Multisensory Approaches to Human-Food Interaction*

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ABSTRACT

Here, we present the outcome of the 4th workshop on Multisensory Approaches to Human-Food Interaction (MHFI), developed in collaboration with ICMI 2020 in Utrecht, The Netherlands. Capitalizing on the increasing interest on multisensory aspects of human-food interaction and the unique contribution that our community offers, we developed a space to discuss ideas ranging from mechanisms of multisensory food perception, through multisensory technologies, to new applications of systems in the context of MHFI. All in all, the workshop involved 11 contributions, which will hopefully further help shape the basis of a field of inquiry that grows as we see progress in our understanding of the senses and the development of new technologies in the context of food.

CCS CONCEPTS

• Human-centered computing~Human computer interaction (HCI)~Interaction paradigms

KEYWORDS

Multisensory, Human-Food Interaction, Senses, Technology

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1 Introduction

Building on the successful development of the first three workshops on Multisensory Approaches to Human-Food Interaction (MHFI, Asia: 18th ICMI Tokyo, November 2016; Europe: 19th ICMI Glasgow, November 2017; North America: 20th ICMI Boulder, October 2018, see Figure 1), we decided to organize its fourth version in 2020, in Utrecht, the Netherlands.

Figure 1: Logo of the workshop designed by Simplicio Michael Luis Asis Herrera (http://www.mthemovement.com/). To see the outcomes of previous workshops, visit: https://multisensoryhfi.wordpress.com/previous-workshops.

There has been an increasing interest in the topic over the last few years [1-3], and recent surveys have highlighted these workshops as one of major communities of researchers contributing to develop the area of Human-Food Interaction (HFI, [4]). It is for these reasons that we were happy to continue developing this space, where those researchers interested in studying the multisensory aspects of HFI (from engineering, psychology, food science, marketing, and a number of other fields) can present their ideas and discuss them in an open, constructive, multi-disciplinary environment.

Moreover, as noted for the previous workshops, there is a growing interest in the context of HFI to capitalize on multisensory interactions to enhance our food- and drink-related experiences [5-7]. This should not, perhaps, come as a surprise, given that flavor, for example, is the product of the integration of, at least, gustatory and (retronasal) olfactory perception, and can be influenced by all our senses [8]. Variables such as food/drink color, shape, texture, sound, and so on can all

influence our perception and enjoyment of our eating and drinking experiences, something that new technologies can build on in order to "hack" them.

For this workshop, we called for investigations and applications of systems that create new, or enhance already existing, eating and drinking experiences ('hacking' food experiences). Moreover, we were interested in those works that were based on the principles that govern the systematic connections that exist between the senses. HFI also involves the experiencing of food interactions digitally in remote locations. Therefore, we were also interested in sensing and actuation interfaces, new communication mediums, and persisting and retrieving technologies for human food interactions. Enhancing social interactions to augment the eating experience was another issue we wanted to see addressed in this workshop.

Building on the structure of previous workshops, we have also developed a Research Topic in Frontiers on "Perspectives on Multisensory Human-Food Interaction", where both extended versions of the research papers presented in the workshop, as well as new works will be welcomed (see https://www.frontiersin.org/research-topics/13399/perspectives-on-multisensory-human-food-interaction).

2 4th Workshop on Multisensory Approaches to Human-Food Interaction

In total, 15 submissions were received, from which 11 were eventually accepted for the workshop, covering the different themes presented in the call for papers. Below, we present a summary of these contributions.

Contributing to the theme of healthy eating, Aisala et al. present a study designed to assess the influence of different odors on the perception of sweetness of rye-based cakes using a novel olfactory display. Consistent with previous research, the authors document how odors such as vanilla appear to enhance sweetness perception. In addition, they suggest that novel olfactory displays may be used in food experiences that target changes in sugar consumption.

In their paper, De Vries et al. examine interactive dining with technology, putting forward the ultimate aims of 1) helping to convince children to eat their greens and 2) potentially helping young adults to eat less by means of their Sensory Interactive Table. The table incorporates embedded load cells and colorful LEDs to provide feedback to diners as a result of the amount/speed of consumption. Although it was only possible to test this solution virtually (given the current pandemic conditions) it is nevertheless intriguing to see that the gamification of food interaction continue apace.

