

Fridge Studies – Rummage through the fridge to understand food waste

1. Introduction

The global environmental and ethical consequences of food waste is now on the agenda of governments across the world, as a significant amount of research on the issue during the last decade has revealed the scale of the waste problem. Reducing food waste by 50% by 2030 is one of the UN Sustainability Development Goals, which is giving the cause further momentum (UN, 2017). About 1/3 of all food produced in the world is never eaten (FAO, 2011), and in the Western world about half of the food waste comes from households (Stenmarck, Jensen, Quested, & Moates, 2016). This has directed the attention of policy makers, activists, and researchers towards the consumer, resulting in numerous research projects investigating the drivers of food waste in households (Boulet, Hoek, & Raven, 2020). Although much knowledge has been derived from this research, developing effective measures to reduce this waste seems to be difficult (Lake, McFarland, & Vogelzang, 2020). The most applied approach by policy makers has been knowledge and awareness campaigns (Reynolds et al., 2019). However, evidence points to the fact that knowledge and awareness are not decisive factors causing food waste in households (M. Hebrok & N. Heidenstrøm, 2017) Furthermore, campaigns not sufficiently informed by knowledge on how to trigger changes in consumer practices, nor are they applying inclusive approaches involving consumers directly in developing campaigns (Kim, Rundle-Thiele, Knox, Burke, & Bogomolova, 2020).

Research efforts into the issue of food waste have been growing exponentially during the last decade, with recent volumes seeking to connect the different strands of this multifaceted field (summarized in recent contributions such as Boulet et al., 2020; Närvänen, Mesiranta, Mattila, & Heikkinen, 2020; Reynolds, Soma, Spring, & Lazell, 2020). Methodologically, research has approached the investigation of food waste drivers in households both quantitatively and qualitatively, providing a diverse body of complementary knowledge. Consumer surveys and content analysis of waste from households have thoroughly documented the amounts and types of food wasted within households (e.g. Stenmarck et al., 2016; Stensgård & Hanssen, 2016). Furthermore, ethnographic studies over long periods of time have shown that wasting food cannot be seen as something that is done in itself, but rather as an outcome of many practices in everyday

life, not only related to food but also to transport, work and leisure time (e.g. Evans, 2014b; Mavrakis, 2014). Food related practices that have been subject to particular attention in literature are planning, food provisioning, storing, cooking, eating, cleaning and tidying (Hebrok & Boks, 2017). Significant discrepancies between ideas about proper meals and actual food practices have been identified by several scholars in food studies (e.g. Hebrok, 2018; Poulain, 2002; Warde, 2016b).

In conducting research on food waste, as well as in developing measures to effectively reduce waste, this ubiquitous nature of food waste related practices poses a methodological challenge - as they must be understood in relation to other practices of everyday life and the ideals and goals that motivate them (Southerton & Yates, 2014). Food can be seen as being on a continual path towards becoming waste (Watson & Meah, 2012), nevertheless, the configurations of household practices will contribute to either push it further towards, or pull it away from decay (Mattila, Mesiranta, Närvänen, Koskinen, & Sutinen, 2019). It is not possible to observe all the practices in context that are causing food to go to waste, neither is it possible to get an overview of how food is handled through methods that document consumers' attitudes towards food waste rather than their actions. Food can be seen as being on a continual path towards becoming waste (Watson & Meah, 2012), nevertheless, the configurations of household practices will contribute to either push it further or pull it away from decay. It is not possible to observe all of the practices in context that are causing food to go to waste, neither is it possible to get an overview of how food is handled through surveys that document consumers' attitudes towards food waste rather than their actions (M. Hebrok & N. Heidenstrøm, 2017). Food can be seen as being on a continual path towards becoming waste (Watson & Meah, 2012), nevertheless, the configurations of household practices will contribute to either push it further or pull it away from decay. It is not possible to observe all of the practices in context that are causing food to go to waste, neither is it possible to get an overview of how food is handled through surveys that document consumers' attitudes towards food waste rather than their actions (Marie Hebrok & Nina Heidenstrøm, 2017). In fact, surveys are providing the least accurate accounts of food waste measurements and causes (van Herpen, van der Lans, Holthuysen, Nijenhuis-de Vries, & Quested, 2019). Given that everyday practices are performed routinely, consumers may find it difficult to describe how they actually handle food also in interviews (Sedlačko, 2017). Moreover, the multiple ways in which agency is distributed

between humans and non-humans within everyday practices related to food falls out of view (Pickering, 2017). Therefore, there is an urgent need for further methodological development within food waste research, methods that enable the researcher to go beyond talk, towards activating and focusing on the material elements of food handling practices.

In this paper, we outline a method we have called *Fridge Studies* to address this methodological challenge. Throughout the paper, we draw on recent empirical studies that employ a variety of methods and combinations of methods to study food waste, and relate to their efforts in exploring the agencies of the material in relation to competencies and meanings of food related practices (i.e. Sirola, Sutinen, Närvänen, Mesiranta, & Mattila, 2019; Urrutia, Dias, & Clapp, 2019). In the development of the method, we have sought to gain access to knowledge about performed practices through the materials embedded within them – predominantly through food items present at the time of inquiry, but also through the fridge itself and its connection to the kitchen as a place of storing and preparing food. We have two main motivations in developing fridge studies. The first is conceptualising a framework for qualitative food waste studies by detailing the practical procedures of fridge studies. The second is to provide researchers with a time and resource efficient way to gain critical knowledge about the various socio-material antecedents of food waste.

