XTag: Designing an Experience Capturing and Sharing Tool for Persons with Aphasia

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ABSTRACT
In this paper we describe the design and exploratory field evaluation of an experience tagging and sharing application for people with expressive aphasia. We conducted a probe study with representatives from this target user group to gain a deeper understanding of the potential use of technology to capture and share everyday experiences. We used the obtained insights in the design of a new experience tagging tool (XTag). Our field study with the resulting prototype suggests that multimedia (picture, audio and GPS) indeed offer great potential for assisting aphasics while retelling their past experiences. Specifically, the tagging application improved support over a digital camera as it could be more easily operated single-handedly, which was much appreciated by aphasics. We also share some methodological lessons that we learned from our study.

Keywords
Aphasia, sharing experiences, photo tagging, technology probe, digital photo, storytelling, inclusive design

ACM Classification Keywords
H5.2. [Information interfaces and presentation]: User Interfaces-Evaluation/methodology, user-centered design; K.4.2 [Computers and Society]: Social issues-Assistive technologies for persons with disabilities

INTRODUCTION
An important part of our personal life is being able to share with others different kinds of stories. Storytelling is a key element of social interaction, as it allows a person to develop his or her bond with other people [30]. When a person, due to injury or disease, looses or becomes limited in his/her ability to use language (for example, because of aphasia) she or he also loses the ability to share stories, which can in turn lead to increased social isolation [16]. Language disturbances interfere with narrative communication at the single word or sentence level [26, 4], so that this ability to share stories is one of the most prominent and disabling characteristics of aphasics. The basic premise in our research is that enabling aphasics to better recount and express what has happened to them during the day can help them to regain some confidence in their ability to communicate with others.

Aphasia is an acquired communication disorder that cannot be cured, so that most aphasics have to learn how to cope with this disability. Specifically, individuals affected by expressive aphasia have difficulties expressing themselves through language. They can potentially benefit from technical support during the creation of a story and/or while expressing it. Aphasic individuals usually retain the ability to recognize image-based representations of objects [33]. This is extensively used in different assistive tools [29, 36], which are often referred to as Augmentative and Alternative Communication (AAC) devices. Both high-tech and low-tech AAC devices, are used extensively in aphasia therapy [35]. AACs mostly assist users in basic communication needs during the early stage of aphasia. However, AAC devices often fail to meet the needs beyond the initial stage. Therefore, the acceptance of AAC devices among aphasics decreases in the long run [21]. Though AAC devices have obvious merits, they also have drawbacks such as (a) AAC devices mainly support need-based communication, (b) AAC devices depend on the use of icons and symbols, which restricts the use since not all functions can be mapped to icons that are easily understood and remembered, (c) AAC devices stigmatize people, which implies that they prefer not to use them in a social setting.

People have various communication needs such as sharing information, social closeness and social etiquette [24]. AACs fall short to meet such needs of people with aphasia. There are very few examples of systems that aim at supporting such higher level communication needs. One example is the ESI planner [28]. ESI is a multi-modal daily planner designed to enable individuals with aphasia to independently manage their schedule. There are other isolated systems such as desktop-PDA [7], and Photo Talk [2] aimed at persons with aphasia. All these systems are intended to support some specific tasks, and are less suitable for complex communication needs such as storytelling. Social exclusion and social isolation are often uttered as prominent characteristics of persons with aphasia [9, 12]. We believe that technology, when properly...
designed, has the potential to assist in reducing such social isolation. Specifically, we think that technological support to capture, build and share daily stories is likely to help aphasics to reduce social isolation and to improve their quality of lives.

RELATED WORK
Storytelling is not only essential for the transfer of information, but also for promoting social connection and maintenance or establishment of social roles. Therefore, storytelling exceeds the ability to express direct needs and wants and supports other communication goals. There are several distinct aspects that need to be addressed when designing a storytelling system for aphasics, i.e., (a) the ability to (re)collect materials in support of the story, (b) the ability to build a story from these materials, and (c) the ability to express the story to others or to let others explore the story by themselves. Each of these components creates a challenge in its own.

