

# TalkingTiles: Supporting Personalization and Customization in an AAC App for Individuals with Aphasia

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## ABSTRACT

The development of ‘Post-PC’ interactive surfaces, such as smartphones and tablets, and specialized support software informed by HCI research has created new opportunities for Augmentative and Alternative Communication (AAC) technologies. However, it is unclear to what degree these opportunities have been realized in practice. We conducted a field study to explore the use of one such application, TalkingTiles, by individuals with aphasia. Following a training session and one week of use, we conducted interviews with participants, their partners, and their caregivers at a local support facility. We found that TalkingTiles can be effective in supporting communication when used in concert with other communication methods, and when time can be invested in customizing the app. We discuss our findings, and implications for design with respect to customizability, simplicity, and the limitations of interactive surfaces in supporting communication.

## ACM Classification Keywords

H.5.2. Information Interfaces and Presentation (e.g. HCI): User-Centred Design

## Author Keywords

aphasia; augmentative and alternative communication

## INTRODUCTION

The development of Augmentative and Alternative Communication (AAC) technologies has long been a promise of Human-Computer Interaction (HCI) research. These technologies enable individuals who may otherwise be unable to communicate to participate and engage with those around them. For example, prototype systems have been developed to support communication for individuals living with Alzheimer’s disease [6, 14], memory impairments [27], and disorders such as aphasia [5, 7, 26]. However, the emergence of ‘Post-PC’ interactive surfaces, such as smartphones and tablets, has created new opportunities to develop more personal and more powerful AAC tools. These devices provide unprecedented access to advanced graphics and processing

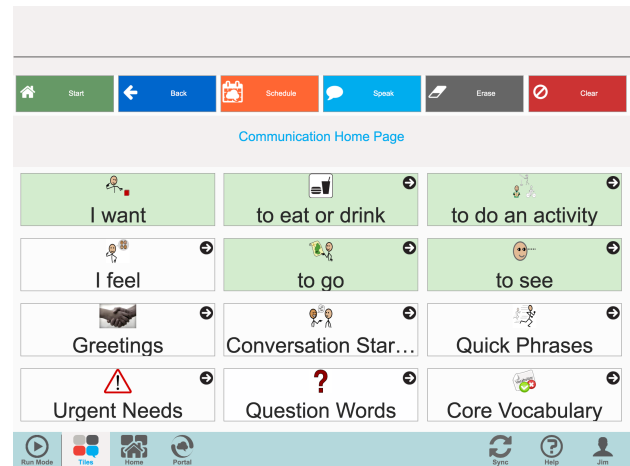


Figure 1. TalkingTiles is an Augmented and Alternative Communication app that enables users to construct sentences by tapping on tiles associated with words or short phrases.

capabilities, a simple multi-touch interface, cameras, GPS, and built-in motion sensors, as well as wireless internet access – all in a light-weight, mobile form factor.

Where HCI research has already explored the design of AAC devices, this work predates the emergence of interactive surfaces as pervasive, rich, and developed ecosystems [3, 5, 6, 7]. Interactive surfaces provide an opportunity for novel, accessible interaction appropriate for AAC applications, and are displacing existing, and often less accessible computer infrastructure such as desktop PCs. In embracing these opportunities for surface interaction, commercially available apps are implementing research outcomes from the HCI literature [3, 26]. Given the knowledge translation that has taken place, we wanted to explore how lessons learned through research conducted on early mobile devices carries over to modern applications and devices, and to understand the new roles that they are playing in facilitating AAC.

We conducted a field study with a new commercial AAC app for iPad, called TalkingTiles<sup>1</sup> (Figure 1). We chose to focus on individuals with aphasia, a communication disorder caused by damage to areas of the brain controlling language, because of the established related research and availability of design considerations in the literature [3, 5, 7, 18, 26]. After training participants in the use of the software, we asked them to use the app over a one week period to understand how it

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<sup>1</sup><http://www.mozzaz.com/index.php/products/talkingtiles>

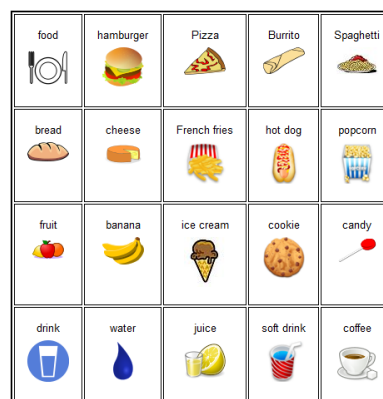
fulfilled their daily communication needs. Following the trial period, we conducted an in-depth interview that explored how participants, their caregivers, and family members had used the app to support their daily communication. We found that TalkingTiles can be effective when used in concert with other communication methods, and when time can be invested in customizing the app. We discuss our findings, and design implications with respect to customizability, simplicity, and the limitations of post-PC devices in supporting communication.

