

**Food waste in the eye of the consumer:
antecedents and consequences of consumer-generated food
waste**

PhD dissertation

Ada Maria Barone

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Supervisor: Simona Romani
Co-supervisor: Matteo De Angelis

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Introduction

Concerns about the amount of food that is wasted along the food supply chain are more and more becoming a topic of conversation among policy makers, companies, and researchers. Indeed, it is estimated that one third of all food produced globally is either lost or wasted (Gustavson et al., 2011), meaning that is discarded either in the supply chain between producer and market, or at retailers' or consumers' level. More specifically, 30-40 percent of the food supply is wasted in the United States (U.S. Food and Drug Administration, 2019) corresponding to an economic loss of \$218 billion per year (Berkenkamp, Hoover and Mugica, 2017), while 88 tonnes of food are wasted in the European Union with an associated cost of 143 billion euros (Stenmarck et al., 2016). Furthermore, when food is wasted, also labour, energy, water, land and work that went into producing it is lost (Gustavson et al., 2011), with negative effects at both the environmental and societal level. For instance, most of the food that is wasted ends up in landfills, generating methane and contributing to greenhouse emissions (Berkenkamp, Hoover and Mugica, 2017). Moreover, the large volumes of food that is lost are a starting point for discussions about food security and equality of distribution of resources, especially given estimates that the quantity of food wasted in industrialized countries correspond to the amount of food that is produced in the whole of the Sub-Saharan Africa (Gustavsson et al., 2016). As a result, the reduction of food waste is now a top priority both at the national and global level, with the UN including the goal of halving per capita global food waste at the retail and consumer level by 2030 (United Nations, 2015) and the European Commission taking action to achieve the goal of reducing food waste without compromising food safety (European Commission, 2019).

Given that the largest share of food is wasted at the consumer level (Stenmarck et al., 2016), recent research has delved into the investigation of the antecedents of consumer-generated food waste and on the understanding of the drivers of consumers' wasteful attitudes and behaviours (Aschemann-Witzel et al., 2015; Cappellini and Parsons, 2012; Graham-Rowe et al., 2014; Schanes, Dobernick, and Gözet, 2018). In this sense, such understanding is paramount for the development of actions to

be implemented by both companies and policy makers aiming at curbing food waste and is furthered boosted by the recent call for more theoretical contributions about the psychological underpinnings of consumers' behaviours in relation to food waste (Block et al., 2016). More specifically, the antecedents of food waste identified by prior research include both individual characteristics of consumers that increase their tendency to waste food (e.g. good provider identity, e.g., Aschemann-Witzel et al., 2015; Cappellini and Parsons, 2012; Graham-Rowe, Jessop, and Soarks, 2014) and contextual or marketing-related factors that makes it harder for consumers to avoid food waste, as well as practices enacted every day that may interfere with consumers' efforts to reduce food waste.

First, behaviours and practices enacted in the household are among the main drivers of disposal of edible food. For instance, the tendency to offer an overabundance of food to guests, family members, or people one cares about – that is the so-called tendency to be “a good provider” – leads individuals to over-purchase and overcook, with the consequence that large shares of food are later discarded (Aschemann-Witzel et al., 2015; Cappellini and Parsons, 2012; Graham-Rowe et al., 2014). Similarly, concerns about the quality and safety of food or leftovers, coupled with consumers' lack of knowledge about expiration dates (e.g., Tsiros and Heilman, 2005), is often translated in the premature disposal of food (e.g., Aschemann-Witzel et al., 2015; Farr-Wharton, Foth, and Choi, 2014; Graham-Rowe et al., 2014). This is in line with research showing that household food waste is successfully reduced when consumers can enact strategies that help them reuse or save leftovers or food that would be usually discarded (Stancu et al., 2016). In other instances, consumers' desire to follow a healthy diet full of fresh, easily perishable produce, leads to the involuntary increase of household food waste (Barone, Romani, and Grappi, 2019) because of the shorter shelf life of these products (Maubach et al., 2009).

However, while these findings show that food is discarded once it reaches the household, other studies have highlighted how behaviors enacted in the planning phase of purchase are equally important for the understanding of consumer-generated food waste. For instance, the lack of planning before going grocery shopping increases the likelihood of purchasing larger amounts of products one

does need and the likelihood of purchasing products one does not need, which cannot be consumed and are later disposed of (Stancu et al., 2016; Stefan et al., 2013). Conversely, often consumers prefer to stock on food to save time on shopping trips (Setti et al., 2018) or to be prepared in case something unplanned happens (Graham-Rowe et al., 2014). Similarly, monetary savings associated with bulk purchases are often counteracted by larger amounts of food waste generated inside the household (Farr-Wharton et al., 2014; Hebrok and Boks, 2017; Setti et al., 2018).

Finally, recent research has started investigating how suboptimal or imperfect products and the unwillingness to sell, purchase, or consume them contributes to food waste at both the retailer and consumer level (De Hooze et al., 2017). Imperfect or suboptimal products are products that deviate from the normal or optimal standard because of their expiration date, physical characteristics such as shape, weight or size, or because of defects in their packaging (De Hooze et al., 2017; White et al., 2016). Indeed, consumers often make inferences about food and its inner qualities based on its external appearance, such that they are reluctant to consume products past their expiration date even if they are still edible, or products that have imperfections in their packaging for fear of contamination (White et al., 2016). Furthermore, recent research provides evidence about consumers' aversion to buy and consume imperfect produce, that is fruits and vegetables that are abnormal in their appearance in terms of features such as color, shape or size (e.g., Loebnitz, Schuitema, and Grunert, 2015; Grewal et al., 2019), because perceived as riskier and less tasty than their perfect counterparts (Cooremans and Geuens, 2019; Loebnitz and Grunert, 2018). Indeed, retailers do not offer these products on their shelves assuming that consumers would not be willing to buy products that are not aesthetically perfect. As a result, this practice leads to the rejection of a large share of fresh, edible food and does not account for the possibility that consumers' may be willing to buy and consume these products or that strategies could be enacted to make consumers more open toward imperfection. Indeed, results from recent research show that there are circumstances that makes consumers more accepting of imperfection (De Hooze et al., 2017) and that simple interventions can be enacted in-store or in communication campaigns to overcome consumers' aversion toward imperfection

(Cooremans and Geuens, 2019; Grewal et al., 2019). Hence, whereas knowledge about this issue is still limited, these results raise questions about whether consumers' perception of these products is unequivocally negative. In turn, this issue opens up to the need of a more in-depth investigation about consumers' orientation toward imperfect produce.

Hence, one of the research questions that will be explored in this dissertation is: which are the factors that affect consumers' orientation toward imperfect produce? The aim – explored in the first paper included in this dissertation – is to provide a broader overview of consumers' reactions and orientation toward imperfect fruits and vegetables. This could provide useful suggestions about potential entry points for the development of interventions aimed at promoting the consumption of imperfect produce and thus reduce food waste. In this sense, building on results from this paper and in line with recent contributions focusing on the development of strategies aimed at overcoming consumers' aversion toward imperfection (Cooremans, and Geuens, 2019; Grewal et al., 2019), in my second paper I propose and test an intervention for promoting the consumption of imperfect produce. Specifically, I focus on the physical processing of imperfect produce (i.e. transforming fresh produce into other products such as juices or smoothies) as a solution to the food waste problem, and I provide evidence for the psychological mechanism explaining why this strategy may be successful in positively changing consumers' attitude toward imperfect fruits and vegetables.

In this sense, the contribution of the first two papers included in my PhD dissertation to literature on food waste is twofold. First, I explore an antecedent of consumer-generated food waste – consumers' perception of imperfect produce – and I provide a detailed account of the reasons underlying consumers' negative or positive orientations toward these products. Second, I contribute to literature on this topic by providing evidence about an intervention that successfully overcomes consumers' reluctance toward imperfect produce and that could be applied by actors operating at different levels of the food value chain. Hence, my first and second paper are positioned in and build on the growing literature exploring the antecedents of consumer-generated food waste from a consumer behavior point of view.

However, it is worth noting that much less is known about the consequences of food waste, and about how consumers react, both emotionally and behaviorally, to a food waste event. Indeed, whereas literature has provided evidence about consumers' feeling guilty or bad after wasting food (e.g., Evans, 2012; Watson and Meah, 2012), this knowledge is still limited, and such notions have yet to be experimentally tested. With the aim of filling this gap, my third paper focuses on consumers' reactions toward food waste and shows that perception of responsibility for a food waste event affects the emotional and behavioral response to food waste. More specifically, I provide robust evidence that consumers feel guilty about food waste only when they perceive themselves personally responsible for this event, and that this emotional reaction is associated with a higher likelihood to engage in behaviors aimed at compensating for the harm done. In this sense, my third paper is positioned at the intersection of the antecedents and consequences of consumer-generated food waste, as it explores an antecedent neglected by prior research – i.e. perception of responsibility for the food waste event – and the emotional and behavioral consequences arising from such perception.

In conclusion, this PhD dissertation is focused on the antecedents and consequences of consumer-generated food waste and on the understanding of these factors from a consumer behavior perspective. More specifically, the goal of this dissertation is threefold. First, to advance knowledge about the psychological underpinnings of consumers' wasteful behaviors, in line with the recent call for more theoretical contributions in this sense (Block et al., 2016). Second, to provide useful suggestions and solutions that could be enacted by both actors of the food value chain and policy makers to reduce food waste at the consumer level. Third, to provide evidence about the emotional and behavioral consequences of consumer-generated food waste. In conclusion, despite limitations, this PhD dissertation aims at offering new perspectives in terms of research about food waste in the eye of the consumer and at encouraging future research building on this topic.

Overview of research papers

Paper 1

The first paper included in this dissertation, titled “*Consumers’ orientations to imperfect fruits and vegetables: a multi-faceted phenomenon*”, explores consumers’ orientation toward imperfect produce and provide a detailed account of the associations elicited by imperfect fruits and vegetables. This topic is relevant as every year up to 40% of edible produce is wasted because of retailers’ stringent aesthetical standards related to shape, size, and blemish for fresh produce (Bond, Meacham, Bhunnoo, and Benton 2013). Indeed, shape abnormalities in fresh produce have been shown to negatively affect purchase intentions, with consumers more likely to buy normally shaped fruits and vegetables (Loebnitz and Grunert, 2015) and less likely to buy extremely abnormal ones (Loebnitz et al., 2015). Indeed, consumers associate fruits and vegetables’ shape abnormalities with genetically modified (GM) foods, such that these products are perceived riskier and less safe (Loebnitz and Grunert, 2018). On the other hand, factors such as high levels of environmental concern, social trust, awareness of food waste problems, and whether the individual is planning to eat the product at home or to buy it at the supermarket have been shown to attenuate these negative perceptions (De Hooge et al., 2017; Loebnitz and Grunert, 2015; Loebnitz et al., 2015).

Building on this evidence suggesting that there might be boundary conditions to the rejection of imperfection and that consumers may not be unequivocally averse to food imperfection, we set out in this paper to provide a broader and more detailed overview of consumers’ orientation toward aesthetically imperfect produce and of the associations developed in relation to these products. More specifically, the goal was to provide a robust account of the cognitive and emotional facets of consumers’ orientation toward these products. Hence, we adopted a mixed-method approach, and conducted a qualitative study (Study 1) and a quantitative study aimed at validating results from our qualitative study (Study 2).

More specifically, Study 1 was aimed at identifying the affective and cognitive facets of consumers’ orientation to imperfect fruits and vegetables. For this purpose, we conducted 31

interviews using the Zaltman Metaphor Elicitation Technique (ZMET, Zaltman and Coulter, 1995; Coulter, 2006). We coded responses of each informant and then identified broader categories and overarching themes. Finally, these themes were traced back to two main dimensions cutting across all our informants, that is the valence of consumers' reaction toward imperfect produce (positive vs. negative) and the presence of *resolved* versus *unresolved* cognitive and emotional tensions toward these products. By doing so, we were able to identify four categories of orientations toward imperfect produce, which roughly correspond to four prototypical categories of consumers. More specifically, we categorized the orientations as either *approach* or *avoidance*; in turn, these orientations can either be *balanced* or *unbalanced* based on whether the cognitive and emotional tensions associated with the consumer's reaction to imperfection are *resolved* versus *unresolved*. For each orientation we have identified, we provide an overview of its specific cognitive and emotional facets, together with a mapping of the behaviors and individual traits associated to it.

Building on the results of Study 1, we have conducted a quantitative study (Study 2) aimed at validating results from the interviews and at verifying whether the factors previously identified would be replicated at the quantitative level. To measure consumers' cognitive and emotional reactions to imperfect fruits and vegetables we used measures already tested by prior research (e.g., De Hooge et al., 2017; Loebnitz et al, 2015; Stancu, Haugaard, and Lähteenmäki, 2017), and generated additional items based on the results of Study 1. We conducted a survey ($N = 135$, $M_{age} = 35.23$, $SD = 12.78$) aimed at a preliminary assessment of the new scales (Study 2a). Structural equation modeling (LISREL 8.8) was used to assess the convergent and discriminant validity of the measures. Given the positive results of this measurement assessment, we used the new scales in Study 2.

In Study 2 ($N = 746$, 56.3% *female*, $M_{age} = 31.08$, $SD = 13.50$) participants were asked to read a scenario and were shown a picture of an imperfect product (i.e. imperfect carrots); after being exposed to the stimuli, participants were asked to answer questions about their general perception of imperfect produce using scales validated by prior literature on food waste and imperfection together with the ones tested in Study 2a. We adopted a cluster analysis approach to the data, which enabled

us to categorize respondents based on their responses to the clustering variables. Results of the cluster analysis provided evidence for four differentiated groups of consumers that we labeled based on the emotional, cognitive and behavioral characteristics emerging in relation to their orientation toward imperfect fruit and vegetables (*Rejecter, Avoider, Acceptor, Embracer*). The four groups identified in Study 2 were significantly different from each other in terms of the cognitive and emotional associations elicited by imperfection, and in terms of behaviors enacted by consumers in each group toward imperfect fruits and vegetables. More specifically, results of the cluster analysis confirmed results from Study 1 and showed that consumers' orientation toward imperfect produce is the result of the interaction of different individual, emotional, cognitive, and behavioral factors. Furthermore, the results provide quantitative evidence for the existence of groups of consumers that have a positive orientation toward imperfection (*Approacher, Embracer*), contrary to results from prior research showing that consumers are unequivocally negative toward these products (e.g., Grewal et al., 2019; Loebnitz and Grunert, 2015).

This work contributes both at the theoretical and practical level. First, we contribute to literature on imperfection by providing a broader and more detailed overview of this phenomenon and by providing evidence for both positive and negative orientations toward imperfect produce. Second, we contribute to literature on food waste as our findings provides an overview of the emotional, cognitive and behavioral facets of consumers' orientation toward imperfect produce. Indeed, these findings provide both a new theoretical perspective in terms of consumers' responses toward imperfection and useful suggestions to actors of the food value chain and policy makers aiming to reduce food waste. Indeed, our results represent useful entry points that could be leveraged for the development of initiatives and campaigns aimed at promoting the consumption of these products and thus at reducing the food waste deriving from imperfection.

Paper 2

The second paper included in this dissertation, titled “*The role of food processing in making imperfection beautiful: the physical processing of imperfect produce as a way to improve attitude and reduce food waste*”, investigates the effect of physically processing imperfect fruits and vegetables on consumers’ attitude and shows through four experimental studies that imperfect produce that has been physically processed is more positively evaluated than imperfect produce in its original state. More specifically, we show that physically processing imperfect fruits and vegetables makes them more prototypical – and thus more representative of their category (Veryzer and Hutchinson, 1998) – with positive effects on attitude. In this sense, we provide evidence for the effectiveness of an intervention – i.e. physical processing of the product – that successfully overcomes consumers’ negative perception of imperfect produce. Indeed, whereas consumers’ negative attitude toward imperfect fruits and vegetables can be explained in terms of the well-known preference of individuals for products that are typical of a product category (Maoz and Tybout, 2002; Veryzer and Hutchinson, 1998), it is worth noting that when products – and food – go through physical changes, their core characteristics are altered. Such changes can lead consumers to perceive the product as belonging to a different category, affecting their evaluation and behavior. More specifically, an imperfect product that has been physically processed is perceived as more prototypical than an imperfect one in its original state, which in turn increases attitude. For instance, an apple with imperfections is less prototypical than an apple with some shape abnormalities (e.g., blemish, size, color); on the other hand, an apple juice is prototypical and a good example of the whole category (i.e. juice) regardless of whether it has been produced with imperfect or perfect fruits. Finally, we also provide evidence for a boundary condition of this effect, namely when the artificial processing of imperfect products does not improve the attitude towards them.

We have conducted four experimental studies to provide evidence for our proposed effects. Study 1 (N = 133, 58% female; median age = 21) used a 2 (perfect vs. imperfect product) x 2 (no processing vs. processing) between-subjects experimental design and was aimed at testing the

interaction between food imperfection and the physical processing of the product on consumers' attitude toward the product. Results of this study show that for imperfect products attitude was more positive when the product had been physically processed than when the product was in its original state, whereas for *perfect* products there was no significant difference between the two conditions. Thus, these results confirmed that physically processing imperfect produce is an effective way to improve attitude toward it.

In Study 2 ($N = 190$, $M_{age} = 33.41$, $SD = 14.43$, 48% female), we used the same experimental design as Study 1 with the aim of providing evidence for the proposed underlying theoretical mechanism of prototypicality for the effect of imperfection and physical processing of the imperfect product on general attitude toward the product. Results of this study provide evidence for the hypothesized mechanism. Indeed, imperfect products that had been physically processed were perceived more prototypical than imperfect products in their original state, with prototypicality in turn having a positive effect on attitude toward the product.

Finally, we conducted two studies aimed at providing evidence for the existence of a boundary condition for the effects shown in Study 1 and Study 2. More specifically, building on findings from prior research about consumers' aversion toward artificiality (Asioli et al., 2017; Shim et al., 2011), we argue that physically processing imperfect produce does not increase attitude. Indeed, results of a pilot study showed that whereas the imperfect product that had been naturally processed was more positively evaluated than the imperfect product in its original state, there was no difference in consumers' attitude between an imperfect product in its original state and an imperfect product that had been processed by adding artificial components such as additives or preservatives. This result suggest that the artificial processing of imperfect produce may not be an effective way to improve attitude toward these products. Hence, in Study 3 ($N = 115$, $M_{age} = 28.71$; $SD = 11.48$; female = 53.9%) we show that whereas artificially processing imperfect fruit and vegetables does improve prototypicality, it also decreases perception of naturalness of the product. In turn, prototypicality had a positive effect on attitude while naturalness had a negative effect on attitude, resulting in consumers

perceiving the imperfect produce in its original state and the imperfect product that had been artificially processed equally negatively.

Our results have several theoretical contributions. First, we contribute to literature on consumers' reactions to imperfect produce by providing evidence for the underlying mechanism –i.e. prototypicality – explaining consumers' negative attitudes toward food imperfection. Second, we contribute to literature on prototypicality by showing that consumers' inferences about prototypicality affect their perceptions about imperfect produce, a product category neglected by prior research. Finally, we contribute to recent research on food waste focusing on the understanding of the psychological mechanisms explaining consumers' attitudes and showing that such understanding is paramount for the development of interventions aimed at curbing food waste (e.g., Cooremans and Geuens, 2019; Grewal et al., 2019). Finally, from a practical point of view, our findings provide useful suggestions for both actors operating at different levels of the food value chain and policy makers aiming to develop solutions for the minimization of food waste.

Paper 3

The final paper included in this dissertation, titled “*Consumers' reactions to food waste: internal attribution, guilt and compensatory behaviors*” investigates how consumers' perceptions of responsibility for a food waste event affect their emotional and behavioural reactions to it. Specifically, we build on attribution theory (e.g. Kelley and Michela, 1980; Weiner, 1985) and argue that the extent to which consumers perceive the cause of the behaviour to be *internal* or *external* will affect the way they will behave emotionally and behaviourally to the food waste event. Indeed, prior research has shown that consumers who are responsible for a negative outcome should also be the ones to solve the problem (Belk and Painter, 1983; Grewal, Roggeveen, and Tsiros, 2008). Hence, we argue that consumers that perceive themselves to be responsible for a food waste event show a higher tendency to engage in compensatory actions aimed at compensating for the harm done compared to consumers who do not perceive themselves as responsible for the food waste episode.

We argue that this effect is driven by feelings of guilt, consistently with prior research showing that guilt is the negative emotion pushing individuals to compensate for the harm caused by their behavior (e.g., De Hooge et al., 2007; Ghorbani et al., 2013; Nelissen and Zeelenberg, 2009).

We conducted five experimental studies aimed at testing the hypothesized effects. We used a range of dependent variables in order to provide convergent evidence to our proposed theoretical mechanism and to provide robustness to our results. More specifically, in Study 1 (N = 196, 53.6% female, $M_{age} = 34.39$, $SD = 10.90$) we used a single-factor experimental design to test whether individuals who feel more responsible for a food waste event show a higher likelihood to engage in compensatory behavior in the future. We conceptualized the likelihood to engage in compensatory behaviors in terms of likelihood to reduce food waste in the future. Indeed, consumers feeling responsible for the food waste reported a higher likelihood to reduce food waste after the food waste event than consumers who did not feel responsible for it. In Study 2 (N = 195, 49.2% female, $M_{age} = 38.06$, $SD = 12.46$) we provide evidence for the role of guilt as the emotion driving the effect that perceptions of responsibility has on likelihood to reduce food waste in the future by showing that consumers feeling responsible for the food waste event feel guiltier than individuals not feeling responsible for the food waste event, and that higher feelings of guilt are associated with a higher intention to compensate in the future. In Study 3 (N = 248, 48.8% female, $M_{age} = 29.92$, $SD = 10.94$) we replicated results from Study 2 using a different conceptualization of compensatory behavioral intentions by using a measure of consumers' likelihood to engage in recycling behaviors, building on prior research showing that people's waste prevention efforts and the choice to recycle are correlated (Thøgersen, 1999). In this sense, we show that the effect we hypothesize for perceptions of responsibility of the food waste event on likelihood to compensate in the future is activated both within the same domain as the event triggering the guilt (i.e. food waste) and across domains (i.e. recycling behaviors). We further strengthen the robustness of our conceptualization in Study 4 (N = 42.8% female, $M_{age} = 33.27$, $SD = 9.56$) where we show that consumers feeling guilt for a food waste event they feel responsible for are also more likely to share information about the reduction of food

waste than individuals that do not feel responsible for the food waste event. More specifically, we use a proxy of real behavior, as participants of the study were led to believe that they were given the chance to actually share an article about tips to reduce food waste on their social media accounts. In this sense, Study 4 provides convergent evidence to our proposed theoretical mechanism and robustness to our results through the use of a measure of real behavior. Furthermore, it shows that the tendency to engage in compensatory behaviors following food waste events manifests not only as private behavioral intentions (e.g., the likelihood that an individual will reduce food waste and engage in recycling behaviors), but also as social behaviors (e.g., an individual's decision to share information on her social media accounts). Finally, in Study 5 ($N = 251$, 50.2% female, $M_{age} = 29.89$, $SD = 10$) we provide further evidence for the mediating role of guilt and explore a situation that might attenuate the effect of this negative emotion on the likelihood to engage in compensatory behaviors after the food waste event. More specifically, building on research showing that the recall of past moral actions acts as a compensatory mechanism that, in turn, reduces individuals' likelihood of engaging in future moral or compensatory actions (Jordan, Mullen, and Murnighan, 2011), we show that individuals feeling responsible for the food waste but that recall having reduced food waste in the past show a lower tendency to reduce food waste in the future than individuals who recall having wasted food in the past, despite feelings of guilt arising from an internal cause. Hence, Study 5 provides converging evidence to our theoretical mechanism through moderation.

