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The role of technology use in food practices during the COVID-19 pandemic

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ABSTRACT

Over the last three years, COVID-19, with its lockdowns, social restrictions, and work from home structures, had a significant influence on our daily lives. The resulting changes in technology practices are likely to be explored in the years ahead. We will contribute to this exploration by looking specifically at the impact of COVID-19 on everyday food practices and the role of involved technology. To explore food practices and technology use, we conducted a qualitative interview study with 16 interviewees and delved into the underlying influencing factors behind them. Thereby we can better understand potential behavioral changes and technology usage by people to design not only for future pandemics and exceptional situations but to also for non-pandemic times.

1. Introduction

The last three years have been dominated by the COVID-19 pandemic: Tragic deaths, severe illnesses, disruptive lockdowns, social distancing rules, mask mandates, and forced business closures determine how we worked, how we spent our leisure time, and even how we ate. While pandemic-induced changes related to education and work (cf. (Afonso et al., 2020; Gaggi et al., 2020; Kelly et al., 2021)) and leisure behavior (cf. (Benford et al., 2021; Niu et al., 2021; Yeung, 2020)) have been explored in recent studies from a human-computer interaction (HCI) perspective, food practices, and in particular the media and technology used during those practices in pandemic times, are rarely examined (cf. (Ceccaldi et al., 2020)). With this paper, we aim to fill parts of this research gap by providing a picture of (non-)changes in technology and media use in food practices during the COVID-19 pandemic. We view food practices reported here as “Human-Food Practices”, following the work of Khot and Mueller (2019), in the sense that they extend the recently increasingly discussed field of “Human-Food Interaction” (HFI) (Altarriba Bertran et al., 2019) to a broader real-world frame, which ought to be researched with qualitative and in-situ methods (Khot and Mueller, 2019). During our study, we revealed that the COVID-19 pandemic was often not the actual reason for the behavioral changes, but rather the changed food practices were caused by five drivers (“underlying influencing factors”) that were affected to varying degrees by the pandemic itself.

The structure of the paper is as follows: First, we summarize research that addressed food consumption and shopping behaviors during the pandemic. Then we dive into the field of HFI by summarizing different

pre-pandemic areas of research on the one hand and highlighting specific approaches during the pandemic on the other hand (Chapter 2). Next, we summarize our research approach (Chapter 3) and then provide a detailed description of the methodology of our interview study (Chapter 4). Outcomes from this are structured along established HFI themes in Chapter 5, which is followed by our derived framework on the underlying influencing factors on food practices (Chapter 6). We discuss our results while referencing back to related work (Chapter 7). In Chapter 8, we address the limitations and potentials for future work, before ending with our conclusion (Chapter 9).

2. Related work

To position our paper accordingly within the current literature, we first look at how food behaviors changed during the pandemic. Afterward, we point to technology-assisted food practices *before* the pandemic and end with an exploration of technology usages in food practices *during* the pandemic. Due to the still ongoing (although mild) restrictions (e.g., mask mandates in public transportation) in parts of life and most countries of the world, we consider only the pre-pandemic state (until early 2020) and the peak phase of the pandemic from 2020 to mid-2022.

2.1. Pandemic influence on food behavior

A report of the EIT Food initiative (Nuijten, 2020) investigated the influence of COVID-19 on food behaviors. The key findings of the report shows that grocery shopping, cooking, and eating behaviors have

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changed significantly during the pandemic and that people are more likely to cook and eat with other household members (as also reported in (Coulthard et al., 2021; Gerritsen et al., 2021)). The report further outlines that there has been a sharp increase in online grocery shopping, and that expensive products are bought less often. Furthermore, people declined to smoke (Di Renzo et al., 2020) and the enjoyment of grocery shopping has decreased (Gerritsen et al., 2021). Regarding eating practice, the report uncovers that people with a high body mass index (BMI) of 25 kg/m² (or higher) altered the amount of food they ate during the first lockdown to a greater extent than people with a lower BMI (Huber et al., 2021). What is interesting, however, are findings that are not quite as unanimous, such as while alcohol consumption generally decreased as 24% of participants in the study reported consuming less alcohol than before, 20% of participants also stated consuming more alcohol than before (Nuijten, 2020).

Schlegel et al. (2020) reported that people with anorexia nervosa (which is an eating disorder) consumed on average more “triggering social media”, shopped less frequently (also reported in (Gerritsen et al., 2021; Janssen et al., 2021) with no relation to eating disorders), ate out less often, spent more time cooking in the first lockdowns of 2020, and perceived the activity of meal planning as quite helpful in coping with their eating disorder. Güler and Haseki (2021) further looked at the psychological impact of cooking practices during the first lockdown period. They showed that cooking can provide a sense of relaxation in the form of an escape from the daily work routine. At the same time, cooking can be used to boost feelings of empowerment as cooking-related skills are improved and culinary knowledge is expanded (Güler and Haseki, 2021).