### APHASIA: MASKING INTELLIGENCE

Aphasia is a communication disorder caused by damage to areas of the brain controlling language, resulting in the complete loss or impairment of language function [4]. This damage is most often the result of a stroke [25], with aphasia being one of the most frequent symptoms in acute and chronic stroke patients [21], but can also be caused by brain tumours, traumatic brain injuries, and progressive neurological disorders [19]. Aphasia has a particularly drastic impact on survivors' quality of life since it inhibits a person's ability to communicate, but does not impact their cognitive ability. That is, while individuals know what they want to say, they are unable to form the words, often leaving them feeling isolated and frustrated. These symptoms are particularly pronounced immediately following the onset of aphasia, as individuals struggle to adjust to their new abilities, and the communication methods they must now utilize to express themselves. Aphasia is therefore said to 'mask intelligence'.

The severity and symptoms associated with aphasia can vary dramatically between individuals, depending on the type and extent of brain damage [21]. For some individuals, aphasia may be very mild and impact only one aspect of communication, such as the ability to recall the names of objects. However, more typically, aphasia affects multiple aspects of communication to varying degrees; for example an individual may have the ability to comprehend images and speech, but not recognize text. In the extreme, severe forms of aphasia can inhibit any form of communication. We base our investigations on three working classifications of the disorder: *receptive*, *expressive*, and *global aphasia*. Wernicke's Aphasia, otherwise known as *receptive* aphasia, impacts comprehension abilities. Broca's Aphasia, which is one of the most common forms of aphasia, and is often referred to as *expressive* aphasia, reduces the ability of individuals to produce speech output, and also affects typing and writing abilities. These individuals are often unable to form complete sentences, and can have difficulty understanding complete sentences. Finally, *global* aphasia hinders both the expression and comprehension of language.

As a result of the limitations aphasia places on language comprehension and expression, and its negative impact on an individual's quality of life, treatment methods have been developed to reduce impairments [15, 22]. However these treatments are not always effective, and individuals who show significant symptoms one year after onset are likely to have some form of aphasia for the rest of their lives. In these instances, there is a need for communication methods and assistive devices to remove language barriers to living with aphasia and



**Figure 2.** A communication board allows individuals to point to symbols for basic needs and wants such as food. The board shown here enables individuals to specify several different types of food and drink.

give hope to individuals and their families [10]. Many organizations that work with individuals on a long term basis embrace this philosophy. Included in this group of organizations is the Aphasia Institute (AI) in Toronto, Ontario, Canada where we conducted our field study.

### Revealing Competence with AAC

Since individuals with aphasia typically have full cognitive abilities, promoted communication methods focus on acknowledging and revealing competence. One such method called Supported Conversation for Adults with Aphasia (SCA) [9, 10, 16] promotes the use of trained communication partners to acknowledge and reveal the competence of individuals with aphasia and has been found to be extremely effective [10]; however it also has shortcomings. For example, the focus on the communication partner allows for the facilitation of conversation, but also means that an individual relies very heavily on their partner. If the partner is not able to reveal what the individual is thinking, they cannot express what they would like to communicate. It is also extremely difficult for an individual with aphasia to guide the conversation, since they are relying on their communication partner to enable them to do so. Finally, there is little awareness of aphasia within the general public [8, 23], making it difficult for individuals to engage with the community through SCA. These limitations have motivated research into assistive technologies that can enable individuals with aphasia to engage in conversation more independently [3, 5, 7, 18, 26].

Early advances in technology allowed for the digitization of communication boards, physical boards with a grid of symbols that individuals can point at to aid communication (Figure 2), with the goal of building complex sentences in software [24]. In designing C-VIC, Steele et al. created an interactive, card-based communication system that still influences the design of AAC tools today. Steele et al. report that creating a digital system was particularly beneficial in enabling individuals with poor expressivity, and that digitizing the system addressed key practical considerations such as removing physical barriers to use such as the sorting of card decks between communication tasks, which improved communication

outcomes. Koul et al. [13] confirm these findings for individuals with chronic severe Broca's aphasia and Global aphasia.

Building on these initial PC-based prototypes, AAC software was developed for early portable and mobile devices such as PDAs [3, 5]. These devices provided a number of advantages for individuals with aphasia, such as their small and lightweight form factor, low cost, and built-in cameras that could be used to personalize communication. For example, Allen et al. [3] developed PhotoTalk, an application that allows individuals with aphasia to capture and manage photos, which could then be used to facilitate communication related to the day's events, their family, and hobbies. Daemen et al. [7], Camelendar [26], and CoCreation [18] take a similar approach for sharing and story-telling tasks. While initial feedback for these prototypes has been positive, researchers have noted trade-offs between customization and usability that often vary significantly among participants, since individuals' capabilities vary according to their severity of aphasia.

### Designing for Individuals with Aphasia

The use of interactive pictures and icons as building blocks for larger sentences has been well established in the literature [3, 12, 18]. Through the development of these systems, researchers have proposed guidelines targeted at maximizing their utility and usability for individuals with aphasia:

1. **Customization of Settings** The abilities and needs of individuals can vary significantly along the receptive and expressive dimensions [1, 17]. Applications should support communication of basic needs as well as more in-depth conversational topics, and labels and navigation should be structured to suit an individual's abilities.
2. **Adding Personalized Content** An app's content should reflect an individual's personal interests [3, 5]. Applications should allow individuals to add personal content to communicate about the topics they care about.
3. **Use of Mobile Devices** The lightweight form and built-in camera have been identified as beneficial features in supporting individuals with aphasia [3, 5]. However, a need to calibrate touch interaction for those with motor impairments has also been identified [7].
4. **Simplicity** Individuals with aphasia have difficulty understanding text and other visual GUI elements. Designers should therefore avoid abstraction, complex structures, and minimize the number of steps required to perform a task [1, 7]. Al Mahmud [1] suggests that categorization and visual support pervade the interface.
5. **One-Handed Use** Aphasia is often accompanied by impairments to a user's right hand, due to injury on the left side of their brain [7]. Applications should therefore not require two hands to use.