This work makes several theoretical contributions for the understanding of food waste from a consumer behavior perspective. First, unlike the bulk of prior research focusing on the antecedents of food waste behaviors (Aschemann-Witzel et al., 2015; Cappellini and Parsons, 2012; Graham-Rowe et al., 2014; Schanes, Dobernig, and Gözet, 2018), this work focuses on the way consumers react to food waste events. Second, it contributes to the understanding of the causes of food waste by providing evidence about consumers' perceived responsibility for food waste events. Third, it contributes to literature about the role of guilt as the negative emotion driving compensatory behaviors enacted by consumers (e.g., De Hooge et al., 2007; Ghorbani et al., 2013; Nelissen and

Zeelenberg, 2009), by showing that this mechanism is activated in a novel consumption context such as food waste. From a practical perspective, our work suggests that making consumers aware of their contribution and responsibility for food waste would make them reduce food waste in the future, engage in environmentally-friendly behaviors such as recycling, and help other people reduce food waste through spreading of information. In this sense, policymakers and non-profit organizations that aim to reduce consumer-generated food waste should focus on communicating to consumers how their behavior is responsible for a large share of this phenomenon. Finally, another implication is that food waste communication campaigns should induce consumers to think about times in which they could have avoided or at least reduced wasting food, as this recall might ultimately lead to the adoption of responsible behaviors in the future.

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Paper 1

Consumers' orientation to imperfect fruits and vegetables: a multi-faceted phenomenon

Introduction

Retailers' decision about which fresh products to offer in their stores results in the loss of about 10 million tons of produce that is undersized, blemished, misshapen or in general deemed unmarketable for sale (ReFED, 2016). As a result, farmers see large shares of their harvest go to waste as the decision about which products are beautiful enough to be offered on shelves is merely marketplace-driven (Alford, 2019). For instance, 25-30 percent of carrots never make it to the stores because of some physical or aesthetical defect (FAO, 2019), while a recent research has shown that between 68.6 percent and 86.7 percent of edible tomatoes were rejected in Australia because the produce did not meet cosmetic specifications (McKenzie, Singh-Peterson and Underhill, 2017).

Retailers base their decision about selling only aesthetically perfect produce on the assumption that consumers seek defect-free products when going grocery shopping (Stuart, 2009). Indeed, anecdotal evidence suggests that consumers are not keen to buy produce that is over-ripe, soft, discoloured or somewhat damaged (FAO, 2019). However, this is in contrast with recent statistics showing that consumers are open to the purchase and consumption of these products, with a recent survey showing that 73 percent of shoppers in US, UK, France and Germany are open to buy fruit and vegetables that have flaws or imperfections (Newsdesk, 2017) and with other evidence showing that 90 percent of people would be happy to buy fruit and vegetables that are blemished or misshapen (Women's Institute, 2017).

On the one hand, the bulk of research on this topic has unanimously supported the idea that consumers are averse to the purchase and consumption of these products (e.g., Loebnitz et al., 2015, Grewal et al., 2019). For instance, research has shown that food shape abnormality in fresh produce negatively affects purchase intentions (Loebnitz and Grunert, 2015; Loebnitz et al., 2015), with

consumers perceiving these products as riskier (Loebnitz and Grunert, 2018; Cooremans and Geuens, 2019), associated with lower taste, health, and convenience perceptions (Cooremans and Geuens, 2019) or as products whose consumption acts as a self-diagnostic signal that negatively influences how consumers' view themselves (Grewal et al., 2019).

On the other hand, only few studies have investigated individual and contextual factors that can potentially attenuate consumers' negative perceptions toward these products. For instance, factors such as a strong pro-environmental self-identity, high problem awareness in relation to food waste, high levels of environmental concern and social trust increase the likelihood that consumers will buy abnormally-shaped fruit and vegetables (Loebnitz et al., 2015; Loebnitz and Grunert, 2015). Furthermore, De Hooge et al. (2017) showed that the tendency to purchase and consume imperfect produce depend on the type of imperfection (e.g., shape vs. colour) and on whether consumers are pondering about purchasing the product in the store or whether they are deciding about consuming an already purchased product at home. Hence, knowledge about the multifaceted nature of consumers' perception of imperfect produce is still scarce, with a dearth of research about the understanding of the factors that make consumers more prone to purchase or consume imperfect produce.

Against this backdrop, we aim to provide a broader and more detailed overview of consumers' orientation toward aesthetically imperfect produce and of the associations developed in relation to these products. Specifically, our work is aimed at providing a robust account of the cognitive and emotional facets of consumers' orientation toward these products. We argue that such investigation is paramount for the development of initiatives and solutions that can be implemented by both actors of the food value chain and policy makers for the reduction of food waste in relation to imperfect fruit and vegetables. Hence, we adopt a mixed-method approach that enables to provide a more robust account of this phenomenon. Indeed, a mixed-method approach has been shown to produce more relevant results than a single method study (Arunachalam et al., 2019; Davis et al., 2011) and enables to start by being open and exploratory and move to being more focused and exploratory (Batra,

Ahuvia, and Bagozzi, 2012). We argue that this approach is the most appropriate and consistent with our goal of providing broad and robust evidence about the emotional and cognitive associations activated by these products and because it allows for the development of insights that can be sequentially and further tested in follow-up studies. Specifically, we conducted a qualitative explorative study aimed at broadening results of prior research and at identifying the main emotional and cognitive associations activated by imperfect produce (Study 1). In this study, we provide a multi-faceted account of consumers' orientation toward imperfect produce and we show that such orientation depends on both the valence of the consumer's reaction to the product (positive vs. negative) and the presence of perceived emotional and cognitive tensions toward imperfect products. Specifically, whether these tensions are resolved versus unresolved determines whether the consumer has a (positive vs. negative) balanced or unbalanced orientation toward imperfect produce. Furthermore, with the aim of providing more robust evidence of the account we present in our qualitative study, we further tested our results in a quantitative study that shows that results from our interviews are quantitatively replicated (Study 2).

Our work makes several contributions. First, we provide a more detailed account of consumers' emotional and cognitive associations elicited by imperfect produce, thus adding to prior literature on imperfection. In addition, unlike prior works on this topic supporting the assumption that consumers are inherently averse to imperfection (e.g., Loebnitz et al., 2015; Grewal et al., 2019), we show that consumers can be either *positively* or *negatively* oriented toward imperfection. Furthermore, we provide a detailed overview of the cognitive and emotional tensions activated by imperfect produce and show how this affect consumers' orientation toward these products. Third, our work is consistent with the recent call for more theoretical contributions aimed at understanding consumers' behaviour that can lead to food waste (Block et al., 2016). This understanding is paramount for the development of successful solutions that can be implemented by actors of the food value chain aimed at reducing food waste and at promoting the purchase of products that would otherwise be discarded. In this sense, by providing a broad overview of consumers' reactions toward

imperfection, our works provide several entry points that can be exploited by retailers for initiatives both inside the store (e.g., in store display, leaflets) and outside (e.g., promotional campaigns). Finally, our findings provide guidance for policy makers for the development of awareness campaigns targeting consumers and aimed at promoting the consumption of imperfect products.

Research background

Imperfect produce are fruit and vegetables that deviate from normal or optimal products based on aesthetical characteristics such as weight, shape, size (Bunn et al., 1990; De Hooge et al., 2017) and in terms of the extent to which they can be deemed *abnormal* in terms of their appearance (Loebnitz et al., 2015). As such, imperfect produce can be generally defined as abnormal produce that is less aesthetically pleasing (Cooremans and Geuens, 2019) because of a variation resulting from the product's natural process of growth (Grewal et al., 2019). Given that the external appearance of the product is often the first cue consumers use to develop their first sensory impressions of a product (Bloch, 1995) and given that fruits and vegetables are often sold without extensive packaging (Helmert et al., 2017), prior research on this topic has argued that deviations in appearance in fresh produce may lead consumers to infer a lower quality of the product (Cardello, 1994), which in turn determines their negative attitude toward these products. Indeed, past studies have shown that food shape abnormalities negatively affect purchase intentions, with consumers tending to prefer normally-shaped rather than abnormally-shaped fruits and vegetables (Loebnitz and Grunert, 2015; Loebnitz et al., 2015). More specifically, when no information is available consumers associate the natural deviations of the product with genetically modified foods, leading to higher risk perceptions (Loebnitz and Grunert, 2018). These results are further supported by more recent research showing that shape abnormalities trigger both higher risk and lower taste perceptions (Cooremans and Geuens, 2019). Finally, a study by Grewal et al. (2019) has proposed that the consumption of unattractive produce negatively impacts how consumers view themselves, resulting in lower attitude and willingness to pay for an imperfect product compared to a more attractive alternative.

However, prior studies on this topic provide evidence about the existence of boundary conditions for this general negative perception of imperfect produce, opening up to the idea that there are circumstances or factors that make consumers more positively inclined toward these products. For instance, Loebnitz and Grunert (2015) investigated the role of environmental concern and trust toward the institutions and showed that consumers that are environmentally-concerned are more likely to purchase imperfect produce, and that consumers having both a strong environmental concern and high social trust reported higher purchase intentions than consumers having weak environmental concern and high social trust. In a similar vein, Loebnitz et al. (2015) showed that being aware of the link between imperfect produce and food waste increased consumers' likelihood of purchasing abnormally-shaped foods and that purchase intentions were further increased when considering consumers having a strong pro-environmental self-identity. Similarly, but adopting an even broader perspective on this issue, De Hooge et al. (2017) investigated both contextual factors and personal characteristics that can affect consumers' choice of imperfect produce. In this sense, they provided evidence that produce that is imperfect in colour (i.e. an apple with a spot) is less likely to be chosen in the supermarket than a product that is imperfect in its shape (i.e. a bent cucumber), providing preliminary evidence for different reactions to different types of imperfection. At the same time, while imperfect produce is more likely to be associated with something to be discarded when considering the purchase in the supermarket, this is less so when consumers are pondering the consumption of the product at home, suggesting the importance of contextual factors when investigating individuals' perceptions of imperfect produce. In terms of personality aspects, factors such as biospheric value orientation, commitment to environmental sustainability, and perceived household food waste significantly affect consumers' decisions to discard imperfect products at home (De Hooge et al., 2017). Taken together, these studies suggest that consumers may not be unequivocally averse to imperfection and further strengthen the need to adopt a broader perspective for the understanding of consumers' orientation toward imperfect produce. Finally, they call for broader and more detailed contributions explaining the nature of this orientation and the associations underlying it.

Hence, we aim to fill the gap in the literature by providing a more robust account of consumers' orientation toward imperfect produce. More specifically, our work is aimed at providing an overview of both the cognitive and emotional facets of consumers relationship with aesthetically imperfect fruit and vegetables. In this sense, we aim to extend findings from prior research in terms of beliefs activated by imperfect produce (e.g. Loebnitz and Grunert, 2018; Cooremans and Geuens, 2019), and to provide novel insights by investigating the emotional features of consumers' orientation toward these products. Indeed, the role of emotional reactions to imperfect products has been largely overlooked by prior research on this topic. This overview is paramount for the development of well-grounded theoretical explanations of the reasons why consumers may be averse to imperfect produce. Furthermore, the identification of the factors that positively and negatively affect consumers' orientation toward and in turn purchase intention of imperfect fruit and vegetables is of primary importance for the design of successful interventions aimed at curbing consumers' negative attitude toward imperfect products and at promoting their consumption.

With this aim in mind, we have conducted a series of qualitative interviews with the goal of identifying consumers associations with imperfect fruits and vegetables. We argue that such qualitative approach has the potential to provide a more nuanced picture of consumers' reactions toward imperfect produce and enables the identification of factors that may have been overlooked by methodological approaches primarily driven by theory adopted by prior research. In this sense, we argue that such approach is more fruitful for an explorative investigation of consumers' perception of imperfect fruit and vegetables. In turn, this lays the basis for the development and quantitative testing of solutions and interventions aimed at promoting the consumption of imperfect produce that can be enacted by both retailers and policy makers.

In the next sections of the paper we present the results of our qualitative study (Study 1) and we provide an overview of the multifaceted nature of consumers' orientation toward imperfect produce. Specifically, we identify the main emotional and cognitive associations activated by these products. Results from our interviews were used for the development of items aimed at measuring

the constructs emerging from our qualitative study and were coupled with measures from prior research for the quantitative testing of the framework we present in our qualitative study (Study 2).

Study 1

Sample and data collection

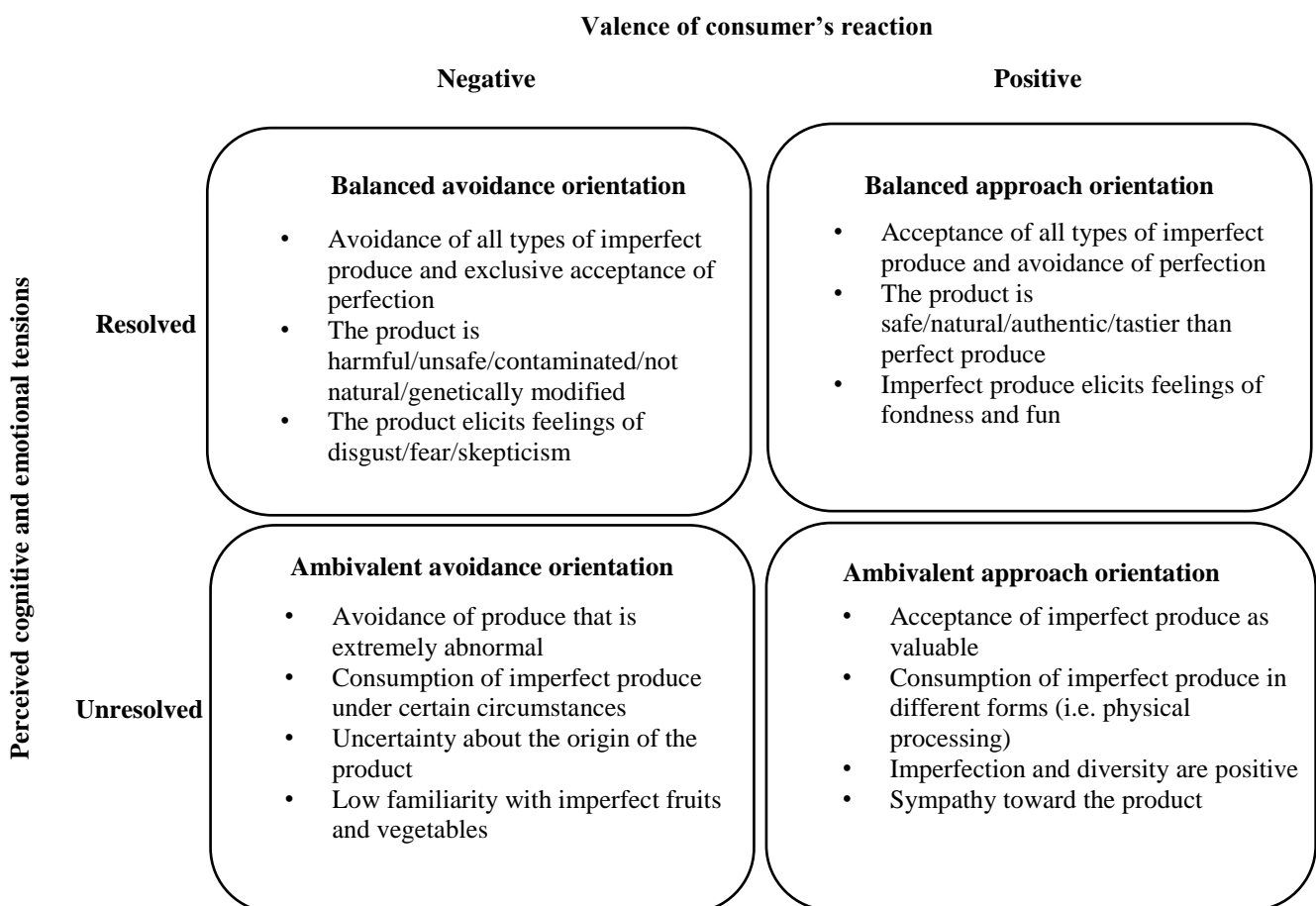
Study 1 was aimed at uncovering both the affective and cognitive facets of consumers' experiences with imperfect fruits and vegetables. Interviews were conducted between September 2016 and January 2017 and lasted between twenty and forty-five minutes each. We purposefully sampled 31 adult consumers (74% *female*, 26% *male*, average age 35.23, SD = 12.78) responsible for grocery shopping in their household.

A semi-structure protocol was developed to conduct the interviews, following the steps of the Zaltman Metaphor Elicitation Technique (ZMET, Zaltman and Coulter, 1995; Coulter, 2006) with the aim of gaining insights into individuals' perceptions, associations, and feelings toward imperfect fruits and vegetables. Approximately a week before the scheduled interview, informants were instructed to think about their idea of "imperfect produce". In order not to probe consumers toward a specific idea of imperfect fruits and vegetables, we did not provide any definition of imperfect produce, meaning that informants were free to develop their own idea and thoughts about the focus of the interview. Furthermore, informants were asked to select about 10-15 images that best represented their concept of imperfect produce, both in terms of pictures representing what they meant by imperfect fruits and vegetables and pictures of concepts they believed to be associated to imperfect produce. The pictures were then used during each interview to probe issues related to each participant's relationship with, perception and consumption of imperfect fruit and vegetables and in order to elicit the voicing of consumers' experiences in relation to these products at both cognitive and emotional level.

Our analysis broadly followed the open-coding techniques of grounded theory development (Strauss and Corbin, 1990), starting with the coding of responses of each informant at a level of

analysis as close as possible as to the way they were voiced by each individual. The coding categories emerging from the individual-level coding analysis were then compared across informants and collapsed into broader categories and overarching themes. Finally, these themes were traced back to two main dimensions cutting across all our informants, that is the valence of consumers' reaction toward imperfect produce (positive vs. negative) and the presence of resolved versus unresolved cognitive and emotional tensions toward these products. More specifically, the combination of these dimensions translates into four differentiated consumers' orientations toward imperfect produce. The orientations emerging from our qualitative interviews are summarized in *Figure 1* and further detailed in the next sections.

Figure 1: Summary of consumers' orientations emerging from the qualitative study



Findings

Four categories of consumers' orientations emerged from our interviews in relation to consumers' perception of imperfect fruits and vegetables. More specifically, we classified consumers' general orientations as either *approach* or *avoidance*. These orientations are the result of both the valence of the consumers' reaction to imperfection (positive vs. negative) and the presence of resolved versus unresolved cognitive and emotional tensions that can either strengthen (*balanced orientation*) or attenuate (*ambivalent orientation*) the general orientation toward imperfect produce. As a result, we identify four categories of nuanced orientations that cut across these two main dimensions and roughly correspond to four prototypical categories of consumers.

Balanced avoidance orientation

This orientation is characterized by a strong negative reaction to imperfect products, with some of our informants mentioning that they would never consume products that they deem imperfect (*I eat with my eyes first, so if something is not consistent with some specific characteristics, for me it is not good*", female, 60). In this sense, these consumers were consistent in providing a representation of imperfect fruits and vegetables as produce that is imperfect or "abnormal" in its aesthetical appearance in terms of shape, size, bruising, texture or color, consistently with conceptualization of imperfect produce adopted by prior research (e.g., De Hooge et al., 2017).

We characterized the orientation manifested by these consumers as *balanced*, because it is coupled by cognitive and emotional responses to imperfect produce that further reinforce their negative reaction to the product. For instance, informants included in this category consistently reported their ideas about these products as being not natural, genetically modified or associated with an unknown origin (*I think this one has been manipulated somehow and is not really natural*", female, 60), resulting in the belief of imperfect produce being contaminated, unhealthy, unsafe to consume or generally riskier than other available alternatives. This finding is consistent with results from prior research showing that consumers associate imperfect products with higher risk perceptions (Loebnitz and Grunert, 2018) and thus with a higher likelihood of the product being harmful

(Cooremans and Geuens, 2019). Finally, consistently with these beliefs, consumers with a *balanced avoidance orientation* reported being “disgusted”, “scared”, or “disturbed” by imperfection in fruits and vegetables (“*I feel disgust when looking at it, so for sure I won’t eat it*”, female, 48; “*it has an incomprehensible shape, it doesn’t even look like a carrot, it doesn’t even look like a vegetable. It is something horrendous*”, male, 52). Taken together, these factors suggest the existence of a type of consumer that is strongly averse to imperfection as result of a general negative reaction to imperfect produce that is further reinforced by the presence of resolved cognitive and emotional tensions that are consistent with their negative reaction toward these products.

Ambivalent avoidance orientation

Despite voicing a general negative reaction toward imperfect produce (“*the fruit and vegetables I choose need to conform to the shape and size I am used to, I would not choose things that are so strange*”, female, 38), some of our informants were more uncertain about their general orientation toward these products. More specifically, despite being worried about the consumption of these products or being unsure about the way in which these were produced, they also voiced a general acceptance of small imperfections (“*I would be willing to buy some of these, but not the others because they are too odd*”, female, 35; “*I would not buy the one that is too misshapen, but I would be more willing to buy the one with a more balanced shape*”, male, 40) or the willingness to purchase these products under certain circumstances, such in a specific retail context (“*when you go grocery shopping you seek something perfect, but if you buy at the farmers’ market it is different (...) sometimes the products I buy are not perfect because I bought them at the farmers’ market. On the other hand, at the supermarket everything is the same and almost all products are perfect*”, female, 55; “*I wouldn’t buy at the supermarket because it does not comply with the standards of all the other produce available in the store*”, male, 40). These findings are in line with results from De Hooge et al. (2017) showing that the type of imperfection and the contextual factors surrounding the purchase or consumption of the product affect consumers’ perception of imperfect produce. In this sense, these

consumers show unresolved cognitive associations that attenuate their negative evaluation of the product, making them more ambivalent in their perceptions of imperfection and thus somewhat more open or less extreme about the possibility of purchasing or consuming them.

