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Designing a Reminiscence Aid in Personal Soundscape

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Abstract: Auditory perception can evoke strong emotions; emotions can enhance memory processing. We believe there should be a preferred state that differentiates *reminiscence aids* from the total recollection of utility-based memory aids, where human experience is enriched and thicken. In this research, we bring back auditory experience, a gradually marginalized perception, into the core of the interaction design of personal reminiscence. With an epistemological stance of research through design, we aim at gaining the knowledge of enrolling and utilizing *auditory association* as a design resource in everyday practice of reminiscence. We provide a design example of reminiscence aids and suggest an intervention with *self-associative artifacts*, which locate in a place between totally random and deterministic design. The findings from a field study show that our digital artifact participates in users' meaning-making processes in their daily practices of reminiscence and keeps personal mementos being value-laden.

Keywords: Reminiscence aid, soundscape, experience-centered design, research through design

1. Introduction

The focus of user experience research has shifted over the past few years from an emphasis on user's satisfaction to attention to *felt experience*. McCarthy and Wright argue that people do not merely use technologies, but living with them [11]. Interactions between human and technological artifacts enrich people's lived and felt experience. Furthermore, drawing on Kahneman's notions of *experiencing* and *remembering selves* [9], felt experience could be gradually accumulated and stored as part of our remembering selves through later meaning-making processes. Meanwhile, personal values are also reflected onto our life stories and interwoven with our belongings. These processes make personal belongings become mementos possessing capabilities of evoking reminiscence dialogue in our daily life.

We regard reminiscence activity as an on-going dialogue between the existing self and the past self or between the self and others. During reminiscing, personal value carried on message that texts, images, or sounds convey is mediated by artifacts in the dialogue. For example, people pass and point at their (physical) photo albums for highlighting personal significance, browse private and personal photo collections on their smartphones alone, or even upload photos onto social networking sites for contributing collective memories. All these performances are for communication, identity, and experience [20]. Therefore, we have the understanding that the participants in a reminiscence dialogue include not only human being but also the physical or digital artifacts, which are often intentionally overlooked in traditional utility-optimized applications.

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In this paper, we articulate that *reminiscence aids* should be discriminated from utility-oriented memory aids and allow people to reflect on their personal values through the interaction with the artifacts. Traditionally, reminiscence artifacts play a passive and silent role as a mediator. They mediate message in a conversation without their own "voice." The authenticity of information mediated among human participants is demanded. However, we always gain new insights from others' opinions and perspectives. We believe a different perspective from an artifact in situ would have significant impacts on human participants' experiencing selves. In the meantime, these experiences could also be resources for *memory adaptation* for their *future identities*.

Digital material is provided with feasibility to modulate the information that it mediates. Thus, we try to explore the design space of mediating message on digital reminiscence aids in this work. We follow a research-through-design approach where a design-relevant model comes after the theoretical departure and derives the designed artifact that is used to explore user experience in situ [24]. We were informed by Clark's theory on using language [4] to initiate our design. The designed artifact then participated in everyday reminiscence practice with human participants in a field study. The lessons came from the field study turned into design implications. The *SoundTag*, our designed artifact, was focused on intrapersonal reminiscence practice happening on everyday usage of young adults' smartphones. We chose "*auditory association*" as its "voice," a *self-association* from the artifact's perspective.

We use the term *self-associative artifact* to articulate our argument that the *comparability* among digital mementos could be a resource for users to reflect on their past selves and create meaning with the existing one. It reflexively juxtaposes comparable experiences and provides an opportunity for memory adaptation and consolidation for individual's future identity.

2. Literature Review

2.1 Reminiscence as Dialogical Language Use

Reminiscence has been viewed as a phenomenon across our whole life. It is not an exclusive activity in late life; indeed, recent studies have shown that the amount and the emotional experiences have no age differences between younger and older adults in reminiscing [21]. In Bluck and Levine's definition [2], reminiscence is a voluntary or involuntary process of recollecting one's past memories, no matter whether these memories are specific or generic, forgotten or remembered, private or shared. All the recollected memories are stories of the original experiences and reconstructed in relation to the existing self and environment. These stories are the building blocks of people's biographies through which the inner self of being is constructed, concreted, and connected with others and the future.