2.2. The growing role of technology in food practices at pre-pandemic times

Even before the current pandemic, modern technologies have changed the way we deal with food. Images of food are shared via social media (Chung et al., 2017; Petit et al., 2016), recipes are accessed digitally on the web instead of reading a recipe book (Bischof et al., 2018), smartphones are used to assess restaurants’ reviews, hours of operation, and menus (Weber et al., 2020), and restaurant bookings are made via smart voice assistants (Welch, 2018). This movement is finding traction in the emerging and growing field of Human-Food Interaction (HFI), which can be described as a subfield of HCI that deals with a variety of ways people interact with food (Altarrriba Bertran et al., 2019). “Human-Food Practices” (Khot and Mueller, 2019) range from food production, growing, shopping, eating, and cooking to food disposal and are studied from a range of perspectives (Comber et al., 2014) such as social identity (Fischler, 1988), choice and ethics (Kaplan and Thompson, 2019), and shifting culture (e.g. (Cherry, 2006)). This resulted in a variety of design spaces that were explored through different interventions and design approaches.

One of the most obvious application areas when it comes to Human-Food Interaction is the technology used during eating practices. As such, several studies examine the usage of technology in private spaces (Ferdous et al., 2015, 2016), as well as in public spaces (Porcheron et al., 2016; Su and Wang, 2015; Weber et al., 2020). Within both spaces, approaches aim to trigger or reinforce a positive feeling of commensality, i.e., sharing and eating food together in a social group, which is for instance essential for defining and maintaining a family as a social unit (Ochs and Shoheit, 2006). Here, the focus is on strengthening the experience and relationship of the people present in situ, e.g., by combining individual smartphone displays into one large display to be able to better share stories of the day during family meals in a technology-supported manner (Ferdous et al., 2017).

Digital commensality encompasses technology usage to fulfill social needs for companionship during mealtime. The idea is to connect remote diners or use screen-based media, digital pets, or robots (Khot et al., 2021; Spence et al., 2019). An example of remote dining, or virtual

co-dining, is provided by approaches such as the *Telematic Dinner Party*, where cameras and projections not only connect dinner guests across different locations but also make their table activities visible (e.g., cutlery movements) (Barden et al., 2012). Another approach to foster digital commensality considers telepresence robots, which have already been studied with positive results to strengthen feelings of social connectedness while shopping (Yang et al., 2018) and during long-distance relationships (Yang et al., 2017; Yang and Neustaedter, 2018, 2020). Telepresence robots can be used to remotely control smart home devices such as televisions, vacuum cleaners, lights, or printers (Yang and Neustaedter, 2020).

Due to the unique circumstances during the pandemic, changes in shopping and eating behavior occurred during the pandemic (see Chapter 2.1). The desire to further deepen these behavioral changes or to drop (especially new negative) behaviors and to ease dietary adjustments may have been or may be met with technology. In the past, some design techniques (e.g., nudging mechanisms) have already been used to subtly change behavior (Caraban et al., 2019; Thaler and Sunstein, 2008). For example, a lambent shopping handle equipped with LED lights indicates whether food products are organic as well as how many miles they had already traveled, to trigger ethical engagement during grocery shopping (Kalmnikaitė et al., 2011). Similarly, game-based approaches can change behavior, as demonstrated by the gameful app *Pirate Bri’s Grocery Adventure*, which teaches food literacy while shopping, resulting in fewer (often unhealthy) impulse purchases (Bomfim et al., 2020). Through regular interaction with the chatbot *Rupert*, behavior was changed to reduce meat intake and increase fruit and vegetable consumption (Casas et al., 2018). To be less distracted by screens while eating, SWAN is a smart spoon that is designed to fold and become functionally unusable if a person has been looking at a screen for too long (Khot et al., 2020).

However, technology has also been used in the past to suggest recipes, dishes, and restaurants to broaden culinary horizons. One of the first pieces of research in this area was *Kalas*, which was conceptualized as a digital recommendation system for recipes and thus served as a “social navigation” of them (Svensson et al., 2005). To find suitable plant-based substitutes for ingredients of non-vegan recipes, the *Veganaizer* app tries to assist through AI assistance (Lawo et al., 2020). Other chatbot-based approaches pursue the goal of offering suitable restaurant recommendations: For example, to recommend appropriate restaurants to people with allergies (Hsu et al., 2017) or to support the decision-making process of choosing a restaurant during lunch breaks among work colleagues (Terzimehić et al., 2018).

