved user interfaces to support the adoption of technology along many of the same vectors provided by a physically present, human tutor.

The tutoring activities typically consisted of recurring one-on-one or small group two-hour sessions, in which various features and functions of the iPad device were taught, with each session dedicated to a single aspect (function) of the iPad. Trainees were mostly interested in learning how to use the iPad more proficiently and had a prior but fundamental knowledge of one or two essential functions (e.g. sending emails). Ten two-hour training sessions throughout five weeks, were conducted with two older adult users (Mean age = 79).

The tutor's reflections on the several sessions conducted with older adults motivated the design of the learning aid introduced in this paper. In particular, such decisions are anchored in the tutor's reflections on when the lesson plan was not adequate or when additional time and additional resources were allocated. Lessons were structured in a scaffolding manner, moving from simple functions around hardware buttons towards more complex application use.

The tutor's planned allocation of time was adequate for the hardware aspects, and surprisingly, even for teaching more complex interactions (e.g. multitouch gestures). When teaching, the tutor found themselves in an unexpected role; not the planned one of a coach, but the one of an "emergency" help contact. Participants would routinely 'freeze' when encountering a new and unfamiliar interface and would not attempt to interact with the device again until reassured by the tutor. In addition to providing technical guidance, the tutor was often called upon to allay learners' worries that they "broke something" or that they got "stuck." We understand how a fear of inadvertently breaking the device is common in older adults' interactions with technology [1]. This indicates that the 'facilitating conditions' factor of UTAUT is an aspect that requires particular attention, as older adults may need a carefully designed environment that provides support to both the tasks they need to perform, and in learning how to perform them.

Overall, there was an apparent, noted absence of unguided exploration within an unfamiliar application. Most notably, the tutor found that the allocated support for learning to navigate and configure settings menus to be insufficient. Compared to ordinary, single purpose applications, the device settings presented far greater effort on the part of tutor and the learners, possibly due to the sensitive nature of the settings, the volume of technical jargon, and tiered navigational menus. The observation that the device settings interface presented a significant degree of the UTAUT factor expected effort, and motivates our decision to focus on the iPad settings as the testing environment in our study.

There was also a stark contrast in the means by which digital natives (of whom the tutor is one) learn how to use new devices and applications. Digital natives are more inclined to explore the functions of a new application due to their prior experiences, opting to employ a 'trial-and-error' approach that is less common in older adult users [7].

Our insights from this experience, into the relative difficulty of supporting older adults as they learned how to use the settings menu, identified an explicit need for older adults to be supported when learning to use highly technical interfaces.

BARRIERS TO INDEPENDENT LEARNING

If older adults report a preference for 'trial-and-error' style exploratory learning, what is preventing them from doing so, and how can that be supported in a manner that does not require frequent 'emergency' access to a tutor, or outdated documentation?

Human-centered design approaches to increasing the usability of mobile interfaces have dramatically improved, such as commonality in design elements [3]. However, the iterative methods used in the process of designing consumer applications assume the defined 'user' to possess significant technological fluency and digital mental models for various tasks. Older adults without the prerequisite mental models for independent interface use are left behind in this process, as designers march towards increasingly complex interface designs that do not take into consideration the knowledge gap between older adult learners and presumed users. For example, abstracted iconography does not logically allude to its intended functionality. For users without underlying knowledge and experience with digital technologies, such designs are ineffective at conveying their intended affordances, and instead exacerbate barriers to adoption.

The dual objectives of this work are as follows: To design an interface that provides users with instructional information at the moment they become 'stuck', and to provide older adult users with information that is structured in a way that aligns with existing learning preferences.

The following research questions were formulated to guide the design of the study, to evaluate the design of the prototype contextual aid, and to further our understanding of older adults' technological learning behaviour.

1. How does the embodiment of help invocation interactions (digital or tactile buttons) affect older

adults' ability to successfully navigate unfamiliar interfaces, and their difficulty in performing such tasks?
2. How does the presentation of contextually applicable help information (documentation or overlay modals) influence older adults' proficiency and difficulty in navigating unfamiliar interfaces?
3. How does the relationship between the type of help invocation and the type of help information influence older adults' proficiency in navigating unfamiliar interfaces?"

In the following section, we describe related work in this domain, and how it has informed the design and implementation of this work.

DESIGN OF THE CONTEXTUAL AID

The prototype implements two different conditions for invoking the help information: Through 1) a tactile button and 2) through a digital, on-screen button embedded in the underlying interface.