With a constructive perspective, we borrow the concepts from Clark's psycholinguistic theory [4] and regard reminiscence as a dialogical process happening among the participants. For example, reminiscence might be a dialogue between the existing self and the past self. The past self, the *speaker*, presents stories "at that time" to the existing self, the *addressee*. These stories could be the experience being captured at that moment or the accumulated memories till then. The existing self listens and interprets them with his/her new experiences. Then, the existing self might modulate this information and shape these stories into a new version. The new stories re-establish the *common ground* of the two selves and, as a result, reconstruct their preferred autobiographical memory for the future self.

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Similarly, above *joint activity* of reminiscence could also happen between the self and others. It could be recognized as a grounding process as well. First, the existing self shares his/her past correspondent with others. After information is imported, others give feedback on the past self to the existing self according to their understanding and interpretation at that moment. Sometimes, others might also share their elicited stories that have connection with the conversation. The existing self takes those feedback and stories into account to shape his/her autobiographical memory; meanwhile, the common ground for growing the following conversation is established through this joint action ladder.

The grounding process described in Clark's language model is the foundation in a face-to-face conversation. It is a dialogical meaning-making process. In this process, the serendipitous felt experiences that are evoked by past memories or other participants resonate with the Bakhtin's *creative understanding*, which is never ready a priori but must be finalized dialogically [11]. We borrow this constructive perspective from psycholinguistics to inform the interaction design of our reminiscence artifact. It would be emergent but not anticipated. It should depend on the signals performed, the context in situ, and the intentions that are carried by participants.

2.2 Reminiscence Aid

Technologies have been used for reminiscence since they participate in our everyday life. They quickly evolve over time and are constantly provided with different forms and functions. In contrast, people seem to be steadier within their value system. Value-laden memorabilia are usually kept with thick and rich personal meaning, which is enriched through mundane interactions with people. From physical to digital to ubiquitous, digital memory aids are gradually capable of controlling the way they present memory triggers. For this reason, we believe that a well-designed reminiscence aid should present its digital materials in a way that enriches the lived and felt experience in situ and elicits meaning making in our everyday reminiscence.

A growing number of researchers and practitioners are focusing on designing digital artifacts for reminiscence or memory augmentation. CIRCA, for instances, engages elders with dementia in a reminiscence activity with their caregivers [1]. Pensieve encompasses a dialogical emailing mechanism to elicit a conversation with users' past selves represented on social media sites [12]. SenseCam actively logs users' life and helps them recollect their past, sometimes, with a different perspective [10, 16]. There are also works that include different forms and media to enrich the interaction, such as Living Memory Box [17], CaraClock [18], FM Radio [13], and Audiophotography [6, 7].

In this paper, we discriminate artifacts that augment people's memory capacity, i.e. memory aids, from ones that help people shape their autobiographical memory and engage in an on-going meaning making process, which we define as *reminiscence aids*. Although these two categories of artifacts all designed for triggering users' memory, a memory aid tends to let users recollect or recognize rather than reinterpret regarding its reminding purpose [15, 16]. The information presented from a memory aid is also demanded to be unaltered. However, a reminiscence aid should help its user join in a dialogical process where the triggering contents only play an eliciting rather than a constraining role. This echoes the dialogical concept of Pensieve where the users have opportunities to re-interpret their past experiences sent to them and reply through writing text [12]. It would be a playful usage designed for *ludic engagement* [3, 8] rather than a problem-solution mapping for need fulfillment based on utility-oriented design.

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3. The Design Case

3.1 The SoundTag

The *SoundTag*, a *framing artifact* [23], is a personal mobile application designed to associate user's memories through a "sounds-like" experience. It is a note-taking app with a feature by which users can annotate events with *sound tags*, short recorded sound clips, and then associate and retrieve event records by these sound tags through their soundscape similarity (see Figure.1). We provide the artifact with "auditory association", the *self-association* ability, as its "voice" in a reminiscence dialogue. The *SoundTag* utilizes the perceptual association among experiences for provoking creative understanding.

