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Human-Food Interaction

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Human-Food Interaction

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ABSTRACT

Food is not only fundamental to our existence, its consumption, handling or even the mere sight of its also brings us immense joy. Over the years, technology has played a crucial part in supporting and enriching food-related practices, beginning from how we grow, to how we cook, eat and dispose of food. All these practices have a significant impact not only on individuals but also on the surrounding ecologies and infrastructures, often discussed under the umbrella term of *Human-Food Interaction* (HFI).

This article aims to offer the reader an overview of the existing research in this space and to guide further its exploration. We illustrate how HFI builds on recent trends within HCI. We position this growth across four phases of HFI, namely, *Growing, Cooking, Eating* and *Disposal*. We categorize and disseminate the existing works across each of these phases to reveal a rich design space and to highlight the underexplored areas that interaction designers might find intriguing to investigate.

Using the design space, we articulate a set of opportunities that emphasize particular features the technology, especially hardware, has yet to offer to drive the human-food

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interaction field forward. We highlight the design space for designing novel interactions with technologies by taking motivation from traditional food practices related to cooking and eating food.

Finally, we introduce "*Human Food Practices*" (HFP) an emerging field of investigation that concerns itself with the formation and transformation of practices as they are enacted within the dynamics, motivations and perceptions of societal norms associated with food.

"If more of us valued food and cheer and song above hoarded gold, it would be a merrier world."

— J.R.R. Tolkien

1

Introduction

"One of the very nicest things about life is the way we must regularly stop whatever it is we are doing and devote our attention to eating."

— Luciano Pavarotti

Food is undeniably an essential facet of our life. From birth until the moment we die, we spend countless hours procuring, preparing, eating and digesting food (Rozin *et al.*, 2003). Food engages our senses and connects us with other people. Food also has a rich cultural and social history. Its preparation, consumption and even its mere sight bring us immense joy (Cabanac, 2010; Lupton, 1996). As French gastronome Brillat-Savarin (Brillat-Savarin and Buford, 2011) notes, pleasures associated with eating and drinking constitute some of life's most enjoyable experiences. It is thus no surprise that most millennials identify themselves as "*Foodies*" (Sarasohn-Kahn, 2016).

Today, food is the world's biggest industry (Murray, 2007). The rapid evolution and uptake of digital technologies have blurred "the lines between the physical, digital, and biological spheres" (Schwab, 2016) and played a crucial role in supporting our food-related practices starting from how we grow, shop, cook, present, eat and dispose of food with

the use of digital technology (Khot *et al.*, 2017b). Food practices are here defined as any human activity in which food is involved, ranging from agriculture, food preparation, eating, gifting food, sharing meals and cleaning up. Symons (Symons, 1994) refer to these practices as "*the human food cycle*". These efforts are studied in HCI under the umbrella term of *Human-Food Interaction* (HFI) (Comber *et al.*, 2014).

Although there exists no one agreed upon definition of Human-Food Interaction, Choi and colleagues (Choi *et al.*, 2014) define it as "the interconnection between the self and food" (p.4). This interconnection is important because, "food fundamentally influences the self and, at the same time, a person's actions also significantly influence – beyond individual food choices – the real food and related systems" (ibid, p. 4).

This article offers a first of its kind overview of research in this fascinating interdisciplinary field. We are motivated to illustrate how HFI builds on recent trends within HCI across all phases of the human food cycle.

Early-adopter HFI researchers are experimenting with new and emerging technologies like food printing (Khot *et al.*, 2017a; Sun *et al.*, 2015), virtual reality (Arnold *et al.*, 2018b), robotics (Mehta *et al.*, 2018), acoustic levitation (Vi *et al.*, 2017) and shape changing interfaces (Wang *et al.*, 2017) to illustrate new ways of interacting with food. These works offer a glimpse of a possible ubiquitous future where food and technology could converge, leading to new possibilities for interacting with food. At the same time, experts in the fields of gastrophysics (Spence, 2017) and molecular gastronomy (Adria *et al.*, 2006) outline various innovative ways in which restaurants and food industry could innovate in food design.

This movement occurs in tandem with technological advances which have seen agricultural robots¹ and drones² designed to support efficient farming practices while smart kitchens (Mizrahi *et al.*, 2016) and appliances (Laursen *et al.*, 2015; Sun *et al.*, 2015) are also paving their way in consumer markets offering efficient food preparation processes. Visual

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¹ Farm Bot: https://farm.bot/

² Sensefly: https://www.sensefly.com/solution/ag-360/

social media like Instagram and Facebook are framing and intervening in many of our dining out experiences, leading to the fetishization of food and food experiences (Ibrahim, 2015). At the time of writing (Mar 2019), there were 327,368,100 posts on *Instagram* for #food and 191,080,154 posts for #foodporn (and these numbers will grow in a mere matter of minutes). People are using various online forums³, print⁴, and digital media⁵ to seek expert advice and to share ideas on cooking, fermentation, gardening, diets, and sustainable living. Food is also a favourite theme amongst digital games with titles such as *Cooking* $Mama^6$, *Fruit Ninja*⁷, and *Cooking Dash*⁸ that simulate cooking, selling or eating activities in virtual environments. Practices of personalized nutrition (e.g., Soylent) (Dolejšová and Kera, 2017), DIY food sciences (Kuznetsov *et al.*, 2016b), and open genomics (Shaer *et al.*, 2017) are also gaining currency among the millennials.

