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Distributed Agency in Food Waste – A Focus on Non-Human Actors in Retail Setting

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The purpose of this chapter is to identify and analyse how non-human actors participate in production and/or reduction of food waste in a network of actor relations. Our empirical study focusses on a bread and bakery product section of a Finnish hypermarket where we follow how bread may – or may not – turn to waste in a network of various human and non-human actors. In so doing, we adopt the Actor-Network Theory (ANT) approach (Latour, 1999a, 1999b, 2005) as our analytic tool, which enables us to look beyond the dominant role of human actors, such as managers, employees and customers, in producing and/or reducing such waste. Thereby, we join the emerging stream of food waste studies recognising the distributed agency and re-emerging relations between humans and non-humans in the socio-material network (Evans, 2018; Mattila et al., 2018; Waitt & Phillips, 2016).

Until now, research on food waste in a grocery retailing setting has been largely neglected as a research topic (Cicatiello et al., 2017; Filimonau & Gherbin, 2017). The extant studies have concentrated on the quantification of food waste (Cicatiello et al., 2017; Food and Agriculture Organization of the United Nations [FAO], 2011; Katajajuuri et al. 2014; Teller et al., 2018) or adopted a managerial perspective to the issue (Evans, Campbell, & Murcott, 2013; Gruber, Holweg, & Teller, 2016; Mena, Adenso-Diaz, & Yurtc, 2011). This stream of food waste research takes a methodologically distant view of managers higher up in the organisation hierarchy and industry experts or gleans insight through secondary data (Teller et al., 2018). There is still a need for more in-depth understanding of the causes of food waste as well as ways to reduce it, including analysing the operational reality of retailers or frontline staff in the store environment rather than approaching the issue from a more aggregated level (Filimonau & Gherbin, 2017; Teller et al., 2018). Furthermore, we argue that studying “the human reality of food waste” (Gruber et al., 2016) is just one aspect of this wicked problem.

Therefore, in this chapter, we suggest that the food waste problem in the retail setting should be understood as a more dispersed and complex issue, rather than as a question of top-down management or as an issue to be solved through human-led processes. This requires investigating the issue in a store environment and adopting an analytical perspective that enables exploring the relations of heterogeneous human and non-human actors in the food waste network, each having different capacities to participate in waste production and/or reduction. In this manner, the current research sheds light on how it is not only human actors and their conscious decisions that may cause food to turn – or not – to waste. We also need to acknowledge the mobilisation of various related non-human actors in this process.

Although a few researchers have pointed out that food waste is a result of various factors in retailing, such as improperly functioning freezing and cooling equipment, and lack of adequate storage facilities (see Parfitt, Barthel, & Macnaughton, 2010), the non-human actors that participate in producing and/or reducing food waste in the food waste network remain largely unexplored. As an exception, Mattila et al. (2018) studied human and non-human actors in the household context to discover their potentials in organising temporality, thus preventing and reducing food waste. However, the ways in which food turns to waste in the interaction of human and non-human actors in the socio-material network in the retail setting have remained unresearched to date.

To fill these gaps, we adopt the methodological lens of ‘following the thing’ (Bettany & Kerrane, 2011; Latour, 1987) – the bread in this case – in a selected bread and bakery product section. The bread provides us with a particularly fruitful resource to investigate. Firstly, bread is categorised as one of the foodstuffs that most easily turns to waste (Mena et al., 2011, p. 653; Silvennoinen et al., 2012, p. 6). Secondly, bread appears as a multi-sensorial material object that evokes human and non-human interaction practiced through, for instance, touching, smelling, and tasting. It is thus capable of generating action in which multiple

variations of distributed agency may emerge. Therefore, bread and its (potential) transition into waste is considered here as our focal object of interest that is analysed in relation to other human and non-human actors.

We begin the chapter by outlining our theoretical framework. Actor-Network Theory provides us with theoretical lenses for understanding how distributed agency appears in interaction in a food waste network in the retail setting. Then, we move on to discuss our methodological choices, followed by the analysis and presentation of our findings. We describe how multiple heterogeneous (human and non-human) actors interact to produce and/or reduce food waste in the observed bread and bakery section. Then, we further zoom in on the interactions of the non-human actors – bread and its package, natural-temporal actors and techno-material actors – and other human and non-human actors involved in producing and/or reducing bread waste. We conclude our chapter by outlining practical implications and suggestions on how retail food waste could be reduced and even prevented. We highlight a need to focus on processes instead of (individual) human acts and consider different ways to confront food waste in relation to the heterogeneous actors of a food waste network in the retail setting.

