

# WeScream!: Toward Understanding the Design of Playful Social Gustosonic Experiences with Ice Cream

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## ABSTRACT

Prior psychology studies have shown that eating ice cream increases happiness, while human–computer interaction work has shown that interactive technology can enrich the eating experience. We explore the opportunity to combine these two through WeScream!, a playful social gustosonic system we designed—*social gustosonic* referring to the link between the acts of eating and listening as part of a social multisensory experience. WeScream! consists of two interdependent ice cream cones that allow users to interact with musical sounds generated through the act of eating ice cream together. We report on an in-the-wild study that highlights how our system facilitated a “hard fun” experience through eating together, increased participants’ awareness of relatedness, and drew shared attention to the ice cream’s taste via increased face-to-face interaction. Drawing on these study insights, we also present three design tactics to guide designers in designing future social gustosonic experiences. Ultimately, we aim to contribute to a playful future of social eating experiences, supporting people in enjoying eating together.

## Author Keywords

Food play; Sound; Human-Food Interaction; Gustosonic experiences; Social eating

## CCS Concepts

•**Human-centered computing** → **Ubiquitous and mobile computing design and evaluation methods**; *Interaction design*;

## INTRODUCTION

Eating is a social activity of everyday life [21] with the resulting pleasures constituting some of “life’s most enjoyable ex-

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Figure 1. Two players experience WeScream! together.

periences” [11]. Drawing from this, researchers have explored the use of eating activities as positive psychology interventions to increase everyday happiness and well-being [37]. Studies have also shown that people who engage in social eating feel happier and are more satisfied with life [21, 54]. We find this intriguing and note that interactive technology is increasingly entering the eating space. For example, we often see a person focusing on a smartphone in one hand while eating with a utensil in the other [54]. This affects not only how people eat, but also the social interactions within the eating context [29, 54]. Most research regards this invasion of technology into the eating space as undesirable for the eating experience [46]; however, we agree with Grimes et al. who have previously proposed that technology can also embrace the “pleasurable aspects of eating experiences and eating as a social experience” if designed well [23]. We respond to this and also the call by Bertran et al. who asked for more work in the human-food interactions (HFI) field to support the experiential aspects of social eating, rather than a focus on technology that supports instrumental purposes for individuals [2]. *Playful eating* for us refers to a mindset where people pursue the often rather mundane activity of eating with an enthusiastic and in-the-moment

attitude [16]. We also respond to prior studies that have called for more playful approaches to enrich eating experiences. For example, Bertran and Wilde [3, 68] called for more work that enriches the playful aspects of the dining experience. Similarly, Chisik et al. [14] called for more “gastroludical” design work where physical sensations associated with eating combined with digital technology create new ways to play with food as a way to enrich our everyday eating activities. Furthermore, Mueller et al. [43] called for more design work to support eating as a form of interactive play. We respond to these calls for more work on playful food interactions that consider the social context through our focus on the design of playful social gustosonic experiences around ice cream, where *gustosonic* [60] refers to the link between the acts of eating and listening as part of a multisensory experience.

We present a playful social gustosonic system called “*WeScream!*”. *WeScream!* consists of two interdependent capacitive-sensing ice cream cones that allow users to interact with musical sounds generated via the act of eating ice cream together. *WeScream!* offers open-ended gameplay where players can freely perform any eating action and explore how to play music or create a steady flow of sounds through eating ice cream together (Figure 1). We conducted an in-the-wild [50] study of *WeScream!* with 10 participants to gather qualitative data to understand the user experience.

Our work makes the following contributions: 1) Through presenting *WeScream!*, we introduce the opportunity to support social eating interactions through the design of playful gustosonic experiences. 2) We contribute a conceptual understanding of the interrelationship between sounds and social eating by presenting the results from a study of participants experiencing our gustosonic system in-the-wild, helping researchers understand playful social gustosonic experiences. 3) We also articulate three design strategies to guide practitioners when aiming to develop future playful social gustosonic experiences. Our work can help not only game designers to develop playful experiences around food, but also food designers and chefs who are interested in incorporating interactive technology into their practice.

## RELATED WORK

In this section, we detail what we have learned from prior work around technology-supported social eating, playful eating experiences, and sound as a playful design resource.

### Technology-supported social eating

Eating together is an important social activity that supports positive interactions [55]. Building on this, prior human-computer interaction (HCI) work has explored how interactive technology can enrich the social eating experience [19, 66, 20]. For example, Barden et al. developed a distributed dinner system to enable a sense of “togetherness” and “playfulness” through eating together [9]. Similarly, CoDine [67] developed a connected dining table to enable social eating experiences for remote family members. Nawahdah et al. [45] designed *Kizuna*, a tele-dining system to enrich dinners’ social interactions and increase “enjoyment” between a local and a remote person through eating. Moreover, Choe et al. [15] investigated

a Korean livestream phenomenon called *Mukbang* where a host eats alone while interacting with viewers over the Internet. Anjani et al. [4] explored technology-supported eating with others for remote social eating through synchronized *Mukbang* streaming. We learned from these studies that interactive technology can enrich social eating experiences; however, these works mostly focused on supporting instrumental aspects of eating for distributed dinners. To promote people eating together, a few studies have focused on celebratory technology for people physically eating together. For example, Ferdous et al. created *TableTalk* and *Chorus*, which transform personal screens into a shared communal display on the dining table to enrich social eating for co-located diners [19, 20]. Similarly, Nabil et al. developed *ActuEating*, a dining table which changes shape and color in response to diners’ actions in order to enrich the social eating experience [44]. Moreover, Mitchell et al. designed *Keep Up With Me*, an augmented dining table that draws on the synchrony that can often occur between diners through raising and lowering the bowls of two diners simultaneously [42]. Inspired by these studies, we aim to enrich experiential aspects of social eating; in particular, we focus on designing playful eating experiences for people who are physically co-located.

