Toward Understanding Playful Beverage-based Gustosonic Experiences

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Recent advances in interactive technology are being used to enrich our interactions around food and drinks. Making use of sound to enrich dining - providing "gustosonic" experiences - has recently garnered interest as an exciting area of ubiquitous computing. However, these experiences have tended to focus on eating. In response to the lack of drinking-focused experiences, we explore the combining playful design and drinking activities so as to allow users to experience playful personalized sounds via drinking through "Sonic Straws". We present the findings of an in-the-wild study that highlights how our system supported self-expression via playful drinking actions, facilitated pleasurable social drinking moments, and promoted reflection on drinking practices. We discuss the implications of this work for designers of future gustosonic experiences, including how to amplify entertainment experiences around drinking/eating, how to highlight the joy coming from multisensory experiences, and how to facilitate mindful engagement with what one drinks. Ultimately, we aim to contribute to the enrichment of dining experiences through playful design.

CCS Concepts: • **Human-centered computing → Ubiquitous and mobile computing design and evaluation methods**; *Interaction design.*

Additional Key Words and Phrases: Food play, Human-Food Interaction, Gustosonic experiences, Sound

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Fig. 1. (a) Sonic Straws is a beverage-based gustosonic system that supports the experience of playful personalized sounds via drinking beverages through straws; (b) Sonic Straws consists of a paper cup, a customized lid, and a holder; (c) the customized lid with two holes includes removable copper conductive tape for sensing via the straws.

1 INTRODUCTION

Drinking is essential to life. People drink beverages to satisfy their thirst and for pleasure [26, 32]. We use the term "beverage" to encompass all types of drinks (however, in our study we focus on soft drinks (soda) and in particular water). Drinking is a rich multisensory experience that we repeat every day and we often share drinking experiences based on love and companionship [39, 60]. Prior research has focused on ways in which interactive technology can offer instrumental benefits when drinking beverages. For example, researchers have embedded a liquid-level sensor into a smart bottle to give individuals visual feedback on their water intake [34], and created smartphone applications to send automated reminders to promote water intake [78]. To complement this work, recent research has explored how to support the experiential benefits of consuming beverages. For example, a playful drinking system used colorful sports drinks as palatable visualizations of physical activity, to encourage hydration and entertain people after exercise [35]. Furthermore, Grimes et al. [24] advocate for the design of "celebratory technology" for eating and drinking; technology that considers foods and beverages not just as energy and nutrient intake, but also celebrates the experiential aspects of enjoying a meal or drink. In this context, we further explore how a playful approach can enrich the beverage experience because playful design embraces the ways in which technology can enhance and enrich experiences [11, 21, 52].

We present "Sonic Straws"[1], a playful gustosonic system in the form of an augmented cup that supports the experience of playful, personalized sounds when drinking through straws (Figure 1). "Gustosonic" refers to the multisensory interactions between sounds and the acts of eating/drinking [69]. The Sonic Straws system allows players to use personalized sound clips to generate melodies by drinking through two straws. We conducted an in-the-wild study [57]: eight participants used the system for one week and we gathered qualitative data through semi-structured interviews. Based on an inductive thematic analysis [12], this paper offers three themes that articulate how our system provided three types of user experiences: supporting self-expression via playful drinking actions; facilitating pleasurable social drinking moments; and promoting participant reflection on their drinking practices. We also combine our study insights and our craft design knowledge to discuss the implications of this work for designers of gustosonic experiences.

[1] https://youtu.be/GLpoT2yhT0g

Our work makes four contributions. First, we illuminate technology's under-explored capacity to enrich beverage-based experiences through sound, exemplifying this capacity through Sonic Straws. Second, we contribute qualitative insights from our in-the-wild study, to help researchers better understand playful beverage-based gustosonic experiences. These insight could be useful for the analysis and evaluation of augmented eating and drinking experiences, thereby expanding knowledge in the human-food interaction (HFI) field [36]. Third, the results of our thematic analysis could be applied to work that aims to support meaningful and pleasurable eating/drinking experiences by amplifying entertainment, by highlighting the joy that comes from multisensory experiences, and by facilitating mindful engagement with what we drink. Fourth, we offer three design implications to guide practitioners and designers of gustosonic experiences.

2 RELATED WORK

In undertaking this work, we considered prior work on playful eating/drinking interactions, sounds in relation to eating/drinking, and augmented drinking experiences.

2.1 Playful Eating/Drinking Interactions

Prior human–computer interaction (HCI) work highlights the need to design technology that supports the experiential aspects of eating/drinking, not just the instrumental [11, 24]. In particular, playful approaches have been advocated for enriching eating/drinking experiences [3, 15, 51, 76]. We concur that playful eating/drinking can bring joy into what can sometimes be a mundane, everyday activity, and encourage people to engage all their senses [2]. Prior work has also argued that playful eating/drinking interactions can improve mental well-being, increase happiness [11], and support meaningful social interactions through commensality (the positive interactions associated with people eating and drinking together) [46, 74]. Combining eating/drinking with digital technology might offer new ways to facilitate meaningful play that supports curiosity, exploration, and reflection [15, 77].

Our work is inspired by existing playful eating/drinking systems, one of which is "Chewing Jockey" [38] a system that enriches eating experiences by playing cartoon sounds when users chew gummy sweets. Another example is "Lickestra" [10]: a musical art performance in which performers improvise various baselines and tones via licking actions. "You better Eat to Survive!" [5] is a system that enriches a virtual reality experience by using chewing noises detected by a sensor attached to the face as a game controller. A public drinking installation called "Drink Up Fountain" [40] talks to users while they drink water from its fountain. While these works help us understand that sound can be a rich and playful resource for eating and drinking experiences, we note that they were mostly designed to offer individuals a brief experience, or an art performance, and, consequently, they provide limited insights into everyday augmented eating/drinking experiences.

The interactive ice-cream project [74, 75], in which ice-cream cones play different sounds as participants eat the ice cream, has, perhaps, the most everyday relevance. Associated studies suggest that digitally generated sounds could affect in-the-moment, ice cream eating experiences. However, because ice cream is frequently cited as an example of "mood food" [41] and generally considered to be an occasional, pleasurable treat when consumed in moderation [72], the study findings might not be directly transferable to more mundane and repetitive experiences like drinking water. Consequently, we possess limited knowledge about how augmented food and drinks other than treats are experienced. Nevertheless, these prior works still suggest that users find value in playful gustosonic experiences [74, 75], and they offer a foundation for a more expansive approach, focusing on playful everyday life activities and the pervasive play agenda [49], and exploring how to enrich everyday drinking/eating experiences. We believe that such knowledge could lead to enriched drinking experiences and facilitate pervasive play [1] in everyday life, promoting entertainment, sociality, and reflection [31], and could even potentially be used to guide

future systems that use play to help people drink water more proactively and frequently, with the objective of improving their physical and mental well-being.

