SonAmi: A Tangible Creativity Support Tool for Productive Procrastination

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Our goal is to help creative writers make procrastination productive. Interviews with eight creative writers highlighted two key practices: *Over Criticizing*, where perfectionism and negative self-appraisal demotivates them and reduces their output; and *Creative Voicing*, where speaking their text aloud promotes reflection and inspires new possibilities. A structured observation study compared writers' perception of their own, pre-recorded text versus computer-generated voices. The latter distances them from their text and offers new perspectives. We developed *SonAmi*, an interactive coaster that voices selected dialog whenever the author lifts their mug. Two creative writers said *SonAmi* made them feel they were listening to "someone else's text" or "a podcast", which helped them identify and improve writing issues. We show how tangible creativity support tools can build upon authors' existing strategies i.e. voicing their own words, and take advantage of naturally occurring events e.g., taking a sip of coffee, to support productive procrastination without interfering with creative flow.

CCS Concepts: • **Human-centered computing** → *Sound-based input / output*; *Empirical studies in HCI*.

Additional Key Words and Phrases: Embodied Interaction, Tangible Interfaces, Creative Writing, Creativity Support Tools

1 INTRODUCTION

We are interested in designing creativity support tools (CSTs) that inspire writers while explicitly avoiding interference with their 'creative flow' [11]. Creative writing is a complex cognitive process that not only requires generating original ideas but also extensive decision-making and problem-solving [30]. As Hemmingway famously said: "Rewriting is very painful [49]." This causes many writers to procrastinate [48] or develop 'writer's block' [30, 58], which acts as a 'creativity killer' [45]. A key challenge, then, is how to transform procrastination into a creative activity in its own right.

Most creativity support tools focus on accomplishing specified tasks with mimimal time, effort, and difficulty [2]. Some offer writing prompts[1], e.g., sentence starters, character names, and randomizers. Others try to improve the writer's style[2] by highlighting common writing errors, such as cumbersome sentences or overusing adverbs. While clearly useful, these require a conscious shift from being immersed in writing to accomplishing specific editing tasks. Another strategy is to create environments conducive to writing, such as *Ommwriter*[3], which sets up a full-screen, distraction-free writing mode with inspirational music. Schraefel [55] argues against forcing users to sit unnaturally still in front of the screen, and proposes liberating their hands from the keyboard so that their physical gestures can stimulate creative thinking. McCoy and Evans [43] show that different environmental stimuli, e.g., material, light, and smell, can either foster or diminish creative thinking [43]. For example, writers

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[1]*Listly List: list.ly/list/EdQ-writing-prompt-apps*
[2]*Hemingway App*: www.hemingwayapp.com/
[3]*OmmWriter*: https://ommwriter.com/

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become more alert with the smell of coffee [22] and are more creative in dim light [59]. Similarly, Zhao et al. [67] reveal that by mediating the surrounding environment we can support well-being and productivity. This suggests that CSTs should consider the role of all five senses, moving beyond the desktop [66] to take advantage of users' other senses. Tangible [22, 44] and embodied interaction [29] offer an intriguing approach that offers a more natural way of responding to the user's actions and blending into the writer's existing routines.

In order to design CSTs that inspire writing without interrupting creative flow, we must first address two key research questions: First, how do professional creative writers actually write, including their daily routines, environment, and sources of inspiration? What are their self-motivation techniques and strategies for maintaining focus? Second, can tangible artifacts fit naturally into the author's existing writing process, supporting creativity without interrupting it?

We first review the literature on creativity support tools, and then describe the results of an interview study with professional and semi-professional creative writers to better understand their creative processes. We explain how the results influenced the design and implementation of *SonAmi*, a tangible, voice-based CST. Next, we present the results of a structured observation to compare human-generated and synthetic voices, and an *in situ* technology probe study. We conclude with a discussion of how tangible CSTs can be designed to support embodied interaction, fitting seamlessly into existing writing practices without interfering with creative flow.

2 RELATED WORK

Creativity research spans over a century, from its early investigation as a human phenomenon to more recent work on designing creativity support tools. After presenting some of the diverse approaches to defining creativity, we concentrate on factors that have been shown to affect the writing process. We then present related creativity support tools and conclude with a brief discussion of the potential offered by tangible interfaces.

