Towards a Framework for Designing Playful Gustosonic Experiences

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Abstract
The notion of gustosonic refers to the link between eating actions and listening within a combined multisensory experience. When it comes to designing celebratory technology for eating, i.e. technology that celebrates the experiential and playful aspects of eating, the use of sound has been mostly underexplored. In this paper, we present our work based on two case studies for the design of playful gustosonic experiences. Through an analysis of user experiences of our work, we propose a design framework for designing playful gustosonic experiences to understand the interrelationship between interactive sounds and eating experiences. Ultimately, with our work, we aim to inspire designers in creating gustosonic experiences supporting a more playful relationship with food.

Author Keywords
Gustosonic; Sound; Human-Food Interaction; Play

Introduction
Interactive technology is increasingly entering the eating space, for example, we often see people holding cutlery in the one hand and their smartphone in the other while dining. Recent research sees this as a problem [24], but we believe that there is also an opportunity that interactive technology can offer positive benefits to the eating experience. However, prior work in the field of Human-Food
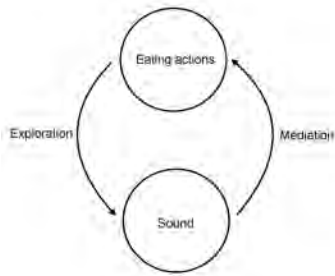
Figure 1: *iScream*'s interaction pattern that highlights an ongoing loop between eating actions exploring sounds and sounds mediating eating actions.

Interaction (HFI) seems often to focus on building corrective technology, that is technology that aims to fix people's eating problems or promote healthy eating behaviours. For example, technologies have been developed that aim to help people make the right food choice [29], improve eating habits [14], and balance daily nutrition [23]. In contrast, Grimes et al. [12] argue that we should also design more celebratory technologies that celebrate the experiential and in our case playful aspects of eating, after all play and eating are close interlinked and highlight for us what makes us human [6]. In particular, Bertran et al. [4, 3] suggested extending playfulness to the practice of chefs and food designers to enrich the experiential and playful aspects of the dining experience. Similarly, Chisik et al. [6] defined "gastroludical experiences" as those involving a combination of eating sensations and play activities via physical and/or virtual means that enrich our everyday eating activities. Moreover, Mueller et al. [21] suggested designing technology to support eating as a form of interactive play. Drawing inspiration from this, we begin by presenting a first conceptual understanding of the interrelationship between sounds and eating by showing the results from two studies of players experiencing our gustosonic system. The result could be a way to support a more positive relationship with food.

Prior research has demonstrated that sound plays a very critical role in our relationship with food than commonly assumed [26]. In response, research on the relationship between sound and eating has emerged in recent years [27]. For example, what we hear during eating affects our enjoyment of food and hence the overall experience [16, 15]. This relationship can be altered through technology, for example, even if an actual food texture is soft, people can perceive food as crunchy through the addition of crunchy sounds [9]. Another example is the work by Crisinel et al. [7] that demonstrated that participants can match sweet

tastes to woodwind instruments, while bitter tastes can be matched with brassy instruments. Our eating behaviours themselves are also influenced by sounds. For example, fast-paced background music can increase people's eating speed and also facilitate taking more bites [20]. Furthermore, some restaurants use sound as an "extra ingredient" to facilitate a rich dining experience. For example, the "Sound of the Sea" dish encourages diners to listen to the sound of sea waves through headphones while they eat a seafood dish [28].These works motivate our approach of investigating the interrelationship between eating and sounds, an in particular, it guided us in developing an initial structured understanding of how they inform each other. Based on this, in this paper we present an initial framework that provides guidance for designers on how to create system for this interrelationship.

We present an initial framework through the reflection on two of our own case studies called "*iScream!*" [31, 30] and "*WeScream!*". Through a thematic analysis of user experiences of *iScream!*, we propose a first attempt at an interaction process (Figure 1), in which we highlight an ongoing loop between eating actions exploring sounds and sounds mediating eating actions. This process appears to confirm the theory by Mueller et al. [22] that individuals could experience their body as play, including through multisensory eating. Through the process of designing "*iScream!*" we reach an understanding about the way interactive technologies can support playful eating experiences. The next step we take is "*WeScream!*", as an extension of *iScream!*, we explored the social dynamics of playful gustosonic experiences.