2.2 Sounds in Relation to Eating/Drinking Experiences

We point to recent research on the relationship between sound and eating. For example, people's enjoyment of food/beverages, and their overall multisensory dining experience, are affected by what they hear as the eat and drink [62, 63]. The Korean livestream phenomenon *mukbang*—in which a host eats alone while interacting with internet viewers—is driven by the sounds of consumed drinks and foods [16]. Many *mukbang* hosts use special microphones to amplify the sounds coming from their eating and drinking [4].

Sounds can also impact how we perceive beverage/food attributes, such as texture and flavor. For example, if a food texture is soft, the addition of crunching sounds makes people perceive the food as crunchier [61]. Similarly, people perceive red wine as heavier when they hear "powerful" sounds [65], and high-pitched sounds increase the perceived sweetness of cinder toffee [17]. The hospitality industry has also used sound as an "extra ingredient" to enrich eating experiences [64]. While these works highlight the relationship between eating/drinking and sound, they focus more on measuring the effects of particular sound stimuli on specific taste perceptions, and less on the associated eating/drinking interactions.

We also note that prior HCI work highlights how sounds can offer meaningful engagement and enjoyment [30, 33] at almost any time in everyday/domestic settings. For example, everyday sounds can facilitate playfulness and meaningful engagement by evoking dementia patients' past memories [28]. Also, playing pre-recorded voices and soundscapes in homes can create strong emotional reactions and support social interaction [27]. Accordingly, we contend that sound can support people's everyday lives, even as part of a beverage-based experience, and that the relationship between sounds and drinking interactions are underexplored aspects of drinking experiences.

2.3 Augmented Drinking Experiences

We have also learned about the potential to design augmented drinking interactions from prior work on developing augmented drinking experiences. For example, the "Straw-like User Interface" [25] allows users to experience virtual drinking via replicated pre-recorded drinking sounds. Also, "FunRasa" [55] produces artificial taste sensations through a 3D-printed straw and a control module that overlays colors on the beverage and stimulates the tongue using electrical stimulation. Similarly, "Vocktail" uses electrical stimulation to augment a beverage's existing flavors [56]. The "Affective Tumbler" [68] conveys thermal sensations to the nasal area to stimulate the skin's temperature response during drinking, the change in skin temperature attributed to the beverage can lead users to experience pleasant or unpleasant feelings. Also "Virtual Lemonade" [54] teleports a soft drink by replicating its color and pH value remotely using plain water. While these prior works focus primarily on either supporting the instrumental aspects of beverage-based interactions, or on augmenting taste sensations, we focus on supporting the experiential aspects. With respect to the prior work discussed here, we have identified a gap in understanding the design of playful beverage-based experiences in everyday life and, to begin closing this gap, we offer an answer to the question: *How do we design playful beverage-based gustosonic experiences?*

3 SONIC STRAWS

"Sonic Straws" (Figure 1) is a playful gustosonic system that dynamically generates playful digital sounds (including user's own sound clips) when the user drinks any beverage through one of the system's two straws, or both of its straws. The system is portable, stand-alone, and comprises two straws, a customized lid, and a holder, which contains a microcontroller (Adafruit Circuit Playground Express (CPX)), an amplifier, and a 3.7 V lithium battery attached to the base of a regular (food-safe) cup. The system senses capacitance data via the two straws. The user's drinking actions (via the straws) produce variations in the sensed capacitance values and the system

maps that data to trigger sounds when the value goes above a threshold. To further enrich playful interactions, we designed two straws that can sense drinking actions simultaneously while generating different sounds as a connected sequence. When the user drinks through two straws together, they can experience another additional sounds as a surprise. This feature lets the user move their mouth between the two straws to create a continuous melody.

4 DESIGN PROCESS

We developed Sonic Straws through an iterative design process involving sketching, group discussion, and the creation and testing of low-fidelity prototypes (Figure 2). We conducted three group discussions to help refine our prototypes and to gather insights into how people drink in everyday life. The group discussions included seven experts from diverse academic backgrounds, four interaction designers (from general HCI, with two of them also from HFI), one industry designer, and two sound designers.The first group discussion aimed to identify and observe the actions undertaken while drinking through straws. To arrive at the possible design choices, we discussed the motivations for people drinking beverages together in various settings. We found that sometimes people like to share a beverage with others based on companionship. Therefore, an intriguing design space appeared to be designing straw-based interactions for drinking together.

The aim of the second group discussion was to set up a sound system for drinking beverages in everyday life. The idea was to build a sound system that can simultaneously play different personalized sounds. Also, to prolong and enrich the user's engagement, the two sound designers helped select possible preset sound samples based on a soundscape appraisal model [69] and the PLEX framework [43] for choosing sounds in terms of pleasantness, arousal, and playfulness. We discussed three possible sound interactions: first, using MIDI single notes with consonance inspired by playing instruments; second, using preset playful sound clips based on prior work [75]; and third, using personalized sound clips selected by users. To demonstrate different sound interactions, the sound designers designed three possible sound systems in Max/MSP. We conducted initial playtesting and mapped drinking actions to each sound system. We then discussed the pros and cons of each system and identified an initial sound configuration. We set up a sound configuration after 20 trials with different paces of sipping actions.

The third group discussion focused on designing a straw-based interface to support sustainability and ease of use. We aimed to support common forms for both the cup and the straws (size, weight, shape) to ensure their ecological and social acceptability. We used sticky notes to explore, categorize, and narrow down solutions to support sustainability and ease of use. Finally, we conducted a pilot study for the in-the-wild [57] study.

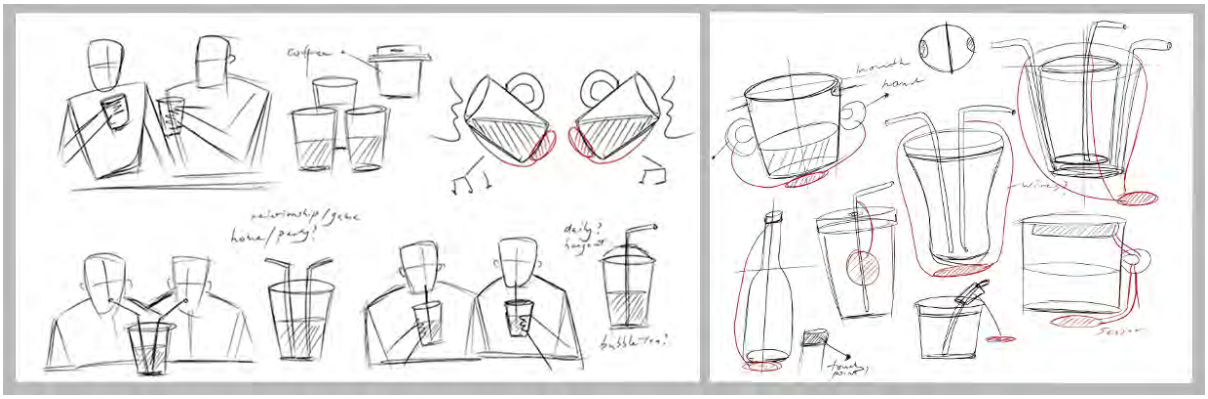

Fig. 2. The sketches from the design process showed potential drinking scenarios (left) and initial system concepts (right).

