HelpCall: Designing Informal Technology Assistance for Older Adults via Videoconferencing

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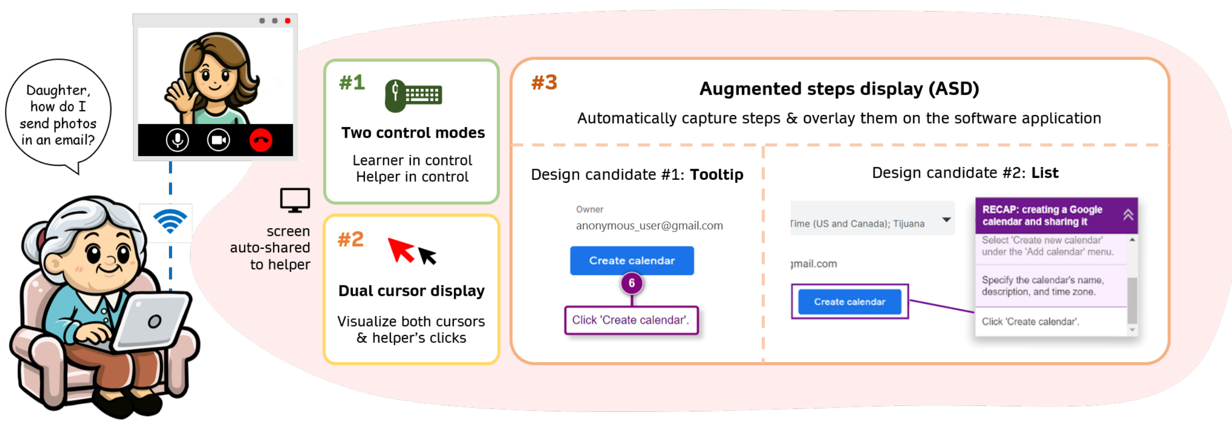

Figure 1: Illustration of HelpCall design concept: the older adult learner connects to their helper for tech support. With HelpCall on, the learner's screen is automatically shared with the helper and augmented with the three components of HelpCall – the most important of which, *Augmented steps display (ASD), has two design candidates called* Tooltip *and* List.

ABSTRACT

Older adults commonly rely on younger family members for remote tech support, but the current general-purpose video-conferencing platforms fall short of effectively catering to their needs. We introduce the design concept and prototypes for HelpCall, an augmentation of these platforms that provides aids for learning computer tasks, including a step-by-step visual guide automatically generated from synchronous human instruction. Through observations and interviews with older adults (N=14), we assessed the potential of the HelpCall concept and compared its two design candidates: Tooltip with numbered location markers and List of written steps. All participants acknowledged HelpCall's potential to improve the comfort and efficiency of synchronous tech support. Tooltip emerged as more promising and could be enhanced by incorporating the well-received features from List. Our findings provide clear directions for advancing HelpCall design and new insights into designing synchronous software help for older adults, taking a step towards universal accessibility of digital technology.

CCS CONCEPTS

• **Social and professional topics** → **Seniors**; • **Human-centered computing** → *User centered design*; *Accessibility design and evaluation methods.*

KEYWORDS

older adults, seniors, synchronous, remote, informal support, software learning

ACM Reference Format:
Teerapaun Tanprasert, Jiamin Dai, and Joanna McGrenere. 2024. HelpCall: Designing Informal Technology Assistance for Older Adults via Videoconferencing. In *Proceedings of the CHI Conference on Human Factors in Computing Systems (CHI '24), May 11–16, 2024, Honolulu, HI, USA.* ACM, New York, NY, USA, 23 pages. https://doi.org/10.1145/3613904.3642938

CHI '24, May 11–16, 2024, Honolulu, HI, USA

ACM ISBN 979-8-4007-0330-0/24/05
https://doi.org/10.1145/3613904.3642938

1 INTRODUCTION

In recent years, older adults (OAs) have become increasingly eager to learn and incorporate technology into their daily routines [17, 37, 50, 82]. One of the common and preferred ways with which OAs acquire a new technology skill is through over-the-shoulder help from a family member [14, 37]. But with the recent COVID-19 pandemic and the rapid growth in video-mediated communication (VMC) technologies, many have transitioned to remote support through video-conferencing or remote desktop access software, such as Zoom, Skype, or TeamViewer [37, 72, 76]. However, these tools are neither optimized for learning nor designed for the specific needs of many OAs. Some OAs tend to perceive themselves as slow learners who need a lot of clarifications and repetitions, and thus can easily feel reluctant to request help from family and friends [72], creating a barrier from getting the support they need.

Many research and commercial solutions provide learning support as an interactive step-by-step instruction solely for asynchronous use [1, 20, 30, 41, 92]. However, none of them was designed to generate real-time instruction on the learner's device nor evaluated in a synchronous context, limiting the possibility of personalization and human interaction that users tend to prefer for software learning [27, 46, 83, 86]. Therefore, our goal is to explore such an approach to synchronous assistance for OA learners. Our overarching research question is:

RQ1. To what extent is the concept of a synchronous augmented VMC viable for supporting OAs in learning software tasks on their own devices?

For the concept to be viable, we also need to address these design and evaluation questions:

- **RQ2.** What would be the design of such a system? How would it integrate the helper's instructions such that OAs could learn and then complete a task independently?
- **RQ3.** How would such a design be experienced by OAs? For example, how do OAs perceive the tradeoff between any added interaction complexity (relative to the simplicity of a basic VMC) and the added benefits?

Using a user-centered design process, we drew on prior work on remote communication for other contexts (e.g., collaboration, asynchronous learning) and younger populations to develop a set of design requirements and the design concept of "HelpCall," a VMC-based assistive help tool for OAs. The most important and novel component in HelpCall is a display of the how-to steps extracted from the helper's instruction in real-time, called augmented steps display (ASD), which is intended to help OAs follow the instruction and connect the visualized step to the demonstrated action, so that they can independently recall it later. Relying on literature, design experts and a small group of OAs, we evolved the HelpCall concept into a prototype, with two ASD candidates to explore: Tooltip attaches a clickable tip to each step's location, while List consolidates all steps into a centralized, scannable list (Fig. 1). With medium-fidelity prototypes of both candidates, we conducted an exploratory comparative qualitative user study with 14 OAs to investigate the potential of the HelpCall concept and compare the ASD's two candidates for design insights.

We make two key contributions. The first is the HelpCall design concept, a VMC augmentation that leverages live human assistance to create a visual, step-by-step, in-application instruction for users to review and master at their own pace. The second contribution is the empirical findings from a qualitative comparative evaluation of the medium-fidelity prototypes of two design candidates for HelpCall and the basic Zoom during synchronous help sessions for OAs. In addition to assessing the efficacy of the design concept and ensuring its promise before investing the effort in a comprehensive design and implementation, we also present findings on OAs' preferences and needs when seeking computer support and discuss implications for future designs.

2 RELATED WORK

2.1 Older Adults' Needs and Preferences in Receiving Computing Assistance

Over the past few decades, an increasing proportion of the OA population is going online and using digital technology [4, 17, 34, 50, 75]. Individual OA's use of help resources and human support varies depending on digital aptitudes, skills, and access to support, as well as the task's difficulty [37]. Despite such diversity in the population, on average, OAs encounter more difficulties and need more time and support than younger people to acquire computer skills [10, 25, 43].

Research indicates that the effects of aging on working memory capacity, perceptual speed, and ability to maintain focus on task-relevant information tend to be evident by the age of 65 [49] and may present challenges for some OAs in the process of learning to use computers [16, 21, 35, 62, 81]. To account for these, there are basic guidelines for training OAs, based on empirical results and educational psychology theories, such as cognitive load theory (CLT) and cognitive theory of multimedia learning (CTML) [18, 61, 93]. These include providing clear, concise, step-by-step reference, immediately correcting mistakes, and maintaining a comfortable pace. In terms of lesson structure, OAs appear to learn better in an informal, personalized, active learning environment [2] and by being exposed to the correct steps before scaffolding by practicing, ideally self-paced, with gradually reduced support to minimize confusion and reduce cognitive load [18, 61]. The preference for complete step-by-step instructions has also been confirmed in more recent empirical studies [54, 72]. To the best of our knowledge, these guidelines have yet to be applied in the context of remote computer assistance for OAs.

In addition to learning efficiency, we consider OAs' preferences for different means of getting support. Recent studies have found that, despite the willingness to try to figure out things on their own, it is still very common for OAs to turn to family, friends, or technicians to synchronously teach them what to do and correct their mistakes [37, 72]. Family and friends, in particular, can tailor the support to the OA's skills or preferences, and draw on their shared experience [39, 55]. Continuous support from them has been shown to prolong an OA's technology use [48, 63], while the lack of social support and resources could have the opposite effect [73]. Prior to the COVID-19 pandemic, a helper could provide in-person, over-the-shoulder help, but now, many resort to online methods such as video-conferencing instead. Compared to in-person help, research found that video-conferencing offers lower cost, convenience, promptness [14, 22, 37, 76], and allows the OA to connect with and collaboratively learn from their families or others in their social circle, making the experience emotionally valuable or even enjoyable [44, 72, 77, 83]. However, some OAs are cautious of using this form of support for fear of interrupting, bothering, or burdening their family and friends, especially if they perceive themselves to be a slow learner or often have to ask repeated questions [54, 57, 76, 83]. This could be alleviated by providing assistive tools or support to boost their learning efficiency [57, 72], which is what our design concept aims to do, but in the context of remote synchronous support, which has not been done before.

2.2 VMC for Older Adults and for Tech Support

Recent studies have shown a growing acceptance of and willingness to use VMC technology among OAs, especially since the COVID-19 lockdown [5, 14, 37, 69]. As with other populations, OAs have used VMC for communication, entertainment, learning, and services [5, 67, 69, 77], and recognized its benefits [44, 67–69, 71]. However, studies have also identified their challenges in using VMC independently. For example, a recent study with OAs aged over 65 found that many had trouble receiving a Skype call even after a 45-minute training [68]. Common barriers include the need for support, coupled with limited patience, access to resources, or self-evaluated capacity to learn, and concerns about safety and privacy [3, 44, 67–69, 71, 77]. These, however, may be counteracted by their perceived value of a convenient channel for social interaction, as well as endorsement and support from family and friends [67, 77].

VMC-based tools such as video-conferencing and remote desktop software are currently the standard platform for remote support. VMC is suitable for one-on-one learning wherein the content is continuously negotiated and adapted to the learner [52]. However, it also requires from both sides an ability to utilize the tool's features and an understanding of the medium [65] (e.g., how conversations in VMC tend to involve fewer turns and interruptions compared to face-in-face [88], or how to use nonverbal cues to coordinate speaker turns [36]). Not only are VMC tools utilized by family or friend helpers, but also professional tech support. MicroMentor, for example, facilitates this process by connecting learners to an expert for a 3-minute video-call [42]. However, it targets tech-savvy users as it requires learners to submit a detailed request, imposes a time limit, and provides no learning assistance beyond what standard VMC tools already offer.

Other helpful video-conferencing tool features such as screen sharing and synchronous remote control [14, 37, 42] are studied more extensively in the area of shared virtual space, where the focus is on creating an intuitive and seamless experience. Previous work has featured many designs that integrate concurrent actions and sharing controls between remote [40] and co-located users [38, 74], as well as many theoretical frameworks on using communication cues to coordinate in a remote synchronous session [24, 28, 31, 32] and studies on giving and taking control of a mouse between *co-located* users [38, 74]. All of these are situated in a collaborative context, hence the focus is on integrating work done in parallel or switching controls. However, sharing and switching control could be counterproductive in an instructional context, especially with OAs. Few studies have touched on sharing a computer's control for instruction [12, 37, 74, 87], and their findings inform our design concept. To the best of our knowledge, no work has been done on augmenting video-conferencing tools for providing computer support, let alone with OAs.