The paper starts out framing fridge studies within practice theory, arguing that causes of food waste can be identified through food handling practices. The design of the fridge studies method is then outlined, and we provide a checklist for employing fridge studies in future research projects. The knowledge provided by fridge studies is exemplified with data from three projects on sustainable food consumption in Norwegian households. The paper concludes with a list of what we consider to be the strengths and limitations of fridge studies and how to address these limitations.

2. Performing food handling practices at home

The present study deals with food waste within a broader understanding of consumption as consisting of the acquisition, use and disposal of products and services (McCracken, 1988). Fridge studies provides data on the use phase of consumer goods, an important but often neglected phase by those dealing with issues of sustainable consumption (Gregson, Crang, Fuller, & Holmes, 2015;

Laitala, Klepp, & Henry, 2018; Mylan, Holmes, & Paddock, 2016; Strandbakken, 2018; Welch, Keller, & Mandich, 2016). We use insights from social practice theory (Reckwitz, 2002; Schatzki, 1996) to open up the use phase and understand how food is handled at home and how different forms of use leads to waste.

Our take on practice theory stems from its use in consumption studies over the past fifteen years (summarized in Warde, 2016a). A turn from focusing on symbolic consumption patterns and lifestyle choices, to studies of mundane everyday consumption has directed the attention of researchers towards everyday life as based on routine performance of socially shared practices, and not merely on symbolic, reflexive and rational market choices (Gronow & Warde, 2001; Shove, 2010; Warde, 2016b). Although practice is a term used in different disciplines and for different purposes, most approaches share the fundamental premise that the practice is the smallest unit of analysis and the social world is composed by practices, while individuals carry and perform practices (Cetina, Schatzki, & Von Savigny, 2001). Practice theory thus offers a structural rather than individual perspective on consumption, claiming that practices (not individual motivations or inclinations) steer the wants and needs of consumers (Southerton, 2013). Shove, Pantzar, and Watson (2012) summarize the elements of a practice to be our embodied and explicit competences, the socially shared meanings attributed to performing an activity, and the materials that are explicitly or implicitly engaged in this performance. Following Warde (2005), consumption is viewed as a ‘moment’ within these practices, not as an action on its own.

We take our starting point in *food handling practices*, meaning all practices of which food is part, to study food waste. Strengers and Maller (2012) propose empirical studies to start with ‘practices of interest’ and ‘intersecting practices’ to grasp how elements from different practices intersect, connect, and shape each other often in inconspicuous ways. In accordance with Evans (2014a), food waste is then understood as the outcome of these practices as well as what shapes them, never detached from them. We pay attention to how the embodied competences (e.g. portioning, evaluating edibility, timing meals, cooking etc.), shared meanings (what is a proper meal, what food items are considered good or bad, how much food we store or eat etc.), and material enablers of these practices (infrastructures, houses, kitchens, food items, fridges and freezers, cupboards, counters, utensils etc.) connect and are performed by household members. Fridge studies is a tool used to gain knowledge about how food handling practices such as planning,

shopping, storing, cooking, eating, managing leftovers, assessing edibility, and disposal interconnect and might lead to food waste (Schanes, Dobernig, & Gözet, 2018). It does so by being attentive to the materials that are used to perform a practice and how these materials can be used as entry points to talk about the mundanity of food handling.

2.1 The materialities of food handling practices

A main challenge for practice-oriented studies is to enable practitioners to express their performance through language, and in particular for practices that are unobservable as an integrated practice, so-called ‘dispersed practices’ (Schatzki, 1996). Household food waste cannot be studied as an entity consisting of interconnected elements but must be understood as part of and outcome of integrated food handling practices. By paying attention to the material elements of these food handling practices we can identify and follow the trajectories of food through the phases of consumption. Evans (2018) observes that even though the household is now commonly referred to as a ‘site of consumption’, practice-oriented studies of sustainable consumption have thus far not focused on following the ‘social life of things’ (Appadurai, 1988) within the household. Things, that in themselves are usually taken for granted, can become meaningful when seen as manifestations as well as creators of a society’s cultural practices (Miller, 2010). In cultural studies, the well-known study by Du Gay et al. (1997) of the Sony Walkman as an expression of the interrelation between production, consumption and identity, demonstrates that major cultural processes can be made explicit through material objects and their biographies (Kopytoff, 1986). of the Sony Walkman shows that the interrelation between production, consumption, and identity can be told through the history of one paradigmatic cultural object. The Walkman is both representing and producing key practices of the 1980s urban spaces

Food waste studies emphasise the relational meanings ascribed to food items as what produces waste (Van Bommel & Parizeau, 2020). Using the classical analysis of purity and danger by Douglas (2003[1966]), food disposal is shown to be an act of maintaining classifications (e.g. Evans, 2018; Gregson, Metcalfe, & Crewe, 2007; Hetherington, 2004; Waitt & Phillips, 2016; Watson & Meah, 2012). Douglas’ analyses demonstrates that a society’s social orders depend on categories and classifications. Placing some things within and some outside creates and maintains borders and thus defines the boundaries of a specific culture. Pollutants, or dirt, are what violate this order. How consumers categorise foods as edible (pure, fresh), leftover or partially edible (in-

between, at mercy or liminal) or inedible (polluted, waste) tells us something about how our practices are used to affirm and reproduce social belonging to a specific culture. Evans (2014a, 2018) argues, however, that food items are more than expressions of cultural categories. They shape modes of consumption through their social life expressed for example in their stages of decay (drawing on Gregson, Crang, Ahamed, Akhter, & Ferdous, 2010). This is an important point because it entails that studies cannot treat food items merely as filled with cultural inscriptions, they are producers of culture (Goodman, 2016; Waitt & Phillips, 2016).