4.1 Designing a Sound System for Connected Gustosonic Experiences

The main sound design challenge was to provide users with sustained playful engagement, because drinking is a pervasive, repeated, everyday activity. We identified that each straw sipping action usually lasts between two and four seconds. We therefore limited each sound clip to three seconds, with a one-second fade-out to allow players to react to what they hear during each sipping action. For our initial sound system, we used already successful, playful sounds [75]. In our preliminary investigations, we found that even playing the same sound appeared to maintain people's engagement with Sonic Straws. However,we acknowledge that users might disengage with a novel system after the initial excitement diminishes [23], and we note that participants reported that, after experiencing all the preset sounds, participants looked forward to richer sound feedback. Consequently, we decided that our sound system should support playing both preset sounds and personalized sounds selected by users, based on their preferences. This decision led us to design connected gustosonic interactions to facilitate a more sustained engagement. Inspired by musical instruments, we created two straws that can sense drinking actions simultaneously while generating different sounds as a connected sequence. Users can move their mouths between the two straws to make a continuous melody. To further enrich playful interactions, we also set up additional sounds for when the users drink through both straws together. During our design iterations, we found that the tempo of sounds also plays a key role in linking sounds together. Based on the pace of the sipping action, we first set up the rhythm of the sounds to be 80 beats per minute (BPM). We subsequently discovered that users needed a faster pace to establish a perceived link between two sounds. After three further iterations, we decided on a rhythm of 110 BPM, allowing the user to perceive a transition between two sounds without losing context. As a result, the users are able to create connected sound interactions individually or collectively (Figure 3).

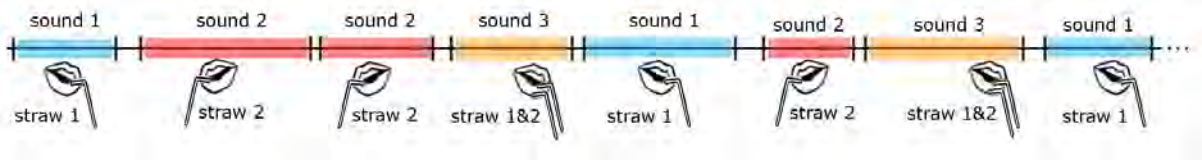

Fig. 3. A connected sonic interaction between two straws with different sounds selected by the user.

4.1.1 Choosing Preset Sounds as Guidance for Gustosonic Experiences. Previous work has suggested that giving prior information about playful interactions can be useful in customizing experiences [21]. Consequently, in consultation with the two sound designers from our group discussion sessions, we selected preset sounds (that users could change later) that represented a broad range of sound designs. The four sound sets we chose (anthropomorphism, fantasy, old school, and nature) were intended to match the four main components of "pleasantness" in the soundscape appraisal model [69]: active, interested, enjoying and relaxed. Each set consisted of two sound clips for each straw. The set for *anthropomorphism* consisted of human vocal sounds that playfully responded to each other. *Fantasy* offered metaphorical sounds based on people's natural cognitive experiences [8] (such as a cat meowing, or a bird singing). The *old school* set consisted of short, legato, and consonant classical instruments sounds (violin chords and cello chords). Finally, the *nature* set offered meditative sounds (raindrops and forest sounds). Having made these design decisions, we acknowledge that a user's understanding of these sounds is based on their cultural conditioning and natural cognitive experience mapping [7, 8], and that further exploration regarding sound content might be needed.

4.1.2 Implementing the Final Design. We adopted the experience prototyping design method, allowing users to gain first-hand experience by engaging with prototypes [13]. Two researchers used the Wizard of Oz technique [18] to play back the preset sounds using a normal coffee cup as a low-fidelity prototype in the first group discussion session. Based on the research team's initial experience with the low-fidelity prototype, we then identified the following four design challenges for Sonic Straws:

- The design should prevent the electronics, including the battery, and drinking liquids coming into contact.
- The form factor should resemble a standard sustainable cup.
- The cup should be easy to refill; moreover, users should be able to exchange the straws easily.
- All material in contact with the beverage should be food-safe.

We explored various forms in response to these design challenges (Figure 4). Our initial idea was to place the microcontroller and speaker into a lid structure (Figure 4a). However, during trials, we found that this form evoked surprise and interfered with the sounds being heard. Our second design was inspired by a regular smoothie cup. We embedded a replaceable cup inside a 3D-printed cup-shaped cover (Figure 4b). However, we considered the size and weight of our second design too bulky and heavy and it also caused a sensing issue while filling the cup. Inspired by the "Affective Tumbler" [68], which comprises a holder containing a microcontroller attached to a paper cup, we decided on individual components for our system (Figure 5). We designed a container for the electronics, a replaceable paper cup that sits on top of the holder secured with Velcro, and a customized lid with two holes including removable copper conductive tape for sensing via the straws. We then conducted a pilot study with two participants to finalize the sound system and to make sure that the technical aspects of the system were working as intended.

Fig. 4. (a) In the first design, a speaker and a microcontroller were placed into a lid structure; (b) in the second design, a replaceable cup was covered with a 3D-printed cover.

5 SONIC STRAWS IN ACTION

We conducted an in-the-wild study [57] to understand the Sonic Straws user experience (Figure 7). The study took place in four households with two participants from each household. The recruitment followed a combination of the snowball method and convenience sampling. We decided to engage more than one person from the same household to better understand the social dynamics of Sonic Straws use. We told participants that they could use the system any time and in any way they wished, over a one week period. No compensation was provided. Figure 6 provides participant details for each household along with their relationships, professions, and their familiarity with technology use. Participants did not have any musical training. No participants reported problems with hearing or drinking disorders. We had received ethics approval from our university under the reference number 24232.

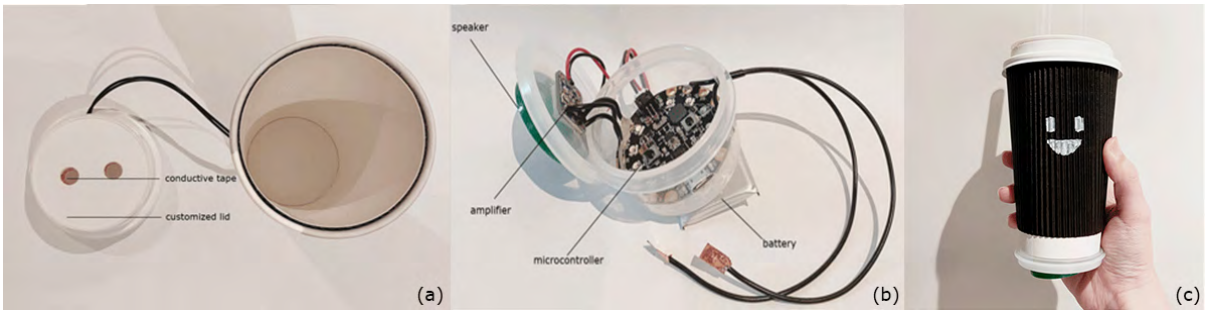

Fig. 5. (a) A customized lid with two holes; (b) our electronics in the bottom container; (c) the Sonic Straws with all components

Household	Name	Relationship	Professional	Familiarity of technology use
H1	Keith (M, 23)	Roommate	Information technology	Familiar
	Mark (M, 24)		Information technology	Familiar
H2	Rina (F, 24)	Roommate	Design	Familiar
	Aiko (F,26)		Media	Familiar
H3	Jeannie (F, 26)	Partner	Design	Familiar
	Ethan (M,32)		Business	Familiar
H4	Roger (M, 28)	Partner	Computer science	Familiar
	Zoe (F, 26)		Information technology	Familiar

Fig. 6. Participants in the in-the-wild study (pseudonyms used).

