Zaturi: We Put Together the 25th Hour for You. Create a Book for Your Baby

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ABSTRACT

We introduce Zaturi, a system enabling parents to create an audio book for their babies by utilizing micro spare time at work. We define micro spare time at work as tiny fragments of time with low cognitive loads that frequently occur at work, such as waiting for an elevator. We show that putting together micro spare time at work helps a working parent (1) build a tangible symbol conveying his/her thoughts to the beloved baby and (2) develop his/her own feelings of parental achievement without compromising regular working hours. Zaturi lets the parent immediately be aware of micro spare time and provides a crafted interface to seamlessly record the book piece by piece, so that the baby can enjoy listening to the book recorded in the parent's own voice. Through an extensive design process, we characterize the notion of micro spare time and build a working prototype of Zaturi. We also report parents' perceptions and family reactions after a two-week deployment.

Author Keywords

Micro spare time; Parenting; Reading books to babies

ACM Classification Keywords

H.5.3. Group and Organization Interfaces: Asynchronous interaction

INTRODUCTION

Entering parenthood brings incomparable happiness and blessings. But such joy does not come for free; the responsibilities and obligations of parenthood are big enough to change parents' lives forever. Such responsibility often costs in the currency of time, requiring the parents to spend a significant amount of time on childcare, e.g., to fulfill the child's needs or share time with the child.

In spite of reports indicating that the amount of time parents spend with their children has increased significantly for the last several decades [5, 21], many parents still feel they spend too little time with their children [20]. Not surprisingly, their levels of satisfaction with the time they share with

their children seem negatively correlated with their working hours, e.g., 39% of full-time working mothers responded that too little time is spent with their children, while only 14% of part-time working mothers responded so. A higher ratio of dissatisfaction (around 50%) was observed from full-time working fathers. It is a common belief that hours spent at work and hours devoted to children are mutually exclusive; therefore, more hours spent at work yield fewer hours devoted to children.

In this study, we imagine that these two buckets of time might not be mutually exclusive, but could be blended to some extent. To be specific, we ask: *can we design a new way to devote time to children at the workplace, without compromising the quality and quantity of working hours?*

To this end, we first address the notion of *micro spare time at work*, which we define as tiny fragments of time with low cognitive loads that frequently occur while at work. A few examples include the moments waiting for an elevator, walking to a different building, waiting for public transportation, and so on. Following studies on the prevalence and current practices with micro spare time at work, we present *Zaturi*, a childcare application utilizing micro spare time at work. Zaturi is a mobile application that enables a parent user to create an audio book for her child in the parent's own voice. Zaturi continuously senses the user's activity and detects micro spare time in real time. Upon every moment of micro spare time detected, Zaturi fetches a new unit of a micro recording subtask that would fit in the micro spare time, helping the user instantly and seamlessly continue the voice recording. Zaturi provides a situation-friendly interface to mitigate the social awkwardness of theatrical reading in public space. Zaturi is a Korean word with a meaning close to "remnants," but which also carries an implication of being "useless on its own."

Zaturi is unique in terms of (1) building a gift for one's child even while at work *without* compromising existing working hours but by discovering and carefully arranging new spare time that otherwise would be left unaware and likely wasted; (2) not only making use of the parent's micro spare time in a piecewise manner [7, 28], but also pursuing incremental creation of a tangible outcome that the child can perceive and enjoy as a whole; and (3) proposing a widely applicable service to the general population of working parents who commute daily, not only those work-separated over a long distance [34] or across different time zones [16].

The design and deployment of Zaturi has been conducted through a multi-phase study procedure. We carefully developed the initial notion of micro spare time at work through a focus group study and subsequently verified its real-world distribution and practices in quantitative terms through online questionnaires. We designed a mock-up of the Zaturi system based on the newly found design rationale of micro spare time at work for parenting, and further crafted the design of Zaturi through a design workshop with working parents. We implemented a fully working Zaturi system and evaluated micro spare time detection through shadowing and using a mobile application. Zaturi was also deployed to real users for a period of two weeks. Our findings include the satisfaction of using Zaturi, impact on work productivity, effectiveness of intervention, reactions from spouses and children, and more importantly, parents' perceptions and self-awareness of micro spare time at work, which provided us with implications of other creative ways to utilize micro spare time to increase their participation in parenting while at work.

The major contributions of this study are three-folds. First, we open up a new potential for additional parental achievement on top of existing working hours by developing a new notion of micro spare time and understanding the prevalence of specific forms of micro spare time at work. Second, we show the feasibility of this provocative idea by designing and deploying a novel application of creating audio books for children that features micro spare time detection and subtask design in favor of utilizing micro spare time. Third, we share the design considerations for future applications utilizing micro spare time in terms of understanding the user context, extending participation to other family members, and identifying suitable tasks to be performed in micro spare time. We hope our study provides a new agenda to the CSCW community regarding the co-existence of parenting time and working hours by utilizing one's micro spare time.

RELATED WORK

Our study on Zaturi can be viewed with respect to multiple research problems, including identifying one's spare time, exploring microtasking in terms of task goals and stakeholders, and computer-supported parenting. We discuss the previous angles and approaches taken toward each problem, and position Zaturi among them with what Zaturi contributes therein.

Computing Aids to Spot One's Micro Spare Time

Strategies for recognizing one's spare time for further utilization have been mostly planned within specific usage models of a few designated computing applications. Among existing work, we note a commonality of *tiny wait times*. WaitChatter focused on the moments when an instant messenger user is waiting for a response from a partner, presenting a short quiz at such a moment to help learn a foreign language [7]. Similarly, Pull-To-Learn utilized the moments when an email user pulls down the screen to reload emails [28]. Our study is in line with these researches, as our user studies to find commonly occurring micro spare time have found the majority property of wait time. However, we address the far more expanded notion of micro spare time throughout daily work

life, decoupling it from a specific computing application usage. Furthermore, we show the feasibility of automatic detection of such moments of micro spare time by continuous sensory monitoring through an off-the-shelf mobile device.

Our notion of micro spare time is partly analogous to *plastic time* [27], which has been loosely outlined as unplanned opportunistic moments that fill the gaps between coordinated activities and may be volatile in people's memory. Comparing the notion of plastic time to our notion of micro spare time, we believe that the key difference of micro spare time is its even more microscopic temporal granularity, as well as users' practices of realizing and utilizing such tiny moments. In an instance of plastic time, users are likely aware of the available spare time and do less-immersive activities, such as web surfing while on a commuter train. In contrast, our concept of micro spare time addresses tiny moments that the users are likely unaware of and often do not consciously utilize for anything else, as we can see when users are walking to another building or waiting for an elevator. We also extend the coverage of such moments that are observable by technical means, through not only utilizing the foreground mobile device usage but also actively sensing the user's activities.

Microtasking: For Whom and By Whom?

Microtasking has been extensively studied, notably on well-known specific tasks such as writing [4, 8, 31], or in terms of task characteristics such as decomposable structure [9] and time constraints [3]. From the task's structural point of view, Zaturi could be simply viewed as an instance of a microtasking system with independent piece-wise reading tasks. However, we discuss the research space of microtasking through a different lens of who the workers and the beneficiaries are. In terms of the workers, Zaturi drew inspiration from selfsourcing [32], which divides a time-consuming personal task into manageable microtasks that are completed by the task owner himself, rather than by anonymous crowds [4] or a collaboration team [31]. In terms of the beneficiaries, a large body of previous work has assumed the task to benefit the owners themselves. In Zaturi, we present and experiment with a new task type that has an additive altruistic flavor on top of the existing nature of self-benefit. As an initial attempt, we study the case with the beneficiaries at the closest distance in altruistic selection–the offsprings [13, 23].