Equally, if not more interestingly, technologies are transforming, in diverse and significant ways, multiple socio-cultural aspects of food. For example, whole societies are increasingly doing away with communal meal times to eat alone (Lahad and May, 2017), while individuals rely on digital media to fill the growing gaps in dining companionship (Parrett, 2016). Worldwide obesity has nearly tripled since 1975 with over 40% of adults are now overweight⁹ and technology use is considered to be a key part of the problem (Kautiainen *et al.*, 2005; Reid Chassiakos *et al.*, 2016). Food waste, on the other hand, is a globally concerning phenomenon, with roughly one third of the food produced in the world for human consumption getting thrown away or wasted¹⁰. Ironically, U.N.'s 2017 annual report reveals that 11% of the global population is

³ Homebrewing association: https://www.homebrewersassociation.org/forum/

⁴ Fine cooking magazine: https://www.finecooking.com/magazine

 $^{^5}$ Garden design search on Pinterest: https://www.pinterest.com.au/search/pins/?rs=trending&q=Garden%20Design

⁶ Cooking Mama: http://www.cookingmama.com/

⁷ Fruit Ninja: https://fruitninja.com/

⁸ Cooking Dash: https://www.glu.com/games/cooking-dash/

 $^{^9}$ WHO report on obesity: https://www.who.int/news-room/fact-sheets/detail/ obesity-and-overweight

 $^{^{10}}$ FAO report on food waste: http://www.fao.org/save-food/resources/ keyfindings/en/

still living in hunger with no easy access to clean and healthy food¹¹. In these challenging and interesting times, there is certainly plenty of onus to think and reflect before designing technology mediated ubiquitous food future and shape a better relationship with our environment and our own humanity.

The field of HFI has already been actively studying these topics through various workshops (Choi *et al.*, 2012; Clear *et al.*, 2013; Comber *et al.*, 2012; Dolejšová *et al.*, 2018; Kuznetsov *et al.*, 2016b; Raturi *et al.*, 2017) and symposia¹². There are emergent active communities working in this field, including: *FoodCHI Special Interest Group* (Khot *et al.*, 2017b); *SIGCHI foodCHI network*¹³; *Facebook FoodCHI group*¹⁴ and; an *ACM Future of Computing Academy working group on Computing and Food*¹⁵. Besides, Altarriba Bertran et al. (2019) have introduced the "*making sense of HFI*" dataset that offer a web-based visualisation tool on existing HFI research in HCI.

In this article, we offer a review of the modest but rapidly growing body of academic literature on the topic of HFI. We present a structured overview of literature across four phases of HFI, namely, growing, cooking, eating and disposal. We systematically examine and outline the critical literature within HCI on each of the food cycles and offer a comprehensive picture of opportunities, challenges, and research gaps to guide further research. Our work offers a knowledge base through accumulating findings from a range of projects and studies, while for HFI researchers and scholars, this article presents opportunities for further research. We conclude this article by offering a vision towards "*Human-Food Practices (HFP)*" that goes beyond the dyadic interaction between the self and food and considers the dynamics of social norms, motivations and perceptions, and how they are formed

 $^{^{11}}$ UN's report on food security: http://www.fao.org/state-of-food-security-nutrition/en/

¹² HFI Symposia: http://datamaterialities.org/foodchi.html, http://foodchi.urbaninformatics.net/

¹³ SIGCHI FoodCHI network: http://prior.sigchi.org/communities/foodchi

¹⁴ Facebook FoodCHI group: https://www.facebook.com/groups/FoodCHI/

 $^{^{15}}$ ACM group on Computing and Food: https://acm-fca.org/2018/07/01/future-of-computing-food-manifesto/

and transformed through the continued enactment of a particular food practice.

Although we have framed HFI as a sub-discipline of HCI here, we do acknowledge the transdisciplinary nature of food research that extends beyond the disciplinary borders of HCI. It is worth mentioning that research on HFI issues has also been carried out elsewhere in larger fields such as anthropology (Holtzman, 2006; Mintz and Du Bois, 2002), sociology (Schneider, 2018; Warde, 2016), media studies (Counihan and Van Esterik, 2012; Frost and Strickland, 2016), medical sciences (Kendrick, 2008; Scrinis, 2013; Willett and Stampfer, 2013), and psychology (Bays, 2017; Conner and Armitage, 2002; Rogers *et al.*, 2016). As a result, we acknowledge that this article might not be a thorough review of prior research efforts and may miss concepts and ideas from other related fields of research.

The article is structured in the following way. We first argue that designers need to pay attention to two core aspects when it comes to human-food interaction: the *instrumental*, a term which refers to corrective uses of technology, for instance, how food is used as a source of energy and its relation to health and wellbeing; and the *experiential*, which refers to how food affords rich multi-sensorial experiences and its relation to our identity, enjoyment, and society.

These two aspects are then considered across the four phases of HFI: growing, cooking, eating, and disposal. We categorize and disseminate existing works across each of these phases to unfold a rich design space that highlights underexplored areas of investigation that interaction designers may find intriguing for further studies. Using the design space, we articulate a set of opportunities with a particular focus on hardware to advance human-food interaction field forward before concluding with our vision towards designing and studying "Human-Food Practices (HFP)".

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