

Designing for older adults'life storytelling through a tangible interactive device

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Designing for Older Adults' Life Storytelling through a Tangible Interactive Device

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There appears to be a mismatch between current interactive media and intergenerational storytelling, which leads to the elderly are often viewed as passive consumers, rather than active creators of story content. In this paper, we present our study aiming to facilitate storytelling of older adults living in the care facilities with their children, driven by the research questions: *RQ1: What life stories would the older adults like to share?* And *RQ2: How to facilitate older adults to tell stories with their children?* A research prototype named Slots-story was designed, which integrated functions of memory cue generator, story recording, and preservation. In the field study, eight pairs of participants (each pair consisting of an elderly adult and his/her child) were recruited to use the prototype for around ten days. Semi-structured interviews were conducted both with the elderly and their children. Stories collected were transcribed, and thematic analysis was conducted, which formed the foundation of the insights on the research questions.

Keywords: Elderly, storytelling, tangible interface, social Interaction

Introduction

Storytelling plays a fundamental role in human communication. From a hermeneutic point of view, human life is a process of story and narrative interpretation (Widdershoven, 1993). For the elderly, intergenerational storytelling improves psychological well-being, reduces feelings of loneliness and depression of them (Driessnack, 2017). For their children, intergenerational storytelling contributes to the development of a strong sense of intergenerational self, which is associated with children's increased resilience, better adjustment, and improved likelihood of overcoming challenges (Fivush, Bohanek, & Duke, 2008). Given that multiple participants across generations not only co-narrate their shared stories but also jointly evaluate them, intergenerational family storytelling becomes important to identity development (Langellier, 2011)(Peterson & Langellier, 2006). Preservation of life stories is also necessary as they are an important part of identity preservation. The elderly hope they will be remembered, however, when the elderly passed, their family members are only left with bundles of images, materials, objects, and wishes of the deceased (Whittaker, Bergman, & Clough, 2010).

Our target group was older adults living in the care facilities and their children. According to our previous study, these user group mostly they couldn't operate computers or smartphones (Li, Lin, et al., 2018). This was because they were unfamiliar with digital devices and lack of using experiences, as well as suffering from physical decline. Most interviewees suffered from age-related declines, such as fading eyesight, losing flexibility in hands, a lack of mobility. They obtained information mainly by TV and Newspapers.



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While social media like Facebook and Twitter help to share and preserve the stories to some extent, these platforms are more about the “now” moments and less about the past moments (Marcus, 2015). In addition, the elderly are still disconnected from the mainstream social circles due to lack of technology and devices that resonate with them (Waycott et al., 2013). Currently, most interfaces are designed to support younger users. Thus, they are confronted as passive consumers rather than active creators of content (Brewer & Piper, 2016).

In this paper, we describe our explorative work, focusing on prompt older adults to share and preserve their life stories with their children. Knowledge and insights were gained by the implementation of the prototype. Contributions of this paper lie in: A better understanding of elderly people's preference for life story themes, and concrete strategies and insights on facilitating intergenerational life storytelling and preservation for the elderly. In related work section, our literature review allows us to identify the stated research and design focus.

Related work

Multiple Functions of Storytelling of the Elderly

From a physiological perspective, reminiscing and sharing of life stories improve self-esteem, mood, well-being and enhances feelings of control and mastery over life as one ages. Research has also associated reminiscence with improving psychological well-being, reducing feelings of loneliness and depression, and helping older adults find meaning in their life (Driessnack, 2017). From a social perspective, stories transmit cultural and individual traditions, values, and moral codes (Kemper, 1984). Stories told by the elderly create meaning beyond the individual and provide a sense of self through historical time and in relation to family members, and thus may facilitate positive identity (Fivush, 2011). From a broader perspective, stories told by the elderly are treasured intangible source of cultural heritage. When individuals regard that they approach the end of their lives, they tend to document segments of their personal history and issues of generativity and knowledge transmission to younger generations are considered as significant to seniors (Unruh, 1983).