Computer-supported Parenting

Zaturi's child-side application—asynchronous book-reading in the parent's voice—is related to multiple active research topics in computer-supported parenting, including the virtual co-presence for separated family and rich book-reading for children. Below we discuss previous works and position Zaturi with respect to them. That being said, we clarify that a large body of Zaturi's research question is not on evaluating the child-side efficacy of listening to a book in the pre-recorded parent's voice; our main question lies with the parent's experiences and feasibility of putting together under-utilized daily micro spare time towards producing a child's book. Accordingly, our evaluation focuses mainly on the parents' experiences using Zaturi, and then we briefly discuss the experiences of reading the books afterwards.

Illusion of the same time

The remote connectivity and rich media experience of computing systems have significantly innovated parenting activities under temporal and/or spatial separation. Importantly, one of Zaturi's major design elements, conveying parental intimacy across a temporal gap between content production and consumption, was partly inspired from the notion of *asynchronous parent-child interaction*. For parents and children who are in different time zones, there have been research efforts to create an illusion of being in the same time. TimelyPresent addressed a design strategy of deliberately deferring message delivery in order to help the receiver feel like as if he is at the same diurnal time as the sender who is in fact in a different time zone [16]. GlobeToddler presented design principles for an avatar-mediated interaction between preschool children and their traveling parents [19]. Yarosh et al. studied the communication strategies of separated families in terms of communication media, scheduling communication events, virtual shared activities, and so on [34]. We gained initial confidence from their results in terms of the potential efficacy of our idea—asynchronous book-reading in the pre-recorded parent's own voice. While the previous work targeted relatively limited user groups with a long-lasting temporal separation, our design embraces a much larger user population, as we target most families with commuting parents who are separated daily during working hours.

Book reading for children

It is worth mentioning that, among an extensive volume of computer-supported parenting designs, we note that the classic activity of book-reading is reimagined. One strategy is to employ a book as a facilitating medium; Raffle et al. proposed a tool that combines video conferencing and e-books to improve long-distance parent-child interaction through reading a book together remotely [25, 26]. Another strategy is to directly enrich the media of books; Follmer et al. developed People in Books, which supports personalized reading experiences with children by putting family members' face images into the book [11]. The intimate book-reading experience that Zaturi may create is in line with the latter work.

STUDY PROCEDURE

Our study procedure consists of four phases (see Figure 1). All studies in the paper were conducted under IRB approval.

Phase 1: Focus group discussion and online questionnaire. The study was designed to explore the use of micro spare time at work and develop the initial notion of micro spare time. We first conducted a focus group interview with eight working parents and examined their current practices on parenting activities and micro spare time at work. We further conducted an online questionnaire with 82 working parents and explored the prevalence and distribution of micro spare time at work.

Phase 2: Design study. Based on the lessons from the first phase, we designed the Zaturi system that enables working parents to create an audio book for their children during micro spare time at work. We developed a mock-up and conducted a design workshop with eight working parents to establish design requirements for the craft of the Zaturi system.
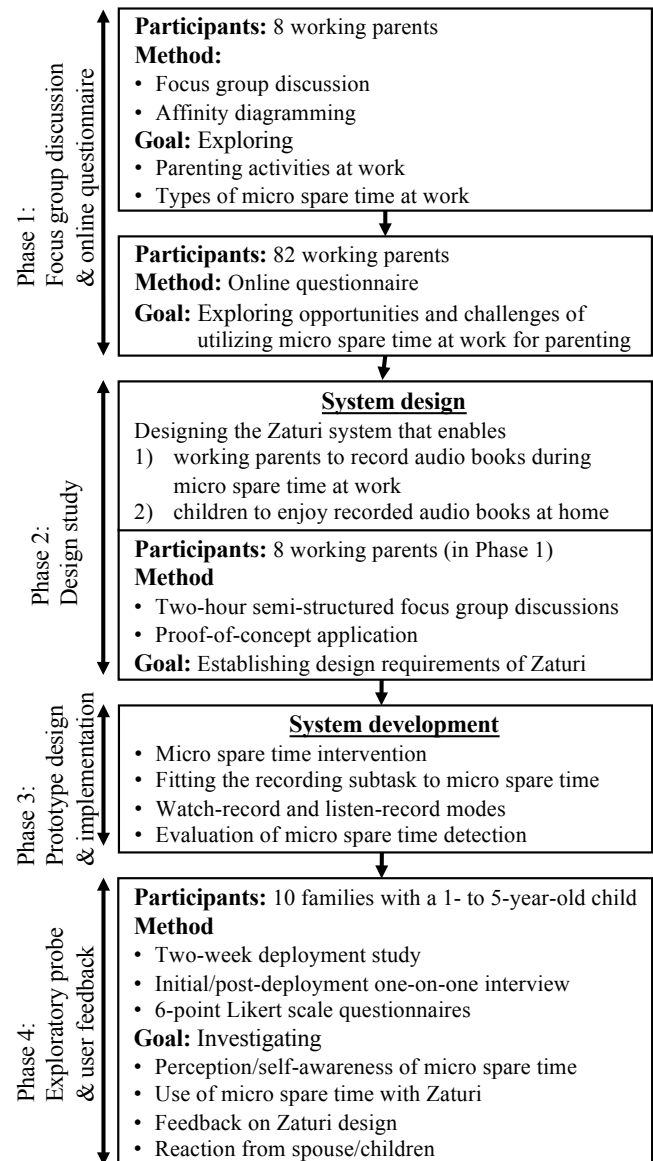

Figure 1: Overall study procedure.

Phase 3: Prototype design and implementation. Considering the design workshop and implementation feasibility, we selected four types of micro spare time at work and devised a mobile-based method to detect those events. We implemented Zaturi on mobile and cloud platforms. The mobile-side Zaturi detects micro spare time of working parents in real time and allows them to record a part of the book during micro spare time. The recorded parts are aggregated on the server and played on the tablet-side Zaturi by their child. We also investigated the accuracy of the micro spare time detection.

Phase 4: Exploratory probe and user feedback. With the prototype of Zaturi, we conducted a two-weeks deployment study with ten working parents and explored their usage patterns of and satisfaction with the Zaturi system as well as reactions from their family members. Based on the user feedback, we discuss the further design implications for the Zaturi system.

FOCUS GROUP DISCUSSION AND ONLINE QUESTION-NAIRE

Focus Group Discussion

In order to explore parenting and develop the initial notion of micro spare time at work, we conducted a focus group discussion. We recruited eight working parents who have one or more children, namely P_A1 to P_A8, through the KAIST online community. The parents' occupations included office workers and graduate students. The focus group discussion consisted of two sessions, each of which lasted about one hour. In the first session, we asked them about their typical parenting activities at work and their satisfaction with those activities. The key questions included "*what do you usually do for parenting at work?*", "*how often do you do such activities at work?*", "*are you satisfied with your current parenting activity and why?*", and "*if not, what do you want to do for parenting?*"

In the second session, we collected the cases of micro spare time at work. We provided a ten-minute tutorial on micro spare time with examples such as waiting for an elevator and taking a break at work. We then asked the participants to freely write down their experiences of micro spare time that often occur at work. Note that in this paper, *at work* includes situations when people are outside of the office, e.g., commuting and going out for lunch. We analyzed the collected cases using affinity diagramming and developed a category scheme for the types of micro spare time.