In this work, we investigate how these guidelines have been applied in practice, and aim to understand how modern tablets can serve as platforms for AAC. To focus our exploration, we studied the use of one application, TalkingTiles.

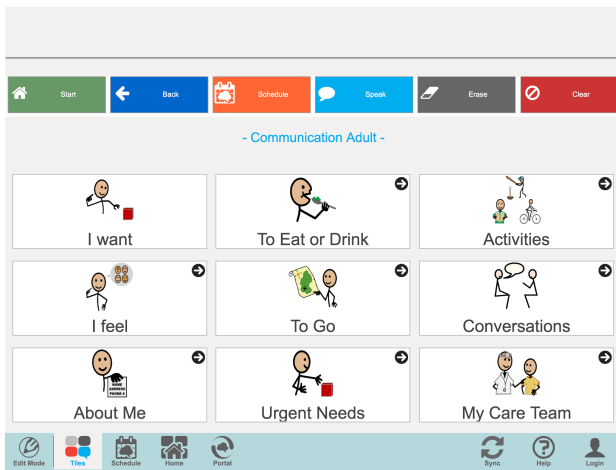
### TALKINGTILES

TalkingTiles (Figure 1) is a commercial AAC app designed for individuals with a variety of verbal communication difficulties, including autism, amyotrophic lateral sclerosis (ALS), memory impairments, and aphasia. The TalkingTiles name is derived from the interaction metaphor of building sentences from representative images, or tiles. As a user taps on individual tiles featuring pictographic and textual labels, corresponding text is immediately vocalized and added to a constructed sentence which can later be spoken via the iPad's Text-to-Speech functionality. By supporting communication in this manner, TalkingTiles is designed to enable individuals to engage in a variety of communication activities, ranging from therapy sessions, to basic daily needs, to storytelling and in-depth conversation.

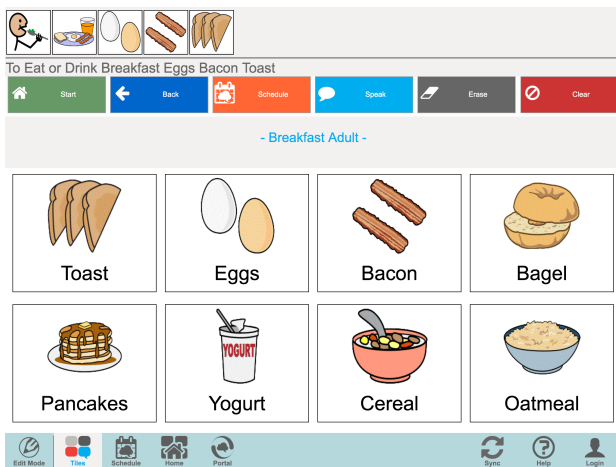
The app commercializes customization features developed in research systems, such as PhotoTalk [3], allowing users to create personal tile sets (called 'Pages') and link those tiles to captured photos or online content. In addition to those features, the combined use of the cloud and extensive editing functionality to support deployment, customization, and daily use of the app is a key differentiating feature between TalkingTiles and other commercially available AAC apps. The use of the cloud to store user data enables caregivers to remotely upload content to a user's account, which can then be downloaded onto a user's device without taking it away from them. Usage data is also tracked using the cloud, enabling caregivers to track which components of the app are used, and how often. The ability to launch observation/question forms from tiles also provides an opportunity to receive more detailed and explicit feedback from users. In providing this functionality, the app addresses the above guidelines:

- **Simple Interface** – The app provides a simple, touch-based interface that enables users to create sentences of various complexity levels by tapping on tiles associated with words or phrases. While one-handed use was not a specific design consideration, the interaction metaphor enables interaction for a broad group, including those with aphasia.
- **Customizable** – Users can edit aspects of the app's interface to suit their individual needs, including: language, gender and speed of text to speech output, image and text size, colours, number of rows and columns of tiles featured on pages, and their size, representative text or image, and functionality.
- **Personalizable** – Users can create custom pages (and tiles) from text, captured photos, or online content to meet their personal communication needs, and link tiles on these pages to webpages, videos, and pictures.
- **Cloud Storage** – TalkingTiles provides access to pre-made pages through their customer portal. This feature eases setup and reduces required storage space on the device, and allows for content to be updated remotely by users' family, friends, and caregivers.

Users interact with TalkingTiles through two modes: run and edit. In run mode (Figure 3) users construct sentences, and pages are separated into tiles that have associated words or



**Figure 3.** In run mode, participants tap on tiles corresponding to words or short phrases to create sentences. As tiles are selected they are verbalized by the app and combined into a sentence, displayed at the top of the screen, that can be replayed as a whole using the ‘speak’ tile.