2.3 Asynchronous Approaches to Software Assistance

Plenty of asynchronous designs, tools, and resources allow users to self-pace their learning, and complete the task as often as needed, summarized in Table 1. In the 'Separate from the software application' column are tools that search for or generate tutorials in the form of text, visual media, or interactive video. Whilst more effective than manuals, they still require users to match the tutorial's content to the application by themselves. Meanwhile, tools in the 'In-application' column integrate the help resources into the target application as an interactive, within-context tutorial. Some of these require manual curation of the instructional content, while others are done automatically using various heuristic and machine learning algorithms. In this regard, techniques from Programming-by-Demonstration (PbD), which aims to train machines to imitate demonstrated actions, may also apply to our automated step extraction. It should be noted, however, that PbD emphasizes the machine's ability to mimic the helper's actions while our approach creates a human-readable guide to help users learn to perform tasks themselves.

Among existing interactive step-by-step guide tools, HelpCall has a unique concept and user flow. As acknowledged in Jin et al., recording the guide asynchronously implies that the guide is based on a different machine/device with a potentially different model, software version, settings, etc. [41], which could lead not only to a different UI from that of the learner, but also to different available features or task flows. Unlike tools like Remo [1], Tipper [20], and Synapse [41], HelpCall generates guides that are intended to be *created* or *used* synchronously, in a setup where learners can communicate with the helper and customize the task to their needs. Further, while these other tools provide an interactive step-by-step guide, they do not support *demonstration* of the complete and correct sequence of steps. It is also worth noting that Remo and Tipper are only partially developed, published as a poster and late-breaking work.

To leverage the benefits of both asynchronous and synchronous modalities, Help Kiosk supports both modalities together in one large tabletop screen, where the synchronous channel is only basic VMC [72]. Taking another approach to integrate synchronous and asynchronous modalities, HelpCall explores the novel concept of generating an instruction from a synchronous help session and displaying it in real-time, so that the OA gets a visual demonstration with live interactions, as well as a generated personalized set of instructions to use as a reference asynchronously.

3 DESIGN OF AN ASSISTIVE COMPUTER HELP PLATFORM FOR OLDER ADULTS

We developed the design concept of HelpCall, a VMC-based computer assistance platform for older adults, and its prototypes through phased user-centered design. With a high-level concept of an assistive tool for remote synchronous computer help, we curated design requirements (3.1.1) from the literature and used them to refine the concept and define the key features. After multiple brainstorming and design critique sessions (3.1.2) and cognitive walkthroughs (3.1.3), we had a medium-fidelity prototype ready for the formal evaluation (Section 4).

Source of content \ Location of help content	In-application	Separate from the software application
Demonstration *(directly or from a demo video)*	Synapse [41], Remo [1], EverTutor [92]	DemoWiz [13], MixT [12], Torta [70], photo editing tutorial from demo [29], HelpViz [96], Scribe, TutorialPlan [56]
Manually created tutorial *(incl. those without explicit content creation process)*	IP-QAT [60], Tipper [20], ToolClips [30]	Ambient Help [59], RePlay [23], instructional video from markdown [11], crowd-sourcing steps for how-to videos [47], WikiHow, help forums

Table 1: Examples of asynchronous tech help tools and resources

3.1 Informing the Design

3.1.1 Design Requirements. Our goal is to achieve a universally usable design, namely one that meets the needs of older adults but will be usable by others as well. To that end, we began by reviewing need-finding and design work on remote support and software learning, with a focus on older adults and inclusive design principles. From these previous works, we curated a list of requirements, which served as a foundation for the entire design process. The requirements marked with an asterisk (*) are based on research involving older adults, while the rest apply to general users.

- Req1. *Support screen-sharing and giving remote desktop control of the learner's machine to the helper [18, 37, 61, 72].
- Req2. Provide voice communication as the base channel [33].
- Req3. *Use visual cues (instead of verbal explanation) to help OA identify UI components in a way that does not distract the learner or cover important information [22, 33, 54].
- Req4. Provide material to help OA follow instructions and facilitate self-paced scaffolding practices:
  - *Record the exact steps, including the step's text description, location of the relevant UI component(s), and possible pitfalls [54, 87].
  - *Split information into small steps and arrange steps into a logical sequence to reduce cognitive load [14, 66].
  - *Remove unnecessary information and provide the appropriate details for the learner's skills [22, 54, 66, 87].
  - Present the steps in a readily accessible location (e.g., overlaid or side by side) [79, 87].
- Req5. *Base all demonstrations and visual displays on the learner's version of the UI to reduce effort and avoid mistakes from having to reconcile different UIs [41].
- Req6. *Follow basic recommendations when designing for OAs: minimal new concepts, plain language, and unambiguous icons, accessible UI, consistent visual cues [20].
- Req7. Support tasks involving multiple software applications [87].

3.1.2 Brainstorming and Design Critiques. Starting with a high-level design concept and a set of design requirements, we generated and iterated on design ideas through four sessions of collaborative brainstorming and design critique. These sessions took place over a six-month period and varied in size, each involving between 6 to 30 participants, consisting of HCI graduate students and faculty members with diverse levels of familiarity with the project.

3.1.3 Cognitive Walkthrough with Three OAs and Three Design Experts. After refining the design ideas based on the brainstorming and critique sessions, we implemented the first version of medium-fidelity prototypes with the minimum interactivity needed to communicate the design's mechanism for the two most promising design candidates. With six participants (three OAs and three experts who participated in the design critiques), we conducted an informal cognitive walkthrough and asked for open feedback. We identified several usability issues, from insufficient visual contrast to unintuitive interaction flow, and concepts that are difficult to grasp for OAs. Interestingly, between the two design candidates, participants' preferences were evenly split, thus we proceeded with both.

3.2 HelpCall Design

3.2.1 Design Concept. HelpCall builds on top of VMC, which provides the base channel for communication (Req2), but is intended for only two people: a learner and a helper. When the help session starts, the learner's entire screen is automatically shared with the helper. Except for the camera feed (optional), the learner and the helper always see the exact same screen, including both cursors and all assistive displays, to establish a fully shared virtual space and eliminate the possibility of one person referring to something that the other cannot see, satisfying Req5.

In addition to this basic setup, HelpCall has three main components (Fig. 1), all designed to operate independently from the target application(s) to support tasks involving multiple applications (Req7). Appendix A describes these three components in more detail, and Appendix B illustrates how they come together through an example task.

1) Control modes. When providing remote technology support, there are two common modes of sharing control over the mouse and keyboard inputs: *learner in control* and *helper in control* [87]. HelpCall users can switch back and forth between them during the session, fulfilling Req1.

2) Dual cursor display. To reduce the cognitive load needed to interpret a location's description, visual cues are used to supplement verbal descriptions whenever possible (Req3). Thus, the learner's and the helper's cursors are always visible to both parties, enlarged and differentiated by color [74]. An animation is used to further highlight the helper's clicks (see Fig. 3).

3) Augmented steps display (ASD). Based on Req4, the ASD automatically captures a helping interaction, extract "steps" from it, then displays them immediately by overlaying them on top of the target application(s). Each step contains the location of the interaction performed and the text that summarizes the interaction. The ASD's objectives are: 1) to reduce the need for the OA to catch and memorize every step; 2) to reduce the OA's need to ask/repeat questions; and 3) to facilitate and encourage some degree of self-paced learning.

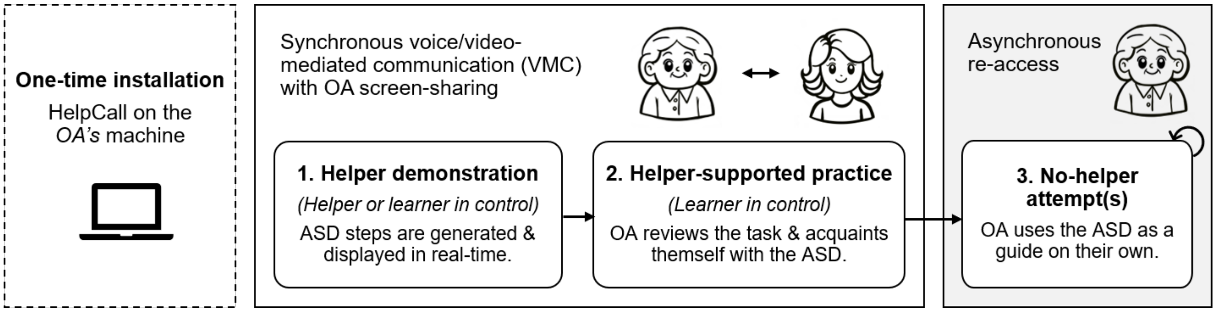

Figure 2: An intended 3-round interaction flow between the OA learner and the helper when using HelpCall. (Note that the full design of the asynchronous re-access, as well as its full evaluation, is left for future work.)

3.2.2 Interaction Flow. HelpCall is to be installed once on the OA's machine. Each time the OA wants help, they establish a voice or video call with the helper and activate HelpCall. The 3-round interaction flow in Figure 2 outlines one of the ways it may be used. During the helper demonstration round, the helper shows and explains the steps needed to complete the task. In this round, the demonstrated steps get extracted and displayed in real-time to help the OA follow and comprehend the sequence of steps. Next, in the helper-supported practice round, the OA attempts to do the task with the help of the ASD, during which the helper can still provide hints, answer questions, or modify the steps in the ASD if needed. Finally, after the call, the OA can pull up the saved ASD on their device and use it as a reminder when attempting the task on their own. It should be noted that this is only one of the multiple ways HelpCall can be used, as it provides users with the flexibility to consult it however they need, rather than enforcing a specific flow.

3.2.3 Design Candidates for ASD. Unlike the control modes and dual cursor display, the ASD is the novel component with rich design possibilities. Through the design critiques and cognitive walkthroughs, we narrowed down to two promising candidates: 'Tooltip' and 'List'. The visual design of both candidates follows the basic guidelines for designing for OAs to the extent possible (Req6). A demo of both design candidates is available as a video figure.

1) **Tooltip** displays a numbered tip next to the UI component that can be clicked on to view the step's auto-generated text description, similar to Tipper [20]. As shown in Fig. 3, it takes up little screen space, is conceptually straightforward, and supports two levels of hint: location only (closed tooltip) or location and text description (open tooltip). When a new tooltip is created, it appears in a closed state by default, and multiple tooltips can be independently opened and closed. The visual and interaction design of a tooltip is relatively simple, but there were still questions about its effectiveness and usability left to be answered through the evaluation study. For example, we wondered if users might struggle to find a tooltip in a long, scrollable page. Since tooltips are attached to the step's location, users also cannot see and have no information about tooltips on a different view or page at all, which might create confusion.

2) **List** presents the steps in a scannable, interactive list. The entire list can be collapsed to save space, but otherwise, text descriptions of the steps are shown in a scrollable box on the side of the screen, as shown in Fig. 4. Clicking on a visible step reveals a 'location anchor' linked to the relevant UI component, adopting a similar concept to context-preserving visual links in information visualization [84] (note that the desired design is to have the anchor line emanate from the list item it is associated with as in Fig. 1, but for a technical reason we had to do it from the purple banner instead). When a step is recorded, a notification appears near its location (Box 1, Fig. 4), and as the subsequent step is logged, the previous notification shifts into the step list (Box 2). The rationale for the List design is to allow the learner to see the complete sequence of the steps compiled in one place [12, 29, 66]. In exchange for scannability, it sacrifices screen space and conceptual simplicity. More design decisions and rationale are included in Appendix A.

3.3 Prototype Implementation

The medium-fidelity prototypes are an interactive mockup of predetermined tasks, with Wizard-of-Oz control by the researcher to emulate partial functionality. The control modes and dual cursor display are simulated with Windows built-in wireless screencast, MouseMux Pro[1] (for using two mice and keyboards), and Carnac[2] (for click highlighting). For the ASD, implementing an automatic step extraction would be too technically complex for this design stage, so we instead created partially functional replicas of real websites (e.g., Google Calendar, YouTube) in Axure RP and hard-coded the visual guide for all steps into them. If a participant tries to perform an action not implemented in the prototype, a pop-up message notifies them that the action is "unsupported"

4 EVALUATION STUDY

We conducted a user study with OAs following a structured observation approach [45, 51], relying primarily on qualitative analysis to understand the participant's full experience in a comparison between basic Zoom, Tooltip and List; quantitative metrics were secondary. To minimize technical issues and confusion between participating in a remote study and receiving remote tech support, the study was conducted in person with two mirrored laptops.

