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INTRODUCTION

Nearly 1.3 billion tons of food produced for human consumption are lost or wasted globally each year (Gustavsson, Cederberg, Sonesson, Otterdijk, & Meybeck, 2011). In response, food waste reduction and prevention have been integrated into national (e.g., Mourad, 2015) and international policy agendas, such as the sustainable development goals (SDG)—which include a target to halve per capita food waste at the retail and consumer level by 2030 (United Nations, 2016)—or the Circular Economy Package issued by the European Union (European Commission, 2015, 2017). In industrialized countries, households account for the largest share of food waste along the supply chain. Of the 88 million tons of food waste occurring in the EU-28 per year, approximately 52% occur in households (Stenmarck et al., 2016).

Domestic spaces and beyond: Consumer food waste in the context of shopping and storing routines

Karin Dobernig1,2 | Karin Schanes1,3

Abstract

To significantly reduce the volumes of food currently wasted in industrialized countries, tackling food waste on the household level is paramount. While awareness campaigns and economic incentives are important measures, it is crucial to look beyond individual decision making and scrutinize how contextual factors frame consumer lifestyles in ways that intensify the issue of food going to waste. This paper addresses the role of material contexts—in particular, infrastructures and technologies—in the shaping of food shopping and storing practices and thus consumer food waste. It presents an in-depth, qualitative study with 24 Austrian households, conducted from November 2016 to February 2017. Data were collected through food waste diaries, semi-structured interviews and a total of 16 focus group discussions. In line with other studies, we find that food waste is a largely unintended outcome of entangled daily routines revolving around food, such as meal planning, grocery shopping and food storing. The characteristics of food retail infrastructures—in terms of accessibility, density and type—shape these routines and thus potentially influence excess food purchases. Food storing practices as well depend on the characteristics of domestic infrastructures and co-evolve with technologies used for storing food. Unraveling the interconnectivity between material contexts and household food practices can inform policy, product design and food retail development and thus has implications for reducing consumer food waste.

KEYWORDS
consumer food waste, domestic technologies, infrastructure, material context, shopping practices, storing practices

1 | INTRODUCTION

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Austria, food waste generated on the household level amounts to approximately 276,000 tons per year, of which over 50% are considered avoidable (Pflader, Bernhofer, Kalleitner-Huber, & Hietler, 2016).

Policy initiatives aimed at the reduction and prevention of food waste in households (i.e., consumer food waste) still largely centre on information campaigns and economic incentives. However, consumer food waste cannot (only) be traced back to individuals being ignorant about the problem (Evans, 2011) but is driven by various interconnected, food-related practices and daily routines, ranging from meal planning and shopping through food storing, cooking and eating, to disposal and re-distribution (Schanes, Dobernig, & Gözet, 2018; Wahlen & Winkel, 2016). Along this consumer food journey, issues relating to food shopping (e.g., when more food is bought than needed) and storing routines (e.g., when food is stored at home but not consumed) are especially relevant.

Recently, there have been calls for other, complementary means of intervention to reconfigure how food and waste are handled in households. Most prominently, discussions on the contextual and material aspects that shape food routines—such as objects, technologies and infrastructures—have gained momentum. In particular, technological solutions and design interventions, such as smart fridges that combine information provision with feedback mechanisms, are studied to encourage practices that might result in less food waste (Bucci, Calefato, Colombetti, Milani, & Montanari, 2010; Ganglbauer, Fitzpatrick, & Comber, 2013; Farr-Wharton, Foth, & Choi, 2014). What is comparably less explored is how such practices are embedded within existing infrastructures such as the physical space of private households as well as contexts that are geographically and temporally distant from the home (Wahlen & Winkel, 2016).

The present study adds to the still modest discussion on the material contexts of consumer food waste. Using an in-depth, qualitative study of everyday food practices in Austrian households, we investigated the role of infrastructures and domestic technologies in food shopping and storing routines among consumers. This paper is structured as follows: First, we briefly review existing academic literature on consumer food waste, focusing on the contextual and material elements of food practices. Subsequently, the research design of the empirical study is outlined. Finally, we present the main findings and discuss their implications for the study of consumer food waste, closing with suggestions for further research.

2 CONSUMER FOOD WASTE

A systematic literature review recently conducted by Schanes et al. (2018) shows that the drivers of consumer food waste range from socio-demographic through psycho-graphic to contextual factors. Past research has, for instance, enriched our understanding of how consumer food waste results from concerns about food risk and safety (Evans, 2011; Meah, 2014; Watson & Meah, 2012). Consumers articulate and assess the quality of food in various ways, often relying on date labels for indicators as to whether a food is still edible (Blichfeldt, Mikkelsen, & Gram, 2015; Domaneschi, 2012). Moreover, food waste is embedded within tendencies towards procrastination when consumers defer the reuse of leftovers until these become inedible (Blichfeldt et al., 2015; Evans, 2011).

