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Where to start fighting the food waste problem? Identifying most promising entry points for intervention programs to reduce household food waste and overconsumption of food

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ABSTRACT

Preventing household food waste and overconsumption of food represents a crucial leverage point for the promotion of global environmental sustainability with various food waste related behaviors (i.e. planning, shopping, storage, preparation and consumption practices), which should be taken into account when developing appropriate intervention programs.

In order to identify the most promising entry points for intervention development, we conducted an online survey (N = 402) to quantify effects' strength of various food waste related behavioral categories on food waste outcomes as well as on overconsumption outcomes referring to specific, environmentally relevant food groups (i.e., meat, dairy products and bakery products). In line with previous research, we identified (1) food waste preventing consumption practices referring to leftovers, (2) food waste preventing consumption practices referring to expired/ suboptimal food, and (3) food waste preventing shopping practices as characterized by effects of significance and meaning on food waste outcomes and/ or overconsumption outcomes referring to these food groups. Additionally, these three behavioral categories have been found to be characterized by low performance levels and, therefore, hold high potentials for the promotion of behavioral changes by intervention programs.

In addition to providing valuable results for intervention initiatives, our study also provides empirical evidence and draws attention to appropriate developments in food waste research by considering (1) specific behavioral characteristics, (2) specific food characteristics, and (3) sufficiency strategies and overconsumption of food as an independent issue reaching beyond the issue of household food waste to improve the sustainability of the modern food system.

1. Introduction

1.1. Decreasing household food waste – a crucial leverage point to improve global environmental sustainability

Globally, 1.3 billion tons per year of all food that is produced for human consumption are lost or wasted (see e.g., Gustavsson et al., 2011) with industrialized countries producing high amounts of *food waste*, i.e. food that is discarded/ not consumed in time being suitable for human consumption (see e.g., Buchner et al., 2012; Lucifero, 2016; Parfitt et al., 2010; Priefer et al., 2016; Stuart, 2009; Thyberg and Tonjes, 2016). Furthermore, studies conducted, for example, in Germany (e. g., Kranert et al., 2012), Italy (e. g., Buchner et al., 2012), Switzerland (e. g., WWF Schweiz, 2012) or in the European Union (EU; e. g., Lucifero, 2016; Stenmarck et al., 2016), unanimously indicate private households as main contributors of food waste. For example Stenmarck et al. (2016) estimated 53% of the total EU food waste coming from households.

Aside from relevant economic and social consequences (see e.g., Food and Agriculture Organization of the United Nations, 2013 for details), high amounts of household food waste also contribute significantly to global environmental problems. (1) In addition to environmental consequences associated with food waste disposal (see e. g., Stuart, 2009), high amounts of food waste represent high amounts of unnecessary global food production, resulting in high amounts of unnecessary global environmental impacts, like unnecessary amounts of greenhouse gas emissions, water consumption, land use as well as unnecessary threats to natural biodiversity, both on land and in water (Food and Agriculture Organization of the United Nations, 2013). In consequence, significant reductions of household food waste can be

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seen as a crucial leverage to increase global environmental sustainability (West et al., 2014). Thus, the United Nations defined global food waste prevention at the consumer levels (in addition to food waste prevention at the retail levels and the reduction of food losses along production and supply chains, including post-harvest) as an important *Sustainable Development Goal* (SDG 12.3; United Nations, 2015). But to meet this challenge, we need a clear understanding of the drivers of household food waste.

1.2. Research on the drivers of household food waste

1.2.1. Considering specific behavioral characteristics

Even though research on the drivers of household food waste is growing in frequency – especially during the last decade (see e g., Chen et al., 2017; Porpino, 2016; Schanes et al., 2018), it still remains relatively scarce (Roodhuyzen et al., 2017; Stefan et al., 2013; Van Doorn, 2016). Nonetheless, a relevant issue regarding household food waste is already shared by most researchers (e. g., Quested et al., 2013; Roodhuyzen et al., 2017; Schanes et al., 2018; van Geffen et al., 2016): comparable with other forms of household pro-environmental behavior (e. g. decreasing household's energy consumption by household members' performance of several energy saving behaviors like switching off the light when leaving a room), "[…] the generation of food waste is best viewed not as a single behavior but as the result of multiple behaviors that can increase the likelihood or amount of food being wasted. These behaviors relate to many different aspects of food's journey into and through the home: planning, shopping, storage, preparation and consumption of food […]. This means that by the time an item of food is thrown away, the opportunity to prevent that food from becoming waste has usually passed, i.e., the action (or actions) leading to the waste may have been some time, often many days, in the past" (Quested et al., 2013). Therefore, the amount of household food waste (i. e., *food waste outcome*) finally represent the delayed result of household members' performance of such various *food waste related behaviors*, which are typically seen as immediate drivers of food waste outcome (e. g., Roodhuyzen et al., 2017).