[1]https://mousemux.com/
[2]https://github.com/Code52/carnac

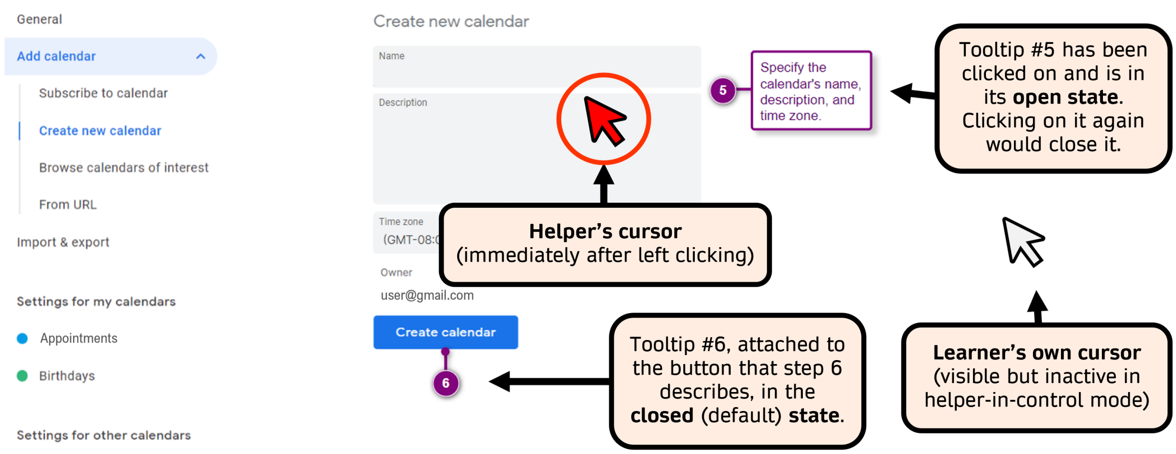

Figure 3: Annotated screenshot of the TOOLTIP design on an example of creating a new calendar on Google Calendar, at the 5th-6th steps, in the helper-in-control mode. The red circle around the helper's cursor indicates a left click and disappears after 3 seconds (blue is used for right clicks). The screen looks the same in the learner-in-control mode but without click highlighting. Note that the orange boxes with black outlines and arrows are annotations and not part of the prototypes.

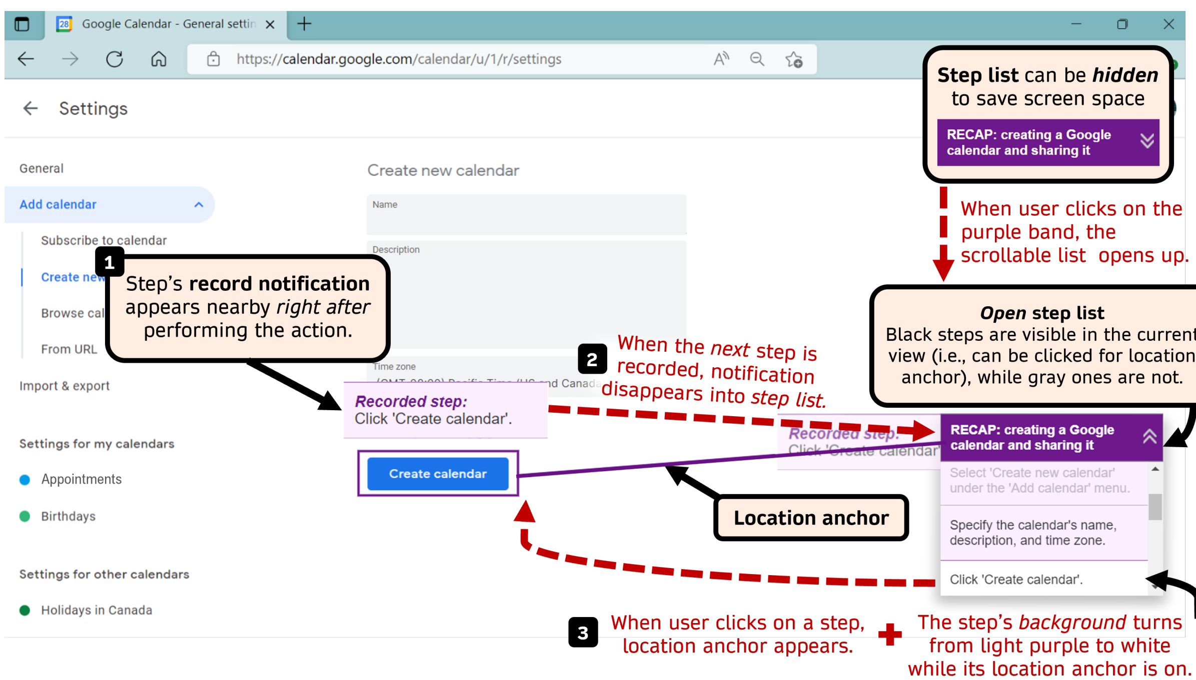

Figure 4: Annotated screenshot of the LIST design on an example of creating a new calendar, at the step of clicking the 'Create calendar' button. Each orange box describes a UI component and the red texts and arrows describe user actions (not part of the prototypes).

4.1 Research Methods

Each participant learned three computer tasks from a helper, acted by a research assistant, under three conditions, one task per condition. The first condition imitated Zoom (i.e., the learner shared their screen and only received verbal instruction) and served as a soft baseline and a warm-up task. Between the other two conditions, half the participants experienced TOOLTIP first and the other half LIST first to mitigate the order effects and the impact of first exposure to the novel concept shared by both design candidates. Participants were asked to confirm that they did not already know how to do the task before it was assigned to minimize the effect of the participant's prior experience with each task. To gain preliminary insights into whether OAs prefer or find it helpful to see the helper's face and gestures, half of the participants had a cardboard screen separating them and the helper (voice only), and the other half did not, allowing them to see one another over the laptops (voice+visual). We also ensured that all participants experienced both control modes (learner in control and helper in control).

Tasks. Prior to the study, we selected six learning tasks of beginner to intermediate difficulties and implemented a Tooltip and a List version for each. Then we assigned three tasks to each participant such that they were equally unfamiliar with them, and that each task was assigned to every condition at least once. The tasks were:

A. Create a recurring event in Google Calendar and set up notifications
B. Upload an unlisted video on YouTube
C. Schedule an email with attached images to be sent on the specific date and time in Gmail
D. Create a new Google Calendar and configure its time zone and sharing setting
E. Place a book on hold on a public library website and pause it until a specific date
F. Copy a news article and tweet it as a thread on Twitter

Procedure. Prior to the in-person session, eligible participants completed an online questionnaire on their demographics, living conditions, experience with technology, CPQ-12[3], and familiarity with the six prepared tasks to inform task assignment. At the session (60-90 minutes), participants learned three tasks from a researcher acting as the helper, while the lead researcher moderated and observed the session. The participant was asked to imagine that the provided laptop was theirs and the helper was remote; they were also seated so that they could not see each other's screens.

For each task-condition pair, there were three rounds corresponding to the intended flow (see 3.2.2): helper demonstration, helper-supported practice, and no-helper attempt. Self-rated confidence was collected before the first and after the last round. Following the tasks was a semi-structured interview where participants reflected on their experience and shared suggestions. This procedure (Fig. 5) was finalized after three pilots with one OA and two younger volunteers, and has been reviewed and approved by our university's ethics board.

4.2 Participants

We screened participants to be over 65 years old, in good health, and capable of operating mice and keyboards. They must also have at least 1-year experience using a personal computer (either desktop or laptop) on a regular basis and have used any video-conferencing tool at least three times. We recruited 14 eligible participants (no overlap with cognitive walkthrough) through convenience and snowball sampling, as well as advertisements on a paid studies website, a senior community's Facebook group, and a local senior's residence. Each participant was compensated $25.

We collected demographics and background information related to computer experience to better understand our participant pool (Table 2), and found it to be fairly diverse in terms of age, gender, cultural background, and occupation before retirement. Our participants had a wide spectrum of computer proficiency, with CPQ scores ranging from 17.3 to 29.7 out of 30. Experience in independently operating video-conferencing tools and preferred methods to seek computing help also varied, reflecting diversity in the degree of self-reliance within our sample. All data were self-reported except CPQ-12, which we administered.

4.3 Data Collection and Analysis

Given the exploratory nature of the study, we focused on analyzing qualitative data from the post-study interview in conjunction with behaviors observed during the tasks. During the session, the screen of the laptop (provided by us) and their voice were recorded through Zoom. Qualitative data used for analysis included observation notes from the session (taken both in-situ and post-hoc from the recording) and the interview transcript, generated by Zoom and manually proofread. We analyzed the data with a bottom-up thematic analysis [9], starting inductively and finishing deductively. We began the analysis after the first 6 participants with two researchers open-coding the transcripts and discussing possible themes in order to probe further into them with the rest of the participants. One researcher coded the rest, but continued to regularly discuss the codes and themes with the other researcher to ensure rigor and consistency.

To contextualize qualitative findings, we also collected six quantitative metrics: pre-task self-rated confidence in completing the task (1-5 Likert scale), post-task confidence with and without the ASD, duration of the helper demonstration and no-helper attempt rounds, and rate of mistakes. Mistakes are defined as steps skipped or incorrectly done (excluding those they noticed and fixed by themselves), and are normalized by the total number of steps in that task. The Wilcoxon signed-rank test was employed to assess the differences between paired samples, given the small sample size ($n = 14$) and that the normality assumption was not met. Tooltip, the more positively received variant, was used to represent HelpCall in its statistical comparisons against Zoom. Due to the exploratory nature of the study, we did not anticipate statistically significant results and only selectively reported them to complement qualitative results.

4.4 Positionality Statement

To contextualize our analysis results, we reflect on the potential influence of our individual backgrounds and motivations. The lead researcher (early 20s) grew up in a large Asian household with extended family and has maintained close connections through regular video calls after moving to another country. As their family members often seek their help with technology, they have direct experience with intergenerational technology support and believe in its practical and emotional value. Similarly, the other co-authors also remotely assist their parents with technology. In the context of this study, we recognize that our background and experiences may

[3]CPQ [8] measures an OA's computer proficiency by self-rated ability to perform six groups of computer tasks on a scale of 1-5. The score is the sum of each group's mean. To keep the study a reasonable length, we opted for the abridged version with 12 questions, supplemented by four questions selected based on pilot participants, hence the score range is 6-30.