Parenting in the workplace and satisfaction

The participants' parenting activities at work were mainly grouped into two categories: making a phone call and preparing things for children. Making a phone call was reported by all participants, and was done once a day on average. Interestingly, while working fathers make calls only to their children, working mothers make calls to other people as well, e.g., kindergarten teachers for counseling (P_A4, P_A5, P_A6) and the pediatric hospital for appointments (P_A5). Preparing things for children was mostly done by working mothers. The most frequently reported activity in this category was shopping for goods for their children, e.g., online shopping (P_A4, P_A5). For other types of activity, P_A4 added, "*In the office, I sometimes print documents or use sticker-labels for (my child's) belongings.*" The participants reported that they do these types of activities occasionally.

Most participants were not satisfied with their parenting activities at work due to the limited types of activity they can do. P_A2 reported, "*I want to participate more in parenting. (...) what I can do at work is very limited. I always feel sorry for my wife and kid.*" P_A6 stated, "*If I have extra available time, I want to make or do something meaningful for my children, for example, creating education materials.*"

Types of micro spare time at work

The participants reported a total of 55 experiences of micro spare time at work. We categorized the experiences into three main categories: wait time (C1), transportation time (C2), and break time (C3). Wait time, the most frequently reported category, is further divided into two subcategories: waiting for a

Gender	Female (45), Male (37)
Age	20s (12), 30s (57), 40s (11), 50s (2)
Occupation	Professional (30), Office worker (24), Housewife/Househusband (13), Management (5), Student (4), Self-employed (3)
Country	Korea (71), USA (11)

Table 1: Participant demographics (online questionnaire).

turn (C1.1) and waiting for a person (C1.2). The representative examples in each category are as follows:

- C1.1: Standing in line, waiting for food after ordering, stopping the car at a red light
- C1.2: Waiting for a meeting, waiting for an instant messenger response
- C2: Walking inside a building, walking to another building, commuting by bus
- C3: Having a rest after lunch, taking a break at work, smoking outside, a moment after hanging up the phone.

Online Questionnaire

To expand our initial understanding of how working parents use their micro spare time at work, we conducted an online questionnaire with 82 working parents. Table 1 shows their demographics. We recruited the participants through online social networks and online community sites within KAIST. We randomly selected 20 participants and provided them with a gift card equivalent to $5. The questionnaire consisted of three parts: (1) demographic information, (2) prevalence and usage of micro spare time at work, and (3) challenges in utilizing micro spare time for constructive actions.

Prevalence and usage of micro spare time at work

We investigated how often micro spare time at work occurs, and how working parents usually use it. The most effective way to accurately track micro spare time and its usage would be shadowing, i.e., observing a person's office life right next to her all day [22]. However, shadowing a large number of people is very labor-intensive, and the observee could be distracted and annoyed. Instead, we collected the responses from respondents with a broad range of demographics via an online questionnaire and analyzed the overall trends.

As in the previous section, we found various types of micro spare time. It might have been difficult for the respondents to think of all of their micro spare time situations and respond with their experiences. Thus, we chose the top six specific cases most frequently reported in the previous section (three in C1.1, one each in C1.2, C2, and C3). We asked the participants to assume that they were alone because when people are with acquaintances, they often have a chat together and thus the time might not be spent for other purposes.

- T1: Waiting alone for public transportation
- T2: Waiting alone for an elevator
- T3: Waiting alone for others
- T4: Waiting alone for coffee/food in cafe/restaurant
- T5: Taking a break alone during work
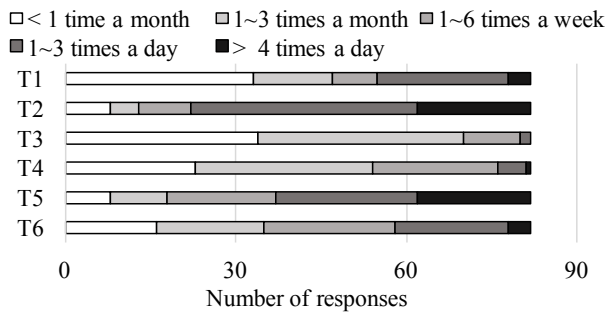- T6: Walking to a place alone.

Figure 2: Frequency of micro spare time; Y-axis: waiting for public transportation (T1), an elevator (T2), others (T3), and coffee/food (T4), taking a break (T5), walking to a place (T6).

Q1: *How often does your micro spare time of 'Tx' occur at work?*: Overall, the responses were significantly different depending on the type of micro spare time. Figure 2 shows the frequency distribution of micro spare time. We observe that certain types of micro spare time occurs multiple times a day. Most frequently, *wait alone for an elevator* occurs 1 to 3 times a day and 4 or more times a day for 24% and 49% of the respondents, respectively. The second most frequent response was *taking a break alone during work*, which was marked "1 to 3 times a day" or "4 or more times" by 30% and 24% of the respondents, respectively.

On the other hand, we found a few other types of micro spare time occurring less than we anticipated; only 2% responded that *waiting alone for others* occurs at least once a day, and 12% did so at least once a week but less than once a day. Similarly, 7% responded that *waiting alone for coffee/food in cafe/restaurant* occurs at least once a day, and 22% did so at least once a week but less than once a day. In spite of fewer occurrences of some cases, we expect more types of micro spare time outside the questionnaire's coverage; therefore we conjecture that working parents have micro spare time at work several times a day.

Q2: *What do you usually do during your micro spare time 'Tx'?*: We asked what the usual activities during micro spare time at work are. We provided seven options: (a) reading books, (b) listening to music/podcast/etc., (c) exercising, (d) doing work-related activities, (e) using a smartphone for leisure (e.g., social networks, web surfing, games), (f) doing nothing, and (g) other, where the respondents could type in the activities. To eliminate the order effect, we randomly ordered the choices. We carefully selected the six activities based on the focus group discussion in the preliminary study. The participants were allowed to select multiple options.

Overall, *using a smartphone for leisure* was the most popular activity and was the most frequently reported activity in T1, T3, T4, and T5 (see Figure 3). This result indicates that there might be a great potential to use micro spare time at work in a more productive way using smartphones. The second most frequent response was *doing nothing*; 69% and 38% of the respondents marked it for T2 and T6, respectively. The *other* option was hardly selected. Three respondents wrote that they often make a call while walking, and two respondents wrote that they look in a mirror while waiting for an elevator.
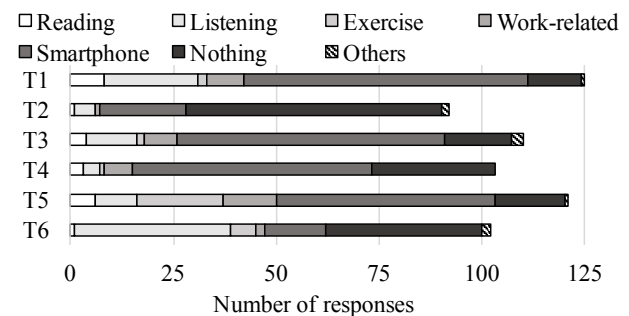

Figure 3: Activities during micro spare time.