Help Invocation Methods

To facilitate the invocation of help by older adults in our help interface a physical, tactile button was chosen as one of the two metaphors connecting the real-life metaphor of a 'panic button' to the interaction. The design of current mobile UIs suffers from low discoverability of navigational affordances [24], so the explicit affordances of a tactile button may provide a more accessible means for accessing help. Pressing on the tactile button once invokes the help modal, pressing again dismisses the modal (Figure 1).

Personalized User-Carried Single Button Interfaces (PUCSBIs) have been proposed as effective and usable single-step interfaces for smart devices [21]. It has also been shown that older adults are comfortable carrying additional supports (e.g. manuals) to support their use of technology [23]. We conjecture that such 'shortcuts' can be effective in delivering contextually pertinent help information to older adults. While our prototype implements a wireless button that is physically separated from the tablet, the envisioned user-carried single button interface may be embedded onto a keychain, case, or stylus – to clarify the button's relationship to the device, and to reduce the risk of loss.

We hypothesize that the metaphor of a pressable, tactile 'panic button', and the embodiment of the button interface in physical space, will be conducive towards a more usable and effective user experience for older adults. We expect such design considerations to positively affect the technology adoption factors identified by TAM, perceived usability and perceived value.

Fig. 2: On-Screen Digital Help Button

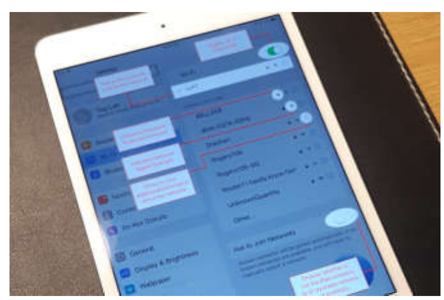
An on-screen digital button (Figure 2) is also implemented as a method of invoking the help interface. The digital button is embedded within the context of the interface and contrasts the physical embodiment of the tactile button described above. The digital button is otherwise identical in function to the tactile button in the way that it invokes and dismisses the help modal.

Help Information Presentation Methods

The prototype also explores two different conditions for visually presenting the help information: In the form of traditional, 'user manual' style descriptive documentation (Figure 4), and by overlaying the help information on top of the view, calling back to the functionality of "F1" help keys, on-screen "help balloons" [11] and "tooltips" introduced in Mac OS 7 and Windows 95 (Figure 3).

'Help balloons' annotate each highlighted element providing older adult users with an understanding of the interface, with the goal of improving their confidence and self-efficacy, in contrast to instruction manual-style documentation. Pressing the help button a second time dismisses the help overlay. Users can interact with the interface beneath the overlay and changing interface states (e.g. turning Wi-Fi off) are also reflected in the overlay.

Fig. 3: Overlay Modal, presenting Wi-Fi help.



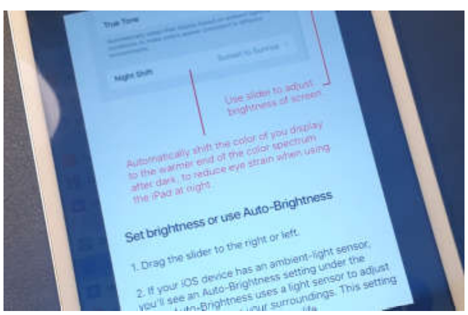
Strategies for 'training wheels' modes in programs [5] that involve blocking typical side tracks and error states are effective in facilitating the applied learning of unfamiliar interfaces. Related work in this space shows similar solutions to the problem of technology adoption. *HelpMe* [9] presents users with contextual help tooltips in an overlay, and an on-screen invocation button is revealed after a period of user inactivity. In the design of this prototype, the help button is always available, to convey the metaphor of a 'panic button' specifically for when older adult users become stuck. The tactile button additionally provides an opportunity to evaluate this user experience when the invocation method is detached from the device itself.

StencilMaps and *EphemeralMaps* [29] also presents an interface for supporting inexperienced users by restricting the screen, highlighting only the interface elements of interest on the screen. In addition to highlighting only the interactive elements, the overlay modal in this work also embeds descriptions of each element into the help.