Ambivalent approach orientation

In our interviews we also identified consumers reporting a general positive reaction toward imperfect produce, in the sense that they recognize imperfection as valuable (*“imperfection is still beautiful”*, female, 60; *“aesthetical appearance is not everything”*, female, 22) and as something that can be interesting to look at or to further explore. More specifically, some of our informants mentioned how imperfect fruit and vegetables can be easily reused after they have been physically processed and transformed into other products (e.g., soups, juices, etc.) (*“this is the idea that either perfect or imperfect fruit and vegetables always end up in the kitchen or cooked”*, male, 36). In this sense, these consumers are open to imperfection, but report purchase and consumption intentions that are contingent upon the use they want to make of the imperfect produce.

Balanced approach orientation

Another group of consumers that emerged from our interviews was characterized by a strong positive reaction toward imperfect products, which translated into acceptance of all types of imperfection and avoidance of perfection in produce (*“I would never eat the peel of the shiny fruit, not even in a million years”*, female, 40; *“I would never eat them, not even if they were given to me for free”*, female, 22). For these consumers the associations elicited by imperfect fruits and vegetables are consistent with their positive evaluation of the product, as imperfection is believed to be safe, natural, and even tastier than its less imperfect counterpart. Additionally, this is further reinforced by the high familiarity that these consumers show toward imperfect produce, as they often mentioned being taught about the value of these products within the family context in which they were raised, and remembering it with fondness (*“I was raised like this and for me the banana with spots is tastier and better”*, male, 22; *“it reminds of my grandfather and the apples from his garden”*, female, 22). These factors show that the positive reaction toward imperfection is associated to the presence of

resolved cognitive and emotional tensions that reinforce the valence of their reaction, resulting in an overall balanced approach orientation toward these products.

Discussion

Findings from the qualitative interviews show that consumers' orientations toward imperfect produce are the results of both consumers' reaction toward the product, that can be either positive or negative, and the presence of resolved versus unresolved emotional and cognitive associations elicited by imperfection. In this sense, we identified four different orientations, corresponding to four differentiated categories of consumers. Furthermore, our findings show that consumers can be either averse or open to imperfection, in contrast with prior literature suggesting that consumers are unequivocally averse to imperfect produce (e.g., Loebnitz et al., 2015; Grewal, 2019). In this sense, our findings open up to the need of a more in-depth understanding of consumers' orientations toward imperfect produce. Hence, building on the results of our interviews and using an approach that overcomes the limitations of our qualitative study, we have further tested our findings in a quantitative study aimed at validating results of our qualitative interviews and at providing a more robust account of consumers' orientation toward imperfect produce.

Study 2

A quantitative study was conducted with the aim of strengthening results from Study 1 and of providing more robust evidence for the existence of the four categories of orientations toward imperfect produce we have identified with our qualitative interviews. A range of quantitative scales aimed at measuring characteristics of consumers' attitude toward imperfection were used with the goal of mapping the multifaceted nature of this phenomenon. Study 2 validates results from Study 1 and provides further insights into consumers' characteristics in relation to their attitude toward imperfect produce.

Study 2a

To measure consumers' orientation toward imperfect produce, in addition to measures tested by prior literature on food waste (e.g., De Hooge et al., 2017; Stancu et al., 2016) we have generated additional items based on the results of Study 1 and conducted a survey aimed at the preliminary assessment of these new scales (see **Table 1**). More specifically, the additional items were aimed at capturing the emotional and cognitive nuances of associations elicited by imperfect produce.

Structural equation modeling (LISREL 8.8) was used for assessing the convergent and discriminant validity of these measures. The final sample for the analysis included 135 adult consumers ($M_{age} = 28.11$, $SD = 9.98$). A CFA was performed with all the variables, measured on 7-point scales (1 = not at all, 7 = very much): disgust ($M = 2.41$, $SD = 1.57$); skepticism ($M = 2.91$, $SD = 1.63$); positive affect ($M = 2.92$, $SD = 1.50$); surprise ($M = 3.70$; $SD = 1.84$); health concerns beliefs ($M = 1.77$, $SD = 1.11$); unworthiness beliefs ($M = 2.45$; $SD = 1.42$); rejection behaviors ($M = 1.82$; $SD = 1.20$); disdain behaviors ($M = 1.89$; $SD = 1.45$); avoidance behaviors ($M = 2.45$; $SD = 1.69$); acceptance behaviors ($M = 3.56$; $SD = 1.73$). The fit of the model was excellent (χ^2 (df) = 1200.13 (558); RMSEA = 0.08; NNFI = 0.95; CFI = 0.96; SRMR = 0.07), all factors loadings were high and significant. These results, together with the overall fit, suggest achievement of convergent validity. The reliability of all constructs was satisfactory, as they ranged from a minimum of 0.65 to a maximum of 0.96, providing evidence for acceptable reliability. Furthermore, all the average variances extracted (AVE) reached the recommended threshold of 0.50 for each of the dimensions (Hair et al., 2005). Given the satisfactory results of this study, we included the new scales in the main study.

Table 1. Descriptive statistics of measures pretested in Study 2a

Scales	items	Source	M	SD	reliability
Disgust	Aversion Disgust Revulsion Contempt	Study 2a	2.41	1.57	0.75

	<i>Scale: from (1) not at all to (7) very much</i>				
Skepticism	Suspicious Skepticism Uncertain	Study 2a	2.91	1.63	0.89
	<i>Scale: from (1) not at all to (7) very much</i>				
Positive affect	Joy Content Relaxed Sense of trust Sense of appreciation Grateful	Study 2a	2.92	1.50	0.90
	<i>Scale: from (1) not at all to (7) very much</i>				
Surprise	Astonished Surprised	Study 2a	3.70	1.84	0.83
	<i>Scale: from (1) not at all to (7) very much</i>				
Health concern beliefs	Harmful Unsafe Unhealthy Not-nutritious	Study 2a	1.77	1.11	0.91
	<i>Scale: from (1) strongly disagree to (7) strongly agree</i>				
Unworthiness beliefs	Alarming Disturbing Stale Contaminated Wrong Negative	Study 2a	2.45	1.42	0.93
	<i>Scale: from (1) strongly disagree to (7) strongly agree</i>				
Rejection behaviors	Avoid looking at them Not touch them Not buy even the closest products	Study 2a	1.82	1.20	0.79
	<i>Scale: from (1) strongly disagree to (7) strongly agree</i>				
Disdain behaviors	Not buy also in presence of very low prices Not buy also if they were the only ones available Not buy also if I will consume them transformed	Study 2a	1.89	1.45	0.96
	<i>Scale: from (1) strongly disagree to (7) strongly agree</i>				
Avoidance behaviors	Reject the idea of buying Refuse to buy them Not buy them Not like to try them Not like to eat them	Study 2a	2.45	1.69	0.79
	<i>Scale: from (1) strongly disagree to (7) strongly agree</i>				
Acceptance behaviors	Positive word of mouth Participation in initiatives for imperfect products (advocacy)	Study 2a	3.56	1.73	0.65
	<i>Scale: from (1) strongly disagree to (7) strongly agree</i>				

Study 2b: main study

Sample and data collection

Data was collected online with a new sample of consumers recruited through a snowball sampling procedure. A total of 746 consumers (56.3% % female, $M_{age} = 31.08$, $SD = 13.50$) participated in the study and answered the questionnaire. Respondents were asked to read a scenario and to imagine they were going grocery shopping to buy some carrots and found themselves looking at a shelf of imperfect carrots (see **Appendix**). After reading the scenario, they were asked to answer

to questions about their general perception about imperfect products such as the ones shown in the picture. The study included measures adopted and validated by prior literature on food waste and imperfection (see **Table 2**) in addition to the ones we pretested in Study 2a (see **Table 1**). Specifically, given our goal of providing a broad and detailed overview of the multifaceted nature of this phenomenon we adopted an inclusive approach and included in the questionnaire measures for all the theoretical constructs that have been shown to affect consumers' attitude toward imperfect fruits and vegetables (e.g., De Hooge et al., 2017; Loebnitz et al., 2015). Furthermore, the inclusion of these variables provides insights into the individual characteristics associated to consumers' orientation toward imperfect fruits and vegetables.

Table 2. Descriptive statistics for measures used in Study 2.

Scales	items	Source	M	SD	reliability
Altruistic value orientation	Equal opportunity for all A world free of war and conflict Correcting injustice, care for the weak Working for the welfare of others <i>Scale: from (1) not at all important to (7) extremely important</i>	adapted from de Hooge et al., 2017	6.05	0.99	0.78
Biospheric value orientation	Protecting natural resources Harmony with other species Fitting into nature Preserving nature <i>Scale: from (1) not at all important to (7) extremely important</i>	adapted from de Hooge et al., 2017	6.02	1.10	0.82
Egoistic value orientation	Control over others, dominance Material possessions, money The right to lead or command Having an impact on people and events <i>Scale: from (1) not at all important to (7) extremely important</i>	adapted from de Hooge et al., 2017	3.84	1.40	0.76
Pro-environmental self-identity	I think of myself as an environmentally friendly consumer I think of myself as someone who is very concerned with environmental issues <i>Scale: from (1) strongly disagree to (7) strongly agree</i>	adapted from Loebnitz, Schuitema, and Grunert, 2015	4.58	1.33	0.62
Consumer effectiveness	I feel personally helpless to have much of an impact on a problem as large as the environment (<i>reversed</i>) I do not feel I have enough knowledge to make well-informed decisions on environmental issues" (<i>reversed</i>) <i>Scale: from (1) strongly disagree to (7) strongly agree</i>	adapted from de Hooge, 2017	3.89	1.53	0.66
Problem awareness	Food waste increases the burden on the environment We can avoid food waste by selling fruits and vegetables with 'abnormal' shapes It is a good thing that atypical products are not being sold in regular shops (<i>reversed</i>) <i>Scale: from (1) strongly disagree to (7) strongly agree</i>	adapted from Loebnitz, Schuitema, and Grunert, 2015	5.73	1.17	0.64
Attitude	Very negative – very positive Very negative – very positive I don't like them at all – I like them a lot Very bad – very good <i>Scale: from (1) to (7)</i>	adapted from Stancu, Haugaard, and Lähteenmäki (2016)	4.09	1.87	0.96
Subjective norms	People who are important to me find acceptable my decision to not consume imperfect fruits and vegetables	adapted from Stancu,	2.86	1.76	0.79

	Person that are important to me agree with my decision not to consume imperfect fruits and vegetables <i>Scale: from (1) strongly disagree to (7) strongly agree</i>	Haugaard, and Lähteenmäki (2016)					
Perceived behavioral control	I find it difficult to consume imperfect fruits and vegetables I find it difficult to plan my shopping related to imperfect fruits and vegetables <i>Scale: from (1) strongly disagree to (7) strongly agree</i>	adapted from Stancu, Haugaard, and Lähteenmäki (2016)	from	2.92	1.75	0.75	
Perceived household waste	Estimate your own household waste; how much food that you buy or cook ends up being thrown away at home? <i>Scale: from (1) not at all to (7) very much</i>	adapted from Hooge et al., 2017	de	2.66	1.41	--	
Perceived household waste importance	Specify the relative importance of reducing food waste in comparison to "Reducing obesity" Specify the relative importance of reducing food waste in comparison to "Reducing environmental pollution" Specify the relative importance of reducing food waste in comparison to "Stabilizing the global economy" <i>Scale: from (1) much less important (7) much more important</i>	adapted from Hooge et al., 2017	de	4.98	1.45	0.70	
Subjective knowledge	I know more about food production than the average person I know a lot about how to evaluate the quality of vegetables People who know me consider me as an expert in the field of food production <i>Scale: from (1) strongly disagree to (7) strongly agree</i>	adapted from Loebnitz and Grunert, 2018	from	3.75	1.36	0.67	

Results

A cluster analysis approach to the data was applied with the aim of identifying the characteristics of consumers' orientation toward imperfect produce. A two-step cluster analysis was conducted to categorize respondents based on their responses to the clustering variables (Punj and Stewart, 1983) and average scores were used. In the first stage, Ward's hierarchical clustering method with squared Euclidean distances suggested a 4-cluster solution. In the second stage, a non-hierarchical, k-means clustering procedure was employed to develop a 4-cluster solution. Multivariate analysis of variance was used to assess internal validity of the cluster solution (Maute and Dubè, 1999). **Table 3** details the resulting segments. To assess differences between clusters, chi-square, ANOVA analyses and Tukey pairwise comparisons tests were run to compare the 4 clusters on demographic information and on the clustering variables (see **Table 3**).

Table 3. Consumers' characteristics by cluster

	Clusters								Comparison tests
	REJECTER Cluster 1		AVOIDER Cluster 2		APPROACHER Cluster 3		ACCEPTER Cluster 4		
Cluster size (%)	85 (11.4%)	✕	185 (24.8)	✕	247 (33.1%)	✕	229 (30.7%)	✕	
									F value (df); p
Cluster 1 Disgust	4.39 (1.65)	(2;3;4)	3.56 (1.36)	(1;3;4)	1.80 (1.01)	(1;2;4)	1.39 (0.69)	(1;2;3)	242.41 (742); p<.01

Skepticism	4.67 (1.60)	(2;3;4)	3.96 (1.36)	(1;3;4)	2.51 (1.30)	(1;2;4)	1.83 (1.04)	(1;2;3)	146.94 (742); p<.01
Positive affect	2.03 (1.29)	(2;3;4)	2.50 (1.18)	(1;4)	2.54 (1.24)	(1;4)	3.98 (1.49)	(1;2;3)	76.25 (742); p<.01
Surprise	3.90 (1.94)	(3)	4.21 (1.52)	(3)	3.03 (1.61)	(1;2;4)	3.92 (2.04)	(3)	18.51 (742); p<.01
Health concern beliefs	3.60 (1.49)	(2;3;4)	2.17 (0.98)	(1;3;4)	1.41 (0.63)	(1;2;4)	1.15 (0.36)	(1;2;3)	218.39 (742); p<.01
Unworthiness beliefs	5.03 (1.06)	(2;3;4)	3.36 (0.93)	(1;3;4)	1.83 (0.72)	(1;2;4)	1.41 (0.5)	(1;2;3)	582.7 (742); p<.01
Rejection behavior	4.06 (1.37)	(2;3;4)	2.32 (0.97)	(1;3;4)	1.34 (0.52)	(1;2;4)	1.12 (0.37)	(1;2;3)	370.0 (742); p<.01
Disdain behaviors	5.01 (1.31)	(2;3;4)	2.29 (1.14)	(1;3;4)	1.27 (0.52)	(1;2;4)	1.07 (0.31)	(1;2;3)	577.44 (742); p<.01
Avoidance behaviors	5.72 (1.10)	(2;3;4)	3.39 (1.25)	(1;3;4)	1.73 (0.81)	(1;2;4)	1.26 (0.49)	(1;2;3)	627.05 (742); p<.01
Acceptance behaviors	2.48 (1.52)	(3;4)	2.75 (1.11)	(3;4)	3.06 (1.28)	(1;2;4)	5.16 (1.54)	(1;2;3)	158.70 (742); p<.01
Altruistic value orientation	5.82 (0.93)	(3;4)	5.63 (1.17)	(3;4)	6.09 (0.88)	(1;2;4)	6.42 (0.79)	(1;2;3)	26.20 (742); p<.01
Biosferic value orientation	5.80 (1.02)	(2;4)	5.42 (1.30)	(1;3;4)	5.94 (1.02)	(2;4)	6.66 (0.62)	(1;2;3)	55.34 (742); p<.01
Egoistic value orientation	4.51 (1.35)	(3;4)	4.25 (1.32)	(3;4)	3.75 (1.34)	(1;2;4)	3.35 (1.35)	(1;2;3)	23.59 (742); p<.01
Pro-env.al self-identity	4.64 (1.31)	(2;3;4)	4.06 (1.28)	(1;4)	4.22 (1.12)	(1;4)	5.38 (1.21)	(1;2;3)	51.68 (742); p<.01
Consumer effectiveness	4.35 (1.50)	(2;3;4)	3.91 (1.46)	(1)	3.86 (1.53)	(1)	3.72 (1.59)	(1)	3.46 (742); p<.02
Problem awareness	4.60 (1.11)	(2;3;4)	5.14 (1.09)	(1;3;4)	5.82 (1.03)	(1;2;4)	6.51 (0.74)	(1;2;3)	109.34 (742); p<.01
Attitude	3.20 (1.46)	(2;4)	3.83 (1.09)	(1;3;4)	3.35 (1.80)	(2;4)	5.44 (1.85)	(1;2;3)	79.02 (742); p<.01
Subjective norms	4.35 (1.65)	(2;3;4)	3.58 (1.54)	(1;3;4)	2.21 (1.49)	(1;2)	2.40 (1.72)	(1;2)	57.42 (742); p<.01
Perceived behavioral control	5.18 (1.45)	(2;3;4)	4.13 (1.27)	(1;3;4)	2.26 (1.15)	(1;2;4)	1.83 (1.31)	(2;3;4)	226.94 (742); p<.01
Perceived household waste	3.22 (1.58)	(3;4)	3.20 (1.48)	(3;4)	2.46 (1.21)	(1;2;4)	2.21 (1.26)	(1;2;3)	25.27 (742); p<.01
Perceived household waste importance	4.95 (1.38)	(2;4)	4.57 (1.44)	(1;3;4)	4.85 (1.49)	(2;4)	5.48 (1.30)	(1;2;3)	15.71 (742); p<.01
Subjective knowledge	3.83 (1.42)	(2;3;4)	3.36 (1.26)	(1;4)	3.41 (1.26)	(1;4)	4.42 (1.29)	(1;2;3)	32.11 (742); p<.01
									Chi square (df); p
Demographic information	Gender (% of women)	49.4%	62.4%	60.6%	46.2%	14.61 (3); p<.01			
	Age Mean (SD)	31.09 (16.22)	26.24 (10.07)	31.33 (12.99)	34.66 (14.20)	13.94 (739); p<.01			

The number in parentheses under the columns Ψ shows the cluster(s) from which this cluster was significantly different at .05 level of significance based on the Tukey pairwise comparison tests.

The four groups emerging from the cluster analysis were labeled based on the emotional, cognitive, and behavioral characteristics emerging in relation to their orientation toward imperfect fruit and vegetables. Consistently with results from Study 1, we have identified four groups of consumers whose orientation toward imperfect produce range on the basis of their behavioral reactions toward these products, and as a result of the cognitive and emotional associations elicited when thinking about imperfect produce.

Cluster 1, labeled as “Rejecter”, is comprised of 85 individuals (11.4% of the sample) who show the strongest negative reaction toward imperfection in terms of both the behaviors enacted toward these products, and the cognitive and emotional associations reported in relation to imperfection. Indeed, this group of consumers is significantly different from the other segments on

all the variables included in the questionnaire as measures for the cognitive and emotional associations reported by consumers in Study 1 (disgust, skepticism, positive affect, health concerns beliefs, unworthiness beliefs, rejection behaviors, disdain behaviors, avoidance behaviors). Furthermore, despite showing high values of pro-environmental self-identity and consumer effectiveness, this group shows the lowest attitude toward imperfect produce. In this sense, these findings are in line with prior research showing that consumers perceive food waste more as a food-related behavior than as an environmental behavior (Stancu et al., 2016). This is further supported by the lowest value reported by this cluster in terms of problem awareness, suggesting that this group of consumers might be unaware of the link existing between imperfection in fresh produce and food waste.

Cluster 2 is labeled as “Avoider” and is comprised of 185 individuals (24.8% of the sample). Despite showing a generally negative attitude toward imperfect fruits and vegetables, these consumers are significantly different from the segment of “rejecters” in terms of the emotional and cognitive associations they report in relation to imperfect produce. Indeed, they report lower levels of disgust and skepticism toward these products, as well as holding less intense negative beliefs toward imperfection. Similarly, they are significantly less likely than rejecters but more likely than the other two segments to engage in rejection, disdain and avoidance behaviors toward imperfect produce. In terms of individual traits, consumers included in this group appear to be more aware of the link between food waste and imperfection, which supports their milder negative cognitive and emotional associations elicited when thinking about imperfect produce.

Cluster 3, labeled “Approacher”, is comprised of 247 individuals (33.1% of the sample) who score high in terms of positive affect toward imperfect produce while scoring low in terms of emotional associations such as disgust and skepticism. In line with these findings, they report a higher likelihood than rejecter and avoiders to engage in positive behaviors in relation to imperfect fruit and vegetables, while reporting low likelihood of engaging in negative behaviors toward these products (rejection, disdain, avoidance). However, their attitude toward these products is lower than the attitude

reported by the segment of “avoiders”, suggesting that there may be factors that conflict with their evaluation of the product, thus dampening their perception of imperfection. Indeed, consumers in this segment report moderate perception of consumer effectiveness and perceived household waste importance.

Cluster 4, labeled “Acceptor”, is comprised of 229 individuals (30.7% of the sample) who score lowest in terms of disgust and skepticism elicited in relation to imperfect fruit and vegetables, and highest in terms of positive affect toward these products. Consistently, they score lowest on both the negative beliefs that can be associated with imperfect produce and the negative behaviors that can be enacted to avoid imperfection. Furthermore, they score highest in terms of acceptance behaviors and attitude toward these products. Finally, their positive attitude toward the product is further reinforced by a strong pro-environmental self-identity and problem awareness, as well as a strong perceived household waste importance.

Discussion

The four segments identified are significantly different from each other, as they differ in terms of behaviors enacted toward imperfect fruits and vegetables, and the emotional and cognitive associations that are activated when in contact with these products. Furthermore, results of the cluster analysis parallel the ones of Study 1 as they show that the interaction of different factors – at individual, emotional, and cognitive level – results in different orientations toward imperfection. In this sense, results of Study 2 validate findings from Study 1 and further reinforce the conclusion that consumers’ attitude toward imperfect product is a multifaceted phenomenon whose investigation needs to account for several factors simultaneously. Furthermore, we provide further and more robust evidence that consumers’ attitude toward imperfect produce is not unequivocally negative, but that consumers show positive attitudes toward these products, which can potentially translate into positive intentions to buy them. Finally, the identification of a broad and inclusive set of factors affecting consumers’ attitude toward imperfect fruit and vegetables provide insights for the development of successful interventions aimed at reducing food waste related to imperfect produce.