Difficulties in utilizing micro spare time at work
We further investigated the difficulties of utilizing micro spare time at work for constructive activities. We asked the respondents to name a constructive activity they desire to do during micro spare time, then asked what is (if any) the major hurdle discouraging them from doing that activity during their micro spare time.

Q3: *What are the reasons that discourage you from using your micro spare time at work for the desired activities?*: We provided the following seven options in a randomized order. Respondents were allowed to check multiple options.

- R1: I have never considered utilizing micro spare time for the desired activity.
- R2: Micro spare time appears unexpectedly, and thoughts of doing the desired activity do not cross my mind.
- R3: Micro spare time is too short to do the desired activity.
- R4: I cannot think of any specific task to do for the desired activity in my micro spare time.
- R5: I miss the chance for the desired activity because I usually spend my micro spare time doing other things such as using a smartphone.
- R6: I would rather use my micro spare time for rest or entertainment.
- R7: "Other" to write-in.

The most popular response was "*R3: micro spare time is too short*," selected by 50% of the respondents. The second and third were R2 and R5, selected by 35% and 30%, respectively, followed by R6 (22%), R1 (21%), and R4 (11%).

Summary
Focus group discussion: The results indicate that, even at work, parents are participating in diverse parenting activities such as shopping for goods for their children. However, they are not satisfied with the way they spend their spare time for parenting, due to temporal and spatial constraints.

Online questionnaire: The results signify opportunities to leverage under-utilized micro spare time at work. Micro spare time at work occurs frequently enough to be utilized; 73% of the respondents reported that they wait alone for an elevator, and 54% take a break alone during work more than once a day. We also observe a significant potential to utilize the micro spare time for more constructive activities; 47% of the participants responded that they use a smartphone for leisure in micro spare time. The participants reported that the main

difficulties in utilizing micro spare time are: (1) too short a duration, (2) unexpected occurrence, and (3) being overridden by habitual smartphone entertainment activities.

DESIGN STUDY

Design Rationale

The insights gained from the focus group discussion and online questionnaire motivated us to enable working parents to utilize their micro spare time at work for parenting purposes, hopefully without compromising the quantity and quality of the working hours. The main challenges in realizing this aim are three-fold: (1) working parents are physically distant from their children, (2) their micro spare time at work hardly coincides with the available time of their children, and (3) micro spare time at work occurs unexpectedly and for short duration. Due to these challenges, working parents' participation in parenting activities at work is usually very limited.

As an attempt to overcome such spatio-temporal constraints in utilizing micro spare time at work for parenting activities, we target the *reading-to-child* activity and transform it to an asynchronous communication. The key idea is that parents record parts of an audio book during their micro spare time at work and their children read the book at home (with the help of a caregiver if necessary). The reading-to-child is a well suited activity to be done during micro spare time. This is because recording a whole book could be easily divided into several small recording tasks, e.g., recording a sentence at a time, and each task would fit in a single session of micro spare time.

Note that we do not argue that recording a book is the only suitable parenting activity that can be done during micro spare time at work. There are three representative positive engagement activities with a child; (1) doing a physical activity together, (2) reading a book together, and (3) singing and listening to music together [17]. The main scope of this paper is to investigate the parents' impact of using micro spare time at work for parenting purposes, and we select the reading-to-child activity as a use case.

Based on our idea, we designed *Zaturi*, a mobile system that enables working parents to make audio books for their children during micro spare time at work. More specifically, with the mobile-side Zaturi, working parents can record a part of their child's favorite book during each available unit of micro spare time, eventually creating a whole book narrated in their own voices. The child can then read and listen to the audio books with his/her parent's voice using the tablet-side Zaturi.

Besides the piece-wise book-recording feature, Zaturi helps the working parent be better aware of the possible presence of micro spare time. We observed from the online questionnaire that major challenges come from the unexpected and short-lasting nature of micro spare time. To address these challenges, Zaturi is designed with a configurable and extensible set of conditions so that it can nudge the user when certain conditions are met. A condition can be defined in terms of information available from the smartphone, such as application name, usage time, sensors, and so on.

Figure 4: Design workshop.

The service provides the following unique advantages. First, it enables working parents to engage in more parenting activities at work without disrupting their work schedule. Second, working parents can contribute to parenting from work whenever they are available to, even for a tiny moment, regardless of when their child is available at home. Third, the use of Zaturi might help parents develop a feeling of parental achievement, mitigating working parents' typical feeling of being limited and helpless. Fourth, whereas today's many parents at work only glimpse their children's photo and reminisce about the time with children, Zaturi enables working parents to be part of one of their children's favorite activities and create a new medium to communicate with their children.

Moreover, Zaturi-created books are advantageous compared with existing audio books for children. Intuitively, the children can enjoy the intimate voice of their own parents, rather than listening to an arbitrary voice-actor's voice. With Zaturi, parents can tailor the book to different audio versions and customize it with their own story. Also, parents can make any book that their children enjoy the story of, regardless of whether that book is available on the market.

To specify our target age group to craft the design, we screened a large spectrum of children's books. Those books exhibited huge diversity in terms of textual and pictorial composition as well as the length of individual scenes. Our screening led us to target children in the age range of 1–5 years. Books for this age group have higher picture-to-text ratios and contain 1–2 sentences per page, making them suitable to be recorded during micro spare time at work. Also, the semantic continuity between pages is relatively weak, making such books more favorable to working parents, as they can likely record the pages separately. Other than the advantages in terms of the books' structures, literature supports the age-specific benefit of book-reading activities; reading books helps children in this age group develop early language skills that could later affect their language learning [10].

Design Workshop

In order to elicit the design guidance of Zaturi, we conducted a design workshop with eight working parents (see Figure 4). The participants were the same as those in the focus group discussion. We did not exclude the parents who had children aged over five because we wanted to open the possibility of collecting a broader range of responses and implications of Zaturi for potential service to children in different age groups.

For the design workshop, we developed a mock-up application of Zaturi; it is a working Android application providing a few sample pages of a storybook and a quickly accessible

record-and-play interface. In the beginning, we provided the participants with a short tutorial about our notion of micro spare time at work, demonstrated using the mock-up application, and let them freely use the mock-up application. We also informed the participants that the Zaturi application can be configured to nudge them under likely conditions of micro spare time. We then conducted a two-hour semi-structured focus group discussion. The discussion was audio-recorded and transcribed, and the transcripts were analyzed individually by two researchers in our group. They finally reached a consensus on the high-level themes of the discussion [30]. The key questions were "*how do you read books to your child at home?*", "*what would be needed for you to use the service during your micro spare time at work?*" and "*what difficulties do you expect to face in using the service during micro spare time at work?*" As an incentive, each participant was additionally provided with a gift card equivalent to $25.