Figure.1 Reminiscing with the *SoundTag*

By installing the application on participants' own smartphones, we would like it to participate in their daily reminiscence, and also, to reduce the intrusiveness of new equipment. We chose Apple iPhone and iPod Touch 4G as our client-end devices. Users could collect their digital mementos and retrieve them in the two respective modes of the system, *My Memories* and *Recall by Sound*. A remote server was responsible for analyzing the uploaded sound tags. It calculated timbre similarity among all sound tags then sent a ranking result back to the mobile devices. The two modes and the definition of soundscape similarity are described in detail in the following sections.

My Memories

It is the place for storing past memories. The list in *My Memories* shows all event records sorted by their timestamp, where the latest created one shows on the top. Tapping on each record in the list will bring users to the detail of the event. An event record could be composed of a photo, text tags, and sound tags. Users can come back to modify the record whenever preferences have changed. The design makes the event records more like human memories, which would be reconstructed and shaped whenever being retrieved.

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The length of a sound tag here is limited within 10 seconds. The limitation is applied for the reason of capturing the smallest self-contained particle of a soundscape. Schafer [14] defined the term *sound event* as the smallest self-contained particle of a soundscape perceived by the human ear. We borrowed the concept to define our *sound tag*, which is "the shortest and most representative sound clip recorded by user and used to annotate an event." The ten-second constraint is the insight from Frohlich's audiophotography research: the most popular duration of sound on audiophotos is ten second [7].

Recall by Sound

In this mode, all sound tags are listed and grouped by event. Tapping on a sound tag entry will lead users to the ranking page. In the ranking page, the associated and retrieved events are sorted by timbre similarity between their sound tags and the previous chosen tag. If there are multiple sound tags in an event record, only the most similar one with the chosen tag will be representative and used for sorting. Users then can browse the event content by tapping on an event record. This playful retrieval-by-association feature is different from an indexical utility-based search function. It is designed for weaving richer connections among memories and increasing serendipitous resources for reminiscence stories.

Another interesting feature of this mode is that users can directly hold the device to "listen" to a sound in situ and do the association in almost real-time. We call it *timbral listen*. When users hear a familiar sound source in a soundscape and want to recall past events records through it, they can directly press the listen button to let the artifact listen. After finishing its listening, either stopped by users or reaching the 10 seconds limit, the smartphone will send the clip to the server and get the ranking information back immediately. We would like this feature to be served as a connection between the *experiencing self* and the *remembering self* in order that those evoked memories could enrich the felt experience in situ.

Soundscape Similarity

We chose timbre as the primary characteristic of a sound tag for calculating soundscape similarity. The intuition is that people can easily differentiate a sound source from another according to its distinct timbre. Timbre helps people conceptualize components in a soundscape and categorize similar sound sources from different soundscapes. As a result, the *timbral features* defined by MARSYAS [19], an open source framework for audio processing, are employed as the primary factor in calculating the similarity. After the feature extraction, the similarity is the Euclidean distance of two points of *timbral features* with each feature as one dimension in feature space of each sound sample.

3.2 The Field Study

Participants

We conducted a one-week field trial to probe the participants' reminiscence experiences with the *SoundTag* in their lifeworlds in order to help us reframe the design. Because the purpose of this study is to acquire variety in personal meaning-making process, we adopted a purposeful sampling method to recruit our participants with various backgrounds. We aimed our target at younger adults who are regular smartphone users. Therefore, ten participants (four males, six females) from different backgrounds were recruited. They aged from 20 to 27 years and had iPhone or iPod Touch 4G use experiences ranging from 1 to 18 months. Seven participants are college or graduate students, two are software engineers, and the other is an accountant. Among the seven students, two

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major in management, two major in social sciences, and other three are studying in medicine, agriculture, and engineering respectively. The users were rewarded about 10 USD for completion of the field study.

Procedure

During the first recruitment interview, the *SoundTag* was installed and tested on participant's own device. All the functions of the *SoundTag* were described. The post-trial interview about one week after was also scheduled with the participants. Each participant was encouraged to collect 60 complete event records in their daily life as well as to freely and creatively use the associate-to-retrieve functions. A complete event record was defined as an event record containing one photo, two text tags, and at least two sound tags. Users were suggested to upload their sound tags every day to get the latest soundscape similarity ranking from the server.