### **Non-human Agency in the Food Waste Network**

Until now, only a few studies on retail food waste have sought to understand the root causes of food waste (Gruber et al., 2016; FAO, 2011; Teller et al., 2018). The identified reasons for food waste include undesirable customer behaviour and erratic demand, inefficient store operations and replenishment policies, and elevated product (quality) requirements (Teller et al., 2018). To shift the viewpoint from human-led processes to the socio-material network, in which human and non-human actors interact in ways that produce and/or reduce food waste, we rely on the theoretical premises stemming from ANT.

As the stream of research grounding on ANT and other post-humanist views is still in its infancy in food waste research (for notable exceptions, see Evans 2011; Mattila et al., 2018; Waitt & Phillips, 2016), we strengthen our theoretical bases with the emerging post-humanist studies from marketing and consumer research (e.g. Borgerson, 2013; Canniford & Bajde, 2016; Canniford, Riach, & Hill, 2018; Lugosi & Quinton, 2018; Otnes, Ruth, & Crosby, 2014; Syrjälä, Jaskari, & Leipämaa-Leskinen, 2016; Syrjälä & Norrgrann, 2019; Walther & Schouten, 2016) building on seminal thinkers such as Latour (1999a, 1999b), Miller (2010), and Haraway (2003). Thereby, we are able to adopt a relational perspective on food waste, in which producing/reducing food waste appears as a network of actors “acting within the confines of their material-semiotic milieu, the heterogeneous relationalities within which it is embedded” (Bettany & Kerrane, 2011, p. 1754).

Basing our research on relational ontology, we define a food waste network in the retail setting as the emerging and changing arrangements of heterogeneous actors. The arrangements include humans (e.g. customers, grocery store managers, and employees) and non-humans (e.g. bread and its package date labels, and displays) that produce and/or reduce food waste and unfold within practices carried out in the retail context. This perspective allows us to better understand how food turns to waste. It also yields a fruitful perspective on exploring the distributed agency emerging in the interaction of the different human and non-human actors at the point in which food turns to waste, and thus provides ideas for new solutions to cut down food waste. While we focus our description of the food waste network on the bread and bakery products section, we recognise its complex relations to other networked actors that are not scrutinised in our efforts. The food waste network in the bread and bakery section of a hypermarket is embedded in a network of various other actors, such as other retailers, policy makers, food charities and food banks (Gollnhofer & Schouten, 2017). Thereby, the food waste network is to be understood as being connected to other

networks, to more localised mundane interactions and coming up as a global arrangement (Askegaard & Linnet, 2011; Canniford, et al., 2018; Latour, 1996).

Within this food waste network, we trace agentic moments or “flickerings” (Borgerson, 2013; Syrjäälä & Norrgrann, 2019) that take place in the interaction between different actors and contribute to those occasions in which food turns – or not – to waste. ANT acknowledges that agency is not a human property, but a property of a heterogeneous network consisting of human and non-human actors (Latour, 1999b). Thus, from the ANT perspective, no single action within the food waste network can be traced back to any sole actor, be it a human or non-human; instead, each action always needs the mobilisation of multiple actors (Bajde, 2013) and their interconnected relations (Canniford & Bajde, 2016). Therefore, agency is to be seen as *distributed* (Bajde, 2013; Brembeck, 2008) and the ontology of actors within consumption spaces, such as the retail site, as *relational* (Hill, Canniford, & Mol, 2014).

Furthermore, stemming from Borgerson’s (2013) categorisation of agentic capacities as effects (non-humans), and as effects and intentions (humans) of different actors, we rely on the idea that the expressions of the agency of material objects, such as bread, a waste trolley and a shelf in a hypermarket, may not appear to be purposefully intentional. Instead, these things are capable of producing agentic mobilisations through their interconnected relations with human and non-human actors in their socio-material network (ibid.). This refers to the idea that different actors are ontologically indeterminate, meaning that their boundaries and meanings are not fixed, but co-constituted and negotiated in a continuous state of mutual becoming (Haraway, 2003). Hence, food waste is a relational effect acted upon in everyday practices, rather than a fixed end of the pipe phenomenon (see also Mattila et al., 2018).

In conclusion, we respond to the call of Canniford and Bajde (2016), who have suggested that research should illuminate differences and interdependencies between human

and non-human actors to show how varied and multiple qualities of agency mobilise a network. Thereby, we are able to discover, as Evans (2011) proposes, the role of the non-human actors in food waste emergence, which has been overlooked and even excluded when concentrating mostly on the human-led process of managing waste. Further, the emerging and constantly changing relations in a network emphasise the dynamic nature of the food waste network, which is helpful in our efforts to move from food waste production to waste reduction and more sustainable practices.