Fig. 7. Participants in the same household experienced the Sonic Straws in action (left and middle photos were taken by a friend at a party, the selfies on the right were taken by participants).

We provided off-the-shelf disposable cups, straws, and lids. Although our system can support reusable materials, we opted for single-use components for hygienic reasons. Each pair received a package (Figure 8) containing a packet of straws, a packet of disposable paper cups with lids, two Sonic Straw containers with the electronics, an adhesive-backed conductive tape, two power banks, and a MacBook Pro laptop for converting sound formats and storing sound data. All participants were comfortable with using laptops, including converting sounds formats,

Fig. 8. Each pair of participants received a kit containing two Sonic Straw systems.

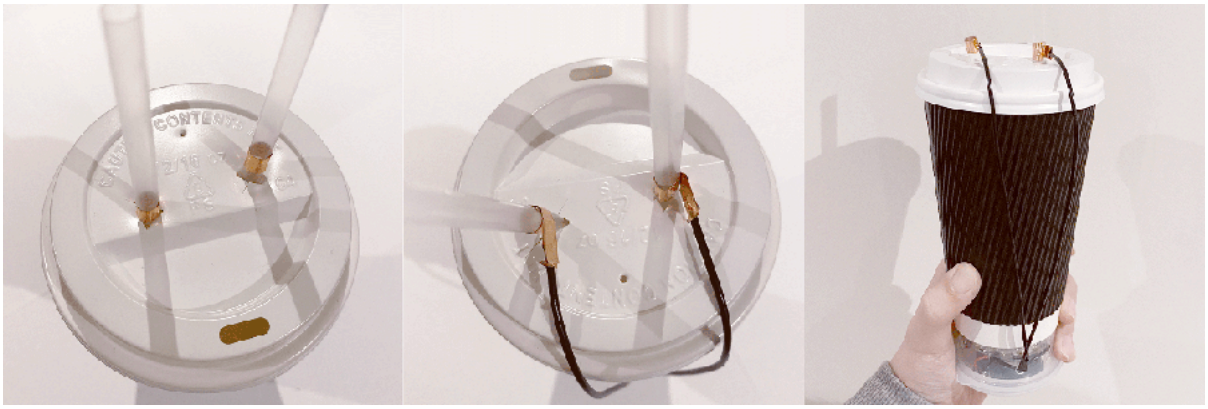

Fig. 9. The setup phase of using Sonic Straws.

which could be done using their own computers or via the laptop provided. We installed and set up the Audacity software [6] on the laptop so that participants needed to take minimal steps to use their own sounds, convert them to the format Sonic Straws required, and load them onto the system. We expected the process to take less than one minute. We spent around 30 minutes explaining the study procedure and performed a video conference demonstration of how to use the system. We provided written instructions on how to set up the system and how to replace the cups, straws and sounds. We also stored the same instructions and a setup video on the laptop. We maintained contact with participants through emails and phone calls in case they needed technical support. We asked to engage with Sonic Straws at least once per day, either individually or with their partner. We also asked participants to log the personalized sounds they used during the study.

Participants performed the following tasks:

- Setup phase: After selecting personalized sound files, participants encoded them into the WAV format via Audacity [6]. We supported the conversion process by providing instructions and offering help, but

our participants did not report any challenges. After conversion, participants connected the system to the laptop and uploaded their sounds. Then participants attached the conductive tape to the straws and the microcontroller (Figure 9).

- Use phase: Participants clicked a button on the microcontroller to start the system. They could also adjust the volume via a small knob we included in the system's container. Participants were then free to drink at any time, in any way they liked, using any beverage. Participants were encouraged to make diary entries online after each drinking activity, logging any information they thought may be relevant to the analysis of the experience such as: what kinds of beverages they drank; what kinds of sounds they used; why they chose those sounds; and how they felt at the time; as well as any reflections on using Sonic Straws.
- Replacement phase: Participants were free to dispose of the cup, lid, and straws, and replace them as needed.

6 DATA SOURCES AND ANALYSIS

Our main source of data were 30 to 45-minute interviews conducted with each participant pair at the end of the study and the personalized sounds used. Figure 10 shows the sounds used by the participants. We used a semi-structured interview approach, leaving room for discussion of other topics and supporting a deeper elucidation of participants' responses and thought processes [42]. During each interview, we took notes and recorded the audio, which was later transcribed. We asked questions related to the research aims to remain on track while leaving sufficient flexibility for other matters to be raised. The questions focused on motivations, expectations, and experiences of using Sonic Straws, such as: when participants used the system; what kinds of beverages they used; what types of sounds they used; and how the sound affected their drinking experiences; as well as observations or insights they had regarding their own or their partner's drinking actions and any interesting stories that arose from using the system. Additionally, we welcomed opportunities to view any photographs or recordings of their experiences with Sonic Straws that participants had captured during the study. This data helped us to understand how the users reacted to and integrated Sonic Straws into their everyday life.

Name (Household)	Pre-set sounds used	Personalized sounds used
Keith (H1)	Anthropomorphism, old school, fantasy	Flute, violin, drums, vocal
Mark (H1)	Anthropomorphism, old school, fantasy	Drums, percussion, vocal, defibrillator
Rina (H2)	Anthropomorphism, old school, fantasy, nature	Bubble, vocal, creek, dolphin, dog barking, cartoon voice (animal crossing)
Aiko (H2)	Anthropomorphism, old school, fantasy, nature	Forest, bubble, wind, stir-fried tea, rain, cheering, air
Jeannie (H3)	Anthropomorphism, old school, fantasy, nature	Waves, thunder, birds, morning coffee, rain, waterfall, drizzle
Ethan (H3)	Anthropomorphism, Old school, nature	Rain, wind, stream
Roger (H4)	Old school, nature	Bubble, waves, vocal, robot voice
Zoe (H4)	Anthropomorphism, old school, fantasy, nature	Vocal, bubble, waves, soda, stewed-soup

Fig. 10. The sounds used by the participants during the study.

We use NVivo [53] to undertake an inductive thematic analysis [12]. Each question, and each participant pair's answer, were put together and considered to be one unit of data. In total, there were 332 units of data. Two

researchers read the transcripts three times to become familiar with the data and then coded it independently. These codes helped to identify the most interesting features of the data units in order to group them. In the first-round iteration of the thematic analysis, we developed 37 labels, including “Type of drinking”, “Collective interactions”, “Sensation of taste”, and “Drinking actions”. In the second round, two researchers discussed and re-examined the codes to merge similar ones into 18 labels and reduce complexity. These labels were then iteratively clustered into higher level themes with the help of two senior researchers.