Difficulties in theatrical recording: Most participants agreed that reading aloud in the workplace would be the biggest hurdle in using the Zaturi system. P_A1 said, "*I think it will be very awkward if I record it theatrically in the office. But in the car would be a nice place to use it.*" P_A3 and P_A5 agreed that finding a private space would be challenging in the workplace. As a way of overcoming lack of space for the theatrical reading, P_A8 suggested a functionality that would allow the user to record the book using a phone-call-like interface. He suggested, "*Myself apart, there are many other people who talk to their children on the phone (in the office corridor). If I record the book by pretending that I got a call, it will be fine.*" There was difficulty with theatrical recording even among family members. Some participants expected that they could record the book more theatrically without any family members around them. P_A3 stated, "*From my experience, reading books to the baby when my husband is not at home is different from reading when he is.*" Based on this result, we found that overcoming difficulties in theatrical recording is one of the most important design considerations.

Recording books with multiple versions: The participants commonly stated that their children have a small set of favorite books and repeatedly read those books. P_A4, P_A5, and P_A6 reported that they read the same book to their child frequently. P_A8 mentioned, "*My daughter has two to three favorite books.*" P_A2 stated, "*My son sticks to a preferred book that usually lasts for a month. We get a new one after.*" After recording a book, the participants wanted to record the same book with a different tone and reading style, rather than to record another different book. Some participants enthusiastically suggested Zaturi to allow them to record multiple versions of a book. P_A6 reported, "*(I think) kids see, read, and think differently even when they read the same book. The service will be helpful if fathers can record the book differently each time, and children can play them selectively.*"

Applicability of Zaturi to grade-schoolers: The participants who have children over five years showed concerns with the current Zaturi implementation. They commonly mentioned that their children currently enjoy reading books alone. P_A5, who had 7-year-old twins, said, "*My son started reading books alone when he was six and my daughter started when she was five.*" Although P_A4 agreed, she still wanted her children to use Zaturi, "*As a working mom, it would be great if my kids often heard my voice.*" P_A5 raised concerns about recording the books that her children read, "*In the books my kids read, there are 10–20 sentences and it takes a long time to complete even a single book.*" Their feedback strengthened our target age range from toddler to preschooler (aged 1–5 years). However, our design space is still open to grade-schooler or above in a future version of the Zaturi design.

Needs for functional extension: P_A7 and P_A8 wanted to be motivated to use the service, although they agreed that reading books is very important for their children. P_A7 asked, "*What if the service forced me to record the book before doing Facebook? If I didn't record, the service would block Facebook.*" P_A8 agreed but suggested a different approach: "*It would be good if the service led me to take a walk after I work for one hour. It would then push me to record the book while I was walking.*" P_A4 and P_A6 wanted the service to run on multiple phones, thereby enabling other family members to collaboratively create the book. P_A4 stated, "*It would be better if my husband and (children's) grandparents made the audio book together.*"

PROTOTYPE DESIGN AND IMPLEMENTATION

Design Goals
Based on the findings from the above studies, we developed the Zaturi prototype with the following design goals.

- **Fitting a single recording into a micro spare time:** The recording task that Zaturi provides should be reasonably small enough to be completed during a single session of micro spare time. At the same time, it should be large enough to make all combined recordings natural and fluid.

- **Maximizing opportunities:** In order to maximize opportunities in utilizing micro spare time, Zaturi needs to proactively notify parent users when recording is available.

- **Allowing situation-friendly recording:** Micro spare time at work usually occurs in a public space, which is likely to be with other people nearby, e.g., co-workers in the lounge. Theatrical recording of a book near other people could make a parent user feel awkward. Zaturi aims at supporting situation-friendly recording to reduce the awkwardness of theatrical recording in a public space.

Prototype Design
Zaturi operates collaboratively on a smartphone, a tablet, and a server. An overall operation flow of Zaturi is as follows. The smartphone-side Zaturi is for a parent user's recording in micro spare time. It monitors phone-related events continuously and detects the user's micro spare time at work (the details in the next subsection). Upon detection, Zaturi notifies the parent user of the event via a notification bar as shown in Figure 5 (a) with vibration. To help users select a book to record, Zaturi displays a list of preregistered picture books with the title, the cover thumbnail, and the recording progress (See Figure 5 (b)). If the user completes recording all pages of a book, Zaturi marks its state as *finished*.

(a) Notification

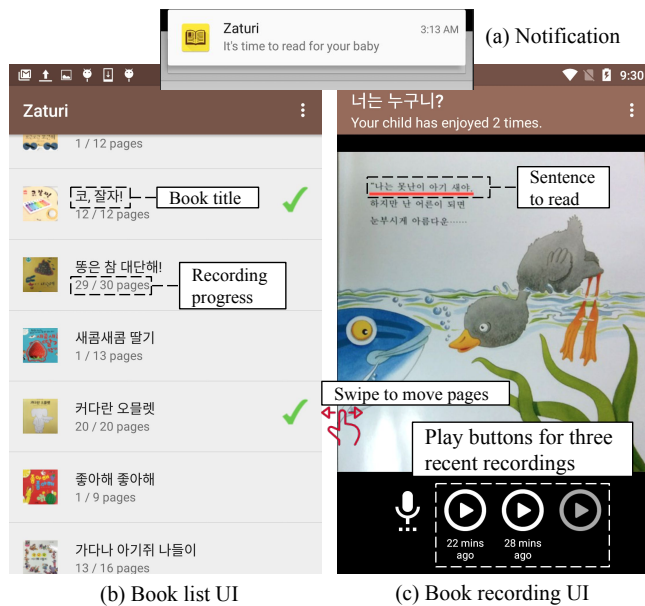(b) Book list UI   (c) Book recording UI

Figure 5: Screenshots of mobile-side Zaturi.

Zaturi provides the user interface for book recording as shown in Figure 5 (c). Its key feature is to display one page on the screen and provide one sentence as a unit of a recording task. One sentence is a suitable length to record in a single session of micro spare time because the sentences in picture books are often short, and it takes about ten seconds to read out one sentence. For pages that have multiple sentences, Zaturi highlights the sentence to read by underlining it.

Zaturi provides two recording modes; *watch-record* and *listen-record*, which can be selectively used depending on a parent user's situation. The watch-record mode allows the user to record the book while watching the page. It starts and ends recording when the user presses the recording button. The listen-record mode is for situation-friendly recording when there are other people nearby. It is automatically activated when a user holds the smartphone to her ear and deactivated when she takes the phone away. Zaturi detects such events with the proximity sensor, which is usually placed next to the upper speaker of smartphones. When the user holds up the phone, it plays a sentence to read with a computer-generated voice through the earpiece. We use the Android text-to-speech APIs to transform the texts to the voice.

On a tablet device at home, Zaturi allows a child (or a caregiver) to play the audio book. The user interface of the tablet-side Zaturi is almost identical to that of the smartphone application, except that it does not display the recording button. The tablet-side Zaturi also monitors a child's interaction with the book, e.g., how many times the child reads the page and how many books the child completes reading.

The server-side application maintains real-time synchronized information of recorded files, recording status, and playback status in the smartphone and tablet. Such information can be viewed on both the phone and the tablet.

Implementation of Micro Spare Time Intervention

It is extremely challenging to accurately detect all types of micro spare time with only smartphones. Recognizing micro spare time requires deep understanding of user contexts and interactions among people, which often requires infrastructure support. Considering these challenges, we carefully selected four types of micro spare time that meet three requirements: (1) frequently occurs at work, (2) could be used for recording, and (3) is detectable on a smartphone and with low overhead.

