Food Texture Manipulation by Face Deformation

Yuji Suzuki
The University of Tokyo
ysuzuki@cyber.t.u-tokyo.ac.jp

Jotaro Shigeyama
The University of Tokyo
jotaro@cyber.t.u-tokyo.ac.jp

Shigeo Yoshida
The University of Tokyo
shigeodayo@cyber.t.u-tokyo.ac.jp

Takuji Narumi
The University of Tokyo
narumi@cyber.t.u-tokyo.ac.jp

Tomohiro Tanikawa
The University of Tokyo
tani@cyber.t.u-tokyo.ac.jp

Michitaka Hirose
The University of Tokyo
hirose@cyber.t.u-tokyo.ac.jp

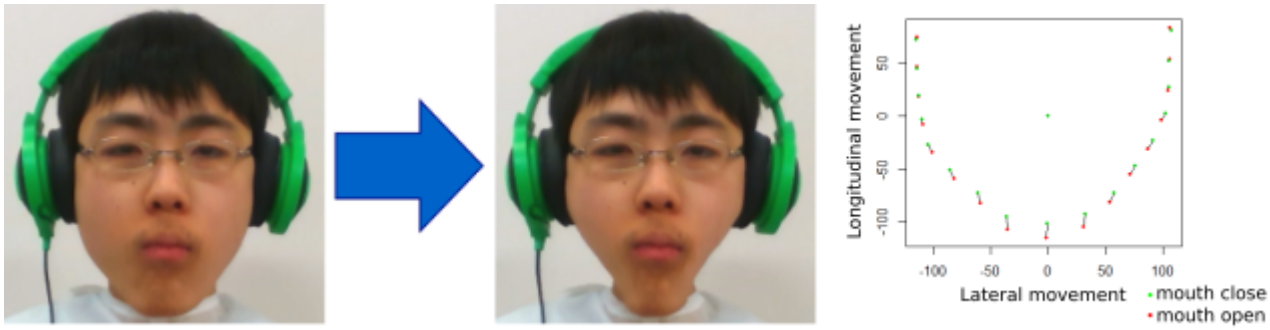

Figure 1: Proposed method: an image in which the contour of the face is deformed is presented in accordance with the mastication motion (left : source image, center : deformed image). Also, feedback on the mastication sound is included. The image on the right shows the measured mastication movement which was used to deform the contour of the face.

ABSTRACT

Food texture plays an important role in the experience of food. Researchers have proposed various methods to manipulate the perception of food texture using auditory and physical stimulation. In this paper, we demonstrate a system to present visually modified mastication movements in real-time to manipulate the perception of food texture, because visual stimuli efficiently work to enrich other food-related perceptions and showing someone their deformed posture changes somatosensory perception. The result of our experiments suggested that adding real-time feedback of facial deformation when participants open their mouths can increase the perceived chewiness of foods. Moreover, perceptions of hardness and adhesiveness were improved when the participants saw their modified face or listened to their non-modified chewing sound, while both perceptions were decreased when participants were presented with both stimuli. These results indicate the occurrence of the contrast effect.

SIGGRAPH '18 Posters, August 12-16, 2018, Vancouver, BC, Canada

ACM ISBN 978-1-4503-5817-0/18/08.
https://doi.org/10.1145/3230744.3230814

CCS CONCEPTS

• **Human-centered computing** → *Empirical studies in HCI*; • **Applied computing** → Consumer health;

KEYWORDS

Food texture, Mastication, Exaggerated deformation

ACM Reference format:
Yuji Suzuki, Jotaro Shigeyama, Shigeo Yoshida, Takuji Narumi, Tomohiro Tanikawa, and Michitaka Hirose. 2018. Food Texture Manipulation by Face Deformation. In *Proceedings of SIGGRAPH '18 Posters, Vancouver, BC, Canada, August 12-16, 2018,* 2 pages.
https://doi.org/10.1145/3230744.3230814

1 INTRODUCTION

Enriching the food experience is important for our overall enjoyment of food. Food texture, like the appearance and taste, plays an important role in the food experience, and a recent report demonstrates that texture expressions dominate the top ranking of sizzle words, which are the words food critics use to describe food experiences[1]. On the other hand, more and more people are experiencing decreased oral function as they age and are obliged to eat nursing home diets that have little texture. Previous studies on texture perception only focus on mechanical [Iwata et al. 2004] and auditory stimuli [Koizumi et al. 2011], and auditory stimuli have been proven to have a great effect on texture perception. However, these methods have some limitations that include the foods they can be

[1] http://www.bmft.jp/pdf/services/kotoba.pdf

applied to and require a special device. Although visual stimuli are expected to have significant effects on texture perception because of its huge effect in other food perception manipulation, visual manipulation of food appearance has little effect on texture perception [Inoue et al. 2016]. Considering other visual stimuli, we focus on studying the manipulation of somatosensory sensations by visual cues showing that the sense of weight is changed by presenting a modulated posture [Jauregui et al. 2014]. Texture is perceived when masticating food, and mastication causes a change in facial configuration. Therefore, we tried to manipulate texture perception by modulating the appearance of mastication movements. As mentioned above, auditory stimuli greatly affect texture perception but are limited in the foods that can be applied to. We believe this limitation can be lessened when combined with visual stimuli and face deformation and have tested the effects of this.