7 FINDINGS

We present the analysis in the form of the three themes: self-expression via playful drinking actions; pleasurable social drinking moments and reflection on participants’ everyday drinking activities.

7.1 Theme 1: Self-expression via Playful Drinking Actions

This theme depicts six aspects of the participants’ experiences of self-expression while using the system: enjoying aligning personalized sounds with the beverage taste; extending playful drinking experiences through personalized sounds; being rewarded with different sounds with each sip; engaging in self-expression through turning sipping into music-making; turning drinking into an engagement with sound’s narrative potential; and enjoying how the sounds could turn drinking into a relaxation opportunity.

F1: Participants enjoyed aligning personalized sounds with the beverage taste. All participants appreciated that they could use their own sounds for self-expression. They aimed to select sounds that matched their emotions or past personal experiences and tried to align them with the beverage taste. For example, Aiko said: “I used sounds associated with my mood. And I would also think about the flavor of beverages for a few minutes before I used it. Then I would be focusing on whether the sound suited that flavor of beverage. Sometimes I drank milk bubble tea with a pleasant sound and I preferred to drink green tea with a forest sound.” Moreover, Aiko reflected on her experiences during the study: “Sometimes I can hear background music or ambient noise while eating outside, but I do not pay attention to the content of these sounds. When it [Sonic Straws] generated sounds during drinking, I would get excited but also wondered, what is the next sound? Or what if there is no sound for the next sip?” Similarly, Rina said: “I enjoyed pleasant sounds when I used it; in particular I enjoyed bubbling sounds with sparkling water and soft drinks. "

F2: Participants extended playful drinking experiences through personalized sounds. All participants felt that Sonic Straws was intriguing and exciting. For example, Jeannie emphasized how she was impressed by the sonic feature of Sonic Straws, especially in comparison with typical experiences of drinking water: “I have a lot of cups, I bought them because of aesthetics or as a souvenir, but Sonic Straws stood out from other cups because of its playful and sonic features. I could design sounds for my favorite beverages.” Similarly, Mark said: “This [Sonic Straws] is a new thing for me. It is interesting and lovely. I haven’t seen this sort of thing before.” Jeannie also designed her sounds according to the weather forecast while drinking tap water. She said: “When I used it over time [during the study], it made me think about other ways to design sounds. I often forgot to read the weather forecast, but I think that is important for daily routine. So I started by looking for the weather forecast in my location. I first selected sounds that could represent the weather for each day, like thunderstorm sounds, wind sounds and rainy sounds." Jeannie also described how she used Sonic Straws in particular ways: “Sometimes, I used one straw to represent daytime and the other for the night. If the weather suddenly changed, I would change the soundtracks. I also set up a sound that represented the weather for yesterday when I was drinking via two straws together. On the last day I used Sonic Straws, I reviewed all sounds on the laptop. It was fascinating to experience the sounds changing day by day while drinking.”

F3: Participants were rewarded with different sounds with each sip. Six participants described how they explored the four preset sounds sets by moving their mouth between the two straws. For example, Mark said: "When I drank with one straw the generated sound was slightly different from the second drink, then I moved my mouth to the other straw. Each sound was different. Later I quickly moved my mouth between two straws and the connection was interesting. It was like two animals could talk with each other. It provoked my imagination with a story while playing with two sounds." Aiko added: "I tried all the preset sounds with two straws, but when I drank with two straws together, the sound was totally different. It was like a reward for exploration."

F4: Participants engaged in self-expression through turning sipping into music-making. Two households reported that the different sonic interaction possibilities allowed them to experience drinking as music improvisation, which facilitated self-expression. For example, Keith said: "At first, I was excited to show my improvised sounds to my roommate. I tried different instrument sounds and various actions of drinking in order to present a piece of listenable melody. You know, the sound was like chaos at the beginning. After trials, I found my way to perform better. I moved my mouth between two straws and counted beats." Mark added: "Yeah, he did a really good job. You know, he is like a one-man band."

F5: Participants turned drinking into an engagement with sound's narrative potential. Two participants reported that they preferred to use human vocal sounds because these could turn them into a story through drinking. For example, Mark said: "When you gave us this system, I tried all your preset sounds first. Those sounds were pleasant. But I found that I liked slow-paced human vocals for the system. Later, I used similar vowel sounds and my favorite cartoon character's vocal sounds. It was like creatures were whispering to me while I was drinking!" Keith added: "I used two coherent vocal sounds for each straw. When I moved my mouth between the two straws, it sounded like echoes when you are shouting in the mountains."

F6: Participants enjoyed how the sounds could turn drinking into a relaxation opportunity. Four participants felt that hearing nature sounds enhanced their perception of being more relaxed while drinking. Jeannie compared her experience of drinking without sound: "Normally I drink beverages in a very relaxed situation or for releasing stress. With Sonic Straws, I mostly liked the forest sounds. Although the sound was episodic, this made drinking beverages more enjoyable." Zoe added: "I think drinking is relaxation and sounds like rainy sounds make me feel very relaxed. I liked the slow sounds; they made me enjoy drinking a lot and calm down."

7.2 Theme 2: Pleasurable Social Drinking Moments

This theme depicts six ways in which participants' use of Sonic Straws influenced how they drank beverages together: enjoying coordinating drinking actions via playing with sound together; inferring their partner's emotions based on sound selection; sounds facilitating social play over beverages; facilitating shared beverages experiences; making participants curious about their partner's taste in beverages; and creating conversation opportunities.

F7: Participants enjoyed coordinating drinking actions via playing with sound together. Sonic Straws appeared to facilitate coordinated drinking actions while participants played sounds together. Participants said that playing sounds with Sonic Straws together was challenging, yet enjoyable. Successful collaboration, to produce a harmonious melody, depended on the proper drinking actions, such as the drinking pace, release time, and the volume of beverage consumed with each sip. For example, Roger said: "We shared one cup of Coke while using it [Sonic Straws]. We found that coordinated actions were crucial for playing with shared beverages together. You could prevent one person consuming a lot." Zoe laughed and added: "He sipped a lot each time. In the end the system only played his sounds." Interestingly, Keith and Mark said that they tried to use two Sonic Straws together for making music via drinking water. They found a drinking pattern for generating a melody. Keith said:

"We figured out how to collaborate with each other to generate melodies with this [Sonic Straws]. For example, we chose instrument sounds from the system. I could sip one of my straws first and not release for five seconds, then he [Mark] could sip one straw twice and quickly move to the other straw for one sip."

F8: Participants inferred their partner's emotions based on sound selection. Two participants reported that their partner's sound selection drew their attention to their partner's emotions. For example, Rina said that the sounds selected by Aiko drew her attention to Aiko's emotions: "I knew she selected sounds based on her mood. Those sounds made me realize how her mood changed. Sometimes the sounds were pleasant, like a bird sound or a cat sound. But I heard her favorite idol's voice a lot in one day. I think she was excited at that time." Similarly, Roger said: "Her [Zoe] selected sounds attracted my attention to her emotional state. I knew she preferred to use nature sounds while drinking water. When I heard different sounds one night, I asked her if there was anything making her happy."