Storytelling can potentially be done without (spoken) language by means of multimedia such as photos, as was demonstrated in some recent prototypes [5]. However, these systems were not tailored to persons with aphasia. Digital photos are beneficial for several purposes such as for cognitive assistance [11], supporting conversation [17], creating personal stories [20, 27], and self expression [23]. As the cognitive abilities of many people with aphasia are not seriously affected, we can assume that they can potentially utilize digital photos to express daily experiences if appropriate support is provided.

Life logging tools such as SenseCam [6, 14] help their users to collect daily experiences continuously and passively. The downside of such systems is however that the volume of collected information grows very fast and that an increasingly large effort is required to select from these materials for story creation [8]. Life logging tools have however been used by patients with dementia and Alzheimer to assist their memories, rather than to build stories [22]. AACs such as TouchSpeak [36] and MindExpress [29] have been used by persons with aphasia to express simple stories, despite the fact that these AACs offer only very limited storytelling support. One early exploration of improved storytelling support for persons with aphasia was discussed in [10]. The resulting prototype has some obvious limitations: 1) it was not easy for aphasics to capture events with the web camera while the camera was attached to a tablet pc, 2) the prototype did not offer ample support to organize the captured materials, such as photos, while constructing and expressing experiences, and 3) there was no provision for aphasics to collect experiences in a mobile setting and later arrange these materials to create stories or re-experience the past. There is hence ample room for improving different aspects of the storytelling experience. In this paper we focus on how people with expressive aphasia can be assisted in gathering story materials such as photos, audio, etc.

We discuss different stages in the design of a new capturing and sharing device, called XTag, intended to enable aphasics to better capture everyday experiences. This device is intended to be used in combination with other life logging tools. XTag is different from existing life logging systems in at least two respects: (1) it assists in capturing experiences manually, and (2) it assists in categorizing the captured materials, which should make it easier to query them later with the help of a narrative interface. Our long-term goal is to use XTag as one of the components in an overall system that helps aphasics in communicating everyday experiences as a form of conversational storytelling. The contributions of this paper are therefore: (a) a better understanding of how technological aids can support communication in persons with aphasia, (b) the design of a specific photo tagging and sharing application (XTag) that is inspired by principles of storytelling, and (c) the results of a limited field evaluation of XTag.

In the following sections we first describe the requirements gathering process that involved a probe study with two aphasics. In the conceptual design stage following this study three concepts were explored before settling on one specific concept for further development and testing. The resulting prototype was evaluated in a limited field test with the same two aphasics used in the probe study. We present the outcomes of this field test together with some methodological lessons learned. We finish by comparing and contrasting our own design to existing solutions in the extended discussion part.

REQUIREMENTS GATHERING
Technology probes have been used frequently in design environments where it is difficult to apply standard ethnographic methods [18]. We conducted a technology probe study with two aphasic participants. The objective was to determine the potential impact of media such as photos, sound and GPS on the ability of aphasics' to (re)tell personal experiences. Data was collected through logging of probe usage and by conducting semi-structured interviews.

Participants
Two participants (P1 & P2) were recruited through a local rehabilitation center. Earlier a certified speech therapist administered the Aachen Aphasia Test (AAT) to participant P1. The Aachen aphasia test is a standardized test for aphasics to determine progression in different stages of the aphasia [19]. The test addresses six language-related aspects: spontaneous language, token recognition, repeating, written language, naming, and comprehension. The other participant P2 was unable to do the AAT and the speech therapist conducted an Implicit Association Test (IAT) that provides a measure of strength of automatic associations [13].