However, technology can also be used appropriately to support sustainable growing and disposing practices. For example, grassroots groups already use Telegram in local communities to teach sustainable growing and disposing practices (Engelbutzeder et al., 2020). Sustainable growing is also a motivation point for urban gardening, in which green areas throughout the city are used for growing plants of all types. These plants are meant to beautify the cities and improve air quality, but also raise awareness for biodiversity and beekeeping (Winkler et al., 2019). A different approach is the structure of solitary-based food systems. Those systems connect producers and consumers directly and form a socially and environmentally sustainable agriculture (Carlson and Bitsch, 2019). In general, however, the design space around *Sustainable HCI* needs to be explored appropriately with sensitivity towards technology and careful consideration of the field and its practices (Norton et al., 2019). Earlier work in the field of urban food-growing communities concluded that technology should be used sparingly and that explicit non-use of technology can be considered a design approach (Heitlinger et al., 2013). An interesting technological intervention that is based on these principles is an augmented watering-can, which personifies plants and communicates facts and values interactively with new visitors of the urban garden (Heitlinger et al., 2014).

2.3. Pandemic effect on technology use throughout food practices

To explore technology use in the multitude of food practices during the pandemic, and how or how not they differ from previous approaches, we first briefly summarize the most recent research in this area. In general, there has been little research to date that has especially addressed the influence of a pandemic on food practices and people's related technology and media use. In regards to commensality, [Hammons and Robart \(2021\)](#) showed that the usage of electronic devices, such as phones, tablets, or TVs, during family mealtimes has increased. Since some families were unhappy with such an increase, they introduced rules prohibiting the use of technical devices during meals. Considering the recent rise and adoption of web conferencing systems ([Hacker et al., 2020](#)), it is also likely that more forms of digital commensality occurred during the pandemic ([Alhasan et al., 2022](#)).

[Ceccaldi et al. \(2020\)](#) specifically examined the topic of digital commensality, i.e., digitally mediated interactions to make eating alone more bearable, such as eating simultaneously during video calls. However, they revealed that, even during the COVID-19 pandemic, two-thirds of the participants never had the experience of virtual commensality. As the main reasons, they identified technical limitations and personal aversion towards eating online. [Heshmat and Neustaedter \(2021\)](#) studied how family members and friends communicated over distance during the pandemic. They revealed that the experience of video calls, which were meant to eat together (especially with work colleagues) tended to be dissatisfying. The reasons were that each person had to prepare the food differently and some people participated in such video calls without any food, which made the call feel more like a meeting. Instead, they argued that, due to the easier preparation, virtual coffee sessions and tea times were preferably integrated into everyday life as regular practices. [Alhasan et al. \(2022\)](#) observed different situations of digital commensality. They identified different playful interactions resulting in insights that can be used in the future to make digital commensality more fun.

To improve intimacy in asynchronous remote dining situations, [Ye et al. \(2021\)](#) recently designed tangible user interfaces for placemats with buttons and LEDs. They show that the placemats have the potential to support the intimacy of the participants. With more people eating alone at home during the pandemic, making some individuals inclined to skip meals or snack mindlessly between meals, through *Guardian of the Snack*, [Khot et al. \(2021\)](#) provide a playful nudging approach to reduce overeating.

3. Research approach

Looking at the current state of research, only few studies exist on food practices in the context of the current COVID-19 pandemic. In many cases, the insights are limited to quantifiable increases or decreases (e.g., alcohol consumption). However, from a design perspective for HFI interventions, we see it as important to exploratively understand the reasons for these increases and decreases and thereby better understand (un-)changed food practices as a whole. Food practices are also not only limited to the practice of consumption and also include other aspects, such as grocery shopping, preparing food, eating out, etc. ([Khot and Mueller, 2019](#)). However, there are almost no qualitative studies on the role of technology in food practices during the pandemic to describe new practices, identify the underlying reasons, or even report what has not changed at all. For these reasons, our study aims to understand and document food practices and the role of technology use during the pandemic and to identify the underlying reasons behind changed practices. To approach the field in an explorative way, we conducted an empirical interview study which occurred during the third lockdown in Germany in 2021. The aim is to better understand the current food practices and the role modern technology plays in these practices. We relate these findings to the results of an interview study we conducted in 2018 and 2019 (prior to the pandemic), in which all participants in the

present study were already interviewed by us. Similar to the present study, the previous study aimed to better understand current food practices and the role of modern technology. Although it is not our focus to show detailed differences from the previous study, familiarity with participants' practices prior to the pandemic helped us to better contextualize their descriptions in the context of the pandemic. Based on these findings, we derived a model that identifies the underlying factors driving the changed practices even in the absence of pandemics. Thus leading to a better understanding of the reasons that drive behavioral changes in food practices.

4. Methodology

To understand the context of our empirical study, it is first necessary to understand the sociopolitical context during our interview study in Germany. The interviews were conducted in the period from the 28th of April to the 22nd of May 2021. At that time, Germany had already experienced two lockdowns, which resulted in the closure of retail, schools, and service industries. Furthermore, dining in restaurants and bars was prohibited, masks were mandated in public spaces, and many companies and public institutions made remote work mandatory to reduce the spread of the virus ([Federal Ministry of Health, 2021](#); [Federal Ministry of the Interior, n.d.](#)). From the 23rd of April to the 30th of June 2021, the Fourth Law for the "Protection of the Population in the Event of an Epidemic Situation of National Significance", colloquially known as the "Federal Emergency Brake" (In German, "Bundesnotbremse") applied nationwide in Germany. The statutory regulations went into effect on the 24th of April 2021 in all counties and independent cities in which the seven-day incidence rate of new COVID-19 cases exceeded 100 for three consecutive days. These legal regulations resulted in stricter contact restrictions and mask mandates. In addition, there was a curfew from 10 p.m. to 5 a.m. in these counties and independent cities.