In the one-hour post-trial individual interview, we obtained the usage scenarios, the personal preferences, and the behaviors of capturing and retrieving memories from our participants. They were also encouraged to tell unforgettable, emotional, and also unexpected experiences with the *SoundTag* if there was any. The materials they captured on their devices were used for elicitation and evocation during the inquiring. The interviews were audio-recorded for later transcription and analysis.

3.3 Findings

Personal Meaning Encoded in Sound Tags

Table 1. The quantity by category of sound tags used by the participants during the one-week trial

	Natural Sounds	Human Sounds	Sounds and Society	Mechanical Sounds	Sounds as Indicators	SUM
User1	4	79	30	3	4	120
User2	6	10	68	19	7	110
User3	0	3	8	1	0	12
User4	0	8	28	4	4	44
User5	0	5	1	2	1	9
User6	13	4	29	17	8	71
User7	25	37	47	13	3	125
User8	3	8	21	2	1	35
User9	0	18	0	0	0	18
User10	1	12	17	2	0	32
SUM	52	184	249	63	28	576

After the field study, 576 sound tags were collected in total. Unsurprisingly, the number differed from individual to individual and ranged from the lowest number of 9 to the highest 125 (Table. 1). Because we had no constraints on the type of recorded sounds, participants collected sounds from different sources and engaged in many creative collecting practices. For example, several participants recorded their speaking voice, because they wanted to keep track of their life by saying something to represent the happening events. Some participants looked out for interesting sounds in their daily life, which are seldom noticed before, such as sounds of little animals,

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water, and wind. Sometimes, they would also intentionally produce sounds by utilizing materials around them such as knocking on a table and stepping on stairs.

Although there was no constraint on type, the maximum recording time was limited to 10 seconds. We found the limitation worked differently among recorded content. For example, when participants wanted to capture human speaking or playing songs, they always recorded to the maximum of 10 seconds. However, it required less than 10 seconds to record ambient soundscapes, such as birds singing, stepping on leaves, and splashing waves. It shows that unequal duration is needed for comprehending the meaning of different sound sources, especially for those semantic *sound events* of soundscapes.

We borrowed a framework [14] that allowed us to differentiate the representations of sounds. The framework have been using for one of the sub-projects of the World Soundscape Project, an extended catalogue of descriptions of sound from literary, anthropological and historical documents. The main categories are as follows:

- *Natural sounds* (e.g. birds, cats, water)
- *Sounds and society* (e.g. ambient music, street, kitchen, office)
- *Mechanical sounds* (e.g. cars, scooters)
- *Human sounds* (e.g. voice, body)
- *Sounds as indicators* (e.g. ringtones, subway entrance gates)

The result shows that there are two main categories, *sounds and society* and *human sounds* (verbal), among all types of sound tags. According to the accounts from interviews, we understand the reason why participants captured human voice. It is not only the most evocative and memorable type of sounds but also with understandable meaning for them to annotate an event. The other major collection was ambient sound without a specific focus. Participants intended to use these sound tags to represent where the event took place. This third-person perspective of sound could help them to re-experience the event context.

When we tried to classify these sound tags, the participant's intention, actually, is often ambiguous for us to make sure what is the foreground in the recorded clips. For instance, a participant recorded a ten-seconds clip, which sounds like a street soundscape most of the time, but only in a very short period of time there is a birdcall. For a researcher, this sound might be classified into *sounds and society*. However, other accompanied information from image, a picture of bird at a distant, and text, "singing bird," helped us focus on what the recorder was engaged in and listening to, that is, a *natural sound*.

Unlike image and text are quick answers to the creator's attention; sound is more ambiguous that creates space for self-interpretation. When the system calculates the *timbral features* of a sound clip as a whole, it might emphasize other auditory features that were neglected while capturing. Therefore, it might provide users a reflexive opportunity to re-interpret relationships among the clustered events that are juxtaposed by the system.