In both the above work and our system, the overlaid help leverages focused and divided attention between the foreground help overlay and the background view [13]. Users are visually directed to interact with UI elements within the highlighted sections. The overlay modal also features help balloons, which are known to be effective when used for initial familiarization with a product, and for accomplishing tasks [11]. We surmise that by providing users with information in this manner, we can reduce the degree of perceived effort expectancy and improve the degree of perceived ease of use as suggested by TAM and UTAUT. [34]

The design of the overlay modal in this work is similar to the above work but is different in that it is adapted for mobile contexts, and designed to suit the learning preferences of older adults.

Fig. 4: Documentation Modal, presenting Display help.



The documentation modal works by providing the user with information in a form factor that relays the metaphor of a user manual. Upon invoking the help button, the documentation modal provides users with a description of the interface, a labeled overview of the interface elements, and step-by-step instruction for the task associated with the view.

The documentation style modal is similar in design to *Workflows* [17]. Workflows presents contextually-pertinent descriptions and step-by-step information for a specified feature. The help content is adjacent to the subject content, and interactive buttons within the help allow users to quickly perform the task they were seeking help with. Unlike the overlay modal in this work, users can not interact with the underlying interface while the modal is active. Evaluation of this system found it enabled "qualitatively different problem-solving strategies for performing new and infrequently performed tasks, with significant gains in performance and reductions in cognitive load" [17]

We understand from our autoethnography on tech. tutoring with older adults that there is a marked preference for detailed descriptions, and step-by-step instruction. The design of the documentation modal in this prototype additionally accounts for the learning preferences of older adults [20]. By bridging the existing learning preferences of older adults to the design of the contextual aid, aim to improve the degree of perceived usefulness of technology [34] experienced by older adult users.

A limitation of overlaid help information is that they "often describe the function of an interface object rather than present a series of steps that will encompass the complete task." [11]. The documentation modal, and the step-by-step support it provides, is intended to address this limitation.

While we do not expect to be fully able to "future-proof" the assistance offered to older adults, research efforts dedicated to investigating the design of support systems that align with older adults' expectations of use may present novel modes of interaction to support older adults' independent learning of technology.

IMPLEMENTATION

The prototype is an application that simulates the look and feel of the native iPad settings, with the addition of our support features. The prototype was developed in XCode 9 (Objective-C), running on an iPad tablet. An off-the-shelf Flic [12] Bluetooth button serves as the tactile user interface used to invoke the help interface. A digital, on-screen help button also serves as an alternative invocation method for the help interface.

METHOD

To evaluate the design of our interface, we designed a simulation application that re-implements the look, feel, structure and contents of iPad settings, and help documentation was produced for every view. The iPad settings application was selected, as the interface is highly technical, and we can reasonably assume based on our auto-ethnographic evaluation that older adults would struggle to deduce its features intuitively. The sensitive nature of interacting with device settings may be inconducive towards confident use, allowing us to better evaluate the effectiveness of the prototype on user attitudes. We expect that this is generalizable to other tasks involving complex operations on tablet or mobile devices, or within apps running on such devices.

A short demographics survey was collected from participants, pertaining to questions about their gender, age, and education. Semi-structured interviews were conducted at the beginning and end of the session. Interviews and tasks were captured on video for future observation and analysis.

The 16-Question version of the Mobile Device Proficiency Questionnaire was administered following the completion of the introductory interview and is a valid measure for quantifying technological proficiency [27]. The System Usability Scale (SUS) and the NASA Task Load Index (NASA-TLX) were administered following the completion of each task scenario, excluding the baseline task.

Given the relative scarcity of research that quantifies the performance of such designs, we did not formulate a hypothesis. We do however answer the above research questions through a controlled experiment as described below.

The following task scenarios were selected to ensure that the findings from this study could be generalizable to other device settings interfaces. As described in our autoethnographic reflection, these tasks are known to challenge older adults who are unfamiliar with digital technology.

1. Network Settings: In this task, participants used the help systems to assist them in learning about the wireless network settings of the iPad, and to help them complete tasks such as 'turning on the Wi-Fi and connecting to a listed network.'
2. General Settings: Participants used the help systems to assist in learning about the general settings of the iPad, and to help them complete tasks such as 'locating the serial number' and 'changing the keyboard layout'.
3. Display Settings: Participants used the help systems to assist in learning about the display and brightness settings, and to complete tasks such as 'increase the brightness of the screen'.
4. Account Settings: Participants used the help systems to assist in learning about account settings, and to complete tasks such as 'sign into a social media account with existing credentials.
5. Application Settings: Participants used the help systems to assist in learning about application settings, specifically iBooks for iPad. Participants also used the system to help them complete tasks such as 'allowing the iPad to download digital content from the internet'.