Skills and competences related to household management—such as appropriately storing food items and reusing leftovers (Cappellini, 2009; Cappellini & Parsons, 2012)—also play an important role (Aschemann-Witzel, Hooge, Amani, Bech-Larsen, & Oostindij, 2015; Graham-Rowe, Jessop, & Sparks, 2015) for the prevention of food waste within the home. Moreover, consumer food waste is intertwined with the arhythmic dynamics of everyday life. Meal patterns and eating habits are often dictated by perceived time availability and organized around work as well as social obligations. Waste, then, often occurs when food is bought but not eaten because of unplanned events occurring in consumers’ daily lives (Kristensen & Holm, 2006; Lazell, 2016).

In comparison, the material dimension of food (waste) practices has received less attention so far (Hebrok & Boks, 2017). By this term, we refer not only to technologies such as the fridge and the freezer, and everyday objects that consumers use in their food routines, but also to infrastructures of food provisioning (Røpke, 2009). Domestic technologies and infrastructures are not neutral elements in consumers’ shopping and storing routines; rather, their characteristics actively impact how consumers deal with foods in everyday life and thus guide how people shop, store, eat, cook and dispose of food (Metcalfe et al., 2012).

In the context of food disposal, Metcalfe et al. (2012) empirically studied the impacts of waste bins—and their symbolic qualities in terms of aesthetics, size, hygiene and smell—on food waste practices in households. The material agency of waste bins not only steers waste practices and behaviours but also related emotions, such as a consumer’s environmental consciousness. Moreover, bins are integral parts of a waste infrastructure and thus intertwined with waste policies. However, material aspects are also relevant for a better understanding of how the accumulation of food items that consumers never end up preparing or consuming—often referred to as “overbuying” or “overprovisioning”—comes about. This issue is noteworthy, as the prevention of excess food purchases is an effective way of mitigating food waste (Papargyropoulou, Lozano, K. Steinberger, Wright, & Ujang, 2014). Ganglbauer et al. (2013) looked at the reasons why consumers use shopping lists and found that they serve as reminders of important food items or make shopping more efficient. Others focused on the roles of the fridge in daily practices such as food storing, freezing, disposing and assessing the edibility of food items (Evans, 2012b; Wait & Phillips, 2016).

Consumer practices are also mediated, enabled and constrained by material infrastructures (Shove, Pantzar, & Watson, 2012; Warde, 2014). Within the physical structure of the home, the space available for storing food may determine how much food is wasted (van Holstein & Kemna, 2018). Outside the home, the type of existing infrastructure (i.e., retail types, retail density and accessibility) define where, when and how often consumers do grocery shopping and thus shape the place and temporality of grocery shopping practices (Lee, 2018). Jörissen, Priefert, and Bräutigam (2015) furthermore found that the type of store in which food is bought explains the amounts of food waste generated. According to their study,
consumer food waste is higher in households that exclusively shop in large supermarkets compared to households that buy food in different shopping facilities.

The majority of studies addressing infrastructural issues of consumer food waste utilize a quantitative survey methodology. Moreover, while some scholars have studied the influence of food retailers’ practices on consumer food waste, their findings are largely limited to the role that marketing promotions play in encouraging excess food purchases (Farr-Wharton et al., 2014; Mondéjar-Jiménez, Ferrari, Secondi, & Principato, 2016). Putting the material aspects of consumer food waste into focus helps to understand the dynamics of consumer food waste and to identify options for alternative policy interventions.

3 | MATERIAL AND METHODS

We have conducted a qualitative empirical study involving two neighbourhoods in Austria, one located in an urban area (Währing, the 18th district of Vienna) and one located in a rural area (Neumarkt in Styria).

A total of 24 participants from 24 households were recruited for the study; the group in Vienna consisted of eight individuals; the group in Styria was larger, with 16 individuals participating. Recruitment was done via the project website, communication channels of the respective district and region as well as the distribution of flyers in local cafés, supermarkets and farmers’ markets. We used an illustrative sampling method to generate a representing mix of characteristics: Participants had to be at least 18 years old and had (sole) responsibility for food provisioning in their household. We also aimed for a heterogeneous group of participants with regards to the number of household members and their employment status. Moreover, we strived to include participants living with as well as without children in the household, as this was found to be a key aspect in consumer food waste generation (Parizeau, Massow, & Martin, 2015; Visschers, Wickli, & Siegrist, 2016). The recruitment of participants was supplemented by snowball sampling in the case of the rural area. Table 1 provides an overview of the key socio-demographic characteristics of our sample.