P1 is an adult male (age 56) who, as a result of a stroke about one year ago suffers from aphasia and lives with his
wife. P1 speaks full sentences at a fluent pace, but sometimes makes word-choice errors. His AAT test shows that his speech, writing and language comprehension impairments are mild. P1 was unable to return to his job as a mechanical engineer following his stroke. Despite P1’s communication and physical impairments, he is still comfortable performing many activities independently. P1 attends speech therapy once a week. P2 is an adult male (age 53) who, as a result of aortic surgery 2 years ago, suffers from severe aphasia and right-sided paralysis. P2 is unable to speak more than a few isolated words, and is able to write only partial single words. The semantic association test showed that he suffers from severe speech and writing impairments. His comprehension and visual semantics are moderately impaired. P2 was an assistant manager at a grocery store and he was unable to resume work due to his brain injury. However P2 still is able to operate appliances like desktop computers, TV sets, small PDA like devices. For communication he uses limited speech, gestures, or written notes. P2 attends speech therapy once a week. P2 lives with his wife, daughter and grandson.

Procedure
The researcher met the participants at home and meetings were accompanied by family members for support. The first meeting lasted approximately one hour and background information, skills and test strategies were discussed. Probes for the test were: a digital camera, a voice-recorder, and a GPS data logger (Figure 1). Participants were asked to take pictures of events/experiences they would like to share, for a period of one week. Audio samples could be collected as well. Furthermore they received a GPS data logger which kept track of their locations over time. At the subsequent meeting (day after capturing), the researcher asked questions about how they had been using the probes for capturing experiences. The discussion involved several steps. Firstly, sharing the captured experiences without the help of pictures, audio, or GSP information as participants had to tell about the experiences they captured just from memory. Secondly, the participant used the captured pictures, audio and GPS data for retelling the experiences. Participants narrated the experiences by browsing through the pictures one by one with the help of MS PowerPoint. During this round the researchers asked questions to elicit detailed stories and provided cues that could be suitable for aphasics while retelling an experience. Thirdly, the participants were asked to cluster and categorize pictures into several events. Finally, the participants were asked to answer some post-test questions and rate some statements. The sessions were videotaped and observation notes were taken for further analyses.

Results
Both P1 and P2 used the probe(s) outside of their home and in a social setting such as during a group therapy meeting. P1 took 19 photographs and P2 took 8 photographs. P1 recorded 1 audio sample and used the GPS data logger at all times. The events P1 captured were: playing with the dog, internet banking, cycling, watching TV, waking up, breakfast, cab ride, speech therapy, relaxation, and fitness. P2 did not use the sound recorder and the GPS data logger. He captured images of meeting people at the rehabilitation center, of relaxing, a picture of his therapist, etc. The captured images were categorized as people (who), places (where) and activity (what) category. Most of the captured materials were related to the activity category.

P1 used pictures and audio for assistance while sharing experiences. His memory and communication skills were sufficient to share experiences without the help of additional media. However, he did point out that pictures and audio supported him to explain and share his experiences in a more detailed manner. Some of the pictures that P1 had taken were very blurry up to the point where he had problems remembering their content. While discussing the usefulness of the photos for experience sharing, P1 mentioned that the chronology of events was of no great importance to him. Chronology of pictures and other media within a single event however did matter and such media should hence be properly sequenced in time. A few usability problems were uncovered during the field study. As explained, the autofocus feature of the digital camera created problems in that several pictures were out of focus. Both participants were also uncomfortable with operating the camera single handedly, as the camera was clearly not designed with such usage in mind. P1 wished to take pictures of himself when he wanted to share his feelings, which was simply too difficult with the existing camera. We analyzed the picture content to understand what kind of stories people conveyed with the photos. We observed that aphasics easily recognized the photos and the underlying stories behind the photos. Words expressing emotions were often used while expressing stories. Digital photos created shared content and context for the discussion partner. Since the communication partners were not present during the photo capturing, there was a need for detailed descriptions while showing the captured information, unless the materials were self explanatory or preprocessed. For P1 less prompts were required to extract the underlying stories from the photos. Spontaneous narrations were most frequent for P1, while for P2 induced narrations were dominating. This was in accordance with the fact that P1 only has mild aphasia, while P2 is a severe aphasic. The word/sentence length in case of P1 was significantly longer than in case of P2. P2 found it very difficult to express himself through the photos. He was
mostly focusing on what was in the pictures rather than on the underlying experience. For P2, much support was required from the communication partner in the form of cueing to answer something properly, or questioning to gain details of the event being portrayed. For example, in one of the photographs, P2 recognized the person but was unable to name her. His wife and daughter were helping him by uttering the first few letters of the name.