2.1 What is Creativity?

Psychologists have long examined creativity, seeking to understand how people in particular situations come up with creative solutions [16], measure individuals' inherent creativity [26, 54], or explain the creative process itself. For example, Amabile's Componential Theory [1] distinguishes between algorithmic tasks with clear, straightforward solutions, and creative tasks that lack readily identifiable paths to solution. Seligman et al. [56] define three interdependent components of creativity: "Creativity requires originality, which in turn requires prospection, which in turn requires imagination." Sternberg and Kaufman [61] argue that an idea is creative when it is novel, valuable, and surprising. Ideas are considered 'original' when a person uses abstract thinking, thinks specifically, and puts usually non-combined ideas together [64]. "Any unusual experience can increase cognitive flexibility" and foster creation of original ideas. [56] Cognitive flexibility refers to considering multiple ideas and seeing different perspectives [14]. As a fuzzy phenomenon, creativity intersects with serendipity [3], where chance—being surprised by something unexpected—and sagacity—seeing a breakthrough through an unexpected connection—are key. Creative ideas may appear spontaneously, although as Louis Pasteur said: "Chance favours the prepared mind" [53]. Csikszentmihalyi [12] also examines the effect of focused consistent work on creativity: "At the highest levels of creativity, it is the members of a discipline to which original ideas apply".

2.2 What affects the creative writing process?

Csikszentmihalyi [11] popularized the notion of 'flow' as essential to creativity, arguing that all forms of distraction should be eliminated. Perry [47] identifies four requirements for creative flow: 1. Being intrinsically motivated by the task; 2. Maintaining flow via regular feedback; 3. Engaging in rituals that focus attention inwards and prepare for writing; and 4. Using strategies to minimize anxiety with respect to potentially critical audiences.

External stimuli clearly affect mood and feelings, which in turn affects creative thinking. Many such stimuli are perceived unconsciously [52]. For example, lighting [59] and the natural environment [6] affect mood, as do auditory and olfactory stimuli [22]. Writers can also benefit from story prompts [17], pictures [24], physical material and aesthetics [44, 63], as well as taking physical breaks [55]. This suggests that creativity support tools should include external environmental stimuli that foster inspiration, concentration, and immersion.

Evaluation and revision also play a critical role in creative thinking [30], since writing is a reflective process that can make writers feel vulnerable and experience self-doubt. King [32] encourages writers to edit their first draft themselves, and only later give revised versions to selected readers. He recommends waiting for six weeks after finishing the work before embarking on a critical revision, to ensure a fresh perspective and to allow time to forget any any written notes. Even so, many authors, including Hemingway [49] and Lamott [35], edit their work the following day. This suggests that CSTs should support cyclical evaluation of work [41], based on personal preferences.

Social interaction plays a complex role in the creative process: Kaufman [30] shows that working for the benefit of others increases creativity, and Sawyer argues that social interaction and cultural context serve as beneficial constraints in the creative process [30]. For example, *Gloomy Streets* [36] revealed the process of writing a poem during the live writing performance. On the other hand, Perry [47] notes that others' negative judgements can induce writer's block, with a corresponding loss of productivity, self-doubt, and anxiety. The key challenge for CSTs is how to benefit from social interaction, without suffering negative effects. This poses a problem since: "There is no way to tell if the idea that seems to be stupid is ground-breaking or actually stupid" [9].

2.3 Which tools support creativity?

Shneiderman [57] argues that designing tools to support human creative processes is a 'grand challenge' for both researchers and practitioners. Perhaps not surprisingly, text editors remain the most popular creative writing tool. Gonçalves et al. [23] compared how four creative writing tools: *Microsoft Word, Scrivener, OmmWriter* and *Ulysses*, support entering and maintaining a state of creative flow. Most effective was *OmmWriter*, with its minimalistic interface and calming audio. However, as participants became more focused on their writing, the audio became more distracting than engaging. They also explored how subliminal priming with rapid, subconscious prompts might inspire writers, but found that these random words did not improve creativity. Instead, participants found them annoying and distracted them from their writing. This suggests that creativity support tools, rather than distracting writers, should take advantage of opportunities when they are engaged in other activities, such as when they are already procrastinating.

Gabriel et al. [18] designed a CST for writers *InkWell* that generates a variety of revisions by a given text using Natural Language Generation. Another writing tool *Lexichrome* [31] introduced a word-color associations to the text editor, it inspired reflection, but interrupted the flow. Some CSTs add specific features to increase efficiency. For example, Biskjaer et al.'s [7] visual time constraints pressure the writer, but result in more creative text. However, DeCharms [13] warns that adding external pressures and enticements diminishes individual autonomy and reduces intrinsic motivation. Other factors, such as as negative feedback, impending deadlines, and surveillance also lower writers' motivation [39]. Kaufman [30] shows that even positive motivators and rewards can harm the creative process, although the specific type of reward matters. For example, Domenico and Ryan [15] demonstrate that verbal praise not only increases motivation, but the effect endures even after the removal of the reward. These findings suggest that tools for supporting creative writing must be designed to explicitly account for the potential effects of both positive and negative external factors.
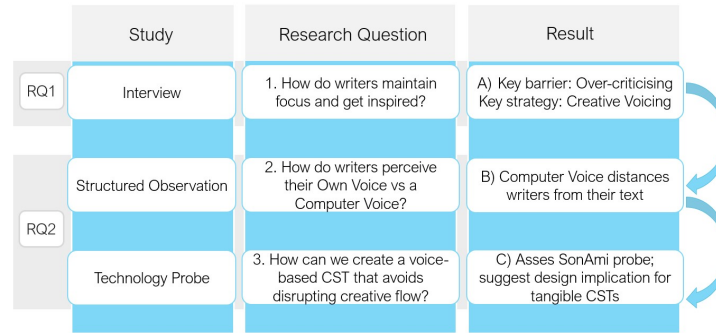
Fig. 1. *SonAmi* design: Three studies address two key research questions