**Figure 4.** An example sentence is constructed and displayed symbolically at the top of the display. ‘I want’, ‘to eat or drink’, ‘breakfast’, and ‘eggs’, ‘toast’, ‘bacon’. The sentence can be edited on the fly using the ‘Back space’ and ‘Erase all’ tiles.

phrases. When the user taps on a tile its associated text is vocalized using Text-to-Speech (TTS), and added to an in-construction sentence in the speech bar (top). Tiles can also have actions associated with them when they are tapped, for example tapping on the ‘Breakfast’ tile would navigate the user to a new page containing common breakfast items (Figure 4). Other actions can include linking to web pages, the start page, visual schedules of upcoming dates or events, or loading an image or video file for display.

Once a sentence is created, it can be vocalized by tapping the ‘Speak’ button, the most recent item erased using the ‘Erase’ tile, or deleted using the ‘Clear’ tile. The menu bars are customizable, and may be different for participants in this study. If users do not wish to create full sentences by selecting multiple tiles, they can disable the speech bar, which removes the tiles associated with editing from the menu bar. Finally, at the top of each page there are ‘Back Page’, ‘Home Page’,

and ‘Select Page’ navigation tiles, enabling users navigate through the app without vocalizing text.

In edit mode users make customizations to the app, including: images and text visible on tiles, the size, colour, and number of tiles displayed on each page, and global accessibility settings such as the rate of speech and gender of the TTS agent. TalkingTiles allows for these customizations to be uploaded and downloaded from the cloud, allowing for caregivers and family members to edit pages remotely.

## FIELD STUDY

We conducted a field study to understand how TalkingTiles could help remove language barriers to living with aphasia. We chose a one-week duration to allow sufficient time for participants to configure and familiarize themselves with the application, use it in a variety of settings, and identify strengths and weaknesses. As TalkingTiles is a commercial application that implements features developed in research, we were interested in how its features were used in practice, and in identifying barriers to acceptance and areas for improvement.

## Participants

Participants were recruited from an iPad working group at the Aphasia Institute. Focusing on this working group ensured that all participants were familiar with tablet use. We relied on AI staff to provide information on the severity of aphasia for all individuals interested in participating in the study, and limited involvement to individuals who could understand pictures/symbols or written text. This requirement meant that individuals with more severe forms of aphasia could not be included in the study, but ensured that we were able to confidently assess their interactions with the TalkingTiles app.

In total, we recruited four participants with different severities of aphasia who we identify using the following pseudonyms:

**Emmett** is a 70 year old male who has had moderate aphasia for 18 years. He has excellent comprehension skills, and is physically able, but has limited verbal expression and writing capabilities. Although he has impaired use of his right arm, he is able to drive. Emmett is technologically savvy, and uses apps such as TalkRocket and Proloquo2Go. Emmett’s wife also participated in the sessions.

**Nina** is a 68 year old female who has lived with more severe aphasia for 14 years. While she has reasonable comprehension abilities, she has limited verbal expression abilities, and extremely little writing ability. Nina is able to formulate basic sounds such as ‘uh-hmm’, ‘nono’, and ‘ohohoh’ but cannot formulate any words.

**Victor** is a 60 year old male who has lived with mild aphasia for 2 years. He has excellent comprehension and expression skills and is often able to write the first few letters or verbalize words. Although he has little control over his right arm, he is otherwise physically capable and drives himself to sessions. Victor primarily attends the Aphasia Institute for the iPad working group but had not previously used AAC apps.



**Sonya** is a 74 year old female who has lived with severe aphasia for 7 years. She is only able to verbalise basic words such as ‘yes’ and ‘no’, but has strong comprehension skills. Sonya has severe physical limitations as a result of her stroke and requires the use of a wheelchair. She had previously downloaded Proloquo2Go, but only used it infrequently. Sonya completed all sessions with a caregiver.

### Procedure

This study consisted of two sessions per participant, with each session lasting between 1-2 hours in length. Investigators were trained by the Aphasia Institute in SCA to facilitate effective communication with the participants. Participants were encouraged to bring a spouse, family member, or friend to the sessions as they were likely to play an important role in customizing the app for participants.

During the first session, participants learned how to use the TalkingTiles app and cooperatively created customized communication page sets with the investigators. Following this session, participants were given the app to take home to continue to use over a one week period. During the second session, scheduled at least one week later, participants were asked to complete a variety of communication tasks they engage in on a daily basis such as requesting to watch TV shows, reading the news, or telling stories about themselves and their families. Finally, they engaged in a semi-structured interview to assess the app’s support for less structured situations, and to reveal additional use cases or usability issues.

### Data Collection & Analysis

Video was recorded throughout all interviews, and was accompanied by the investigator’s field notes. We performed a grounded theory analysis of all collected data, and examined how the app supported basic tasks such as requesting something to eat, to do an activity, or to go somewhere. We also gathered and analyzed data regarding how participants used the app to support daily activities, and what improvements could be made to support those use cases. Although interaction data can be logged by the app, this feature was not completed in time for the study, and thus our analysis does not include quantitative aspects of use.