### **Methodology**

Next, we briefly present our research design, followed by a description of the data generation and analysis. Then, we move on to elaborate our findings.

#### **Research site for ethnographically informed ANT research**

In this study, we combine an ethnographic research design (e.g. Arnould & Wallendorf, 1994) with that of ANT (Latour, 1999a, 1999b, 2005) to discover how bread may or may not turn to waste. As our purpose is to gain insights into the emergence of food waste before food ends up on consumers' plates, we chose a hypermarket as our field site. More specifically, we focused on its bread and bakery section, in which the multi-method data generation took place.

The food waste network in retailing is part of a systemic food waste problem; local and situated interactions are nested in and interconnected with a global arrangement (Canniford et al., 2018; Askegaard & Linnet, 2011). We firstly describe the Finnish retail market system to produce an understanding on how the focus of the current exploration – the food waste network in a retail store setting – relates and connects to other networks, constituting a global arrangement of food waste. The Finnish grocery market is highly concentrated, with two retail chains dominating almost 90% of it. Both of these retailers engage in robust supply chain management, due to which their bread and bakery selections

are very similar across their stores. In Western countries, grocery stores typically have a wide assortment range (Gruber et al., 2016) and retailers strive to avoid out-of-stock situations using volume and sales promotions to manage the supply (Theotokis, Pramataris, & Tsiros, 2012). The same applies in Finland. According to the Finnish Grocery Trade Association (FGT, 2017), the average grocery store product selection has grown threefold during the last 20 years, and in large hypermarkets the selection can include over 25,000 products. The bread selection in a Finnish hypermarket is typically very varied. It includes breads with a variety of grains, ranging from white wheat bread to dark rye, freshly baked products and crisp bread, sliced breads and whole loaves, buns and baguettes. The selection also includes other bakery products such as sweet and savoury pastries, and seasonal and regional specialities, as well as products geared towards special diets.

The bread and bakery section was chosen as the current field site, firstly, because bread is one of the main product categories causing food waste in the Finnish food retailing sector. According to Stenmarck et al. (2011, p. 62), bread and vegetables are the biggest food waste groups, with a waste level reaching 10 per cent of sales. This is in line with research carried out in the UK and Spain, which reported bread as one of the biggest contributors to food waste in retail, with waste levels in excess of 7 per cent (Mena et al., 2011, p. 653). Considering the environmental impact, Brancoli, Roustas, and Bolton (2017) estimated that bread waste, together with meat waste, contributes the most to the environmental footprint in a hypermarket. Secondly, bread, together with a variety of non-human actors connected to it, forms an abundance of variety and sensorial allurements (Alhonnoro & Norrgrann, 2018, p. 85–90). Breads come in many different types of packages, from colourfully branded plastic bags to more modest paper bags, and are presented in differently laid out product displays, some situated in big piles next to the aisles, and others placed without packaging in see-through stands at the in-store bakery for customers to pick and

choose from. An in-house bakery that does not actually bake but only heats up the products at the point of purchase adds to the multitude of atmospheric and sensory actors taking part in the network by bolstering the often forgotten sensual feature of consumption sites: smell (see also Canniford et al., 2018).

### **Data generation and analysis**

To identify and analyse how the different human and non-human actors are connected with each other in the chosen empirical setting, with a particular focus on how non-human agency appears in the food waste network, we utilised a variety of multi-method ethnographic materials. The first author represents the insider in this study. Most of the materials used in this study were generated as part of her dissertation thesis on bread waste.

Our primary data consists of participant observations. These data were generated in the bread and bakery section of a Finnish hypermarket in autumn 2014. During the three-day fieldwork, the first author observed the human and non-human actors and daily activities taking place in the bread and bakery section. She accompanied three employees in the grocery store, asking them to answer questions and describe what they were doing and why. Particular attention was paid to noticing when, how and through what types of interactions bread turned or did not turn to waste. The main focus was on identifying how the non-human and human actors interacted in the food waste network, and how distributed agency appeared in these interactions, (potentially) enacting the emergence of bread waste in the section. The managers and the employees of the hypermarket knew about the study. Before starting the fieldwork, the first author asked for their permission to observe and interview them. The resulting empirical materials include field diary notes and pictorial data. We protect the privacy of the informants and the hypermarket by guaranteeing their anonymity during the analysis.

We also generated supplementary data to enrich our understanding on retail food waste. These include online and offline materials concerning food waste in Finland during the years 2010–2017. The online articles were searched and collected using the keywords “food waste” from the archive of the Finnish public broadcasting company Yle. The offline articles consisted of collected local and national newspaper articles on food waste.