To take part in the study, each household member had to commit to (a) participating in a total of four project meetings taking place over

<table>
<thead>
<tr>
<th>No.</th>
<th>Gender</th>
<th>Age</th>
<th>Education level</th>
<th>Household composition</th>
<th>Employment status of household members</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>f</td>
<td>53</td>
<td>Vocational training</td>
<td>4 adults, 1 teenager</td>
<td>2 FT; 2 Students; 1 Retired</td>
</tr>
<tr>
<td>2</td>
<td>f</td>
<td>NA</td>
<td>Vocational training</td>
<td>3 adults, 1 teenager</td>
<td>2 FT, 1 PT; 1 SE</td>
</tr>
<tr>
<td>3</td>
<td>f</td>
<td>54</td>
<td>Vocational training</td>
<td>4 adults</td>
<td>2 FTEs; 1 Stay-at-home woman/man; 1 UE</td>
</tr>
<tr>
<td>4</td>
<td>f</td>
<td>60</td>
<td>High school</td>
<td>2 adults</td>
<td>1 FTE; 1 Retired</td>
</tr>
<tr>
<td>5</td>
<td>f</td>
<td>61</td>
<td>Graduate</td>
<td>2 adults</td>
<td>1 SE; 1 Retired</td>
</tr>
<tr>
<td>6</td>
<td>f</td>
<td>62</td>
<td>High school</td>
<td>2 adults</td>
<td>1 FTE; 2 Retired</td>
</tr>
<tr>
<td>7</td>
<td>f</td>
<td>53</td>
<td>High school</td>
<td>2 adults</td>
<td>1 FTE; 1 PTE</td>
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<td>8</td>
<td>f</td>
<td>53</td>
<td>High school</td>
<td>2 adults</td>
<td>1 FTE; 1 PTE</td>
</tr>
<tr>
<td>9</td>
<td>f</td>
<td>54</td>
<td>High school</td>
<td>2 adults</td>
<td>1 FTE; 1 SE</td>
</tr>
<tr>
<td>10</td>
<td>f</td>
<td>66</td>
<td>High school</td>
<td>2 adults</td>
<td>2 Retired</td>
</tr>
<tr>
<td>11</td>
<td>f</td>
<td>72</td>
<td>High school</td>
<td>NA</td>
<td>2 Retired</td>
</tr>
<tr>
<td>12</td>
<td>f</td>
<td>49</td>
<td>High school</td>
<td>2 adults, 1 teenager</td>
<td>1 FTE; 1 PTE; 1 Student</td>
</tr>
<tr>
<td>13</td>
<td>f</td>
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<td>2 adults</td>
<td>1 FTE; 1 Stay-at-home woman/man</td>
</tr>
<tr>
<td>14</td>
<td>f</td>
<td>53</td>
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<td>4 adults, 1 teenager</td>
<td>3 FTEs; 1 Student</td>
</tr>
<tr>
<td>15</td>
<td>f</td>
<td>40</td>
<td>Vocational training</td>
<td>2 adults, 2 teenagers, 1 child</td>
<td>1 FTE; 1 PTE</td>
</tr>
<tr>
<td>16</td>
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<td>Vocational training</td>
<td>2 adults</td>
<td>2 Retired</td>
</tr>
<tr>
<td>17</td>
<td>f</td>
<td>40</td>
<td>Graduate</td>
<td>2 adults</td>
<td>1 PTE; 1 SE</td>
</tr>
<tr>
<td>18</td>
<td>m</td>
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<td>Undergraduate</td>
<td>1 adult</td>
<td>1 SE</td>
</tr>
<tr>
<td>19</td>
<td>f</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>20</td>
<td>f</td>
<td>47</td>
<td>Graduate</td>
<td>2 adults, 1 child</td>
<td>1 FTE; 1 PTE; 1 Student</td>
</tr>
<tr>
<td>21</td>
<td>m</td>
<td>28</td>
<td>Undergraduate</td>
<td>2 adults</td>
<td>2 Students</td>
</tr>
<tr>
<td>22</td>
<td>f</td>
<td>58</td>
<td>Postgraduate</td>
<td>2 adults</td>
<td>1 FTE; 1 PTE; 1 Student</td>
</tr>
<tr>
<td>23</td>
<td>f</td>
<td>44</td>
<td>Vocational training</td>
<td>2 adults</td>
<td>1 FTE; 1 SE</td>
</tr>
<tr>
<td>24</td>
<td>f</td>
<td>NA</td>
<td>Graduate</td>
<td>2 adults, 2 children</td>
<td>2 PTE</td>
</tr>
</tbody>
</table>