We believe that our framework could benefit game and play designers who are venturing into food and applying their expertise. With our work, we hope to guide designers to
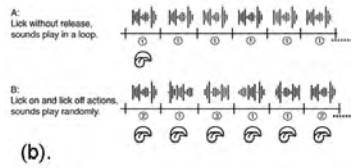
Figure 2: (a) The player is experiencing *iScream!*, (b) Sound interaction of *iScream!*

create playful gustosonic experiences to support a positive eating experience.

Examples: *iScream!* and *WeScream!*

We now present two of our own playful gustosonic systems that we used to derive our design framework.

iScream!

The *iScream!* (Figure 2) system dynamically generates four randomly playful sounds in real-time when the player eats regular off-the-shelf ice cream. *iScream!* detects eating actions through capacitive sensing. The *iScream!* experience goes through the following stage: before the ice cream is being eaten, when ice cream is licked, while a portion of the ice cream is being consumed. The data generated is then mapped to different playful sounds. When the player performs a lick-on and lick-off action, the system randomly triggers a pre-recorded sound, like: a crunchy, giggling, burping and roaring sound. If the player keeps biting or licking the ice cream without release, the sound continuously plays in a loop. The process stops after the ice cream is completely eaten.

WeScream!

"*WeScream!*" is designed to enable eating interactions while players are eating with each other. The system offers players the opportunity to generate musical sounds while eating ice cream. Each player holds one cone to create a musical phrase via licking or biting into ice cream. The system consists of two capacitive-sensing cones that we developed ourselves. 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. An integrated Bluetooth speaker in each cone enables localized sound from the ice cream cone. Each cone contains a microcontroller board ("Huzzah32 feather") [2] and a Bluetooth speaker board 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 [25], which maps the normalized capacitance data to a five-octave musical scale. 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. Then, 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 players to try different instruments as offered through the Ableton library. *WeScream!* offers open-ended gameplay. 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 gameplays around the system. For example, players might implement a set of rules to determine the eating order and eating actions.