Participants first completed the first task without the use of the prototype help system to evaluate their baseline performance. Following tasks introduced one of the four button/modal configurations. Each task provided the participant with time to familiarize themselves with the interface, with the given help interface condition. Following the study period, participants were asked to complete the aforementioned task scenarios. Participants were given use of the help system during the task scenarios, to be used if they became 'stuck'.

The study was a repeated measure (within-subjects) design, with five task groups and five conditions. Latin squares of size 5 were chosen to randomize and counterbalance the tasks and conditions, and to ensure that each condition is paired with each task an equal number of times. Each pair of conditions, including a baseline test (no conditions present) were tested in the course of the usability test.

1. **Baseline** (Control): Participants complete tasks without the aid of any button or help modal.
2. **Tactile Button: Overlay Modal** (TbOm)
3. **Tactile Button: Documentation Modal** (TbDm)
4. **Digital Button: Overlay Modal** (DbOm)
5. **Digital Button: Documentation Modal** (DbDm)

During each task scenario, we measured participants' error rate (ER) and the task completion time (TCT) in seconds, in addition to administering NASA-TLX and SUS questionnaires. These measurements and instruments were previously used in similar research. E.g. error rates and completion time were used to measure how well semi-novice users are supported when they transition to a new interaction paradigm [31], and especially for smaller form factor devices [6]. NASA-TLX was previously employed to determine the effort required by older adults when learning to use an interactive mobile helper system [9], while SUS is a commonly-employed instrument for assessing the usability of new interfaces [2], which is an important factor for the adoption of such systems especially by older adults [23].

We define error rate as the count of mistakes made during the task scenario. Errors were defined as incorrect selections during a task or backtracking away from the given task. Interactions associated with pathfinding back to the correct task were not considered errors in our evaluation. These measurements are used to evaluate the overall effectiveness of the prototype, as they are reliable and valid instruments for user experience research.

As UTAUT describes social influences as a determining factor of technology acceptance [34], Care was taken to ensure that interaction between the participant and the researchers did not become a confounding factor.

RESULTS

We present the results of the controlled experiment with 15 older adults, defined as age 60+. Quantitative usability metrics (Error Rate, SUS, NASA-TLX, Task Time) from the scenarios are analyzed to evaluate and contrast the effectiveness of the different contextual aid designs. Qualitative insights from the semi-structured interviews conducted with participants are presented to provide context to our results.

Participants

Participants were recruited by word of mouth, and from the community (through mailing list announcements) following Research Ethics Board approval for the study. All participants received compensation of 40 dollars (Canadian) at the conclusion of the session. 16 participants were recruited for the study; data from one session was discarded due to unanticipated physical impairment impeding the completion of the session. Half had prior experience as research participants with our lab and expressed interest in learning how to use mobile devices.

The mean age for participants was 67; among those, 47% held a bachelor's degrees, 26% held a master's degree, and 20% did not hold a degree. 80% of participants (N = 12) were retired, while two participants worked full-time and one worked part-time. 12 of the 15 participants were female.

The population demographics suggest that our recruitment protocol suffered from external factors resulting in a disproportionate sampling of highly educated, retired professionals, which is not convincingly representative of the general population. However, aside from prior exposure to mobile technology, we do not believe that the socio-economic status of our participants will have a confounding effect on our analysis. Additionally, the sample of participants was representative of our location in a very large, fairly well educated, metropolitan area.

While participants were screened for technology proficiency through self-reporting, formal screening tests for proficiency were not administered as part of the recruitment process on ethical considerations.

Each participant completed a 16-Question Mobile Device Proficiency Questionnaire (MDPQ16) to quantify self-reported technology proficiency. The authors of the MDPQ16 instrument [27] found the mean proficiency score of a sample of older adults to be 20.0 with a standard deviation of 11.0. Our participants reported an average proficiency score of 25.4.

One third of participants (n = 5) reported technological proficiency scores exceeding 31.0, more than one standard deviation outside of the mean. However, the proficiency scores of these participants are still well below the mean proficiency reported by young adults (38.4) [27].

Regression analysis of age in relation to proficiency reveals no significant correlation between these two factors ($r = .05$, $p = .40$). This is a rather unexpected result, as we anticipated age to be a factor of self-reported proficiency.