### Playful social eating experiences

Although one can play and eat alone, we have been guided by the fact that both eating and play have strong social connotations [54, 55]. We note that using interactive technology to enrich a playful social eating experience is not new and the play-focused HCI community has especially contributed here. For example, Arnold et al. developed a virtual reality (VR) game that uses eating as a way to facilitate social game play between one player eating and the other feeding them [6]. Similarly, Mehta et al. designed an augmented eating system called *Arm-A-Dine* [39] that uses wearable robotic arms attached to players’ bodies to enrich the often playful feeding actions that occur between diners. Moreover, there is the art project *Pixelate*, which was inspired by *Guitar Hero*, where players compete to consume the most fruit in the correct order within one minute [31]. The focus here is on demonstrating a playful way to encourage people to eat more healthy foods. We learned from these studies that interactive technology can enrich playful social eating experiences and our work proposes that sound is an underexplored element during the experience of eating; it plays a key role in our design for playful eating.

### Sound as a playful design resource

We focus on sound in our exploration as it is a common design resource for enriching both social and playful experiences [25, 26]. For example, Tolmie et al. [59] inspired us to consider Irish music sessions where musicians gather together to play in pubs. One player starts off playing a specific tune (e.g. G major and D major) with other musicians joining in the sessions. These sessions not only allow a number of musicians to collaborate in playing music, but also engage people in social interactions in the pub setting. When it comes to sound related eating experiences in HCI, existing studies have also guided our work. For example, *Chewing Jockey* [30] enriches playful eating experiences by playing cartoon

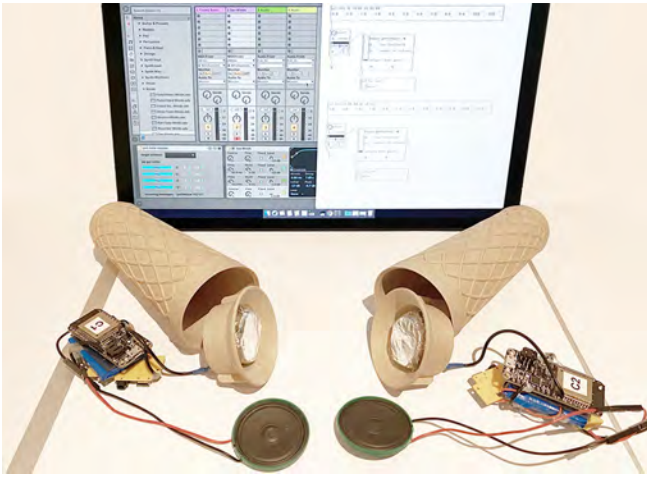


Figure 2. The WeScream! system contains two capacitive-sensing cones.

sounds when chewing gummy sweets. Similarly, Polotti et al. designed a sonically augmented dining table called Gamelunch that allows people to experience continuous sound feedback while having lunch [47]. Wang et al. designed an ice cream cone [63] that randomly plays four different sounds through eating to offer a playful eating experience. Similarly, the artist Baltz designed Lickestra [8], a musical art performance where performers improvise various baselines and tones through licking actions. These works show that sound can be a playful design resource, even within an eating experience; however, they are mostly designed for an individual or as part of an art performance. Our research extends these prior studies through an empirical investigation into the user experience of a playful social eating system as engaged with through multiple users in-the-wild [50].

We have also noted that the role of sound during eating is generally under-appreciated. Research on the relationship between sound and eating has emerged in recent years [52, 57]. What people hear during eating affects their enjoyment of food, and hence the overall experience [28, 27]. This can be altered by technology; for example, even if an actual food texture is soft, people can perceive the food as crunchy through the addition of crunchy sounds. Similarly, people perceive red wine as heavier when hearing “powerful” sounds [58] and the sweetness of cinder toffee is increased with high-pitched sounds [17]. Crisinel et al. demonstrated that sweet tastes are associated with the sound of woodwind instruments, while bitter tastes are associated with brassy instruments [18]. We learned from these works that sound as a design resource goes well together with food; however, the prior studies have focused more on measuring the effects of particular sound stimuli on specific taste perceptions than on the associated user experiences. As such, we identified a gap in understanding the experience of technologically enriched eating and, in particular, sound as a design resource to enrich social eating experiences through a focus on the playful aspect of eating. In order to close this gap, we aim to answer the **research question**: how do we design playful social gustosonic eating experiences?