2.4 What about Tangible Interfaces?

Tangible interfaces offer an intriguing alternative to standard, screen-based creativity support tools. Weiser and Brown's [65] concept of 'calm technology' emphasizes the need for simple interaction and lack of invasive disruptions. Resnick [51] focused on the importance of play, simplicity, and support for different user styles as key design principles. Beeftink et al. [5] showed that self-initiated breaks improve performance, whereas unexpected interruptions reduce not only productivity [42] but also problem-solving ability. Their work suggested that technology that fosters creativity need not require focused attention, but should instead adapt to the varying states of the user.

Giaccardi et al. [21] highlighted the importance of understanding how sensory experience affects creative cognition, e.g., materiality can stimulate memory and imagination, which are crucial when designing for creative practice. The aesthetic qualities of tangible interfaces can significantly enhance the user experience [25], e.g., *Mudtub* consisted of a mud-based, organic interface that encouraged "user improvisation and made the system inherently adaptable". Similarly, an organic interactive device *Stone Mouse* [20] allowed user to select the stone of their choice as a computer input device. The electronics let users click, drag and move the stone. *SocialBowl* [37] shows how a tangible interface encourages play and positive social dynamics. It included both a sensing table surface and an actuated bowl which mediates conversations by responding to users' gestures to hold different content and move in different directions. Using water as a material affected the dialogue between participants: it could either be nurturing or threatening. *ComTouch* [10] offered audio-tactile interaction that served as nonverbal cues that might otherwise be lost during a remote conversation. This use of touch, which is underused in CSTs, shows its potential for enriching interpersonal communication. Löwgren [40] argues that "digital is a material without qualities" and Wakkary et al. [63] recommends enhancing expressiveness via unconventional materials, such as soft fibres, food, and wood. This work suggests that creativity support tools can benefit from tangible interfaces that involve physical objects, ideally with an aesthetically pleasing look and a simple form of interaction (see Figure 1).

3 STUDY 1: INTERVIEWS

Before attempting to design a creativity support tool, we must first understand how creative writers actually write (RQ1). We conducted an interview study to learn about the barriers they face in their writing process, and the strategies they use to address them.

Participants: We recruited eight creative writers (P1-P8): 5 women, 3 men, ages 20-45, at different stages of their careers, including one creative writing teacher. One had just published a book, and three were in the publication process.

Setup: One interview was face-to-face, six were via video conference and one was via telephone.

Procedure: Each semi-structured interview lasted approximately one hour, and focused on obtaining detailed, recent or memorable stories about their writing experience. We asked each writer about their inspiration, motivation, routines and focus. We also asked about their writing tools and environment, how and when they write, edit and whether they do it alone or collaboratively.

Data Collection: We collected audio recordings and handwritten notes.

Data Analysis We used a mixed-approach thematic analysis to identify specific themes [9]. We started top-down, looking for evidence of the five themes drawn directly from the interview questions (feeling inspired, getting motivation, finding focus, getting feedback, and editing). We also followed a bottom-up process, looking for new themes that emerged. After highlighting relevant comments from the handwritten notes, we transcribed the audio (50 pages) and re-read the text, both hand-written and transcribed. We highlighted "interesting" phrases and created corresponding codes.

3.1   Results

We identified a total of seven themes, including the five aforementioned interview themes and two themes that emerged during the analysis process: *Over Criticizing* — being overly critical hurts writing — and *Creative Voicing* — speaking text out loud inspires and verifies ideas. Figure 2 shows participants' comments related to these latter two themes. **Barriers to Creativity:** All participants experienced creative blocks caused by both internal and external events:

- **Over criticising:** All participants (8/8) express self-doubt, self-criticism, or a desire to be perfect, which lowers the quality of their writing. For example, P5 moves text to the bottom of the page, to hide rather than delete it, since she feels overly critical about her writing. P1 doubts the importance of her work: "Why would people care?" P2 writes very little because "I rewrite and rewrite and rewrite", and P6 rewrites "chapters over and over".
- **Editing focus:** Even though editing requires concentration and critical evaluation, all participants (8/8) treated it as a practical step that needs to be done, rather than a form of creative expression. P1 felt it was monotonous: "The process is hard." and that "Editing does not feel creative." P8 felt editing is "more critical".
- **External Distractions:** Most participants (6/8) reported getting distracted by external events or situations. P4 pretended to be productive: "I was searching for a good way to structure my writing instead of actually writing something." and P5 was sometimes distracted by their emotional state: "If I'm sad, I can't write".
- **Discouraging feedback:** For some (3/8), negative, non-constructive feedback, or lack of feedback altogether, destroys motivation and turns on the writer's inner critic. P5 said that no feedback hurts writing, and P7 complained that a colleague "was never giving me feedback — and for me that was the worst feedback".