Practices of older adults' story sharing

Given that one of the most precious characteristics of older adults is their memory of events, people and places during their childhood and adolescence (Dryjanska, 2015), older adults could be deemed as story content producers. Jenny Waycott et al. further investigate the nature and role of digital content that has been created by older adults in the care facilities, for the purpose of forging new relationships, and their findings demonstrate that older adults are willing to express themselves creatively through digital content production (Waycott et al., 2013). We build on this idea and extend it into intergenerational story sharing.

Applications of storytelling for the elderly

On the application side, in terms of applications and tools for the storytelling for the elderly, there is a system aiming to help residents in care facilities make connections through sharing stories (Linnemeier, Lin, Laput, & Vijjapurapu, 2012), game-based reminiscence service that enables elders to capture memories and annotate photos (Lee et al., 2014), design of encouraging reminiscence and storytelling with objects, as a tool for building connections of older residents in care facilities (Bennett et al., 2015), an interactive table for sharing memories, skills and demands (Giorgi, Ceriani, Bottoni, Talamo, & Ruggiero, 2013), and a system aims to make the elders feel more connected to the outside environment, and further facilitate their sharing of stories with citizens from local communities (Li, Lin, et al., 2018).

In terms of intergenerational storytelling, current applications are mostly smartphone applications or website, which are inaccessible for elderly users. There are smartphone applications or webs for creating multimedia stories (Druin, Bederson, & Quinn, 2009) (Bentley, Basapur, & Chowdhury, 2011b), a software of managing family stories (Marcus, 2015), software for videos to be saved in user-specified real-world locations, shared with friends and family (Bentley, Basapur, & Chowdhury, 2011a), and a software support digital reminiscing of the elderly (Thiry & Rosson, 2012).

Since TUI (Tangible user interface) has been identified by Spreicer as having great potential to improve older adults' acceptance of technology acceptance (Spreicer, 2011), applications that support story sharing for non-tech-savvy older adults mostly adopt tangible interface. There are applications focus on improving older adults' connections with other fellow residents: a tangible system aiming to help residents in the care facilities

make connections with their fellow residents through sharing stories (Linnemeier et al., 2012). Using landscape tangibles as proxy objects to aid storytelling and reminiscence for older people in care facilities (Bennett et al., 2015). There are applications focusing on improving their connections with people outside: *Interactive Gallery*, a tangible installation placed in care facilities aims to facilitate story sharing between older adults and citizens from local communities (Li, Lin, et al., 2018).

Summary

The literature indicates that storytelling benefits the elderly from the physiological, social, and a broader perspective. We focus on older adults' life stories, and we particularly adopt trigger questions as memory cues. We probe how to provide the older adults explicit memory trigger questions through a tangible device and bring them an enjoyable using experience. Since our target group is non-tech-savvy older adults in the care facilities, we also build on tangible interface to bridge the technological gap for older users. In the next section, we introduce our prototype in details.

Design intervention

We based the design of Slots-story on our previous work-in-progress work (Li, Hu, Hengeveld, & Hummels, 2018). Its design process included an interview study. The following is a summary of the interview. We found the elderly were unfamiliar with digital devices and lack of using experience. They had regular contact with children, who were almost the only people that the elderly could really tell personal things to. Nostalgia was prevalent among the elderly and they would like to share their life stories, but they were rarely asked specifically, which made the stories hard to preserve. Currently, life story sharing was fragmented and happened unconsciously. The younger generation was lack awareness of the elderly's stories. Memory triggers were necessary to facilitate life storytelling, and their life memories were recalled by conversation topics, family mementos, etc. Given that the meeting time of the young and the elderly was limited every week, we could also consider separating the process of storytelling and story listening. We then conducted brainstorm, sketch and mock-up, and user consultation, and the resulting design was Slots-story (Figure 1).

Prototype: Slots-Story

Based on the above design requirements, Slots-Story is designed. The metaphor of slots-machine is applied in it. Slots machine is operated by one lever on the side of the machine and is familiar to most elderly people. When the user pulls the lever, a trigger question is displayed in a similar fashion as slots-machines. It consists of a slots-machine-like device and a flash disk, and it could either be used face to face or independently by the elderly and their family members.

Appearance: For ease of use and ergonomic purposes Slots- Story is wedge-shaped, making the display easy to see, and lever and buttons easy to access. A 7-inch display and a microphone are arranged on the upside and a button is on the front side. The handle on the back, together with a portable dimension, makes it easy to carry. The MDF material is covered with a wooden laminate texture, making it look slightly old-fashioned, which is in line with the aesthetic taste of the elderly.