While our data is ethnographically informed in the sense that it involved a close and situated exploration of a bread and bakery product section and in-depth qualitative materials from various sources, the analytical focus and procedures differed from a traditional ethnographic study. Instead of following humans and seeking a culturally informed description, our ontological premises are based on the logic of ANT. Thus, in the analysis we concentrated on following the focal object (bread and its package) and how it is enacted in relation to other human and non-human actors in the food waste network. Consequently, the analysis was developed by tracing the hotspots where food may or may not turn to waste, and identifying the heterogeneous human and non-human actors involved in this transformation.

The iterative analysis process of the generated data started while observing in the bread and bakery section. At this stage, the researcher followed the relational ontology in terms of treating everything as a potential actor and avoiding a presupposed social order (Latour, 2005). To deepen and try out her interpretations, she asked the employees questions about the observed practices and actors. The same analysis process was followed systematically during iterative readings and inductive coding of the whole research material by the first author, thus zooming in and out from more or less emic descriptions like employee talk or singular observations to the recognition of the heterogeneous relationalities and network of various humans and non-humans. The preliminary codings and interpretations were discussed jointly by all the authors to reach a consensus on the findings. Eventually, this analysis identified three sets of non-human actors – the focal object, the natural-temporal

actors and the techno-material actors – whose interconnections to other human and non-human actors are elaborated next in the findings section.

### **Distributed Agency in the Food Waste Network**

We begin the findings section by describing how multiple heterogeneous human and non-human actors interact to produce and/or reduce food waste in the observed bread and bakery section. Then, we zoom in on three particular sets of non-human actors to analyse how agency appears distributed in the interaction between them and other human and non-human actors in the food waste network.

Let us begin by illustrating how multiple actors take part in producing and/or reducing bread waste. The following quote from the field notes pinpoints the occurrence of agentic (non)mobilisation:

There are still too many of brand A's breads left to be sold, and the same was mentioned [by an employee] yesterday. Handytec [portable ordering device] indicates that there are still more to come, but John cannot use Handytec to reduce the order, not permanently or just for tomorrow. Instead, he would have to decrease the order from the desktop computer that is located in the office. Then the problem is, of course, that John is not the primary user of the office computer, but Cynthia is. So he can't change the order right after he sees the need for it. Placing a new order via Handytec would be possible, [but since this is not what is wanted] John does nothing.  
(Field notes)

The above description demonstrates how a complex network of human and non-human actors comes together in the everyday practice of ordering (or reducing the order) bread and bakery products, and how the arrangement of multiple actors ends up producing waste. The starting point in the excerpt is the large amount of brand A bread. The employee, John, had already noticed on the previous day that there are many packages of this bread in

the rack considering the amount that is usually sold, and he uses “Handytec” to check the order and to try to reduce it. Handytec is a portable ordering device that the employees use for making new orders of bread and bakery products, tracking the orders and adjusting the orders when needed. The field note shows further how the actors, i.e. bread (in fact, a network of many breads that together constitute “too much bread”), the techno-material device Handytec, and John, the employee who notices the amount of bread and uses the ordering device, together form an inherently heterogeneous and sociomaterial practice (Mattila et al., 2018, p.3), where agency is distributed between the actors. Thus, John should change the order, but Handytec cannot be used for this purpose. John should ask Cynthia to change the order on the office computer, but Cynthia is not currently present. John has much work to do, so he proceeds with his work. Moreover, John is not the only one to act: agency appears distributed between human and non-human actors, in this case the Handytec, the office computer, Cynthia, the spatial arrangement and the distance between these actors, and John. Thus, coming together in the relational food waste network, heterogeneous actors take part in the ordering practice, which ends up producing food waste. Regarding this descriptive example as a starting point for our analysis, we next move on and focus more closely on how the food waste network in the bread and bakery section appears from the perspective of three sets of different non-human actors – the focal object, the natural-temporal actors and the techno-material actors.

### **Distributed agency from the perspective of the focal object**

We first zoom in on the food waste network in the bread and bakery section from the perspective of our focal object, i.e. bread and its package. Here we consider the package to also include signs (e.g. discount stickers and best-before-date markings) and symbols attached to the package.