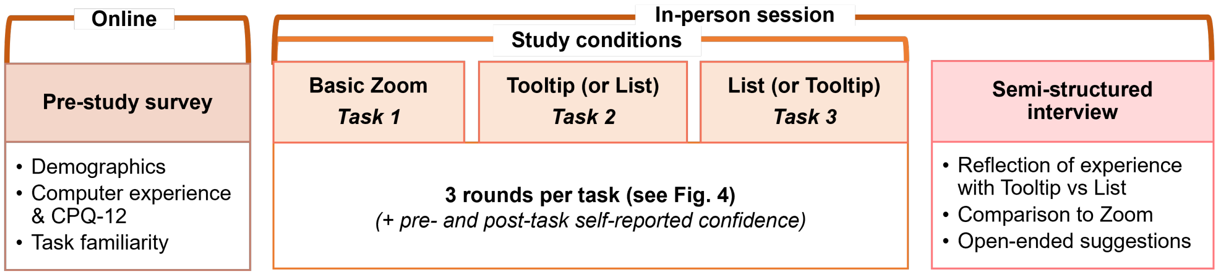

Figure 5: Overview of the study procedure

P#	Age	Years of computer experience	Gender	Cultural background	Former occupation	CPQ-12[3]	Have gotten remote tech help before?
P1	81-85	15	Male	Canadian	Lawyer	26.7	Y
P2	70-74	30	Female	East Asian	Engagement coordinator	27.3	Y
P3	76-80	24	Female	European	Nurse	29.7	N
P4	81-85	15	Male	Canadian	Sales and marketing	27.5	Y
P5	76-80	30	Male	European	Post-secondary instructor	21.3	N
P6	76-80	30	Female	European	Teacher	29.5	N
P7	65-69	35	Male	European	Investigator	21.7	Y
P8	86-90	34	Female	Canadian	Counsellor	29	Y
P9	81-85	25	Female	European	Travel agent	24	N
P10	81-85	37	Female	Canadian	Artist/realtor	28.7	N
P11	76-80	13	Female	European	Lab technologist	30	N
P12	65-69	40	Female	European	Nurse	27.2	Y
P13	81-85	25	Female	Jewish	Therapist	18.5	Y
P14	76-80	30	Male	European	Senator	17.3	Y

Table 2: Summary of participants' characteristics

have impacted the questions asked in the interview and conclusions drawn from the data. Thus, throughout the data collection and analysis process, we remained mindful of our positionality and constantly examined the validity of our interpretations.

5 FINDINGS

Our thematic analysis reveals three themes. The first (5.1) demonstrates the potential of the HelpCall concept by highlighting its positive impacts felt by participants (RQ1). The second theme (5.2) explores the design considerations for integrating the helper's instruction to support OAs' learning by comparing the two design candidates of ASD (RQ2). The third theme (5.3) delves into other aspects of OAs' experience, focusing on hindrances to HelpCall's adoption (RQ3).

5.1 Strengths of the HelpCall Design Concept

HelpCall shows positive influences on perceived learning experience and performance (5.1.1). Participants attributed this to the synchronous interactions with the helper, enhanced by both the real-time ASD (5.1.2) and the dual cursor display (5.1.4), as well as the ASD's reusability both within and after the session (5.1.3).

5.1.1 HelpCall overall appears to positively affect learning experience and performance. As anticipated, participants had a fair amount of trouble following instructions using basic Zoom. Based on both observation and interview, 10 out of 14 participants had moments where they struggled to find where to click based on the helper's explanation when using Zoom (P4: "I didn't like [Zoom]. It was hard to follow and to remember.") On the other hand, P1, P7 and P12 found it helpful to have the instruction in a "step-by-step" format, and all participants appreciated it as a memory aid. P13 explained that "[With Zoom], I was put into anxiety where I wasn't with [Tooltip] and [List]. The memory piece is difficult, and if I can't remember, it will throw me into anxiety, so then that stops learning." This also aligns with the quantitative data, as the mistake percentage with Zoom (Mdn = 0.08) is significantly higher than with HelpCall (Mdn = 0), $n = 14$, $W+ = 8$, $p = .049$. Similarly, the average post-task confidence on Zoom (Mdn = 4) is significantly worse than that with HelpCall (Mdn = 3), $n = 14$, $W+ = 8$, $p = .044$.

Manual note-taking was first brought up by P2 as the common unautomated counterpart of the ASD. In total, eight participants shared that they typically take notes on paper when learning computer tasks. When asked to compare, all eight indicated a strong preference for HelpCall over their usual note-taking routine. The most popular reason was the reduced effort; the only exception was P9, who wanted to actively type out the step's description because "I'm used to using my fingers to make the connection to my brain." Other reasons include: (1) the step's descriptions are more detailed, accurate, and neat, (2) the step’s locations are precisely visualized, (3) everything is contained in one place.

5.1.2 A synchronous session with a helper eases subsequent navigation of the ASD. Participants found the synchronous demonstration valuable for various reasons. First, *participants appreciated having the steps’ visual guides appear immediately after that step is taught.* Even though they were focusing on the task and only noticed it in the peripheral during the helper demonstration, out of eight participants we probed into this with, six prefer seeing the visual guides getting populated, because it (1) highlights the logical flow, (2) associates instruction with action (P13: “I think seeing [the visual guides] appear after each step, each action, helps connect the action to the number and the text, and I’d know how many steps there are and where they all are too,”), and (3) is less overwhelming than “getting the entire list thrown at me at once” (P9).

After the demonstration, *the helper-supported practice facilitated additional conversation and familiarization with the ASD*, which all participants found helpful. 10 out of 12 had clarification or exploratory questions that they did not ask in the first round. Furthermore, we found that participants used the practice round “not just to do the task one more time, but also to become familiar with where the tooltips are before you are left on your own.” (P6). In other words, it gives participants an opportunity to orient themselves to the ASD and develop a strategy for using them on their own. In fact, P6 and P12 believe that the ASD was only easy to use later because they had seen and performed the whole sequence before, and it would have been challenging to directly try to follow the ASD without using it with the helper first.

Finally, *a synchronous session allows the helper to elicit a precise task description and demonstrate the task on the OA’s device.* We asked participants to share what tasks they imagine using HelpCall with, and the following were mentioned: calendar, social media, video player, printer, settings, online shopping, organizing/creating/saving/zipping files, editing photos, transferring photos from camera, using variations of copy-cut-paste. This shows that tasks OAs want help with can be both broad and specific, so a common problem with online solutions is that they often “say, ‘do these steps and then get back to me’, and it never works” (P12). This is inevitable, as the ‘correct’ solution depends on a precise task description and the OA’s operating system, software version, etc. While nearly impossible to do asynchronously, a synchronous session with a helper allows them to ensure this by working together on the OA’s device.

5.1.3 ASD’s reusability facilitates repetition within and after the session. With the ASD, *learners can watch the helper’s demonstration first without the pressure to memorize.* Out of 14 participants, everyone except P5 and P2 prefers to watch the helper’s demonstration using the helper-in-control mode first, as seeing the correct sequence right away reportedly lowers their workload and saves both sides from frustration. P13 and P14 also felt that they retained more information by watching. With the ASD, they felt that they could do so without worrying about the helper going too fast because “the steps are set up so that you can go through them again” (P10). In line with these sentiments, quantitative data show that *helper’s demonstrations* went significantly faster when the helper was in control (Mdn = 177, in seconds) than in the learner-in-control mode (Mdn = 264.5), n = 14, W+ = 97, p = .003, but no signs of difference in the OA’s performance or confidence. Only two participants preferred to use learner-in-control mode right away, because “If I’m following the instruction and doing the movement, it would be a stronger reception of the information.” (P5).

Beyond the help session, *the availability of the ASD for asynchronous reuse is highly valued.* All participants expressed a desire to repeat the task a few more times and appreciated that they could do so at their own pace without taking more of the helper’s time (P1: “it’s a good tool to have, to be able to go back… What’s lacking on computers is how to do things and then, you know, follow up.”) They explained that they might need reminders to recall the steps after a while, but the helper may be unavailable or they may feel bad to ask again. P1, P3, P4, and P6 also shared that even if they can figure the task out on their own, they feel more reassured to have the ASD to fall back on. This ability to re-access the ASD in their own time was identified as the key strength of HelpCall by P1, P2, and P6. In fact, P14 and P12 even misunderstood that to be its only intended use (P12: “I was just assuming that once you actually develop this, there wouldn’t be a person at the other end.”). Although the asynchronous usage was not a primary focus of the study, this shows that the asynchronous part of the HelpCall’s interaction flow is easily recognizable and highly valued.

5.1.4 Both dual cursor display and click highlighting supplement the verbal instruction. 11 out of 14 participants found it helpful to see the helper’s cursor as a spatial guide to complement the verbal explanation when the OA was in control of their machine, while the rest thought it was unnecessary because the helper’s verbal explanation was clear enough. On the other hand, five found the click highlighting helpful for clarifying where to click, while others felt neutral about it.

5.2 Design Trade-offs of Tooltip vs. List

All things considered, nine participants preferred Tooltip, three preferred List, and two indicated no preference. Both design candidates proved to be effective ways to show the spatial location of steps. Yet we uncovered the strengths and weaknesses of Tooltip (5.2.1) and List (5.2.2), which made them suitable for different levels of guidance (5.2.3).

5.2.1 Tooltip provides more scaffolding and better illustrates the task’s logical flow. One of the unexpected strengths of Tooltip is how it provides scaffolding. ASD was designed to present the steps as visual guides without any specific consideration for adapting to individual OA’s learning progress. However, we learned that Tooltip essentially provides two levels of scaffolding with its closed and open forms, and users can choose when to use which form according to their own learning needs. As P11 described, “It feels like it’s testing me too. When I saw the number I just knew that that was the next step, and then without clicking it, I tried to figure it out on my own first, and it made me feel good if I could do that without having to click it [open].” This corresponds to a core tenet of scaffolding that added support elements push learners to challenge themselves, and thereby reduce their need to use the support elements [6]. It is also consistent with the consensus among participants that they would use the ASD a few more times, but would rely on it less and less until they no longer need it. To better assist this process, there is room to provide even more scaffolding by adapting the visual guides to a user's task familiarity (e.g., hiding steps that learners can already do quickly).

Another strength of Tooltip is that it shows the logical sequence and strongly associates it with spatial information. As P6 explained, "You've pointed out the logic rather than giving me a list of things." Not only does this help OAs internalize the logical flow, but it also attaches visual and spatial information to it, reportedly helping them memorize both the location and the action more easily. Four participants also thought the Tooltip is conceptually simpler than List, and three liked how it required little effort to follow. As a result, 10 out of 14 participants reported using the tooltips as a spatial reminder and only opened them when they needed further clarification, and everyone except P4 and P9 preferred the tooltips to be closed by default for the cleaner interface.

5.2.2 *List offers scannability and unmistakable location anchors.*

The three List voters (P4, P9, P10) all gave different reasons for their preference. P4, along with four others who did not vote for List, appreciated how List compiles all steps into one *scannable* step-by-step instruction. However, P9 liked how it felt more classic and similar to paper notes – a sentiment P7 also shares – while P13 simply enjoyed reading and interpreting words. In addition, even though they gave equally high confidence ratings when using Tooltip and List, P1, P3, and P4 mentioned in the interview that they felt particularly 'confident' or 'reassured' using List because they have access to a complete list of steps, including previous ones, with them at all times. These benefits are, however, somewhat curbed by the current design that can be scrolled once the steps have filled up the allocated space. The steps became not fully scannable and participants appeared to engage less with the later steps in the task. P13 explained that "because I had to scroll to find the right step, I just didn't bother to [do so] for the steps I remembered."

Another strength of List is the location anchor's clarity. According to P13, "Because there's lots of stuff here that can detract, whereas the line is right there. You cannot miss that." In fact, P4 and P8 even clicked on list items to open the location anchor without even reading the text descriptions, suggesting that they found the location anchors to be the most essential design element. There were, however, six participants who relied almost solely on reading during the List condition, either because they preferred to read or forgot to use the location anchors.

5.2.3 *List is more suitable when the OA needs detailed and comprehensive guidance, while Tooltip better supports OAs who only need occasional reminders or confirmations.*

To better understand individual differences in design preferences, we looked into participants' characteristics and found that all three participants who voted for List have CPQ scores below our sample's average, while those with above-average scores unanimously prefer Tooltip. Thus, we investigated whether participants' proficiency and task expertise may be related to their design preferences.

Interestingly, we found that participants seem to prefer different design candidates based on how familiar they are or have become with the task. For example, P3 explained that they only prefer List after forgetting how to do a task completely, as it would be easy to read and follow the steps in order. Similarly, P1 thought they should use the List for the first few times, switch to Tooltip as they become more comfortable, then eventually turn the ASD off altogether. From our observation, we suspect two plausible reasons for this. Firstly, Tooltip provides spatial hints that take minimal effort to follow if users do not need a detailed text description. However, less proficient OAs appear to benefit from the text description, so they need to open the tooltips and are less able to utilize their closed form in a rapid manner. Secondly, List is apparently much easier to use if the user follows the steps in order without skipping, as it otherwise becomes difficult to know which step they are on. On the contrary, users only need to look at the number on the tooltip near their last action to know the number of the next tooltip. As such, the two design candidates are suitable for different situations: List better serves OAs who follow the step's visual guides closely and sequentially, while Tooltip allows those more familiar with the task to more easily skip steps.