In total, we conducted 16 interviews via video calls ranging from 30 min to 65 min with an average length of 40 min. During the interview, the interviewer turned on his camera, whereupon the majority of the interviewees also had their camera turned on during the interview. In a few exceptions, participants either did not have a camera available or felt more comfortable without a camera. Even in these cases, the interviewer's camera was left on to at least provide some familiarity and visual cues to participants. We informed each participant about the video recording and that we will use anonymized statements as part of research publications. All participants agreed.

While the study was still ongoing, we started to transcribe the interview data and coded the first four interviews, then discussed the coding scheme among all authors and used it to code the remaining interviews. Due to the highly diverse thematic focuses in the conducted interviews and the rather open nature of the guideline, it was necessary to first work with the material in an inductive manner (from our perspective). Following an initial assessment of the first inductive codes drawn up after the first four interviews, it became apparent, after consultation between the authors, that there were many similarities to the identified main themes of HFI by [Khot and Mueller \(2019\)](#) (growing, cooking, eating, disposing of food). To improve the interpretability of our result, we decided to align more closely with their established themes, but added the theme of "shopping/buying food". The resulting framework allowed a distinct classification of the reported food practices with a few exceptions. Some overlaps exist between shopping/buying food and disposal of food and between shopping/buying food and cooking. Subsequently, each identified food practice was either coded as a changed regular practice, an unchanged regular practice, or as an "experimental" activity, which was tried during the pandemic but has not (yet) become established as a common practice. For each practice, we coded the use of technology and media. For the changed practices, we additionally coded the actual reasons for the changes, which inductively resulted in five underlying influencing factors. For this publication, we translated important phrases from German to English as

accurately as possible. Furthermore, we aimed to make certain reported app or technology usages, which are more common in the German-speaking region, accessible to an international audience by providing additional descriptions, context, and references.

4.1. Participants

As briefly indicated above, we invited and interviewed again those participants whom we had already interviewed about their food practices before the COVID-19 pandemic [anonymized paper]. By having the same group of interviewees twice, we had the opportunity to spot recall biases (Hassan, 2005) even while conducting the interviews. A total of 16 individuals (seven males and nine females; labeled I01 to I16), each from a separate household, agreed again to participate in our interview study (Table 1). Within the table, the columns “Work from home (now)” and “Work from home (prior to the pandemic)” are estimations by the participants of their work hours which are/were done remotely at the time of the interview and prior to the pandemic. While at the time of the interview, the majority were working from home, at least half were familiar with the new situation, whereas the other half had to adapt their working practices to their place of work.

4.2. Interview guideline

During our interviews, we asked the participants to compare their current food practices with their pre-pandemic practices, with a particular focus on technology and media use. First, we wanted to know about regular eating out situations. Since eating out barely took place during the pandemic, we instead asked them to describe the routines of their regular meals during typical work-from-home days. The participants were asked specifically with whom, where, and how they ate and prepared their meals. Subsequently, we asked questions about descriptions of less obvious meals, such as coffee & cake, shakes, and snacks. Further topics revolved around (un-)changed grocery shopping behavior, online grocery shopping, food delivery services, gardening homegrown plants, virtual co-dining, and (un-)changed consumption of semi-luxury foods, such as alcohol, cigarettes, and sweets. Afterward, we asked the participants to mention anything, which was not covered by our questions but could still be relevant (e.g., recently used technology or apps). If new topics were identified in this way, we adjusted our guideline and asked about these topics proactively in the following interviews. An example of this was asking about the payment methods during grocery shopping after it was brought up in one of the first interviews.

5. Results

While conducting the interviews, it became obvious that, throughout the pandemic, many participants tried various individual and different food practices and used several forms of technology and media. In some cases, these practices became part of everyday routines; in other cases, experimental activities were only tried out for a few days or weeks and failed to become a regular part of everyday life. For this reason, we refrain largely from quantifying our qualitative findings and, only in a few cases, highlight tendencies by specifying the number of people who report similar behavior. Instead, we focus on the reasons why such behavioral changes occurred and strive to provide a descriptive picture of technology and media use in food-related practices during the pandemic. Overall, we were able to identify many different behavioral patterns among the interviewed group of young adults in Germany.