Similar to typical bread and bakery sections in Finnish hypermarkets (FGT, 2017), the field site of our study included a high number and wide variety of bread products available for consumers. In addition, our analysis highlights the salience of “perfect” presentation of the products, that is, the products are shelved in a way that showcases them for optimal freshness and abundance (see also Alhonnoro & Norrgrann, 2018). This practice may eventually lead to an increase in the amount of food waste because employees more readily throw away bread packages that are not “perfect” (e.g. ruptured packages, too few pieces of bread in the package, and packages lacking best-before-date markings). In fact, aligned with the results presented by Cicatiello et al. (2017), our analysis showcases that nearly all the food waste emerging in the bread and bakery section would still have been fit for human consumption. The following field note illustrates this kind of situation:

One plastic bag has opened. One piece of bread drops out of the bag. The whole thing is put into the waste trolley. (Field notes)

In the field note, one of the employees put the package into the waste trolley after noticing that it was open. Thus, waste is created relationally, in the interaction of the focal object and the human actor. The focal object acts as a mobiliser and “invites” other actors to join the food waste network, in this case the employee, who uses her agentic capacity to decide whether a certain package is waste or not. Interestingly, the boundary between edible bread and bread waste changes according to what kind of agentic (human) actors they relate to. For example, a ragged bread package is not sold to customers, but employees can buy it at a 50 per cent discount. Cicatiello et al. (2017, p. 279) explained that the high amount of bread waste was due to the quality standards required by the customers and the low cost of these products for the store management. However, our analysis addresses also how agentic mobilisation can take an opposite direction due to the acts of an employee. The next quote exemplifies how one employee ends up saving the opened or ruptured package for resale:

One of the plastic bags has opened. John notices it and walks to the bakery area to close it with an adhesive tape. (Field notes)

The substantial difference between the aforementioned raw data illustrations is that the employee needs to notice the problem before bread slides out of the bag. If s/he does not, and slices drop out of the bag, then the whole bag of bread is in danger of ending up in the waste trolley. Thus, working practices may emerge as agentic in terms of exhibiting either as an opportunity or as an obstacle for reducing the amount of food waste. In any case, from the viewpoint of bread and its package, employees still exhibit strong agency in influencing the resulting food waste. They decide, for example, which products are visible to the customers and which are hidden, as exemplified in the following field note and Figure 1: John rearranges the display of rye bread packages. There is still much bread left, even without the large amount of new packages they have received. John does not place the discount products on the top of the pile, but instead lets them be buried in the pile. (Field notes)

[Insert Figure 1 here]

***Figure 1. Bread packages marked with discount sticker buried underneath new products.***

However, our analysis indicates that the human agency is not that straightforward. Instead, the focal object may induce agentic effects in relation to other human and non-human actors. This is especially notable in the case of discount products, as the discount stickers are important for certain customer groups. Their agentic mobilisation works in a two-way direction: they may appeal to some customers, but drive away other customers, who prefer to buy only fresh bakery products. Our research material includes plenty of remarks about how the customers move around in the section and use different methods to find the “best bread”, that is, the freshest and newest product by digging from the piles and moving racks, checking the best before dates, and touching the products, as described in the field note below:

Customers dig out the products from the bottom of the pile, because they know that older products are located on top, and the newest are underneath. (Field notes)

This field note showcases how the bread can exhibit agency in relation to human actors by causing effects on their behaviours – customers may take or leave bread based on its softness or dryness. These agentic properties are also assigned to the best before dates (and to the missing best before dates) as well as to ruptured or deviant packages, all of which may become signallers of waste.

**Distributed agency from the perspective of natural-temporal actors** Next, we describe the distributed agency related to the second identified set of non-human actors in the bread and bakery section, namely the natural-temporal actors. These actors include animals, weather conditions, seasons, weekdays, and time of the day. They can manifest strong agentic capacities in relation to other human and non-human actors, mobilising food waste production and/or reduction in the network.

The analysis reveals that the demand for bread and bakery products is closely connected to changes in weather conditions and seasonal variations. One employee describes how the demand for white bread and baked goods increases in summertime: Cynthia says that the warm weather [June-July] could be seen in the demand. [The employee speculates.] People did not bother to bake buns at home, and demand for them increased in the stores. (Field notes)

Changes in demand may increase the amount of bread waste, and act as mobilisers in the network producing food waste. Even though there are national weather forecasts available on the changing weather conditions, these weather forecasts are not taken into account by the automated (and agentic) ordering system. If employees do not or cannot respond to changing weather forecasts and adjust orders, food waste can occur. In relation to changing weather,

other natural-temporal actors can also enter the food waste network. For instance, one field note describes a hot summer day situation in which flies, attracted by the sweet smell of fruits and jam, entered the pastry boxes. This lowered the demand for sweet pastries and eventually those pastries had to be thrown away:

Cynthia discards the pastries from the upper shelf. She has noticed that fruit pastries tempt small flies into the store. The same thing has happened before and she has rejected fruit pastry orders for a while. The best before date has not yet been reached, but who wants to buy flies? (Field notes)

Furthermore, weekdays and paydays are natural-temporal actors that may appear agentic in relation to other actors in the food waste network and, consequently, may influence the emergence of bread waste. These non-human actors are usually acted upon by the ordering system and the employees working in the bread and bakery section: “Bread sales change according to weekdays. The lowest amounts are sold on Wednesdays. (Field notes)” and “Paydays can be seen in the monthly statistics. People buy more fresh bread on the payday, while minus 30% products are sold before the payday. (Field notes)”. Thus, the amount of fresh bread should be adjusted according to the weekday and time of month in line with demand and to avoid food waste.