## RESULTS

We present key themes that arose during our analysis of study sessions. We present these themes as a series of vignettes, with each theme illustrated through a particular use case with a specific user. However, our data suggests that each identified issue was experienced by *all* participants, and we later discuss broader implications for the design of AAC. In presenting these themes, we pay particular attention to the experiences of our participants in relation to configuring the TalkingTiles application, how it supported their daily activities and storytelling, and what deficiencies they may have identified during their week of use.

### Emmett: Creating Personal Content

Emmett, one of our technically savvy participants, was quickly able to understand the TalkingTiles interface and use the app effectively. We therefore placed a stronger emphasis



**Figure 5.** Emmett created pages with content associated with his recent vacation, such as images for Epcot Centre in Disney World.

on teaching Emmett and his spouse how to edit TalkingTiles during the training session. By the end of the training session, Emmett and his wife understood and could use most of TalkingTiles’ editing functions, but at a slow pace. In the following week, Emmett spent considerable time customizing the app to suit his needs, and used the app regularly. During the interview Emmett and his wife noted a need for enhanced editing functions, and to be able to do so more efficiently. One of their main concerns was the ability to manipulate text and image sizes, especially for the purpose of storytelling. For example, they found that images were not big enough to show other people, even when it was the only image on the screen, and that the user interface should be more flexible in minimizing space for UI elements when users would like to share a single image. However, they offered the caveat that these features were most appropriate for users with high expressiveness, and that others with severe aphasia may find the app useful without customization.

One way in which Emmett personalized the app was to add options for common items that he would want to communicate about, such as family and friends and places to go such as shopping malls, parks, and restaurants. These options served to establish subject matter for the conversation, after which his wife could determine more precise detail via SCA. For example, Emmett is interested in NHL hockey, and added an extensive page to help him communicate that his favourite team is the Toronto Maple Leafs, and that they are not playing well. He could indicate that he wanted to talk about the recent game played between Toronto and Ottawa by selecting the two teams in succession. Between the study sessions Emmett had been on vacation and uploaded pictures he took with his iPad to the TalkingTiles app. With the help of his wife, he was able to add sentences describing the vacation; such as which attractions and restaurants at Disney World they had visited, and with whom they had vacationed (Figure 5).

Emmett also configured the app for use outside of the home. For example, due to Emmett’s aphasia, he cannot use bank machines, and thus needs to talk directly with a bank teller. These interactions are very stressful and difficult, if not impossible, unless the teller is aware of aphasia and trained in communication methods such as SCA. Emmett and his wife

therefore edited this bank page to include common phrases, such as his name and communicating that he has aphasia, and common bank transactions such as making a deposit or withdrawal. These phrases were simple enough that Emmett could understand them without the help of pictures, allowing him to select the phrase he desired from the Talking Tiles app. Emmett and his wife stated that this functionality was promising, and could be used for other circumstances such as placing an order at a coffee shop.

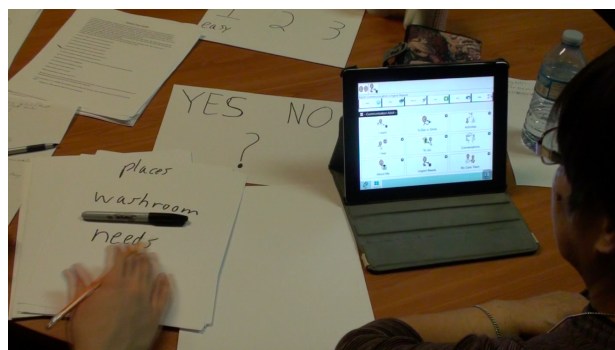
### **Nina: Customization Improves Navigation**

Nina was not accompanied by another individual to her sessions, and has more severe aphasia than Emmett. Communication was therefore more difficult, and it took her longer to become proficient with the app. In particular, Nina struggled with navigating the app's tiered menus, and consistently confused menu buttons such as 'Erase', 'Back', 'Start', and 'Speak' (Figure 1). After 40 minutes of training Nina was better able to navigate the app, but still struggled with the 'Clear', 'Erase', and 'Speak' buttons. Due to these difficulties, and Nina not having someone to help her with customization, she did not receive full training in TalkingTile's editing functionality.

Overall, Nina found TalkingTiles hard to navigate during the first session, but after a week of infrequent practice it was less difficult. When Nina returned for her second session she was much better able to use the app, and could use each of the menu buttons and access some pages such as 'activities', 'food and drinks', and 'about me'. Nina still struggled with accessing other pages such as 'urgent needs', 'to go' (places), and 'I feel'. When Nina struggled to complete a task, she would sometimes become very frustrated, and would click many buttons, start gasping, and place her hands on her head. When this occurred, we reminded Nina to go back to the beginning, and she was consistently able to tap the home page button, after which she was almost always able to navigate correctly.