Error Rate (ER)

Table 1. Descriptive Statistics, Error Rate

Condition	N	Mean	Std. Deviation
Baseline ER	15	1.47	.834
TbDm ER	15	1.53	.990
TbOm ER	15	.53	.743
DbDm ER	15	1.13	1.187
DbOm ER	15	.87	1.060

Friedman's Analysis of Variance (ANOVA) was used to analyze the error rate in the total user group (N = 15). Due to the sample size, in addition to the experiment being run under a two-variable factorial design, assumptions of normality are not met. As such a non-parametric post-hoc test was used; Wilcoxon being the most appropriate given the ordinal and matched-sample nature of the data.

Table 2. Friedman ANOVA, Ranked Means

Ranks	Mean Rank
Baseline ER	3.73
TbDm ER	3.63
TbOm ER	2.10
DbDm ER	2.87
DbOm ER	2.67

Table 2 shows the baseline task ranking highest in error (3.73), while the Tactile button and Overlay modal condition pair ranked least in error (2.10). All help condition pairs reported fewer error rate than the baseline. Substantial differences in error rate were observed between Documentation and Overlay error rates between Tactile button conditions but not between Digital button conditions. High error rates were observed in the use of the tactile button, paired with the documentation modal, but only marginally different in error rate than the baseline.

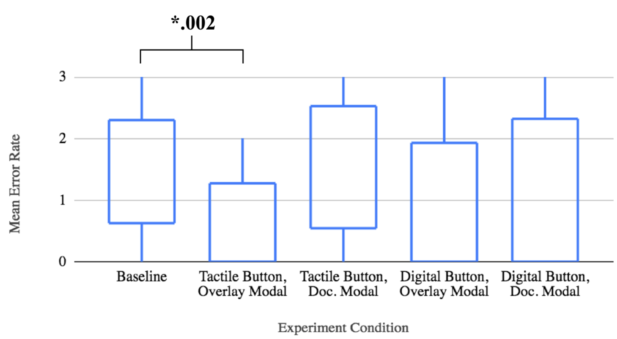
Investigating further, the results of the Friedman ANOVA test (Table 3). make apparent that error rate among conditions is significantly different (p = .005) between the different conditions and the baseline.

Table 3. Friedman ANOVA, Error Rate

Test Statistics (ER)	
N	15
χ2	14.696
df	4
Asymp. Sig.	**.005***

Post-hoc tests were used to identify the significant condition pair. 10 Wilcoxon tests were run in parallel post-hoc tests, therefore the threshold p-value for significance is adjusted for multiple comparisons. Using Bonferroni adjustment, we define the threshold for statistical significance to be p < = .005.

Fig 5. Visual representation of mean error rates across all conditions (as indicated in Table 1). Friedman ANOVA indicates that these error rates are significantly different across all conditions (as stated in Table 3), with Wilcoxon post-hoc showing pairwise statistically significant difference (p=0.002) between baseline and Tactile+Overlay (indicated with an overhead connector).



Statistically significant differences in error rate were found between the Baseline, and the Tactile button & Overlay modal type condition (p = .002), as shown in Figure 5. No other condition pairs reported statistically significant difference in error rate. Thus, we infer that, of all the condition pairs: **The assistance provided by the combination of Tactile button & Overlay modal significantly reduced error rate among older adults learning to use and interacting with the settings interface.**

Task Completion Time (TCT)

The Task Completion Time (TCT) was measured in seconds, for each of the five task scenarios.

Of the support interfaces, **TbOm** reported the fastest TCT and the smallest standard deviation of the condition pairs (M = 28.61, SD = 21.99). **DbOm** reported the longest TCT and greatest standard deviation (M = 54.94, SD = 48.99), as the only variable factor between these conditions is the method of invocation. In both cases, the documentation modal reported greater TCT than their overlay modal counterparts**: DbDm** (M = 31.53, SD = 31.40), **TbDm**: (M = 45.63, SD = 33.61). However, the **Baseline** ultimately reported the fastest TCT (M = 22.61, SD = 15.04), compared to any of the help conditions. This result is not unexpected, due to our sampling of older adults with relatively high levels of proficiency (Proficiency Score > 31.0, N = 5), who are less likely to perceive the settings interface as a significant challenge.

Friedman ANOVA was used to analyze Task Completion Time and did not find significant differences between conditions (χ2 = 8.53, df = 4, p = .074).