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Taken together, social practice theory and a renewed interest in the materialities of consumption frames food waste within the social world and not as an externality that must be managed, as something that occurs at multiple sites within the stages of consumption and not the result of a linear process, and as material expressions as well as producers of culture.

3. Three projects on household food consumption in Norway

Fridge studies has been developed as part of the data collection in three research projects¹ aiming to develop measures to increase sustainable food consumption. In CYCLE, 10 shop-alongs and at-home visits were conducted to study causes of food waste. During the data collection, we found that the shop-alongs, where we followed participants through a routine grocery shopping in the store (following Kusenbach, 2003; Miller, 1998), did not provide sufficiently relevant data on why they wasted food at home. We assume that this is a result of observing in the wrong location. The grocery store is where consumers choose what to purchase based on what is available. To most, it is a highly routinized activity where loyalty towards familiar food items is high. Following participants through this routine gave us some information on food preferences, some on planning, and attention to labelling. However, what was lacking was the thick descriptions of how food travels towards the waste bin. In the next project, FoodWaste, we visited 16 households. This time we spent most of the time in the kitchen, looking into their fridges, freezers, and cupboards. In the third project, PLATEFORMS, we were interested in how digital food acquisition platforms might contribute to more sustainable food consumption. We combined digital walk-throughs of apps and websites with fridge studies to explore whether changes in acquisition and transportation practices might reduce food waste.

The total sample of fridge studies so far consists of visits to 57 households, detailed in appendix 1. The households are localized in the South-East of Norway, in the capitol Oslo or surrounding municipalities. Household 1-10 were recruited by Ipsos MMI recruitment agency, household 11-26, 27-36, and 48-57 by Norstat recruitment agency, while household 37-47 were recruited through social media. Previous research on household food waste in Norway has identified families with children as the type of household that waste the most food (Stensgård & Hanssen, 2016). In the three projects, we strategically selected different household compositions (families with and without children, with younger and older children, single households, couples without children or children that have moved away from home) to get a deeper understanding of

CYCLE (project period 2013-2017, data collection in 2015) financed by the Norwegian Research Council.

FoodWaste (project period and data collection in 2017), financed by the Norwegian Ministry of Children and Equality.

PLATEFORMS (project period 2018-2021, data collection 2019-2020), financed by EU H2020 ERA-NET CoFund on sustainable Food Production and Consumption.

The Norwegian Centre for Research Data (NSD) has approved the data collection in all projects.

why family composition matter to the level of food waste. The sample does not include households with a particular interest in food consumption or food waste, however, the PLATEFORMS project includes a sample of households using digital platforms for food acquisition regularly (household 27-57).

All the participants volunteered to a home visit and received a gift certificate of 50 euros for their participation. They were informed of anonymity, research ethics, regulations for storage of research data prior to and at the start of the visit, and they signed a written consent with a separate section on the use of photographs in dissemination activities at the end of the visit.

The visits to household 1-10 was conducted by one researcher. Juggling a conversation, an audio recorder, and a camera whilst walking around in the kitchen was however a demanding task, which might have resulted in lack of attention to details. Therefore, in the visits to household 11-57 two researchers participated. While one was responsible for leading the conversation, the other was responsible for photographing and asking follow-up questions about specific food items. The authors conducted most of the visits together, a further two researchers assisted in visit 39-48. The following sections outline how we developed fridge studies throughout the three projects. All quotes are translated from Norwegian.

4. Learning about food waste by looking into people's fridges

When planning the first data collection, we wrote an interview guide that consisted of a set of questions on food handling practices. We had not planned to spend a lot of time looking into people's fridges. We wanted participants to talk about a few food items, perhaps some leftovers from last night's dinner, and to look in their garbage bin. However, something happened when we moved from the living room, where we had asked them about their everyday routines, to the kitchen. We became aware of a shift in the conversation from talking about food waste as a societal problem, and their own food handling in general, to talking about the handling of a particular meal or food item. The conversations were suddenly filled with objects; the kitchen, leftovers in the fridge and freezer, rotting fruit on the countertop, and the dry bread in the drawer. This initial finding led us to further structure how we looked into people's fridges as a method.

Previous sociological research on household food waste has employed similar methodological techniques to grasp the materialities of food handling. Participatory techniques such as accompanying participants on shopping trips, while cooking and eating, as well as rummaging through fridges and freezers, have been applied by a number of researchers (e.g. Cappellini & Parsons, 2012; Evans, 2014b; Mavrakis, 2014; Ose, 2018). Evans (2014b) did ethnographic work in UK households where he visited kitchens, went on shopping trips and interviewed households about food related practices. . Evans (2014b) did ethnographic work in UK households where he visited kitchens, went on shopping trips and interviewed households about food related practices. He argues that following the food items throughout the practices that were performed by the participants is a way of foregrounding how food is understood on its way from food to waste (Evans, 2014b, p. 23). Both Evans (2014) and Ose (2018) performed a rummage through fridges and freezers. Similarly, Mavrakis (2014) used food maps and photography of kitchens, storage spaces etc., to support in-depth interviews in households. Thus, we are not the first to use material contexts to talk about food waste. However, an explicit and elaborate description of methods and techniques used to include the material aspect of practices causing food waste has not been published. In this paper, we aim to further develop what many studies briefly mentions as rummaging or fridge inventories, into the method of fridge studies, shown in figure 1.