During the session it became apparent that some of Nina's confusion arose from the phrasing used in text labels. The communication page had been constructed to enable users to string together icons to create sentences, and therefore labels were created using language that would fit into sentences. For example, the feelings page was entitled 'I feel' and could be combined with other tiles to create a sentence, such as 'I feel happy'. During Nina's second session we edited these labels to be more direct, and not to fit into sentences. We noticed an immediate difference in Nina's ability to select the desired page, but she still struggled with completing tasks that required her to navigate to the 'urgent needs' page, such as requesting to go to the washroom, or saying that she was in pain. When Nina was asked to request to go to the washroom, she consistently went to the 'places page', which made it seem as if the 'urgent needs' label did not carry meaning for her. It was also much easier for Nina to navigate the app when the homepage was changed to the communication page, reducing the steps required to indicate a need or desire.

Nina was unable to further edit the app or change it to suit her needs since she was not able to have a caregiver attend



**Figure 6.** During Nina's sessions, we worked extensively to edit the TalkingTiles interface to provide clear navigation. In particular, Nina had difficulty with labels representing parts of sentences such as 'To go', which we renamed 'Places'.

the sessions. This lack of customization was less of an issue since Nina's priority was to express basic needs and desires. At the end of her second session, Nina reported that the TalkingTiles app better supported basic wants than SCA. However, the inability to edit the app was raised again in this session, and we made some additional customizations. Due to time constraints and a lack of personal knowledge about Nina, the level of personalization was limited, but we were able to create a page entitled 'about me' that held information about Nina's spouse, children, and her home address.

### **Victor: Unsupported Editing**

Although Victor attended the sessions by himself, he quickly understood how to use TalkingTiles and was able to reliably use the app to communicate. He initially struggled with the 'Activities' label, but was able to use it more reliably after we showed him the content on the Activities page. With all other tasks such as requesting something to eat or drink, requesting to see or talk to someone, or requesting to go somewhere, Victor was quickly and accurately able to use the app to express his desires.

His training session therefore focused on editing the app, and training him to complete the editing independently. By the end of the two hour training session Victor had completed a considerable amount of editing with the investigator's assistance, but found editing himself very confusing and could not remember which buttons to press. In order to ensure that the app was sufficiently customized to suit Victor's preferences, two additional editing sessions took place over the following weeks. By the end of the second two hour session Victor was consistently able to use the editing functionality to complete tasks such as creating new pages and editing tiles. However, he would occasionally require assistance in remembering where certain buttons were located.

Victor wanted to use the app to engage with others, rather than communicating basic needs. He planned to use the app for needs such as requesting to see or talk to someone, but less so for requesting food and drinks. He therefore placed most of his focus on creating pages that would help him tell stories, and creating ways to begin conversations and share his interests. For example, he had detailed 'Hobbies', 'Fam-

ily’, and ‘Friends’ pages that allowed him to quickly establish subjects. Much like Emmett, Victor was an avid sports fan who wanted to use the app to guide conversations around topics such as the FIFA Women’s World Cup. To do so, he created a schedule for his favourite team that enabled him to start conversations about upcoming games.

### Sonya: Managing Complexity

Sonya quickly understood how to use the app, and could accurately use the menu buttons for their intended purposes. She, like Nina who also had severe aphasia, wanted to use the app for basic communication needs. Her caregiver felt it best to simplify the content of the app as much as possible, and therefore reduced the number of tiles on the Start page to six, all of which linked to other pages. These linked pages were also customized to focus on more limited and practical communication tasks. For example, Sonya’s ‘About Me’ page listed her phone number, home address, medical condition, and allergies instead of providing more personal details such as the names of relatives, as had been created by Emmett and Victor.

Since Sonya’s severity of aphasia inhibited her from editing the app herself, the majority of the training session was spent teaching her caregiver to edit the app. Her caregiver found the editing interface confusing at first, and even after some practice would need reminders of where buttons were located. Sonya’s caregiver advocated increased simplicity, and thereby fewer editing options. She found the various editing features to be overwhelming, and she did not plan to use most of them. In her opinion it could make the edit mode much less confusing if some of these features were removed.

One set of editing features she found difficult to use were those related to Text-to-Speech. The app has been developed to require a number of steps to change all Text-to-Speech related fields, including the text that the app reads aloud for each tile. Sonya noted that this process is unintuitive and, in combination with a bug that required the user to select an additional option when changing the TTS engine, created significant confusion. Finally, she reported a need for the pre-made pages to better reflect the needs of individuals with aphasia, as she spent considerable time editing the default templates to suit Sonya’s needs.

### OPPORTUNITIES FOR DESIGN

Although TalkingTiles was used differently by each of our participants, it was ultimately effective in supporting many of their communication needs. Emmett customized the TalkingTiles interface to meet his needs, both at home and while running errands. Nina initially struggled with the application, but customization with the investigators enabled her to effectively use the ‘places’, ‘about me’, and ‘food/drinks’ pages, supporting her most critical communication needs. While Victor struggled with customizing the app himself, he was able to effectively communicate interests such as the FIFA Women’s World Cup. Sonya’s caregiver was careful to focus customizations around only Sonya’s most critical activities. However, our field study also revealed areas for improvement, not only for the TalkingTiles app, but general opportunities to understand how modern, interactive surfaces can be used