F9: Sonic Straws' sounds facilitated social play over beverages. Participants used the sounds to play games together, with some of them using the beverages as game rewards. For example, Keith said: "I was looking forward to hearing the sounds he [Mark] used every night. He used some cartoon characters' voices. It was cool. I could guess which character it was." Mark added: "It was like a puzzle game. We then talked around characters and related stories based on sounds." Similarly, Rina and Aiko designed a game with Sonic Straws before sharing beverages. Rina said: "I used Sonic Straws to share beverages with her [Aiko]. I only set up one straw to generate sound before sharing. Then I asked her to guess which straw should be used for creating sounds. If she chose right, she could drink first and consume more beverage."

F10: Sonic Straws' sounds facilitated shared beverages experiences. Six participants appreciated that Sonic Straws allowed them to share beverages while playing with sounds together. For example, Zoe said: "It [Sonic Straws] created opportunities for my partner [Roger] and me to interact with each other more. He used to spend most of his time on PlayStation or TV when we were staying in the living room. But when I used Sonic Straws, we didn't have to talk much, we would play with sounds together and share drinks." Similarly, Rina and Aiko reported: "We placed the Sonic Straws on our dining table. We enjoyed playing with sounds together and shared our favorite beverages after dinner."

F11: Sonic Straws' sounds made participants curious about their partner's taste in beverages. Two participants pointed out that the sounds drew their attention to their partner's choice of beverage. For example, Roger said that just hearing the drinking sound made him curious about his partner's tastes: "It's quite fascinating. The generated sounds also attracted my attention to what kind of beverage she drank. Those sounds made me feel that the beverage tasted special." Similarly, Ethan said: "The sounds attracted my attention to her [Jeannie's] drinking actions when she was drinking with that cup [Sonic Straws]. Then I asked her what kind of beverage she was drinking for fun."

F12: Sonic Straws' sounds created conversation opportunities. All participants appreciated that Sonic Straws sounds created conversation opportunities. For example, Zoe said: "While Roger used it one night, I had a Skype call with my mum. My mum also paid attention to it [Sonic Straws] because of the sounds generated by drinking water. Then all of us started a conversation naturally around it." Participants mentioned that the sounds helped them to bring their attention back to the social aspects of dining together. For example, Aiko said: "When we ate together, we used to spend time on our phones. But when I drank water with it [Sonic Straws] at the dining table, the sounds could bring our attention back. Then we started a conversation naturally."

7.3 Theme 3: Reflections on Participants' Everyday Drinking Activity

This theme depicts the six different ways in which Sonic Straws facilitated reflection in everyday life: motivating participants to drink more frequently and proactively; raising participants' mindfulness with everyday drinking activities; facilitating reminiscence through personalized sounds; including Sonic Straws sounds as gift-giving when making a drink for someone; inspiring a desire for further personalization; promoting reflections on voice-based smart agents at home; leading to moments of silence; and improving audio quality.

F13: Sonic Straws motivated participants to drink more frequently and proactively. Six participants reported that the playful gustosonic interactions motivated them to drink more frequently and proactively. They used the Sonic Straws system instead of their original cups for drinking during the study. Aiko said: "I drank more frequently than usual because of the sounds [bubble sounds], and I wondered how the sounds would sound differently each time while sipping beverages." Similarly, Zoe said: "I drank proactively with it when staying at home. It made me to enjoy drinking water by bringing in the aspect of sounds."

F14: Sonic Straws raised participants' mindfulness with everyday drinking activities. The Sonic Straws system raised participants' awareness of their everyday drinking activities. For most participants, the study was an effective ingredient in their daily routines while staying at home. Ethan described how the Sonic Straws system triggered a reflection on drinking interventions: "I know these sounds can not only be a playful resource but also affect the method of drinking in everyday life; for example, following a kind of musical rhythm, people can drink more slowly and stay mindful of getting hydrated." Similarly, Rina said that the system helped her to reflect on how she drank during the day: "Although this kind of experience is episodic, this [Sonic Straw] was more for fun, for mood. I liked undertaking this playful drinking activity because playing with sounds made me happy." Interestingly, participants mentioned how the Sonic Straws system became a part of their daily lives: "I found it was easy to use. When I was familiar with the sound system, I could use the drinking cup as usual while drinking water. When I wanted to have some fun while drinking, I would also easily turn it on or turn it off."

F15: Sonic Straws facilitated reminiscence through personalized sounds. Participants reported that engaging with Sonic Straws facilitated reminiscence regarding their past drinking experiences. For example, Jeannie said: "When I heard rainy sounds while drinking tea, it evoked my memories: because of a thunderstorm, we [she and Ethan] had to stay at a small tea shop and had afternoon tea there when we travelled to Kyoto two years ago." Ethan added: "Yeah, I could still remember the taste of oolong tea and the rainy sounds hitting the roof." By using sounds from her dog, Rina reported that the drinking actions supported her in reminiscing about her dog: "I think this [Sonic Straws] could be my companion. I used puppy sounds as I missed my puppy dog so much. It was like she was staying with me."

F16: Sonic Straws' sounds were part of the gift-giving when making a drink for someone. Four participants performed the act of giving particular sounds to others. Rina conveyed one such event: "One day, I felt my roommate [Aiko] was frustrated. She told me she was struggling with her homework. She seemed a bit tired and down. That night, I secretly changed her sounds on the Sonic Straws. I felt I could give her a surprise." Aiko added: "It was so specific and a big surprise when I used it the next day. She used a cute cheering sound. It's kind of like she was telling me: 'You can do it!'. I felt much better at that moment." Similarly, Ethan told us: "I was a bit busy with my work at home. I had not tried the sounds as much as I wanted to, yet I enjoyed the sounds Jeannie selected for me. It was like a gift; you did not know when the sounds would be chang[ing]."

F17: Sonic Straws inspired a desire for further personalization. Interestingly, we found that Sonic Straws inspired a desire for further personalization beyond the sound. For example, Rina drew some doodles on the outside of the cup that she believed matched the sounds she had selected: "I found that I could do more around the cup. I sketched two doodles on the surface of the cup when I heard those sounds. I used a cat meowing and a puppy

barking, then I drew a kitty and a puppy to complete the story." Aiko said: "I wanted to explore more of Sonic Straws rather than just playing with sound, so I played with those straws a little bit. I used different lengths of straw and designed a connected straw."

F18: Sonic Straws prompted reflection on smart voice-based agents at home. Two participants reported that sensing errors with Sonic Straws promoted reflection on smart voice-based agents. In the system, the capacitance sensing can be influenced by strong electrical signals from devices such as a laptop, mobile phone or TV. Participants reported that the resultant sensing errors added personality to the cup. This was not negatively judged by the participants but, rather, described as a space for reflection on smart voice-based agents at home. Zoe explained: "Once, I forgot to reset the system after I refilled the water one night. I put it near my laptop on the desk, then I went back to work. After a while, it [Sonic Straws] started 'yelling'; that was surprising me. Then Roger walked through and looked at it, and then said: 'Stop yelling, stop yelling'." Roger laughed and explained how this resonated with his experiences with smart voice-based agent lik Siri and Alexa: "It was like a companion but also had its personality."