General discussion

Concerns about the role of practices adopted by actors of the food value chain in terms of generation of food waste and its environmental impact are gaining momentum in both the retail and public policy sector (e.g., Kor, Prabhu, and Esposito, 2017). In particular, aesthetical standards set by retailers for fresh produce largely contributes to food waste based on the assumption that consumers would not be willing to buy produce that is aesthetically imperfect. Hence, the development of more theoretical contributions about the psychological underpinnings of consumers' responses to these products is paramount for the design of successful interventions aimed at curbing food waste. In order to meet this need, we set out to provide a broad overview of the facets of consumers' orientation toward imperfect fruits and vegetables. Across a qualitative and quantitative study, we demonstrate that consumers can be categorized in different groups based on their positive or negative orientation toward imperfection, challenging the assumption adopted by prior research about consumers' being unequivocally averse to imperfect produce (e.g. Grewal et al., 2019; Loebnitz et al., 2015). More specifically, in Study 1 we provide preliminary qualitative evidence about the nature of consumers' orientations toward imperfect produce and about the cognitive and emotional associations activated by imperfect produce, and the type of behaviors consumers enact toward these products. These results informed a quantitative study (Study 2) aimed at validating results from Study 1 and at providing a more robust evidence for the account we provide in our qualitative study. More specifically, we show that consumers can be grouped in four clusters differentiated based on their orientation toward imperfect fruits and vegetables, and that each group is characterized by different nuances of emotional and cognitive associations elicited by imperfection, of behaviors enacted toward imperfect produce, and by a series of relevant personal characteristics. In this sense, our findings provide support to the idea that consumers' orientation toward imperfect produce is a multifaceted phenomenon, and that future works on this topic should account for these different factors when investigating consumers' purchase and consumption behavior toward these products.

Our work contributes both at the theoretical and practical level. First, our findings contribute to recent literature on imperfection (e.g., Grewal et al., 2019; Loebnitz et al., 2015; Loebnitz and Grunert, 2015) by providing a broader and more detailed perspective on this phenomenon. More specifically, we provide a new point of view of consumers' reactions to imperfect produce by showing that consumers can be either averse or open to imperfection. Furthermore, while prior research has suggested possible explanations for why consumers may reject imperfect fruits and vegetables (e.g., Grewal et al., 2019), no prior work has provided evidence for the factors that make consumers more open to the purchase and consumption of these products. We provide such evidence and we show that the associations elicited by imperfect produce can have a behavioral, cognitive, or emotional nature. In this sense, we contribute to this stream of literature by showing that both positive and negative emotions are activated when consumers think about or encounter imperfect produce, an issue that has been largely neglected by prior research. Second, we contribute to literature on food waste by mapping relevant entry points that could be exploited by both actors of the food value chain and policy makers to promote the consumption of imperfect produce, and thus reduce food waste. In this sense, our findings can inform retailers and push them towards the adoption of less stringent aesthetical standards for fresh produce. Indeed, our findings suggest that consumers are open to the consumption of these products, meaning that retailers could benefit from the sale of food that is currently discarded while at the same time promoting the reduction of food waste. Furthermore, retailers could use findings of our research to develop communication campaigns or pamphlets leveraging on the emotional and cognitive associations elicited by imperfect produce and aimed at promoting the consumption of these products. These types of actions are being progressively implemented by large retailers around the world, as shown by large supermarket chains such as Intermarché, ASDA, Woolworth, and Tesco developing large communication campaigns about the sale of imperfect produce on their shelves. In this sense, our results about consumers being often unaware of the link between imperfection and food waste suggests that Woolworth's choice of focusing their promotional efforts on the problems of imperfect produce being wasted, ("Unique

produce that dreams of being tasted, not wasted”), might be a successful one. Moreover, our findings could provide useful suggestions for both policy makers and non-governmental organizations aiming at reducing food waste and wanting to engage in conversations with actors of the food value chain; indeed, our results about consumers’ openness to imperfection could inform these actors’ initiatives and could help them in obtaining the cooperation of retailers in their fight toward food waste.

Limitation and future research

Our work has limitations to be acknowledged. First, while we show that consumers can enact different behaviors and have different orientations toward imperfect produce, we measure intentions and not real behavior. Second, we used convenience samples in both our qualitative and quantitative study. Future research could further investigate consumers’ orientation toward imperfect produce using larger and more representative samples of the population. Third, whereas our findings provide potential entry points that could be leveraged for the development of interventions aimed at promoting the consumption of imperfect produce, we did not test for such effects. In this sense, future studies could use findings of our work to experimentally test interventions that could be implemented by retailers or policy makers for overcoming consumers’ aversion toward imperfect produce. For instance, our results about the role of disgust in association to imperfect fruits and vegetables suggests that efforts enacted by policy makers and actors of the food value chain could focus on ways to counteract this negative emotion. Similarly, our findings about beliefs held by consumers in relation to consumers provide the basis for the development of communication both in- and out-of-store about the qualities and benefits deriving from the consumption of these products. Finally, future research could further investigate the psychological mechanism underlying consumers’ responses to imperfect produce and provide a more detailed account of how the different factors we have identified interact with each other in defining consumers’ orientation toward imperfect fruits and vegetables.

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Appendix

Stimulus used in Study 1



Paper 2

The Role of Food Processing in Making Imperfection Beautiful: The Physical Processing of Imperfect Produce as a Way to Improve Attitude and Reduce Food Waste

Introduction

Standing atop a huge pile of perfectly safe but slightly “imperfect” bananas, Australian television presenter Craig Reucassel visually summarized one stark statistic: of the 80 million bananas that are grown by producers in Australia, 30 million are discarded because they do not meet retailers’ stringent aesthetic standards for fresh produce (Lallo, 2017). Similarly, 40% of the overall fruit and vegetables produced in Australia never reach the shelves because they are a bit misshapen, blemished or simply not beautiful enough for retailers to offer them to their customers (Helbig, 2018). Similarly, in Europe 50 million tons of fruit and vegetables are wasted because of how they look (Porter et al., 2018) while in the US more than 10 million tons of produce are either left unharvested or ploughed back into the soil because of their colour, size, weight or aesthetic imperfections (ReFED, 2016). Hence, retailers have the power to decide which food products are offered to consumers (Gruber, Holweg, and Teller, 2016), thereby influencing consumers’ attitudes and behaviour toward foods, as discussed by the food well-being (FWB) paradigm (Block et al., 2011; Scott and Valen, 2019). Indeed, prior research suggests that consumers may be reluctant to consume produce that is aesthetically imperfect (e.g. Grewal et al., 2019; Loebnitz and Grunert, 2018). Thus, finding ways to promote consumers’ acceptance of imperfect produce is particularly relevant for policy makers, as the potential positive effects connected to the recovery of such large volumes of imperfect – but perfectly edible – food are manifold: reduction of food waste; reduction of monetary losses for farmers through the recovery of large shares of their harvests that would otherwise be discarded;

promotion of healthy diets; and finally, reduction of food inequality through the recovery of safe, nutritious food to be redistributed to those in need (Stenmarck et al., 2016).

Indeed, general public and retailers alike (Gunders and Bloom, 2017) are starting to discover the potential benefits deriving from the sale of these previously overlooked products. From the highly popular “Ugly Veg and Fruit” campaign running across all social media, to ugly food advocates such as activist Tristram Stuart and the English chef Jamie Oliver, the potential of these products both in terms of reduction of food waste and as an opportunity for sales revenues is now undeniable. As a result, many retailers are now capitalizing on the benefits of this less attractive but equally edible and marketable produce. For instance, retailers have started selling these products at lower prices (e.g. Tesco’s “perfectly imperfect” range; Young, 2018) with associated advertising campaigns promoting the intrinsic value and the “beauty” of imperfect produce (Kane, 2016). However, it is still an open issue whether these strategies are sustainable in the long run and effective in overcoming consumers’ resistance to these products (Grewal et al., 2019). Indeed, selling imperfect produce at a lower price can exacerbate the already low evaluation consumers attach to these products (Aschemann-Witzel et al., 2017), potentially erasing the positive effects of campaigns aimed at promoting their consumption. This raises the issue of finding new and more effective interventions to be promoted by policy makers and enacted by actors of the food value chain with the goal of encouraging the consumption of imperfect produce.

In line with this idea, some actors have started to physically process imperfect produce and present this strategy both as a solution to the food waste problem for producers and as a sales-generating opportunity for the retail sector. For instance, Tesco has teamed up with a Spanish fruit supplier to produce juices made from visually imperfect foods with the goal of stopping edible produce from being dug back into the soil or used as animal feed (Smithers, 2018). This means that retailers are offering imperfect produce in physical shapes that have different degrees of mechanical alteration, ranging from the liquid or semi-liquid such as juices and soups to the solid such as chips (Peters, 2015; Szocs and Lefebvre, 2016). In this sense, physically processing imperfect produce

overcomes the problem of visual imperfections for retailers and consumers alike, contributing overall to the reduction of food waste. However, the reasons why consumers should be more prone to consume physically processed versions of imperfect produce rather than imperfect fruit and vegetables in their original state are still open to question. Thus, we focus on the effects of physically processing imperfect fruit and vegetables on consumers' perceptions and show through three experimental studies that imperfect produce which has been physically processed is more positively evaluated than imperfect produce in its original state. We define imperfect produce as fruit and vegetables characterized by deviations in their appearance due to a natural process of growth (i.e. shape abnormalities) and exclude deviations in their appearance due to damage or disease (i.e. blemish, abnormalities in colour) (Grewal et al., 2019). More specifically, we show that physically processing imperfect fruit and vegetables makes them more *prototypical* – and thus more representative of their category (Veryzer and Hutchinson, 1998) – with positive effects on attitude. Indeed, consumers prefer products that are congruent with their category schema, whereas deviant or atypical products are less positively evaluated (Maoz and Tybout, 2002; Veryzer and Hutchinson, 1998). Finally, we identify a boundary condition for this effect, namely when the artificial processing of imperfect products does not improve the attitude towards them.

Overall, our study is relevant at both the theoretical level and the practical. We contribute to literature on food imperfection by identifying an antecedent – *prototypicality* – of consumers' negative attitude toward imperfect fruit and vegetables. Furthermore, we show that policy makers, producers, and retailers can leverage on perceptions of prototypicality to create solutions and design interventions that would make consumers more willing to accept imperfect fruit and vegetables and thus reduce food waste – i.e. by physically processing them. In this sense, this work is consistent with recent findings showing that consumers are more likely to buy normally-shaped fruits than abnormally-shaped ones (e.g., Loebnitz and Grunert, 2015; Loebnitz, Schuitema, and Grunert., 2015), but it adds to this literature by providing an explanation as to why this happens and by offering a solution to consumers' resistance to imperfection. Hence, we contribute to literature on food waste

as well as to research into how consumers' category schemas and categorization processes can affect perceptions and behaviour across product categories (e.g. Creusen and Schoormans, 2005; Meyers-Levy and Tybout, 1989). In this sense, the findings of our work recognize the issue of food waste as involving a series of linked actors and institutions (Block et al., 2016) and suggest a solution that can be implemented by actors of the food value chain, i.e. selling imperfect produce that has been naturally processed. Finally, policy makers could design awareness campaigns focusing on the alternative uses of imperfect products and on the ways in which these can be recovered.

The remainder of the paper is organized as follows. First, we review prior research and provide an overview of the theoretical framework serving as the basis of our hypotheses. We then present the results of two experiments providing evidence for our main conceptualization. After that, we present the results of a pilot study and of an experiment providing support for the existence of a boundary condition for the effect of physically processing imperfect produce on attitude. Finally, we discuss the theoretical, public policy, and managerial implications of our study, pointing out the limitations of our work and paving the way for future research.

Food Imperfection and Physical Processing

Food imperfections and shape abnormalities are an intrinsic cue of the product and as such they have the potential to affect consumers' perceptions (Olson, 1972). Indeed, unlike other categories of products, external appearance – e.g. size, colour, shape, blemish – is the main cue consumers can use to infer the inherent characteristics and quality of fresh produce (Grunert, Bredahl, and Brunsø, 2004). In accordance with this idea, recent works have shown that imperfections and deviations from the norm in fresh produce significantly affect consumers' purchase intentions (e.g. De Hooge et al., 2017; Loebnitz and Grunert, 2015). For instance, Loebnitz and Grunert (2015) found that purchase intentions decreased as shape abnormalities increased, along a continuum that goes from normally shaped foods to extremely abnormal ones. In a similar vein, Loebnitz, Schuitema, and

Grunert (2015) showed that while there is no difference in purchase intentions between normal and moderately abnormal foods, consumers are less likely to buy extremely abnormally shaped food. Furthermore, abnormally-shaped vegetables are associated with higher perceptions of risk, so natural deviations in their appearance are associated with genetically modified (GM) foods (Loebnitz and Grunert, 2018). On the other hand, consumers are more likely to buy in a supermarket food that is abnormally shaped (i.e. a bent cucumber) than food that is imperfect in terms of colour, because the latter is perceived as unattractive, unsafe to eat, and bad-tasting (e.g. an apple with a spot) (De Hooge et al., 2017). As a consequence, individuals need a considerable discount before they are willing to buy these products, consistent with the presumption that they are “to be discarded”.

Overall, these results suggest that consumers have negative attitudes towards imperfect foods and that they would not be willing to buy them, providing evidence for the retailers’ decision not to offer them on their shelves (Bond et al., 2013; Gustavsson et al., 2011). However, some boundary conditions exist whereby consumers are less likely to reject these products. For instance, high levels of environmental concern are associated with higher purchase intentions toward abnormal food. In particular, individuals who are both environmentally concerned and have high levels of trust toward the institutions are more likely to buy extremely abnormal foods (Loebnitz and Grunert, 2015). Similarly, increasing awareness of food waste issues increases the consumers’ likelihood of purchasing abnormally shaped fruit and vegetables, especially those consumers that have a strong pro-environmental self-identity (Loebnitz, Schuitema, and Grunert, 2015). On the other hand, the consumers’ attitude toward imperfect products varies, depending on whether they are pondering to purchase the product in a supermarket or, having already purchased it, deciding to consume it at home (De Hooge et al., 2017).

However, despite consumers’ established aversion toward aesthetically imperfect produce (e.g., De Hooge et al., 2017; Loebnitz and Grunert, 2015; Loebnitz and Grunert, 2018), products – and especially food – can go through a number of physical changes that alter their core characteristics (Trudel and Argo, 2013). These distortions – either in the product itself or its packaging – have in

turn an effect on consumers' perceptions and subsequent behaviour, so that changing the physical shape, or physically processing aesthetically imperfect produce by turning it into new products such as juices or soups, has the potential to positively influence the consumer's attitude toward it. For instance, changing the shape of a product – e.g. piece of paper – affects the consumers' decision to either trash it or recycle it (Trudel and Argo, 2013). Changes in product shape can affect perceptions of the quantity of food contained in the package and in turn influence the amount of product to buy (Yang and Raghurir, 2005). For instance, food consumed as a snack leads to greater subsequent consumption than the same food consumed as a full meal (Capaldi and Owens, 2006). Similarly, consumers perceive whole foods (e.g., fruit and vegetables) to be more organic than foods that have been processed (e.g., ice cream, cake, pasta) (Prada, Garrido and Rodrigues, 2017). Furthermore, foods that are raw or less processed are considered healthier and lower in calories than foods that are more processed (Szocs and Lefebvre, 2016).

Thus, based on evidence from prior research showing that changing the physical state of a product changes consumers' perceptions and behaviour, we hypothesize that altering the physical state of imperfect fruit and vegetables – i.e. by transforming fresh produce into products such as juices or soups – has a positive effect on consumers' general attitude toward these products. More specifically, we expect that physically processing the imperfect product increases the general attitude towards it. Formally:

H₁: *The effect of imperfection on the general attitude toward the product is moderated by the physical processing of the product. Specifically, for imperfect products the general attitude is more positive when the product has been physically processed than when it is in its original state. Conversely, there is no difference in attitude between perfect products in their original state and perfect products that have been physically processed.*

Mediating Role of Prototypicality

We argue that the positive effect that the physical processing of imperfect products has on attitude is driven by the perception of prototypicality. Prototypicality has been defined as the extent to which an object is representative of a category (Barsalou, 1985; Rosch, 1999). Category representativeness has a graded structure, whereby objects – and products – range on a continuum that starts with the most representative members of the category, goes through atypical members, and continues to non-members of the category (Barsalou, 1985). More specifically, prototypical objects can be either objects that are frequently encountered as examples of the category or objects that have attributes that occur frequently within a specific category (Nedungadi and Hutchinson, 1985). For instance, Coca-Cola is a prototypical exemplar of its category (Nedungadi and Hutchinson, 1985), so when a consumer thinks of colas, Coca-Cola is the first instance that comes to mind (Amaldoss and He, 2013). Yet while it has been shown that prototypical products are more likely to be included in the consumer's consideration set (Amaldoss and He, 2013; Nedungadi and Hutchinson, 1985), there are instances in which an atypical product is more likely to be successful. For instance, an atypical external appearance is beneficial for products for which prestige, exclusiveness, novelty or differentiation are important (Creusen and Schoormans, 2005). In these cases, product designers can use *prototypical distortion* to alter designs that already exist in the marketplace and create newly designed products that differ from prototypical ones (Trudel and Argo, 2013; Veryzer and Hutchinson, 1998). By making these physical modifications either to the product design itself or to the product packaging, designers affect consumers' aesthetic responses and the way they think about a product (Creusen and Schoormans, 2005). A non-prototypical appearance can communicate that the new product has features that members of the category do not possess or can even be perceived as a member of its own individual class (Rosch et al., 1976).

On the other hand, consumers prefer prototypical products in low-involvement purchases (Creusen and Schoormans, 2005), namely when they do not consider the purchase of the product

important or interesting (Alba and Hutchinson, 1987). In these cases, the consumer's effort is minimal and prototypical products come easily to mind (Amaldoss and He, 2013). In this sense, food products such as staples (Ahmed et al., 2004), soft drinks (Holmes and Crocker, 1987; Torres and Briggs, 2007), meat (Lind, 2007; Zaichkowsky, 1987), and snacks (Dahlèn, Ekborn, and Mörner, 2000) have all been considered as low involvement products by prior research. Based on this evidence, we argue that fruit and vegetables are low involvement products, and as such are preferred by consumers when they are prototypical of their category. Conversely, fresh produce with aesthetical imperfections in terms of colour, size, shape, and weight are considered less prototypical of their category – i.e. fruit and vegetables – because they are not easily recognized by consumers. However, physically altering such products, by cutting them to pieces or by processing them to turn them into new products such as juices, smoothies or chips, will make them more prototypical. Specifically, we argue that the physical processing of the product will influence the consumer's categorization process so that an imperfect product that has been physically processed will no longer be considered a member of the *produce* category but a member of the category corresponding to the processed product it has been turned into. For instance, an apple with aesthetical imperfections (e.g., blemish, abnormal size, unusual colour) is less prototypical than an aesthetically perfect apple; on the other hand, an apple juice is prototypical and a good example of the whole category (i.e. juice) regardless of whether it has been produced using imperfect or perfect fruits. Hence, we hypothesize that:

H₂: *The positive effect of physically processing imperfect products on consumers' general attitude toward the product is mediated by perceptions of prototypicality. Specifically, imperfect products that have been physically processed are perceived more prototypical than imperfect products in their original state, which in turn leads to a more positive attitude toward the product. Conversely, there is no difference in prototypicality and thus attitude between perfect products in their original state and perfect products that have been physically processed.*

Overview of Studies

We conducted three experimental studies in order to test our hypotheses. Study 1 tests how the physical state (original state vs. physically processed) of the product influences the effect of food imperfection on consumer attitude while Study 2 investigates the proposed underlying mechanism of prototypicality (see Figure 1). Finally, in Study 3 we investigate circumstances in which physically processing imperfect produce does not benefit consumer attitude toward the product. Specifically, we provide evidence for a boundary condition of the effect shown in Study 1 and Study 2 and demonstrate that the artificial processing of the product simultaneously increases perceptions of prototypicality and decreases perceptions of naturalness; as a result, artificially processing the imperfect product does not ultimately lead to a favourable attitude (see Figure 4).

Study 1

Study 1 was aimed at testing the moderating effect detailed in H₁, namely, that of the interaction between food imperfection and the physical processing of the product on the consumer's general attitude toward the product.

Method

One hundred and thirty-three participants took part in the study (58% female; median age = 21) recruited through a snowball sampling procedure. A 2 (perfect vs. imperfect product) x 2 (no processing vs. processing) between-subjects experimental design was used, with participants randomly assigned to one of four experimental scenarios: the picture of a perfect fruit (a peach with no shape abnormalities) that was either presented in its original state (no processing) or was accompanied by a picture of a processed product (a peach salad); the picture of an imperfect fruit (a peach with shape abnormalities) that was either presented in its original state (no processing) or was accompanied by a picture of a processed product (a peach salad) (see Appendix A). To reduce potential demand effects, no mention of either perfection or imperfection was used when the stimuli were presented, with the products being simply labelled as either "peach" or "peach salad".

Furthermore, for both conditions in which a physically processed product was presented, a claim stated that the processed product (i.e. peach salad) had been produced using the fruit shown on the left side of the screen, either a perfect or an imperfect peach. By doing so, we made sure that respondents were aware that the product had been produced using either a perfect or an imperfect fruit, thus ensuring that the product of origin was salient in both conditions in which the product had been physically processed.

In each condition, participants indicated their attitude toward the product that was presented at the beginning of the study, using a scale adapted from White et al., (2016) (“dislike very much/like very much”, “unfavourable/favourable”, “negative/positive”, “undesirable/desirable”, “bad/good”, on seven-point scales). Before providing demographic information, respondents also completed a manipulation check measure aimed at verifying that the imperfect versus the perfect product was perceived as intended (1= “imperfect”, 7 = “perfect”). Moreover, in order to verify the processing manipulation, respondents were asked to state whether they had seen either a picture of “a single peach”, “a peach salad” or “a peach with a peach salad”.