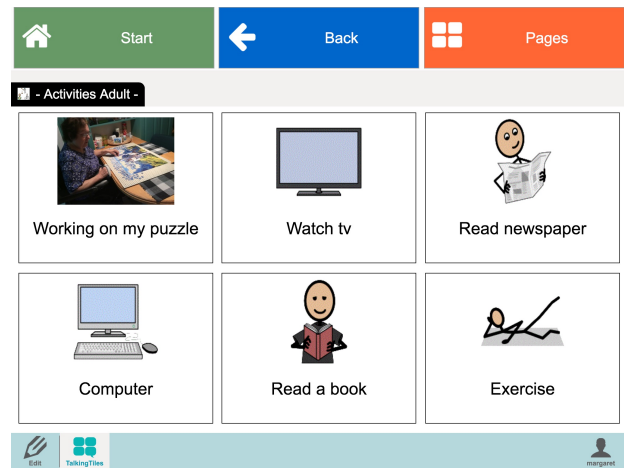


Figure 7. Sonya’s caregiver limited pages to six options to reduce complexity. Her activities page comprised ‘working on my puzzle’, ‘watch tv’, ‘read newspaper’, ‘computer’, ‘read a book’, and ‘exercise’.

to remove language barriers to living with aphasia. We now discuss these opportunities and challenges, and in particular, the advantages and disadvantages of customization, balancing customization with navigation, the role devices play in supporting communication, and new opportunities for supporting communication with interactive surfaces.

### Editing is an Ongoing Responsibility

Customization and personalization of AAC software is often recommended [1, 17]. Our interviews confirm the need and utility of these features; our participants universally supported the need for an app that they could tailor to suit their own communication needs. For example, Emmett and Victor were very positive about their ability to add information about hobbies and sports, favourite restaurants, and even recent vacations. However, the work required to customize or personalize an app creates overhead that is often difficult for individuals with aphasia to manage on their own, and is typically carried out by a caregiver, therapist, or family member [5]. This reliance on others for personalization and customization may ultimately impact the utility of the AAC software, and should itself be considered in its design.

All of our participants noted that the current customization and personalization interface was too complex for individuals with aphasia. Difficulty in performing personalization or customization are significant barriers to adoption, and occurred both initially and on an ongoing basis. For example, during the first session we changed labels such as ‘to go’ and ‘I feel’ to ‘places’ and ‘feelings’, respectively, to better enable all our participants to navigate the app’s interface. Such customizations should be expected to ensure that generic application presets match an individual’s needs, and incur a one-time cost in data entry and may be manageable through caregivers and loved ones. During this initial setup, participants also unanimously wanted to personalize their app by including details surrounding their family, friends, hobbies, interests, and nearby places. However, even these tasks may be prohibitive for individuals such as Nina who do not have support from caregivers.

Other personalization and customization tasks take place on an ongoing basis. For example, when Emmett went on vacation with his wife and wanted to share photos, he needed to add words or sentences for each photograph. Victor wanted access to an up-to-date schedule for upcoming FIFA matches. This type of editing can be expected to take place on a regular basis, as individuals hope to expand the topics available for conversation to reflect changes in their lives. Emmett and his Wife suggested that training volunteers at the Aphasia Institute would be a good way to support this customization, but it is unclear if this solution would be practical based on the time demands placed on support staff. It is also more difficult for individuals who do not know the user well to edit the app, as editing requires a deep knowledge of the user's personal preferences, hobbies, and tastes. We suggest that an opportunity exists to better enable individuals with aphasia to customize the app, and that automated support for the creation of new materials could play a significant role in these developments.

### **Balancing Personalization, Customization, and Simplicity**

Personalization was critical to the adoption of TalkingTiles, but also incurred a cost in the simplicity of navigating the app; an important consideration for individuals with aphasia [7]. Many researchers have investigated the use of custom photos in supporting communication, but we are not aware of any research that has provided means for individuals with aphasia to easily manage those photos. This need was reflected in the edits made by Sonya's caregiver, who was concerned with balancing personalized content with ease of navigation and limited most pages to contain only 6 tiles. Sonya's caregiver also felt that the edit mode was more complex than necessary, and that a simplified interface would be sufficient for individuals with severe aphasia. As apps become loaded with personalized content, this burden is shifted to navigation – an identified weak point for individuals with aphasia [1, 7] – and there is a need to understand how simple, multi-touch interfaces can be designed to simultaneously support personalization and customization for these users.

However, not all customization resulted in this trade-off. For example, we found that for all of our participants, the ability to edit the keywords displayed on tiles made navigating the app easier. We also found that modifying TalkingTiles' interface to hide the speech bar tended to improve its usability. Participants found it difficult to navigate the app when they were encouraged to string together sentences, and being able to focus only on which keyword to press next was a welcome simplification. The reduced complexity of the interface also made it easier for participants to interpret and navigate the remaining menu buttons. The ability to perform these customizations in-app, in collaboration with users provided an opportunity for participatory design, and through the course of the study we identified edits that enabled the general-purpose AAC application to be tailored for use by individuals with aphasia.

### **Augmenting, not Replacing, SCA**

We found that participants were not interested in forming complete sentences, contrasting Steele et al.'s [13, 24] findings. Instead, TalkingTiles was typically used to vocalize in-

dividual keywords to indicate basic needs or *steer* conversation. For individuals like Nina and Sonya who focused on basic communication, such as indicating a need to eat or go to the washroom, TalkingTiles' default vocalization features enabled individuals to quickly communicate these needs to their caregivers. The creation of personalized content such as details about their family further enabled these individuals to initiate conversations about more personal topics.