F19: Sonic Straws led to moments of silence. Although participants mostly had positive experiences with Sonic Straws, they also mentioned that using the Sonic Straws system sometimes resulted in awkward moments of silence when coordinating the drinking actions "wrongly". Four participants found such moments of silence occurring when they performed a very fast pace of sipping actions. For example, Mark said: "You need [to be] a little bit careful about sipping it [straw] with a fast sipping pace, especially when you were dehydrated and gulped down the water: the sounds would suddenly stop."

F20: Sonic Straws' audio quality could be improved. Participants also commented on the quality of the sounds. In particular, two participants reported that the quality of the generated sounds could be improved. Aiko said: "They sound like "mono". I would like richer notes when sipping." As we designed Sonic Straws as a portable stand-alone system, we focused on making the system small, including a microcontroller that is limited to playing a 16-bit WAV file at a sample rate of 22KHz. We also used a small speaker, which reduced the weight of the system but also reduced the sound quality.

8 DISCUSSION

The above findings contribute to existing playful gustosonic works by describing how a beverage-based playful gustosonic system can facilitate self-expression experiences, pleasurable social drinking moments and reflections on everyday drinking activity. We will further discuss the implications of these results for design research, and present practical insights for designing emerging technology for playful gustosonic experiences. In order to contextualize our discussion, we compare our results with prior works, particularly prior work on gustosonic experiences with ice cream, which also focused on playfulness [74, 75]. Fig 11 shows a comparison of findings between our work and related playful gustosonic works (*WeScream!* and *iScream!*).

The Sonic Straws study indicates that the technology in a beverage-based gustosonic system can afford a sense of open-endedness that gives the participants an opportunity to engage with playful eating/drinking interactions actively and realizes the personalized multisensory food/beverages experiences' potential. This in line with prior work that proposes openness in playful design can empower the user to find their own way of being playful [20]. This open-endedness of food-related technology adds value to the applicability of the gustosonic experience across diverse domains of multisensory food/beverages experience design. For example, we envisage that catering professionals, wanting to deliver engaging beverage experiences to clients, would find our insights useful. Theme parks might want to take playful gustosonic work to offer playful beverage experiences to their visitors, complementing drinks with theme park character sounds. Beverage brands might benefit from our insights when aiming to create unique drinking experiences. When considering the future of personalized

beverages marketing, the gustosonic experience may also be useful when designing experiences to match the customer's personal taste and musical preferences. The playful gustosonic experience might result in benefits known from immersive and playful features since the sounds can enhance or modify the multisensory eating and drinking experiences. Therefore, such playful multisensory eating/drinking experiences might not only benefit a customer's journey but also engage people with immersion in any specific food context.

Fig. 11. A comparison of findings between Sonic Straws and related playful gustosonic works.

Moreover, our research illustrates how participants reflect on their everyday drinking activity through continuously engaging with a playful gustosonic system with beverages (i.e. drinking water multiple times a day), compared to exiting gustosonic works that tend to focus on episodic gustosonic experiences where the participant eats a few scoops of ice cream occasionally. These insights from our work and related works [74, 75] raise important considerations designers should take into account when it comes to the temporality of playful gustosonic experiences. Prior work highlights that experientially driven technology can be studied through different temporal lenses: anticipation (before first use), momentary interaction (visceral response to use), episodic

experiences (reflection on an experience) and cumulative experiences (usage over multiple times) [58]. Moreover, Velasco et al. [70] have proposed that creating that, when it comes to multisensory experiences in HFI, it is worth looking at the consumer journey in three stages associated with given food, namely, pre-consumption, consumption and post-consumption. Inspired by these theoretical works, we argue that the playful gustosonic experience can be studied through at least three temporal stages: experiencing at the initial moment, engaging in the moment, and reflecting beyond the moment. Compared to prior gustosonic works, the Sonic Straws study shows the user's process of using the playful gustosonic system in three stages. For example, the first stage is concerned with our system being able to evoke the surprise by drinking with sounds at the initial moment to facilitate exploration of the system. The second stage is that participants customize personal playful gustosonic experiences through aligning sounds with taste of beverage preferences to have fun with drinking interactions in the moment. The final stage is about the Sonic Straws system being a reflection facilitator to promote the participants' reflection on their everyday drinking behaviors beyond the moment. Our work extends prior work in regard to sounds not only having the greatest influence on the eating/drinking experiences when played during tasting [73], but also potentially influence everyday habitual eating/drinking behaviors through experiencing drinking as play [50]. Furthermore, by considering the different moments of playful gustosonic experiences, designers may able to embrace interactive technology and specific sounds in either one of the moments or the whole journey when designing gustosonic experiences.

Furthermore, most participants reported that they mainly interacted with Sonic Straws at their home. Participants could create different playful eating interactions through personalized sounds in a spontaneous way. However, when thinking about the use of Sonic Straws in public spaces (food courts or bars), designers could also consider the content of sounds. Prior studies show that people do not like to use speech interaction to communicate in public spaces as the speech interaction might be misunderstood by bystanders [9]. In our study, although we utilized pleasant sounds as preset sound sources to facilitate pleasurable drinking experiences, any future design could find a way to avoid how unpleasant vocal sounds affect the participant' s drinking/eating experiences with others.

9 IMPLICATIONS FOR DESIGN

Based on the results of our in-the-wild study, and our craft knowledge of having designed the system, we present three implications for design. We present these implications in the form of practical design tactics, in the hope that they can provide designers with guidance when aiming to create playful beverage-based gustosonic experiences.

9.1 Support Personalization to Facilitate Self-expression via Drinking

Our first strategy recommends to designers to support personalization to facilitate self-expression via drinking. Self-expression has been previously described as a key element of playful experiences, articulated as "manifesting oneself creatively" [44]. In the Sonic Straws study, we allowed participants to use personalized sounds, which appeared to support their self-expression via playful drinking actions. Prior work highlighted that supporting personalization can facilitate self-expression and contribute to a positive experience with technology [67]. When our participants first interacted with Sonic Straws, it appeared that the preset sound surprised participants and stimulated their curiosity. Participants explored the system through normal drinking actions (sipping via one of the straws). The sound generated by these drinking actions gradually raised participants' awareness of how to play sounds via drinking. The experience that began with initial "regular" drinking, resulted eventually in playful sounds that facilitated a lusory attitude [66] . This attitude, itself a key driver for immersion of pervasive play [31], was important as it seemed to motivate participants to explore the system further. They actively explored the playful potential of the system by incorporating their own sounds. These personalized sounds were aligned with different everyday contexts in which the beverages were consumed, with some consideration of

participants' emotions, past personal experiences, and their own and their partner's drink and sound preferences. Participants mapped their personal drinking styles with their personal tastes for certain sounds and beverages. As such, participants viscerally and emotionally engaged with playful drinking activities to express themselves: through the mapping between the sounds they chose (and played) and the beverages they selected. In contrast with prior playful gustosonic work around iScream [75], we found that this personalization here was able to offer more space for self-expression compared to iScream's customization. In the iScream project, participants ate ice cream and only experienced playful sounds selected by the designers, which limited self-expression opportunities. The customized sounds mainly prompted participants to modify their eating behaviors to explore different sounds. The participants would pay more attention to their eating actions to play with sounds until the ice cream had finished. Our research extends this prior work by highlighting that the beverage-based system can facilitate playful experiences by supporting players to express themselves through the ability to generate novel personalized mappings between pervasive play elements and everyday actions. As such, to facilitate participant experiences of drinking as pervasive play in everyday life, we recommend to designers to support personalization to facilitate self-expression via drinking.