Figure 1: Slots-Story prototype, and question and recording interfaces

Display Interfaces: Slots-story includes two display interfaces: the “Question interface” and “Recoding interface”. Vintage style is also applied both in the interface elements and fonts. Considering fading eyesight of the elderly, bold and huge fonts are used for the text. There are also usage tips at the bottom: Press “REC/STOP button before/after recording.

The “Question interface” displays one specific question, which could be switched to Next/Previous question by pulling down/pushing up the lever. The “Question interface” will be switched to “Recoding interface” if the

REC/STOP button is pressed. In the “Recording interface”, a dynamic recording icon is placed to provide real-time feedback.

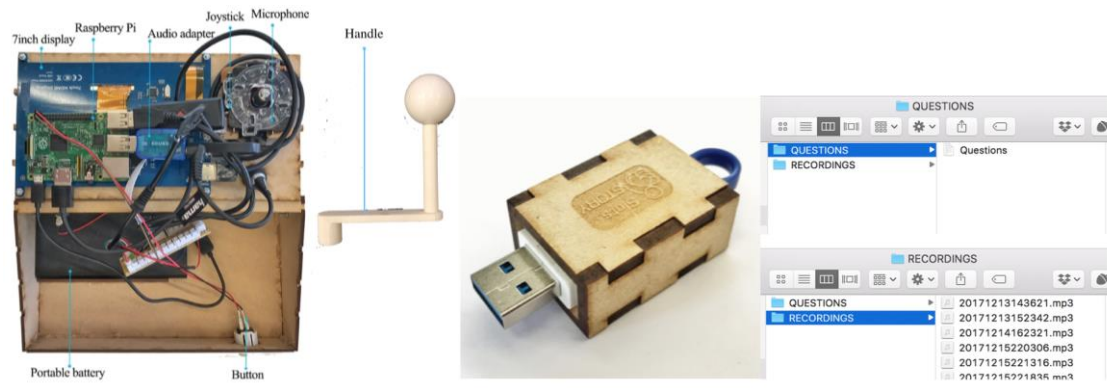


Figure 2: Hardware of Slots-Story prototype, Flash disk and question and folders inside

Interaction: The interaction process is: (1) The young inserts flash disk into the prototype and gives it to the elderly. (2) The elderly operates the lever to switch trigger questions. (3) The elderly pushes the button to start recording. (4) The elderly pushes the button again to save the recording. (5) Stories told by the elderly now are in the flash disk. (6) The young Plugs the flash disk into a computer to listen and keep stories, and further modifies trigger questions. (7) The slots-story could also be used face to face.

USB Flash Disk: The flash disk is not only used to store the trigger questions and preserve the story audios. There are two folders in it: “QUESTIONS” and “RECORDINGS”, the former contains a text formatting document, the latter contains all the story audios told by the elderly.

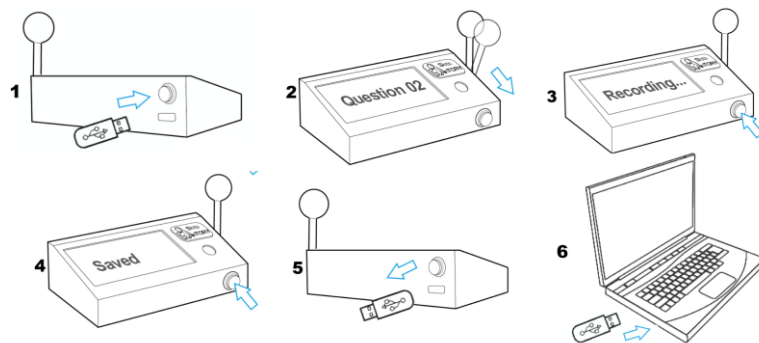


Figure 3: Operating procedures

Trigger Questions of Different Themes: Explicit questions are employed as memory cues (Table 1). Compared with other types of memory cues, questions are more explicit and straightforward, and targeted answers will be triggered. Trigger questions in our case are from The Life Story Interview(Atkinson, 1998), questions cover most aspects of an entire life course, including childhood, family, school, work, friend, historical events, and others, which are arranged within a thematic framework chronologically. Additionally, considering the emotional consequences when recalling deep memories, we avoid adopting negative topics.