## WESCREAM!

WeScream! is a two-player system offering users the opportunity to generate musical sounds while eating ice cream. The name *WeScream!* is inspired by the popular 1927 song “I scream, you scream, we all scream for ice cream”. *WeScream!* extends our previous iScream! project [64]. Building upon the iScream! prototype, we improved the wireless connectivity for a cone-to-cone communication. The WeScream! system comprises of two capacitive-sensing cones. Each cone has a miniature speaker inside and a more powerful battery that allows for longer use. We integrated a Bluetooth speaker into the cone, which enables localized sound to come from the ice cream cone. Each participant holds one cone to create a musical phrase via licking or biting a regular off-the-shelf ice cream. To enrich the ice cream eating experiences, we 3D-printed each ice cream cone using a light wood filament to mimic the look and feel of a regular ice cream waffle cone (Figure 2). The cone contains a microcontroller board (“Huzzah32 feather”) [5] and a Bluetooth speaker board (Journey Mini Bluetooth speaker) paired with a speaker. The ice cream is “connected” to the microcontroller board via a concealed piece of removable food-safe aluminium foil. The microcontroller sends the capacitive data wirelessly to our Pure Data program [48], which maps the normalized capacitance data to a major pentatonic musical scale. We also set up automatic calibration of the sensing data to support sensing different types of ice cream. Then, the Pure Data program outputs musical notes to Ableton Live [1] via Open Sound Control (OSC) that generates a piece of a melody played back through the Bluetooth speaker. We customized a MIDI interface in Ableton Live to control two different instruments that strongly differentiate the two cones. We set up a collaborative way to play with sounds by adding a chords effect in one of the sound patches to make the final sound output on top of each other. We also suggested that players try different instruments as offered through the instrument library of Ableton Live with our system during playing.

## DESIGN PROCESS

Existing studies in psychology show that everyday eating activities, in particular consuming specific “mood foods,” can provide an everyday source of happiness for most people [34]. For example, researchers have compared the effects of ice cream consumption on mood with moods resulting from consuming yoghurt and chocolate [62]. The results indicate that eating ice cream is a pleasurable experience satisfying both psychological and physiological needs that more necessary foods may not necessarily meet and provides people with positive emotions from moderate consumption [37]. Furthermore, although the general belief is that ice cream is an unhealthy food [13], we noted that the ice cream can be used as an effective vehicle to deliver nutrition to older people because of the dynamic texture and melting creamy mouthfeel [56]. At the same time, eating ice cream can also be associated with a positive social activity [56]. These studies motivated our approach to investigate the experience of eating ice cream. As such, we believe that designing a playful gustosonic system with ice cream can facilitate engagement with an everyday source of happiness.



Figure 3. Participants had a great time experiencing WeScream!, talking and laughing in the pilot study.

To design WeScream!, we conducted three group discussions following a co-creation approach [51] to help refine our design choices and to gather diverse insights into how two people eat ice cream together with sound. The group discussion sessions included seven experts with diverse academic backgrounds: four interaction designers (two from HCI and two from HFI), one industry designer, and two sound designers. The aim of the first group discussion session was to identify different possible social eating interaction patterns and decide on the technical feasibility. We discussed the ways that two people eat ice cream together. We found that people seldom share one ice cream if they are eating ice cream in a waffle cone. However, people like to eat ice cream together as a social activity [53]. Therefore, a desirable design space appeared to be the design of playful ice cream eating experiences together with sounds for social bonding.

The focus of the second group discussion session was on designing a sound system for eating together. The idea was to build a sound system that can support two interdependent ice cream cones at the same time. Two sound designers helped us in creating a possible sound system. For the first iteration, we discussed three possible sound-composing patterns that included two single notes with consonance, a major pentatonic musical scale with different instruments, and overlapping composed sounds created by professional composers followed by a synaesthetic approach [40]. The last group discussion session focused on envisioning and evaluating potential interactions based on the PLEX cards [36]; for example, what forms of play can be facilitated by eating physically together.

### Designing a sound system for collaborative eating

We started by exploring the literature and took into account findings from earlier studies [10, 25, 69] to identify possible sounds while eating ice cream. Each biting or licking ice cream action is usually around 0.5 to 0.9 seconds long. The consumption time for a regular one-scoop ice cream portion is about 5 to 10 minutes on average [63]. To design a playful social experience, the main challenge for the sound design of our system was that each player's sound should work musically with the other's. As a result, we decided that the generated sounds should be a short musical phrase. We first set up two distinct instruments with a single note in Ableton Live for each cone (i.e. grand piano and wind instrument) to have strongly differentiated sounds. Then, we observed people's

initial experiences in the pilot study. We found that players could play a melody on top of each other based on a similar eating speed, while the sound seemed to turn into "chaos" if the eating speed was very different. Nevertheless, we were encouraged to find that even generating a simple note through eating ice cream appeared to make the overall eating experience much more engaging than eating ice cream in the regular way. The simplicity of a single note appeared to cause people to stay engaged. However, we acknowledge that this could be because the participants were using the system for the first time. Our intention is to support also repeated engagement with our system. We therefore attempted to work with richer sound elements. We mapped the normalized capacitance data to a major pentatonic musical scale to generate continuous sounds, rather than a discrete sound (Figure 4). When the player performs a lick-on and lick-off action, the system triggers different tones along a major pentatonic musical scale. Inspired by piano-based play [41], we also set up a chord effect in one of the sound patches to support a collaborative way of playing. As result, the overall melody was like a piece of high-pitched, consonant, and legato sound. WeScream! offers open-ended game play. Players can freely perform any eating actions and explore how to play music or create a steady flow of sounds through eating ice cream together. Players can also design various game plays around the system. For example, players might implement a set of rules to determine the eating order and eating actions (Figure 4).

