Balanced Glass Design: A flavor perception changing system by controlling the center-of-gravity

Masaharu Hirose
The University of Tokyo
Tokyo, Japan
hirose@star.rcast.u-tokyo.ac.jp

Masahiko Inami
RCAST, The University of Tokyo
Tokyo, Japan
inami@star.rcast.u-tokyo.ac.jp

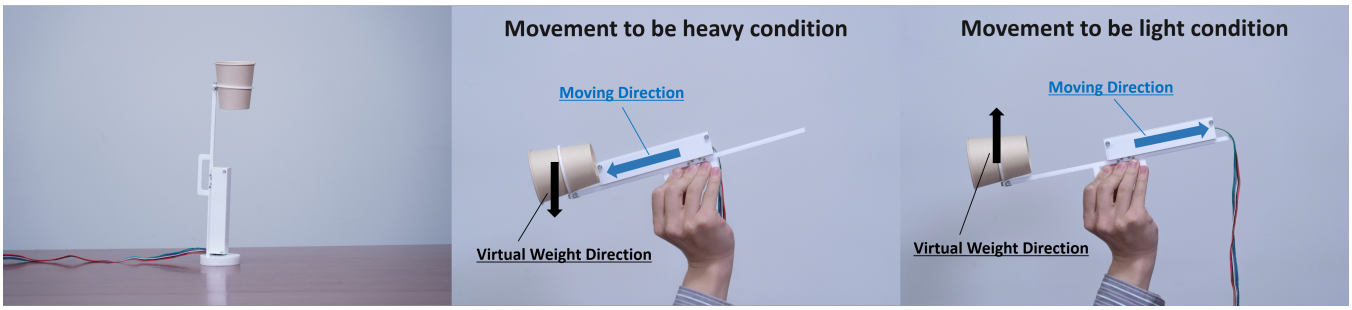

Figure 1: (Left) Appearance of Device. (Center) Mechanism for adding heaviness. (Right) Mechanism for adding lightness.

ABSTRACT

We propose Balanced Glass Design, a flavor perception changing system. The system consists of glass-type device shifting its center of gravity in response to the user's motion which allows drinking a beverage with a virtual perception of weight through drinking motion. We thought It's possible to intervene in the user's perception of flavor by displaying virtual weight perception, and so conducted demonstrations as a user study. In this paper, we describe the system design and comments obtained through a user study.

CCS CONCEPTS

• **Human-centered computing → Human computer interaction (HCI)**.

KEYWORDS

Cross-modal, Human Food Interaction, Virtual Reality

ACM Reference Format:
Masaharu Hirose and Masahiko Inami. 2021. Balanced Glass Design: A flavor perception changing system by controlling the center-of-gravity. In *Special Interest Group on Computer Graphics and Interactive Techniques Conference Posters (SIGGRAPH '21 Posters), August 09-13, 2021.* ACM, New York, NY, USA, 2 pages. https://doi.org/10.1145/3450618.3469145

1 INTRODUCTION

In this study, we propose a system to change flavor perception through drinking a beverage with a perception of a virtual weight. The system consists of glass-type device. The device shifts its center of gravity causes a perceptual change in the beverage's weight and changes the flavor.

Whether the perception of flavor can be changed by the perception of weight, it's based on the hypothesis of the cross-modal phenomenon. Harrar et al. conducted a study in which they examined the changes in taste when the size, weight, shape, and color of cutlery were changed. In this work, they found that the characteristics of the cutlery changed the thickness and saltiness of the yogurt, and also made it seem more luxurious [Harrar and Spence 2013]. Similar to the cutlery in their research, we thought glass is also an interface between humans and food.

As a previous project, our research team proposed a system that enables people to eat food while presenting its weight [Hirose et al. 2015]. In the previous system, we showed that increasing the weight of the food by changing the center of gravity of the tableware affects the food's flavor through psychophysical experiments. Namely, in our previous work, we focused on tableware and realized the change of food perception from weight perception. In this research, we have extended the previous method to beverages, and improved the method not only for heaviness but also for lightness.

2 BALANCED GLASS DESIGN

In this section, we describe the mental models and the system details. The system consists of a glass-type device that can change the the center of gravity, allowing the user to drink while feeling its heaviness or lightness. This weight shifting changes the moment of inertia at the grasping part's fulcrum, which results in changing weight corresponding to the weight or lightness of the tip of the module(Figure 1). The purpose of the system is to change the food perception by intervening in the parameter, heaviness or lightness of the drink, which it's actually hard to change. We conducted preliminary experiments using the adjustment method and found that it is possible to present a weight of 31.7[g] for a drink.