It should be however noted that TCT may naturally be higher for the conditions where a help menu is present, as users will spend more time engaging with the provided help. This is in contrast with the baseline that provided no help, thus creating a situation of additional stress and anxiety on participants, even if they were able to complete the assigned task in shorter time. As such, we are also reporting on relevant subjective measures.

System Usability Scale (SUS)

While Friedman ANOVA on SUS scores did not reveal significant differences in usability across conditions (χ2 = 3.633, df = 3, p = .304), the descriptive statistics suggest some potential differences in perceived usability between each condition pair. As expected, due to the significant effect of TbOm on error rate compared to the baseline, **TbOm** reported a high mean SUS score (M = 76.50, SD = 18.04). The **DbDm** condition pair reported the greatest mean usability score (M = 77.16, SD = 16.82), which is interesting as it was not found to have a significant effect on error rate in the previous analysis. **TbDm** reported lower usability scores (M = 70.33, SD = 18.46), and **DbOm** reported the lowest usability of all condition pairs (M = 68.83, SD = 24.89).

Cognitive Workload (NASA-TLX)

Similar to SUS scores, Friedman ANOVA did not find significant differences in cognitive workload across condition pairs (χ2 = 6.476, df = 3, p = .091). However, the inspection of descriptive statistics suggests additional corroborating evidence in support of our earlier statement that **the combination of Tactile button & Overlay**

modal (TbOm) is an appropriate design choice for a help and support interface.

TbOm reported the lowest subjective workload (M = 5.78, SD = 1.71) with participants among condition pairs. This is consistent with our understanding of TbOm being a significant factor in reducing error rate, in addition to scoring high on the system usability scale. **TbDm** reported the second lowest workload score (M = 6.48, SD = 3.35). **DbDm** reported the highest workload (M = 7.12, SD = 2.33), followed by **DbOm** (M = 6.50, SD = 2.88).

DISCUSSION

The evaluation of the prototype with older adult participants interacting with the settings interface found a statistically significant difference in error rate between the Baseline condition, and TbOm (p = .002). As no other condition pair reported statistically significant difference in error rate against the baseline, we conclude that the assistance provided by the Tactile button and the Overlay modal was effective in significantly reducing the error rate.

We found that the DbDm and TbOm condition pairs reported similarly high mean SUS scores, which is interesting considering the other permutations of the button and overlay conditions reported far lower scores. These findings may be explained by the differences in how the help invocation interaction is embodied. The tactile button is small, which, while being well received by most participants, it may present additional barriers to usability for those with impaired dexterity. As participant P3 described the tactile button: "*You can have it on you, though it could also use slightly less pressure. I'm just thinking of people that have problems with their hands and fingers, other than that, it's very easy and you can wear it. The pressure isn't that great, for me personally."*

The difference in reported usability score between the invocation modes and the documentation modal is also interesting. **DbDm** reported a high SUS score (M = 77.16) compared to **TbDm** (M = 70.33), which could be related to a mixed preference for documentation style information amongst our participants; *"I'll be honest, I don't like manuals cause I find most manuals are so convoluted"* (P15). This in contrast to preference for manuals: *"I'm an old-timer, so I just, I want to read first and learn first and, you know, like so if I open the box with a new product, I look for sure for things like that."* (P8).

It is curious that while the tactile button paired with the overlay modal always reported the lowest error rate across groups, the tactile button paired with the documentation modal always reported the highest error rate across groups, even when compared to the baseline. We speculate that the dramatic contrast between these condition pairs is the result of the tactile button and the overlay modal sharing metaphors pertaining to immediacy. In the case of the tactile button, the help metaphor of a physical 'panic button' disentangled from the interface itself may lend itself to greater immediacy compared to the on-screen digital button. Likewise, the contextually integrated and overlaid help style may lend itself to great immediacy when compared to the more traditional, documentation style of help. As such, we suggest that a physical "panic" button is an effective and supportive aid for older adults navigating new mobile interfaces, when combined with an overlay style help.