Finding inspiration: All participants reported strategies for finding new ideas and motivating themselves:

- **Creative Voicing:** All participants (8/8) vocalize their text at different stages of the writing process. *Mental writing* involves verbalizing or discussing ideas in the head before typing them. P3 is "a writer in my head" who knows "what I was writing about before I sit down". P2 developed a plot with a friend "and then he wrote it."
Co-writing involves talking aloud with others to generate and inspire new ideas. A few participants (2/8) set up in-person collaborative writing sessions that increase their motivation and make the overall writing process more entertaining.

Reading aloud involves voicing their own work or asking a friend to do it (5/8 participants). P5 usually waits a few days to make it feel "like reading stranger's work". This helps make self-feedback more objective, ensuring that the text "sounds right and the rhythm is important" (P6). P5 also records audio of her friend reading the text out loud: "She talks a line of my story and I know what's wrong."

- **Establishing routines:** All participants established routines or tricks that encourage them to write. Most prefer (5/8) to write in the morning and over half (5/8) drink when writing. Some (3/8) use a timer and P6 uses a word counter and enters words into a spreadsheet and tweets about her progress. P1 changed his *MS Word* settings to make the page look smaller, "so it feels I do more". P5 forces herself to stop writing after a specified period to "keep the thirst of writing". P6 sets up separate writing and editing sessions, since "writing and editing do not work together". Participants consciously limit their use of the internet, mute notifications, and put their phones away. Half (4/8) play music or maintain silence, but all (8/8) said they prefer silence when writing and two wear earplugs to block external noise.

- **Searching for ideas:** Although any experience can lead to inspiration, participants engaged in a few activities to help them find new ideas. *Reading* a story or a book is a key source of inspiration for most participants (6/8). *Writing* can be very inspiring, as participants become immersed in the flow of focused writing. *Physical movement* also sparks new ideas: P8 did not sleep well and then "went biking to a wonderful cliff next to the sea...I was so inspired of what I saw [that] things started creating themselves in the process". Simply walking around can ignite inspiration: P7 feels "the energy of places" and P3 says that "Walking around inspires me". P4 noted differences between walking to a café to write versus writing at home. *Sharing work* can provide social motivation and quiet the critical voice. P2 said co-writing with a friend served as a source of motivation and focus, and P5 produces more "if I have someone to review my work, so I delete less". P4 finds that "sharing what you work on motivates you to produce more".

- **Seeking feedback:** All participants seek feedback, both positive and negative: "Every writer is looking for feedback" (P5), only some of which is useful. *Positive feedback* from others can be highly motivating. P8 said his teacher told him "You have a beginning of a novel and you should just write it." P1 found positive feedback to "help confidence" and reassure overly self-critical writers. *Useful feedback* need not be positive, but instead expresses what the reader feels, what is best, or what is good. It helps to see summaries of the story from somebody who "knows tools and techniques" (P5), to see if readers truly understood what the writer meant. P8 said "My editor is a musician. He listens to a lot of music and he liked the sounds of the text." This latter comment shows the role of the rhythm and sound of the text, and helped inspire design ideas.

In summary, the most common barrier to creativity is *Over Criticizing*, where the writer's desire for perfection leads to an overly critical voice and reduced productivity. However, a key strategy for addressing this is *Creative Voicing*, where writers read their text out loud. Listening to themselves (or others) has proven useful at every stage of the creative writing process, from supporting early ideation by hearing text from a new perspective, to assessing the rhythm and 'music' of the text, to finding the right words and making sure it sounds right. We decided to build upon these findings to address the second research question, which is how can we design a tangible artifact that fits naturally into the author's existing writing process, to support rather than interrupt their creativity.

4   INITIAL DESIGN

To address RQ2, we identified two key design challenges drawn from the findings of study 1. First, we wanted to avoid key barriers to creativity, including interrupting or distracting writers, providing discouraging feedback, or contributing to their tendency to over-criticize their work. Second, we wanted to take advantage of their own

Fig. 2. *Over Criticizing* and *Creative Voicing*: Participants often over-criticize their work, but also develop self-motivation strategies, including voicing their text out loud to gain perspective and new ideas.

strategies for finding inspiration, especially the fact that they establish writing routines, seek feedback, and voice their text. The goal is to enhance their creativity without interrupting their creative flow.