Table 1: Trigger questions in Slots- Story

Childhood	Friends and Fun
Were you ever told anything unusual about your birth?	What childhood or teenage friendships were important to you?
What is your earliest memory?	Did you make friends easily?
What was the most significant event in your life up to age 12?	What special people have you known in your life?
What clubs, groups, or organizations did you join?	Did you have a steady boy or girlfriend in high school?
Did you have any dreams as a child? As an adolescent?	How do you use leisure time?
Family	Historical Events
What was going on in your family and the world at the time of your birth?	What historical events did you participate in?
What beliefs or ideals your parents tried to teach you?	What is the most important historical event given to you by your family?
Are there any family stories told about you as a baby?	What has your life contributed to history of your community?
What characteristics do you remember about your grandparent?	Do you remember what you were doing on the days in World War II?
How would you describe your parents?	Do you recall any legends, tales, or songs in your community?
Did your parents spend enough time with you? What did you do with them?	
School and Work	Others
What is your first memory of attending school?	Do you remember your first date? Your first kiss?
What was your first experience of leaving home like?	What gifts (tangible or intangible) are still important to you?
What are your best memories of school?	What were the crucial decisions in your life?
What accomplishments in school are you most proud of?	What has been the happiest time in your life?
Is there anything that you miss about your work?	How would you describe your worldview?
What is the best part about being retired?	What have been your greatest accomplishments?

Field Study

As previously mentioned, we want to explore the possibilities of facilitating the elderly to tell life stories through the implementation of the Slots-Story. Therefore, the research questions addressed in this paper are: *RQ1: What life stories would the older adults like to share?* And *RQ2: How to facilitate older adults to tell stories with their children?*

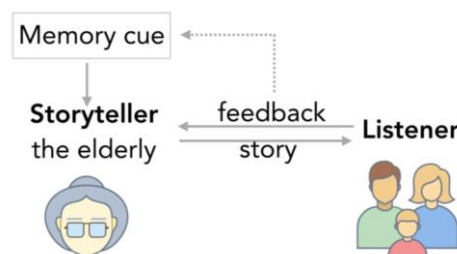


Figure 4: The process of story sharing

Procedure

Overview: In the field study, three same prototypes were made and were distributed to participants. Each set of the prototype was provided with an instruction for use. Eight pairs of participants (each pair consisted of an old adult and his/her children) were recruited. The older adults were from local Dutch care facilities. Purpose, functions, and operation procedure were first introduced to them, and then they were interviewed. After that, each pair used the prototype for around five days. After they used the prototype, interviews were conducted with them again. All the interviews were audio-recorded with the interviewees' consent. Interviews and story audios were then transcribed and analyzed.

Participants: eight families, the age of the older adults ranged from 63 to 86. There were four females and four males, and their marital status were: five married, living with a spouse; three widowed. They agreed to share their audio recordings. None of them reported any significant physical impairments. The age of their children ranged from 38 to 43.

The first round semi-structured interview

Interview questions: Semi-structured interviews were conducted twice, before and after the implementation of the prototype. The aim of the first interview was to understand the actuality of intergenerational storytelling of the elderly. All interviews were analyzed by a qualitative, grounded theoretical approach, informed by situational analysis, to inductively analyze our data and generate the findings (Charmaz, 2014). Interview questions of the first round were as follows. **Basic Information:** Age, gender, physical condition.

Communication with family: Way of keeping in touch (face-to-face, phone, skype, etc.). **Current story sharing situation:** Whether they like to share stories, and why. **Situations and reasons for sharing stories:** Who, when, how to share stories (face-to-face, phone, skype, etc.). Topics, duration, and frequency of story sharing. The trigger of life story sharing. Problems encountering during story sharing.

Findings

Communication with Family Members: Firstly, they had regular contact with children, but wanted more: "Sometimes they eat here when they visit me, it is the coziest moment, and I like that." "I want they could visit me more often, but I don't call my children very often because I don't want to disturb them, they have to work after all." Secondly, Family members were almost the only people that the elderly could really tell personal things to. Although talking topics were various: daily lives, sports, weather, politics, etc., and they were mainly about the family that was private and personal.