In detecting four types of micro spare time, we aim at achieving high precision so that the user is most likely to be notified when it is deemed micro spare time by the user him/herself, because frequent false-positives would negatively impact the user experience. We do not necessarily aim at high recall, as the entire amount of micro spare time at work would be loosely defined subject to individuals; it would be impractical to detect every occurrence of micro spare time. Also, this paper is mainly intended to explore parents' new experiences of utilizing micro spare time at work, rather than maximizing their use of micro spare time.

Long use of a smartphone for leisure: According to our survey, we discovered that working parents often use their smartphone for leisure during micro spare time at work. The smartphone-side Zaturi detects such events by monitoring the application usage using *AccessibilityService* in the Android framework; AccessibilityService broadcasts the package name of the application when the application is launched. We preregistered the top 10 web browsers and social networking services in Google Play. Zaturi sends a notification if those applications are used for 90 seconds. We carefully select the timeout based on our lab-setting trials. When it was set too short, the notification was often ignored because users preferred to keep using the application. On the contrary, the alarm was not often issued when the timeout was too long. To reflect a user's own preference, we also provide an interface to configure the timeout value.

Right after phone calls: Calling someone often implies that a user is in a place where she can speak aloud, e.g., in a break room. Using *TelephonyManager* in Android, Zaturi detects when incoming and outgoing calls are finished or canceled and sends a notification upon such events.

Walking alone: Walking alone was one of the prominent cases we had previously discovered. A representative way of detecting nearby people with only a single smartphone is to use the speaker recognition technique. However, its performance is very sensitive to the smartphone position, and its continuous execution incurs high energy cost. Thus, we target a situation when a user walks while listening to music with her earphone, which might indicate she is alone. Zaturi detects walking status with a step detector sensor implemented in hardware for low power consumption. It also monitors earphone-related events through *AudioManager* in Android. The notification is sent when both events are activated.

Daily micro spare time at a specific time: Zaturi supports the time-based alarm when a user wants to be notified at a spe-

cific time. For example, a user can set the alarm at 8:50 AM if she routinely arrives at the office at that time and wants to use Zaturi before starting work.

Evaluation on Micro Spare Time Detection

In order to examine how accurately Zaturi detects micro spare time in real workplace situations, we designed two-phase experiments. First, we recruited two researchers and one graduate student and observed their office life for six hours via shadowing. Note that in this experiment, we did not limit the participant group to working parents because we aimed at evaluating generic performance of micro spare time detection of Zaturi. We expect the types of micro spare time at work do not significantly differ between a parent and a non-parent.

The participants installed the Zaturi application on their smartphones. A researcher in our group closely monitored each participant's office life and took notes whenever the researcher determined that the participant had micro spare time. Specifically, we collected: a set of all researcher-determined micro spare time (M_R), a set of all researcher-determined micro spare time in which one-time recording could be done (M_{Rr}), and a set of micro spare time notified from Zaturi (M_Z). We consider M_Rr as the ground truth.

While shadowing enables detailed observations, it is inevitably limited in scalability (as described in the 'Focus group discussion and online survey' section). Thus, we conducted an extended experiment using an application only, without the observer. We modified the Zaturi application to allow users to instantly answer the following question whenever micro spare time was detected, '*Do you think this moment is micro spare time that you could use to make a one-time recording?*'

The observation using a mobile application was solely for evaluating the precision. We further recruited nine participants (three researchers, five graduate students, and one software engineer) and collected their responses for one week. After the one-week experiment, we conducted an interview for deeper understanding of their responses. The participants were provided with a gift card equivalent to $20 and $10 for the first and the second experiments, respectively.

Observation from shadowing: We observed $|M_{Rr}| = 15$, i.e., the total number of moments that were regarded by the researcher as micro spare time and eligible for recording. It was about 0.8 times an hour. At the same time, we observed $|M_Z| = 7$, i.e., the total number of notifications from the Zaturi application. It was about 0.4 times an hour. To break down the data, six of seven notifications were triggered by the condition of "long use of a smartphone for entertainment" and the remaining one by "right after a phone call." Note that we obtained a precision of 1.0 (i.e., $|M_Z \cap M_{Rr}|/|M_Z|$) and a recall of 0.47 (i.e., $|M_Z \cap M_{Rr}|/|M_{Rr}|$). Surprisingly, the participants responded that all moments when they received notifications from Zaturi were indeed the moments when they had time to spare and could record a single sentence.

Overall, Zaturi did not trigger any false-positive notifications and detected almost half of the micro spare time moments in the workplace. The moments that were not detected by Zaturi

Micro spare time type	# of detected events	Precision
Long smartphone use	260	85%
After a phone call	61	56%
Daily alarm	25	84%
Walking alone	16	94%

Table 2: Performance of micro spare time detection.

but labeled as micro spare time by the shadowing researchers included browsing/gaming on a desktop, coffee brewing, and walking alone without listening to music.

Observation using a mobile application: The result shows that Zaturi achieves a reasonable precision in micro spare time detection. In total, the mobile application collected 362 moments of micro spare time that were detected by Zaturi, and 292 (80.7%) were identified by the participants as actual micro spare time in which one-time recording could be done. Table 2 shows the number of events detected by Zaturi and the precision. On average, there were 4.6 times a day to record a book, leveraging the micro spare time detected by Zaturi.

The participants agreed that the time using a smartphone for leisure is generally micro spare time. A male software engineer in his 20s said, "*Regardless of the purpose, whenever I was browsing the mobile web was micro spare time.*" Different from our expectation, *phone calls* showed low precision. The participants reported that it was due to the difference between calling and receiving situations. A male graduate student in his 20s stated, "*When I call someone, I go to the corridor and talk. The time returning to my desk is micro spare time. But I usually cannot schedule incoming calls.*"

EXPLORATORY PROBE AND USER FEEDBACK

In order to examine the user experience of the Zaturi system, we performed an evaluation study that included (1) initial surveys and interviews, (2) two-week deployment of Zaturi, and (3) post-deployment surveys and interview.

Method

We posted flyers to social media and KAIST online community, recruiting ten working parents who have one or more children in the age range of 1–5 years, i.e., toddler-preschooler babies (see Table 3). Each participant was rewarded with a gift voucher worth about $80.

Initial survey and interview: We introduced the features of Zaturi to the participants and gave a tutorial on how to use Zaturi. We then conducted a survey to figure out their initial perception of micro spare time in their workplace. More specifically, we were interested in (1) the users' satisfaction with childcare participation and micro spare time use, (2) the impact of the Zaturi use on work productivity, and (3) the expected awkwardness of theatrical reading in public space.

Four Likert questions were given and followed by an interview. Our survey asked: Q1: *Are you currently satisfied with your level of participation in childcare?* and Q2: *Are you currently satisfied with your use of micro spare time?* The participants responded on a 6-point Likert scale: strongly dissatisfied, dissatisfied, slightly dissatisfied, slightly satisfied, satisfied, or strongly satisfied. We then asked: Q3. *Would*

Participant			Children		
ID	Gndr	Occupation	NoC	Months	Gndr
P_B1	M	Programmer	1	14	M
P_B2	F	Graduate student	2	27, 68	F, M
P_B3	M	Graduate student	1	26	F
P_B4	M	Researcher (Postdoctoral)	2	2, 24	M, F
P_B5	M	Graduate student	1	23	F
P_B6	F	Graduate student	1	19	F
P_B7	M	Graduate student	1	19	F
P_B8	M	Graduate student	2	33, 62	F, M
P_B9	M	Researcher (Research inst.)	2	43, 96	M, F
P_B10	M	Graduate student	1	14	F

Table 3: Participant demographics. *NoC: Number of Children.*

it interrupt your work if you use Zaturi during your micro spare time? and Q4. *Would it be awkward if you read a book theatrically in your workplace?*, with the options of strongly disagree, disagree, slightly disagree, slightly agree, agree, or strongly agree.