Design Process: We first created three personas with traits, goals, activities and writing habits drawn from the interviews. *Distracted Daniel* is in the flow and very focused, but gets distracted by something and his flow is interrupted. After some time, he realises that he is not writing anymore. *Reflective Rosie* is drinking her morning coffee, editing, and seeking new ideas. She reads some dialog out loud to see what sounds good. Her boyfriend enters the room and she feels embarrassed to be speaking out loud, so she stops. *Self-Doubting Sid* is feeling depressed that his work is not good enough. He does not know what to write next, is bored with editing and feels discouraged. He puts on a timer on for 30 minutes, opens his document and reads it, which triggers him to start editing.

Next, we created three short scenarios, based on their stories, both to clarify the challenges participants face as writers, and to spark ideas for a tangible creativity support tool that addresses those challenges. We brainstormed various ideas and created several video prototypes in which we acted out how the three personas would interact with the most promising ideas.

Creative constraints: Since many writers are perfectionists who doubt themselves and engage in *Over Criticizing*, we decided to prioritize the audio channel and avoid visual interaction with the text. This avoids over-charging the primary visual channel and limits distraction while writers are immersed in their creative flow. Since obtaining positive feedback can be challenging, we wanted to mimic the role of a helpful friend who offers an external perspective without creating a negative feedback loop. (This led to the name *SonAmi*, because it means both "sound friend" and "his friend" in French.) We also focused on the most boring and monotonous task — editing — which is a major source of procrastination. We sought a strategy that could be integrated into the writer's established routines, and spark self-reflection when they were already procrastinating. We were inspired by systems such as *Marking Menus* [34] and *Octopocus*[4], which only operate when the user pauses their regular activity.

As noted earlier, all participants use *Creative Voicing* to support their writing, so we decided to ask writers to first record their own voice reading their text, and then, when they are ready to take a break from immersive writing, listen to their words played back to them. The goal is to let writers hear their words so that "it feels like reading stranger's work" (P5). This provides a simple approach to engaging in "objective" self-editing and reflective ideation, without disturbing the flow of the creative process.

5   STUDY 2: STRUCTURED OBSERVATION

We decided to use a Structured Observation-style study [8, 19, 33] to assess the basic idea and compare how creative writers perceive listening to their own pre-recorded voice versus a computer-generated one.

Participants: We recruited six creative writers (P9-P12), aged between 25-65 years old. P4 & P7 also participated in the interview study.

Setup: Participants used a phone or recorder on their computer to record own voice. Participants listen to the computer-generated voices using either a custom-designed Windows-based application, MS Word's read-aloud function, or a web-based alternative.

Technology: We built a *Windows*-based desktop application that generates a computer voice which reads text uploaded by the user. Basic user functions include uploading text, selecting voice, speed and accent, playing the text, and pausing.

Procedure: The initial briefing session explains the study design. Participants are asked to perform two tasks, each over a period of at least two days: the *Own Voice* condition involves recording the writer reading their own text and listening to it. The *Computer Voice* condition involves uploading their text and listening to computer-generated voice reading it. The final session includes a 20-30 minute discussion of their experiences.

Data Collection: We collected handwritten notes and answers to a Likert scale-style questionnaire.

5.1   Results

All participants (6/6) reported that listening to their text helped them reflect on their writing process, find mistakes and discover new insights about their text. Most participants (4/6) preferred the computer voice, because "it was more intellectually interesting" (P11). When asked which method they would recommend to a friend, two preferred the recording of their own voice, and the rest said "both are useful" (P12).

Own voice for Inspiration, Computer voice for Objectivity: Most participants (4/6) found that the *own voice* condition generated more insights. P7 said: "While listening to my recording I closed my eyes and imagined, stopped it a couple of times, edited. [...] When I hear with my voice it is still my story, I am more in the scene because I am part of it, I'm experiencing this from the first place." By contrast, P7 said that the computer voice "gives me more objectivity but takes away inspiration." P11 found that "hearing the text is not for creative thinking but editorial thinking", and P12 removed significantly more text in the *computer voice* condition. Note that the writer's genre may have an effect, since P9, the only playwright, found the computer voice more inspiring. Similarly, P12 liked to hear the "voice in your head materialize".

Participants reported that listening to the computer-generated voice increased their objectivity, encouraged self-reflection, and distanced them from their own text by offering a different perspective: P7 said "It was not me anymore [...] When I listen to my voice, I am reading my memory." but when he listens to the computer voice "It is like I am there for the first time." (P7). P11 said the computer voice "helped to slow down" and offer "an outsider's perspective", and P10 said it gives a "universal way of how the reader is going to read it". P9 said the computer voice "was like listening to my friend." P9 also said it ensures that the text is "simple enough to be memorized by the potential actor" and helped him realize when a particular text "did not really work because it does not sound right".