Enriched Experiences with the SoundTag in Situ

Our *self-associative* artifact elicited ludic engagement in participants' lives. The *SoundTag* brought users to re-experience in their lived life and engaged them in new meaning-making opportunities, which might be overlooked before. One participant described an embarrassing experience of capturing a sound tag of duck walking at a pond:

Because when [a duck] flew on the paved road it made lots of noises like "po ko ko", it was scary to get near the duck as it became really aggressive, staring directly at me, suddenly standing on its toes and started walking towards me. I was scared and tried to run away but I felt stupid when I found out I only

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recorded the sound of myself rubbing against the bushes and my heavy breathing sound. Because there were local residents, I felt embarrassed when I was surprised by the duck and screamed "ah" so loud. In the end, I didn't succeed in recording the duck's sound but my screaming instead. What a shame! (SH)

It started from an awareness of environment that is elicited through understanding of the function of the artifact. In the end, it came to an experiential and emotional improvisation that is kept in autobiographical memory for sharing. It reminds us that designing a reminiscence aid should not only focus on its functional capabilities but could also help users capture their unintended experiences in situ.

Constraints on information mediation caused by hardware limitation, i.e. the "cost" mentioned by Clark [5], acted like a mirror that reflects participants' actions and increases their self-awareness of perception and feeling in situ. There is an account from one participant: "*Yea, just like you can only record the sound of streets when you are on the streets, even though I raised it as high as I could, still couldn't [record the target sound]. My ears can hear that, very sensitive, but the recordings just can't ...*" (SH) There is a similar experience from another participant: "*Just like walking on a street, Taipei is a noisy city, that's my feeling towards Taipei. That high level of noise is not easy to get recorded however.*" (WC) Although we provide an opportunity for engaging users in extemporaneous experiences, we should be aware of the tradeoff between the user's intention that must be fulfilled and the unexpected gain a reminiscence aid tries to offer.

Meaning Making with the SoundTag

To our surprise, the *self-association* of the design artifact is contagious. The concept of *auditory association* among past experiences evoked similar reflections in participants' interview sessions. Although they might not re-encounter those unforgettable events in the one-week trial, some of the participants shared personal and intimate events about auditory association in their autobiographical memory. For example, the following improvisatorial and playful meaning making with trivial surroundings was elicited.

JY: "*I like the sound of cracking when I step on the leaves.*"

Interviewer: "*What does that give you?*"

JY: "*Memories. I like this sound a lot already, and I told my close friends about it, then I remember we were all like idiots stepping on the leaves on the road. For most of the time, it was enjoying.*"

In fact, the *SoundTag* could only be capable of differentiating different sound sources based on their timbre features. It was not prepared for music, song, or speech recognition. However, the participants could still generalize the concept with their own interpretation to evoke their personal experiences. Three participants mentioned about their similar experiences with songs that are rooted in their memory long time ago. One participant indicates:

Actually this experience happens quite often, just like some sounds might have weird bonds with you. For example, when I was reading the book Dream of the Red Chamber a long time ago [...] Around that time I bought one album of Stefanie Sun, I will listen to the album while reading the book. Now whenever I heard that album, I will relive that experience of reading the book again. (WC)

Self-association not only had impact on episodic memory retrieval but also connected feelings. SH said: "*Just like if you listen to a song repeatedly during a high school event, if you hear it again now, you will remember the feelings during that time, the feelings that sticks in your head.*" With the embodiment of felt experiences, digital

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materials could then be value-laden in a reminiscence practice. As a result, these meaningful mementos, e.g. a nostalgic soundscape, could be then served as the axes of related memories.

Eh, it is like, the streets of Taipei is much noisy but with its own twist. [...] I came from Kaohsiung city ... so it will be much quieter when I got back to my home city, not that quiet, but less noisy. ... but coming back to home [in Taipei], when you hear that sound again, you will hear the familiar sound telling you that you are "back home." (WC)

Personal Value on Digital Mementos

The *SoundTag* embodied the common ground, i.e. sounds-like events, between the existing self and the past self with its self-association on auditory perception. The common ground was dialogically constructed out of digital materials that were captured, stored, and associated within the participants' daily practice of reminiscence. It is an implicit meaning-making process where the digital materials being value-laden and extracted from unorganized data collections.

In this study, the meaning-making process started from an intentional awareness of the environment. One of the motivations might come from that we encouraged participants to collect an expected number of events, which amplified the being of the artifact in their lifeworlds. Though there was few participants reached this requirement, we noticed an increase in their awareness of the potentiality of a perceptual experiences for future reminiscence.