For the deployment, we asked them to bring their children's three favorite books. We then set up Zaturi with five books in total (three from each participant and two from our selections of toddler-preschooler picture books).

Deployment of two weeks: The participants' families freely used Zaturi for two weeks. For the quantitative study, we logged the events related to the use of Zaturi (including recording and playing) and the micro spare time detection.

Post-deployment survey and interview: After the deployment, the participants were asked to complete the same questions Q1, Q2, Q3, and Q4 based on their experiences. We conducted an one-hour interview to collect their experiences and episodes of using Zaturi in the workplace. We walked through the results together to ask follow-up questions on why such results occurred. We also obtained the responses from their spouses about the use of Zaturi with their children.

All interviews were recorded, transcribed, and reviewed to investigate underlying topics. After open coding of those transcripts, we used axial coding to examine user responses and conducted affinity diagramming to narrow the codes into a set of three main themes [30].

Findings

We discuss the findings in three aspects: (1) satisfaction of using Zaturi, (2) feedback on Zaturi design, and (3) reactions from family members.

Satisfaction with using Zaturi

We investigate the change in the participants' perception of parenting and micro spare time at work after using Zaturi.

Participating in parenting at work: Overall, Zaturi improved the participants' level of satisfaction with participating in parenting at work. For Q1, the post-deployment questionnaire yielded a higher satisfaction score (*M=4.7, SD=0.95*) than the initial questionnaire did (*M=3.7,*

SD=1.49). The difference was statistically significant (*t=-3.35, p=0.008*). Six of ten participants responded that their satisfaction with participating in parenting at work increased after using Zaturi. They reported that recording books for their baby gave them new opportunities to think about the baby and be involved in childcare. P_B7-O[1] said, "*When using Zaturi, I imagine my baby reading the book I've composed in my own voice. It makes me feel rewarded!*" P_B1-O mentioned that Zaturi reduced his feeling of being sorry for his wife when she alone cared for the baby the whole day.

Four participants (including three fathers) whose satisfaction did not increase stated that they already devote enough time to childcare at work. Extra micro spare time spent for the child was not significant for them. P_B8-O said, "*I am spending enough time with the baby. I don't think doing something for the baby during micro spare time is that critical.*"

Spending micro spare time at work: Overall, the participants' level of satisfaction with spending micro spare time at work improved. For Q2, the post-deployment questionnaire showed a higher satisfaction score (*M=3.4, SD=1.36*) than the initial questionnaire (*M=2.6, SD=1.14*); the difference was statistically significant (*t=-3.28, p=0.01*). Seven participants whose satisfaction level improved commonly responded that, before the study, they have not recognized opportunities to utilize micro spare time for other purposes. After using Zaturi, they realized that they could better utilize micro spare time for their own benefit without sacrificing their work productivity. P_B6-O said, "*I usually wasted my time when the so-called micro spare time occurred. [While using Zaturi] I realized there could be many ways to use micro spare time better.*" They also mentioned that their use of micro spare time for recording books was very satisfying. This was mainly because the participants thought that recording books for the baby was a more productive and valuable way to spend micro spare time than surfing the web, playing games, etc. They also felt the sense of additional achievement of creating a book while they were mainly doing something that required little cognitive load (e.g., walking).

Three participants stated that the satisfaction with using micro spare time did not change much as they spent only a small portion of micro spare time on recording books.

Impact on work productivity: When responding to Q3, every participant agreed that recording books with Zaturi did not disturb their work. This was mainly because, upon a notification from Zaturi, the participants decided whether to record a book based on their situation and used Zaturi only when it was not expected to affect their work productivity. P_B8-O said, "*I didn't begin recording when this task was expected to interrupt my work. I recorded only when the situation allowed. Keeping this in mind, using Zaturi never affected my productivity while using it.*" The other reason was that recording one sentence at a time was a suitable task to complete in a single session of micro spare time and thus did not overwhelm the participants.

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[1]We refer to each participant by P_B[ID] - [Oneself or Spouses].

Feedback on Zaturi design
During the two-week deployment, on average, each partici-
pant recorded 7.7 pages (*SD=2.3*) a day and completed 4.6
books (*SD=0.52*). Based on their experiences, we evaluate
the Zaturi design in terms of micro spare time utilization,
sentence-level recording, and the listen-record mode.

Effectiveness of intervention: The participants reported that
interventions in their micro spare time were effective in re-
minding them to use Zaturi. They felt that, without interven-
tion, micro spare time easily goes unnoticed because (1) the
moment occurs unexpectedly and passes quickly and (2) they
tend to keep doing what they are doing (e.g., web browsing,
social networking, etc.). P$_B$3-O said, "*In my case, the number
of recordings due to the interventions was almost three times
higher than that without interventions.*" Interestingly, P$_B$7-O
said that recording books using Zaturi became a habit over
time. He explained, "*Interventions were helpful for me in the
initial stage. As I used it over time, it became my routine.*"

However, in some cases, the effectiveness was different de-
pending on the participant's context around micro spare time.
Some participants reported that interventions after an outgo-
ing call were effective, whereas those after an incoming call
were not. This was mainly because the incoming calls were
often work-related, thereby requiring them to take immediate
actions afterward. Three participants also reported that the
interventions while browsing the web were ineffective. P$_B$2-
O said, "*(In micro spare time) I purposely browse the web on
my phone when people are around me. I felt awkward read-
ing aloud around them.*" Two participants reported that they
did not use Zaturi immediately while surfing the web in spite
of notifications because they were in the middle of searching.
P$_B$6-O said, "*I received a notification while browsing the web
and used Zaturi after I finished reading the page.*"

Micro spare time vs. single-session: To identify the im-
pact of using micro spare time, we asked the participants to
imagine they had recorded a whole book in a single session.
They then compared it with their experiences obtained from
Zaturi. Most participants preferred recording a small amount
of the content over multiple sessions because it was less bur-
densome and they could easily resume working. They also
reported that there was a feeling of incremental achievement.
P$_B$4-O said, "*Each time I recorded a portion of a book, I was
more motivated to finish the whole book. As I got closer to
the goal, the expectation that my kid would enjoy it also grew.
It was quite a pleasant experience.*"

One sentence as a recording unit: Nine of ten participants
reported that sentence-level recording fits well into micro
spare time. Recording multiple sentences at a time has three
drawbacks compared with our design: (1) users are prone
to make more mistakes in a longer recording session, (2) it
is hard to memorize multiple sentences to record at once,
and (3) many instances of micro spare time do not last long
enough to complete multiple sentences. P$_B$1-O said, "*If the
recording unit is too long, I may make a mistake. I didn't feel
inconvenience in recording one sentence at a time.*" Interest-
ingly, some participants reported that recording sentence by
sentence also helped them feel they were making progress

more frequently and clearly. P$_B$7-O said, "*Recording one
sentence at a time makes me feel the step-by-step progress
in recording a whole book. I was satisfied as I was grad-
ually moving forward towards something important.*" How-
ever, P$_B$6-O preferred recording multiple sentences at a time.
She explained, "*I want to make as much progress as I can.*"

Listen-record mode: In the initial survey of Q4, all partic-
ipants reported that recording aloud in a public space would
be awkward for three reasons: (1) the topic of the book was
childish, (2) theatrical reading could disturb people nearby,
and (3) nearby people might think weirdly of speaking aloud
in an unusual tone of voice.