[Insert figure 1: Fridge Studies - A method to study food handling practices]

4.1 Everyday life at home

The home is a central site for a number of practices (Miller, 2001). When we visit families at home, we gain access to large parts of their everyday lives, even without explicitly talking about it with them. Materially, we learn a lot about the infrastructures the household is connected to, such as transportation and waste disposal systems. We get important information about the internal infrastructure such as food storage capacity, the fridge itself (size, layout, freezer capacity) along with its placement in the kitchen and in relation to other storing units such as freezers, cabinets, and the countertop, which make up the kitchen infrastructure. Socially, we learn about how families organise their activities at home, and we get an impression of their socio-economic status. We visit them backstage, or behind closed doors (Goffman, 1959).

Additionally, we can use the home to generate conversations about food handling practices. Hitchings (2012) argues that people can talk about their practices sufficient time is spent explaining the importance of knowledge about seemingly trivial everyday life activities. Hitchings (2012) argues that people can talk about their practices, if the researchers spend time explaining the importance of knowledge about seemingly trivial everyday life activities. In the recruitment process, we did not inform the participants that we were going to look into their fridges. They were informed that we were going to talk to them about food waste, which most participants initially understood as recycling. Thus, it became important to introduce the project and its aims thoroughly at the beginning of the visit. We included a paragraph in the introductory section of the interview guide that clearly stated our interest in everydayness:

We are interested in what you as a family do on an everyday basis concerning buying food, storing food, cooking, eating, and wasting food. We are going to ask you about what you normally do, about small and seemingly insignificant tasks, but they matter to us to document the everyday life of Norwegian consumers. We would also like to look into your kitchen and fridge afterwards, to look more closely at how you handle food.

We found that this clarification of our intention and interest put participants at ease. It gave them a certain confidence in what they could offer us. By introducing them to our frame of mind we managed to trigger them to talk about seemingly trivial sequences of events and activities, thoughts and emotions, sensory experiences, and the consequences of these in the form of food waste.

The introductory part of the visit was done in the living room, and included a set of questions about household members, dwelling, and general food acquisition, storing and cooking. Particular attention was paid to the acquisition of food, as the fridge study only grasps the food handling practices that are performed within the home. The living room session provided us with a more general understanding of how participants thought about their own food handling practices. The important contribution of fridge studies, however, is its function as a vehicle for moving from the general to the specific, from thoughts about food handling practices to descriptions of actual food and its trajectories.

Fridges can be considered part of households' backstage and revealing of their economic, social and cultural resources (Bell & Valentine, 1997). Initially, some of the participants were

embarrassed about what they defined as clutter in their kitchens and fridges and excused themselves for not having cleaned before we arrived. Sometimes they also felt a need to explain why they had a lot of food, little food, or unhealthy food in their fridges. Embarrassment or shame might have led participants to rationalise their actions. Some of these rationalisations we have termed ‘can and should strategies’, which are expressions of ideal practices, discussed in more detail below. In the visits we conducted, these initial reactions seemed to disappear within minutes and they openly showed us their fridges.

4.2 Rummage through the fridge

There is a large body of research that has quantified the types and amounts of food wasted in households (recent efforts include Caldeira, De Laurentiis, Corrado, van Holsteijn, & Sala, 2019; Guo, Broeze, Groot, Axmann, & Vollebregt, 2020; Jeswani, Figueroa-Torres, & Azapagic, 2021; Stenmarck et al., 2016). Although systematic registering identifies important food categories to address in developing policy instruments to reduce waste, it provides little knowledge about the underlying structural barriers to food waste prevention rooted in current food handling practices.

Rummaging through the fridge connects the wasted food to a larger array of interlinked practices of interest. A fridge study includes an unstructured exploration of the fridge together with the participants. By unstructured we mean that the complete content of the fridge was not registered systematically. Rather, selected food products, dishes, and leftovers in the fridge were used to evoke stories about food waste. This selection is done both by participants themselves based on their own understandings of what foods are wasted in their household, and by the researchers who asked specifically about food types that are commonly wasted in Norway, such as dinner leftovers, fruit and vegetables, dairy products and bread, identified by Stensgård and Hanssen (2016). Unstructured is not merely a step towards structuring or systematising data collection. We contend that the unstructured rummage has a purpose of its own, acting to co-produce knowledge by giving space to the participants stories.

As we stood together in front of the fridge, we asked the participants so-called ‘performative questions’, which is a form of ‘practice-based talk’ that evokes narratives about how a certain practice or task is done (Halkier, 2010; Halkier & Jensen, 2011; Hitchings, 2012). For example, we asked about dinner; ‘what do you usually cook?’, ‘what did you make yesterday?’, and ‘were

there any leftovers and what will you do with them?’. These questions are specific and meant to trigger stories about dinner. We found that the participants spent a lot more time talking about planning, making, and eating dinner when they themselves could see the actual food, as well as showing us the products. Thus, combining the performative questions with the actual dinner from yesterday, or ingredients for today’s dinner in the fridge, seemed to aid the participants in articulating the taken for granted aspects of this practice. The excerpt below is about some leftovers:

[Insert Figure 2: Finding use-occasions for leftovers (photo by authors)]

One food item, the leftovers, gives us valuable information about several of the identified causes of food waste. First, that the organisation of everyday life as well as individual preferences affect the use of leftovers (see also Laakso, 2017). Second, that the types of food that are unsuitable for other dishes is more often wasted. Third, that the use of embodied knowledge is important to assess the edibility of the leftovers.

In addition to questions about food handling practices such as dinner, we asked the participants if they wanted to talk about specific food items. These were often ambiguous items not meant for a particular meal or dish, new or unfamiliar foods, food gifts and leftovers that they were unsure of how to use. The participants were first asked to describe the item, and why and when it was purchased. Second, to assess the shelf life of the item, which is demonstrated in one of the cases below. Third, we asked them about the item’s potential future use (or whether it would be wasted).