Note: Teenagers are 11–17-year-olds; children are 10 years old or younger. Abbreviations: FTE, full-time employees; PTE, part-time employees; SE, Self-Employed; UE, Unemployed.
a period of 16 weeks from November 2016 to February 2017 and (b) completing two food waste diaries for a period of 7 days each (14 days in total) in which all food waste occurring in the respective household was weighted and recorded. The project meetings comprised a total of 16 focus groups in which (a) practices that caused the participants to throw away food and (b) strategies used by the participants to reduce food waste in their households, were discussed. Thereby, consumers reflected on their daily routines as well as on barriers they experienced when attempting to minimize their food waste. In this process, the food waste diaries served as an entry point for the focus group discussions, as participants not only recorded what they had wasted in the preceding 7 days but also why these foods were thrown away. In addition, two semi-structured interviews were conducted with consumers who could not participate in all project meetings.

All focus group discussions and the interviews were audio-recorded and transcribed verbatim. The analysis of the transcripts was oriented along the grounded theory approach outlined by Urquhart (2013). First, the data were summarized in a descriptive fashion (open coding). Second, specific open coding categories (related to shopping and storing routines) were put into focus and additional categories created from the data (axial coding). Finally, propositions were developed to describe the interrelationships of the different categories. The objective was to come up with an abstract analytical schema of the studied process (Creswell, 2007; Strauss & Corbin, 1998), that is, participants’ routines with regards to food waste. Throughout the analysis, instances of data labelled as a particular category were compared with other instances of data in the same category (Urquhart, 2013). As core themes started to emerge, these were related to existing literature and used to further densify the emerging concepts. The results of the analysis were discussed collaboratively by the authors. In presenting the data, the direct quotes from our Austrian participants were translated from colloquial German into English to make them understandable for an international audience.

4 | FINDINGS

Throughout our focus groups, there were lively discussions on various issues pertaining to food waste. The vast majority of participants considered food waste as a problem, albeit many were not aware of its actual scale or the attributed environmental impacts. Most consumers portrayed food waste as the result of “buying too much” or “buying more than we need”, thus linking food waste generation in their households with routinized shopping practices that unfold outside the physical structure of the home. Participants expressed different perspectives in the discussions, especially on meal planning and food storing practices, which reflects the diversity of consumers who took part in the study.

4.1 | Food shopping routines

The majority of our participants bought food primarily from supermarkets or discounters, which reflects the general trend in Austria (AMA, 2017). Some of our respondents also shopped regularly—or even primarily—at local farmers’ markets and a few had experiences with community-supported agriculture (CSA) or box schemes. The high density of supermarkets and discounters in Austria justifies this type of retail outlet easily accessible for consumers—both in physical and temporal terms (i.e., geographical distance to the store and opening hours, respectively).

The physical proximity of food (retailers) allowed our participants to shop frequently and purchase rather low volumes per shopping occasion. Indeed, for the respondents in our sample, grocery shopping mostly provided food only for one or a few days. Living close to a supermarket also meant that there was no need to use public or private transportation, as one consumer explained:

> It only takes me 1 minute to get to Billa [a major food retailer in Austria] and 2 minutes to get to Spar [another major food retailer in Austria]. I can always walk, so I only buy small amounts. (Participant #6)

Moreover, as consumers reported that they shopped frequently and for small quantities, they pointed out that there was less need for storage space in their homes:

> Nowadays, the food retailers themselves actually serve as storage spaces for groceries. [...] I think I have less and less fresh food at home because it’s possible to shop more frequently. (Participant #20)

If consumers bought food fresh rather than storing it at home, in particular food that was easily perishable such as vegetables or fruits, it was less likely that these food items were spoiled.

The easy accessibility of food retail outlets also played a role when participants discussed the planning of meals. For many, shopping more frequently reduced the need for advanced planning. As one woman described, “...only when I am already in the store, I start thinking about what I will cook today” (Participant #8). Indeed, only a few households in our sample did active meal planning on a regular basis. One participant argued that “if there are more people [in the household], you need to plan everything [i.e., every meal] in advance” (Participant #2). Another woman explained how meal planning helped her manage her time when she was still working as a teacher:

> I wrote my class schedule in my calendar and did cooking and grocery shopping accordingly, depending

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1 In Austria, food retail is dominated by supermarkets, which account for 43% of all food retail revenues and about 50% of retail outlets (Nielsen, 2016). While the density of food retail outlets is still high by international comparison, the number of food retail outlets in Austria has decreased by more than a third over the last 20 years, from 8,522 outlets in 1994 to 6,397 in 2004 and 5,508 in 2015 (Nielsen, 2016; Schnedlitz, Cerha, & Salesny, 2016). Not surprisingly, this development has mainly affected small and medium-sized, privately owned food outlets. Between 2010 and 2014 alone, shops with an area size of up to 400 m² have decreased by 17% in absolute numbers and 11% in revenues (Schnedlitz et al., 2016).
on how much free time I had on the respective day. (Participant #10)