When trying to identify more underlying drivers of food waste outcome, most researchers are looking for effects of individuals' attitudes towards food waste (e. g., Stancu et al., 2016; Stefan et al., 2013), sociodemographic features of household members/ households (e. g., Baker et al., 2009; Consumer View GmbH, 2011; Edjabou et al., 2016; Graham-Rowe et al., 2015; Hamilton et al., 2005; Herath and Felfel, 2016; Jörissen et al., 2015; Koivupuro et al., 2012; Parizeau et al., 2015), or other potential drivers on food waste outcome. Of course, such an *outcome focused research approach* is very promising, already resulting in relevant findings regarding the underlying drivers of food waste outcome. But considering household members' performance of various food waste related behaviors as immediate drivers of food waste outcome, an alternative research approach seems also appropriate: since specific behaviors or at least specific behavioral categories are generally characterized by specific underlying drivers (i.e., specific costs and benefits; see e. g., McKenzie-Mohr, 2000), each food waste related behavior or at least behavioral category, should also be characterized by its specific underlying drivers. For example, food waste related shopping practices referring to impulsive purchases due to quantity discounts in supermarkets could be strongly determined by the individual's preference for economical grocery shopping (see e. g., Aschemann-Witzel et al., 2015; Schmidt, in press). Instead, the consumption of expired (but probable still edible) food could be determined strongly by the individual's perceived health risks regarding consumption of expired food (see Section 4.1.2 for details), while the individual's preference for economical grocery shopping could be irrelevant for this specific behavior. Thus, by focusing on effects of potential underlying drivers on food waste outcomes, it seems quite difficult to discover such specific behavioral characteristics. So, in order to further identify underlying drivers of household food waste, we should consider such specific behavioral characteristics by also using a *behavioral research approach* considering specific drivers of various food waste related behavioral categories resulting in specific findings, which can finally be integrated into a complex, but comprehensive pattern of drivers of household food waste. But in order to do so, initially, we need to get a deeper understanding of effects' strength of various food waste related behavioral categories on food waste outcome.

Keeping in mind that those food waste related behavioral categories that are characterized by stronger effects on household food waste outcome (i. e., causing higher amounts of household food waste outcome than other food waste related behavioral categories), represent more effective entry points for intervention programs that try to optimize peoples' behavioral performance in order to decrease food waste outcome, it seems quite obvious to further focus on underlying drivers of these more effective behaviors. Thus, more information about effects' strength of various food waste related behavioral categories on food waste outcome is needed in order to identify the most promising entry points for future intervention programs. Therefore, we conducted a study trying to quantify effects' strength of various food waste related behavioral categories on food waste outcome.

Additionally, empirical data about the number of people performing various food waste related behaviors (i.e. *performance levels* of various food waste related behaviors or behavioral categories) could provide further insight into the most promising entry points for future intervention programs to reduce household food waste (see e. g., Dietz et al., 2009; Klöckner, 2015). For example, low performance levels of food waste related shopping practices referring to avoidance of impulsive purchases represent higher potential for desired behavioral changes than already high performance levels. Thus, in order to use resources wisely, intervention programs should focus on food waste related behavioral categories not only characterized by strong effects on food waste outcome, but also by low performance levels. Therefore, our study should also provide information on the performance levels of various food waste related behavioral categories.

1.2.2. Considering specific food characteristics

Apart from considering specific behavioral characteristics in order to further identify underlying drivers of household food waste, we also have to consider specific food characteristics, only sometimes considered by previous research on household food waste so far (e. g., Aschemann-Witzel et al., 2018; de Hooge et al., 2017; Wilson et al., 2017). Since research shows both, diverse amounts of household food waste and different amounts of consumption regarding various food groups (e. g. meat vs. vegetables and fruits, see e. g., Food and Agriculture Organization of the United Nations, 2013), differences in an individual's performance of food waste related behavioral categories regarding various food groups seem also obvious and are already indicated by some empirical work (e. g., Aschemann-Witzel et al., 2015, 2018; Wilson et al., 2017). For example, food waste related shopping practices referring to impulsive purchases due to quantity discounts in super markets, which could be strongly determined by an individual's preference for economical grocery shopping, could be performed differently regarding food groups characterized by higher prices (e. g., beef) compared to cheaper food groups (e. g., conventional produced dairy products, like milk, yoghurt etc. or bakery products, like bread). So, it seems reasonable to assume some food specific differences in performance levels of various food waste related behavioral categories as well as some further food specific differences in effects' strength of various food waste related behavioral categories on food waste outcome. Therefore, we also considered a *food specific research* approach in our study when measuring performance levels of various food waste related behavioral categories as well as when quantifying effects' strength of various food waste related behavioral categories on food waste outcome.