Our argument is that this unstructured approach to the fridge, its contents, and how food handling practices are talked about, provides richer narratives about why some foods are wasted than a structured interview guide with predefined questions. Creating narratives around food items in the fridge enables articulation of performances that otherwise would not be brought forth as they are perceived not to have a direct effect on the amount of food wasted. We do of course go into the field with knowledge about food waste, however, letting the participants and the current content of their fridges steer the conversation opened up for unexpected aspects of food handling practices. It

is important to point out that these narratives are not representations of experiences; rather they are performances in an interview context (Kvale, 1996). The stories that are told in the interview is a subjectivity chosen by the participant in the given social setting. Specific food items are given prominence according to the narratives that are constructed with them in the interview setting, by both the participant and the researcher.

4.3 Photographing food and fridges: Method and material

During the data collection, we found that asking to photograph the content of the participants' kitchens with particular focus on fridges and freezers was a way of giving importance to the fridge study and the stories told in the kitchen. The photographing itself was significant for making explicit the type of knowledge we were interested in. It was easier to understand why we wanted to look into their fridges when we also told them that we wanted to photograph the content. Producing images as our data material was a task the participants wanted to take part in, and in doing so their concrete stories about an item became richer, more detailed. Photographing made the food items even more visible when we spent time taking them out of the fridge, holding them, and photographing them. The photographing created a pause in the interview that was filled with stories, and the camera activated elements of photographing practices such as displaying, posing, and pointing at items

The researchers and the participants were collaborating to document their food handling (Banks & Zeitlyn, 2015). The participants were displaying food; pointing at a bowl of leftovers, pulling out two opened glasses of salsa, or opening the vegetable drawer for us to photograph. The photographer and the participants who displayed the items constructed the images together. Photographing provided, as Prosser and Schwartz (1998, p. 119) phrase it '(...) a gateway to the taken-for-granted and reflects deeply embedded and therefore unquestioned aspects of culture which are critical to studies of society'.

Photographing also opened the homes of the families. It served as an incentive for getting access to the kitchen, for moving around it, to follow their lead, to engage with the material surroundings while talking about food waste. During the fridge study, the participants made decisions about what food items to photograph and not, what they wanted to show us, and what they thought of as important items within the kitchen. Photographing made visible the items that

the participants themselves did not want to highlight, which, when asked about them by the researchers, often were items they felt guilty about not eating, or items about to be wasted.

The result of photographing is a collection of detailed narratives about a selection of food items, and a library of photographs of food, fridges, freezers, countertops, and kitchens. During data analysis, the most basic function of the photographs is enriching the transcriptions. Photographs provide texture to the narratives, context, colour, people, and food. Additionally, the photographs have been categorised and analysed as data material to illustrate characteristics of the fridge. Particular attention has been paid to how the fridge is designed, how the families organise the fridge, and what types of food can be found (or not) in the fridge. The photographs, however, are not objective representations of the material infrastructure of food handling practices. They are representation of narratives about a specific moment, and framed by a specific context (Pink, 2007).

In practice studies, photographs are often used to demonstrate how the body performs a specific practice (Dant, 2004; Martens, 2012; Orr & Phoenix, 2015; Pink, 2009). We argue that photographing the materials that belong to food-handling practices can also give important knowledge about how a practice is performed. From the images in figure 3 and 4, we gain insight into food storage that is crucial for the level of food wasted at home.

[Insert figure 3: Jars on the dark top shelf (photos by authors)]

Figure 3 shows a common way of organising the fridge that causes food waste. The top shelf of the fridge is used to store jars and is often unorganised and dark. New unopened jars are placed in front of opened and partially used jars, which stay hidden and eventually become waste. The photographs identify a shared placement and storage practice of these jars that were not evident from the transcripts alone. Moreover, the images make visible the importance of the interplay between the material surroundings, in this case how the fridge is designed, and how food storage is performed by placing food items in a particular way. Placement of food that is no longer used in the top shelf was not articulated, it was an implicit and unspoken background of food handling (Allat & Dixon, 2004). This finding becomes even clearer if we look at a different type of fridge. One of the

participants had recently refurbished his kitchen and chose to install a fridge drawer, shown in figure 4.

[Insert figure 4: Fridge drawer (photo by authors)]

Here, the jars are stored in a different manner where the top lid is visible for all jars. However, the participant explained that *'we thought it would be super orderly, and it is until you start putting things on top of each other, and then it becomes as unorganised as an ordinary fridge'* (Male, 31 years). Thus, the design of the fridge has a significant effect on how storage is performed. The photographs demonstrates that the images are not merely illustrations to the text, they led us further into the organisation of food items in the fridge that might lead to waste.

4.4 Efficient ethnography

As reviewed above, ethnographic studies of household food waste have provided important knowledge on how the interlinked practices of everyday life cause food to be wasted. However, ethnographic studies can be extremely time consuming both in collecting and analysing data. This is not an argument against conducting ethnographic studies, instead we recognize that in many research projects there is simply not enough time or money to conduct ethnography. We believe that fridge studies can contribute with rich narratives about food waste in an efficient manner both in terms of data collection and analysis.

We spent approximately 1-2 hours in each household we visited. This is not a lot of time to gather in-depth narratives about everyday life. However, the fact that we (i) were in their homes, (ii) that the rummage and conversations were unstructured and to a certain degree steered by the participants themselves, provided access to in-depth knowledge about the practices that is related to food waste, and (ii) the photographing and photographs enriched the narratives both in the interview setting and in the subsequent analysis. For example, images were used to indicate similarities between fridges even without a detailed inventory of the fridge and were thus an effective way of providing both detailed views of food items within a households' fridge, as well as an overview of shared traits between households' fridges.