SIGGRAPH '21 Posters, August 09-13, 2021, Virtual Event, USA

ACM ISBN 978-1-4503-8371-4/21/08.
https://doi.org/10.1145/3450618.3469145

2.1 Mental Models

This system aims to change the flavor perception, i.e., taste, satisfaction, and deliciousness, from a weight perception change. As to whether it is possible to induce a change in food perception from weight perception changing, we hypothesized a mentalmodel of the unconscious predictions for food and beverage. For example, when we eat a cream puff, we bite into it expecting a softcrunch, and at that moment, we don't think the cream puff is hardas a rock. In this series of actions, it is difficult to change the perception of the food itself. However, in the case of food prediction, it is possible to intervene by changing the center of gravity.

2.2 A mechanism of center of gravity shifting

In designing the center of gravity shift mechanism, the balance between the entire device's mass and the moving object is essential. If the overall mass is too large or the moving object is too light, users cannot feel the change in the moment. It is desirable to make the overall mass light and the moving part as heavy as the actuator's power will allow. To address this issue, we designed the entire device to be driven by the motor slider itself as a weight because the motor slider itself is the heaviest component in the whole device. The weight of the entire device is 127[g], and the weight of the moving part to change the center of gravity is 100[g], and it moves 100[mm]. Through an extreme implementation in which 79[%] of the mass of the entire device is shifted, we were able to achieve a dynamic change in the center of gravity, even though the overall mass of the device is 127[g], which is about the same as that of an ordinary wine glass.

3 DEMONSTRATION

We demonstrated the system to 20 people(Figure 2). The participants chose five kinds of beverages (tea, juice, sports drink, coffee, and wine) and drank them in two different ways: adding heaviness or lightness. The following are some of the comments we obtained through the demonstration.

Comment for Adding Heaviness

- As the device added the drink's weight while I was drinking it, I felt as if the drink was not decreasing. I felt as if I had drunk a lot. (Tea)

- I felt as if the drink was closing in on me. This feeling was similar to drinking from a plastic bottle or tumbler. I reflexively hesitated to tilt the glass because I felt like I might spill it. (Tea)

- I felt a dry flavor. This change may have been because the glass tipping motion became quite dynamic, and the speed and volume at which I sipped the wine was different from usual. (Wine)

- I couldn't perceive the weight, but I felt like the taste got stronger. It tasted better.(Juice)

- The speed at which the liquid entered my mouth changed relative to the moment shifting, and the taste changed. It felt strange. I felt that it tasted better. (Tea)

- I felt like I was drinking something sticky. I feel like the amount is changing. (Sports Drink)

- Feels like there's water even if there isn't.

Comment for Adding Lightness

- I couldn't feel lightness, but I felt like the taste was lighter. (Juice)

- Felt lighter, but it was like drinking from just a light glass. (Tea)

- If I lighten it, I feel like I won't run out of drinks.(Tea)

- Slow down of drinking speed, moderates spreading in mouth. (Tea)

Overall

- I felt a clear change in the coffee and wine. I think this is because coffee and wine have a complex taste. On the other hand, it was difficult to feel a change with sports drinks and juices because their flavor is simple. (Wine, coffee, Sports Drink, Juice)

- The way the drink touched my mouth changed, so it obviously changed the taste as well. (Tea)

- If we could make the motor slide more smoothly and precisely according to the drinking motion, we could present weight to the user without them noticing. I thought, if such control were possible, it would be possible to cause behavioral changes or changes in flavor without the user noticing. (Tea)

Most of the participants were able to perceive changes in heaviness and lightness. In addition, there were clear flavor perception changes from the weight perception. As several people pointed out, there was an apparent change in the way the glass was tilted due to the weight change when drinking, and thus the taste seemed to change as well. Some feedback showed that the effect of perceptual change differed depending on the drink.

Figure 2: Participants in the demonstration

4 DISCUSSION

It is unclear whether our mental model is accurate or not.In addition, we have not yet been able to quantitatively evaluate how this system changes flavor. It is necessary to repeat several demonstrations, roughly estimate the correctness of the hypothesis of the mental model, and conduct quantitative evaluation by psychophysical experiments.

REFERENCES

Vanessa Harrar and Charles Spence. 2013. The taste of cutlery: how the taste of food is affected by the weight, size, shape, and colour of the cutlery used to eat it. *Flavour* 2, 1 (June 2013), 1-13 pages. https://doi.org/10.1186/2044-7248-2-21

Masaharu Hirose, Karin Iwazaki, Kozue Nojiri, Minato Takeda, Yuta Sugiura, and Masahiko Inami. 2015. Gravitamine Spice: A System That Changes the Perception of Eating through Virtual Weight Sensation. In *Proceedings of the 6th Augmented Human International Conference* (Singapore, Singapore) *(AH '15)*. Association for Computing Machinery, New York, NY, USA, 33–40. https://doi.org/10.1145/2735711.2735795