The high cognitive load scores reported by users of the documentation modal may be reflective of the increased volume of content and the work associated with processing and retaining the information. As one participant stated about the perceived usefulness of manuals: "*I'll be honest, I don't like manuals because I find most manuals are so convoluted, but at the time, you find what you're supposed to be doing"* (P15). In contrast, participants described their experiences with the overlay condition more favorably: *"because it's right there and it shows you, points you, to exactly what needs to be done, and has a little explanation."* (P7) which may explain the variance in cognitive workload. A possible explanation for this is that the overlay modal was more consistent with the task-based objectives assigned in the usability study, and thus provided users with a greater performance expectancy (UTAUT), the degree to which they believed the system would help them to attain gains in performance.

Finally, the high degree of variability in older adults' technological proficiency, mental models for technology use and learning preferences, in addition to the time-insensitive nature of self-directed learning, may explain why task completion time was not found to be an effective measurement for evaluating help interfaces.

Training Wheels or Graduation Boost?

To investigate how the prototype would perform differently between the high-medium and low-medium proficiency subsets of our population, we conducted separate analysis along the same measurements as described earlier. To determine the criteria for each proficiency subset, we compared our results to the calibrated technological proficiency score for older adults (M = 20.0, SD = 11.0) [27]. Scores of >31.0 are outside the expected range of technological proficiency for older adults. Therefore, we consider those participants with scores above 31 (N = 5) as part of the 'high' proficiency subset, alongside five of the "medium" proficiency users. Inversely, the bottom five proficient participants were assigned for the purpose of this additional analysis to the 'low' proficiency subset, together with the same five "medium" proficiency users.

Reductions in error rate were observed in the low-proficiency subset of our sample, between the baseline and TbOm conditions (Z = -2.460, p = .01) and between the TbOm and TbDm conditions (Z = -2.156, p = .03), however, the threshold for statistical significance is not met after adjusting for Bonferroni correction. However, statistically significant improvements in error rate were observed in the higher proficiency subset of our population, between the baseline and the TbOm condition pair (Z = -2.460, p = .001).

Intuitively, the design of this prototype may be seen as effective in helping those with very little tech proficiency (training wheels). However, the above analysis, conducted over proficiency-delineated subsets of our participants, suggest that the combination of tactile help button and overlay contextual help is most useful for those who are already on their way to becoming proficient (acting as a "graduation boost").

Design Implications

Our findings are consistent with those of related work, namely, Stencils-Based Tutorials [14], which also featured help balloons (in the form of sticky notes) in conjunction with a restricted interface. Evaluation of the Stencil-Based Tutorials found that the design of such interfaces resulted in significant improvements to speed, and error rate. The results of our study also found overlaid help information to improve error rate and reported faster task completion times than documentation style help. Designers of technologies for aging population should consider providing contextual help that restricts the possible range of interactions, with help information that is embodied within the context of the visible interface.

User-carried single-button interfaces have so-far shown promising levels of acceptance by users [21], which is also consistent with our findings. Overall, we found that the physical, tactile invocation of the help resulted in improvements to error rate, task completion time, usability and cognitive load compared to a digital, on-screen button. These findings imply that the integration of a tactile help button to invoke help may be effective in reaffirming older adults' confidence, enabling effective, independent technology use. This is also consistent with the UTAUT model defining the degree of ease of use as a determinant of technology acceptance.

LIMITATIONS

While researchers in this study withheld technical support to the participants during the task scenarios, our presence as study moderators meant that we did not observe the use of the aid by older adults under independent circumstances. While care was taken to minimize these effects, there may be unintended social influences, a UTAUT factor, present during the experiment. The researchers' presence may be perceived by the user as pressure to perform. As one participant described: "*And there's really no pressure to be performing in a certain way, but if I were by myself, I think I would probably be more focused on the actual problem solving… I was just very aware that I was performing for someone else.*" (P2). Such external factors may confound the accuracy of the evaluation. Future work will broaden the current investigation by controlling for the social influence factor, such as in a longitudinal deployment study that aims to evaluate the acceptance and longer-term performance of the tactile aid.

While similar to other usability studies with older adult populations [36][4], the gender distribution of participants in this study was not evenly balanced. Future work should sample a greater degree of male participants to account for gender-based variations in technology acceptance and adoption.

CONCLUSION

In this paper, we designed and implemented a prototype help system for tablet devices to support older adults as they interact with unfamiliar interfaces. Usability testing found that help information, overlaid on the interface, and invoked by a physical tactile button, may be effective in supporting older adults as they interact with new interfaces, particularly for those who are no longer absolute novices. We believe that the findings from this study can serve as a useful recommendation for designers of mobile interfaces, who seek to implement effective help and support systems for older adult users.

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