### Pilot study

The final stage of our exploratory design process was to conduct a pilot study (Figure 3) with users to settle on a sound system and to make sure that technical aspects of the WeScream! system were working as intended for the in-the-wild [50] study. We invited three pairs of participants to participate in a series of trials, each lasting 30 minutes, including playing WeScream! with two sound systems each and a short exit interview. Participants could freely perform any eating actions. We noted their facial expressions and eating actions. We acknowledge that ice cream is a calorie-laden food, and its consumption could cause weight gain [65]. In our study, we suggested that players limit themselves to one scoop each time while eating ice cream together. The participants were free to refill the ice cream cone during the study. We observed that participants clearly understood our physical intention with the system - *"I like the feel of this cone, it looks like a real*

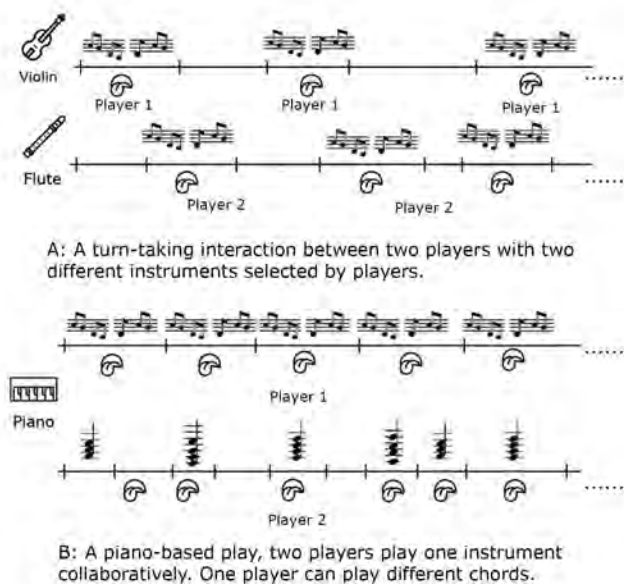


Figure 4. The potential interactions in WeScream!

waffle cone,” - and we noted how *WeScream!* enriched their enjoyment: “It is cool. We can produce sounds together by eating ice cream together.” In terms of the design with two sound systems, participants commented: “The musical scale one is more interesting than the single note because it produces continuous sounds via licking once.” We also noted that participants were able to improvise music based on some rules; for example, one said: “We decided the eating order and tried to keep the same pace of eating. It adds more tension during eating.”

### WESCREAM! IN ACTION

We conducted an in-the-wild study [50] with five pairs (3 males and 7 females, age  $26 \pm 1.8$  (mean  $\pm$  S.D.) years) to investigate their experiences with *WeScream!*. The players in each pair knew each other before the study. The recruitment followed a combination of snowballing method and convenience sampling. We told participants that they could use the system any time they wanted for one week. Table 1 provides the demographic details of each pair (gender, age) along with their relationship. Four participants were fond of ice cream, while the others were neutral. Nine participants were non-musicians and one participant had musical training experiences.

We first conducted a pre-study interview where we checked whether participants were allergic to ice cream. Each pair received a kit containing two 3D-printed cones, one Wi-Fi router, several pieces of food-safe aluminium foil, and a MacBook Pro running the core sound software to take home. To mimic the real eating experiences, we suggested that users to put an off-the-shelf plain waffle cup into the cone before placing ice cream into the device. Participants were given AUD 20 to buy off-the-shelf ice cream of their choice for the study. We also provided sanitizer wipes and napkins to clean the cones and



Figure 5. Each pair of participants received a kit containing the *WeScream!* system.



Figure 6. The preparation process: (a) disinfected cone; (b) placing the aluminium foil; (c) serving the ice cream

spilled ice cream (Figure 5). No other financial compensation was provided. We spent around 30 minutes explaining the study procedure and performed a demonstration of how to use the system. We also provided each participant with written instructions on how to set up the system and how to clean the cones after using it. We maintained contact with participants through emails and phone calls in case they needed any technical support. We asked the participants to engage with *WeScream!* a minimum of five times in one week simultaneously with their partner. We also suggested that players limit themselves to one scoop each time when eating ice cream together. On average, participants used the system once a day, most often after mealtimes, for approximately 10 minutes.

Participant performed the following tasks while using *WeScream!*:

1. Setup Phase. Participants switched on the cone before using it, put a piece of food-safe aluminium foil and a plain waffle cup on the top of the device, then placed one scoop of ice cream on the top of the plain waffle cone. Figure 6 shows the three-step setup phase.
2. Use Phase. Participants began by clicking a button to reset the sensing data in the Pure Data program and chose their preferred instrument in the Ableton live. The participants then ate ice cream. The program would generate a piece of a melody while participants ate ice cream collaboratively.