Current life story sharing situation: Firstly, nostalgia was prevalent among them: The elderly interviewee became emotional and depressed, and would like to recall their past. The first reason was that they could not do some things they could before. The second reason was they tended to be nostalgic naturally when aged: "Past things come to my minds somehow. After I grew old, I often look back to my life and feel life is short." "I don't understand the society of today, and I miss the past." Secondly, the elderly would like to share their life stories, but they were rarely asked specifically: The elderly would like to recall their past, but they were not asked very often, nor did they have many chances to tell the stories. "I myself would like to recall the past. My children almost never ask about that specifically." However, the younger were to lack awareness of the importance of elderly's stories: Life stories of the elderly were seemingly ignored by their children. It was not the young were uninterested in the past of the elderly, but that they were lack of awareness of it. The young realized its importance only when the elderly passed away. Thirdly, currently life story sharing was fragmented and happens unconsciously: The elderly didn't share life stories specifically and deliberately in daily lives. Situations and reasons for sharing life stories were various. For example, when the conversation topics were related to their past, it acted as memory triggers to remind them. In brief, Life story sharing was fragmented and happened casually and unnoticeably, making life stories hard to preserve.

Problems encountering when sharing life stories: The biggest problem for storytelling was lack of topics. Secondly, as most elderly interviewees felt their lives were ordinary and nothing special, their concern was that others might not be interested in their life stories: "I guess those successful or rich people would like to tell their life stories. For us ordinary people, there is nothing worth telling." Next, some of them were emotional, and they might weep when recalling deep memories, which would be embarrassing. Finally, the interviewees were suffering from memory decline.

The second round semi-structured interview

Interview questions: The aim of the second interview was to evaluate the prototype. The interviews were semi-structured and based loosely on the following questions.

Validity: Would you like to use it? Who would you like to share with? Do you think it could facilitate sharing stories? Why?

Contents: Preference for questions A. Childhood B. Family C. School and work D. Friend and Fun E. Historical Events G. Others

Interaction: Do you understand the concept of the prototype? Do you find it easy to use? What is the most difficult part? Which part do you like/dislike most of the prototype? Why? Do you find it easy to use? What is the most difficult part? Which part do you like/dislike most of the prototype? Why? **Other:** Would you like to use it face to face/over a distance?

Comments for improvements: While the interviews with the young were based loosely on the following questions: What's your feeling after listening to the stories? Did you contact parents after listening to the stories? Preference for stories: A. Childhood B. Family C. School and work D. Friend and Fun E. Historical Events G.

Findings of interview the older adults

Validity of the prototype: With respect to validity, the interviewees thought it could facilitate life story sharing. The prototype helped them to remember what they almost forgot, as well as giving them a chance to save memory. One interviewee said: *"It helps me to reflect on my own life again. I could remember something I've nearly forgotten."* They also enjoyed the process of recalling: *"I had a lot of fun recalling and telling my own memories, experiences, and feelings."* The elderly also benefited a lot from recalling the past as they got insights from it: *"The questions give me insights into the past as well as mistakes and reactions of people who are very close to me."* The elderly also thought the story recordings also benefited next generations: *"I would like to have such a device for my grandfather, because I don't even know his name."*

Preferences for the topics: Most of them would like to talk about their childhood, especially the interesting and funny things. As one elderly interviewee said: *"Recalling the past makes me feel go back to the past."* *"Telling happy things itself is a happy thing, which also brings happiness to others."* The second was their achievements and those they were proud of. Part of the reason was they could not do some things they could before: *"I felt happy when recalling happy things, the memories brought me back."*

Interaction of the prototype: They showed great interests in it, especially its intuitive operation. The metaphor of the slots-machine was understood and accepted by them. According to the elderly, sharing stories and handle operation were the most interesting functions. *"The slots-machine-like operation raises me a sense of expecting and curiosity for the unknown."* Most elderly interviewees felt the directly telling stories behavior was convenient compared with writing stories. Especially some of them had difficulty in writing: *"Without good eyesight, you cannot do much alone, even if you are mentally totally fit."*

Comments for improvements: Personalization: Questions were fixed in the prototype, and how to set personalized questions needs to be considered. Sustainability: There were only 35 questions in the prototype, how to sustain the story sharing process in a long-term way after all the questions are answered need to be considered in the future iteration. Usability: Some participants suggested that the sensitivity of operation should be reduced as their hands were clumsy. One participant thought the prototype could be friendlier by displaying *"Thanks for your story"* after stories are told.