Even so, several participants enjoyed listening to their own voice. P12 said it "separated me less" and P10 said it "felt personal, very me". P7 felt it "reminded me of the stuff that I forgotten which did not happen with the computer voice". Overall, listening to their own voices generated new connections with the story and sparked new ideas, whereas listening to the computer voice enabled them to disconnect and gain a different, more objective, perspective.

Recording their own voices: Many participants (4/6) felt uncomfortable recording their voices. P10 said: "I had to stop because I was too uncomfortable, but I learnt to accept [it]." P7 was "preoccupied with my voice
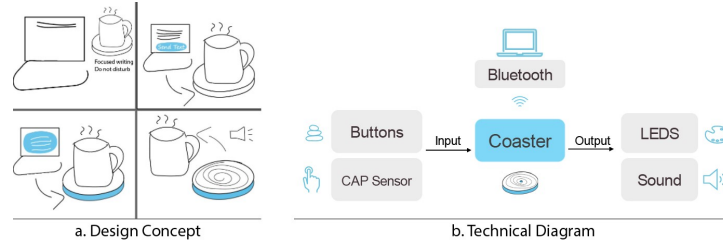
Fig. 3. a. Design Concept: Lifting the mug generates a computer-generated spoken voice. b. *SonAmi* architecture.

and I liked the second part [computer voice] more". P10 "learnt to like my voice. I am going to start my podcast because of that." This suggests that it is important to also provide the computer voice as an option.
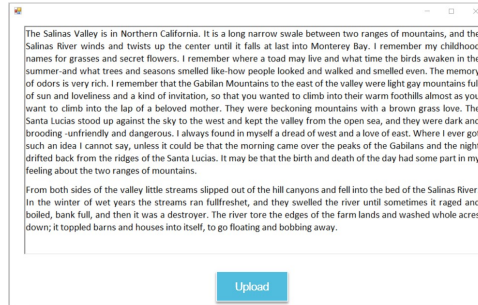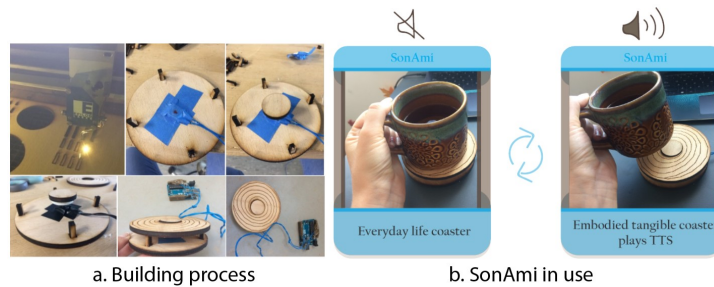
Making editing more engaging: While the majority (4/6) did not find the computer voice particularly inspiring, most (4/6) found it more enjoyable and said that hearing the computer voice made editing more engaging. P11 became more alert when hearing the computer voice, although it is unclear whether this is due to the task or the novelty of using the system. P12 said the computer voice made her more productive and engaged, whereas her own voice felt "a little repetitive". P10 said that the computer voice helped most for editing: "I was inspired to finish the project, the deadlines helped me to get into the zone." This suggests that introducing deadlines that mimic social accountability might help writers reduce their levels of procrastination.

Customizing voices: Half of the participants (3/6) explored different computer-generated voices, changing both accents and speed. P11 preferred one voice but selected another one for clarity and pronunciation. P12 selected a particular voice because it was like a narrator's voice that slows down, is less emotional, more monotonous, and emphasizes punctuation. This suggests that users should be able to select from a variety of computer voices.

Enhancing reflection: All participants (6/6) reported that the computer voice helped them notice a problem with the text. P12 said: "there is something to be caught" when you hear somebody else reading aloud and "there is value in a repeated listening". P11 said that computer voice "inspired me to go back and only became clear later". These findings suggest that listening to an external voice can offer writers new perspectives, beyond simply re-reading the text.

6   DESIGNING *SONAMI*

The results of study 2 indicate that, while most participants (4/6) found that listening to their own pre-recorded voice increases their ideas, it also feels uncomfortable. We thus chose to embed a computer-generated voice into a tangible artifact, to emphasize maintaining an objective distance from the text, but also, ideally, to inspire new ideas. Just as using an *Arm-A-Dine* [44] robotic arm makes eating "strange again", the computer-generated voice makes the writer's own text "strange" and unfamiliar. Voicing the selected part of a text may support *Over Criticizing* writer by promoting a non-linear work, reduce the creative pressure that comes with the expectations of a final piece [62]. Another design goal was to create a tool that fits naturally within the writer's existing routines. Since a majority (5/8) drink tea or coffee when writing, we decided to link our tool to the act of drinking a tea/coffee, which is intimately tied to the writing process but occurs only when the writer wants to take a brief break. We thus designed *SonAmi* as a stand-alone interactive coaster (see Figure 3-a) that plays a computer-generated voice whenever the writer lifts their mug (see Figure 5-b). Separating the acts of writing and taking a sip of tea or coffee offers a form of 'productive procrastination', where taking a break shifts the writer's focus and offers an alternative view of their own work.