Taken together, fridge studies represent an 'efficient ethnography' to explore the complex dynamics of food handling practices where the fridge serves as a starting point for food

consumption research. Depending on financial resources for data collection as well as thematic interest, fridge studies can be supplemented by other qualitative approaches, inventories, or surveys. Figure 5 presents a checklist for fridge studies to be used as inspiration for qualitative food waste research.

[Insert figure 5: Checklist for fridge studies]

5. What the fridge reveals about food waste

We highlight two stories from the fridge studies to demonstrate how knowledge about food handling practices, and thus why food is wasted, is produced by looking into the fridge. Both cases accentuate the importance of following the materials. In the first case, items in the fridge are used to perform assessments of edibility, while in the second case we demonstrate how undesired food is eventually categorized as inedible by staying in the fridge until it goes bad. While the living room session provided us with narratives about ‘ideal practices’ (Hebrok, 2018) fridge studies produced not only concrete stories but also detailed sensory experiences (Pink, 2009) of one single food item.

5.1 Assessing whether a food item is edible

On their way from food to waste, food items are continuously assessed to determine whether they are still edible (Cappellini, 2009; Cappellini & Parsons, 2012). Previous research has pointed to the ethical work that is part of these assessments (Lehtokunnas, Mattila, Närvänen, & Mesiranta, 2020), as well as associations with emotions such as disgust, anxiety and guilt (Ganglbauer, Fitzpatrick, & Comber, 2013; Graham-Rowe, Jessop, & Sparks, 2014; Waitt & Phillips, 2016). The fridge is one starting point for untangling the complexities of these assessments, which are comprised of materialities such as the food item itself but also the storage units and surrounding foods, shared norms of what is appropriate to eat, and multifaceted tacit and explicit knowledges of reading date labels, seeing, tasting, and smelling, trust in food producers and retailers etc. Here, we exemplify one assessment with an extract from a visit with a 30-year-old-man living in Oslo. We have just completed the interview in the living room and are now moving to the kitchen. These detailed assessments of a truffle paste and some cheeses follow after opening the fridge:

[Insert figure 6: Evaluating the edibility of truffle paste (photo by authors)]

He applies knowledge that he has gained from previous experience with the same food item, as well as his senses to assess its edibility. His experience enables him to know what to look for (web-like mould). Furthermore, he has a feeling of how long this item might stay edible and implies that he thinks it might be approaching a state of decay, because the truffle paste has been opened since New Year's Eve. Nevertheless, he applies his senses to assess whether this is the case, he examines it visually, looking for traces of mould, and smells it to detect if it might be starting to rot. He continues to show us all the cheese he has in his fridge and talks about how he assesses whether it is okay to eat it or not:

[Insert figure 7: Evaluating the edibility of Taleggio cheese (photo by authors)]

Again, he uses his knowledge and experience with cheeses to assess what various changes in appearance, smell and texture mean to edibility. Certainly, the specificity of his knowledge exceeds the competence of the average consumer showing that assessments are made in a variety of ways, and with many different outcomes. One of the strengths of fridge studies is that it reveals this sort of specificity and variation of assessment processes.

These excerpts also show how assessing food items is performed as a continuous negotiation between explicit and tacit knowledges (Wynne, 1996). For example, the negotiation between the formal date label system and the embodied knowledge about the shelf life that is gained through experience was making participants insecure about how to assess edibility (Hebrok & Heidenstrøm, 2019). We learn that different types of food are assessed very differently based on the embodied skills of the practitioner. These skills vary significantly between households, and assessing an unfamiliar product more often leads to waste than assessing a familiar product. Finally, our visit to this household exemplifies that food does not become waste at an absolute point, for example when it is rotten. We argue that these sorts of insights gained through fridge studies show a more complex picture of why food is wasted, while retaining some of the effectiveness often associated with inventories.

5.2 At mercy in the fridge

The second practice used an example of insights gained from fridge studies is the practice of keeping food ‘at mercy’ in the fridge. The concept is borrowed from Klepp’s (2001) study of clothing consumption. Klepp finds that the use phase of clothes has several important stages. The last stage of a clothing items life is what Klepp calls being ‘at mercy’. This is when an item is no longer used but is not thrown out because it is still considered wearable though it is not worn. Similarly, we find that the participants in our study have food items ‘at mercy’ in the fridge. These are foods that are no longer desirable, however not yet waste – edible but not eaten. According to Douglas (2003[1966]) we make sense of the world by classification, through separating what is pure and what is polluted. However, in-between purity and pollution, the food ends up in a liminal phase between being food and being waste (Turner, 1987). The fridge reveals a number of these in-between items that are moved around the fridge, from the front to the back where they are left to become waste, as the top shelf images above indicated. The food is travelling within the fridge before it reaches the waste stage and is thrown out. Here, we exemplify this process by looking at a box of potato salad and two jars of salsa. The box and jars had been sitting in the fridge for a while without being assessed for further use. The participants emphasised the items as examples of food they would eventually throw out:

[Insert figure 8: Deciding what must go (photos by authors)].

The potato salad and salsa jars had been kept ‘at mercy’ in the fridge until they no longer could be categorized as food, and hence turned into waste. When the items are in-between, they were uncertain about the status of the product. While mould is a clear indicator of the waste category and determines that the items are no longer edible, more subtle changes in texture, colour or smell are not. Here, time plays a significant role. The participants had various rules of thumb for how long a product could be stored, differentiating between opened and unopened packages, as well as between different food categories. These rules are based both on experience and on the date label system; however, they are often used to legitimize categorizing a product as waste instead of food. Being ‘at mercy’ thus simply means to wait for mould, or to wait for enough time to have passed for a product to be defined as inedible. Wasting what is already waste is easier than wasting food.