Findings of Interview with the elderly's children

Learned new things they didn't know before, and knew more about parents/grandparents: Most of the young participants said they learned completely new things from the recordings, and also they were surprised that there were lots of things they didn't know about their parents after listening to the stories. *"I never know my mother's infant name, and she told the origin of her infant name."* *"I didn't know too much about my great grandfather because he had passed away before I was born. I heard a lot about him through my mother's recordings."* *"I think the trigger questions have been thought of for me, in case I didn't ask the elderly."*

The recordings were a treasure to pass on to next generation: Some young participants thought the recordings could be kept and passed down for generations, as the recordings were like biography

encapsulating the life of the storyteller. *“Our parents and grandparents are guardians of a very personal memory treasure, which need to be preserved. I think that is the meaning of the prototype.”* Another young participant said: *“I think I can play the recording to the next generation and talk about how it was with her grandmother back then, great idea for recording memories to be handed down the generations.”* Recordings would also be a consolation if the elderly passed away: *“If mom once died, these recordings with many heartfelt memories can certainly give a little consolation.”*

A good way to ask some embarrassing questions: Some young participants felt listening the recordings was different from listening to the elderly talking face to face, as the former was a good way to know some embarrassing questions they wanted to know. The prototype provided a way of avoiding awkward situations.

Enabled the young to be aware of the importance of preservation of life stories of their parents: Some of the young participants agreed it enabled them to be aware of the importance of life stories of their parents. The first reason was that they learned new things that they didn’t know before. The second reason was, there were some that the elderly couldn’t remember, so the sooner they tell their stories, the more they could remember: *“When we were young, we might be not interested in stories of parents, but later when we would like to ask them, they might already pass away, and we couldn’t ask anything longer. I will keep all these memories well and will learn much more.”*

Voice contained real familiarity and emotions: Most participants felt familiarity with the voice. The voice contained emotions, personalities, and feelings. One young interviewee said: *“I even hear the meow of her cat. I could imagine the scenes of she telling her stories.”* Compared with text, voice contains real familiarity and emotions. *“I could even hear her laughter when recalling happy memories. the happy stories made me happy too, and that was also nice to remember.”*

Developed conversations when using face-to-face: Trigger questions that Slots-story provided were of different themes. It acted as a conversation topic generator when they used face-to-face.: *“It helps to develop conversations that we would never have had before.”* *“It can serve as a conduit for discussion, and one gets to know each other differently.”*

Thematic analysis of stories

Stories told by the elderly were conducted the thematic analysis. Thematic analysis is a method for identifying, analyzing and reporting patterns (themes) within data. It minimally organizes and describes the data set in (rich) detail (Braun & Clarke, 2006). The thematic analysis emphasizes on the content, as grounded theorists do, investigators collect many stories and inductively create conceptual groupings from the data. Data in the form of personal experience offers the opportunity to uncover topics and themes to study participants would have remained unknown and consequently unanalysed by the researcher using a fixed interview to gather data.

Method

Transcription of the stories: There is considerable variation in definitions of life story, which leads to different methods of analysis, but all the methods require constructing texts for further analysis, which is the transcriptions (Riessman, 1993). In our case, transcription conventions and guidelines were based on Robert L. Miller’s method (Miller, 1999). We didn’t choose what to preserve and what to discard, and all the audios were retained and transcribed.

Thematic analysis: Following (Sanderson & McKeough, 2005), the themes of the stories were defined, and were labelled according to categories.