Design Implications
We have observed that digital photos, sound and GPS data have potential advantages for persons with aphasia. However, how to utilize those media for expressing day-to-day experiences is less obvious. From the probe study we summarize the following requirements for improved support:

- Aphasics would benefit from a simpler capturing device that they can operate with their non-dominant hand only.
- Categorization of the captured media would help aphasics to recall events later on. Support to tag and express emotions therefore seem interesting.
- Support for categorizing and re-telling the underlying experiences could be useful.

DESIGNING A TAGGING AND SHARING TOOL

Conceptual Design
Several design ideas were generated through brainstorming. All ideas aim at coupling extra information to the picture being taken, such as the mood of the user at the time when a picture is captured. The large button on the top of the remote controller device in Concept 1 of Figure 2(left); triggers the digital photo camera. By sliding the slider to the left or right aphasics can express if they feel happy or sad when taking the picture. The second idea (Figure 2-middle) is an extension of the first idea. Instead of adding a one dimensional emotion to the picture, this idea proposes using two-dimensional information. Again, by pressing the button on top of the cylinder the digital photo camera is triggered. The top part of the cylinder can however also be turned, and feedback is provided though changing the color of the light within. The different colors represent different moods such as red for angry and yellow for happy. By shaking the cylinder vertically the intensity of the color can be influenced, hence expressing the intensity of the mood. The third idea (Figure 2-right), which will be explored further, is to add information that is not continuous but discrete, i.e., by selecting an emotion and a category from a number of predefined options. In all concepts, the capturing action could be performed by a camera mounted on an ear headset (or on a pair of glasses).

Final Design: XTag
The initial design ideas were discussed with the speech therapist. The design opportunities were reviewed and it was decided to develop a tool that integrates the capturing of pictures with sound recording. The action of taking a picture was divided into multiple actions, namely aiming, triggering and adding a mood or category. To separate the triggering and aiming actions a remote triggering device was proposed. As we have observed in the requirements gathering phase, operating and aiming a digital camera is cumbersome for aphasics. Therefore, similar capturing devices such as a mobile phone camera may also pose a challenge for them. Consequently, a sunglass camera would potentially be helpful for aphasics as a capturing device. A sunglass camera has several advantages for aphasics such as a) aphasics can wear the glasses and look at a particular object and can take pictures easily, b) aiming the sunglass camera is easy as it is in line with head movement and reduces the burden for aphasics as they do not need to grab the capturing device with both hands. We used an off-the-shelf sunglass camera that can capture 1.3 megapixel still images (at a resolution of 1280x1024) (Figure 3). The sunglass camera has a remote control (RF remote frequency: 2.4GHz) to capture photos and 1 GB of storage. We designed a new handheld controller (tagging tool) to add more functions to the existing remote controller. The resulting tagging tool has several buttons which reflect some storytelling principles, such as answering (some of) the 5 Ws (who, where, when, what and why). Three of the buttons are labeled as: who, where/what and emotion. Either auditory or visual feedback should be provided when one of these buttons is pressed. The four remaining buttons are used to add emotional expression to a photo, and have emoticons on them. The four emoticons are happy, sad, amazed, and
Implementation: XTag and Narrative Interface

The tagging tool (Figure 4) was prototyped using an Arduino controller and the remote controller of the sunglass camera. A sound recorder was integrated into the tagging tool. The casing was designed in SolidWorks[31] and the narrative interface was designed using Flash and Action script. The tagging tool has three large input buttons to select the categories. In addition there are four smaller input buttons to select the desired moods. Pictures are captured by pressing any of the trigger buttons (who, what/where). Sound fragments are captured by pressing a button placed on the left side of the controller. A sound recording can be stopped manually by pressing this button a second time, or the user can leave it up to the system to stop the recording automatically after 1 minute. A typical experience capture follows a sequence of actions. Firstly, pressing the ‘Who’ button trigger a picture capture and will turn the indicator next to the button green. The user can make a (first) sound recording while this green light is on. Secondly, pressing the next button which is ‘where/what’ button will trigger a second picture recording, as well as a recording of the GPS coordinates. The indicator light next to the ‘Who’ button turns red, indicating an off state, and the indicator light next to the ‘Where/What’ button turns, indicating an active state. The user can again make a sound recording if he wants to. Finally, the emotion button is pressed, which turns the green light next to the ‘Where/What’ button red, a desired emotion can be chosen using any of the four buttons with emoticons. The XTag device is now ready to capture a new experience.