However, many perceived the planning of meals an outdated concept that was at odds with the quest for flexibility in daily meal schedules:

What does not work at all for me [...] is a weekly meal plan. I am one of those, I don't know what I want to eat the day after tomorrow. I want the flexibility to say: today, I will not have the time to cook and I will order something instead. (Participant #18)

For this participant, a weekly meal plan symbolized a restriction of personal freedom with regards to what, when and how to eat. This desired spontaneity was possible if retail infrastructures were dense, as consumers could then fulfill their appetites for specific foods in an almost instant fashion when they arose. Other participants mentioned that changing taste preferences lead to food waste in their households, for instance, when children asked for specific foods during shopping trips but never consumed them at home, as one mother explained:

Children change their ideas so quickly, about which food they like. I buy something, but then they suddenly do not want to eat that anymore and then I sometimes throw it away. (Participant #15)

Others threw away food because it was leftover from a meal. As one consumer explained: “we want variety in our meals and do not want to eat the same food 2 days in a row” (Participant #4). Thus, when consumers could align their food purchases with current food preferences, it possibly made it more likely that these foods were consumed and not wasted.

When asked about reasons for overbuying in their households, our respondents provided explanations such as “giving in to special offers in the store” and “buying multipacks of perishable products”. Thus, they pointed to the ways that food products are packaged, placed and promoted in the traditional supermarket as reasons for food waste. The great majority our respondents were aware of and critical towards the marketing practices of food retailers. In contrast, the farmers’ market presented an arena in which participants nurtured a sense of control. Here, they were not exposed to marketing tactics and sales offers and could decide how many pieces of fruit or vegetables to buy and purchase food that is not pre-packed or pre-portioned:

At the market, you don’t have all these packages or these large quantities. It is always seasonal, from the farmer, and always organic. (Participant #22)

For our respondents, shopping at the farmers’ market entailed a feeling of emancipation and opposition to the practice of shopping at supermarkets. Participants described their interactions with local farmers at the market as based on trust: industrial food production, on the other hand, was portrayed as a hard-to-grasp, distant entity that was impossible to understand and control. Some noted a detachment of food consumption and production that one respondent articulated in the following way:

These sales promotions in super-sized packages... This is certainly a trap that many fall into. And then at home, they don’t even like the food anymore. (Participant #2)

For some consumers, grocery shopping often meant failing to withstand inner conflicts because they found it difficult to resist special offers or large packages due to financial considerations:

I am just stupid. I think [I buy it] because it is cheaper, although I have no financial issues. I just cannot get out of my own skin. (Participant #6)

Others felt less helpless and explained that looking at the price per kilo made them more critical towards special offers. Interestingly, our respondents also voiced concerns about the high number of products available in the average supermarket. Some reported that the big offers tempted them to buy more food than planned because they did not want to make a decision that they would regret later on. Other participants described how (too) many products complicated decision making:

There is just too much choice within all kinds of food products. I would prefer to just have less options. (Participant #5)

By calling for fewer promotions, and smaller packages, our respondents generally shoved the responsibility for overbuying towards the food retailers. In contrast, the farmers’ market presented an arena in which participants nurtured a sense of control. Here, they were not exposed to marketing tactics and sales offers and could decide how many pieces of fruit or vegetables to buy and purchase food that is not pre-packed or pre-portioned:

But of course, emotionally it’s easier for me to throw away half a bottle of baby food than something that I cooked or mashed myself. There are less blood, sweat and tears in it. (Participant #24)
Others also mentioned this as an issue when eating out, as one person explained, “it is easier to leave something [i.e., food] in a restaurant, because you do not cook yourself and do not understand the effort that went into making the meal” (Participant #22). However, others disagreed and argued that leftovers in restaurants occurred because the food did not taste well or was served in too large portions.

Generally, our respondents indicated that food purchased at farmers’ markets had a higher symbolic quality and reflected their considerations of health and animal welfare. In this context, our respondents reported that it was more difficult to throw away food that they bought directly from the farmers:

> Because we buy the food in the region, which is not necessarily cheaper, we maybe handle it more consciously. [...] We do not simply throw something away and also do not buy in excess. (Participant #5)

Here, the higher perceived value of food bought at farmer’s markets was ascribed to the locality of the food production—and the efforts related to it—but also to the higher prices at local markets. These served as indicators for higher quality and thus heightened the value attributed to the food bought, which in turn made respondents more conscious about wasting it.