Table 2: A snippet of transcription

Transcription	Theme	Label
<i>The first question is ‘were you ever told anything unusual about your birth’. When I see this question um.....Naturally, I am reminded of when I was little, my mother told me: “My girl, you will be a lucky girl. “I said: “I certainly hope so, but why do you say so?” And she said: “It is because you were born in autumn, and we had a harvest that year. At that time, thousands of people died of famine. We didn’t know where our next meal came. But when you were born, we had an autumn harvest. So, I believe you will be a lucky girl.”</i>	Her mother believed she was a lucky girl as when she was born in autumn harvest	Birth

Results: proportion of the life story themes

Themes of the stories could be roughly divided into descriptions and perceptions. The former mainly includes descriptions of the event, object, or people. The latter mainly includes feelings, self-evaluations, and life insights.

All the themes were generalized into 14 main categories and 38 sub-categories. Proportions of story themes the elderly told are calculated, as it could reflect the preference of talking topics, from an objective perspective.

Themes they talked most were about **Childhood**, among which “funny things” and “historical events” were they talked the most, which was in line with the result of the interview: they would like to talk about happy, positive, and funny things, especially childhood. The next main category was related to **Family**, among which the most is about “family members”. Followed by “parent’s teachings”, which are beliefs and ideal parents taught them. 13.7% of themes were about **Perception**, in descending order it includes “feelings”, “insights”, “self-evaluation”, “world-view”, “belief”, and “regret”. Next is **School** (10.5%), among which “proud things” are they talk the most, which is in line with the interview: they would like to tell stories they were proud of. The category of **Impressive things** includes is complex, mainly about memorable stories: for example, important life decision, mysterious thing, dangerous things, etc.

One thing to note is the “skill instructions” are interspersed in their narratives. For example, making hand-made shoes, chess skills, skills of writing articles. These are also intangible treasure worth preserving. Additionally, in the theme of “**Memento**”, photographs, mementos are important visual clues to help the elderly recall. These kinds of memory cues also need to be explored in the next iteration.

Stories told by the elderly weren’t limited to the trigger questions provided

Results also showed that stories told by the participates were not limited to the 35 trigger questions, and the older participants didn’t slavishly follow the topics of the trigger questions and dutifully record corresponding stories. Three aspects could account for this: Firstly, the narrative was not always linear. The trigger questions acted as jumping-off points which sparked broader memories, and gradually the narrative becomes non-directive and unfocused. One story might remind the elderly of the other related story. Secondly, some participants got used to using it to tell stories gradually, when a story suddenly came to his mind, he would like to use the prototype to record. Thirdly, the process of recalling gave the storyteller an opportunity to review his/her life. After a life review process, the elderly acquired a new sense of personal authorship and life reflections in their life journey, more and new insights on lives emerged.

Discussion

Designing for older adults’ storytelling

Memory trigger is essential to storytelling, trigger questions should be open-ended, concrete, and in everyday language: During our interview, we found one of the problems for older adults’ storytelling was the apparent lack of topics. Therefore, memory trigger is necessary: A memory trigger is a circumstance or piece of information which aids the memory in retrieving details not recalled spontaneously (Dictionary, 2008). Secondly, unlike the close-ended question, the open-ended question needs to be answered with more thought and more than a simple one-word answer. Tigger questions should be open-ended. Secondly, according to the interview, most of them pointed out that trigger questions provided in Slots-Story were easy to answer as they

were concrete and in everyday language. Concrete trigger question is easy to answer as it facilitates reminiscence and prompts a specific story.

Tangible interface employing metaphor makes technology accessible for the elderly, acts as a physical reminder to encourage the elderly to tell stories: According to our interview study, most elderly interviewees still relied heavily on paper and preferred physical interaction and operation. As such, tangible interface could be adopted to provide physical feedback and overcome the limitations of screen-based interfaces. Literature has reported tangible interfaces are more accessible and suitable for the needs of the elderly, and interactions that remind them of familiar devices have a higher acceptance (Rodríguez, Karyda, Lucero, & Herskovic, 2018). Metaphor in the interface could reduce barriers of the elderly to use as well as reduce learning time (Irizarry, Downing, & West, 2002). In our case, the metaphor of slots-machine was understood and accepted by the participants. They showed great interests in its intuitive operation. From the perspective of design, Slots-story device is an interactive device with a tangible interface. The classic aesthetic of the Slots-story makes it unobtrusive when putting it at home, which would encourage and attract the elderly user to use it. Slots-story not only makes the digital content accessible and visible, and it also serves as a tangible reminder for the elderly of what it holds. Research has revealed that tangible materials produce deeper engagement, evoke deep emotional responses. Tangible reminders could be powerful tools in encouraging positive behaviors and thought patterns (Brown, 2009).