2 PROPOSED METHOD

In this paper, we propose a novel method for manipulating the food texture perception of individuals by presenting them with the visual feedback of their modified mastication movements and the audio feedback of their mastication sounds. We used an Intel RealSense Camera (SR300) and its SDK to capture and track feature points of a face. To modify the contour of a face, we used Zhu and Gortler's 3D deformation method [Zhu and Gortler 2007]. We hypothesized that presenting modified face images and chewing sounds in real-time would change the perception of food texture and by combining both, the effect would be further improved.

3 PRELIMINARY STUDY

People do not normally watch their own face while eating. Even when eating with others, not much time is spent watching other's faces. Therefore, firstly, we examined which facial deformation most effectively influenced the texture perception. We evaluated the chewiness when eating gummies using the scale bar. The number of chews, stroke, and chewing time were also measured. Eight participants were asked to sit down in front of a PC monitor and watched their face shown on the monitor. We tested four types of deformation: expanding/contracting in the longitudinal/lateral directions upon opening the mouth. The evaluations of each deformation were compared with the evaluations under the control condition (no deformation). The results of the experiment suggest that upon shrinking in the lateral direction according to the mouth opening movement, the perception of the chewiness is increased.

Secondly, to achieve a more natural deformation, we also measured the actual mastication motion and applied the parameters to the deformation algorithm.

4 EVALUATION

We measured changes in the texture perception and chewing movement when presenting the modulated chewing motion using the measured lateral component and the masticatory sound. Thirteen participants (7 males and 6 females, mean age 27.5 years) joined this study, and they were asked to chew gummies. Four experimental conditions were used: combining the presence/absence of chewing movement deformation and the presence/absence of mastication sounds. The Visual Analog Scale (VAS) ranging from -100 to 100 was used to evaluate the texture. To relatively access the gummies' texture, subjects ate two other different gummies, which were set to -50 and 50 in the VAS referring to the method of Arce-Lopera [Arce-Lopera et al. 2015]. We used hardness, adhesiveness, and springiness for the texture evaluation, and chewing frequency, stroke and chewing time were measured as mastication parameters.

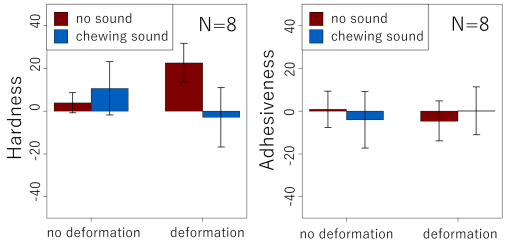

Figure 2: Result of the accessment of hardness and adhesiveness (Mean±SE).

The results suggested that the evaluation of hardness and adhesiveness tended to increase when only one of the two stimuli (modulated image, chewing sound) was presented and decreased when both stimuli were presented. This result can be explained by the theory of expectation effect [Yanagisawa and Mikami 2015]. When one stimulus was presented, the difference between the prediction and the actual sensation was small, which could cause the *assimilation* effect. When the two stimuli were combined, the difference was large, which could possibly cause the *contrast* effect.

Finally, to verify this hypothesis, we measured the occlusal force in a simple manner in the same four conditions. The result indicated that when the modulated image or the mastication sound were presented, the occlusal force increased, and when combined, the force increased. This suggests that the difference between the prediction and actual perception increases then the expectation effect is reversed.

REFERENCES

C Arce-Lopera, T Masuda, A Kimura, Y Wada, and K Okajima. 2015. Model of vegetable freshness perception using luminance cues. *Food Quality and Preference* 40 (2015), 279–286.

Akifumi Inoue, Koki Ymasaki, and Tohru Hoshi. 2016. Increasing the Number of Mastication by Augmented Reality. 2016, 35 (2016), 1–6. In Japanese.

Hiroo Iwata, Hiroaki Yano, Takahiro Uemura, and Tetsuro Moriya. 2004. Food simulator: A haptic interface for biting. In *Virtual Reality, 2004. Proceedings. IEEE.* IEEE, 51–57.

David Antonio Gomez Jauregui, Ferran Argelaguet, Anne-Helene Olivier, Maud Marchal, Franck Multon, and Anatole Lecuyer. 2014. Toward" Pseudo-Haptic Avatars": Modifying the Visual Animation of Self-Avatar Can Simulate the Perception of Weight Lifting. *IEEE Transactions on Visualization and Computer Graphics* 20, 4 (2014), 654–661.

Naoya Koizumi, Hidekazu Tanaka, Yuji Uema, and Masahiko Inami. 2011. Chewing jockey: augmented food texture by using sound based on the cross-modal effect. In *Proceedings of the 8th International Conference on Advances in Computer Entertainment Technology.* ACM, 21.

Hideyoshi Yanagisawa and Natsu Mikami. 2015. HOW DOES EXPECTATION CHANGE PERCEPTION?: A SIMULATION MODEL OF EXPECTATION EFFECT. In *DS 80-9 Proceedings of the 20th International Conference on Engineering Design (ICED 15) Vol 9: User-Centred Design, Design of Socio-Technical systems, Milan, Italy, 27-30.07. 15.*

Yuanchen Zhu and Steven J Gortler. 2007. 3D deformation using moving least squares. *Harvard Computer Science Group Technical Report TR-10-07* (2007).