Upon receiving the signal of one of the trigger buttons the Arduino performs a number of actions. First the Arduino activates the remote control of the sunglass camera. This is done by bypassing the button of the existing remote control of the sunglasses camera. Secondly, the Arduino stores information in its internal memory in the form of text strings. Some string contain information about the activated category (who, what/where, or emoticon), including button events related to the sound recording (start and stop time) or the selected emoticon. Another string contains information about the date, time and location (GPS coordinates) of the recording. All strings related to a single experience are printed out in the narrative template at the time the experience is shown in the narrative interface (Figure 5). The user can transfer the captured pictures, audio and annotations into the narrative interface by connecting the XTag device, the sunglass camera and the GPS logger through USB connectors. The scrollbar on the right in the interface allows to scroll through the captured experiences of a single day, while the calendar allows to select the day of interest. Two pictures, captured with the “who” and “what/where” button, respectively, are shown next to a textual field (currently containing day and time of the recording) and an emoticon field. The user can select the “who” or “what/where” picture by clicking on it, after which he can start and stop playing the corresponding audio recording by clicking on the play button underneath the pictures. Users can play the sound recordings by clicking the play button and scroll through each experience by using the scroll button situated at the right side of the narrative interface.

Feedback Session with the Speech Therapist

The XTag prototype and the narrative interface were demonstrated to the speech therapist. The goal was to understand the suitability of the concept for aphasics and also to discover potential design flaws. The main concern was whether or not, in her opinion, people with aphasia would be able to understand and operate the tagging device and the narrative interface. The therapist advised us to reduce the number of options of the tagging tool as they might confuse persons with aphasia. She also mentioned that the narrative interface would be understandable by the aphasics given that some sort of support would be available from the communication partner. She appreciated the interface as it is based on explicit categories of information that are easy to understand. Based on her comments we reduced the number of emotion buttons from the original 8 to the 4 shown in the final design of the tagging tool in Figure 4.
probes which they were allowed to use for one week. The probes were: the sunglass camera, the tagging tool (see Figure 4), and a GPS data logger. Since both the participants already wore spectacles it was not feasible for them to wear the sunglass camera. Equipping the sunglass camera with prescription glasses was also not an option. Therefore, we attached the sunglass camera to a cap. After handing the probes there were several meetings over the week where the researcher asked questions to the participants about how they had been using the probes for capturing experiences. The discussion involved several steps. Firstly, participants had to tell about the captured experiences from memory. Secondly, the participant used the captured pictures, audio and GPS data for retelling their experiences. The captured experiences were presented on the narrative interface during this stage. Finally, the usability of the concept was discussed through a set of questions and (yes/no) statements. The partners of the aphasics were present during the interview sessions. The interview sessions were video recorded and field notes were taken.

![Figure 5. The narrative interface showing the two pictures associated with a single experience, next to information on the day & time and the attached emotion. Audio recordings can be activated through the play button at the bottom.](image)

**Results**

Here we present general findings followed by the analysis of the two case studies. P1 only used the probes for 2 days, capturing 2 events, due to battery failure. No sound recordings were made but the GPS logger was used at all times. P1 did not have any problems operating the device. The amount of constructive feedback on the concept was satisfactory. Because of the battery failure the sunglass camera started to capture images automatically, with surprisingly positive results. P2 captured daily events such as gardening, having a chat with friends, but did not capture any GPS or audio data. P1 used the device for mundane tasks such as when he was riding a bike (see Figure 6). This was convenient for him since he could operate the camera easily while he was on the move. P1 was more independent while using the probes and expressing stories than P2. During the interview sessions both participants expressed that they found the concept of XTag useful and they understood its operating principles. We now provide more detailed discussion about the feedback on different aspects of the concept.