Moreover, seasonal holidays, such as Christmas and Easter, have two-way effects on the amount of food waste. First, they increase the amounts of food sold, and afterwards they increase the amount of food waste “generated when a food store is closed on many consecutive days” (excerpt from Yle news article). This kind of socio-temporal effect is also pointed out by Evans (2012) in relation to individual consumers’ rhythms of everyday life, like travelling and changes in plans. Also, Mattila et al. (2018) have noted that potential food waste can be revitalised, for example by using cooling equipment for freezing food as a way to store it for future use, thus pausing the process of food becoming waste beforehand. While

we did not observe bread being saved in this way in the hypermarket, the employees reported that bread waste was often picked up by a pig farmer, which shows that some of the bread waste is turned into animal feed.

Some of the natural-temporal actors occur in a routinised way, and employees have become aware of these kinds of fluctuations in demand. However, there may still be disparity between the demand for certain bread products and the number of ordered products. This is due to the work practices and their organisation in the socio-material network. For instance, when only a few employees are at work and they have much shelving and other mandatory tasks to do, the employees concentrate on shelving, having hardly any time to even think about adjusting orders. Thus, the natural-temporal actors also have effects on how employees are capable of dividing their work tasks – in this case, usually in ways that increase food waste.

The distributed agency between the natural-temporal actors and employees is further reflected in how the orders are planned based on the previous year's sales figures. These figures do not contain information on issues such as typical weather conditions, special campaigns, or other timely events, which makes it difficult to forecast orders (see also Mena et al., 2011). A case in point is exemplified in the following field note, which shows that orders are difficult to adjust even though their inaccuracy is acknowledged:

A large amount of readymade sandwich cake sponges is thrown away, as we suspected would happen in the previous day (Cynthia suspected that last year the order was for some reason larger [maybe the order had been increased in response to a request by an individual customer]). (Field notes)

A very concrete example of agentic effects of natural-temporal actors on the amount of bread waste in our analysis relates to the in-store baking point's closing time. The baking

point sells some of the same products that are sold in the shelves of the ordinary bread section, as described below:

The baking point that is located inside the bread section is selling partly the same products that are also available in the bread section. For example, brand B's rye bread is available at the baking point and sold at a unit piece price, while the same bread is sold in two-piece bags in the bread section. (Field notes)

The observations revealed further that while the baking point throws away the remaining bread when it closes – regarded as out-of-date for the baking point at this moment – similar breads are sold in the ordinary section for several days. Thus, although the physical bread is exactly the same, the bread that is located in the baking point – instead of being delivered and pre-packaged by an outside bakery of the same brand – turns to waste at the moment when the baking point closes for the day. Correspondingly, when the same bread is delivered by an outside bakery and sold in the bread and bakery section, it is sellable and consumable for several days. In this example, the natural-temporal actor induces mobilisational agency which, however, is distributed in the interconnection between other human (employees) and non-human (bread, baking point) actors.

### **Distributed agency from the perspective of techno-material actors**

We also scrutinised the food waste network from the viewpoint of the identified techno-material actors. These actors include technological systems and devices that are in use in the field site, but also the spatial arrangements and very concrete materials, such as the location of the employee's office and the shelves in the section, and a waste trolley used for collecting the bread waste.

In the bread and bakery section, various technological apparatuses distribute agency with the employees in terms of making and adjusting orders, and keeping track of the stock. While these techno-material actors are used by the employees to manage and control bread

flows, a closer analysis of their agentic capacities and relations to other human and non-human actors reveals their central role in the food waste network. They not only facilitate daily practices and enable employees to work more efficiently, but they also exhibit agentic effects, which are distributed in the food waste network. To illustrate this in a more detailed manner, we return to the portable device Handytec. The employees use this device in the store for ordering and follow-up of the stock. The device is designed for easy and quick operation. As such, it provides only a limited amount of information about the made orders. It also neither registers nor is able to show all the orders made from other devices such as desktop computers. In addition, Handytec does not communicate very well with the other human and non-human actors of the network. At the same time, it may mislead and hinder the daily working practices of the employees. The following quotes illuminate how Handytec itself may change the orders made by the employees, which in turn may influence food waste emergence:

The system might state that there are no orders to be delivered, while in reality a newly delivered order of bread might be waiting to be shelved in the store. (Field notes)

John tells that Handytec does not always show the right stock status. Handytec may show that the amount in stock is lower than it actually is, and even if you correct it, it may change back during the night and make extra orders. Therefore, the warehouse includes a lot of unpacked platforms. It takes a lot of time to recalculate the stock and make changes to the orders. (Field notes)

Furthermore, our analysis demonstrates that the availability and number of technological devices have effects on the resulting food waste in the network. In the observed bread and bakery section, only one Handytec is in use to provide the employees with access

to information on orders and sales, even though one to three employees work in the section. This means that only one employee at a time can work with the Handytec and make adjustments to orders, for example. Although the orders can also be changed from the desktop computer located in the separate office, using a desktop computer requires the employees to go and work in the office. Thus, the employees cannot often use Handytec while doing their daily work in the bread and bakery section. Contrary to this, the desktop computer allows the employees to make changes to the orders for a longer period of time and utilising more relevant information. Our analysis shows that the employees often opt to shelve the products, rather than leaving their working place and going to the office to make the orders or change them.

Consequently, our analysis demonstrates that the techno-material actors alone are not able to cut down the amount of retail waste. Acting together with the employees, however, they demonstrate the capacity to affect food waste occurrence at the store (see also Silvennoinen et al., 2012, p. 36). In this regard, we partially agree with Cicatiello et al. (2017) who note and explain the significant amount of unrecorded food waste by routinised practices carried out by employees. Related to this, our analysis highlights that the disparity between the orders and the demand may also be closely connected with the techno-material actors that enable distributing agency in a way that has effects on both the employees' work practices and the food waste network:

Cynthia complains that "the computer system" [she is most likely talking about some program that utilises the Internet] was out of order yesterday morning. It happens every now and then, and this time the error impacted systems nationwide, because they received a separate email concerning it. Because of the error, Cynthia is not able to revise the orders. For example, they received a lot of donuts and she did want to cancel the order. (Field notes)

Our analysis also identified the (very large) waste trolley (Figure 2) as a critical techno-material actor enacting food waste emergence at the bread and bakery section. This trolley is used by the employees to collect bread waste in the store. It exhibits agency in terms of normalising large amounts of bread waste. The trolley is over one metre high and so wide and large that it blocks the aisle and requires two hands to push. Thus, it implicitly “invites” the employees working in the section to throw large quantities of bread away. Our interpretation is that the waste trolley not only acts as a collector of bread waste but also as a mobiliser of bread waste in the food waste network.

[Insert Figure 2 here]

***Figure 2. The waste trolley***

Here our findings align with Cochoy’s (2008) description of how consumption is shaped and negotiated not only by consumers, marketers and objects of consumption, but also by other material objects, such as merchandising technologies, shopping lists, and shopping carts. While Cochoy (ibid.) illustrates how a shopping cart may have effects on the amount of goods consumers buy at the hypermarket, the waste trolley in our case shows its influence on how much bread the employees end up throwing away as part of their daily practices in the bread and bakery section.

**Conclusions and Suggestions for Food Waste Reduction**

In this chapter, we have illustrated various occasional moments to show how distributed agency appears in the bread and bakery section and, consequently, the (many) relational effects of these becomings on food waste production and/or reduction. Zooming in on these moments, we were able to demonstrate that the emergence of bread waste in the retail setting is not only orchestrated and managed by the employees (human actors), but is enacted within the network that connects both human and non-human actors. For instance, the weather acts as a mobiliser of food waste when changes in demand increase the amount of

bread waste, and the waste trolley mobilises food waste by normalising throwing away large amounts of bread. Hence, our analysis delineates the distributed agencies of human and non-human actors in the food waste network and thereby extends the current understanding on food waste and provides novel insights into how food waste occurs in a retail setting.

To provide theory-based solutions for food waste reduction, we suggest that an ANT grounded analysis emphasising distributed agency (Latour, 1999a, 1999b, 2005), as opposed to one privileging human agency, helps shed light on the causes of food waste in a novel and a more comprehensive way. Our study complements earlier food waste discussions (Evans, 2011, 2018; Mattila et al., 2018; Waitt & Phillips, 2016) by focussing on the retail setting and emphasising the importance of identifying various human and non-human actors and their complex, interconnected relations in order to address the food waste problem. For instance, while Teller et al. (2018, p. 994) emphasised the role of humans in the execution of in-store logistics and related food waste occurrence, our analysis highlights that food waste reduction is not only a question of human execution. Instead, the focus should be on considering and adjusting the roles of both human and non-human actors that take part in producing and/or reducing food waste.