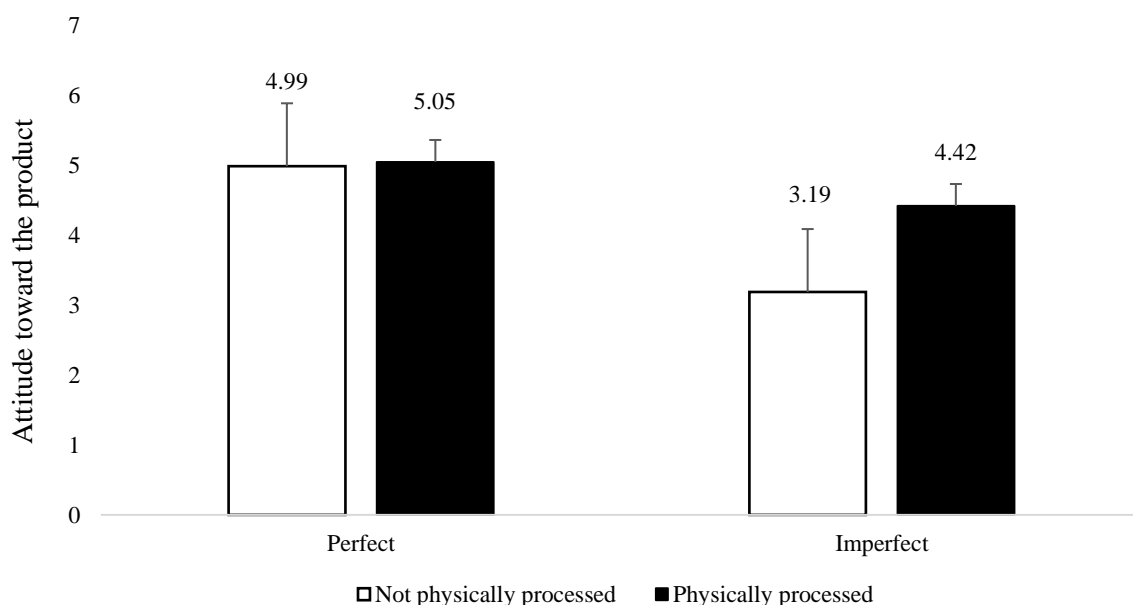
Results

The manipulation check was successful as individuals exposed to the picture of the imperfect product rated the product as more imperfect than did individuals being shown the picture of the perfect product ($M_{perfect} = 4.92, SD = 1.24; M_{imperfect} = 2.42, SD = 1.46; F(1,131) = 114.19; p < .01$). Results also showed that only three respondents out of the sixty-nine assigned to the conditions with the product in its original state and nine participants out of the sixty-four assigned to the conditions with the physically processed product failed the manipulation check for the processing variable ($\chi^2(2) = 103.45, p < .01$). However, the exclusion of these participants did not change the direction of results and thus we included them in the final sample for the analysis. We then combined the six items assessing attitude toward the product ($\alpha = .95$) to obtain an aggregated measure of this construct ($M_{attitude} = 4.43; SD = 1.70$).

In order to test for the moderating effect of the physical processing of an imperfect product on consumer attitude, we conducted a two-way ANOVA with imperfection and physical processing as factors and attitude toward the product as dependent variable. The ANOVA revealed a significant main effect of imperfection ($F(1,129) = 20.59, p < .05, M_{perfect} = 5.02, SD = 1.51$ vs. $M_{imperfect} = 3.75, SD = 1.67$) and a significant main effect of the physical processing of the product ($F(1,129) = 5.77, p < .05, M_{original_state} = 4.10, SD = 1.81$ vs. $M_{processed} = 4.78, SD = 1.51$). More importantly, such main effects were qualified by a significant interaction effect between imperfection and physical processing ($F(1,129) = 4.82, p < .05$). Specifically, planned contrasts revealed that for *imperfect* products evaluation is more positive when the product has been physically processed than when the product is in its original state ($M_{imp_processed} = 4.42, SD = 1.61; M_{imp_original_state} = 3.18; SD = 1.52; F(1,129) = 9.85, p < .05$), whereas for *perfect* products there is no significant difference between the two scenarios ($M_{perf_processed} = 5.05, SD = 1.39; M_{perf_original_state} = 4.99, SD = 1.64; F(1,129) = .23, p = ns$). Furthermore, there is no difference in attitude between the perfect and imperfect product after they have been physically processed ($M_{perfect_processed} = 5.05, SD = 1.39; M_{imperfect_processed} = 4.42, SD = 1.61; F(1, 129) = 2.63, p = ns$) (see Figure 1).

Figure 1

Interaction effect of food imperfection and physical processing on attitude toward the product (Study 1)



Discussion

Results of Study 1 provide support for H₁ by demonstrating that the physical processing of the product moderates the effect that food imperfection has on attitude toward the product. Specifically, we show that physically processing the imperfect product significantly increases consumers' attitude toward it. The increase in attitude after the imperfect product has been physically processed is such that consumers do not perceive any difference between perfect and imperfect products after they have been processed. This provides support to the idea that the physical transformation of imperfect products is a useful method to employ in order to overcome the consumers' negative attitude towards them. On the other hand, physically processing a perfect product does not change attitude as the product is perceived equally positively whether in its original state or after it has been physically processed.

Study 2

Study 2 was aimed at testing H₂ and thus at providing evidence for the proposed underlying mechanism (i.e., prototypicality) for the effect of imperfection and physical processing of the imperfect product on general attitude toward the product.

Method

One hundred and ninety responses ($M_{age} = 33.41$, $SD = 14.43$, 48% female) were collected through a snowball sampling procedure. The same experimental design as Study 1 was used, and thus participants were randomly assigned to one out of four conditions: the picture of a perfect product in its original state, the picture of a perfect product accompanied by the picture of the physically processed version of the product shown on the left side of the screen, the picture of the imperfect product in its original state, the picture of the imperfect product accompanied by the picture of the physically processed version of the product shown on the left side of the screen. In this case, an orange (perfect vs. imperfect) was used as the product of origin and an orange juice as the physically processed version (see Appendix B). As in Study 1, a claim was added in the conditions with the

physically processed products stating that the physically processed product had been produced using the product of origin shown on the screen.

Attitude toward the product was measured using the same items as in Study 1 (adapted from White et al., 2016). Our proposed mediator – i.e. prototypicality – was measured by asking respondents to rate the extent to which the product shown in the picture was perceived to be “an extremely poor example/an extremely good example of its category”, “atypical/typical” and “very unrepresentative/very representative” (adapted from Loken and Ward, 1990, on seven-point scales). A manipulation check was administered to test for perceived differences between the perfect and imperfect product (1 = “imperfect”; 7 = “perfect”). Finally, in order to verify the processing manipulation, respondents were asked to state whether they had seen either a picture of “an orange”, “an orange juice” or “an orange with an orange juice”. After the manipulation checks, demographic information was collected.

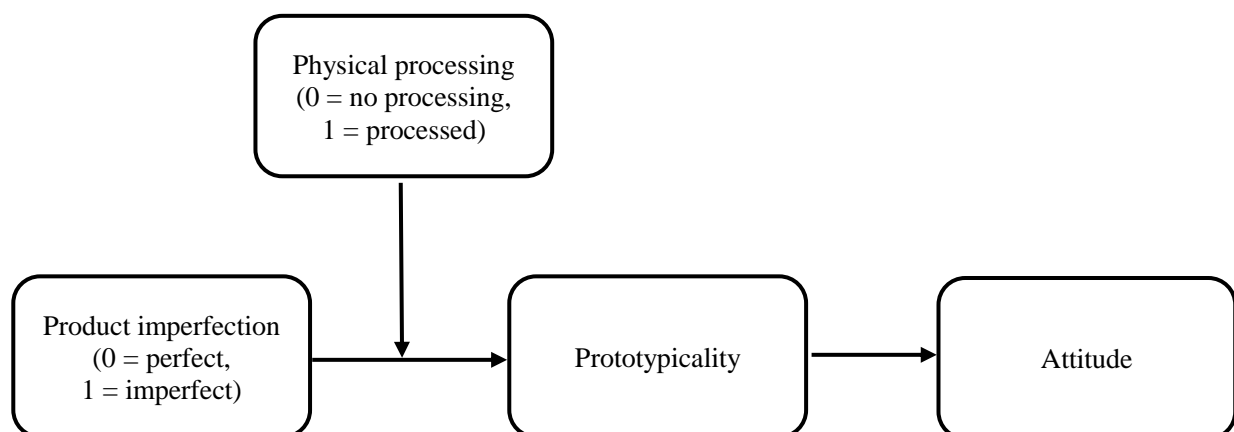
Results

The manipulation check for imperfection was successful, with respondents perceiving the imperfect product as significantly more imperfect than did respondents being shown the perfect product ($M_{perfect} = 4.94$, $SD = 1.63$; $M_{imperfect} = 3.05$, $SD = 1.76$; $F(1, 188) = 58.41$, $p < .01$). Eight participants out of the ninety-four being assigned to the conditions with the physically processed product failed the attention check ($\chi^2(2) = 178.33$, $p < .01$). However, no change in results was observed when excluding these participants and thus they were included in the final sample for the analysis. Finally, the items measuring attitude toward the product ($\alpha_{attitude} = .96$) and prototypicality ($\alpha_{prototypicality} = .88$) were averaged to create combined measures of the constructs ($M_{attitude} = 4.23$, $SD_{attitude} = 1.79$; $M_{prototypicality} = 4.20$, $SD_{prototypicality} = 1.87$).

OLS regression analysis (Hayes, 2017) was used to test for our proposed underlying mechanism (H₂), considering imperfection as independent variable (perfect product = 0, imperfect product = 1), whether the product was physically processed as moderator (0 = not physically

processed, 1 = physically processed), and prototypicality as mediator. We estimated Model 7 of PROCESS macro (Hayes, 2017) to test for our moderated-mediation model (see Figure 2). First, results of an ANOVA show that the physical processing of the product moderates the effect of imperfection on prototypicality ($F(1, 186) = 34.96, p < .01$). For perfect products, there is no evidence of differences in prototypicality between the product in its original state and the product after it has been physically processed ($M_{original_state} = 5.08, SD = .224; M_{processed} = 5.17, SD = .217, F(1, 186) = .08, p = ns$). Conversely, the imperfect product that has been physically processed is perceived more prototypical than the imperfect product in its original state ($M_{original_state} = 2.28, SD = .23; M_{processed} = 4.09, SD = .20, F(1, 186) = 34.73, p < .01$). In turn, prototypicality has a positive effect on attitude ($b = .68, p < .01$), while the effect of imperfection on attitude is not significant ($b = -1.67, p = ns$). The index of moderated-mediation further supports these findings by showing that the indirect effect of imperfection on attitude through prototypicality is moderated by the physical processing of the product ($b = 1.17, C.I.: .63; 1.75$). Both conditional indirect effects are significant [$C.I. -2.42, -1.46; C.I. -1.22, -.32$] and coherently with our expectations, the effect of imperfection on attitude is greater (-1.91) when the product is in its original state than when it is physically processed (-.74). Indeed, the direct effect of imperfection on attitude is not significant [$C.I. -.57, .24$]. Hence, H₂ was supported.

Figure 2
Conceptual model tested in Study 2



Discussion

Results of Study 2 provide support for the hypothesized theoretical mechanism (H₂) explaining the effect of food imperfection on attitude toward the product. Specifically, we have enough evidence to confirm our conceptualization, according to which, for *imperfect* products, a physically processed product is perceived as more prototypical than when in its original physical state, thus increasing consumers' attitude toward these products.

It is worth noting that the processed products used in Study 1 (i.e. peach salad) and Study 2 (i.e. orange juice) require none or little mechanical processing and can be easily prepared by consumers in their households (i.e., by cutting the peach into pieces and by using an orange juicer). Consistently with this idea, no information about ingredients of the products was provided in prior experiments. On this topic, prior research has shown that physically processed products with no-ingredients labels are perceived significantly as more natural than physically processed products with labels providing information about food ingredients and processes used to manufacture the food (e.g. additives) (e.g., Evans, de Challemaison and Cox, 2017; Rozin, 2005). Indeed, we ran an online between-subjects post-test with participants recruited through a snowball sampling procedure ($N = 74$, $M_{age} = 27.04$, $SD = 10.47$, female = 70.3%) with the aim of investigating the extent to which the peach salad used in Study 1 and the orange juice used in Study 2 are perceived as natural by consumers (1 = “not at all natural”, 7 = “very natural”). Results of two one-sample t-tests show that both the peach salad and the orange juice are perceived significantly as more natural than the midpoint of the scale ($M_{peachsalad} = 5.21$, $SD = 1.34$, $t(37) = 7.88$, $p < .01$; $M_{orangejuice} = 4.64$, $SD = 2.19$, $t(35) = 3.12$, $p < .01$). Furthermore, results of an independent t-test show that the two products are perceived as equally natural by respondents ($M_{peachsalad} = 5.21$, $SD = 1.34$ vs. $M_{orangejuice} = 4.64$, $SD = 2.19$; $t(72) = 1.36$, $p = ns$). These results suggest that the extent to which consumers perceive the peach salad and the orange juice in Study 1 and Study 2 as natural is consistent with our assumption of naturalness for these products. Conversely, research shows that consumers are concerned about the use of preservatives, colorants, and artificial sweeteners in foods (Asioli et al., 2017; Shim et al., 2011) and

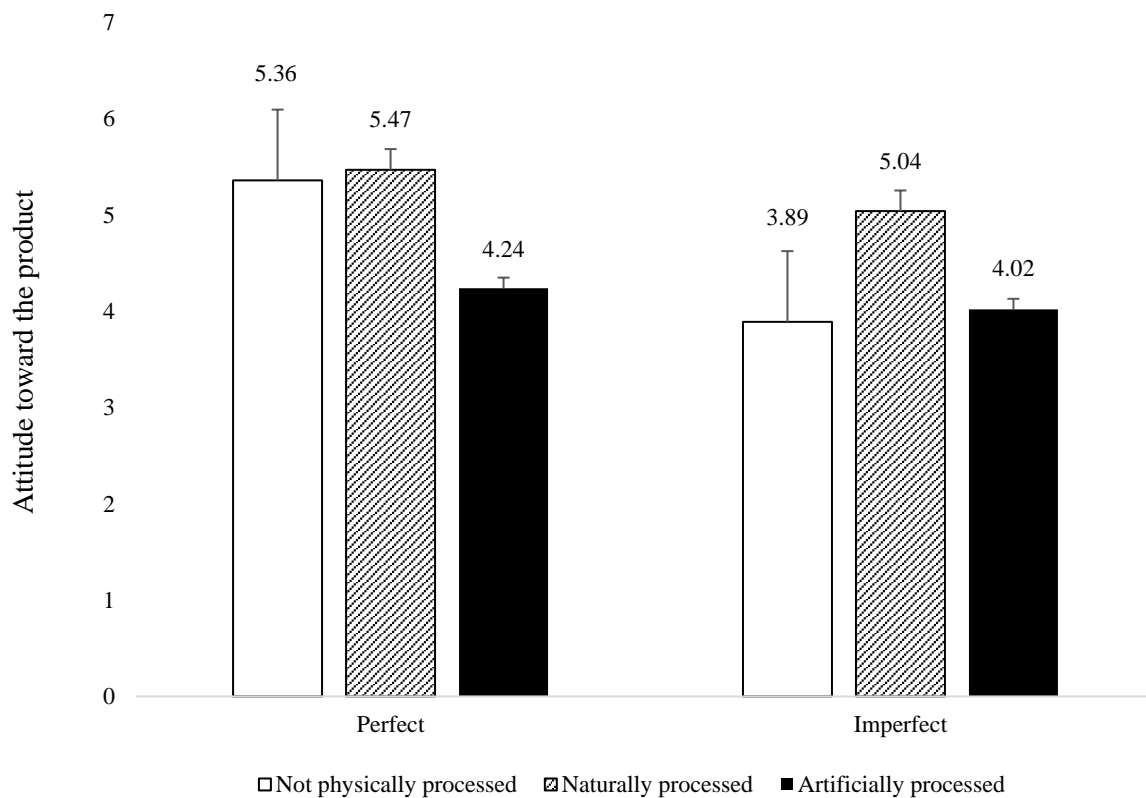
as consequence, they have low acceptance and high-risk perception toward artificial products – i.e. products with food additives (Bearth, Cousin and Siegrist, 2014). Thus, we argue that adding such artificial ingredients when physically processing imperfect produce will not improve the attitude toward the product because of consumers' general aversion towards artificiality.

We ran a pilot study aimed at investigating this idea and at providing preliminary support for the effect of artificially processing imperfect produce on attitude toward the product. We used a 2 (perfect vs. imperfect) x 3 (no physical processing vs. natural physical processing vs. artificial physical processing) between-subjects experiment in which 199 respondents ($M_{age} = 31.39$, $SD = 11.47$; female = 64.3%) recruited through a snowball sampling procedure were randomly assigned to one out of six possible conditions: either a perfect or imperfect product (an apricot) in its original state, or the product (perfect vs. imperfect) accompanied by a picture of a juice that was processed either in a natural or an artificial way. The extent to which the juice was natural or artificial was manipulated through a label on the juice stating the ingredients of the products. Specifically, the juice in the natural conditions was presented with a label claiming that the product contained “100% apricot, no added sugar, no additives, no preservatives”. On the other hand, the juice in the artificial conditions presented a label claiming that the product contained “apricot, added sugar, additives, preservatives”. This manipulation is consistent with results of prior research showing that the addition of such ingredients increases consumers' perceptions of artificiality of the product (Bearth, Cousin and Siegrist, 2014). In all four conditions in which a physically processed product was presented (perfect vs. imperfect natural juice and perfect vs. imperfect artificial juice) a claim stated that the juice had been produced using the apricot shown on the left side of the screen. In this way, we made sure that participants were fully aware of the product of origin used for the physically processed product that was shown to them.

Results of two independent t-tests showed that whereas the imperfect product that has been naturally processed is more positively evaluated than the imperfect product in its original state ($M_{naturally_processed} = 5.04$, $SD = 2.12$, $M_{original_state} = 3.89$, $SD = 1.72$; $t(65) = -2.44$; $p < .05$), there is no

difference in consumers' attitude between an imperfect product in its original state and an imperfect product that has been processed by adding artificial components such as additives or preservatives ($M_{artificially_processed} = 4.02$, $SD = 1.67$, $M_{original_state} = 3.89$, $SD = 1.72$; $t(63) = -.304$, $p = ns$). Furthermore, artificially processing the product is not beneficial for the perfect product either, to the point where a positive attitude toward the perfect product significantly decreases after this has been artificially processed ($M_{artificially_processed} = 4.24$, $SD = 1.75$, $M_{original_state} = 5.36$, $SD = 1.41$; $t(67) = 2.91$, $p < .05$). On the other hand, naturally processing the imperfect product makes it as valuable for consumers as the perfect product that has gone through the same type of physical processing ($M_{perfect} = 5.47$, $SD = 1.71$, $M_{imperfect} = 5.04$, $SD = 2.12$; $t(63) = .903$, $p = ns$). These results, summarized in Figure 3, are a first indication about our prediction that artificially processing imperfect products does not increase consumers' attitude toward them.

Figure 3
Results of pilot study



Thus, we found preliminary evidence of the existence of a boundary condition for the effects shown in Studies 1 and 2. More specifically, we expect that, despite an increase in prototypicality due to the physical transformation of the product, the attitude will not increase because of consumers' perceptions of low naturalness associated with the transformation. Hence, we expect that both prototypicality and naturalness will act as mediators of the effect of food imperfection on attitude, and that the artificial physical processing of the product will moderate the effect of imperfection on both mediators. In this sense, we expect that an imperfect product that has been artificially transformed will be perceived more prototypical but less natural, and that the positive effect that an increase in prototypicality has on attitude will be counterbalanced – and cancelled out – by the decrease in attitude driven by consumers' lower perception of naturalness of the physically processed product. In other words, we expect that the imperfect product that has been physically processed in an artificial way will be perceived as negatively as the imperfect product in its original state. Formally:

H₃: The relationship between artificial transformation of the imperfect product and general attitude toward the product is mediated by perceptions of prototypicality and naturalness. Specifically, an imperfect product that has been artificially processed will be perceived as more prototypical but less natural than an imperfect product in its original state, which in turn will have an effect on the consumers' attitude toward the product.

We test our predictions in Study 3.

Study 3

Study 3 was aimed at providing evidence for the underlying mechanism detailed in H₃, namely the mediating effect of both prototypicality and perception of naturalness explaining the effect of the artificial transformation of the imperfect product on the consumers' attitude. We predict that, in line

with results of Study 1 and Study 2, artificially processing the imperfect product will increase consumers' perceptions of prototypicality; conversely, the artificial processing of the product will simultaneously reduce the perception of naturalness associated with the product. These opposite effects will counterbalance, so the positive effect of an increase in prototypicality will be cancelled out by the effect that lower perception of naturalness has on attitude.

Method

We used a single factor between-subjects experimental design, in which respondents ($N = 115$, $M_{age} = 28.71$; $SD = 11.48$; female = 53.9%), recruited using a snowball sampling procedure, were randomly assigned to one of two conditions: an imperfect apple in its original state or an artificial apple juice with an imperfect apple shown on the label. The artificial juice was accompanied by a claim stating that the juice was produced using the apple shown on the label, and that the apple juice had been treated with synthetic and inorganic components and contained other synthetic components such as added flavours and sulfuric anhydride (see Appendix C). By doing so, we made sure that respondents were aware that the product had been produced using the imperfect apple pictured on the label. Furthermore, contrary to Studies 1 and 2, we showed the original imperfect product on the label of the physically processed one rather than on the side of the screen.

Respondents in each condition rated their attitude toward the product and the extent to which they perceived the product to be prototypical of its category, using the same items administered in prior studies ($\alpha_{attitude} = .89$, $M_{attitude} = 2.14$, $SD = 1.16$; $\alpha_{prototypicality} = .83$, $M_{prototypicality} = 2.23$, $SD = 1.20$). Perceived naturalness of the product was measured using seven items adapted from Camus (2004) and Lunardo and Saintives (2013) (“the product is natural”, “the product is made with natural ingredients”, “looking at the product I can tell where it comes from”, “the product is pure”, “the product does not contain additives”, “the product is safe”, “the product is not refined”, on seven-point scales) that were combined into an overall index measuring consumers' perception of the naturalness of the product ($\alpha_{naturalness} = .85$, $M_{naturalness} = 3.23$, $SD = 1.49$).