5.1. Media and technology use in growing and disposing practices

In the case of growing and disposing practices, technology, and media use are reported only in rare cases. In addition, participants mentioned that practices have remained largely unchanged during the pandemic. Almost half of all participants (7) grow herbs or plants at least on a small scale. This is usually limited to planting herbs such as basil, chives, or rosemary (I02, I09) but can extend to other vegetables such as tomatoes, cucumbers, or zucchinis (I03, I08). Four interviewees (I01, I02, I03, I09) reported growing even more crops during the pandemic, while for four (I06, I08, I12, I14) it was unchanged, and one participant (I10) stated that she no longer had any crops due to pests. The rare media and technology use also revolved around pest identification and control (I03) or information on how to prune plants (I14). One person (I02) stated that she had not found any useful apps to help her with identifying and controlling pests for her indoor plants.

Looking at the disposing practices, there were even fewer reported media and technology uses but nevertheless a few interesting ones. Two participants (I02, I08) tried the app *Too Good To Go* ([Too Good To Go International, n.d.](#)), which allows the user to buy discounted food bags from restaurants and supermarkets that would otherwise be thrown away. Thus, the app can be considered a media support of both buying and disposing practices. However, the app failed to become a regular disposing practice for either of them. Participant I02 disliked the poor quality of the food and the fact that you get food that you may not like since the specific groceries are not known to the buyer at the time of purchase. Participant I08 was not able to get any deals in her area in the first place. Through *Instagram*, I15 realized how big the issue of food waste is in Germany. Since then, she regularly goes dumpster diving with her friend although it is still officially prohibited in Germany (Rombach and Bitsch, 2015). She takes advantage of *Instagram* as a

Table 1
Basic data of the participants.

No.	Gender	Age	Residence Area	Highest Education	Household size	Work from home (now)	Work from home (prior to the pandemic)
I01	m	27	rural	Bachelor's degree	2	100%	0%
I02	w	24	suburban	Bachelor's degree	2	100%	0%
I03	m	29	rural	Bachelor's degree	2	100%	95%
I04	w	30	urban	Master's degree	2	60%	0%
I05	m	25	urban	High school graduation	1	50%	0%
I06	m	30	urban	Master's degree	2	100%	60%
I07	m	28	urban	Bachelor's degree	2	100%	5%
I08	w	27	suburban	Master's degree	2	90%	0%
I09	w	30	rural	Master's degree	2	100%	80%
I10	w	28	urban	Master's degree	2	90%	0%
I11	m	25	urban	Master's degree	2	100%	50%
I12	w	28	urban	Master's degree	2	100%	70%
I13	w	30	urban	Master's degree	2	100%	20%
I14	w	30	suburban	Master's degree	1	95%	0%
I15	w	30	urban	Master's degree	1	100%	60%
I16	m	25	rural	High school graduation	2	0%	0%

platform for documentation, raising awareness for the problem, and encouraging discussion with others.

5.2. Media and technology use in buying/shopping food practices

When shopping for groceries, a complete non-use of technology is rare, with technology and media (especially the smartphone) used in various ways to support and complement these practices. Regardless of the use of technology, three respondents stated that they tend to spend more money on higher-quality food, such as coffee (I06), wine (I06), organic food (I08), and fruits and vegetables (I09) during the pandemic than before. In contrast, there were no reports from people who actively reported restricting their grocery choices heavily for monetary reasons. In one case, I16 reported that he had bought more frozen goods at the beginning of the first lockdown in 2020 but had grown tired of them after several weeks.

5.2.1. Online platforms: meal delivery, grocery shopping and meal kits

Because on-site dining in restaurants and bars in Germany was prohibited during the lockdowns (Federal Ministry of the Interior, n.d.), some participants (I07, I11, I15) compensated for a portion of the meals previously eaten out with takeaway food or the food delivery service *Lieferando* ([Lieferando.de](https://www.lieferando.de), n.d.). No other restaurant food delivery systems were mentioned since *Lieferando.de*, as part of the *Just Eat Takeaway.com* group, has been almost fully serving the German market since 2017 (Sullivan, 2019). On one hand, our participants praised the straightforward use of the website and app, and also the increased variety of restaurants during the pandemic. On the other hand, they criticized the non-transparency of the tipping process, the higher prices compared to ordering directly from the restaurant, and the fact that *Lieferando* takes a high percentage cut of the restaurants' revenue shares and replicates restaurant websites (so-called "shadow websites" (Török, 2021)) to redirect users unknowingly to *Lieferando*.