**Categorization and tagging**

Both participants liked the idea of simultaneously tagging pictures when capturing. P1 mentioned: *I think this is very convenient; categorizing pictures later on takes too much time and effort. The selections who and what/where are okay, but the freedom within one experience is very limited.*

**Narrative interface**

Both P1 and P2 liked the narrative interface as it gave a clear overview of the captured experience. However, participants mentioned that the narrative template was probably too restrictive in its current form.

P1 mentioned: *The interface is clear and simple, which is what I like about it. However I think I would like to see an overview of all the experiences that I took on a single day before focusing on a specific one. Both categories are always shown equally. I would like to see the category which isn’t applicable blend into the background. This way my attention can be focused only on the category that I want to tell something about, so if I tell something about a person the category what/where should fade out.*

Both pieces of advice within the previous comment would be worthwhile to consider in a future version of the interface.

![Figure 6. Some of the pictures captured by participants with XTag](image)

**Advantage over traditional photo camera**

Participants appreciated the design which was better than a normal digital camera. The main advantage was aiming the camera. This was justified from the comments of P1: *With this tagging system you’re able to easily aim the camera just by looking at the desired object. However, the focus point of the camera is a bit problematic because the camera is now placed on a cap on my head.*

P2 liked a normal digital camera since it had a display device which gave direct feedback. However, he
appreciated that the tagging tool was much easier to carry and operate.

**Handheld controller for tagging**
P1 and P2 found operating the tagging tool very easy. The buttons were large enough and the distance in between them was sufficient in order to avoid unwanted selections. The buttons for selecting the categories (who, what/where, emotions) were also clear though sometime P2 was confused by the emotion buttons as they were smaller than the other buttons.

**Use of multimedia to share experiences**
P1 reflected that audio and GPS data would be useful additions to the narrative template for sharing experiences. GPS data was most suited for explaining the location of pictures, whereas audio would help aphasics to remember the events. He quoted the following:

> I like both, audio and pictures. Audio is suitable when I want to capture experiences. Audio helps me to associate images with words. Images in combination with audio can help me refresh my memory. I think audio files should be coupled to the correlating picture in a way that when wanted you can play the audio file when looking at a picture. GPS logging is very handy when I'm traveling; this way I can show where I've been in an easy way. The plotted map of the GPS data could be directly linked to the pictures I took. But there should be links to the pictures instead of pictures integrated into the map that would only distract me when sharing my experience.

However, for P2 there was no particular choice of arrangement of the collected media. He liked the pictures most and the audio. He did not capture GPS information as it was a bit complex for him to understand the photos with the GPS locations.

**Manual vs. automatic capturing**
The participants mentioned that there could be a semi-automatic mode for capturing photos. For example, capturing an experience just by pressing the start button and pictures will be taken every 10 minutes. This would help the person to concentrate on the activity without constantly having to think about taking pictures. Another recommendation was to record sound fragments every time a picture is taken. Therefore, while sharing experiences with photos audio can be played to help refresh the memory of the aphasic.

**DISCUSSION**
The field test showed that XTag helped to view the captured experiences by creating a shared content and context for both the aphasic person and their communication partners. The narrative template with the three different categories was clear and understandable. However, enhancing the freedom to go back and forth between the different categories within capturing one experience would make the device more flexible. The narrative template provided guidance, but in its current form it might cause difficulties because all the categories were present at all times. The category ‘emotions’ could be left out completely or at least should be extended with a neutral emotion. Sharing the experiences with the narrative template made it easier for aphasics to concentrate on the important aspects of the story.