This made me so sensitive to sound. I will pay attention to sound, because I normally wear a headset when I'm on the road, but I don't. It is because I am afraid of how much sound I will miss hearing. Ha-ha. Oh, and I kept thinking about how to collect those sixty events. Like the sound of my classmates knocking their pencil, I will say to myself, oh yea, this is also one kind of sound. I have become more sensitive to sound as a result. (SH)

For those who did not achieve the requirement, the *SoundTag* still stepped aside as a reminder who helped the participants reflect on a trade-off between their experiencing self and the significance of digital mementos. It invited them to think about the question: whether they should experience the moment themselves or through the artifact. It is a provoked intrinsic dialogue on personal value.

I would still prefer to memorize that by myself. I have no idea... But that depends on personal requirements for ways of recording. Sometimes, I might regret not taking a picture after the fact. But, I had so much pressure if I were forced to take pictures after pictures. That made me feel... man, I wish I could just experience that moment myself. (WC)

It is an unfinished meaning-making process as long as new materials are captured and re-arranged the sorting result. It continuously aggregates events with similar sound sources and personal value; thus, it could also amplify the feeling and emotion attached on those similar events when they are all expected in the association result. There is an account with a fulfilled expectation from a cat lover:

I was often recording my cat for a special purr snoring sound with low frequency for a long period of time, and I found that sound to be very cute, so then I would want to know more about it [by retrieval]. You see [the result]! It purrs in sleep, when wanting your attention, or eating midnight snacks, and more ... it also makes that sound when it climbs on you, also in the morning when it wants padding, then eating midnight snacks... (YJ)

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Most of the time the association results juxtaposed incompatible items from participants' expectation. The ambiguity of relationship between them required creative interpretation as long as it could make sense to the participant. It is a spontaneous meaning-making process that bridges the *self-association* of the *SoundTag* and new understanding of presented materials from participants. For example, YJ said: "*Why [the result of] typing [on keyboards] has this sound: 'cat eating midnight snacks??' It might make sound like typing when it eats.*"

4. Discussions and Conclusion

Our design was informed by Clark's theory of language use and participated in a dialogical meaning-making activity with human participants. Instead of a task, we prefer to take reminiscence practice with artifacts as a whole, an experience. It should start with an understanding of the expression and function of the artifact, then generate an expectation of the following joint activity, and perform a coordinated and embodied interaction in felt life. A value-laden grounding on digital mementos should also construct out of both the designer's perspective and the user's personal preference and intention. We should put emphasis on users' *reflection* in the experiencing process and how they adopt the artifact and adapt themselves to the emerging reminiscence dialogue.

In this paper, the *SoundTag*, an always-unfinished artifact, is a carrier of meaning and informed us the design of reminiscence aids. As the findings show, our *self-associative artifact* is not a passive sample collected for being used and observed; instead, it is an active intervention of experiential prototyping for provoking more discourse on users' felt experiences. The *SoundTag* stepped into the wild and was "*situated in time and space and built up over time and space* [22]." In the field study, it appeared to be a magnifier that allows us to examine a snapshot of "*the continuous sensory and sensual connection we have* [22]." It created new interpretations among experiences through auditory association and reminded users of their relationship with the environment and between the different selves: the experiencing and remembering selves, and the existing and past selves. We attempt to conclude several design implications as follows: a reminiscence aid in personal soundscape should (1) present easy-to-understand "voice" for users to follow, (2) participate and capture users' unintended experiences in situ, (3) balance users' intention with designed extemporaneous experiences, and (4) provoke users' reflection and reinterpretation on juxtaposed mementos.

To sum up, we provide an example of design thinking on experience-centered design of reminiscence aids. For designers, we would suggest an intervention with *self-associative artifacts*, which locate in a place between totally random and deterministic design. It should be understandable with its own *perspective* of presenting the common ground with users for developing continuous engagement during a dialogical interaction. For users, a *self-associative artifact* would be a participant of their meaning-making processes. It could play as a role of *reflective self* of users that helps them extract value-laden mementos and shape their remembering selves in felt life.

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