From an HCI perspective, it is particularly interesting to notice that, while participants included food delivery services such as *Lieferando* in their regular food practices and voiced criticisms that were not directly related to the user experience (UX) of the app or website experience, buying groceries online was less appealing and criticism was also more related against UX shortcomings of apps and websites. Though I04 started to use the two online food platforms *Flink* ([Flink SE](https://www.flink.de), n.d.) and *Gorillas* ([Gorillas Technologies GmbH](https://www.gorillas.de), n.d.) on a regular basis during the pandemic and seemed to be very satisfied, especially with fast deliveries even for small orders: "And when we're working from home and are stressed and can't go grocery shopping but still want to cook at lunchtime [...], then we're super happy to just order from *Flink* or *Gorillas*, because the prices are almost about, pretty much the same as the supermarket prices [...] then we really place an order and it's there in less than ten minutes. So once it was 13 [minutes], but that's really insane!" (I04). In two cases (I04, I06), *Flaschenpost*, a beverage-only delivery service at the time of the study (Angelkorte, 2020), was used regularly but it already had been part of the buying practice in both cases before the pandemic. I12 and I14 tried the service during the pandemic but did not integrate it into their daily routines. Although I06 used the services, he criticized the weak options for exploring new beverages on the website and app, "I would have spent more time [...] looking around in a traditional beverage market [...] I could imagine doing that, but I don't really get to scroll around here." Independently, I11 also mentioned the lack of discovery options when buying food through online channels, so he continued shopping for groceries in brick-and-mortar stores.

There was also little change in the purchase of meal kits as a regular food buying practice, which is surprising in light of the fact that *HelloFresh* ([HelloFresh](https://www.hellofresh.com), n.d.) was able to report revenue growth of over 120% in Q3 of 2020 compared to the same period of the previous year ([HelloFresh](https://www.hellofresh.com), 2020). I12 started ordering meal kit boxes from *HelloFresh* a month before the first lockdown happened and has since made it part of her regular food buying practice, "We decided to buy meal kits because we

don't like grocery shopping; we don't enjoy it [...] and now we have it [the meal sizes] just right and we also eat healthier that way." I11 bought meal kits from *HelloFresh* from time to time for five to six weeks in total throughout the pandemic but did not use them more frequently since, in his opinion, the service could not replace grocery shopping and wastes too much plastic for packaging. It is also worth mentioning that I13 and I15 tried *HelloFresh*'s meal kits before the pandemic but have not tried them since because of the subscription model (I13), the limited selection and the low price/quality ratio of vegetarian and vegan meals (I13), and the loss of flexibility in one's cooking practice (I15).

5.2.2. Grocery shopping: necessity or enjoyable practice

While we noted that most reported grocery shopping still takes place in brick-and-mortar stores, participants described changes in the way they shop. We noticed a tendency that the spontaneous and impulsive (passive) practice of buying food or groceries to disappear, e.g., on the way home from work and that some participants are more actively concerned with the practice. As I11 points out: "We go [grocery] shopping much less often, much more thoughtfully, and then we also limit our shopping to just as few stores." In general, participants tended to view grocery shopping either as a necessity or as an enjoyable practice. Some aversions already predated the pandemic (I09, I12, I13), but has been intensified by the face mask mandates and an increased need for avoidance of crowds (I11, I16).

Interestingly, another group of participants expressed that they shop more often. For example, I10 shops more because she passes grocery stores on her strolls, and I08 even describes grocery shopping as an enjoyable practice in itself. "Due to the pandemic [...] I shop more calmly, because you are simply not in such a permanent stress. You take more time, and somehow shopping is also such a highlight after a long day of work."

5.2.3. Smartphones as versatile companions for brick-and-mortar grocery shopping

Smartphones are the key technology used in the reported food buying practices, acting as the jack of all trades, and addressing the needs of *inspiring*, *informing*, *organizing*, and *entertaining*. For *inspiration* (which also overlaps with cooking practices, as the food to be purchased depends on the dishes to be cooked), it is used while searching for recipes. This is done via either *Google search* (I13, I16), social media such as *Instagram* (I08, I13, I15), *Imgur* (I05), a private group for recipe sharing on *Telegram* (I13), or via dedicated cooking apps and websites, such as *Chefkoch* ([Chefkoch GmbH](https://www.chefkoch.de), n.d.) (I05, I07, I09, I10, I13, I14, I15, I16), *KptnCook* ([KptnCook GmbH](https://www.kptncook.de), n.d.) (I10, I14, I15), *Kitchen Stories* ([AJNS New Media GmbH](https://www.kitchenstories.com), n.d.) (I13, I14), *LECKER* ([BAUER XCEL MEDIA Deutschland KG](https://www.lecker.de), n.d.) (I10), and *Cookidoo* ([Vorwerk International & Co. KmG](https://www.cookidoo.com), n.d.) (I10).

