Designing for action: An evaluation of Social Recipes in reducing food waste

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ABSTRACT

Approximately, one-third to half of all food produced globally is wasted. In developed countries, roughly up to half of this food waste comes from consumers. In response to this, the UN has set goals to raise consumer awareness and reduce food waste by 50% before 2030. Our objective is to evaluate how emerging technologies could improve awareness in households. Inspired by future sensing possibilities, we envision a community-based social system that captures in-home food availability and waste patterns and uses this information to support awareness and sustainability. In this work, we describe an evaluation of a component that could be part of such a system. This component or concept, called *Social Recipes*, aims at encouraging food sharing by suggesting groups of related consumers recipes that are based on ingredients from different individuals or households. To evaluate *Social Recipes*, we conducted 3 user studies to see how it could raise awareness and reduce food waste and to suggest implications for its design. In the first two studies, we evaluated expected impacts of the concept. The third study was a home deployment, where *Social Recipes* were sent using technological probes for a more realistic experience. Here, we also evaluated it against the more common method of influence strategy in sustainability research that is restricted to feedback (i.e., eco-feedback). Our main findings showed that *Social Recipes* has raised awareness of in-home food availability and triggered food-related conversations among participants resulting in knowledge gain. However, *Social Recipes* alone was not perceived as effective in directly reducing food waste. And therefore, for the design of a community-based social system, we suggest another component to be added to the system that provides eco-feedback. This component was perceived as more effective in reducing food waste with impacts on awareness of waste generation and social surveillance. Overall, the aim of this work is to contribute to an understanding of how *Social Recipes* could impact consumers and how to design a community-based social (recipe) system that can be integrated in consumers daily activities for effective but pleasurable food waste prevention.

1. Introduction

The impact of food waste on the environment and food security has become a global concern. Previous estimates show that one-third to one-half of the world's food, approximately 1.3 billion tonnes, becomes waste (Gustavsson et al., 2011). This goes hand in hand with the overconsumption of natural resources: food waste produces 10% of rich countries' greenhouse gas emissions and is responsible for the use of 550 billion cubic meters of water globally (Food waste facts, 2015). Despite these numbers, twice as much food is produced than required by nutritional needs per living person (Fox Ceng, 2013). In fact, with less than a quarter of the food we waste, the world's nearly one billion hungry people could have been lifted out of undernourishment (Fusions, 2015). If consumers continue current consumption patterns, food production would need to increase by 70% to feed all 9 billion people in 2050. These global facts show that sustainability research, specifically in targeting food waste, should receive critical attention.

To prevent food waste, changes at various levels are required, such as in policy, technological environment, and education etc. However, as final demand of food is located at the consumer level, consumers could be considered the most important drivers of overall waste generation, resource consumption and impacts on the environment (IPCC, 2007). Research has shown that in high and medium-income countries over 40% of the total amount of food waste occurs at retail and consumer levels (Gustavsson et al., 2011; Beretta et al., 2013). Consumers generate food waste (222 million tons) that is almost as high as the total net food production (230 million tons) in Sub-Saharan Africa (Gustavsson et al., 2011). For example, studies in the United States showed that 19% of the total amount of consumers food supply gets wasted (Buzby and Hyman, 2012). In the United Kingdom, the avoidable food losses correspond to 21.3% of the purchases (Quested and Johnson, 2009). These amounts of food waste were further found
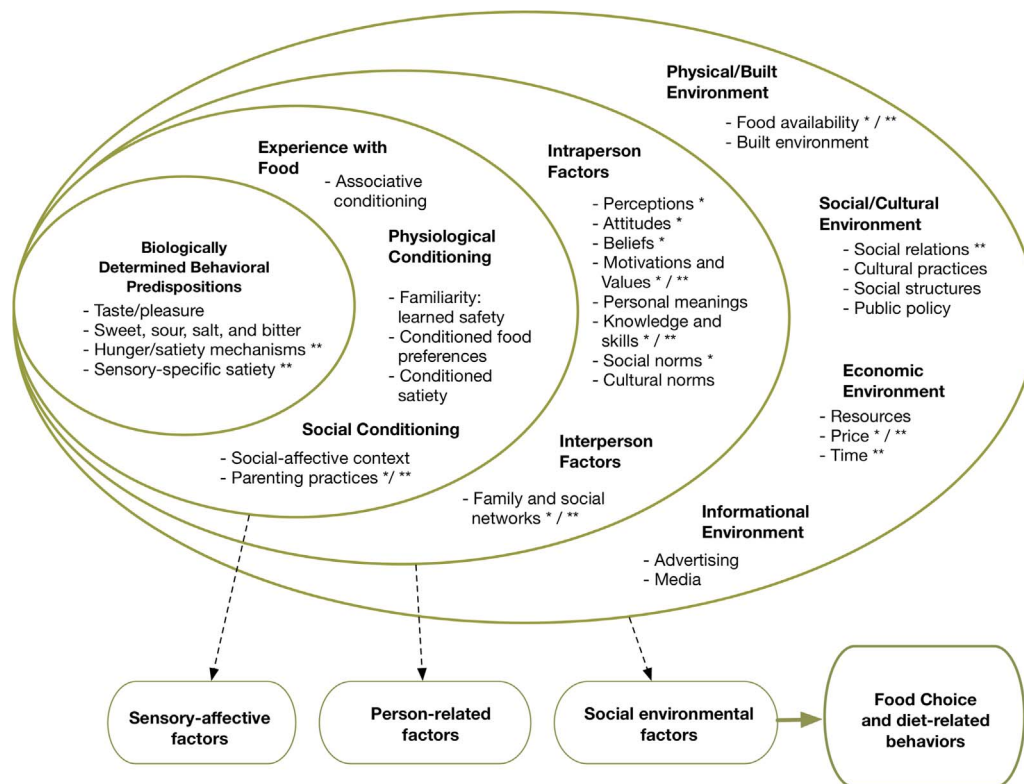
Fig. 1. Factors influencing food choices and dietary behaviors. Source: Contento (2000). Note: factors with "*" indicate determinants of sustainable behaviors and factors with "**" indicate determinants of food waste behaviors as discussed in literature.