5.3 System and social barriers to adoption

We identified potential barriers to adoption involving the complexity of the design (5.3.1) and the social considerations that led to OAs' reluctance to seek help from a family member (5.3.2).

5.3.1 *Complexity of the design concept is a barrier for some.*

P1, P5, and P9 did not manage to familiarize themselves with and fully utilize either design candidate of ASD. Others also had various misunderstandings about HelpCall's concept and features, some taking a while to understand that steps' text description and location are automatically extracted, not manually created, and some not realizing that they needed to click on the application itself, not on a tooltip, to perform the action. We eventually rectified these misunderstandings with all participants but one of the *pilot* participants felt so overwhelmed by the information that they would rather just use Zoom. Thus, if the tool's concept and mechanisms are not communicated well, it can be a barrier to adoption. It should be noted, however, that our participants were learning how to use HelpCall and how to do the assigned task concurrently; ideally, the helper would avoid stacking up the complexity by initially demonstrating HelpCall through a simpler, known task.

5.3.2 *A handful of OAs preferred not to reach out for help.*

While all participants said they would like to use HelpCall when asking someone for tech help, we identified another layer of barrier against asking for help in general: eight out of 14 participants preferred to rely on themselves first and would reach out only if they could not figure it out. We discovered that this may be because they are careful not to burden the helper, because their advanced technological skills reduce the need for personalized help, or, interestingly, due to a misjudgment of the task difficulty and their own skills. In contrast to the well-documented lack of confidence among some OAs in the literature [37, 58, 72], we found that some OAs may also overestimate their ability to complete computer tasks independently. Four of our participants self-rated their confidence higher *before* learning the task than *after*. P4 explained that "...you can get into it and get completely lost with it. But you don't know that until you try and you get lost." This kind of misjudgment could diminish the sense of need for the assistive learning features, making the OA less inclined to reach out and use HelpCall.

On closer inspection, we found that OAs' willingness to seek help also varies based on who the helper is. Out of six participants whose preferred mode of getting help is remote assistance, three preferred to get it from family or friends, and the other three preferred professional tech support. Reasons for preferring professionals include the belief that, by job description, they must be more knowledgeable and willing to help, as well as unwillingness to bother family or friends. When asked if they would use HelpCall with tech support, everyone also said they would, with the expectation of having the steps quickly and easily saved for later use. Altogether, this suggests that professional tech support using HelpCall may be a solution for some OAs who are unwilling to reach out to their social circle for help.

5.3.3 Seeing each other's faces appears to add little value and is undesirable for some. We did not observe or hear of any struggles that are unique to either the voice-only or the voice+visual (i.e., able to see each other's faces and gestures directly) arrangement, nor did we find any hint of quantitative differences between them (see Table 3 in the Appendix). So the value of seeing each other appears to be low. Two participants also had strong opinions *against* having a camera feed. P7 explained that video calls restrict movements, cannot quite replicate the sense of physically being with people, and make them self-conscious about their looks – the reason also given by P9. The expectation of turning on the camera may burden some OAs and deter them from using a VMC-based channel to seek tech support. Only P12 expressed a strong preference for video over voice-only calls because they are slightly hard of hearing and need to read lips.

6 DISCUSSION

Our findings supported HelpCall's design concept and revealed insights that could inform its future improvements or similar tools for OAs. Grounding our findings in the literature, we now discuss broader implications.

6.1 Design Concept Validation

6.1.1 ASD demonstrates synchronous benefits and promises asynchronous benefits. Our design of ASD builds upon and effectively solidifies prior work in breaking lessons into steps and removing irrelevant information to help with learning [14, 61, 66, 93], showing positive impact on both the learning experience and the performance (5.1.1). In addition, in line with OAs' increasing preference for independent technology use [37, 72], the ability to save and re-access ASD both in real-time and asynchronously was deemed highly valuable (5.1.3). Contrary to previous studies' findings that learners tend to struggle with the helper's fast-paced demonstration [37, 72, 79, 87], the ASD, especially the Tooltip design, helped our participants catch the helper's actions with the visual guide. Even for those who did not look at the steps as they got populated during the demonstration, it creates an awareness that the steps are getting clearly and accurately recorded, and will be available to them later, creating a sense of reassurance. In this way, the ASD is useful not only for an asynchronous, self-paced re-access, but also for a more effective and comfortable synchronous learning experience.

6.1.2 Synchronous help remains essential in HelpCall's interaction flow. An OA's social groups play an important role in promoting and maintaining their technology use [53, 90, 91]. Despite ASD's benefits, our findings suggest that personalized human assistance remains valuable to OAs (5.1.2). Several participants mentioned that the demonstration round was "the most helpful", some even indicating that following the ASD on their own right away would have been challenging, highlighting the benefits of using the ASD with the helper before re-accessing it on their own later. The frequent back-and-forth clarifications and confirmations also suggest that a *non*-personalized or asynchronous guidance would have been insufficient. Furthermore, the synchronous demonstration allows for task personalization [13], wherein the learner can interactively communicate their exact requirements to the helper as they go through the task, and guarantees that the solution works on the OA's device and setup. Therefore, despite the potential for the ASD to be used asynchronously, part of HelpCall concept's strengths lie in the initial synchronous session.

6.1.3 HelpCall has the potential to reduce OAs' reluctance to ask for help. Despite the benefits of a synchronous help session, there seem to also be barriers discouraging OAs from utilizing it. The post-study interviews revealed that many are reluctant to ask for help in real life (5.3.2). Among our participants, some were truly capable of troubleshooting most issues by themselves while some underestimated the task's difficulty. Neither is much of a problem, as the former only confirms the wide range of technological skills among OAs [89], while the latter should only delay but not stop them from seeking appropriate help. However, it is a real barrier that several participants were, as previous works have found, cautious not to bother and take up their loved ones' time [26, 64]. In the latter case, the more effort it takes the helper to provide support, the less likely the OA would be willing to ask for it. Our OA participants found that HelpCall helped streamline the instruction and reduce future needs for a helper, suggesting that HelpCall could encourage those who need help to reach out and receive help with fewer qualms.

6.2 Design Implications

Comparing the two design candidates, we found different strengths in each one (5.2.1-5.2.2). With Tooltip, we found that not only is bite-sized, broken-down steps helpful [14, 66], but so is the explicit numbering that ties them into an ordered sequence. With List, we identified the benefits of scannable texts and an 'unmistakable' way to visualize location. As the perceived value of each candidate appears to vary with the learner's perceived task difficulty (5.2.3), these findings provide insights into how to accommodate various task difficulties and learners across proficiency levels. Tooltip is a more natural starting point, but further adjustments are needed to improve its usability for less proficient learners. For example, to help learners locate the next tooltip and see the whole picture, we can integrate a simplified version of List's central overview of steps into Tooltip. Alternatively, we could allow users to toggle between Tooltip and List based on the level of support they need at each stage in the learning process. Furthermore, new features such as a mistake checker, progress tracker, or feature recommender could further ease the OA's learning experience and reduce the design complexity to better accommodate less proficient learners.

Despite the desire for various assistive features, a strong and unanimous preference for simplicity led to unexpected results. While facial and gestural information should enrich voice-based communication through conversational grounding [15], reduced ambiguity [19], and increased social presence [7, 80], our participants did not value having a camera feed, some even preferring not to have it on (5.3.3). Such attitude has been found in other studies as well [94, 95], but not without tension to the emotional value it brings. Thus, our participants' neutral-to-negative attitude should be interpreted considering the fact that our study design did not account for the socioemotional effects or the helper's preferences, i.e., whether the helper wants to see the OA. As such, although voice-only may seem preferable, similar systems should still consider including the option to turn the camera feed on.

A similar trend was found for the dual cursor display and click highlighting. Our design of real-time visual cues appears to have accomplished their intended goal of helping OAs follow software instructions, yet participants didn't feel that they were as valuable as we had expected (5.1.4). With the ASD capturing and displaying the step immediately, it is possible that these additional visual cues were conveying overlapping information and thus were not as impactful as the literature [22, 33, 54] may have suggested. These results also imply that for OAs, keeping the design simple appears to be more important than adding various non-verbal cues to enrich communication.

6.3 Generalizability Across Users, Tasks, and Contexts

6.3.1 Usability and usefulness to broader ranges of learners and helpers. The OA population is highly heterogeneous and ought to be recognized as such in HCI research [89]. Even with our small sample size, we observed variances in their technological skills, attitudes towards VMC, motivations to learn new technology, and social considerations around asking for help. So, while not representative of the population, our findings capture a substantial and insightful portion of the multifaceted landscape. Our participants' enthusiastic reception of HelpCall suggests that the design concept could be usable and useful for OAs of varied abilities; and we anticipate that this may also be the case for younger people who would benefit from a cognitive or memory aid. Moreover, despite a focus on accommodating those with extra needs, HelpCall was designed to support as broad a range of technology learners as possible, echoing the curb-cut effect in universal design where solutions for specific groups can benefit many [85].

On the helper's side, in addition to younger family members, we identified two other groups of potential helpers: tech support staff and peer collaborators (5.3.2). Some OAs feel more comfortable getting help from professionals, who should have no difficulty learning HelpCall even if they have never used it before. Meanwhile, the HelpCall design concept can also be extended to support a collaborative session between people of comparable expertise (e.g., two OAs), which, unlike support from younger kin, is less likely to impede the sense of autonomy [64, 78], and may thus be desirable for some. However, our current system somewhat assumes a knowledgeable 'helper', so to support this, our system would need a more accurate algorithm for extracting the correct steps, along with high-quality description and location, to handle more trial-and-error and lower capacity to manually clean up incorrectly extracted steps. Additional design requirements include the turn-taking mechanism and ASD's manual editing capability. However, as a concept, HelpCall can support non-acquaintance and less-skilled helpers as well.

6.3.2 Applicability to other tasks and contexts. Beyond the six selected tasks, participants shared a broader set of tasks they would use HelpCall with, including those that are hardware-related and/or not web-based (5.1.2). This underscores HelpCall's versatility, but there are also scenarios for which it may be less effective or inapplicable. Step placement could be tricky in interfaces with densely packed elements, especially for Tooltip. Tasks that extend beyond the OS (e.g., BIOS setup) or involving multiple devices (e.g., wireless headphones setup) are not supported. Finally, while supported, HelpCall may not bring many benefits with simple, single-step tasks (e.g., opening an app).

Our findings offer implications for other learning contexts and other VMC tools as well. The pros and cons of synchronous communication, of real-time visual cues, and of keeping some of those cues asynchronously re-accessible can be applied to other uses of VMC, such as remote collaborative brainstorming sessions or customer services. The design implications from Tooltip and List could inspire or inform the other instructional tools/interfaces so that they would better accommodate diverse content complexities and learner's abilities. HelpCall's concept could also be applied to certain forms of *domain knowledge* learning, in addition to *user interface* learning. For example, for graphic design, the ASD's visual guides could be displayed on top of a design artifact itself. In addition, HelpCall can serve as a content generator for knowledge sharing by sharing the generated step-by-step instructions or tutorial videos with others who lack access to a helper, as an alternative design to existing demonstration-based tutorial systems [1, 41, 92].

7 LIMITATIONS

Several limitations should be considered when interpreting the results of our study. Due to the heavy cognitive load needed to learn multiple tasks consecutively, participants performed a single task in each condition, potentially limiting the generalizability of their reflections. Similarly, while we did some assessment of the impact of a "simulated" camera feed, it was done by allowing half the participants to see the helper's face over the laptops and the other half to not see the helper at all. Each participant did not experience both arrangements. Thus, our comparison between voice-only and voice+visual is preliminary. Secondly, participants' experiences were not entirely realistic as the study was conducted in person and the prototypes were partially hard-coded, not fully functional, and operated using the Wizard-of-Oz approach. Although we recognize that the human-written instructions might have inflated participants' perceived value of HelpCall, our findings still provide valuable insights into the potential of the design concept.