Results

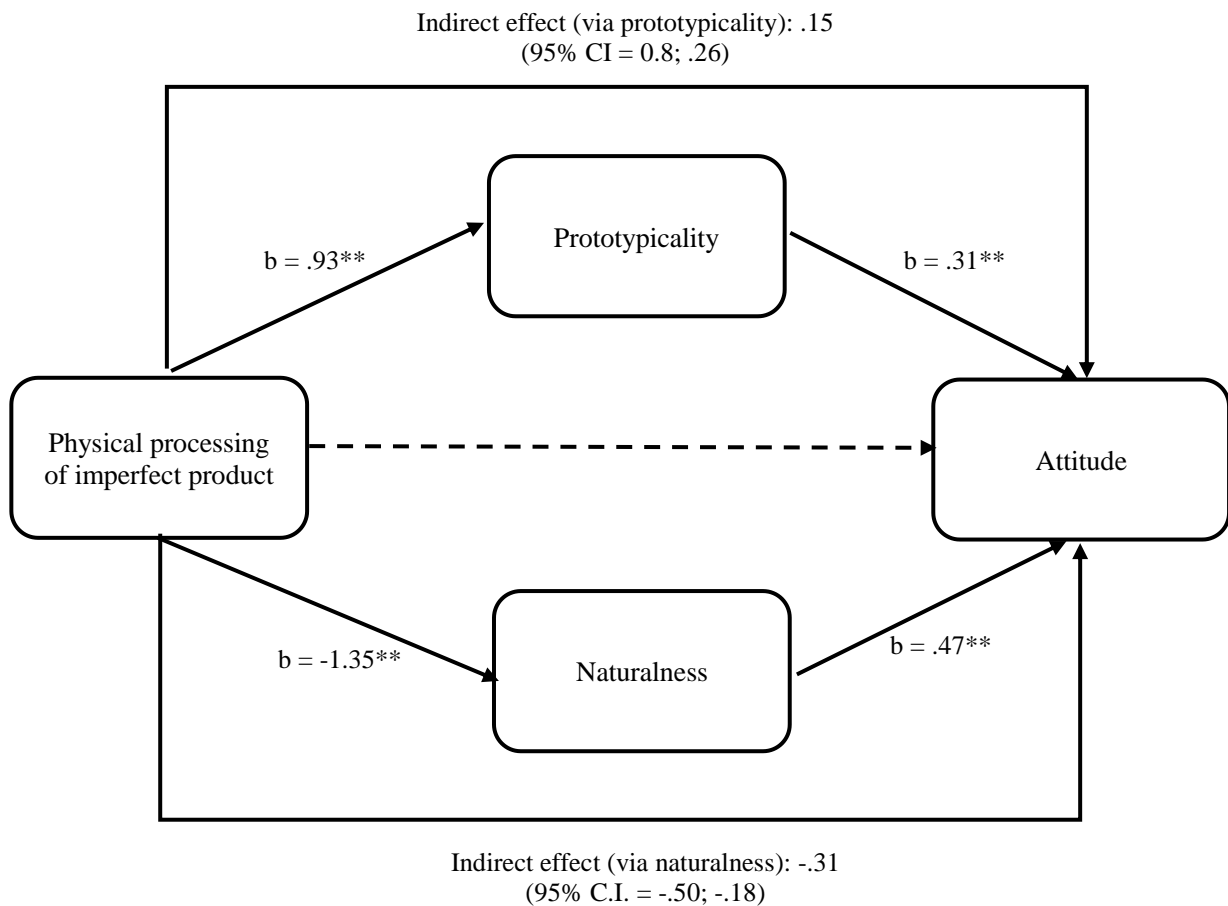
We firstly conducted a preliminary independent t-test that showed that imperfect products that have been artificially processed are perceived as more prototypical than imperfect products in their original state ($M_{original_state} = 1.83, SD = .95; M_{artificiallyprocessed} = 2.77, SD = 1.30; t(112) = -4.43, p < .05$). Conversely, the imperfect product that has been artificially processed is perceived as less natural than the imperfect product in its original state ($M_{original_state} = 3.82, SD = 1.49; M_{artificiallyprocessed} = 2.50, SD = 1.08; t(112) = 5.25, p < .05$). Then, in order to test for the mediating effect of prototypicality and perception of naturalness we conducted a mediation analysis using Model 4 of PROCESS macro (Hayes, 2017) with artificial transformation of the imperfect product (0 = not physically processed, 1 = artificially processed) as independent variable, prototypicality and naturalness as parallel mediators, and general attitude as dependent variable. Indeed, results show that artificially processing an imperfect product has a significant and positive effect on prototypicality ($b = .93, p < .01$); on the other hand, it has a significant and negative effect on consumers' perception of naturalness ($b = -1.35, p < .01$). Considering general attitude toward the product as dependent variable, both prototypicality ($b = .31, p < .01$) and naturalness ($b = .47, p < .01$) have a significant and positive effect on consumers' attitude. Furthermore, the direct effect of the artificial transformation on attitude is not significant ($b = .15, C.I.: -.13; .29$), while both the indirect effect of prototypicality ($b = .29, C.I.: 0.8; .26$) and naturalness ($-.63, C.I.: -.50; -.18$) are significant (see Figure 4). Specifically, the total indirect effect is not significant ($b = -.34, C.I.: -.76; .01$) while the indirect effect of the artificial transformation on attitude through naturalness is stronger than the indirect effect through prototypicality ($b = .92, C.I.: .63, 1.28$). However, given consumers' negative perception of imperfect products in their original state ($M_{originalstate} = 2.22, SD = 1.23$) and the parallel and opposite effect of the artificial transformation on attitude through prototypicality and naturalness, the imperfect product in its original state and the imperfect product that has been artificially processed are equally and negatively perceived

($M_{originalstate} = 2.22, SD = 1.23$ vs. $M_{artificiallyprocessed} = 2.03, SD = 1.08, p = ns$). These results are consistent with our conceptualization and thus H_3 was supported.

Figure 4

Mediating role of prototypicality and perception of naturalness in the relationship between physical processing of the imperfect product and consumers' attitude.

** $p < .01$. Dotted arrows indicate nonsignificant effects



Discussion

Results of study 3 provided evidence for full mediation and confirmed our prediction that artificially processing an imperfect product does not increase consumers' attitude because of the parallel and opposite mediating effect of prototypicality and perception of naturalness on attitude toward the imperfect product. Specifically, in line with Study 2 we show that the artificial

transformation of the imperfect product increases perception of prototypicality. However, artificially processing an imperfect product has a negative effect on perception of naturalness which, in turn, negatively affects consumers' attitude. Such an effect is so strong that it cancels out the positive effect that the increase in prototypicality has on attitude. In this sense, we show that there is a boundary condition for the effect of the physical transformation of the imperfect product on consumers' attitude, namely that increases in attitude for physically processed imperfect products depend on the extent to which that physical transformation is perceived as natural by consumers.

General Discussion

As the call for action by both developing and developed countries to reduce food waste and ensure efficiency and equality of distribution of food resources is getting more and more pressing (Food and Agriculture Organization, 2018; United Nations, 2015), research efforts are required for the identification of psychological and consumer-based interventions aimed at finding effective solutions for curbing food waste. In this research, we show that actors of the food value chain could actively contribute to the reduction of waste of aesthetically imperfect produce by selling physically processed versions of these products. Indeed, our results show the potential positive effect of this intervention, as consumers show a more positive attitude toward imperfect produce that has been physically processed than imperfect produce in its original state. Specifically, we show that this effect is driven by perception of prototypicality, so that an imperfect product that has been physically processed is perceived as more prototypical than an imperfect product in its original state. However, consumers are averse to artificiality and thus physically processing an imperfect product is successful in enhancing attitude as long as the physical transformation is perceived as natural by consumers.

Theoretical Implications

Our results add to recent literature on consumers' reactions to food imperfection by shedding light on the underlying mechanism – i.e. prototypicality – explaining consumers' negative attitudes toward food imperfection. In this sense, we make several contributions to recent research in consumer behaviour. First, whereas recent studies on consumers' perception of imperfect fruit and vegetables have provided evidence for consumers' avoidance of these products (e.g., Aschemann-Witzel et al., 2017, De Hooge et al., 2017; Loebnitz and Grunert, 2015; Loebnitz et al., 2015), we provide an explanation as to why this happens. Specifically, we show that consumers do not recognize such products as members of their category and as such are reluctant to buy them. In this sense, we shed light on the psychological process affecting consumers' decision-making and behaviour toward imperfect food, providing a broader and more complete picture of why consumers may avoid these products.

Second, we contribute to literature on prototypicality. We show that principles of *product distortion* (Creusen and Schoormans, 2005; Trudel and Argo, 2013; Veryzer and Hutchinson, 1998) that can be strategically applied by product designers to affect consumers' response are successful in influencing consumers' response to imperfection in fresh produce as well. In this sense, we add to this literature by showing that such principles can be successfully applied to a product category neglected by prior research.

Finally, we contribute to the recent wave of research on food waste by showing that the understanding of the psychological mechanisms explaining consumers' attitudes and reactions is paramount for the design and development of tools aimed at its minimization (e.g., Cooremans and Geuens, 2019; Grewal et al., 2019), in line with the call for more efforts to fight food waste at the consumer level (e.g., Graham-Rowe, Jessop and Sparks, 2014). Moreover, our work goes one step further by showing that theoretical explanations of consumer-generated food waste provide useful knowledge for actors operating at different stages of the food value chain and for policy makers. Thus, our research highlights the need for the development of theoretical investigations on food waste that accounts for the food value chain as a series of interdependent actors whose actions influence

one another (Block et al., 2016; Ciulli, Kolk and Boe-Lillegraven, 2019). In this sense, our work contributes to recent research underlying the role of retailers and marketers in promoting consumers' sustainable consumption choices and overcoming their negative perceptions of certain types of products (Hingston and Noseworthy, 2018; Pham and Mandel, 2019).

Public Policy and Managerial Implications

Overall, our findings provide useful suggestions for operators working within the food supply chain, which overcome the constraints and limitations of traditional strategies for selling imperfect produce based on lower prices (Aschemann-Witzel et al., 2015; Aschemann-Witzel et al., 2017). Indeed, our results have relevant implications for companies operating in the food sector and for producers as well as for policy makers, consistently with the recent call for a more theoretical understanding of the psychological underpinning of wasteful behaviours as the basis for the development of solutions aimed at reducing food waste (Block et al., 2016). Firstly, companies can use the results of our work to develop successful strategies for selling imperfect products with beneficial effects in terms of both reduction of food waste and economic returns. Secondly, companies can frame their objective of selling imperfect products as their active way of contributing to the reduction of food waste and thus promote efficiency in the use of and equality in the distribution of food resources. Thirdly, from an economic point of view, retailers selling imperfect produce would face significant savings in terms of cost as producers might be willing to sell their produce at a lower price when faced with the alternative of large volumes of their harvest going to waste.

Fourthly, our findings suggest that it could be beneficial for producers to physically process produce that would not meet high retail grading standards and to sell it directly to consumers. By doing so, producers could recover large shares of their harvest that would otherwise go to waste, while at the same time contributing to curbing global food waste. However, both managers and producers should be careful when deciding to process imperfect produce as our study suggests that

this strategy is bound to be successful as long as the physical transformation of the product is perceived by consumers to be natural. Indeed, artificial transformations could backfire with detrimental effects on the resources of companies or manufacturers, as well as on the attitude of consumers toward their products.

In fifth place, our findings provide useful suggestions for policy makers aiming at raising awareness of food waste. For instance, awareness campaigns could be focused on the value that consumers can get from imperfect produce by physically processing them. Similarly, educational materials targeted at consumers could provide useful suggestions in terms of the possibilities for successfully repurposing imperfect produce inside the household. Furthermore, our results are informative for policy makers developing sets of priorities and initiatives targeted at the manufacturing and retail sector.

Finally, our results can explain a recent trend in contemporary cuisine, namely chefs of high-end restaurants including imperfect produce in their recipes and on their menus. This is the case of Italian chef Massimo Bottura who, in reference to produce such as overripe tomatoes and bruised zucchini, claims that these are “*ordinary ingredients for extraordinary recipes*”. Or the case of Anna Posey of *Elske* in Chicago using imperfect produce and any fruit and vegetable waste or trimmings to create new recipes (e.g. tea) to offer to customers. Consumers’ acceptance of these recipes can be explained in terms of perception of prototypicality: imperfect produce that has been physically processed and transformed by the hands of an experienced chef is perceived as more prototypical of the high-end category of food than imperfect produce in its original state.

Limitations and Avenues for Future Research

Our work has limitations that open up fruitful avenues for future research. First, we tested our predictions only with fruit. Nevertheless, given the range of products and transformations used in our study, and that prior research on consumers’ perception of imperfect products has used both fruit and

vegetables interchangeably, we are confident that our results would hold across different exemplars of fresh produce and for both fruit and vegetables. However, whereas different types of physically processed versions of the product were used (i.e., fruit salad, juice, chips), the transformations we used are commonly found in retail stores. Hence, future research could test the extent to which uncommon transformations influence the consumer's attitude toward imperfect produce. Given the proliferation of new ways of physically processing food, and the emergence of new technologies, we expect this to be a relevant topic for companies selling food products and for policy makers aiming to encourage the consumption of these products.

Furthermore, we did not consider the role of social norms. For instance, consumers that are more familiar or have had experience with imperfection in fresh produce, or with specific types of physically processing food, may react differently to imperfect products in their original state and imperfect products that have been physically processed.

Finally, future research could investigate the extent to which the appearance of other categories of food – e.g. snacks – and physical distortions affect categorization and consumers' perception of prototypicality. Whereas prior studies have provided, for instance, initial evidence for how the size of food affects categorization (Scott et al., 2008), this aspect is still neglected by current research. Building on this idea, for instance, future efforts could be devoted to the understanding of how physically altering the aesthetic appearance of food influences the consumer's attitude, as well as the categorization of the product as healthy vs. unhealthy, or virtue vs. vice.

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Appendix A

Stimuli used for Study 1

Study 1		
	Perfect	Imperfect
Not physically processed	 <p>Peach</p>	 <p>Peach</p>
Physically processed	 <p>Peach salad using peach on the left</p>	 <p>Peach salad using peach on the left</p>



Appendix B

Stimuli used for Study 2

Study 2		
	Perfect	Imperfect
Not physically processed	 <p>Orange</p>	 <p>Orange</p>
Physically processed	 <p>Orange juice obtained from orange on the left</p>	 <p>Orange juice obtained from orange on the left</p>

Appendix C

Stimuli used for Study 3

Study 3		
	Not physically processed	Artificially processed
Imperfect	 <p>Apple</p>	 <p>The juice shown above was obtained from the apple pictured on the label. This product has been treated with synthetic and inorganic components. It also contains other synthetic components such as added flavours and sulfuric anhydride</p>

Paper 3

Consumers' Reactions to Food Waste: Internal Attribution, Guilt and Compensatory

Behaviors

Introduction

Everyday consumers are confronted with food waste, with 94 percent of US consumers admitting throwing away food at home (American Dairy Association, 2018) and 76 percent of US households discarding leftovers at least once a month (American Chemistry Council, 2015). Between “cabinet castaways” (i.e., products that are bought and never consumed; Wansink, Brasel, and Amjad, 2000), restaurants portions that are too large, overfilled buffet plates, or unexpected circumstances that lead to discarded food, there are many ways in which consumers are actively involved in the generation of food waste or witness food waste events. At the same time, reducing food waste has become a global priority: The United Nations, for instance, has asked the governments of its member states to make commitments and efforts toward halving retail and consumer food waste by 2030 (Sachs, Schmidt-Traub, Kroll, Lafortune, and Fuller, 2019). Likewise, the United States Department of Agriculture (USDA) recently released a federal interagency strategy to address food waste in conjunction with the U.S. Environmental Protection Agency and the U.S. Food and Drug Administration (USDA, 2019). In the midst of these efforts, academic research has recently called for more theoretical contributions about the psychological mechanisms that underpin food waste behaviors (Block et al., 2016), which can guide the adoption of more successful initiatives to reduce food waste.

Indeed, scholars have shed light on a number of antecedents of consumer-generated food waste, such as the tendency to offer an overabundance of food to people one cares about or to guests (Aschemann-Witzel, De Hooge, Amani, Bech-Larsen, and Oostindjer, 2015; Cappellini and Parsons, 2012; Graham-Rowe, Jessop, and Sparks, 2014; Schanes, Dobernig, and Gözet, 2018), the lack of

planning or bad habits when shopping for food (Romani, Grappi, Bagozzi, and Barone, 2018; Stefan, van Herpen, Tudoran, and Lähteenmäki, 2013), or the tendency to buy in bulk to save money or time (Farr-Wharton, Foth, and Choi, 2014; Hebrok and Boks, 2017; Setti, Banchelli, Falasconi, Segrè, and Vittuari, 2018). Nevertheless, consumers often underestimate their contribution to the food waste issue, with approximately 75% of people in the United States believing that they waste less than the average American (Neff, Spiker, and Truant, 2015). This suggests that consumers may misperceive their responsibility for food waste or displace it onto other entities. Importantly, how consumers attribute responsibility for food waste episodes (whether internally or externally) might meaningfully impact their subsequent behaviors (e.g., in terms of committing to avoiding wasting food in the future). Surprisingly, though, extant research on the antecedents of food waste behavior has neglected to study this issue of responsibility attribution.

Hence, the present research builds on attribution theory (e.g. Kelley and Michela, 1980; Weiner, 1985) in order to argue that consumers' perception that the cause of food waste is *internal* or *external* to themselves will influence how they react. Beyond studying such a novel antecedent of food waste behavior, this paper also investigates the consequences of food waste. To the best of our knowledge, this research is the first to make this relevant contribution to the food waste literature. Specifically, we argue that consumers' perception that the cause of a food waste episode is internal versus external leads to differences in their emotional reactions, behavioral intentions, and actual behaviors. When the perceived cause is internal (i.e., when consumers feel responsible for food waste), we predict that consumers will show a higher tendency to engage in subsequent *compensatory* behaviors than when the cause is perceived to be external (i.e., when consumers believe other people or external factors are responsible for food waste). Such compensatory behaviors have been defined as any consumption-related behavior that is motivated by individuals' desire to attenuate an aversive state or a self-discrepancy (Mandel, Rucker, Levav, and Galinsky, 2017; Rucker and Galinsky, 2008).

Interestingly, we argue and show that consumers' tendency to compensate for the food waste they feel personally responsible for manifests not only in the same domain (i.e., showing a higher

likelihood to reduce food waste in the future), but also in different domains (e.g., showing a higher likelihood to engage in recycling behaviors, such as buying products made with recycled materials). Importantly, we argue and demonstrate that these reactions are driven by consumers' feelings of guilt, in line with past work supporting the role of guilt as the negative emotion pushing individuals to compensate for the harm caused by their actions (e.g., De Hooge, Zeelenberg, and Breugelmans, 2007; Nelissen and Zeelenberg, 2009).

We test our account across five experiments. We offer evidence for not only the basic effect (i.e., the perceived cause of food waste, internal vs. external, on consumers' likelihood to reduce food waste in the future; Study 1), but also for the role of guilt as a mediator of this effect, which drives consumers' likelihood to reduce food waste in the future (Study 2) as well as engage in other compensatory actions, such as recycling behaviors (Study 3) and sharing information about reducing food waste with other people (Study 4). We also uncover a moderator that attenuates the effect of guilt on consumers' likelihood to reduce food waste (Study 5). Because we look at a range of compensatory behaviors, our experiments employ multiple dependent variables and thereby achieve results that are robust and generalizable.

Our work makes several contributions to the food waste domain. First, while the bulk of previous research has focused on the antecedents of food waste (e.g., Graham-Rowe et al., 2014; Hebrok & Boks, 2017; Schanes et al., 2018), we investigate its consequences. Second, we argue that consumers' reactions to food waste episodes are driven by a factor that has not been empirically investigated: namely, whether consumers perceive the cause of a food waste episode as internal or external to themselves. Third, while a few survey-based studies on food waste have suggested that guilt arises from the general idea of wasting food (e.g., Stancu, Haugaard, and Lähteenmäki, 2016; Watson and Meah, 2012), our research specifically looks at *reactive guilt* (Lascu, 1991): an emotion triggered by the appraisal of a specific unpleasant situation (e.g., McGraw, 1987; Nelissen and Zeelenberg, 2009; Smith and Ellsworth, 1987). In other words, this research empirically investigates the feelings of guilt that consumers experience during one specific food waste episode, examining

whether and how the intensity of guilt feelings varies depending on whether consumers attribute the food waste episode to themselves or not. Fourth, we extend the literature on guilt as an emotional trigger for compensatory behaviors (De Hooze et al., 2007; Ghorbani, Liao, Çayköylü, and Chand, 2013; Nelissen and Zeelenberg., 2009) by showing that such a compensatory mechanism manifests in a largely unexplored domain (food waste).

Theoretical Background

Prior Research on the Antecedents of Food Waste

Recent research on consumer-generated food waste – that is, food directed to human consumption that is lost because of consumers' behavior (Gustavsson, Cederberg, Sonesson, van Otterdijk, and Meybeck, 2011; Parfitt, Barthel, and Macnaughton, 2010) – has highlighted that such waste might originate from various factors, such as consumption habits, consumers' perceptions about food, and their personal characteristics.

More specifically, consumer-generated food waste is often the result of practices that individuals perform in their everyday life (Stefan et al., 2013), from the planning phase of purchase to the final disposal of the purchased food. For instance, past studies have shown that consumers rarely make shopping lists (Romani et al., 2018; Setti et al., 2018; Stancu et al., 2016; Stefan et al., 2013) or check their food inventories when planning to buy food (Chandon and Wansink, 2006), with the result that they end up buying products they already own (Stefan et al., 2013). Moreover, consumers may decide to buy in bulk in order to save money (Farr-Wharton et al., 2014; Hebrok & Boks, 2017) or time (i.e., by reducing the frequency of their shopping trips; Graham-Rowe et al., 2014); consequently, they may over-purchase products that are later discarded. In turn, once the food has been purchased and reached the pantry, it may be forgotten (Wansink, Brasel, and Amjad, 2000) or thrown away while still edible (Watson and Meah, 2012) because consumers are generally incapable of judging whether the product is still suitable for consumption (Farr-Wharton et al., 2014;

Schanes et al., 2018) or lack a proper understanding of expiration dates (Tsiros and Heilman, 2005). Additionally, consumers often desire to be “good providers” by offering an abundance of food to family members or guests as a way of showing love and care (Aschemann-Witzel et al., 2015; Graham-Rowe et al., 2014; Schanes et al., 2018; Setti et al., 2018), or else to save time while cooking (Farr-Wharton et al., 2014; Hoolohan, McLachlan, and Mander, 2018; Porpino, Parente, & Wansink, 2015), either of which can lead to over-purchasing or over-preparing food that ends up being trashed because of consumers’ aversion to leftovers (Aschemann-Witzel, 2015; Cappellini and Parsons, 2012; Schanes et al., 2018) or because of unexpected circumstances that prevent them from eating it (Maubach, Hoek, and McCreanor, 2009).

Overall, prior studies on food waste seem to suggest that consumers’ behavior, practices and perceptions significantly contribute to the generation of food waste. In line with this conclusion, Stenmarck et al. (2016) reported that consumers generate 53 percent of food waste, with the retail and food service industries contributing much less to this issue. However, one recent survey found that only 28 percent of individuals recognize consumers as an entity responsible for food waste, with most respondents citing supermarkets and restaurants as its main generators (EMEA, 2018). This apparent mismatch between consumers’ actual and perceived contribution to food waste merits an empirical examination of how they attribute responsibility for food waste episodes.

Such an investigation appears particularly relevant in light of prior literature on attribution, which has established that people’s perceptions about who or what is responsible for a behavior or event affect their subsequent emotional and behavioral reactions to said behavior or event (Folkes, 1988; Kelley and Michela, 1980; Weiner, Graham, & Chandler, 1982). Therefore, understanding consumers’ reactions to food waste behaviors may begin with understanding how they perceive their role in generating food waste, which is an area that has not yet received empirical attention from food waste research. Hence, we focus on this factor and link it to the consequences of food waste episodes in terms of emotional reactions, behavioral intentions and actual consumer behavior.