Methodology

Our framework describes the interaction process of a player experiencing our system (Figure 3). The framework is based around two components from an analysis of our study: edible interface and sound design. We conducted a group discussion to help refine our design framework and to gather diverse insights around play and checked with associated play theory [17, 18]. This section included eight experts with diverse academic backgrounds, including four game designers, three interaction designers (2 from HCI and one from HFI) and one sound designer. We examined 782 interview notes through the process via inductive thematic analysis [5]. We developed 53 labels to identify the fea-
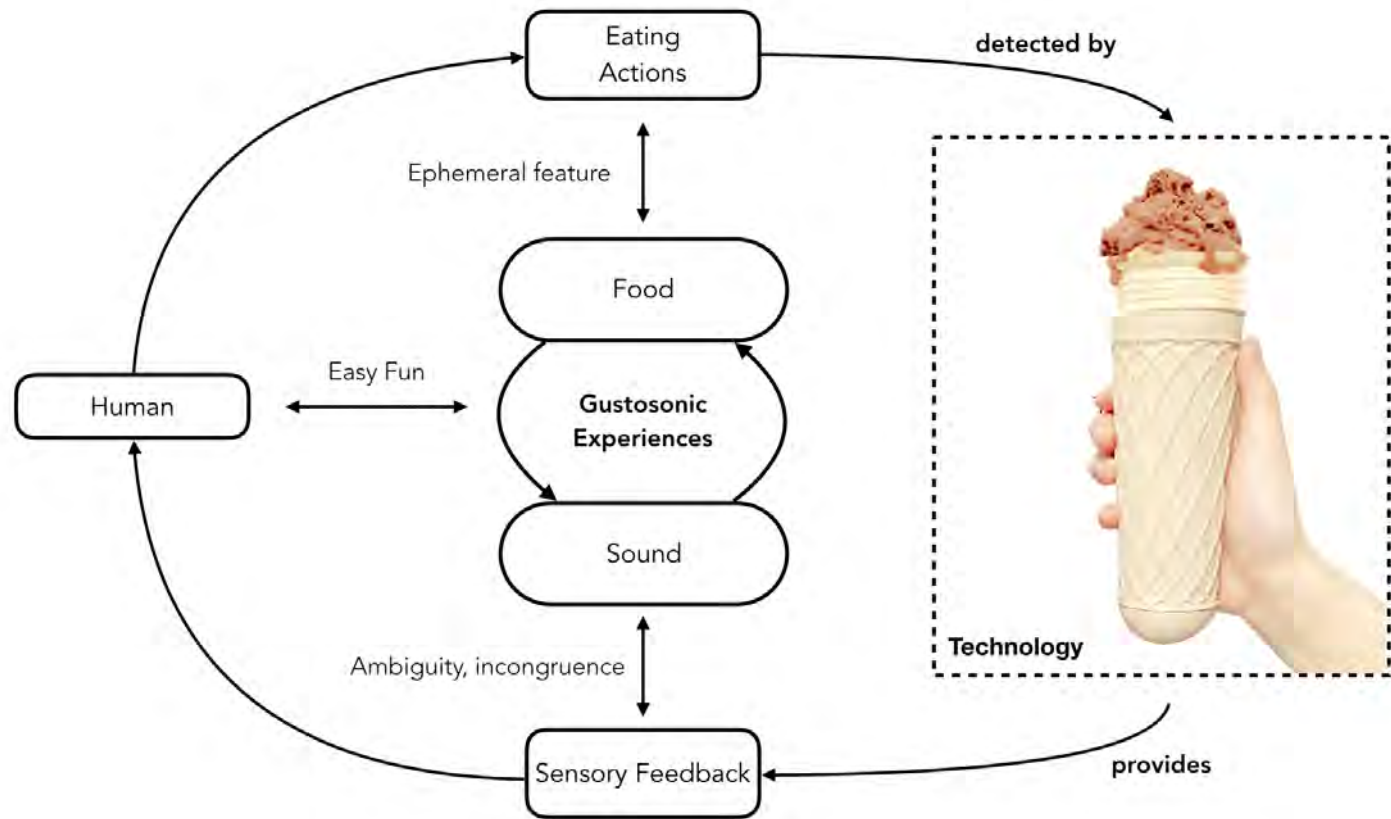
Figure 3: This image shows our initial framework for gustosonic experiences.

tures of the data and grouped them. In the group discussion section, we iteratively clustered related labels into higher-level categories and identified relationships between these categories. We drew a Venn diagram to map out potential relationships from our discussion. The outcome of the discussion and iteration process is depicted in the figure 3.

In the next section, we articulate three strategies on how designers can facilitate playful gustosonic experiences based on our framework above. These strategies are aimed to guide the design of playful gustosonic experiences.

Design tactics for designing playful gustosonic experiences

Consider the ephemeral character of the edible interface
We recommend designers to exploit the ephemeral character [8] of the edible interface for designing playful gustosonic experiences. For example, we utilized regular ice cream as edible interface combined with capacitance sensing technology in our work. In *iScream!*, when participants eat the ice cream, there is always a differently shaped piece of food to be explored left as a result. As players were licking the ice cream, it made a sound, but the ice cream also diminished. As the ice cream was melting, players had to lick quickly before the ice cream fell off the cone, which facilitated exploration of an interplay between what became a soundscape and the food. In *WeScream!*, participants told us that because the ice cream melted over time, they had to engage with the ice cream consistently, which in turn increased the excitement of eating together. This confirms the prior theory that an edible interface can afford intriguing embodied interactions while enriching social enjoyment [13]. Furthermore, this experiment emphasizes that the ephemeral character of the edible interface [19] can be exploited to benefit playful eating interactions. Similarly, Wei et al. [32] with their interactive system called "Foodie" found

that different food textures can facilitate social interactions. We acknowledge that edible interfaces also have limitations for eating interactions; for example, Aminzade et al. [19] found that users tend to engage in less interactions if they are full. Nevertheless, we recommend designers to consider the ephemeral character of the edible interface. This could be combined, for example, the volume of sound (gustosonic experience) could be lowered once satiety levels are reached.