Finally, we acknowledge that our participant pool is not fully representative. Despite our effort to recruit from various channels to capture the heterogeneity of the OA population [89], participants' occupations, computer experience, and CPQ scores suggest they are a socioeconomically advantaged group. We also did not recruit their family or friends as a helper, so the socioemotional effect and the helper's preferences could not be measured. Once we have a more refined and complete design, we can conduct comprehensive evaluations with dyads of an OA and a helper of their choice.

8 CONCLUSION

We present the design concept and prototypes of HelpCall, a VMC augmentation that simplifies control sharing, allows simultaneous use of cursors, and generates persistent, in-application, step-by-step visual guides for a computer task based on synchronous human instruction. It was positively received by all 14 participants. Between our two design candidates, Tooltip is more promising, but we also found a possible connection between design preference and task expertise and identified strengths of List that can be incorporated into Tooltip to mitigate its current flaws. Our findings contribute new insights into a design space of synchronous software help for OAs. As computer adoption among OAs continues to lag behind younger populations, there is a need for innovative approaches to support their technology learning, and we have shown HelpCall to be one promising approach. There remain interesting design and technical challenges, such as how to extract accurate steps in real-time. Yet, as a starting point, this work moves us one more step closer to closing the technology adoption gap between generations.

ACKNOWLEDGMENTS

We thank AGE-WELL NCE and Designing for People (funded by NSERC CREATE and UBC) for funding this project.

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A ADDITIONAL DESIGN DETAILS OF THE PROTOTYPE

(1) **Control modes:**
- *Learner in control:* The learner retains sole control over all inputs, while the helper's interactions are visualized as an additional but non-active pointer. This gives the learner hands-on experience and control over the pace, which is more conducive to learning [74, 87]. The challenge is for the helper to communicate the steps to the learner (e.g., explaining where to do what), which could cause frustration for both parties [87]. Compared to passively watching the helper, learner-in-control also takes more focus and mental energy from the learner.
- *Helper in control:* The helper gains full remote control over the learner's device, and the learner just watches the helper's interactions until the remote control is released by the helper or taken back by the learner. Thus, this mode of support is efficient and convenient for the OA. The downside is that demonstrations tend to be too fast-paced for the OA to replicate, and thus often need to be repeated multiple times [37, 72, 79, 87].

(2) **Dual cursor display:** When the learner is in control, their cursor is active and slightly bigger than the helper's, while the helper's cursor is an inactive pointer (e.g., can move but cannot click). Additionally, to improve the visibility of the helper's actions when they are in control, our design includes click highlighting: the helper's clicks are shown as red (left click) and blue (right click) ripples that expand out from the mouse's position and fade out after 3 seconds (Fig. 3). The visualization is intended to be simple, clean, and intuitive, and was positively received in our informal cognitive walkthroughs (Section 3.1.3).

(3) **Augmented steps display (ASD):** Most design details of the ASD are already in 3.2.3, but with many subcomponents, List was shaped by several detailed but important design decisions. For example, we initially designed the recording notification to disappear after 4 seconds, but two cognitive walkthrough participants felt that it forced them to try to read quickly, causing them stress. So, we used the next step to trigger notification disappearance instead. Another tricky aspect is that the text description of every step is listed, but only the ones anchored to currently visible UI components can be clicked on to show the location anchor. These steps need to be clearly differentiated to minimize confusion on what is clickable. A step's background color (white vs. light purple) shows association with the currently shown location anchor, and the font color (gray vs. black) differentiates unclickable and clickable steps.

B DESIGN WALKTHROUGH EXAMPLE

B.1 Tooltip (on Task A)

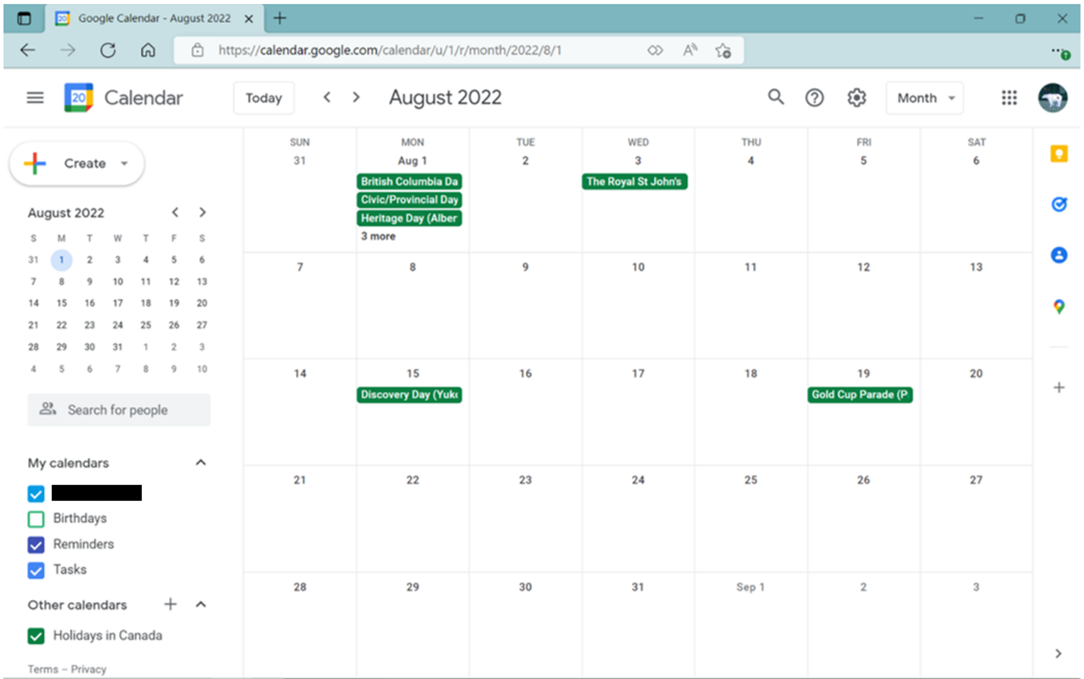

Figure 6: Starting screen of the task: creating a recurring calendar event starting on September 26 (Task A).

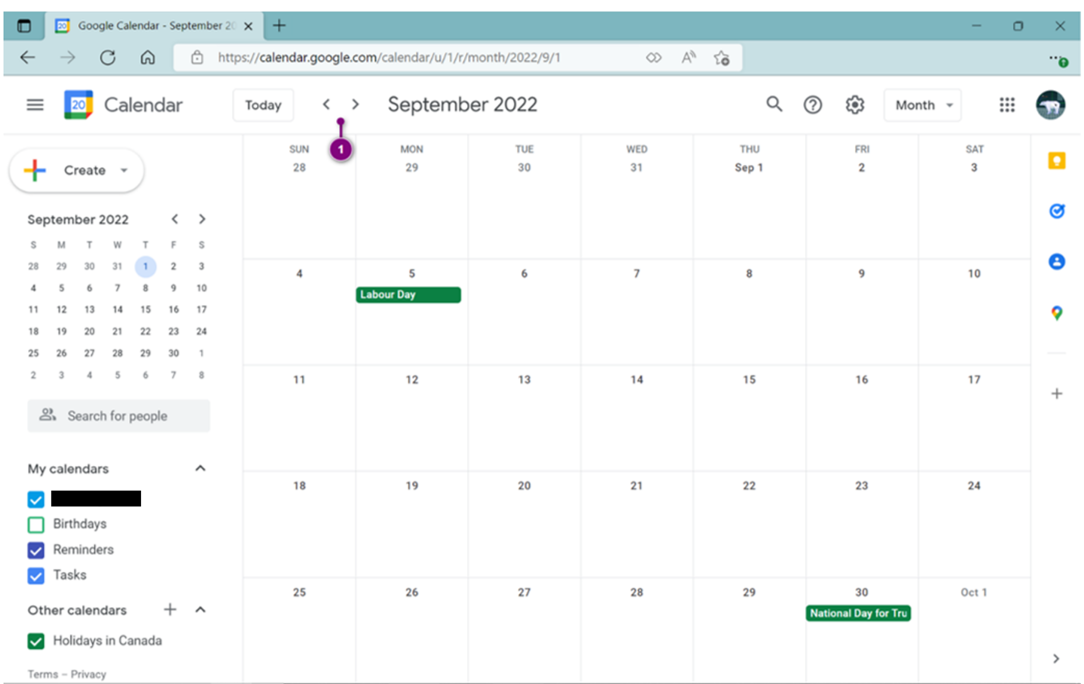

Figure 7: After clicking on the right arrow to change the month to September, Tooltip # 1 appears.

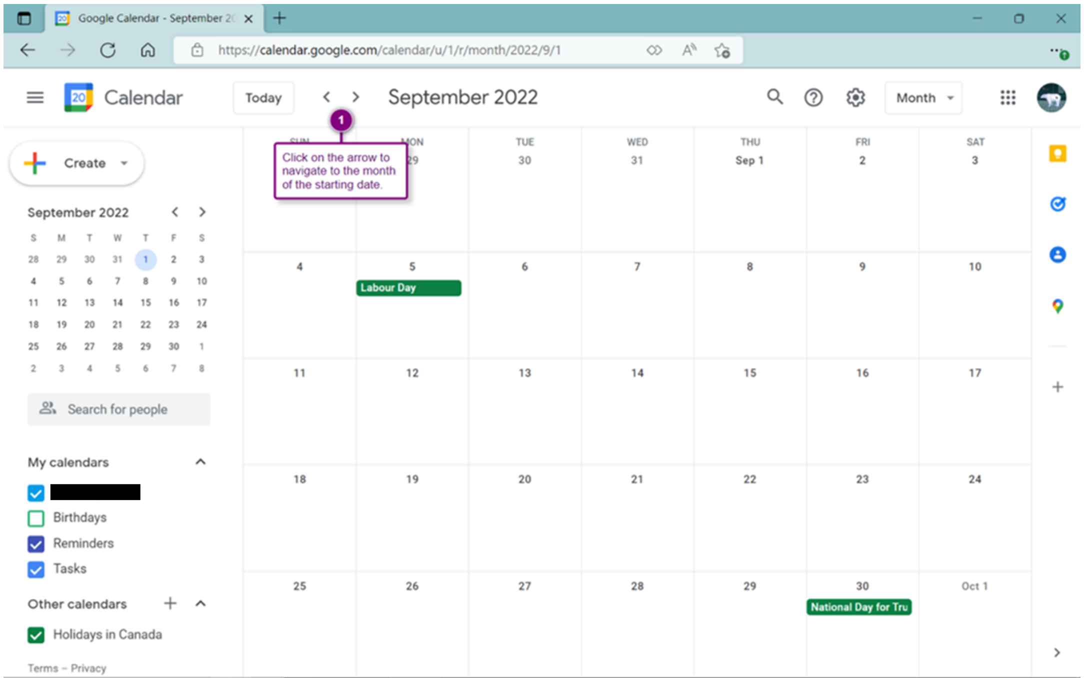

Figure 8: If we click on Tooltip #1, the tooltip opens to show the text description for the first step.