Using audios as the storage medium could lower the cost of narrative for the elderly, which could also retain information to the maximum degree. Given that the elderly felt difficulty in writing gradually, using audios as storage medium could lower the cost of narrative for them, compared with handwriting. Moreover, stories in audio forms could retain information to the maximum degree compared with stories in text form: the audios involve real emotions, feelings, ambient sounds, etc.) In our context, audio also shows advantages over video: A study points out that video is too real to allow room for thinking about the past with others (Chalfen, 1987).

Slots-story contributed to personal content acquisition and preservation: Autobiography is defined as the history of a life story, written by the person who has lived and experienced that life (Birren & Cochran, 2001). The importance of audio recorder has been emphasized by Millett: without it to preserve the very sound of language, we should have no idea of how people really talk: their pauses, inflections, emphases, unfinished sentences, short periods (Millett, 1975). In this sense, story audios collected by Slots-story are an audio version of an autobiography. Slots-story contributes to personal content acquisition and preservation, and helps the young generation to acquire and preserve stories of their parents/grandparents, and the stories could even be kept and passed down for generations.

Designing for intergenerational communication

There exist differences between using Slots-story face-to-face and separately. In our case, Slots-Story could be used face-to-face or separately by the elderly and the young. The reason was as follows: Despite that sitting together to communicate face-to-face is the most common and enjoyable way to share stories (Lindley & Monk, 2008), most older adults lived apart from their children, and duration of each visiting was limited. The older adults and their children's lives were also usually unsynchronized. Hence, the prototype should be able to be used both face-to-face and separately. When the elderly and the young use the prototype face-to-face, trigger questions that Slots-story provide are of different themes, and it acts as a conversation topic generator. While when the elderly use the prototype by themselves, they could be fully concentrated to tell the past things with deeper insights, and needn't care about the other's attitude or expressions. In this case, the stories they told are complete and integrated. Also, using the prototype separately is a good way to ask some embarrassing questions.

The story sharing process is not solitary but a collaboration process, as in addition to the storyteller, the responsive receiver is also needed. Process of storytelling could be formulated (Figure 4): triggered by the memory cues, the elderly tell stories and which are then conveyed to the young, the young provide feedback to the elderly, feedback from the young could effectively encourage the storytellers to tell more, also the feedback may also act as new memory cue. The story sharing circulation could be sustainable when all the above factors are integrated.

Facilitate life story share in a sustainable way: In the design of Slots-story, the memory trigger questions are fixed, and the whole story sharing system is not sustainable. We could close the loop of story sharing process by actively involving the young generation. In the current iteration, the young are passive participants. Efforts

should be made in the aspects of the young to turn them into active participants through personalization of trigger questions: Trigger questions could be raised and edited by the young.

Conclusion and future work

In this paper, we have a better understanding of the elderly's life stories. To be specific, we understand older adults' preference for story topics through thematic analysis. Insights on RQ1 are discussed in the section of thematic analysis. The field study indicated that Slots-story facilitated the storytelling and preservation for the elderly. We further conclude the implications of designing for facilitating elderly's life storytelling through their reflection during using our prototype. Insights on RQ2 could be concluded as Memory trigger is essential to storytelling, trigger questions should be open-ended, concrete, and in everyday language. Using audios as a storage medium could lower the cost of narrative for the elderly, which could also retain information to the maximum degree. Tangible interface employing metaphor makes technology accessible for the elderly, acts as a physical reminder to encourage the elderly to tell stories. Separating the process of storytelling and story listening could make the stories complete and integrated. Personalization of trigger questions, and trigger questions could be raised and edited by the young. The loop of story sharing process should be closed to make the sharing process sustainable.

As some of the stories told by the elderly were related to their mementos, such as album, souvenir, artwork, etc. Photographs, mementos are also ideal memory trigger as they provide visual clues, which help the elderly recall events, even long-forgotten stories. This inspired us to explore their mementos and related stories in the next iteration.

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