The smartphone is also used to *inform* about the operating hours of supermarkets (I13) or promotions using online brochures such as *Markt guru* ([markt guru Deutschland GmbH](https://www.marktguru.de), n.d.) (I02) or *kaufDA* ([Bonial International GmbH](https://www.kaufda.com), n.d.) (I11). When exotic foods are found in the store, background information and recipe options are subsequently accessed via *Google* (I06). The smartphone is also used in a wide variety of ways to support the user in *organizational* matters. There are many different practices regarding how shopping lists are handled. On the one hand, there were simple notes, which are only intended for the individual user, and on the other hand, shared shopping lists were maintained (I02, I06, I07, I11, I12, I16). These shared shopping lists were either shared in dedicated multi-user applications such as *Bring* ([Bring! Labs AG](https://www.bring.com), n.d.) (I15) and *Organizy* ([Organizy Ltd.](https://www.organizy.com), n.d.) (I14) or were maintained via a messenger like *WhatsApp* (I08, I09). However, some participants kept their shopping lists in paper-based form (I03, I06, I10). It was even reported that grocery lists were created during remote meetings: "[...] I actually wrote down during my day in meetings what I actually want to cook for the next two weeks in order to go shopping. I also use an app to create the shopping list" (I14).

In contrast to that, I04 has stopped using shopping lists because she

shops for most groceries online. Furthermore, the smartphone is used to track and share financial expenses (I08, I11), as with the *Splitwise* app ([Splitwise, n.d.](#)) (I11). However, both participants reported that they did this already before the pandemic. Sometimes the smartphone also fulfills the need for *entertainment* if users listen to music or podcasts while shopping for groceries (I06).

5.2.4. Strong increase in acceptance and integration of contactless payment methods for grocery shopping

One of the few aspects most of the participants felt the same about was increased usage of contactless payment methods instead of cash payments; even for smaller transactions like at the bakery. Almost all the participants (14) stated that they regularly use contactless payment methods. (In the two other interviews with I01 and I04, the topic was not brought up.) Many of them primarily used cash before, as described by I12, “*I held on to cash for a long time, and I was laughed at a bit for that, and now I use almost only this cashless payment thing.*” Twelve of the 16 participants reported an increased use of contactless payments during the pandemic as it seemed more hygienic initially (I02) but also realized how easy (I10) and fast it makes the payment process (I05). Most of our participants (12) prefer contactless cards rather than payment by smartphone (2) due to privacy concerns.

5.3. Media and technology use in cooking and food preparation practices

Quite a few people (7) stated that during the pandemic they cook considerably more than they did before the pandemic. In comparison, none of the participants reported that they cook less now. Those dishes that can be easily prepared even at lunchtime are especially popular, as expressed by I09, “*It’s actually about cooking something quickly and efficiently.*” Two of the participants (I02, I04) stated that they now cook more often than they did at the start of the pandemic, rather than using delivery services. The reasons are that it is more affordable (I02, I04), and the quality of food delivery services sometimes is disappointing (I04). In turn, there is also one participant (I09) who stated that she ordered more food deliveries now than at the beginning of the pandemic, simply because she and her partner were running out of ideas for recipes and were having a hard time coming up with new ones. In addition, as in our first study with her, she still suffers from a strong unwillingness to go grocery shopping in stores and prefers to let her male partner do the shopping. However, due to her current pregnancy, a *Thermomix* ([Ribeiro, 2021](#)) has now been purchased to improve their dietary routine. During the first few days of using the *Thermomix*, she reported positive effects: “[...] however, it was probably due to my pregnancy that we said, you don’t eat all by yourself. My partner has now ordered a *Thermomix* book for fast, healthy cooking or suchlike, and we recently tried out a funny week, which was a low carb week somehow with the *Thermomix*, and it told us what we had to buy for the whole week and what we had to prepare on the evenings before. Uh, that was then something like filled peppers or zucchini chickpea salad and then you make it in the evening and then you don’t have so much effort at lunchtime or it was ready in 5 min. We actually tried that out for a week, I thought it was delicious, for my partner it was a bit too healthy, and it is quite time-consuming” (I09). Within the scope of this study, it is unfortunately not yet possible to know how I09’s experience with this has changed their eating routines in the long term, since the device was purchased only a few days before the interview.

5.3.1. New technology enabled cooking experiences

To address the described cooking fatigue (I09, I10) and to satisfy the desire for social interaction (I03, I06, I12), new cooking practices and activities emerged through modern technology. These range from enabling social interactions through virtual co-cooking (I03, I06) to co-working with a collaborative breakfast and lunch practice (I12) to the adoption of new multi-purpose kitchen appliances such as a *Thermomix* (I09, I10). Using a multi-purpose kitchen appliance especially affects the entire existing cooking practice in part because it enables the

automation and combination of multiple preparation steps such as cooking, chopping, stirring, and roasting in one device. However, it also affects the grocery shopping practices through its companion app *Cookidoo* ([Vorwerk International & Co. KmG, n.d.](#)) with which it is possible to create a weekly plan from a large selection of recipes. Out of this plan, a shopping list for the weekly grocery shopping can be directly generated (I10).