### 4.2 Food storing routines

We found that food storage practices of our participants depended on their respective living situations. For respondents from the countryside, the cellar and/or a pantry presented integral elements in their storing strategies that kept food in their proper condition and extended processes of decay. Cool, dark and dry places offered optimal storing conditions for products such as potatoes, onions and beer (amongst other items) and thus helped prolong their shelf life. Such infrastructure proved to be more prevalent in the countryside rather than in the city, where the living spaces of our participants tended to be smaller on average. As one consumer noted,

> people who live in the city may not have such good cooling possibilities. You know, we have a cellar or a pantry [...] We do not only use the fridge for cooling. (Participant #8)

This statement illustrates that having adequate storage possibilities, that is, both enough space and optimal storage conditions (temperature and lighting conditions) was crucial for our respondents to ensure that purchased food was kept fresh. In turn, households lacking the required domestic infrastructure to store perishable foods over a longer period of time were forced to process and consume those foods in a timely manner if waste was to be avoided.

Not surprisingly, the fridge presented the dominant technology when it came to storing practices in the households of our participants. While the fridge was rather prominent in all discussions around storing food, practices of freezing seemed to be more contingent on established household routines. In some households, freezing was a practice deeply embedded in the routines of food shopping, storing and dealing with leftovers in order to avoid food being wasted. Participants described how purchased food (e.g., bread) was frozen directly after shopping to ensure longevity, or how cooked food and leftovers were stored in portion sizes. By contrast, in other households, freezing practices proved to be ineffective as the frozen food was occasionally forgotten. According to one respondent:

> When I freeze something, it is lost. [...] It is frozen and then I never think about it again. (Participant #13)

Our respondents emphasized that one needed to know how domestic technologies, such as fridges and freezers, functioned to optimize their potential for storing food properly. For instance, they had to be informed about different cooling zones, appropriate food storage temperatures or the benefits of vegetable boxes. Participants reflected on their knowledge about the uses of storage equipment:

> My mum always told me about the cooling zones but I never listened. [...] I know that these cooling zones exist but I completely ignore them, except the vegetable bin. (Participant #17)

Others pointed out how cooling practices were steered by the material, that is, the respective design of the product. In the case of the fridge, this concerns, for example, the cooling zones and the vegetable boxes but also design elements such as egg boxes:

> Oh yes, the cooling zones. I do stick to them without actually realizing. But the producers kind of teach you that discretely but definitely; for instance, that the containers for the eggs are always at the same spot and that the doors are normed so that bottles fit. (Participant #24)

Moreover, when it came to freezing practices, some participants were uncertain about the kinds of food that could be frozen, the possible duration of freezing and the correct de-frosting process. Thus, freezing called for a set of competences and knowledge revolving around the preservability of specific food items because, when food was put into the freezer, “you cannot rely on the date labels anymore” (Participant #4). For others, this was not an issue because they felt confident in assessing the edibility of food after defrosting. As one person explained, “I also put meat into the freezer. You just have to rely on yourself” (Participant #16). Other participants argued that “if you put it in the freezer right away, nothing can happen” (Participant #14).

Among our participants, both the fridge and the freezer were portrayed as technological tools that could be upgraded and optimized. While essentially a private necessity, a high-quality fridge could attain the status of a luxury product that consumers invested in, often for allegedly environmental reasons. One respondent described her reasoning for buying a new, expensive fridge:
I bought one of these fridges, with all the different zones. You can also adjust the humidity, for instance at the bottom, where you put the vegetables, depending on whether the fridge is full or empty. I decided to invest in it and I do believe that it makes a difference [with regards to food waste]. (Participant #19)

Not only the design but also the size of the fridge emerged as an issue when it came to food waste prevention. Having a proper fridge that provides optimal storage conditions helped the participant to prolong the shelf life of food products and thus extended the period within which food needed to be used up. Some participants reported a lack of space in the fridge as a reason for spoiled food products:

I don’t really have that much space. In the fridge, there are 2-3 pizzas, some vegetables and bread and that’s it. Sometimes I am not able to store the other stuff that I buy. However, if you have an American freezer.... (Participant #21)

A perceived lack of space in the fridge also disturbed the ordering of food items and thus contributed to food being wasted. Especially leftovers were often "parked" in the fridge and then forgotten. To tackle this issue, our participants used mundane equipment such as cheese covers, glass containers or transparent plastic boxes that helped to properly store food items in the fridge or freezer. For instance, transparent boxes were used for leftovers in order to immediately see what was stored in the fridge and thereby prevent leftovers from being overlooked. These were integral parts of people’s storage strategies—often engrained in long-established household routines and habits—and made it easier both to see which kind of food is available in the fridge and to manage their storage "aesthetics" (Ganglbauer et al., 2013). Our respondents reported these strategies as crucial for ensuring that food was not wasted.