For Emmett and Victor, the tiles provide a means of grounding and steering topics during more in-depth conversations. When conversing with his wife without the app, Emmett needed to go through an extended process to steer the conversation. If no pictures were nearby, he would first establish the general subject, such as people or parks, and then answer 'yes' or 'no' questions to narrow down the topic. For example, if Emmett wanted to talk about a person, he would start by saying the word 'people'. His wife would then list 'West', 'East', 'South', and 'North' (in relation to their house), providing Emmett a chance to confirm each option. After confirming one of the options, Emmett's wife would list possibilities, and in response to each one Emmett could say closer, farther, or confirm the choice. Personalizations within the app significantly reduced the need for these questions, and allowed both Emmett and Victor to create shortcuts to topics that they frequently wanted to discuss, such as professional sports and hobbies. However, the degree to which conversations can be steered is limited by what custom content has been added, meaning that even when TalkingTiles is available SCA is vital to having more complex, detailed discussions.

These limitations, in light of our discussion surrounding the difficulty and ongoing nature of customizations, provide guidance for the development of future AAC applications. In particular, they suggest that AAC is likely to continue to play a support role for individuals with aphasia, rather than a wholesale replacement for SCA, and that future development may benefit from a focus on additional support for this role. Our findings also suggest that the types of customization and personalization that are most useful to users may be those oriented around keywords or short phrases. Many of these customizations are candidates for automation, such as contextually-aware suggestions for nearby places [11].

### **Accessible Surface Ecosystems**

Previous work has largely explored the use of older hardware, such as PDAs and desktops, as platforms for assistive technology. However, recent advances in mobile, interactive surfaces provide new opportunities for support, and we found that individuals with aphasia are living with improved access to technology; suggesting there may be a need to revisit opportunities for HCI research to impact these users. For example, Boyd-Graber et al. [5] report that designing software to prevent users from exiting to the Windows desktop was an important consideration in 2006, since the Windows desktop could be particularly difficult to interpret for individuals with aphasia. When preparing to conduct our study, we found that many individuals with aphasia were already engaged with technology on a regular basis, and we were able to recruit participants directly from an iPad working group.



The touch interface of modern personal devices, with large icons and a touch interface, provides a welcoming platform for individuals with aphasia. In interviewing our participants, we found that many already used smartphones and tablets regularly. Our participants reported using a variety of applications on their iPads, suggesting an opportunity for an ecosystem of applications that support the communication needs of individuals with aphasia. For example, research has explored the development of dedicated email clients [2] and social networking sites [20] for individuals with aphasia. TalkingTiles is currently only available on tablets, and thus is only appropriate for one-handed use when a surface upon which the tablet can be rested is nearby. However, we believe that support for smartphones, which can be used in a greater number of settings with one hand, will increase the app's utility in mobile contexts. We envision that additional applications could be developed to take advantage of these usage contexts, and to support activities such as web browsing, navigation (maps), and instant messaging.

### LIMITATIONS

As is common in studies of AAC for aphasia [3, 5, 7, 26, 18], we conducted interviews with a small number of individuals that excluded those who were unfamiliar with iPads due to the amount of training and practice required to become proficient with TalkingTiles. Individuals with more severe forms of aphasia were excluded from this study since communication with these individuals is difficult, even for experts in SCA [3]. These choices were made for practical reasons, and allowed us to identify needs within the one-week field study, but may not reflect the needs of individuals with aphasia as a whole who have a very wide variety of communication issues [1, 17]. A broader sampling would have likely identified additional usability issues, and we expect to continue to refine our understanding through additional field work.

### CONCLUSION

We conducted a field study that investigates the use of an AAC app, called TalkingTiles, over a one week trial period by individuals with aphasia. Our results demonstrate that these apps, which build on years of scientific research from the HCI community, have significant potential in enabling individuals to communicate with others. However, to fully realize this potential a careful balance must be struck between the support an application provides or customization and its simplicity. The combination of lightweight, portable, powerful computing devices with a simple touch interface and access to high-resolution cameras enables individuals with aphasia to address a variety of topics that are often infeasible with traditional communication methods, such as Supported Conversation for Adults with Aphasia. Our participants were overwhelmingly positive about the potential for TalkingTiles to enhance their lives and remove barriers to communication.

While effective, we found that time and effort must be invested in training individuals and customizing the app to suit their needs, personalities, and preferences. Enabling this customizability is often cited as an important design criterion in the literature, but its ongoing nature is not. Thus, we found that modern AAC apps must often be used in conjunction

with, not instead of, other communication methods. Our field study also identified practical areas for improvement in these apps, particularly related to often-cited design goals in the literature, such as personalization [3, 5] and simplicity. We found that support for such editing often required support from caregivers or loved ones, and may not be feasible on a long-term basis. Finally, we reflected on the potential for Post-PC devices for long-term support, and that improved access to these technologies provides new, unexplored opportunities to support communication for individuals with aphasia.

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