

Change in the amount poured as a result of vibration when pouring a liquid

Sakiko Ikeno¹, Ryo Watanabe^{1,2}, Ryuta Okazaki^{1,2},

Taku Hachisu^{1,2}, Michi Sato¹, Hiroyuki Kajimoto^{1,3}

¹The University of Electro-Communications

²JSPS Research Fellow

³Japan Science and Technology Agency

{ikeno,r.watanabe,okazaki,hachisu,michi,kajimoto}@kaji-lab.jp

Abstract. Visual and tactile stimulation are known to affect the experience of eating and drinking. In this study, we focused on the vibration of a Japanese Sake bottle when used to pour liquid. We manufactured a device that can be attached to the neck of any plastic bottle and investigated how beverage consumption was affected by the vibration. We found that presentation of the vibration affected the amount of poured beverage when visual and sound cues were masked.

Keywords: pouring water, tactile display, drink consumption, vibration, human food interaction

1 Introduction

Serving containers are known to affect the experience of eating and drinking, as well as the appearance and flavor of food and beverages. Wanshink et al. showed that food consumption increased when a larger spoon or dish was used to serve food. Furthermore, consumption of beverages is affected by the size and shape of the cup used to serve them [2]. Sakurai and Suzuki et al. changed the appearance of food and beverage containers and regulated the consumption of food and drink using augmented reality technology [3] [4].

In this study, we focused on the vibration of liquid being poured from a Japanese Sake bottle as an audio-haptic rendition of the liquid. Sake bottles are known for their unique “glug” sound and vibration. We believe that these sounds and vibrations affect subjective impressions of the amount of liquid in the bottle. Thus, we developed a device that can reproduce this vibration [5]. In this study, we manufactured a vibration device that can be attached to the neck of any plastic bottle and investigated how beverage consumption was affected by the subsequent vibrations.

2 An attachment type device

Fig. 1 shows our device, which can be attached to the neck of any plastic bottle. The device has an accelerometer (KXM52-1050, Kionix) and a vibrator (Haptuator Mark II, Tactile Labs Inc.). We used the cap of the plastic bottle as an attachment point for the device. The device does not obstruct the movements required to pour liquid from the bottle.



Fig. 1. An attachment type device

In our previous report, we reproduced the wave of the vibration using the following model, which comprised two decaying sinusoidal waves with different frequencies [5]:

$$Q(t) \cong \sum_{n=1}^2 A_n \exp(-B_n t) \sin(2\pi f_n t) \quad (1)$$

where A_n is the wave amplitude, B_n is the attenuation coefficient, f_n is the frequency of the sinusoidal wave, and t is the time period of one wave. Typically, f_1 was around 250Hz, and f_2 was around 40Hz.

We used this model to describe the motion of the device. When a user tipped the plastic bottle, the device presented a vibration according to the angle of the bottle.

3 Experiment

We conducted an experiment to see if the added vibration had an effect on the amount of liquid poured.

3.1 Experimental environment and procedure

We recruited four participants (two males and two females, 22 to 24 years of age). The participants were blindfolded and any sound cues were masked by white noise that was presented through headphones.

We prepared 500ml of water in a plastic bottle with the device attached. There were two conditions: with vibration and without vibration. The participants were asked to pour a designated amount of water, 100ml, 200ml, 300ml, or 400ml, into a 500ml cup. For each trial, the participants were shown a marker inside the cup that indicated the level of the designated amount of water. They were then blindfolded and asked to pour the water from the bottle. After they felt that they had poured the designated amount, we measured the amount using an electric scale. There were ten trials for each amount of liquid, 40 trials in total for each participant.