**Table 1. Participants' details (names changed) along with their relationship.**

P1	Evian (M,30)	Suki (F,25)	Partners
P2	Amber (F,24)	Emma (F,25)	Roommate
P3	Ben (M,27)	Hanna (F,26)	Partners
P4	Skyla (F, 25)	Rina (F,23)	Roommate
P5	Richard (M, 27)	Zoey (F, 25)	Partners

- Clean Phase. Participants disposed the piece of aluminium foil, as it was for one-time use, and disinfected the disconnected parts of the cone with sanitizer wipes.

## DATA SOURCES AND ANALYSIS

The main source of data was the interview conducted at the end of the study, which went for about 30 to 45 minutes per pair. We used a semi-structured interview approach to leave sufficient room for topics to support deeper elucidation of participants' responses and thinking processes [35]. During each interview, we took notes and audio recordings, which were later transcribed for future analysis. We listed questions related to the research aims that helped us to remain on track, while leaving sufficient flexibility in the discussion. The questions revolved around the motivations, expectations, and experiences of using WeScream!, such as: when they used the system, what kinds of instrument they picked, how this affected the experience, as well as observations or insights they had regarding their own or their partner's eating behaviors, and any interesting stories that came out of using the *WeScream!* together. We also gathered feedback on the system's design, collaborative interactions, and usage scenarios. Additionally, we welcomed opportunities to view any photographs or recordings of their interactions with WeScream! that participants captured during the study; this additional data helped us to investigate how users reacted to and integrated WeScream! into their everyday life.

We utilized the inductive thematic analysis [6] to analyze the collected data. The semi-structured interviews were transcribed using NVivo. Each question and its answer by each pair of participants were put together and considered as one unit of data. In total, there were 382 units of data included in the analysis. We read all units several times to create code labels. These codes helped to identify the most interesting features of the data units in order to group them together. In the first-round iteration of the thematic analysis we developed 40 labels, for example "Understanding the device," "Real-time sounds," "Collaboration," or "Eating actions." In the second round, we discussed the 40 labels and re-examined them to merge similar codes into broader labels to reduce the complexity. The remaining codes were refined and merged into previous labels with the help of two senior researchers. Finally, we decreased the number of codes to 13. Our analysis resulted in three themes that unpack the overall experience: playful social gustosonic experiences supported coordinated eating actions; improvised sounds facilitated shared attention to food; and awareness of relatedness increased through experiencing WeScream!.

## FINDINGS

Our analysis resulted in three themes that detail how the playful social gustosonic experience supported coordinated eating actions, improvised sounds facilitated shared attention to food, and WeScream! increased awareness of relatedness. We then used these themes to articulate three design tactics for designers aiming to create playful social gustosonic experiences.

### Theme 1: Playful social gustosonic experiences supported coordinated eating actions

This theme describes how playing with ice cream through sound supported coordinated eating actions. Consuming ice cream in different ways became a reward to support challenges, competition, and collaboration, and variations of sound facilitated coordinated eating actions.

#### *WeScream! offered challenging yet enjoyable experiences*

Participants told us that they enjoyed the fact that playing sounds and eating ice cream were not separated but connected. Participants also appreciated the distinct sounds from the two cones, allowing them to explore variations of sound through eating together, such as timbre, intensity, and rhythm. Although they struggled to control the sounds well at the beginning, they discussed their experiences and came up with a set of eating rules to create more pleasing compositions. Ben said: "*She [Hanna] suggested we should eat slower with small portions of ice cream each time, then we can create a stable piece of melody.*" All participants liked how eating ice cream allowed them to create sounds together. However, they also said that collaborative interactions with sounds through eating ice cream was difficult. Six participants found it challenging that they could not collaborate as well as they wanted to with their friends or partners. For example, Amber said: "*I think I need to practice my eating skills to produce a good melody. I was hoping that I could interact with the ice cream through my hands, like playing a guitar.*" Rina thought that adding an LED light as a metronome could help them produce a piece of highly rhythmical music. She said: "*If there is a light in the cone as a metronome, that would be great, we can perform a better rhythmic melody.*"

#### *WeScream! supported coordinated eating actions through multiple strategies*

Although controlling sounds well was, for the first time, difficult for most participants. WeScream! offered an enjoyable experience when the participants overcame this difficulty. For example, Emma said: "*Eating with another person and playing some sounds together was fun. This thing I haven't experienced before.*" The success of collaboration depended on the proper synchronization of eating between two players; as Emma explained: "*In the beginning, it was frustrating to play some noise. We stopped and gazed [at] each other. I feel like we got the same ideas without any talk, then we were biting ice cream at the same time.*" Amber also agreed that the playing sounds collaboratively depended on effective communication. She said: "*Eating was like playing a game, but with more fun. We also got to think about strategies, like who will be the first eater and then who will play the main sounds.*" Ben and Hanna said that they tried different eating actions, such as changing their eating pace, extending their licking time, and

consuming larger portions of ice cream. Ben reported that he figured out how his eating pattern could generate a similar melody to what he was able to achieve before. Hanna added: *“We figured out how to create legato melodies through eating with this [WeScream!]. For example, I can ‘quick lick’ two times and not release for three to five seconds, then he [Ben] should lick small portions of ice cream and lick slightly.”*