The ‘at mercy’ period in the fridge contributes to participants’ feeling less guilty about wasting, similar to what Blichfeldt, Mikkelsen, and Gram (2015) calls ‘procrastination’. When asked how they plan to use a food item, they come up with several ideas to reduce guilt. We have termed such ideas ‘can and should strategies’, because seemingly, these often remain at the stage of ideas and do not result in actions. If the food can be categorized as waste, these ideas become redundant, and the food can be thrown out.

The two examples above show how fridge studies bring forward specific moments of assessing food items, as well as telling food stories that trace their trajectories towards the waste bin. However, these moments of reflexivity (Spaargaren, van Koppen, Janssen, Hendriksen, & Kolfshoten, 2013) and telling of stories also reveal the influence of social contexts, gender issues, and material infrastructures on practices resulting in food being wasted in households (M. Hebrok & N. Heidenstrøm, 2017; Hebrok & Heidenstrøm, 2019). Social contexts, such as being invited to dinner at friends, deciding to eat out or order take away because of lack of time or energy to cook, and less people turning up for a meal than expected can result in food waste. Furthermore, the fact that food management is still a workload mostly assigned to women, who must deal with this on top of formal work and other responsibilities of care, is a gendered imbalance that leads to the accumulation of surplus food in households due to a lack of control over the relationship between food stocks and consumption (Bartiaux & Salmón, 2014). Material infrastructures, such as the fridge, the grocery store and the packaging are also elements with significant impact on food waste in households through the way in which they make food stuffs visible or invisible, the time period in which they contribute to the continued edibility of food, and the information they communicate to consumers.

6. Discussion and conclusion: Fridge studies strengths and limitations

The aim of developing fridge studies has been to provide an efficient ethnography to study food waste through food handling practices. This objective stems from our own experience of the ever-existing time and financial constraints in research projects. We have outlined fridge studies by making explicit the data collection techniques employed in three research projects on sustainable food consumption in Norway and the findings these produced. In the following, we summarize the strengths and limitations of fridge studies, shown in figure 9, and discuss supplementary methods

to address these limitations of fridge studies before concluding with how the method can be modified and added on to meet the identified limitations.

[Insert figure 9: Strengths and limitations].

The limitations can be addressed by combining fridge studies with other methods. However, several of the supplementary methods proposed will implicate a higher resource use. To explore practices external to the household, fridge studies can be combined with methods from geography, developed to study practices as situated in geographical spaces and social places. Various forms of go-alongs, not merely to shops, but to and from shops, or other services they use to acquire food will explicitly connect household and external practices (Kusenbach, 2003). Foodmaps, defined by Marte (2007, pp. 262-263) as ‘maps of relations, perceptual models of how people experience the boundaries of local home through food connections’ can be used to link food consumption to geographical and social places. Moreover, mobile ethnography can be used to analyse people and objects’ movements, mobility and flow through spaces, places and landscapes (Novoa, 2015). Sobal and Wansink (2007) propose to study micro geographies of food environment through kitchenscapes, tablesapes, platescapes and foodscapes. Together, methods from geography are attentive to materials as products, spaces and places.

Fridge studies lacks observation of performances. Observation is sometimes referred to as the ‘gold standard’ of practice-oriented methods because it captures what is embodied. Halkier (2017), however, contends that no one method is more valid than others, and that practice-oriented studies will benefit from mixing embodied and discursive methods. Participatory observation can be used in combination with fridge studies to zoom in on specific food handling practices shopping, cooking, or storage, by taking part in one or more of these activities together with the household (Jacobsen, 2013; Leder Mackley & Pink, 2013; Martens, 2012; Pink, 2009). Observations will provide data on how food handling practices are performed, with attentiveness to the embodied competences of these performances.

The snapshots fridge studies produce can be extended using methods to follow objects over time. Object stories, for example, can be used to map out the historic trajectories of food items, inspired by the narratives archaeologists, historians and curators produce about objects to interpret

their function, meaning, and forms of value within various contexts (Bedford, 2001; Brown, Clarke, & Frederick, 2016). Object stories are attentive to the changing expressions of the materials; the growing of mould on a piece of cheese, the smell of fresh, eventually rotting vegetables, or the sensation of surfaces. Additionally, other material entry points, such as the bin (Metcalf et al., 2012) or the waste itself (Hawkins, 2006), can be used to explore how materials affect food handling practices.

Finally, we acknowledge that fridges are access points to knowledge about socio-economic status, health issues, and identity, and that giving access to a backstage context might be difficult for some households. Food diaries (Alaszewski, 2006; Harrington et al., 2001) or forms of photo elicitation (Banks & Zeitlyn, 2015; Byrne, Daykin, & Coad, 2016) where the participants themselves photograph their homes and talk about them in an interview afterwards is an alternative method that can be used without researchers entering the home (Lachal et al., 2012). However, the tacit material and social information will then be (partially) lost.