The Salinas Valley is in Northern California. It is a long narrow swale between two ranges of mountains, and the Salinas River winds and twists up the center until it falls at last into Monterey Bay. I remember my childhood names for grasses and secret flowers. I remember where a toad may live and what time the birds awaken in the summer-and what trees and seasons smelled like-how people looked and walked and smelled even. The memory of odors is very rich. I remember that the Gabilan Mountains to the east of the valley were light gay mountains full of sun and loveliness and a kind of invitation, so that you wanted to climb into their warm foothills almost as you want to climb into the lap of a beloved mother. They were beckoning mountains with a brown grass love. The Santa Lucias stood up against the sky to the west and kept the valley from the open sea, and they were dark and brooding -unfriendly and dangerous. I always found in myself a dread of west and a love of east. Where I ever got such an idea I cannot say, unless it could be that the morning came over the peaks of the Gabilans and the night drifted back from the ridges of the Santa Lucias. It may be that the birth and death of the day had some part in my feeling about the two ranges of mountains.

From both sides of the valley little streams slipped out of the hill canyons and fell into the bed of the Salinas River. In the winter of wet years the streams ran fullfreshet, and they swelled the river until sometimes it raged and boiled, bank full, and then it was a destroyer. The river tore the edges of the farm lands and washed whole acres down; it toppled barns and houses into itself, to go floating and bobbing away.

Upload

Fig. 4. Uploading the text [60] to *SonAmi* coaster

a. Building process   b. SonAmi in use

Fig. 5. a. Constructing the *SonAmi* coaster. b. Lifting the mug plays a computer-generated voice

We designed *SonAmi* as a stand-alone physical coaster (see Figure 3-b) that receives text from a custom app running in *Windows* on an *Arduino Uno*. The user can upload their text as well as change the speed and modify characteristics of the computer-generated voice. *SonAmi* uses text-to-speech recognition (TTS) to play the user's text from embedded speakers. LEDs show if the device is on, and a CAP sensor detects when the mug has been lifted or replaced.

The version we tested is simpler than the diagram, since the software interface only allows the user to upload their text (Figure 4). The writer then controls play and pause by lifting and replacing the mug. The coaster's base was cut with an *Epilog* laser cutter, using CAD *Fusion 360* software (Figure 5-a).

7 STUDY 3: TECHNOLOGY PROBE

We ran a Technology Probe study [28] to better understand how creative writers react to using *SonAmi* in the context of their daily writing process.

Participants: We recruited two as-yet-unpublished creative writers (P13-P14): one male and one female, ages 25 and 35.

Setup: Each participant uses a *SonAmi* interactive coaster with a computer-generated voice, shown in Figure 5.

Procedure: After an initial in-person briefing to introduce the study and demonstrate *SonAmi*, participants are asked to use it for at least four days. The final debriefing lasts 30-50 minutes and consists of rating *SonAmi* with three Likert-scale questions and three semi-structured questions related to their experiences.

Data Collection: We collected handwritten notes from the final interview and answers to the Likert-scale questions.

7.1 Results

Both participants liked the design concept and preferred using *SonAmi* over their normal editing process. Each said they wanted to keep it, and one even asked for the price. P13 said the "device is useful" and said that when he used *SonAmi* to edit his article, he found several mistakes as he listened to the text. Similarly, P14 said it "made me realize my mistakes" and realize that "the text was not flowing".

Encouraging Self-reflection: Both writers said that *SonAmi* explicitly encouraged self-reflection, changing their perspective and providing them with an outside perspective. P13 said that "by listening to someone you can hear mistakes more". P14 likened it to "like listening a story from a third person" or like "listening to a podcast". She said "I noticed the grammar; I just realized my mistakes" and "I listen to it as if I am someone else."

Shifting focus: P13 noted that, unlike reading, *SonAmi* shifts his focus to thinking solely about the text, thus eliminating the multi-tasking nature of the writing process. He felt that simply listening, rather than re-reading, lowered his cognitive load and allowed him to concentrate on the text itself and, sometimes inspire new ideas. P13 also liked the way that *SonAmi* eased the tedious nature of editing: "Rereading many times can be boring. Repetition is always boring, but with this - just by listening - I can focus on other things." Both participants liked the fact that *SonAmi* did not draw attention from the visual channel, and thus was not distracting when they were concentrating on writing.