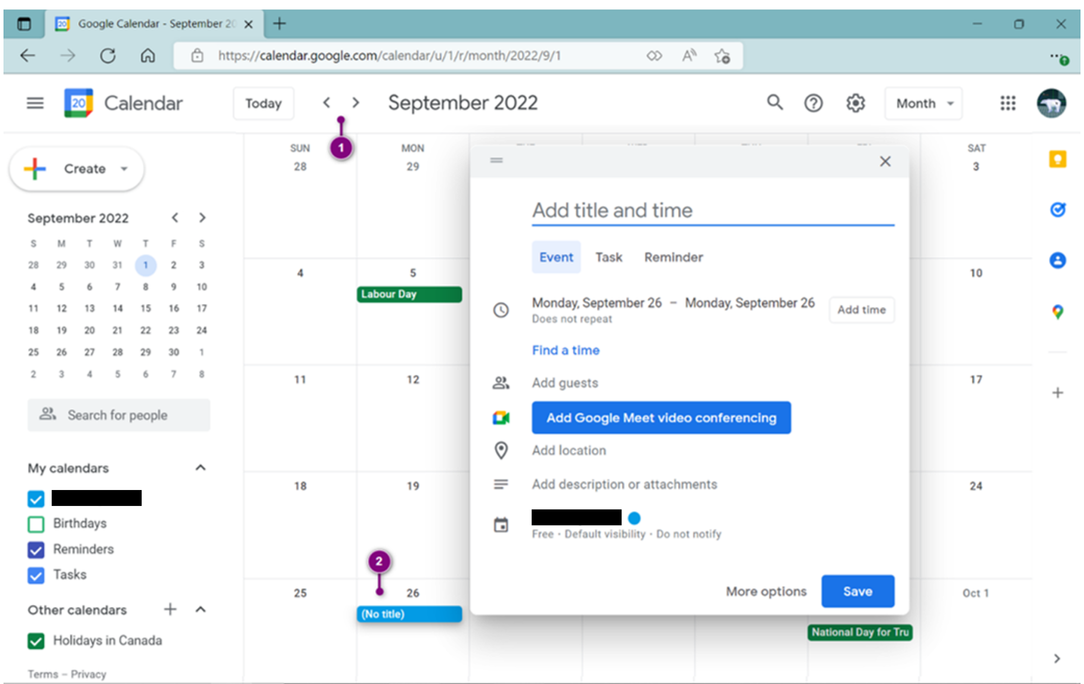

Figure 9: The next step is to click on the event's starting date, the 26th. After doing that, Tooltip #2 appears.

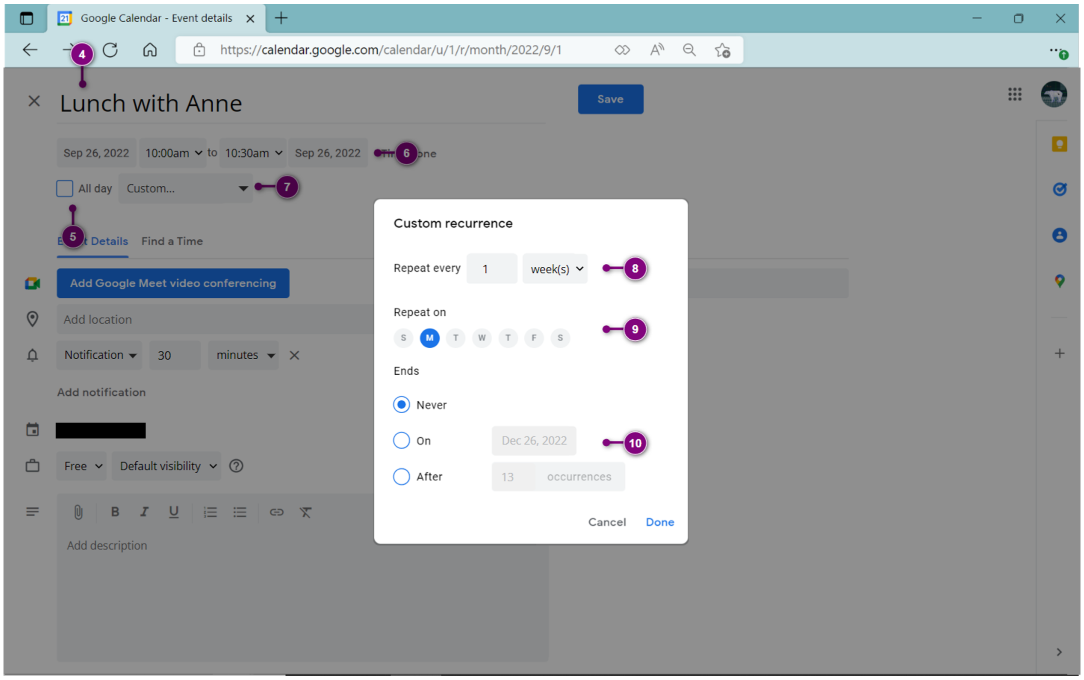

Figure 10: After clicking on 'More options' in the previous view, we arrive at this event creation page. This is the screenshot after filling in the event name, setting the time, and specifying the repeat pattern, which correspond to Tooltips #4 to #10.

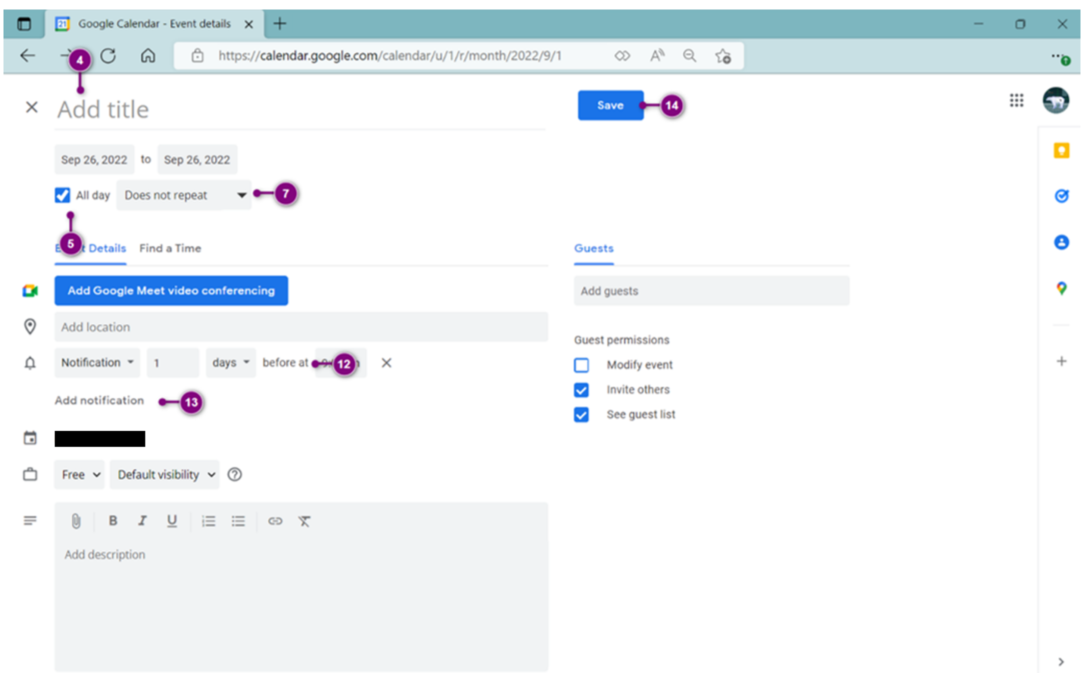

Figure 11: *After completing all 14 steps*, we can try creating an event again and all tooltips would still be visible. Note that Tooltips #1 to #3 are in the starting calendar view, and #8 to# 11 are in the custom pattern pop-up box, so they are not visible.

B.2 List (on Task D)

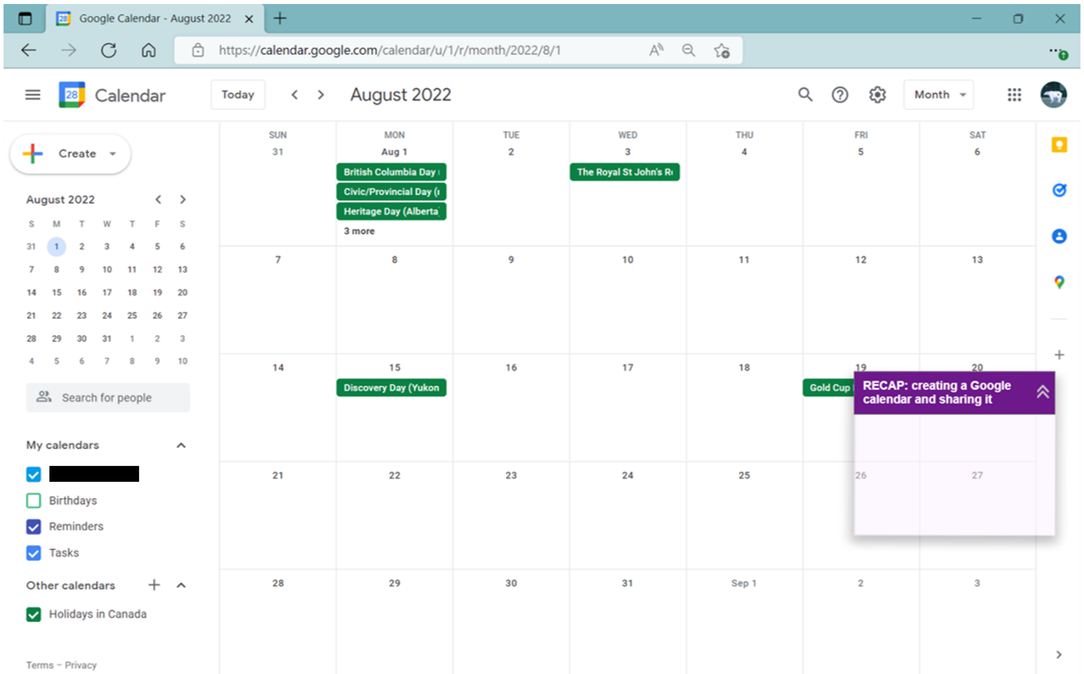

Figure 12: Starting screen of the task: creating a new calendar on Google Calendar (Task D)

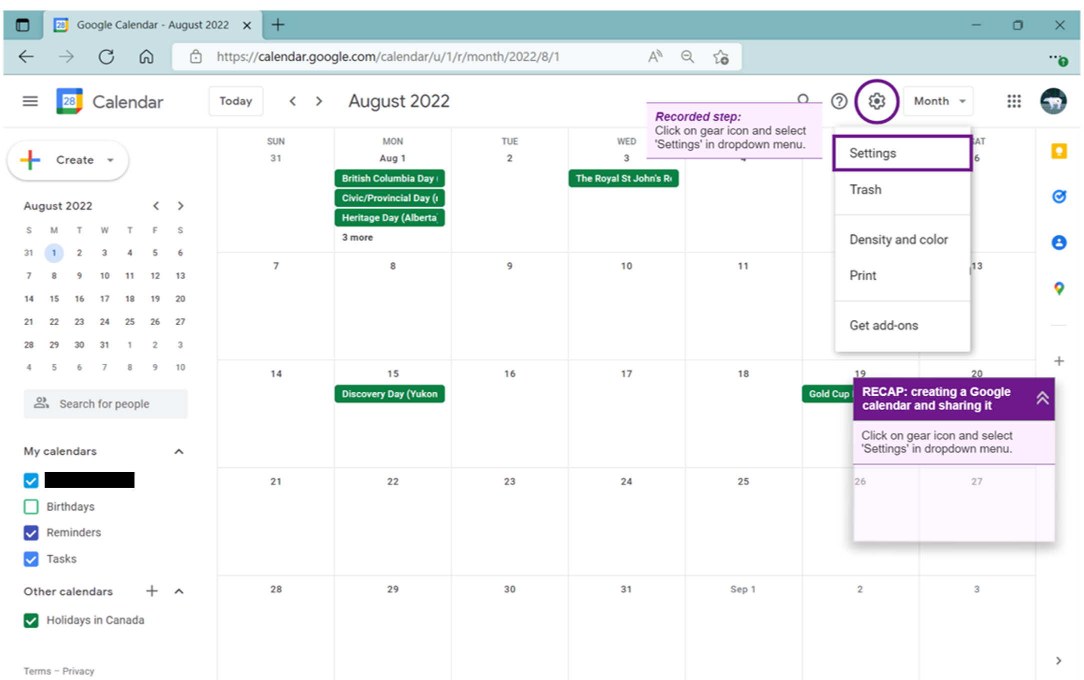

Figure 13: After clicking on the setting icon, the first step's recording notification appears, and the first step is added to the list.