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Appendix 1 – Overview of participants

Participants in the CYCLE project (2015)

Id.	Household members*	Interview context
1	Woman (25), man (unknown age)	Shop-along and at home interview, 41 min recording, 12 photographs
2	Man (25)	Shop-along and at home interview, 26 min recording, 6 photographs
3	Man (31), woman (unknown age), child (1)	Shop-along and at home interview, 1 hr. 2 min recording, 12 photographs
4	Man (32), woman (unknown age)	Shop-along and at home interview, 38 min recording, 8 photographs
5	Man (28)	Shop-along and at home interview, 37 min recording, 8 photographs
6	Woman (34), young children (0-10 years)	Shop-along and at home interview, 1 hr. 8 min recording, 7 photographs
7	Woman (42), man (unknown age), child (unknown age)	Shop-along and at home interview, 46 min recording, 10 photographs
8	Woman (43), man (43), child (8)	Shop-along and at home interview, 49 min recording, 11 photographs
9	Woman (45), man (unknown age), child (16)	Shop-along and at home interview, 1 hr. 5 min recording, 9 photographs
10	Woman (51), man (unknown age) child (teenager), child (20)	Shop-along and at home interview, 1 hr. 2 min recording, 10 photographs

Participants in the FoodWaste project (2017)

Id.	Household members*	Interview context
11	Man (38), Woman (33), child (1)	At home interview, 1 hr 30 min recording, 42 photographs
12	Woman (33), child (3)	At home interview, 1 hr 3 min recording, 41 photographs
13	Woman (34), man (32), child (3), child (1)	At home interview, 55 min recording, 54 photographs
14	Woman (39), Man (45), child (6), child (3)	At home interview, 1 hr 12 min recording, 57 photographs
15	Woman (37)	At home interview, 1 hr 16 min recording, 50 photographs
16	Man (36), woman (30), child (4), child (1,5)	At home interview, 1 hr 40 min recording, 28 photographs
17	Man (26)	At home interview, 53 min recording, 33 photographs
18	Man (31), Woman (29)	At home interview, 1 hr 14 min recording, 36 photographs
19	Man (30)	At home interview, 1 hr 53 min recording, 77 photographs
20	Woman (45), child (14), child (9)	At home interview, 47 min recording, 29 photographs
21	Woman (42), child (15)	At home interview, 1 hr 19 min recording, 30 photographs
22	Man (38), woman (27)	At home interview, 1 hr 49 min recording, 60 photographs
23	Woman (41)	At home interview, 45 min recording, 17 photographs
24	Man (30), woman (26)	At home interview, 1 hr 46 min recording, 36 photographs
25	Woman (26), Man (28)	At home interview, 1 hr 26 min recording, 62 photographs
26	Man (37), woman (35), child (2)	At home interview, 1 hr 30 min recording, 41 photographs

Participants in the PLATEFORMS project (2019-2020)

id	Household members*	Interview context
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27	Woman (36) , man (41), four children (0,3,6,8)	At home interview, 1 hr 52 min recording, 90 photographs, Photo diary
28	Man (34) , man (40), child (5)	At home interview, 1 hr 18 min recording, 11 photographs, 1 video, Photo diary
29	Woman (32) , man (36)	At home interview, 1 hr 20 min recording, 41 photographs, Photo diary
30	Woman (34) , man (40)	At home interview, 1 hr 13 min recording, 65 photographs, Photo diary
31	Man (29) , woman (29), child (5)	At home interview, 1 hr 3 min recording, 34 photographs. Photo diary.
32	Woman (46) , man (53) , son (18)	At home interview, 1 hr 52 min recording, 52 photographs, Photo diary
33	Woman (51) , Man (55) , child (14).	At home interview, 1 hr 38 min recording, 52 photographs, Photo diary
34	Man (47) , children (5,7)	At home interview, 1 hr 40 min recording, 36 photographs, Photo diary
35	Woman (38) , man (42)	At home interview, 1 hr 5 min recording, 59 photographs, Photo diary
36	Man (63) , woman (53), child (20)	At home interview, 1 hr, 10 min recording, 21 photographs, Photo diary
37	Woman (55)	At home interview, 1 hr 11 min recording, 20 photographs, Photo diary
38	Woman (35)	At home interview, 44 min recording, 7 photographs
39	Woman (44) , children (6, 9, 11)	At home interview, 51 min recording, 18 photographs
40	Woman (63) , man (67)	At home interview, 1 hr recording, 34 photographs
41	Woman (54)	At home interview, 53 min recording, 13 photographs
42	Man (45) , woman (35) , child (11)	At home interview, 1hr 26 min recording, 48 photographs
43	Man (44) , woman (43), child (12)	At home interview, 58 min recording, 0 photographs
44	Woman (34) , man (35)	At home interview, 1 hr 23 min recording, 61 photographs
45	Woman (70) , man (64)	At home interview, 1 hr 26 min recording, 38 photographs
46	Man (50) , woman (45)	At home interview, 54 min recording, 8 photographs
47	Woman (34) , children (10, 13)	At home interview, 1 hr 53 min recording, 34 photographs
48	Woman (35) , man (42), child (3)	Digital interview on Zoom, 1 hr, 1 min recording, video of kitchen tour
49	Man (24) , living with parents (unknown age)	Digital interview on Zoom, 44 min recording, video of kitchen tour
50	Woman (52) , man (unknown age)	Digital interview on Zoom, 41 min recording, video of kitchen tour
51	Woman (35) , man (unknown age), child (11)	Digital interview on Zoom, 43 min recording, video of kitchen tour
52	Woman (40) , man (unknown age), children (3,6)	Digital interview on Zoom, 48 min recording, video of kitchen tour
53	Man (43) , woman (unknown age)	Digital interview on Zoom, 28 min recording, video of kitchen tour
54	Woman (48) , man (unknown age), children (13,8)	Digital interview on Zoom, 1 hr, 1 min recording, video of kitchen tour
55	Man (52) , woman (unknown age), two teenage children	Digital interview on Zoom, 1 hr, 5 min recording, video of kitchen tour
56	Man (58) , woman (55), child (19)	Digital interview on Zoom, 1 hr recording, video of kitchen tour
57	Woman (44) , man (50), child (17)	Digital interview on Zoom, 44 min recording, video of kitchen tour

**informants in bold*