Forming trust: Participants reacted positively to the simplicity of the device. However, P13 suggested including an additional features i.e. to replay the most recent sentence to maintain continuity, rather than playing a random sentence from earlier parts of the text. Although P14 was initially concerned about privacy and worried about *SonAmi* recording her, she was convinced by the hand-made nature of the prototype: "I do not feel warmth toward [...] machines." By contrast, *SonAmi* is "cute, innocent, and not capitalist". This suggests that the physical nature of the device affects how it is perceived, and focusing on a single action, voicing text, with a simple trigger, lifting a coffee mug, can fit seamlessly into a writer's creative practice.

8 CONCLUSION

We explored how to design creativity support tools (CSTs) that inspire writers while explicitly avoiding interference with their 'creative flow'. We focus on situations when writers take breaks from writing, with the goal of turning procrastination behavior into productive ideation. Our first research question investigated how professional creative writers actually write, including their daily routines, environment, and sources of inspiration. We were also interested in their techniques for motivating themselves and maintaining their focus. A review of the literature suggests that creativity support tools should include external environmental stimuli that foster inspiration, concentration, and immersion. They should also support established routines, and, rather than distracting users, should adapt to the changing state of the user, taking advantage of situations when they are engaged in other activities, such as procrastination.

We ran an interview study with eight participants and identified key barriers to creativity, as well as successful strategies for dealing with them. Key findings include the participants' tendency to engage in *Over Criticizing* their own work, and their difficulty in maintaining focus, especially in light of external distractions, and discouraging feedback. Participants also described their successful mitigation strategies, especially *Creative Voicing*, in which they read their own text out loud, which serves both as a self-motivation technique and a way to gain perspective and new ideas. Participants also noted the benefits of co-writing and listening to others read their work out loud, as well as seeking positive or 'useful' feedback. Finally, all participants establish regular writing routines and seek inspiration from external sources such as books or through physical activity and a change of locale.

Our second research question investigates how to create tangible creativity support tools that fit naturally into the author's existing writing routines, with the goal of supporting rather than interrupting the creative process. Based on the findings from study 1, we iteratively designed and developed *SonAmi*, a simple interactive

device that lets writers hear their text voiced out loud. The goal is to makes one's writing "strange again" by designing for what Leong et al. [38] calls defamiliarization. We report on two additional studies: Study 2 is a structured observation study that compares the effectiveness of listening to the author's own voice versus a computer-generated voice. Both methods encourage writers to hear their text in new ways, but we found that listening to the author's own voice was more likely to inspire new ideas, whereas the listening to the computer voice better supported editing, by offering a level of objectivity. Many participants felt uncomfortable recording their own voices, although they also reported that it helped them feel closer to their stories. Overall, participants preferred the computer voice, since made the editing process more engaging, by highlighting errors and clarifying when text does not sound right.

Study 3 is a technology probe study that examines how two creative writers use *SonAmi* as part of their daily writing routine. Both found that *SonAmi* encouraged self-reflection and gave them a new perspective on their text. They also noted that it helps them shift focus and concentrate on editing, but only at times when they were not already engaged in writing intensively.

In summary, we demonstrate how to create a tangible creativity support tool that fits into a creative writer's established routines and does not interfere with their creative flow. We take advantage of the audio channel to play the writer's own text back to them, either in their own voice or as a computer-generated one, triggered when the user removes their coffee cup from an interactive coaster base. The resulting CST, *SonAmi*, is inspired by the concept of 'calm technology' [65], and tools such as *Marking Menus* [34] and *Octopocus* [4], which reveal available commands when the user hesitates. *SonAmi* fits easily into the writer's creative process, remaining silent when the writer is busy and activating when the writer takes a break. This natural form of interaction omits the need for conscious interaction, but is also available if the user decides to explicitly trigger *SonAmi* to hear the text. Despite its simplicity, the interface also permits different forms of interaction. One participant used the mug to interact with the coaster, while the other intentionally pushed the button to play the text. As a result of the limited CST evaluation due to exploratory nature of this paper, we encourage further evaluation of *SonAmi* as advised by Remy et al. [50].

In the future, we argue that creativity support tools should go beyond the desktop to include interactive physical objects that can fit seamlessly into everyday activities. We have shown how we can build upon a creative professional's existing strategies for motivating themselves to create a simple technology that helps them transform procrastination into productive activity. Further research on *Creative Voicing* in creative writing should explore the effect of different voices, emotional expression, and even music, and investigate the link between these and the user's perception of their text. An interesting direction could be altering the text and integrating crowdsourcing ideation similar to *Heteroglossia* [27]. In the future, the use group may also be expanded to include writing support within Mental Health Communities [46].

The material form of tangible CSTs is also important, where a simple, unobtrusive artifact such as a coaster can take on new functionality, while still blending into the background. We argue that the strategy of embodying a creative professional's work in another medium to create new expressive forms [29] can inspire new forms of CSTs that reflect the artist's culture and local environment.

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