#### *Participants enjoyed a slow eating pace through competition*

Our system drove an eating competition between three pairs of participants. Richard and Zoey competed with each other in terms of who could generate a more listenable melody through licking or biting actions. Richard said: *“We found the eating pace should be very slow, to control the sounds better. On Saturday afternoon, we started with her [Zoey] first, and she generated a piece of soft and legato melody with a grand piano instrument. Then I tried to eat slower than her, to add some chords on the top of each other. We came to appreciate how to play intricate and listenable music together through eating ice cream. It was a wonderful moment. So, we started laughing.”* Zoey added: *“It was like a competition but to compete who is the slowest.”*

#### *Participants modified sound sources to increase enjoyment*

Participants enjoyed generating new sounds with different instruments and eating different kinds of ice cream as part of that. Evian said: *“I am looking forward to playing something new each time. I feel sometimes we are playing an instrument together and sometimes we are like a band. We tried to create similar sounds like yesterday, but we cannot do that again.”* Suki added: *“If I have plain ice cream as usual, I would already know nothing will come through. It was exciting to try different instruments everyday while eating ice cream.”* Richard and Zoey also reported that they were able to correlate sounds that they had generated the previous day, which in turn encouraged them to try to create new sounds through adding sounds effects in our system.

### **Theme 2: Improvised sounds facilitate shared attention to food**

This theme depicts how improvised sounds facilitated shared attention to food.

#### *WeScream! prompted attention to each other's eating behaviors*

Players reported that WeScream! made them pay more attention to each other's eating behaviours. For example, Suki said: *“It was interesting to notice his [Evian's] eating behaviors during playing. When I have dinner with friends, I have never noticed others' eating behaviors, because we are in a conversation.”* Building on this, Richard said: *“It made me think about how I was eating ice cream with my friends and how they think about my eating actions. I usually eat food fast, but when we eat ice cream together with sounds, I have to slow down to collaborate with my partner.”* In particular, participants' eating behaviors were influenced by their sound collaboration. For example, five participants said that they paid attention to their eating speed. They found that if they kept their eating speed as usual, they could not get a “listenable” melody. To better collaborate with their partners, they

therefore ate the ice cream more slowly. Evian said: *“It was challenging to slow the eating pace at first, but I decided to cooperate with my partner [Suki] to have fun together rather than finishing an ice cream.”* Ben also said: *“I did not know how fast I eat ice cream before this study, or how slowly my partner [Hanna] eats. But we try to synchronize our eating pace and licking actions, creating rhythmical sounds during playing.”*

#### *Ambiguity of sounds led to focus on food*

Six participants reported that a delay in the sound as a result of technical problems with the feedback added a welcoming surprise. Our system sends data from the ice cream via Wi-Fi to a laptop, then outputs the sounds through two Bluetooth speakers simultaneously. These two signals can influence each other sometimes. This situation was perceived as a surprise, which added ambiguity to the experience. This was not negatively judged by the participants, but rather they described it as a space for reflection on the relationship between their eating actions and the ice cream. As a result, it appears this ambiguity brought participants' attention back to their food. For example, Suki said: *“Given the system was suddenly mute, I paid more attention to my ice cream.”* Similarly, Zoey said: *“When it suddenly stopped, it was like a surprise, and we intuitively began to eat again, even touched the ice cream with our fingers.”* Richard added: *“The ambiguity of the mute time is an interesting thing. It made me think about our eating behaviors, and we gazed at each other's ice cream.”*

#### *WeScream! facilitated reminiscing about past social experiences*

Engaging with WeScream! appeared to facilitate participants reminiscing about their past social eating experiences. Participants said that the experience reminded them of the times when they had enjoyed ice cream with friends and they talked about their previous ice cream eating experiences. For example, Evian said: *“The experience reminded me of meeting with my best friend to eat ice cream together in a wonderful restaurant when she went to a university last year.”* Similarly, Skyla said: *“I enjoyed the experience a lot, especially the bit where we were playing sounds through eating together as it remained me of a classical digital drum game called Rock Fever which I played it a lot with my friends in grade nine.”*

### **Theme 3: Awareness of relatedness increased through experiencing WeScream! as an everyday source of happiness**

This theme describes how WeScream! was not just about eating a novelty ice cream but how it was a pleasurable experience towards an everyday source of happiness.

#### *Preparing WeScream! brought participants together*

Four participants reported how preparing the ice cream brought them together. Amber said: *“We started with plain vanilla flavor ice cream because we thought this was a study. But after creating [a] listenable melody together, we enjoyed having ice cream together. Emma and I thought we could go shopping together to get different flavors of ice cream as rewards for the next time.”* Participants also chose each other's favorite ice cream as a gift. Suki said: *“Since we found our ways to*

*play continuous music together, we felt 'success!'. And when I saw he [Evian] had brought some mocha flavor ice cream for playing next time, I felt happy and grateful and [was] looking forward to playing again."*