Attribution Theory and the Consequences of Food Waste Episodes

We build on attribution theory, which posits that the inferred cause of a behavior or event plays a primary role in defining individuals' reactions to that behavior or event (Kelley and Michela, 1980). More specifically, attribution theory has identified three dimensions of causality: *locus*, *controllability*, and *stability*. *Locus of causality* refers to whether an actor perceives that the cause of a behavior or event resides with themselves (internal) or with other actors or factors (external) (Schindler, 1998; Weiner et al., 1982). *Controllability* refers to the extent to which the cause is subject to volitional influence, and thus the extent to which it can be controlled by someone or is under no one's control. Finally, *stability* is the extent to which the cause of the behavior or event are constant (stable) or variable over time (Russell, 1982; Schindler, 1998; Weiner et al., 1982).

We argue that consumers' feelings of responsibility toward the food waste event (i.e., whether they perceive the cause to be internal or external to themselves) is a key determinant of how they will respond, both emotionally and behaviorally, to the food waste episode. To this end, we focus on consumers' reactions to a single food waste episode rather than investigate consumers' general attitude toward food waste, which has been done by prior qualitative and survey-based research on this topic (e.g., Evans, 2012; Hoek, Pearson, James, Lawrence, and Friel, 2017; Stancu et al., 2016). Following Tsiros, Mittal, and Ross (2004) and Weiner (2000), we employ two dimensions of the attribution theory—namely *locus of causality* and *controllability*—to conceptualize responsibility for food waste. We argue that the dimension of *locus of causality* is the most salient when investigating consumers' reactions to food waste and that it is closely related to the dimension of *controllability*. Indeed, consumers are likely to feel that a food waste episode is more controllable when the perceived cause is internal rather than external. Thus, we hereafter refer to *internally- and externally-attributed* food waste episodes as those consumers feel a high or low level of personal responsibility for, respectively. Given our focus on a single food waste episode, we do not account for the extent to which consumers deem the food waste as *stable* (Weiner et al., 1982), as this is beyond the scope of our work.

Past research on attribution theory posits that the entity responsible for causing a problem should also be the one to solve that problem or suggest a solution to it (Folkes, 1988). For instance, people generally believe that individuals responsible for air pollution or littering should be the ones to solve those problems (Belk and Painter, 1983). Similarly, individuals may see poor people as the cause of their own poverty and thus deem them responsible for solving their own issue (Iyengar, 1989); finally, companies that are responsible for service failure are expected to compensate through service recovery actions (Grewal, Roggeveen, and Tsiros, 2008). Building on this evidence, we argue that consumers who perceive themselves to be responsible for a food waste episode (vs. those who do not) are more likely to show a higher tendency to engage in subsequent compensatory behaviors in order to repair the harm they feel they have done compared to consumers who do not perceive themselves as responsible for a food waste episode. Formally, we hypothesize the following:

H1: *Consumers who perceive the cause of a food waste episode as internal (i.e., consumers who feel responsible for it) will manifest a higher likelihood to engage in subsequent compensatory behaviors than consumers who perceive the cause of a food waste episode as external (i.e., consumers who do not feel responsible for it).*

The Mediating Role of Guilt

We argue that the effect hypothesized in H1 is driven by consumers' feelings of *guilt*. Qualitative evidence from prior research shows that consumers often report "feeling bad", "feeling guilty", or "worrying" about wasting food (e.g., Evans, 2012; Watson and Meah, 2012). When asked about their food disposal habits, most admit that they did not intend to waste food (Graham-Rowe et al., 2014). Other qualitative studies suggest the existence of a "social guilt" related to food waste, with some respondents mentioning that it is not appropriate to waste food considering that some people do not have enough to eat (Hoek et al., 2017).

In line with this evidence, a few survey-based studies have shown that consumers have negative attitudes toward food waste (McCarthy and Liu, 2017) and reportedly experience guilt in relation to

wasting food in their household (Parizeau, von Massow, and Martin, 2015; Russell, Young, Unsworth, and Robinson, 2017; Stefan et al., 2013). However, such studies have mostly conceptualized guilt stemming from food waste in terms of its potential detrimental effects on the environment or society (McCarthy and Liu, 2017; Stancu et al., 2016). Other studies have shown that consumers adopt strategies aimed at reducing the guilt generated by food waste events, such as storing the food until the moment in which throwing it away remains the only option (Evans, 2012; Kraus and Emontspool, 2017)—a strategy called “maturation time” (Porpino et al., 2015). Importantly, Parizeau et al. (2015) demonstrated that consumers who mainly eat outside the home report feeling less guilty about food waste than individuals who mainly eat at home, implying that guilt is not a universally experienced emotion following food waste. Nonetheless, we still possess limited knowledge about why, and under which circumstances, consumers might feel a stronger or weaker sense of guilt following food waste episodes.

To address this gap, we investigate this issue through a specific conceptualization of guilt: namely, *reactive guilt* (Lascu, 1991), that is, an emotion that arises after appraising an unpleasant situation brought on by one’s actions (Smith and Ellsworth, 1987). Building on prior research showing that guilt is the negative emotion pushing individuals to compensate for the harm caused by their behavior (e.g., De Hooge et al., 2007; Ghorbani et al., 2013; Nelissen and Zeelenberg, 2009), we argue that guilt mediates the relationship between the perceived cause of the food waste episode (internal vs. external) and the tendency to engage in subsequent compensatory behaviors. Indeed, prior studies have established that guilty individuals are more likely to cooperate (De Hooge et al., 2007) as well as compensate victims for their own wrongdoing (Ghorbani et al., 2013). Furthermore, feelings of guilt have been shown to drive prosocial behaviors (e.g., Dahl, Honea, and Manchada, 2003; Xu, Bègue, and Bushman, 2012), in line with the idea that experiencing guilt boosts consumers’ willingness to compensate for their harmful behavior(s). Hence, we expect guilt following internally-attributed (vs. externally-attributed) food waste episodes to drive a range of compensatory actions, in both the same domain as the triggering behavior (i.e., food waste) and in different domains.

First of all, we expect guilt-feeling consumers to show a higher likelihood of reducing food waste in the future. Second, we expect that guilt should affect other behaviors (beside food waste) that are typically compensatory in nature. For example, prior studies have shown that individuals often use information sharing in a compensatory way, as doing so allows sharers to restore a lost sense of self-worth (Consiglio, De Angelis, and Costabile, 2018; De Angelis, Bonezzi, Peluso, Rucker, & Costabile, 2012; Peluso, Bonezzi, De Angelis, and Rucker, 2017). De Angelis et al. (2012), for example, demonstrated that consumers manifest a tendency to engage in positive word of mouth about their personal experiences with products or services, or in negative word of mouth about other people's experiences with products or services, in order to fulfill their need to self-enhance; such a tendency has been shown to be particularly prevalent following the recall of a self-threatening episode (e.g., the recall of a negative academic performance). In a similar vein, we expect that consumers will be particularly willing to share information about reducing food waste when they feel guilty after a food waste episode. Importantly, this would suggest that consumers' sense of responsibility for food waste—and the subsequent feelings of guilt and compensatory behaviors—may impact the behaviors of other consumers. Third, building on prior research showing that consumers acting in a pro-environmental manner are more likely to engage in other pro-environmental behaviors (Thøgersen and Ölander, 2006; Whitmarsh and O'Neill, 2010), and that waste prevention is interrelated with behaviors such as recycling (Thøgersen, 1999), we expect that consumers who feel a relatively strong sense of guilt following food waste might compensate by showing a higher likelihood to engage in recycling behaviors. This behavior may manifest, for example, in an increased tendency to buy products they can recycle or reuse. Formally, we hypothesize the following:

H2: *The relationship between the perceived cause of a food waste episode (internal vs. external) and the tendency to engage in compensatory behaviors is mediated by feelings of guilt, whereby internally-attributed food waste episodes will lead to higher feelings of guilt than externally-attributed ones, ultimately leading to a stronger consumer tendency to undertake compensatory behaviors.*

Overview of Studies

We conducted five experiments to test our hypotheses. The overall goal of our studies was to provide empirical evidence for the effect that the perceived cause of a food waste episode (internal vs. external) has on the tendency to engage in subsequent compensatory behaviors, as well as for the emotional mechanism underlying this effect. In particular, we aimed to show that feelings of guilt triggered by the food waste event lead to a series of compensatory behaviors in both the same domain of the triggering event – i.e., food waste – and in different domains. Our studies utilize different dependent variables, and thus provide converging evidence for the hypothesized theoretical mechanism (i.e., the mediating role of guilt), which underscores the robustness of our conceptualization.

Specifically, Study 1 aimed at testing H1 about the effect that the perceived cause of a food waste event (internal vs. external) might have on consumers' likelihood to reduce food waste in the future. Study 2, Study 3 and Study 4 aimed at providing evidence for the role of guilt as a mediator in the relationship between perceived cause of food waste and a range of compensatory behaviors. In particular, Study 2 tested whether the likelihood to reduce food waste in the future is driven by feelings of guilt that arise from consumers' perception that the food waste cause was internal (vs. external). Study 3 aimed to replicate the results of Study 2 using a compensatory behavior in another domain: a higher likelihood of engaging in recycling behaviors in the future. Study 4 had a similar aim, albeit with a focus on consumers' willingness to share information about how people could reduce food waste. Importantly, this latter study did not use a measure of behavioral intentions; rather, we employed a proxy of a real information sharing behavior by asking participants to accept sharing on their social media accounts an article that contained tips to reduce food waste. Finally, Study 5 aimed at providing convergence on the results of Studies 2-4 by investigating a possible moderator. Specifically, we tested whether consumers' likelihood of compensating for an internalized food waste

event becomes weaker when they are given (vs. not given) the opportunity to compensate in a different way.

Study 1

Study 1 investigated whether individuals who feel more responsible for a food waste event show a higher likelihood to engage in compensatory behavior in the future. In particular, we focused on how the perceived cause of a food waste episode (internal vs. external) affects consumers' likelihood to compensate in the same domain (i.e., reduce food waste in the future).

Participants and Procedure

We recruited 201 participants on Amazon Mechanical Turk (hereafter, MTurk). Consistent with recent research (e.g., Consiglio, Kupor, Gino, and Norton, 2018; Fernandes, Puntoni, van Osselaer, and Cowley, 2015), we excluded four respondents who deviated more than three standard deviations from the mean score for our dependent variable measure and one respondent who did not complete our manipulation check measure. Thus, our final sample comprised 196 participants (53.6% female, $M_{age} = 34.39$, $SD = 10.90$).

Participants were randomly assigned to one of two conditions, associated with either an internal or external cause of a food waste event. Specifically, respondents were asked to imagine they had just been involved in one of the following situations: In the internal cause condition, they were asked to imagine they had left for a week without doing anything to save the food stored in their fridge, and then were forced to discard the food when they returned home. In the external cause condition, they were asked to imagine they had left for a week and had taken every measure to save the food stored in the fridge, but then the fridge broke down and they were forced to discard all of their food upon returning home (see Appendix A).

We first measured the extent to which participants perceived their assigned food waste event as internally versus externally attributed, using two items adapted from Zeelenberg et al. (1998) (“How responsible do you find yourself for the food waste event described in the scenario?” with 1

= “not at all responsible” and 7 = “very responsible”; “To what extent did you cause the food waste described in the scenario?” with 1 = “a very small extent” and 7 = “a very great extent”). The two items were highly correlated ($r = .69, p < .01$) and were thus combined to form a single measure of attribution ($M_{attribution} = 4.64; SD = 2.03$). High (vs. low) values corresponded to participants perceiving the food waste event as internally (vs. externally) attributed. We measured consumers’ likelihood of engaging in compensatory behavior by asking them to report their likelihood of reducing food waste in the following week (1 = “not at all”, 7 = “very much”).

Results and Discussion

We conducted a manipulation check to verify whether our manipulation of the perceived cause of the food waste event was successful. Indeed, the results of an ANOVA showed that participants assigned to the internal cause condition perceived themselves as being more responsible ($M_{internal} = 5.96, SD = 1.22$) than respondents assigned to the external cause condition ($M_{external} = 3.33, SD = 1.80; F(1, 194) = 142.49, p < .01$). More importantly, in line with our prediction, consumers feeling responsible for the food waste reported a higher likelihood to reduce food waste in the following week than consumers who did not feel responsible ($M_{internal} = 5.68, SD = 1.33$ vs. $M_{external} = 5.04, SD = 1.62, F(1, 194) = 9.12, p < .01$).

The results of Study 1 provide support to H1, as respondents manifested a higher likelihood to reduce food waste after a food waste event they felt responsible for. In this sense, we provide preliminary evidence for the basic effect that an internal (vs. external) cause of a food waste event might have on consumers’ likelihood to engage in compensatory behaviors. In subsequent studies, we will provide evidence for the hypothesized theoretical mechanism: namely, whether feelings of guilt, differentially activated by an internal versus external cause, alters people’s likelihood of engaging in compensatory behaviors in either the same domain (i.e., food waste) or other domains.

Study 2

Study 2 focused on the hypothesized theoretical mechanism underlying the effect found in Study 1 (H2). Specifically, Study 2 tested whether feelings of guilt mediate the relationship between people's perception of responsibility for the food waste event and their likelihood of engaging in compensatory behaviors after wasting food.

Participants and Procedure

For this study, we recruited 200 participants on MTurk. Following the same procedure as in Study 1, we excluded four outliers (three in the external cause condition and one in the internal cause one) on the dependent variable measure. We also excluded one respondent who did not report his age correctly. Thus, the final sample included 195 participants (49.2% female, $M_{age} = 38.06$, $SD = 12.46$). We used the same scenario as in Study 1, with respondents randomly assigned to either the internal or external cause condition.

After reading their assigned scenario, respondents were asked to report the extent to which they felt guilty using three items ("guilty", "culpable" and "remorseful", on a 7-point Likert scale with 1 = "not at all" and 7 = "very much", adapted from Dahl, Honea, & Manchanda, 2005; Han, Duhachek, & Agrawal, 2014; Ghorbani et al., 2013; $\alpha = .91$, $M_{guilt} = 4.63$, $SD = 1.83$). Afterward, respondents were asked to report their likelihood of reducing food waste in the following week and completed the same manipulation check measure used in Study 1 ($r = .79$, $p < .01$; $M_{mancheck} = 4.89$, $SD = 2.01$).

Results and Discussion

We first ran a one-way ANOVA on the manipulation check measure, which confirmed that participants in the internal cause condition perceived themselves as more responsible for the food waste event ($M_{internal} = 6.22$, $SD = 1.07$) than participants in the external cause condition ($M_{external} = 3.54$, $SD = 1.82$, $F(1, 193) = 158.07$, $p < .01$). In order to test for our proposed theoretical mechanism, we conducted a mediation analysis using PROCESS (Model 4, Hayes, 2013), with perceived cause of the food waste event (0 = external, 1 = internal) acting as the independent variable, the likelihood

to reduce food waste in the next week acting as the dependent variable, and guilt acting as the mediator. This analysis yielded a pattern of results consistent with our hypothesized theoretical mechanism. Indeed, the perceived cause had a significant and positive effect on guilt ($b = 1.20, p < .01$), such that respondents in the internal cause condition reported higher feelings of guilt than those in the external cause condition ($M_{internal} = 5.23, SD = 1.58$ vs. $M_{external} = 4.02, SD = 1.87, F(1, 193) = 23.64, p < .01$). In turn, guilt had a significant and positive effect on the likelihood to reduce food waste ($b = .36, p < .01$). The indirect effect of perceived cause on the dependent variable through guilt was also significant ($b = .43; 95\% CI = .23, .72$). Conversely, the direct effect of perceived cause on the likelihood to reduce food waste was not significant once we included the mediator ($b = -.04; 95\% CI: -.46, .38$). Thus, H2 was supported.

Overall, Study 2's results support the notion that guilt mediates the effect of an internal versus external cause of a food waste event on consumers' likelihood to reduce food waste in the future. In other words, guilt appears to drive consumers' likelihood to engage in a compensatory behavior when the food waste event is internally attributed (i.e., when the consumer feels responsible for the food waste). In the following studies, we provide further evidence for this compensatory mechanism by showing that guilt can lead consumers to engage in other compensatory behaviors following a food waste event.

Study 3

Study 3 aimed to provide further evidence for guilt's mediating effect on the tendency to engage in future compensatory behaviors following a food waste event (H2). Specifically, this study focused on whether the guilt triggered by the food waste event alters consumers' likelihood of engaging in recycling behaviors, as prior research has found a correlation between people's waste prevention efforts and the choice to recycle (Thøgersen, 1999).

Participants and Procedure

For this study, we recruited 254 participants on Prolific Academic. As suggested by Pang, Keh, Li, and Maheswaran et al. (2017), we excluded five participants who deviated more than three standard deviations from the mean scores of either the manipulation check measure (one participant in the internal cause condition) or the dependent variable measure (four participants in the internal cause condition). We also excluded one participant who only partially reported demographic information. Thus, the final sample comprised 248 participants (48.8% female, $M_{age} = 29.92$, $SD = 10.94$).

As in Study 1 and Study 2, we used a single-factor experimental design in which participants were randomly assigned to either the internal or external cause condition. Respondents were asked to read a scenario and asked to imagine having gone to lunch at a new restaurant. In the internal cause condition, the participant decides to order multiple dishes despite the waiter's assurances that each dish is quite big; indeed, she is not able to finish the food on her plate and it ends up being wasted. In the external cause condition, the participant orders only one dish given the waiter's assurances that the portions are quite small; however, the portion turns out to be too big and the participant is unable to finish the food on her plate (see Appendix B).

After reading the scenario, participants were asked to imagine going grocery shopping and to report their likelihood of engaging in a series of recycling behaviors ("How likely are you to make a special effort to buy products made with recycled materials?", "How likely are you to make a special effort to buy products that can be recycled?", and "How likely are you to make an effort to look for products that you can reuse?" with 1 = "not at all" and 7 = "very much", adapted from Biswas et al., 2000; $\alpha = .82$, $M_{recycling} = 4.74$, $SD = 1.46$). They were also asked to report the extent to which the food waste at the restaurant made them feel guilty, using the same three-item scale as in Study 2 ($\alpha = .89$, $M_{guilt} = 4.48$, $SD = 1.64$). Finally, respondents completed the same manipulation check measure used in Study 1 and 2 ($r = .68$, $p < .01$; $M_{attribution} = 4.57$, $SD = 1.57$) and were asked to provide demographic information.

Results and Discussion

Like before, we ran an ANOVA on the manipulation check measure and found that participants in the internal cause scenario felt more responsible for the food waste event than participants in the external cause condition ($M_{internal} = 5.36, SD = 1.29$ vs. $M_{external} = 3.82, SD = 1.43, F(1, 246) = 78.95, p < .01$).

In order to test for the mediating role of guilt in the relationship between the perceived cause of food waste and the likelihood to engage in recycling behavior, we conducted a mediation analysis through PROCESS (Model 4, Hayes, 2013): perceived cause (0 = external, 1 = internal) was the independent variable, the likelihood to engage in recycling behavior was the dependent variable, and guilt was the mediator. The results of this analysis provided support for our hypothesized mechanism. First, perceived cause had a significant and positive effect on guilt ($b = .89, p < .01$), meaning that participants in the internal cause condition experienced stronger feelings of guilt than participants in the external cause condition ($M_{internal} = 4.93, SD = 1.58$ vs. $M_{external} = 4.04, SD = 1.58, F(1, 246) = 19.62, p < .01$). In turn, guilt had a significant and positive effect on the likelihood to engage in recycling behavior after the food waste event ($b = .31, p < .01$). Finally, the indirect effect of attribution on the dependent variable through guilt proved significant ($b = .28; 95\% CI: .13, .49$) while the direct effect did not ($b = -.27; 95\% CI: -.63; .09$). Thus, H2 was again supported.

Study 3 provided additional evidence for the proposed theoretical mechanism while revealing that guilt (our hypothesized mediator) can compel compensatory behaviors in a domain outside of food waste. These results further substantiate the notion that people's perceived responsibility for the food waste event triggers feelings of guilt, which then drives their need to compensate for the harm done.

Study 4

Study 4 aimed to offer a further test of H2 while using a dependent variable that differs from those used previously in two key respects: First, the chosen compensatory behavior belongs to the

food waste domain, but concerns individuals' decision to share an article containing tips for reducing food waste. Second, while our previous experiments measured respondents' behavioral intentions, this experiment used a proxy of real behavior (i.e., respondents had the chance to share the aforementioned article through their social media accounts). Based on prior research showing that individuals may share information in order to restore a lost sense of self-worth (e.g., De Angelis et al., 2012; Peluso et al., 2017), we argue that the guilt feelings triggered by a food waste event can activate this compensatory mechanism.

Participants and Procedure

For this study, we recruited 197 participants via MTurk. We excluded three participants in the internal cause condition who deviated more than three standard deviations from the mean score of the manipulation check measure, leaving a sample of 194 respondents (42.8% female, $M_{age} = 33.27$, $SD = 9.56$). We used the same scenario as in Study 3, with participants randomly assigned to either the internal or the external cause condition.

After reading the scenario, participants were asked to report the extent to which their assigned food waste episode made them feel guilty, using the same scale from Study 2 and Study 3 ($\alpha = .94$, $M_{guilt} = 4.09$, $SD = 1.85$). Following the measure of guilt, respondents were shown an article listing tips to reduce food waste (adapted from WWF 2018; see Appendix C) and were led to believe that checking a box would automatically share the article on a social network of their choice (see Consiglio, De Angelis, and Costabile, 2018 for a similar procedure). Whether or not respondents checked the box served as our dependent variable, which captured respondents' real behavior. We included the manipulation check measures described in previous studies to verify whether the attribution manipulation was successful ($r = .74$, $p < .01$, $M_{attribution} = 4.67$, $SD = 1.78$). We also verified whether respondents believed they would really access their social media accounts to share the article ("Did you believe that you would be given the opportunity to share the article on social media at the end of the study?", yes/no). We further asked respondents to report whether or not they

were social media users (yes/no). Before providing their demographic information, participants were told that the study design would not allow them to log in to social media.

Results and Discussion

As in previous studies, we conducted an ANOVA to verify whether the attribution manipulation was successful. Indeed, respondents in the internal cause condition felt more responsible for the food waste described in the scenario than respondents in the external cause condition ($M_{internal} = 5.52$, $SD = 1.42$ vs. $M_{external} = 3.90$, $SD = 1.73$, $F(1, 192) = 49.91$, $p < .01$).