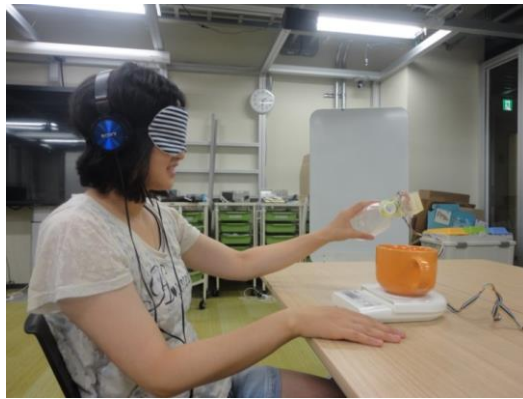


Fig. 2. Experimental setting

3.2 Results and Discussion

Fig.3 illustrates the average amount of liquid poured and the standard errors in each experimental condition. The horizontal axis represents the designated amount and the vertical axis represents the average amount of poured water. The participants poured 35% less in the trials with vibration compared with the trials without vibration at 100ml, 22% at 200ml, 18% at 300ml, and 5% at 400ml.

We conducted a t-test that revealed significant differences between the pouring conditions at 100ml ($p=0.0001$), 200ml ($p=0.003$), and 300ml ($p=0.006$), although we found no significant differences between the conditions for the 400ml trials ($p=0.34$).

These results suggest that the presentation of the vibration affected the amount of liquid poured. Additionally, the effect of the device was more powerful when the designated amount of water was smaller. It is possible that when the amount of liquid to be poured was small, the participants became more conscious of their movements, and were thus more affected by the vibration.

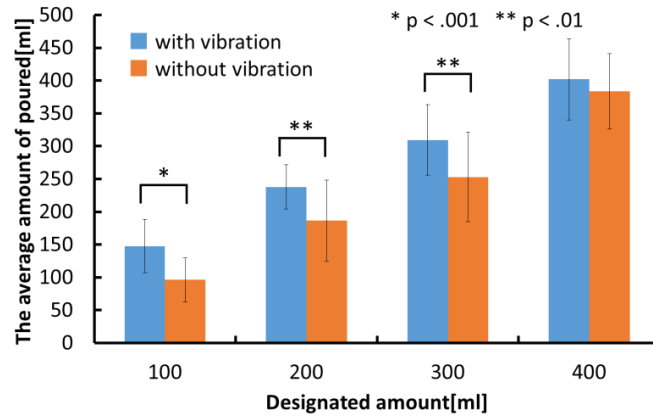


Fig.3. Average amount of poured

4 Conclusions

In this study, we focused on the vibration of liquid being poured from a Japanese Sake bottle as an audio-haptic rendition of the liquid. We manufactured a device that reproduced the vibration created by pouring a liquid. This device can be attached to the neck of any plastic bottle. We investigated how pouring of liquids, which is a precursor to beverage consumption, would be affected by the vibration, and found that vibration significantly reduced the amount of liquid poured when visual and sound cues were masked.

Future research could test the effect of our device in a real environment with naturalistic visual and sound cues. We also plan to investigate changes in the consumption of beverages associated with use of our device.

References

1. Wansink, B., Ittersum, K.V., Painter, J.E.: Ice Cream Illusions Bowls: Spoons, and Self-Served Portion Sizes. *American Journal of Preventive Medicine* 31, 240-243 (2006)
2. Wansink, B., Ittersum, K.V.: Bottoms Up! The Influence of Elongation on Pouring and Consumption Volume. *J. Consumer Res.* 30, 455-463 (2003)
3. Sakurai, S., Narumi, T., Ban, Y., Kajinami, T., Tanikawa, T., Hirose, M.: Affecting Our Perception of Satiety by Changing the Size of Virtual Dishes Displayed with a Tabletop Display. *Virtual, Augmented and Mixed Reality* 8022, 90-99 (2013)
4. Suzuki, E., Narumi, T., Sakurai, S., Tanikawa, T., Hirose, M.: Illusion Cup: Interactive Controlling of Beverage Consumption Based on an Illusion of Volume Perception. *Proceedings of the 5th Augmented Human International Conference* (2014)
5. Ikeno, S., Okazaki, R., Hachisu, T., Sato, M., Kajimoto, H.: Audio-Haptic Rendering of Water Being Poured from Sake Bottle. *Advances in Computer Entertainment* 8253, 548-551 (2013)