#### *WeScream! increased face-to-face communication*

WeScream! appeared to increase face-to-face communication while eating ice cream together. Four participants described explicitly that they usually sat on the couch and watched TV or played video games while eating ice cream together at home. They mentioned how there was rarely eye contact during eating, and the talking was mostly brief, with only a couple of words, since their attention was on the TV. However, they said that WeScream! brought their attention back to face-to-face communication. All participants reported how they enjoyed this as a result of discussing how to play sounds together and how to eat the ice cream. For example, Amber commented: *"It got us talking more, in particular, face-to-face communication, with each other. Although we are sharing a house, we have little conversation during mealtimes in our house. We even send messages via social media to chat with each other when staying in the same house."* Emma added: *"We discussed strategies face-to-face and reminded each other about each other's eating order through eye contact."*

#### *WeScream! was used for comfort and emotional support*

Interestingly, WeScream! motivated participants to give an ice cream to their partner. Zoey told us: *"One day, I felt my partner was unhappy when he got home. He said that his best friend would move abroad soon, which he felt a bit down about. I felt I could surprise him to help him reduce the bad mood. I set up the system [WeScream!] and picked up a bell instruments that sounds like giggling."* Richard was laughing and added: *"That was a big surprise, she fed me ice cream, then some sounds suddenly came out. We were laughing together, and I felt better at that moment."*

#### *WeScream! fostered intimacy in partnership*

Although all participants knew their partners before the study, six participants described that playing with sounds through eating ice cream with their partners fostered intimacy. Ben narrated a scenario to us: *"Sharing one ice cream with friends is a bit weird. However, we [Ben and Hanna] were spontaneously feeding each other with our ice cream during the study."* Hanna added: *"We also crossed our right arms with each other to eat ice cream with sounds collaboratively."*

#### *WeScream! facilitated reflection on social bonding*

Two participants sent messages to the first author after the end of the study. Before the study, Skyla and Rina has known each other for two weeks as Rina was Skyla's new roommate. Skyla said: *"We miss the ice cream cone, it was a good icebreaker. We remembered the enjoyable eating experience with each other and how we collaborated with playing the sound through eating. Now we cook together and share meals every day at home."* Rina added: *"It was more fun to generate sounds collaboratively, as it involves more connections with the other person when eating together."* Participants believed that eating with sounds could act as an icebreaker between strangers in a public place because it pushes people to interact with each other. Rina said: *"I am thinking of this as a good way of*

*interacting with others when eating alone in a food court on campus."*

## **DISCUSSION**

Based on the study insights, we reflect on our findings and discuss them in relation to prior work. Together with our craft knowledge gained from designing WeScream!, we present three design tactics relating to our findings. We hope our design tactics can provide designers with practical guidance when aiming to create social playful gustosonic experiences.

### **Support playing with sound rather than composing music to facilitate playful social gustosonic experiences**

Our study indicates that the ability to play with sounds can be an important factor in a coordinated eating interaction and relate to overall playful experiences. In order to facilitate collaborative interaction, our approach allows each player to control a musical scale via licking-on and licking-off actions. Our initial intention with WeScream! was to support players to compose rhythmic music. For example, the licking-on and licking-off actions would add a number of flute sounds on top of a background sound. However, due to the ephemeral character of ice cream, i.e. it changes its volume and texture with every bite and also melts, which results in different sensing signals, we noticed that it became quite difficult to collaboratively compose music as this required eating very precisely. Prior work has already highlighted that precision is an essential feature for composing rhythmic music in real-time [49]. To solve this problem, we changed the initial design of WeScream! to instead used one single note with a C major chord and a looped note repeating over time. The result was that the system offered an interesting way to play with sounds collaboratively, yet the interaction remained simple. However, participants from the pilot study reported that the collaborative interaction offered very few surprises, resulting in the outcome becoming monotonous. To address this, we altered the design again and this time, mapped the normalized capacitance data to a major pentatonic musical scale with different instruments and added a chord effect in one of the sound patches to enrich social play around sounds. Our study suggests that this approach was successful, with participants describing their activities as playing with sounds, rather than composing music. As such, we recommend that designers consider supporting to play with simple sounds with, for example, different timbres rather than to compose music to facilitate playful social gustosonic experiences. In particular, we highlight that designers should think about using basic sound parameters and the control of global sound qualities such as intensity and pitch. Employing such an approach has the additional advantage that the basic sound palette can be easily exchanged to suit different contexts; for example, some participants might like more bass and synthesizer sounds for a more electrical music-type experience.

### **Utilize ambiguity as a design resource to support savouring**

Ambiguity is usually considered as an undesirable quality in the field of HCI. However, Gaver et al. argued that ambiguity



can be a resource for design to encourage close personal engagements with an experience [22]. Prior work has suggested that adding an incongruous quality to original experiences can be useful in spurring people toward a particular experience [22, 61]. There were several aspects of ambiguity revealed through our study. We offered participants a “natural” ice cream eating experience that integrates well with sensing technology. To design playful eating experiences and technologies, Wilde et al. argued that technologies should support the actual eating activity, rather than disrupt it [68]. WeScream! stepped toward crafting an ice cream eating experiences by considering embodiment thinking to the field of multisensory perception. We 3D-printed a cone with a light wood filament to mimic the look and feel of a regular ice cream waffle cone. Adding sounds as an incongruous quality to a naturalistic ice cream eating experience created ambiguity for participants. Participants liked the tactile experience of the 3D-printed cone because it felt like a real waffle cone. This ambiguity of relationship evoked participants to pay attention to the ice cream during eating and facilitated a free-form exploration [7]. Participants also reported that they became aware of a delay glitch during playing with WeScream! but they did not know the exact cause. This imprecise sound feedback also allowed participants to reflect on each other’s eating behaviors and pay shared attention to the food.