We then conducted a mediation analysis (Hayes, 2013) to test our proposed theoretical mechanism based on guilt, using perceived cause of food waste (0 = external, 1 = internal) as the independent variable, choice to share the article (0 = no sharing of the article, 1 = sharing of the article) as the dependent variable, and guilt as the mediator. The analysis yielded a pattern of results consistent with our hypothesis: Perceived cause of food waste had a significant and positive effect on guilt ($b = 1.31$, $p < .01$, $M_{internal} = 4.78$, $SD = 1.72$ vs. $M_{external} = 3.47$, $SD = 1.74$, $F(1, 192) = 27.62$, $p < .01$) and guilt had a significant and positive effect on the choice to share the article ($b = .37$, $p < .01$), such that higher feelings of guilt increased article sharing. Furthermore, whereas the indirect effect of perceived cause of the food waste event on the choice to share the article through guilt proved significant ($b = .49$; 95% CI = .24, .83), the direct effect did not ($b = .08$; 95% CI = -.56, .71), indicating the existence of a full mediation pattern. These results thus lend further support to H2.

Additionally, we replicated this analysis while excluding participants who a) did not believe they would be given access to their social media account to share the article and b) those who reported not being social media users; these exclusions yielded a sample of 153 respondents (44.4% female, $M_{age} = 32.84$, $SD = 8.92$). A mediation analysis showed that the binary independent variable had a significant and positive effect on guilt ($b = 1.34$, $p < .01$, $M_{internal} = 4.99$, $SD = 1.68$ vs. $M_{external} = 3.65$, $SD = 1.78$, $F(1, 151) = 22.84$, $p < .01$), which in turn had a significant and positive effect on the choice to share the article ($b = .35$, $p < .01$). Again, the indirect effect was significant ($b = .46$; 95%

CI: .19, .84) while the direct effect was not significant ($b = .21$; 95% CI = -.51, .93). Hence, H2 was also supported in this case.

Overall, Study 4 provided additional support for our account while establishing that feelings of guilt activated by food waste can prompt a different type of compensatory behavior—namely, information sharing. Importantly, this study allowed us to show that the tendency to engage in compensatory behaviors following food waste events manifests not only as private behavioral intentions (e.g., the likelihood that an individual will reduce food waste and engage in recycling behaviors), but also as social behaviors (e.g., an individual's decision to share information on her social media accounts). Taken together, results of Study 1-4 provide convergent and robust evidence for the guilt-laden compensatory mechanism we hypothesized.

Study 5

The aim of Study 5 was to provide further support for the mediating role of guilt, while also exploring a situation that might attenuate the effect of this negative emotion on the likelihood to engage in compensatory behaviors. Specifically, we drew on prior research showing that the recall of past moral actions acts as a compensatory mechanism that, in turn, reduces individuals' likelihood of engaging in future moral or compensatory actions (Jordan, Mullen, and Murnighan, 2011). Based on this evidence, we argue that individuals who remember having engaged in behaviors aimed at reducing food waste, or perceive themselves as having made relevant efforts in the past, will show a lower likelihood to compensate in the future despite the feelings of guilt arising from a perceived internal cause. Specifically, we expect that the recall of past compensatory behavior reduces the effect of guilt on consumers' likelihood to compensate for the harm done. In other words, this study aims to establish a moderating effect and thereby offer converging evidence for our theoretical account.

Participants and Procedure

We used a 2x2 experimental design in which respondents assigned to the internal or external cause conditions were respectively asked to recall either an instance in which they had wasted food

in the past (compensatory behavior absent) or an instance in which they had successfully managed to reduce food waste in the past (compensatory behavior present). This design is consistent with the one used by Jordan et al. (2011).

We recruited a total of 266 respondents on Prolific Academic for the study. We conducted a content analysis of the recall tasks and excluded nine participants who either did not complete the recall task according to the instructions, only partially completed it, or provided responses that were not intelligible. Furthermore, we excluded six outliers (four in the internal cause condition and two in the external cause one) as their reported values on either the manipulation check measure or the dependent variable deviated more than three standard deviations from the mean. This yielded a final sample of 251 respondents (50.2% female, $M_{age} = 29.89$, $SD = 10$).

We used the same scenario as in Study 1 and Study 2 (i.e., the fridge scenario), with participants being assigned either to the internal or external cause condition. After reading the scenario, respondents reported the extent to which they felt guilty after the food waste event using the same guilt scale as in our previous studies ($\alpha = .85$, $M_{guilt} = 4.43$, $SD = 1.70$). They were then asked to recall either an instance in which they had wasted food in the past (compensatory behavior absent condition) or reduced food waste in the past (compensatory behavior present condition). Finally, they reported their likelihood of making an extra effort to reduce food waste in the next week and completed the manipulation check measure. We expected guilt to exert a weaker effect on the likelihood to reduce food waste for individuals who felt responsible for the food waste but recalled an instance in which they reduced food waste in the past. Relative to people who felt responsible and recalled an instance in which they wasted food in the past, we expected the former respondents to have partially fulfilled their need to compensate through the recall act.

Results and Discussion

The manipulation check was successful, with participants in the internal cause condition feeling more responsible for the food waste than individuals in the external cause condition ($M_{internal} = 5.76$, $SD = 1.07$ vs. $M_{external} = 3.34$, $SD = 1.80$, $F(1, 249) = 166.97$, $p < .01$).

To test the moderating effect of the presence versus absence of a past compensatory behavior on the relationship between guilt and likelihood to reduce food waste, we conducted a moderated-mediation analysis through PROCESS (Model 14, Hayes, 2013). The perceived cause of food waste served as the independent variable (0 = external, 1 = internal), the likelihood to reduce food waste served as the dependent variable, guilt served as the mediator, and the recall of past compensatory behavior (0 = compensatory behavior absent; 1 = compensatory behavior present) served as the moderator. In line with our prediction, we found that the binary independent variable had a significant and positive effect on guilt ($b = 1.65, p < .01, M_{internal} = 5.26, SD = 1.50$ vs. $M_{external} = 3.61, SD = 1.75, F(1, 249) = 77.77, p < .01$), which in turn had a significant and positive effect on the likelihood to reduce food waste ($b = .47, p < .01$). Furthermore, the interaction between guilt and absence/presence of past compensatory behavior was significant ($b = -.18, p < .05$), as was the index of moderated mediation ($b = -.30; 95\% \text{ CI} = -.653, -.002$). Both conditional indirect effects were significant, but, consistent with our hypothesis, the effect of guilt on the likelihood to reduce food waste proved to be weaker when past compensatory behavior was present ($b = .47, 95\% \text{ CI} = .25, .75$) than when it was absent ($b = .77, 95\% \text{ CI} = .50, 1.11$). Hence, we provide further evidence of our hypothesized theoretical mechanism by showing that individuals can attenuate the effect of guilt on their likelihood to compensate by recalling past compensatory behavior.

Overall, the results of Study 5 demonstrate the existence of a boundary condition for the effect of guilt on behavioral intentions. Since the findings are consistent with those of Studies 2-4, they offer converging evidence for our core idea that guilt activates consumers' tendency to engage in compensatory behaviors following food waste episodes.

General Discussion

In this research, we demonstrated that consumers who waste food and feel responsible for it are likely to compensate by showing a higher tendency to engage in compensatory behaviors within and outside the food waste domain. Furthermore, we provide converging evidence that this effect is

driven by feelings of guilt. In Study 1, we showed that consumers who assume responsibility for causing food waste (i.e., an internal cause) report a higher likelihood to reduce food waste in the future; in this way, we provided preliminary evidence for the compensatory mechanism triggered by a food waste event that consumers feel responsible for. In Study 2, we found that the higher likelihood to reduce food waste in the future is driven by feelings of guilt, which result more from an internally-attributed food waste episode than an externally-attributed one. In Study 3, we replicated and extended the results of Study 2 by showing that feelings of guilt activated by an internally-attributed food waste event increase the likelihood of engaging in compensatory behaviors outside the food waste domain—in this case, engaging in recycling behaviors. In Study 4, we provided converging evidence for our hypothesized theoretical mechanism by showing that consumers are more inclined to share information about reducing food waste via their social media accounts when faced with an internally-attributed food waste event, driven by feelings of guilt. Finally, in Study 5, we uncovered further evidence for our account by discovering a moderator of the effect of guilt on consumers' likelihood to compensate. Specifically, we showed that simply recalling past efforts to compensate for food waste reduces the effect of guilt on consumers' intention to reduce food waste in the future.

Contributions

This research makes several theoretical contributions to the domain of food waste and consumer behavior. Indeed, whereas prior research on consumer-generated food waste has illustrated several antecedents of this phenomenon (e.g., Graham-Rowe et al., 2014; Hebrok and Boks, 2017; Schanes et al., 2018) and speculated about consumers' perceptions of food waste (Evans, 2012; Hoek et al., 2017; Stancu et al., 2016), it has yet to shed light on how consumers react to food waste and on the circumstances that shape their response to a food waste event. We fill this gap in the literature by focusing on the emotional and behavioral consequences of a food waste event. In doing so, we underscore that perceptions of responsibility for food waste are paramount to understanding consumers' behavior following food waste episodes. Furthermore, we show that consumers

compensate for food waste by not only expressing a higher likelihood of reducing food waste in the future (Study 1, Study 2, Study 5), but also by enacting compensatory behaviors in other domains such as recycling (Study 3) or by publicly sharing information that promotes the reduction of food waste (Study 4). Thus, these results robustly support the broad scope of compensatory behaviors that consumers can engage in to mitigate their guilt in the wake of food waste events. They also suggest that the consequences of this compensation effort may extend beyond the food waste domain, and even beyond the consumer who wasted food. Indeed, by showing that consumers who feel guilty tend to share information about reducing food waste with others, we demonstrate that a food waste episode can produce beneficial consequences for other consumers, and therefore for society at large.

Additionally, our findings provide novel insights about the causes of food waste behaviors. Specifically, they shed light on an antecedent that prior studies have largely neglected: namely, whether or not consumers feel responsible for the food waste. Indeed, the bulk of scholarly research on the antecedents of food waste behaviors has focused on consumers' habits (e.g., Chandon and Wansink, 2006; Romani et al., 2018), daily practices (Farr-Wharton et al., 2014; Graham-Rowe et al., 2014; Hebrok and Boks, 2017) and individual characteristics (Farr-Wharton et al., 2014; Tsiros and Heilman, 2005). However, understanding how consumers perceive their responsibility for food waste is important because they may misperceive their role and their contribution to this phenomenon—as suggested by recent results showing that 30 percent of consumers believe they do not create any food waste (International Food Information Council Foundation, 2016). Moreover, whereas prior survey-based and qualitative research has hinted at consumers generally feeling guilty about the idea of wasting food (Evans, 2012; Russell et al., 2017; Stefan et al., 2013), this is the first work to empirically test this idea. Unlike previous studies, we focused on a single food waste event and pinpointed the specific circumstances that facilitate feelings of guilt, showing how they can affect subsequent behaviors. Finally, we contribute to the literature on the role of guilt in driving compensatory behaviors (e.g., De Hooge et al., 2007; Ghorbani et al., 2013; Nelissen and Zeelenberg, 2009) by showing that this mechanism is activated in a novel consumption context such as food waste.

From a practical perspective, our research has broad relevance. Consumer-generated food waste is a widespread phenomenon in developed countries – e.g., US consumers waste nearly one pound of food every day (Conrad et al., 2018) – and understanding how consumers perceive their role in its generation and mitigation has huge implications for the fight to reduce food waste (FAO, 2015). Indeed, our findings suggest that helping consumers understand their contribution to the generation of food waste is a fruitful strategy: When individuals feel responsible for a food waste event, they are more likely to reduce food waste in the future, engage in actions that are more environmentally-friendly, and help others understand how to reduce food waste. In this sense, policymakers and non-profit organizations that aim to reduce consumer-generated food waste should focus on communicating to consumers how their behavior is responsible for a large share of this phenomenon. Furthermore, our results suggest that awareness campaigns focused on the effects of food waste in terms of environmental consequences or the unequal distribution of resources might not be effective, as consumers may underestimate the extent of their contribution to food waste and underplay their own reduction efforts. One major implication of our results is that food waste communication campaigns should induce consumers to think about times in which they could have avoided or at least reduced wasting food, as this recall might ultimately lead to the adoption of responsible behaviors in the future.

Limitations and Further Research

Although we provide a novel perspective on consumer-generated food waste, our methods have limitations that should be acknowledged. Despite providing evidence for our proposed theoretical mechanism over a series of five experiments, we recognize the potential limitation associated with some of our measures of behavioral intentions. That said, the results of Study 4—in which we have used a proxy of real behavior by asking participants to share an article on social media—gives us confidence that our experiments’ results would be replicated when testing the effect with real behavior. Furthermore, while our studies employed scenarios to describe food waste events, future

research could investigate the consequences of food waste by measuring consumers' emotions and behavioral intentions after real food waste events.

Our findings also open up fruitful avenues for future research. For instance, consumers' perception that the consequences of a food waste event are either large or small could have an effect on the extent to which they feel guilty, which may, in turn, alter their likelihood to compensate for the food waste. In this sense, future research could test the relationship between attribution and guilt by exploring effects related to the perceived magnitude of consequences (e.g., Culiberg and Bajde, 2014) or the extent to which individuals consider the consequences of their behaviors when judging their actions (e.g., Strathman, Gleicher, Boninger, and Edwards, 1994). Such evidence would be useful for strengthening the effectiveness of campaigns aimed at reducing food waste.

Another area worthy of investigation is understanding the strategies that consumers enact in order to shift their responsibility for food waste events to other actors or entities. Prior research has suggested that consumers may employ such strategies to reduce their negative feelings toward food waste (Evans, 2012; Kraus and Emontspool, 2017; Porpino et al., 2015), but this remains an empirical question. By establishing the importance of responsibility attribution, our findings lay the groundwork for such an endeavor.

Conclusion

The present research highlights the importance of understanding consumers' emotional and behavioral consequences in relation to food waste events. Across five experiments, we showed that consumers who perceive themselves as directly responsible for food waste tend to engage in a series of compensatory behaviors within and outside the food waste domain. We provide robust and converging evidence that this effect is driven by feelings of guilt.

The current findings extend knowledge about consumer-generated food waste and make several theoretical contributions to both the literature on food waste and research on the role of guilt in compensatory behaviors. Furthermore, they provide guidance and useful suggestions to policymakers

and non-profit organization who want to reduce food waste. Indeed, our work suggests that addressing consumers' responsibility for generating food waste may successfully push them toward more beneficial, less wasteful behaviors.

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Appendix A

Scenarios used in Study 1, Study 2 and Study 5

Internal cause

You are leaving for a week and you have some food left in your fridge.

You forget about it and you leave without doing anything to consume it or store it so that it would last longer (e.g. putting it in the freezer). When you come back, you open the fridge and you realize that it is all spoiled. You are forced to throw everything away.

External cause

You are leaving for a week and you have some food left in your fridge.

You want to eat it once you come back and so you put it in the freezer so that it would last longer. However, when you come back you open the fridge and you realize that the fridge broke while you were out of town and all the food is now spoiled. You are forced to throw everything away.

Appendix B

Scenarios used in Study 3 and Study 4

Internal cause

Imagine you are out for lunch with your friends in a new restaurant.

You feel particularly hungry and so you ask the waiter about the size of the dishes. He tells you that the portions are quite big. Nevertheless, you order different dishes. However, once the waiter is back with the food you realize right away that you ordered way too much, even though the waiter had warned you about the size of the dishes. You are not able to finish the food and thus most of it ends up being wasted.

External cause

Imagine you are out for lunch with your friends in a new restaurant. You do not feel particularly hungry and so you ask the waiter about the size of the dishes. He tells you that the portions are quite small. Nevertheless, you order only one dish. However, once the waiter is back with the food you realize right away that the dish is way bigger than expected, even though the waiter had told you that it was going to be really small. You are not able to finish the food and thus most of it ends up being wasted.

Appendix C

Article used in Study 4 (adapted from WWF, 2018)

FOOD WASTE

PLAN AHEAD
WRITE A SHOPPING LIST
Making a list lessens the chance for impulse buys. Try not to shop on an empty stomach – you may be tempted to purchase more than you need!

FREEZE IT
Make good use of your freezer when you have lots of leftover food. Freeze portion sizes in air tight containers to reuse later, when you have less time to cook meals from scratch.

PLAN MEALS
Plan your meals & serve what you need. Planning meals & portion sizes can help ensure you don't throw away food after meals & that your family is eating a healthy diet.

TIP: To keep food in your fridge fresher for longer, be sure to have your fridge set at the right temperature at around 4°C lower.

TAKE IT HOME
Enjoying a restaurant meal but can't finish it? Ask to have your leftovers wrapped up to take home & enjoy later.

COMPOST
Get a compost bin or worm farm for food scraps. Means less landfill & great for your garden.

Overall discussion and contributions

Food waste has important implications at both the environmental and societal level (e.g. Berkenkamp, Hoover and Mugica, 2017). Given the primary role played by consumers in the generation of this phenomenon (Stenmarck et al., 2016) the understanding of the antecedents and consequences of their wasteful behaviors is paramount from both a theoretical point of view and a marketing and public policy one. This dissertation was aimed at advancing knowledge in this sense by adopting a theory-driven approach to the comprehension of some of the drivers leading consumers to waste food (i.e., imperfection in fresh produce), by providing evidence for a successful intervention that could contribute to the reduction of consumer-generated food waste (i.e. physical processing of imperfect produce), and by shedding light on the emotional and behavioral consequences of food waste events (i.e. compensatory behaviors).

From a theoretical point of view, this work makes several contributions. First, the findings of the research papers included in this dissertation are in line with the recent call for more theoretical contributions aimed at the understanding of the psychological underpinnings of consumers' decisions about product disposal, in this case food (e.g., Block, 2016). On the one hand, findings from the first research paper contribute to recent research about consumers' reactions to imperfect fruit and vegetables (e.g., Grewal et al., 2019; Loebnitz and Grunert, 2015) and provide novel insights about the cognitive and emotional associations elicited by imperfect produce that can lead to either consumers' aversion or acceptance of these products. On the other hand, results from the second research paper included in this dissertation provide evidence for the theoretical mechanism underlying consumers' aversion toward imperfect fruit and vegetables (i.e., prototypicality), and leverage on this theoretical understanding for the development of a successful intervention that has the potential to reduce food waste. Finally, results from the third research paper contribute to the understanding of consumers' emotional and behavioral reactions to food waste and contribute to research about the role of negative emotions such as guilt in affecting consumers' behavior. Second, this dissertation adds to literature on the antecedents of consumer-generated food waste and it is the

first to provide experimental evidence about consumers' emotional and behavioral reactions to food waste. Third, this work contributes to recent literature focusing on the development of interventions aimed at reducing food waste and leveraging on consumers' psychology (Grewal et al., 2019; Cooremans and Geuens, 2019). Finally, these research papers contribute to literature on consumer behavior in relation to product disposal (e.g., Jacoby, Berning, and Dietvorst, 1977; Van Birgelen, Semeijn, and Keicher, 2009), a topic that has received scarce attention and whose knowledge is still limited.

From a practical point of view, the findings of this dissertation provide useful suggestions to both policy makers and companies aiming to reduce food waste. For instance, my work on consumers' reaction to imperfect produce provide several entry points that could be leveraged for the development of interventions aimed at curbing food waste. More specifically, these results could be used for the development of both communication in-store and advertising campaigns, as well as for the development of informational materials aimed at educating consumers about the benefits of these products. Similarly, results from my second research paper suggest that the physical processing of imperfect produce can be a successful way to reduce food waste. In this sense, while producers currently see large shares of their harvest go to waste because not in line with retailers' standards for fresh produce, they could recover these products by physically processing them and by selling them directly to consumers or retailers. Indeed, consumers show a higher attitude toward imperfect produce that has been physically processed than imperfect produce in its original state. Furthermore, my work provides useful recommendations for the development of awareness campaigns targeted at consumers and aimed at reducing food waste. In this sense, results from my third paper suggest that these campaigns should focus on communicating to consumers their responsibility in the generation of food waste, as this is the main factor determining whether they would feel guilty about the food waste event, which in turn affects their likelihood to engage in behaviors aimed at compensating for the harm caused by the food waste. Overall, the results of my research papers provide suggestions that could be successfully enacted by both actors operating at different levels of the food value chain, such

as producers and retailers, and policy makers working to reduce food waste. In this sense, the focus of this dissertation on both the antecedents and consequences of consumer-generated food waste allows for the development of a broad range of solutions, and shows that efforts to reduce food waste could focus on both the factors that lead consumers to food waste (i.e. antecedents) and on the emotional reactions emerging after the food waste event, and that could be leveraged for affecting subsequent behaviors in this sense.

Furthermore, the research papers included in this dissertation are part of a broader research agenda developed throughout my PhD and aimed at investigating food waste from a consumer behavior perspective. In this sense, the research papers here included are related to and informed by two prior works that I published in the last two years. In the first paper, titled “*Domestic food practices: A study of food management behaviors and the role of food preparation planning in reducing waste*”, we identified the main food management behaviors leading consumers to waste food, and we developed and tested a successful intervention for helping consumers reduce their household food waste. In the second paper, titled “*The road to food waste is paved with good intentions: When consumers' goals inhibit the minimization of household food waste*”, we show that consumers may pursue positive goals (i.e., being a good provider, concerns over possible health risks, and healthy diet) that conflict with their negative attitude toward and thus reduce their intention to minimize food waste. In this sense, we show that the understanding of consumer-generated food waste needs to account for other factors that may affect consumers' decision to dispose of food. Hence, these two works extend knowledge about the antecedents of consumer-generated food waste and contribute to literature on food waste. Building on and extending the contribution of these works, the papers included in this dissertation are aimed at providing strong theoretical explanations for the hypothesized relationships and effects, which in turn could be leveraged for the definition of relevant implications for both companies and policy makers. In this sense, these works have the potential to contribute to both more practice-oriented research on food waste and more theory-driven research

about consumer behavior. In this sense, the goal is for these research papers to be disseminated through publications in consumer behavior and marketing-oriented journals.

Limitations and directions for future research

While the papers included in this dissertation make several theoretical and practical contributions, there are limitations to be acknowledged. First, while this work provides insights about consumers' attitudes and behavioral intentions, we did not measure real behavior. In this sense, future studies could extend the results of this dissertation by further exploring the research questions included in this work using measures of real behaviors and methodologies such as field experiments. Second, mostly online and convenience samples were used; results of the papers included in this dissertation could be extended using larger and more representative samples. Finally, while suggestions were provided about potential interventions to be developed based on the findings of the papers included in this dissertation, such interventions were not tested and thus there is no evidence about the potential effects of these actions in real life. Future research could use the results of this dissertation for the design and testing of interventions aimed at food waste minimization.

Conclusion

As concerns about the negative impact of food waste grow wider and more pressing, the need for theoretical contributions that help the understanding of this phenomenon becomes equally pressing. This dissertation was aimed at contributing to this understanding by investigating food waste from a consumer behavior perspective and by focusing on the antecedents and consequences of this phenomenon. Despite limitations, this dissertation provides novel insights about consumer-generated food waste and advances knowledge about both the drivers and the consumers' reactions to this phenomenon. Finally, it provides the theoretical foundations for the investigation of new research questions, thus paving the way for further research on food waste from the perspective of the consumer.

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