After using Zaturi, the majority opinions were positive about
a listen-record mode; six participants reported that record-
ing aloud with a listen-record mode made them less awkward
than they had expected, but they still felt self-conscious about
other people nearby. For other opinions, four participants an-
swered that they did not feel the advantage of the listen-record
mode. P$_B$9-O said, "*I didn't use the listen-record feature be-
cause recording while watching a book was more comfort-
able.*" P$_B$10-O claimed that it was hard to read theatrically af-
ter he listened to the machine sound because he tended to fol-
low how the machine spoke out. Interestingly, P$_B$7-O shared
his experience with circumventing the social awkwardness is-
sue by not relying on the listen-record mode. He stated that
the public announcement was quite helpful: "*I told people
around me that I was using Zaturi. It wasn't that awkward
because they already knew or guessed what I was doing.*"

Reactions from family members
We examine how the spouses participated in the Zaturi ser-
vice and reacted to the participant's use of the service. We
also report how the children enjoyed the audio book, based
on the parents' observation.

Reaction from the spouse: Every participant's spouse pos-
itively acknowledged the participant's effort in recording
books at work. The spouses generally gave three types of
feedback: (1) encouraging the participants to record, (2) re-
questing a specific book that the child liked, and (3) improv-
ing the recording quality. P$_B$7-O said, "*My wife appreciated
my time and effort. It motivated me to use Zaturi more.*" His
wife, P$_B$7-S said, "*I liked Zaturi. The recording itself is to-
tally up to my husband. I wanted him to make as many audio
books as he could. (...) I gave my husband a prioritized list
of books.*" P$_B$3-S said, "*I asked my husband to record books
in a more funny and dramatic way, like I do for the baby.*"

Zaturi was also used as a new playing tool for the child. P$_B$1-
S stated that it was really good to have an additional option to
play with her baby when the baby got bored with other toys.

Reaction from the child: We asked the participants and
their spouses how their children reacted to the audio books
recorded in the parent's voice. Eight of ten participants re-
sponded that their children really liked it, and even the reac-
tion from the child was a huge motivation to use Zaturi. P$_B$3-S
said, "*After using Zaturi for three days, my daughter started
using it by herself. I told this to my husband and it seemed
like it encouraged him to record more frequently.*"

Many participants reported that their children recognized their voice. When the recorded book was played, their children said "*Papa!*" Three reported that their children liked the recorded book more than other toys. P$_B$1-O said, "*My son didn't get bored with his daddy's recorded book. (...) I'm not sure how long he will like it, but he really enjoys it.*"

Summary of the findings

First, the participants were satisfied with their increase in participating childcare at work by utilizing micro spare time through Zaturi. Second, Zaturi provides opportunities to change the perceptions on using micro spare time, participating in childcare, and recording in a public space. Third, a positive reaction from family members is a huge motivation for the working parents to keep using Zaturi.

DISCUSSION AND DESIGN IMPLICATIONS

Understanding the User Context

Zaturi currently supports four types of micro spare time. However, leveraging more types of micro spare time would significantly increase the chances of recording audio books and the utilization of micro spare time for other purposes as well. It is very challenging to computationally model and accurately detect diverse types of micro spare time in real-life situations. It requires deep understanding of personal, social, and surrounding contexts and their interactions.

Recently, extensive research efforts have been put toward understanding user contexts such as personality [15], emotion [24], semantic location [2], physical information [29], and conversation [18, 14]. We will extend Zaturi to cover diverse types of micro spare time by incorporating these techniques.

Family Sourcing: Participation of Other Family Members

Zaturi can be extended to invite more family members, e.g., grandparents, to create an audio book for a child. In the deployment study, some participants reported that their spouse showed a huge interest in recording the book together, which sheds light on the possibility of family-wide collaboration.

We suggest the concept of *family sourcing*, utilizing each family member's micro spare time to conduct a shared collaborative goal, such as planning a family trip together. In our settings, family members can collaborate to make an audio book by using their own micro spare time for their children. For example, a family can create a new version of *Alice in Wonderland* in which each character is recorded by a different family member (e.g., the mother covers *Alice*'s part, the grandfather covers *The Hatter*'s part, etc.).

Suitable Tasks to be Performed in Micro Spare Time

As a parenting activity to leverage micro spare time at work, we focus on creating an audio book. We plan to extend Zaturi to a more comprehensive service platform by incorporating diverse activities. In the deployment study, several participants enthusiastically suggested other parenting activities. P$_B$4-O wanted to add commentary by dubbing into his child's favorite video clips. P$_B$9-O wanted to record messages into the doll that his son always holds in bed. We believe these activities can be easily incorporated into Zaturi because they can be divided into a series of short and independent subtasks. Also, those subtasks do not need to be conducted with children at the same time with arranging an appointment. However, not all parenting activities are applicable to Zaturi, and thus it is important to carefully select and redesign activities to be suitable for micro spare time. For example, video calls with children would not be suitable to be done during micro spare time because they cannot be divided into independent subtasks and imposes restricted spatio-temporal constraints.

Demographic Diversity

Our study has the limitation of representing narrow demographic spectrum in terms of their country of residence and profession diversity. The OECD report [12] reveals that Korea is an extreme case of work-life imbalance as well as parenting imbalance between the working parent and the staying-at-home parent. These imbalances might not be as severe in different cultures, and it might affect the outcome of which type of micro spare time a working parent has available and how the parent utilizes it for reading to the baby. We believe that our findings on micro spare time and Zaturi would work as an initial cue to understand parents under different cultures. Additional study in various cultural backgrounds with more participants is required to further examine the utilization of micro spare time and the effectiveness of Zaturi.

Direct Feedback from Children

A limitation of our research is that we did not collect direct feedback from children. We agree that children's feedback is important to evaluate the usefulness of the Zaturi service. However, we did not interview them for two reasons: (1) the primary goal of the paper was to explore working parents' opportunities for utilizing micro spare time at work and (2) it is very difficult to obtain the detailed feedback directly from interviews with children in our target age group, i.e., 1-5 years old [1, 33]. To interview children, we need another study design, which crosses into another research domain. Thus, we have provided indirect feedback from children based on the parents' reports and left direct feedback as future work.

Effect of Book with Parent's Voice on Child's Development

Reading books plays a critical role to promote children's language development [10]. The parent's voice is also known to be important for early language development of babies [6]. However, this might not necessarily mean that a child's listening to books recorded in the parent's voice contributes to language development. A long-term study is required to evaluate this outcome, which is beyond the scope of this paper.

CONCLUSION

We pose the question of achieving additional parenting while at the workplace without sacrificing working hours. As an initiative, we propose the notion of micro spare time. We designed a family-oriented way of utilizing micro spare time over multiple design phases, and developed Zaturi, a system for reading books to babies by utilizing working parents' micro spare time. We envision that the insights on micro spare time help design future services to enrich our daily lives.

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