The incongruous and imprecise features of the WeScream! system allowed people to experience savoring. *Savoring* refers to a focus of attention on the sensory input of consumption experiences [12], highlighting a “heightened awareness” that makes people “more fully conscious of the pleasurable things we see, hear, smell, touch, or taste.” With WeScream!, participants became aware of changing sounds through eating ice cream together and, as they started paying attention to each other’s eating behaviors, they appreciated playful social eating moments despite enduring struggles in controlling sounds. Therefore, we suggest that designers consider ambiguity as a design resource to support savoring around social eating scenarios. Moreover, this study indicates that ephemeral characteristics of an edible interface [38, 32] might be a design resource to facilitate reflections on savoring.

### **Design playful social gustosonic experiences as “hard fun”**

Our study has identified that playful social gustosonic experiences were not just about eating a novelty ice cream together. They appeared to also become “hard fun” experiences toward a playful engagement with social eating experiences. *Hard fun* is defined by Lazzaro [33] as the “rewarding process of mastering a challenge that involves the creating and testing of strategies and the application of effort.” The key to the enjoyment of “hard fun” is generating strategies and applying creativity and the development of skills. In our study, we found that participants enjoyed the challenges of creating sounds through coordinated eating. They relished putting in effort to pursue a sense of completing a piece of melody together. They quickly realized that their awareness of their differences in terms of eating behaviors was a valuable asset to enrich the sound-making experience. They then came up with strategies

and tested these out to achieve more listening pleasure. For example, participants discussed how to create a particular piece of music by having the more skilled player (i.e. the one whose eating speed was slower) trigger the main rhythmic chords for both players. Another example is where players discussed how they would try to lick as slowly as they could to generate a better melody than their partner, turning it into a competition. They also enjoyed the process of exploring how much better they could play with sounds through slowly licking with each repetition. Our findings also suggest that players often started the experience by engaging in similar, simultaneous eating actions as a way to collaborate with their partner. As such, participants explored strategies for being dependent on one another through their eating actions, challenging participants’ normal eating behaviors as a way to facilitate social eating experiences. Prior work has already suggested that designing interdependence in cooperative play can enhance players’ perceptions of connectedness and social engagement [24]. With WeScream!, when participants encountered failed cooperation, the negative experience also increased focus and concentration on the ice cream and potentially enhanced eating behaviors through coordinated eating interactions. Overall, we suggest that designers consider designing interdependent and open-ended gameplay to create competition or cooperation as hard fun supporting playful social eating experiences.

### **LIMITATIONS AND FUTURE WORK**

We acknowledge several limitations of our work. First, we only explored ice cream in our study. The investigation of other kinds of food might broaden our findings. Nevertheless, we believe our work can serve as a valuable starting point for future investigations with different food types. Second, we understand our work not as a complete investigation into the playful side of social gustosonic experiences, but rather that it could serve as a springboard for future explorations. We also hope that our approach can help future exploration how a sound-based playful approach can influence participants’ perceptions of different flavors. Third, although our study indicates the potential benefit of combining playfulness and coordination of gustosonic experience for healthy eating behaviors and well-being, this work did not further investigate the project’s impact on health. We situate our work in play research in order to fully understand the experiential perspective of gustosonic systems. We believe such an understanding can benefit and inspire future investigations on how playful eating could benefit the players across a range of domains, including health and well-being. Fourth, we recruited participants via a mix of convenience sampling and snowball sampling method. We might recruit all ages participants in the future. Future work could also explore how different stakeholders experience gustosonic systems in different places besides the home. This might result in a more complete understanding of social gustosonic experiences. Nevertheless, we believe that our work contributes initial knowledge to the design of playful social gustosonic experiences that can inform the design of future systems.

### **CONCLUSION**

This paper offers an initial understanding of the coming together of eating and social play through the design and study

of WeScream!. WeScream! is a two-player system offering users the opportunity to generate musical melodies while eating ice cream together. Through our work, we highlight that eating with sounds together with others can be an intriguing, playful gustosonic experience. Our key contribution is an understanding of the design of gustosonic systems to support social eating experiences. Along with the details of the design and implementation, we have also described the insights from our collected data. Through a thematic analysis approach, we have presented three themes that we hope can help researchers and designers who are interested in designing playful social interactions involving food and sounds.

To conclude, interactive technology has been increasingly considered when it comes to eating experiences, and we are excited about these developments and have hence presented initial knowledge about how designers can engage with this through a focus on playful social gustosonic experiences. We note that our goal is not to change any social eating norms or address specific health concerns in relation to eating, but rather we begin by focusing on how a system could and should be designed to support playful social eating experiences. To advance such knowledge, we invite more explorations into the design of playful gustosonic systems and provide designers with an initial understanding of how to begin such explorations. Ultimately, with our work, we aim to enrich our understanding of the design of future playful social eating experiences, supporting people in enjoying eating together.

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