to be dependent on the size and composition of households. Large households with unrelated adults and large households with related adults with children were found to waste the most, while single-occupancy households the least in terms of weight and costs (Wrap, 2008). Thence, if larger households are targeted, *more* food could be saved from being wasted. Moreover, large households have easier access to share or coordinate with others, which opens up design opportunities for reducing consumer food waste more effectively from a collective point of view. Overall, reducing food waste at the consumer level in Europe only is expected to impact Gross Domestic Product (GDP) increase, land use within Europe, and food security in Sub-Saharan Africa (Rutten, 2013).

Despite these findings, sustainability research has mainly put effort into areas such as sustainable energy consumption and water or resource consumption (Brynjarsdttir et al., 2012). Although ecological sustainability is an increasing concern in sustainability research, to date, food waste has received little attention. Fortunately, the United Nations have set goals to reduce food waste by 50% and reduce food chain resource inputs by 50% before 2030 (Fusions, 2015). The United Nations Environmental Program (UNEP) is aiming at raising awareness on the value and environmental impacts of food people eat by redirecting consumption patterns to less resource-intensive foods or behaviors (Moomaw et al., 2012). This has raised our interest in exploring how emergent technologies could improve awareness, resource efficiency and prevent food waste in consumers every day lives.

The central aim of this paper is to work towards the design of a domestic community-based social system for sustainable food practices. Specifically, we aim at exploring the potential of a concept called *Social Recipes* that could be integrated as a component in such a system, evaluate its impact on users and suggest implications on its design. In this concept, ingredients available from different households are combined into one or more recipes, which are suggested to a group of users. The prospective is to collectively prevent food waste by encouraging collaboration and food sharing. Apart from this altruistic

aim, the concept is expected to incentivize people to share, cook, learn and enjoy food together. The concept is evaluated in 3 steps. In the first study, we identified the amounts and types of food waste as well as the reasons of wastage to see how and which food items to target. In the first and the second study, we explored the experiences expected from such a concept by presenting it verbally to study participants. In the third study, we evaluated the concept in a home deployment using technological probes (Hutchinson et al., 2003) and a Wizard of Oz approach to explore actual experiences (Dow et al., 2005). The Wizard of Oz approach is a widely used method in human-computer interaction research to explore user interfaces for pervasive, ubiquitous, or mixed-reality systems that combine sensing and intelligent control logic. With this approach, the logic behind the user interface interactions are enacted by a person rather than a system. In addition to the concept of *Social Recipes*, we prototyped the more common method of persuasion that is restricted to feedback (i.e., information of what one has wasted) for comparison purposes. With these user studies early in the design process, we can specify the behavior of the overall envisioned system and increase the likeliness of acceptance in daily lives. For our studies, we recruited students and young professionals, as they often live in large and shared households. The United Nations estimated the global population of young people has hit 1.8 billion, hence there are more young people in the world than ever before. We chose a specific target group following Wrap's claims that interventions should be developed with the specific needs of different groups in mind (Wrap, 2014); as they might require different approaches due to the complexity of waste generation.

We structured this paper as follows. In Section 2, we first discuss related work on how consumers make decisions around food and the factors influencing sustainable choices and food waste-related behaviors. This is followed with current solutions that aim at reducing domestic food waste. Based on these reviews, we conclude the section with opportunities for designing food waste-related technology. In Section 3, we present the overall system; a community-based social