5. DISCUSSION AND CONCLUSION

To unravel the complexity of food waste occurring in private homes, both the analysis of consumer food waste as well as suggestions for interventions have to go beyond individualistic accounts of consumer behaviour. More specifically, a theoretical shift of focus towards food practices and the contexts in which these practices unfold is crucial. The current study set out to disentangle the interconnectivity of food provisioning infrastructures, domestic spaces and technologies in scripting food shopping and storing practices, thus influencing the generation of food waste. Thereby, the paper adds to a growing body of literature analysing the contextual dimensions of consumer food waste.

5.1 Accessibility of food provisioning infrastructure

Overprovisioning has been identified as a fundamental reason for superfluous food and thus food waste occurring in households (Evans, 2012a; Southerton & Yates, 2015). Our findings demonstrate how infrastructures of food provisioning—in particular, the density and type of food retail outlets—provide the setting for daily shopping routines and play a role for overprovisioning and consumer food waste. The physical and temporal accessibility of food retailers not only influences how frequently consumers do grocery shopping but also how much food they buy per purchase occasion. The latter aspect is partly related to the density of food retailers in a certain area, which determines the mode of transportation that consumers (have to) use when transporting groceries from the retailer to their homes (Lee, 2018; Sonesson, Anteson, Davis, & Sjödén, 2005).

Furthermore, the frequency of shopping trips can affect the amounts of food that remain uneaten in consumers’ homes (Lee, 2018). Williams, Wikström, Otterbring, Löfgren, and Gustafsson (2012), for example, showed that a higher frequency of shopping is related to less food waste. In the same vein, Jörissen et al. (2015) found that in Germany, food waste decreases with increased shopping frequency; however, the opposite tendency was observed in their case study in Italy. In accordance with our findings, a high frequency of shopping trips makes it unnecessary to store food that is easily perishable at home and could potentially reduce or prevent overprovisioning and thus food going to waste. As the role that consumers attribute to the supermarket diverges into that of a warehouse and storing practices do not need to take place in domestic spaces, consumer food waste is reduced. More broadly put, a dense food retail infrastructure allows food purchases to align temporally with consumer needs and preferences that are increasingly dynamic as consumers seek variety and flexibility in their meals and food choices. In turn, this might lower food waste because needs can be matched with actual purchases and shopping can be done according to needs (Jörissen et al., 2015).

We found that the perception that food preferences can be addressed and fulfilled ad-hoc at (almost) any time and any place, makes the planning of meals and food shopping trips unnecessary. However, meal planning, writing shopping lists or checking inventories prior to grocery shopping can reduce overbuying and thus consumer food waste (Stefan, Herpen, Tudoran, & Lähteenmäki, 2013). Some studies have already tried to measure an effect of better planned shopping on the amount of food waste generated (e.g., Stefan et al., 2013; Stancu, Haugaard, & Lähteenmäki, 2016) and, showed that stronger planning routines often relate to lower reports of buying unplanned items and big packs (Stancu et al., 2016). Moreover, as food preferences often only take shape at the point of purchase (i.e., the supermarket), unplanned shopping trips make consumers more susceptible to marketing activities within the store.

5.2 Types of food provisioning infrastructure

Food provisioning outlets themselves present material elements that necessitate specific types of knowledge, competences and understandings of what it means to "do grocery shopping". In the
traditional supermarket, consumers may feel that their intentions to “only buy what you need” are at odds with retailer practices aimed at designing a store environment that encourages excessive shopping. In particular, as the retail store has transformed from a place of selling to a place of marketing, practices of retailers increasingly centre on “creating shopping experiences” for the consumer rather than just selling products. As others have already pointed out, marketing activities steer consumer shopping practices through product unit sizes, pricing and promotions and labelling (Aschemann-Witzel, Hooge, & Normann, 2016). In response, consumers often feel that they have little control over the quantities in which they buy food (Evans, 2014) and face trade-offs between various priorities related to food and eating (Aschemann-Witzel et al., 2016). In turn, consumers portray themselves as victims of marketing efforts, overwhelmed by choice, when reasoning about food waste resulting from overprovisioning.

In contrast, food provisioning through alternative food networks such as a farmers’ market is loaded with a certain symbolic quality revolving around trust, purity and authenticity (Autio, Collins, Wahlen, & Anttila, 2013). The sense of buying local feeds into notions of “cultural distance”—at the market, consumers can get to know the personal stories of the local farmers and their growing practices and learn more about the food they sell. Moreover, with the geographic distance between food production and consumption presumably being rather short, one could potentially travel directly to the farm and investigate production practices (Princen, 2002)—which is not possible in the case of globalized food supply chains.