The placement of the photo camera on the head of the participant was considered easy, although the view of the camera in the current solution was slightly different than our initial solution. Operating the tagging tool was simple and understandable, but in its current form it might be daunting, because awareness of the system was constantly present. This might hinder daily activities. A solution would be to capture experiences semi-automatically. Additional media other than photos was useful for retelling experiences and audio was most suitable when telling about an event whereas GPS data for telling about trips. It would be advisable to convert the GPS data into an understandable picture format, such as a map. Both the audio and the GPS data should be more clearly linked to the correlating picture.

The battery failure brought new insights to the research, namely semi-automatic capturing of events (experiences), a concept that requires the user to only initiate the capturing at regular time interval (such as 5 minutes). Such a sequence of events may still be tagged with a capturing mood. Although during the field study only few audio files were recorded, aphasics still saw the benefits of adding audio. We think that the use of GPS data would be too complex to understand for severe aphasics. Overall, the findings suggest that the concept of simultaneously tagging and capturing has merit for our aphasic participants.

Another remark about the field test is the short testing period. A preliminary usability test could have indicated that the battery life of the tagging tool was limited to 14 hours. Although only two participants were recruited for the field study, still the field test provided us with valuable insights.

**Comparison and Contrast with other Experience Capturing and Sharing Devices**
Here we would like to discuss the comparison and contrast of our approach with other works. First of all, our approach is different from existing storytelling system [8] in a number of ways.

Our work extends the option of capturing life experiences to a mobile setting, whereas existing systems [8] are more limited, as the capturing device is a web camera that needs to be connected to a computer, such as a tablet pc. As it is well known that most aphasics have right sided paralysis, operating such a camera-computer combination is quite tedious for them. Moreover, this would be mostly restricted to an indoor (home) context. In our approach it was feasible to collect experiences both at home and outside. The sunglass camera helps to focus on a particular thing and reduces the burden of operating it. The notion of a
camera build into a pair of sunglasses, although popular in areas of security, seems to be quite novel for our application of supporting aphasics. The use of the tagging tool helps to capture the information in a more structured way, which also reduces the burden to organize the materials for story building afterwards. The prototype reported in [10] does not provide support for the organization of the captured materials. The narrative interface that we propose helps to view the captured materials in a more structured way. Our approach is also different from traditional tagging applications [3] where pictures are explicitly tagged as people, places, etc. In our approach the captured photos are categorized as who, where/what, emotion and date and time. These categories add an additional label to the captured information and are in agreement with categories used in existing Augmentative and Alternative Communication (AAC) devices and also in the therapy book for aphasics created by the Dutch aphasia union (afasie.nl). These categories are known to be effective for persons with aphasia.

In our approach with XTag information is captured manually by the participants, whereas in traditional life logging systems the information is collected autonomously [6, 14]. One obvious difficulty is the huge number of materials collected by existing life logging systems which would probably requires partner assistance to help filtering irrelevant information. Another concern with a system such as SenseCam is that it uses a fish eye lens. The resulting pictures are therefore not rectangular and of insufficient quality for subsequent viewing. The pictures taken by the sunglass camera are rectangular in shape and have fairly high resolution. SenseCam needs to hang on the user’s neck and thereby it moves frequently when the participant is on the move, which adds to the risk of capturing images with motion blur. In the sunglass camera solution, the camera is usually more stable. As evident by our field study, automatic or semi-automatic capture might be helpful such as when the participants are on the move. However, we believe that the ideal device should have both automatic and manual functionalities for capturing life experiences. As found in earlier research, assistive technologies tend to stigmatize their users and therefore, people don’t want to use them in a social setting [21]. Therefore, our concept would help to reduce this barrier as the solution is more unobtrusive, i.e. other people might not notice that someone is using the sunglass camera and looks like a disabled person.

Isaac [20] is an early application which has been designed to capture and edit photos. It is based on a version of ‘Apple Newton’ with a CCD camera and phone handset integrated in a modified cover. The total weight of Isaac is 2 kg, including a 7.2 V/2.5 Ah NiMH power pack. Therefore it is not suitable for aphasics to handle the camera. With Isaac users can select a particular photo and annotate it with the help of a keyboard. The application contains complex menus and is not intended for persons with aphasia who have unique problems in reading, writing and or speaking in addition to physical disabilities. However, the post-capturing interface of Isaac is interesting and might be useful for people with aphasia. The application needs to be redesigned to make it suitable for people with aphasia, however.