Design sound ambiguity to direct attention back to food
We recommend designers to design ambiguity in the sound's feedback to direct attention from the sounds back to the food in order to facilitate playful interactions around the food. Gaver et al. [11] proposed that ambiguity is a resource for design to encourage close personal engagements with a system. In *iScream!*, we designed four playful sounds for engaging players. The result was that player reported that there is a mismatch with the information from the other senses when eating the ice cream. This ambiguity arose in the way that is in-congruent with in the perception of the ice cream being presented. In *WeScream!*, we found that ambiguous aspects of the sound design motivated players to direct attention back to each other's ice cream and eating actions, which facilitated playful social interactions. Players reported that they became aware of a sound delay in the produced sounds but did not know the exact cause. In response, they changed their collaboration methods, for example, they increased eating speed to catch up with the signal glitch. The ambiguity appeared to evoke players to pay attention to each other's eating actions and encouraged imaginative play with ice cream cone. By drawing attention back to the food, playful interactions around the food emerged; as such, the moving back and forth between ice cream and sounds appeared to fuel the playful character of the experience.

Design the gustosonic experience as "easy fun"
Synthesizing our findings, we find that the playful gustosonic experiences were not just about eating a novelty ice cream. It appeared to also become an "easy fun" experience towards an everyday source of happiness. By "easy fun" we refer to the work by Lazzaro [17], who has proposed four forms of fun in regards to enjoyable user experiences. Easy fun is open-end play without pursing a wining purpose. In particular, we find it telling that easy fun is described as players enjoying what they already know how to do, here, it was eating ice cream, an activity we know (and enjoy) from a very young age onwards. To understand the easy fun experience, Lazzaro suggests considering four aspects of immersion in play in terms of visceral, cognitive, behaviour and social immersion. The playful gustosonic experience appears to align well with these four aspects of an immersive experience.

- First, visceral immersion is a pleasure from the senses, from using incomplete and surreal details in a playful experience. *iScream!* offered such a pleasure from the senses through tasting ice cream, and the incomplete and surreal details emerged in the form of the sound bites being produced.
- Second, cognitive immersion describes how players figure things out but focus more on surreal things. In *iScream!*, participants enjoyed trying to figure out how to generate different sounds through eating. And in *WeScream!*, participants engaged with producing certain melodies through collaboration or competition interactions while eating together.
- Third, behavioural immersion refers to players doing particularly enjoyable behaviours in their own manner. *iScream!* offers players self-expressive licking actions. Players can freely perform any eating actions while generating sounds. In *iScream!*, players

also enjoyed accommodating the dripping of the ice cream in order to generate different sounds. They changed the ways of holding the cone and use their fingers and tongue to catch dripping ice cream. In *WeScream*, participants found that different collaborative eating interactions could generate rich melodies. So, they changed their previous eating manners of consuming ice cream. For example, participants explored changing the eating speed, consuming different portions of the ice cream, changing the licking force and extending the licking time.
- Four, social immersion describes engagement in the interaction between people, it refers to the importance of commensality [10]. Through experiencing *WeScream!*, participants not only enjoyed collaborative interactions of playing with sounds, but they also increased face-to-face communications in comparison to regular ice cream eating as we found out through examining the videos.

Conclusion
While our work is not yet a complete framework for designing playful gustosonic experiences. We believe that our work can serve as valuable starting point for future investigations. We hope our work can encourage game designers and interaction designers to consider how their expertise could be useful for playful human-food interaction. In future work. we aim to further develop the framework next and then validate it. Ultimately, with our work, we aim to inspire designers in creating playful eating experiences to support a more playful and positive relationship with food.

Acknowledgments

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