9.2 Employ Amplified Playful Sounds to Expand the Social "Magic Circle of Play" to Facilitate Shared Playful Gustosonic Experiences

Our second strategy recommends to designers to use amplified playful sounds to expand the social "magic circle of play" to facilitate shared playful gustosonic experiences. The metaphorical "magic circle of play" depicts the space in which the normal rules and the real world are suspended and replaced by the artificial reality of a game world [59]. Pervasive play can blur the line between the magic circle of play and everyday life by expanding social boundaries of traditional digital games through pervasive computing [49]. Here, we extend this theory by demonstrating that the social "magic circle of play" can be expanded by a playful gustosonic system that amplifies playful sounds (chosen by participants) that lead to various social interactions with bystanders. Prior gustosonic work has demonstrated that playful social gustosonic experiences can facilitate positive social interactions between two participants through coordinated co-located eating [74], albeit, in this earlier work, the "magic circle" boundary was limited and contained only two players and their coordinated eating interactions. In contrast, the amplified sounds produced by our Sonic Straws system expanded the social "magic circle of play" to encompass more than two participants: when participants drank beverages using Sonic Straws, others heard the sounds (especially through the in-built amplifier and larger speaker), which would not usually be the case when somebody is making drinking noises with a conventional cup. This effect facilitated social interaction; that is, the augmented sounds generated interest among others about what the participants were drinking and encouraged those others to join in and share beverages. When deploying Sonic Straws in a social setting where the sound can be heard and interpreted by other household members in the co-located environment, the other household members might have different interpretations of the sound because of different cognitive processes of the perception of acoustic phenomena [19]. These differences might promote social connections and continuous engagement. Interestingly, although our participants might had different interpretations, Sonic Straws appeared to increase their awareness of their partner's moods and motivated them to care for each other. Furthermore, Sonic Straws facilitated laughter in response to (mis-)coordination when participants tried to harmonize their sounds and encouraged discussion among additional household members. As such, we recommend to designers to employ amplified playful sounds to expand the social "magic circle of play" to facilitate shared playful gustosonic experiences.

9.3 Reframe Drinking Actions as Play to Facilitate Reflection on Everyday Drinking Activities

Our third strategy recommends to designers to consider reframing drinking actions as play to facilitate reflection on everyday drinking activities. Sonic Straws integrated with the players' everyday life because of the pervasive nature of drinking activities (especially water), and, in turn this integration facilitated participants' reflection on their everyday drinking activities. Drinking is an essential daily activity for everyone, regardless of age, gender, race and cultural background [14]. As a pleasurable, augmented, multisensory experience, Sonic Straws appeared to integrate with everyday life and this integration seemed to reframe everyday drinking activity as play [29, 50]. This outcome contrasts with many other pervasive play experiences, which are specific to a particular context or targeted at a particular user group and, while they might pervade everyday life [45, 49], do not integrate with it. In contrast, every time the Sonic Straws user drank a beverage, they engaged with the system, giving rise to an opportunity to explore the playfulness of the system and be playful, facilitating a reflection on their drinking experiences. Such an integrated experience is in line with the prior theory of "unselfconscious interaction" [71], which describes "a form of interaction facilitated by ongoing and incremental intersection with interaction design artifacts that over time and even unknowingly lead to improvements in everyday settings". While prior research in this area has mostly focused on instrumental improvements [37], our work extends the theory of unselfconscious interaction by highlighting a design artifact's potential to also facilitate experiential improvements. Sonic Straws also speaks to prior research around interaction design for reflection, which suggests that we integrate reflection facilitators with everyday life to better support everyday self-reflection [47]. Acknowledging that reflection requires time [22], we argue that integrating opportunities for reflection through gustosonic experiences offers an opportunity to unobtrusively encourage reflection [48]. In this respect, a gustosonic system can reframe drinking actions as play by allowing participants to engage with drinking activities through play design, rather than through the creation of, for example, a completely new game. Therefore, we recommend to designers to consider reframing drinking actions as play to facilitate reflection on everyday drinking activities.

10 LIMITATIONS AND FUTURE WORK

We acknowledge that our work is not a comprehensive investigation into playful beverage-based gustosonic experiences but, rather, that it can serve as a springboard for further exploration. Future work could explore how different stakeholders experience beverage-based gustosonic systems outside domestic settings. We acknowledge that participants might consume alcohol or over-consume sugary beverages while using our system and we encourage future work to understand these risks. In this respect, we note that we recommended that our participants drank non-alcoholic drinks. We also acknowledge that our participants' reactions to the sounds were based upon their cultural understandings of these sounds. Longitudinal studies in different geographical locations and cultures might unveil additional insights in terms of cultural experiences and provide a more complete understanding of gustosonic experiences. Furthermore, although our work suggests that playful gustosonic experiences carry potential to encourage healthy drinking behaviors, this research did not further investigate the project's impact on health and well-being. We also acknowledge that our participants' experiences might have been influenced by their pre-existing interest in novel technology. We would consider interviewing participants with a more varied interest (including dis-interest) in novel technologies in future work. Nevertheless, despite the aforementioned limitations, we believe that our work contributes useful initial knowledge.

11 CONCLUSION

This paper has explored playful beverage-based gustosonic experiences through a novel system called Sonic Straws. Through our work, we have highlighted that drinking beverages with our gustosonic system can facilitate enriched experiences. Our work makes four contributions: first, a contribution to design practice via the Sonic Straws beverage-based gustosonic systems; second, the articulation of the results of an in-the-wild study, which

shows that our system facilitated novel, pleasurable drinking experiences; third, the use of inductive thematic approach to analysis to develop three design themes to help researchers understand playful beverage-based gustosonic system user experiences; and, fourth, the presentation of implications for interaction designers who aim to create future gustosonic systems. We focused on understanding how the design of a playful gustosonic system can facilitate pleasurable experiences in everyday life, hence we did not aim to change any drinking behaviors or address specific health concerns. However, we believe our work may inspire and guide designers to explore the role that gustosonic interactions can play in facilitating positive eating/drinking behavior change interventions. Overall, we believe our work can be helpful for designers and researchers as they investigate and design interactive technologies around food and drinks. Ultimately, with our work, we aim to enrich our understanding of the design of a positive future for everyday eating and drinking experiences through playful design.

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