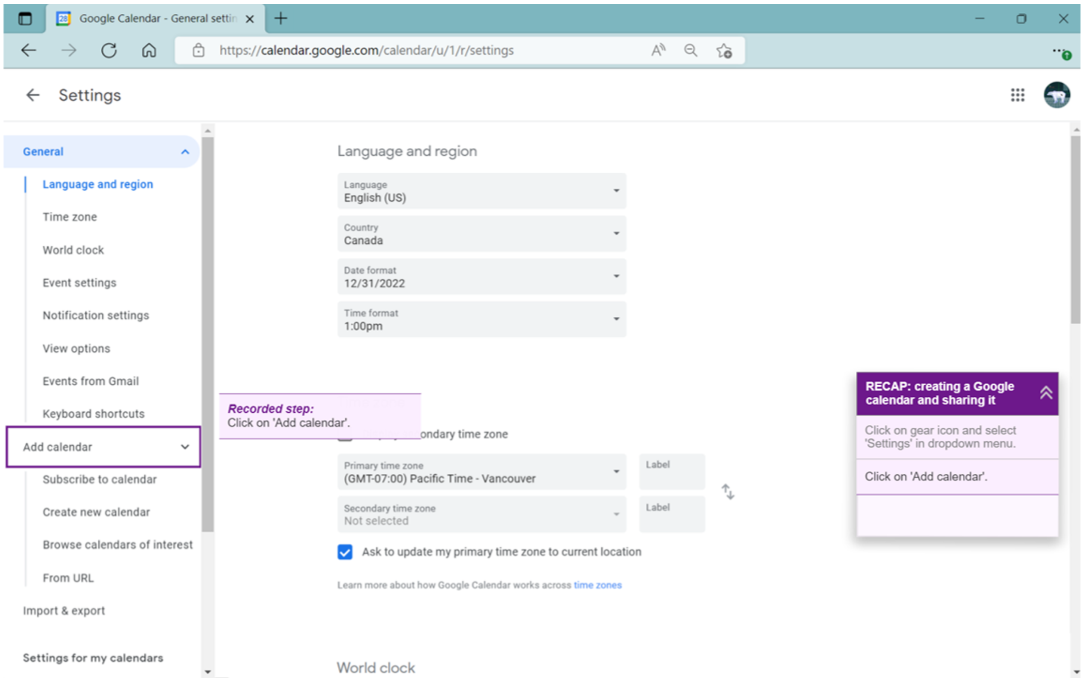

Figure 14: In the Settings page, the next step is to click on 'Add calendar'. The recording notification appears next to it and the corresponding step is added to the list.

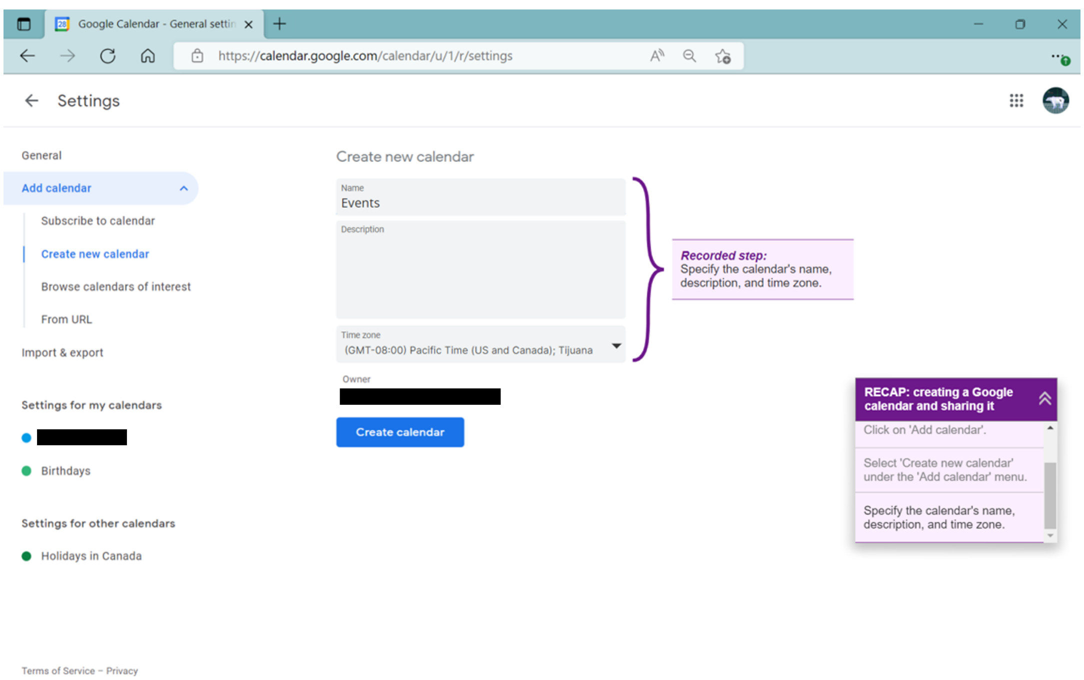

Figure 15: This is the screenshot two steps later, after clicking on 'Create new calendar' in the Settings page (recording notification is not visible because it leads to a different page) and filling in the event detail.

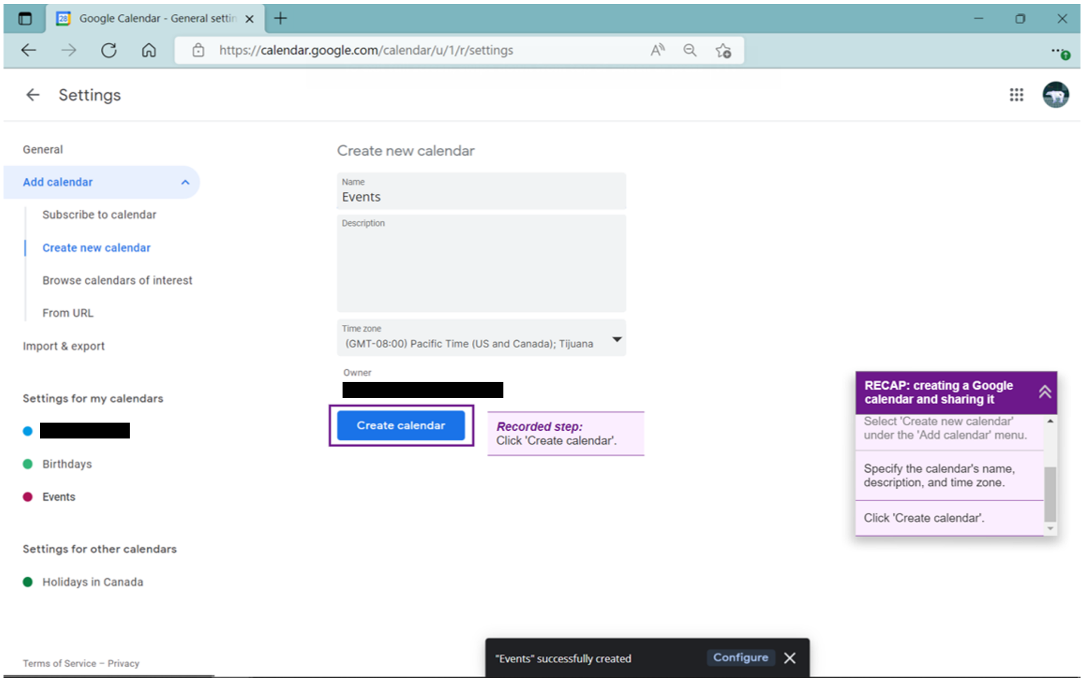

Figure 16: After clicking on the 'Create calendar' button and the event has been successfully created, the recording notification appears, and a new step is added to the list.

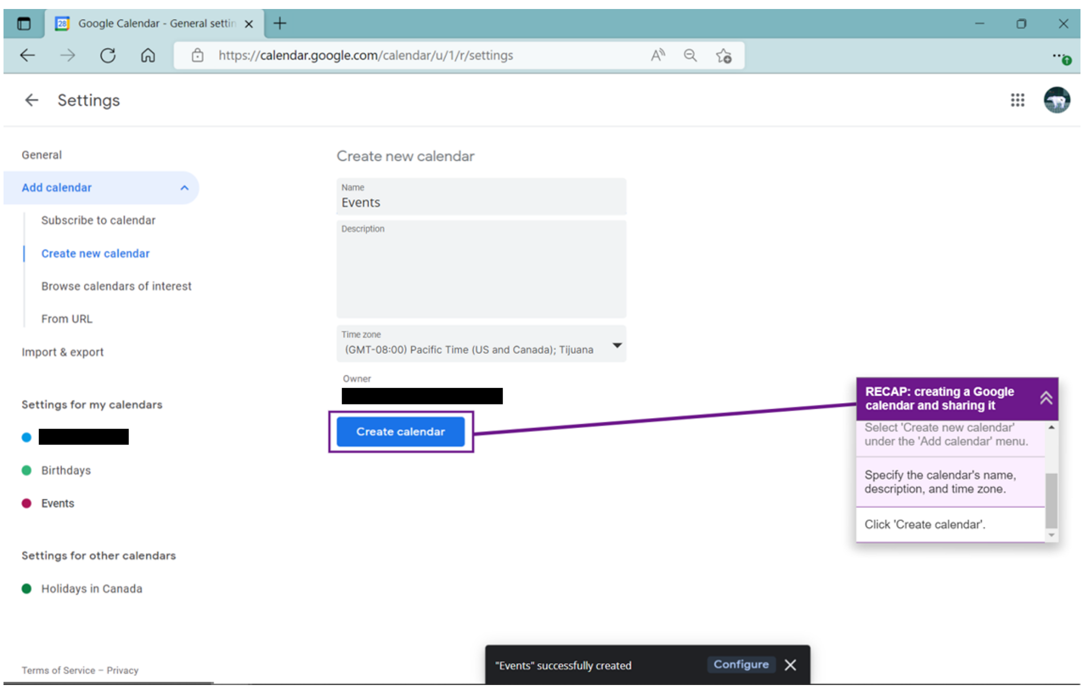

Figure 17: If we click on "Click 'Create calendar' " in the list, the location anchor pointing to the 'Create calendar' button appears. Note that every step except for the last two is now gray since they are not on this page.

C SUMMARY OF QUANTITATIVE METRICS

	Helper demo duration (m:s)	Help-free attempt duration	% mistakes	Pre-demo confidence	Post-task confidence with steps	Post-task confidence without steps
By designs						
Zoom	4:58	2:34	20.02	2.71	N/A	3.71
Tooltip	3:54	3:30	4.14	1.79	4.36	3.07
List	3:51	3:13	7.57	1.79	4.43	3.07
By control modes (excluding Zoom)						
Learner in control	4:35	3:16	7.08	1.93	4.21	2.96
Helper in control	3:10	3:28	4.63	1.64	4.57	3.18
By base communication channel (excluding Zoom)						
Voice only	4:00	2:58	5.51	1.57	4.31	2.66
Voice and visual	3:42	3:53	6.32	2.00	4.5	3.63
By learning tasks (including Zoom)						
A	4:59	5:13	6.12	1.79	4.63	3.29
B	3:50	2:20	3.30	2	4.4	3.43
C	4:04	2:54	4.76	2.29	4.5	3.71
D	3:31	3:01	14.29	2	4.3	3.29
E	3:25	1:53	9.38	2.56	4.3	3.56
F	5:59	3:26	28.33	1.83	4.25	2.33
HelpCall mean	**3:52**	**3:22**	**5.85**	**1.79**	**4.39**	**3.09**
Grand mean	**4:14**	**3:06**	**10.58**	**2.09**	**4.39**	**3.29**

Table 3: Averages of quantitative metrics (task durations, completion accuracy, and self-reported confidence on a 1-5 Likert scale) by design candidates (study conditions), control modes, communication modes, and learning tasks.