Further, the current study highlights and illuminates how the emergence of food waste is a matter of multiple and constantly moving relations of interconnected actors. Consequently, the fluid network of bread poses challenges when seeking to identify the exact points when a particular bread turns to waste. This can be seen for instance when the bread is considered as waste because of its ruptured package, but it can still be offered for employees to buy. Thus, we agree with Mattila et al. (2018) that the food waste concept is negotiable in nature. Using terms such as “surplus food” or “potential food waste” could be helpful in bringing out the potential of the food (waste).

Next, we move on to practical solutions for reducing food waste in the retail setting and discuss the role of non-humans in food waste occurrence. To start with the focal actor, the bread and its package, our findings address the critical role of the package and its signs, turning the bread to waste without any changes in the bread's physical properties. This was the case for example when the edible and sellable breads ended up in the waste trolley due to the lack of best before date markings or because discounted products were not visibly displayed for consumers. Thus, instead of blaming picky consumers and building consumer awareness on the food waste issue (Filimonau & Gherbin, 2017), we suggest that demand for older products and, consequently, transformations in consumer behaviour should be made in relation to changes in the non-human actors, for example by adjusting pricing according to best before dates and making sure that discounted products are visible for consumers.

Considering the natural-temporal actors, our findings indicate that weather forecasts, holidays, paydays, and the statistical data on these actors should be used as background information when making bread-related orders. Based on our analysis, employees might not have the time and possibility to consider these actors in their daily work, which is why we recommend that manufacturers and system designers should incorporate this data into the ordering systems. Further, following household practices for saving food before it goes bad (Mattila et al., 2018), bread and other food products could be revitalised also in stores. For example, if there are large amounts of unsold bread about to reach their best before date, food waste could be avoided by freezing the bread before it expires.

Finally, we urge to (re-)evaluate the role of techno-material actors in the retail setting, especially regarding food waste reduction. While previous studies have linked technology primarily to cutting down food waste (Giuseppe, Mario, & Cinzia, 2014; Silvennoinen et al., 2012), we suggest taking a more critical stance in evaluating the techno-material actors in relation to other actors in the food waste network. As illustrated in this

study, agency in the food waste network is distributed and relational. Therefore, food waste reduction cannot be based solely on technological improvements. Educating the users (employees) to spot problematic situations and providing means (e.g. Handytecs for all employees working in the bread and bakery section) for them to act in alternative ways during their daily practices would also facilitate efforts to reduce food waste.

Furthermore, we recommend taking into account the role(s) of seemingly mundane objects like the bread package, the weather, and technological devices in the efforts to manage and cut down food waste in the retail setting. While Teller et al. (2018, p. 994) emphasised the role of humans in the execution, this study highlights that it is important to consider the food waste-related tools and surroundings, and how they could be changed in order to reduce food waste. For example, we demonstrate in the study that the (large) waste trolley may normalise the emergence of food waste in stores. Thus, the efforts to fight against food waste must be communicated and put into practice at every level in the retail setting, not just in management speeches but also in ground-level practices, taking into consideration the various roles of non-human actors in producing and/or reducing food waste. Regarding the aforementioned example, this could mean using a smaller waste trolley or other changes in its design. A measuring tape could be included in it to show how much bread is thrown into the trolley. In addition, a target level of waste could be marked on the trolley in order to focus the employees' attention on the actual amount of food waste and to encourage them to reduce food waste.

In conclusion, based on the limitations of our explorative study, we suggest several future research opportunities. Firstly, our study has focussed on several non-human actors and their interconnected relations to other (human and non-human) actors in producing and/or reducing food waste. Therefore it cannot concentrate on exploring the role of specific actors such as technological devices in more detail. In this, we agree with Bettany's (2016, p. 193)

suggestion to analytically focus on a particular material thing (like Handytec) as a boundary object in order to discover the continually moving and messy network related to it. Secondly, shifting the perspective from actor relations to practices and focussing on the (underlying) power relations in the hotspots in which food turns to waste could be an interesting avenue for future research. Thirdly, while we have concentrated on bread and bakery products, investigating the food waste network within other food product groups in the retail setting might also yield innovative solutions in the fight against retail food waste. Finally, we encourage future research to focus on food waste prevention. It is not enough to study food waste only after it has been created. Instead, there is a constant need to better manage food handling processes so that food does not turn to waste in the first place.

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