**Improvements of the Tagging and Sharing Tool**

Problems were discovered with the shape and design of the tagging tool during the field study. The shape and design of the tagging tool were judged as too big and ergonomically weak. This problem was admitted by the researchers, but due to time and manufacturing limitations improvements could not be carried out. The tagging tool needs redesigning, aesthetically as well as electronically, to create a smaller shape and more robust operation. Improvements can be done to the tagging procedure as well. At present tags are stored on the tagging tool, while synchronizing pictures with the correlating tags is done manually. Further improvements are required to the presentation of audio and GPS data, whereas current research has confirmed only the merit of those media. The presentation of the events for sharing is another aspect that should be investigated. Test results show that presentation of events using the designed template (who, what/where, emotion) has advantages over the use of pictures without the narrative interface. Presenting an overview of the pictures first and then highlighting the core categories step by step as they were captured and fading out other categories could be a solution. It might also be helpful to add additional labels to the captured pictures. This could be accomplished while eliciting detailed stories from the captured materials by the communication partner by asking questions. For example, the categorized pictures can have additional tags such as name of the person, place etc. Enriching pictures with additional labels would be helpful for people with severe expressive aphasia.

Redesign of the capturing device should also be investigated, as the current sunglass camera solution causes problems if users already wear prescription glasses. In the next design iteration the camera device will be integrated into the aphasics’ own glasses. We believe that for P2 due to his severe aphasia it would be advantageous to do some preprocessing with the captured images such as annotation with text/icons to clarify the story to the story recipients.

**Notes on Methodology**

Repetitive question asking worked well for the aphasics as we observed in both the pre and post test interviews. Since aphasics mostly remain passive and quiet, repetitive question asking is most suitable for them to extract opinions. Such an approach followed from requirements gathering with Alzheimer’s patients [15]. It has been observed that involving the help of domain experts [1] can assist in the design process, despite the fact that these experts are not aphasic themselves. We however observed that the feelings and enthusiasm of aphasics could
the tagging tool and narrative interface. We see that there
is a couple of things we can improve. One is the size of
the tagging tool and also the look and feel. The other one is
improvements to the narrative interface. One of the
prospective directions is to enhance the interface with
additional functionalities for off-line tagging (adding more
information related to the 5 W’s). Another prospective
direction is to look at offline ways of distributing collected
experiences, such as through email. Aphasics are slower in
processing but can spend time to compose stories and share
them with other people. Email is such an application that
aphasics can benefit from. Therefore, we would like to
build add-ons for the narrative interface. The envisioned
tool will be able to handle diverse communication needs of
aphasics (face-to-face, offline production of stories etc.).
Another key direction is the improvements of the capturing
device itself i.e. the sunglasses camera. As we learned that
many aphasics wear prescribed glasses, it would be
advantageous to build a pair of glasses with a built-in
camera that would allow to simply changing the glasses
within.

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REFERENCES
experts in assistive technology research. Universal
design and field evaluation of PhotoTalk: a digital
image communication application for people. In
motivations for annotation in mobile and online media.
In Proceedings of CHI ’07, ACM, 971-980.
impairments in progressive aphasia and frontotemporal
Storytelling with digital photographs. In Proceedings of
CHI ’00, ACM, 564-571.
camera, SenseCam, as a pictorial diary to improve
autobiographical memory in a patient with limbic
encephalitis: A preliminary report. Neuropsychological
Rehabilitation 17(4): 582-601.
7. Boyd-Graber, J. L., Nikolova, S. S., Moffatt, K. A.,
Kin, K. C., Lee, J. Y., Mackey, L. W., Tremaine, M.
proxies: developing a desktop-PDA system to support
people with aphasia. In Proceedings of CHI ’06, ACM,
151-160.


29. MindExpress. www.jabbla.com


36. TouchSpeak. www.touchspeak.co.uk