New interactive HFI technologies were also presented. For example, Van Beers et al. developed a mobile tool designed to measure implicit approach-avoidance motivational tendencies in the real world. The approach, based on the well-established approach-avoidance task (AAT), builds on previous studies that have typically had participants either pull or push a joystick in response to a visual stimulus shown on a screen. The open source variant of the task presented here is designed for mobile devices and has the added advantage that the food (image shown on screen) is actually moved toward (vs. away) from the participant. Given that the decision to approach vs. avoid a stimulus is one of the most fundamental of the choices that any of us make, the hope is that this tool should prove useful to many real-world food researchers.

Gayler and colleagues presented a study designed to explore the design of food-related cues for self-defining memories in older adults. The results of their study suggested that the content of self-defining memories and food-based cues relate mostly to multi-ingredient dishes, thus opening up the path for the use of food in the context of memory.

How food is presented and eaten influences the overall eating experience. Vi et al. investigate such experiences in children when food is presented through levitation instead of using a plate with a knife and fork. Are children willing to eat "flying" food? This type of food delivery brings differences in the taste intensities of food and beverage. Are children ready to accept this mid-air delivery method at the dining table and does it have impact on their liking of foods and beverages? Some preliminary results, looking at the liking and willingness to eat vegetables, are presented.

Nivedhan et al. investigated the influences of extrinsic visual and auditory cues on the perception of coffee in a VR environment. Two colors and two pieces of music with opposing valences were used for the experiment. The results revealed that visual and auditory cues related to more positive valence increases sweetness and liking of coffee compared to cues related to less positive valence. Moreover, when only one factor (color or music) was manipulated, positively-valenced color increased coffee liking compared to negatively-valenced color.

Zushi et al. examined the role of arousal on taste perceptions. Participants watched movies which induce high arousing positive emotion or low arousing positive emotions. They then drank and evaluated a juice sample. Taste perception did not differ between high arousing and low arousing conditions. However, significant relations between electrophysiological markers of emotions (facial expression, skin conductance) and taste ratings were observed. Electrophysiological markers of emotions may thus shed light on the relationship between emotion and taste perception.

The topic of food computing is also represented, with Chen et al. investigating the possibility of classifying taste-liking based on facial expression recognition. They created a dataset as a ground-truth, and applied different strategies including deep neural network models to determine the one with the best performance. Their results show that the deep spatiotemporal architectures provide better classification results than engineered feature models; the personality-aware network that fuses participants' personality information with that of facial reaction features tends to worsen classification performance; and classification results vary across gender, but not across facilitator type nor the ethnicity of the participant.

Ma et al. discussed the use of Convolutional Neural Networks (CNNs) for food eating classification. Technology for food identification benefits food and media industries and can

improve human-computer interaction. The classification dataset that was used has been assembled from hundreds of YouTube videos of different food types. Apart from the accuracy results, the authors present a number of qualitative observations on distinguishing texture properties and eating action differences in food classification performance.

Gallagher et al. explore the influence of technology on commensally (i.e., eating in a social setting), using a toy robot to investigate how a participant's eating behavior can be influenced by the presence and persuasion offered by the robot. While the results were not statistically significant, the authors nevertheless still discuss the possible implications of their results for future research on HFI [9].

In 2020, many countries have adopted lockdown and social distancing policies, forcing people to stay home, often alone and away from their families and friends. Ceccaldi et al. report the initial results of an online survey about the reasons for online remote commensality during Covid-19 lockdown to explore the psychological motivations behind remote eating and behind deciding not to. A 10-item questionnaire consisting of social and other motives for online commensality was developed in their study and received responses from 154 participants. The results of factor analysis revealed that social interaction, closeness, and non-social dimension were three important factors to consider in online commensality.

3 Conclusions

As evidenced by the contributions to the workshop, the field of MHFI keeps growing. Previous workshops accepted seven, six, and eight articles, respectively, whereas the 2020 workshop accepted 11. This, together with the increasing digitization of human experiences, in light of the coronavirus pandemic, make the field of MHFI a key means to develop solutions that tackle humanity's key challenges associated with food [7]. For example, much research has migrated to digital environments and many consumers have had to eat in different circumstances, for instance, in isolation, something which was happening already for certain groups before the pandemic (e.g., some older adult communities). We believe that the current coronavirus pandemic demonstrates the scope for the integration of technology in our food experiences. Our prediction is that by lifting some of the barriers to the adoption of technology, the current situation will facilitate the development and integration of technology solutions that are based on multisensory processes associated with food experiences.

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