A lack of knowledge about production processes makes it more difficult to appreciate the materiality of the produced good (Schor, 2011): for instance, the less you know and have experienced what it takes to produce a tomato, the harder it is to appreciate and ultimately value the growing process and the produce itself. This not only applies to food production per se but also to the making of raw food into meals. Similar dynamics have been distilled through gardening and food growing practices (Dobernig & Stagl, 2015; Ganglbauer et al., 2013): through the experience of growing food and harvesting it, practitioners attribute more value to it. Ganglbauer et al. (2013), for instance, found that people place greater value on food they grow and source themselves and tend to waste less such foods.

To conclude, the accessibility and density of the food retail infrastructure as well as the type of food provisioning outlet play a role in shaping consumers’ perception and handling of food and thus in generating food waste. Moreover, infrastructures of food provisioning not only influence shopping routines but also related practices, such as (meal) planning and food storing, both of which play a role in food waste generation (e.g., Schanes et al., 2018).

5.3 | Domestic infrastructures and storing technologies

The present study shows how attributes of domestic storing technologies and appliances become central to notions of food practices and waste generation as they co-evolve with food routines. Moreover, it underlines the importance of consumers’ competences when it comes to the proper storing of food, which has already been identified as a crucial issue in food waste reduction and prevention (Graham-Rowe, Jessop, & Sparks, 2014).

Various scholars have investigated the role of storing practices in preventing and reducing food waste in households (Metcalfe et al., 2012; Waitt & Phillips, 2016). According to them, placing foods and leftovers in the fridge in an ordered manner and cleaning out storing spaces on a regular basis are key to keeping an overview and avoiding the contamination and subsequent wasting of food (Waitt & Phillips, 2016). We found that the availability of space and the characteristics of the infrastructure in the home co-dictate storing strategies and thereby prolong the durability and freshness of food items, helping to prevent food from becoming spoiled.

However, an adequate storage of purchased food or leftovers demands consumer knowledge and competence regarding the optimal storage conditions of fruits, vegetables and other food items (Graham-Rowe et al., 2014) in order to leverage the characteristics of domestic living spaces. Technologies such as the fridge and the freezer furthermore can assist in properly storing food only if consumers know about their functionalities. Many scholars have stressed the importance of optimized fridge design and storage temperatures for keeping foods fresh and reducing food waste due to spoilage, decay and/or a decrease in quality (van Holsteijn & Kemna, 2018). Others, such as Evans (2011), however, debunk the domestic fridge as an active player in the process of procrastination, occasionally transforming valuable food (in particular leftovers) into waste by allowing the unpleasant disposal of food to be deferred.

This highlights how domestic technologies such as the fridge are scripted in that they embody a certain form of knowledge and competence which leads to specific reciprocal dispositions between people and things (Sahakian & Wilhite, 2014). This also points to the potential of technology and design to make up for a possible lack of consumer knowledge with regards to the proper handling and storing of food.

Taken together, the findings illustrate that consumer food waste cannot be discussed in isolation from consumer realities and from issues such as the design of the living space, available technologies, as well as the types and densities of food provisioning infrastructures with which consumers are faced. Thus, regarding the question how food waste practices develop, both their internal dynamics and the external conditions of their existence are considered. Our results constitute an entry point for policy measures and design interventions, adjustments of material contexts such as infrastructures of provision, and touch upon the role of retailer and marketing practices in the occurrence of consumer food waste.

5.4 | Limitations and suggestions for further research

Although we aimed for a heterogeneous sample and the study spanned a socio-demographic range of individuals, it is important to bear in mind the limitations of the sampling process. As people
self-selected into the sample and were informed about the study’s main focus, we have to assume a certain degree of self-selection bias. In particular, the decision to participate in the study may indicate an already existing interest in food waste among our participants. Thus, we cannot assume that the findings reflect the general practices of Austrian consumers. In addition, the findings should be interpreted in the country context in which the study was carried out. Dietary habits, tastes and other characteristics of Austrian food culture as well as the retail infrastructure present in Austria frame the opinions and reported practices of our participants. Further research should scrutinize these relationships between food waste generation and socio-cultural factors.

Moreover, research endeavours dealing with the materiality and contextual dimension of consumer food waste so far largely focus on the potential of technology and design to encourage practices that might result in less food waste. Much less explored is the link between different types of food provisioning systems and food waste generation. As food retail infrastructures are in constant flux, it would be interesting for further research to explore how anticipated developments such as online grocery shopping will influence food provisioning practices and thus food waste generation. Similarly, it will be compelling to observe in which form the “digitalization of the home”—more specifically, the further technological advancement and spread of smart fridges or other networked devices that are able to inter-operate with digital infrastructure—will drive or impede the transformation of more sustainable and less wasteful food practices.

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