In reference to *virtual co-dining* ([Ceccaldi et al., 2020](#); [Spence et al., 2019](#); [Takahashi et al., 2017](#); [Ye et al., 2021](#)), we use the term *virtual co-cooking* to describe the activity of cooking together with people who are physically separated from each other. In the scenarios described to us, communication took place using video conferencing systems such as *Zoom* (I06) while all participants were cooking the same meal. After the virtual co-cooking, a joint virtual co-dining usually followed (I03, I06). One of the perceived shortcomings during the virtual co-cooking was an acoustic echo when using multiple devices in one room, for example, when a couple wants to broadcast their kitchen from multiple angles with different devices (I06). Further, varying preparation times between the groups became a problem since skilled (or simply more) people prepare the dishes faster (I03, I06). Also, the initial effort of planning such a virtual co-cooking evening and organizing follow-up appointments was considered difficult (I03, I06), partly because it is difficult to choose a new recipe that all participants will most likely enjoy (I03). Due to these obstacles, neither virtual co-cooking nor co-dining was established with regularity among our participants.

The situation is different for the practice of co-working including joint breakfasts and lunches, which is regularly practiced by I12 with her partner and a couple who are close friends. Here, the use of technology does not primarily support the actual cooking practice, but rather fosters such a practice, as all four people can pursue their work with a notebook from anywhere during the pandemic. An interesting aspect is that even during the process of cooking, some people continue to work on their notebooks when others in the group take over the cooking tasks.

5.3.2. Use of technology to support and enrich the cooking experience

Technology can directly support the cooking process. It can be divided into three categories with some overlapping in between: getting inspiration, assistance during preparation, and facilitating communication. Apps like *Instagram*, *Pinterest*, *Kitchen Stories* (curated cooking videos ([AJNS New Media GmbH, n.d.](#))), *KptnCook* (an app that presents only three different recipes a day to prevent choice paralysis ([KptnCook GmbH, n.d.](#))), as well as analog media like magazines and cookbooks are used for inspiration. In addition, messengers are used to share cooking recipes with friends. In another case, a messenger is used in the household of a participant (I09) where the person who is cooking informs the other person, who is still doing remote work in the meantime, that the meal is served, to avoid interrupting potential video calls. Furthermore, technologies such as tablets or smartphones are used to display recipe instructions or to set timers and act as kitchen assistances.

The interviewees also used technology to enrich the cooking experience by engaging in leisure practices or performing work-related tasks. Mentioned leisure practices included listening to music, podcasts, radio, audiobooks, or *Clubhouse*, watching *YouTube* videos, *Twitch* streams, or retrieving news. On the other hand, reading emails (I16), checking text communication channels of work colleagues (I12), or even working on smaller tasks (I05), are summarized under work-related practices while cooking and preparing food.

5.4. Technology use during eating practices

5.4.1. Eating alone and compensatory use of technology

There was a radical shift to working remotely from home during the pandemic ([Herhold, 2020](#)) which was also apparent in our sample size. Exceptions to that are I04, I05, and I16 who work mostly in the office, but even they were not allowed to eat with their colleagues. Following the shift to remote work, I16 reported that lunches that had been

previously shared by smaller groups of work colleagues at venues such as restaurants stopped immediately. While more meals were now shared with their significant other, many respondents complained that they often ate alone and missed eating together with their colleagues, as expressed by I15, “*The social element is now also gone because I always eat alone.*” The informal kind of communication and loosely exchanging ideas with colleagues during mealtimes were especially missed (I04, I05). To feel less alone during these situations, the lunch break was spent watching TV, YouTube, Twitch, or a series on Amazon Prime or Netflix, and even some lunches were spent in bed with a tablet watching series (I02). Similar to a previous study (Weber et al., 2020), participants talked about how they use such media more when they are eating alone: “*So when I eat by myself, I use my smartphone more often*” (I11). Within our study, screening-based eating or eating alone was not discussed in terms of its influence on overeating or meal duration. Although past studies have indicated that a reduction in consumption monitoring may lead to overeating (Wansink, 2010), thus suggesting that screen-based eating could have a negative impact. However, recent results show that screen-based eating may not necessarily lead to overeating, but rather may have a relaxing effect on individuals, thereby even prolonging meal time without overeating (Khot et al., 2022). Therefore, the practice of screen-based meals in bed described by I02 could be interpreted as another form of mindful eating with screens (Khot et al., 2022; Mathieu, 2009).

5.4.2. Media and technology to enable new eating experiences

Our participants not only use technology in a compensatory manner but also to facilitate social experiences at a distance, for example with practices of virtual co-dining and virtual commensality (Ceccaldi et al., 2020; Spence et al., 2019; Takahashi et al., 2017; Ye et al., 2021). Though none of the reported cases of virtual co-dining were on a regular basis. The results show that there is also a practice we call *virtual co-drinking*, where individuals socialize virtually with beverages, such as coffee, beer, or wine. In one case, this even led to I07 stating that because of the pandemic, he now maintains regular contact with people who live further away and with whom he could not otherwise easily have a beer before the pandemic. I07 stated that such virtual co-drinking evenings were now so frequent and regular that even his alcohol consumption during the pandemic has increased as a result, he states, “*I often drink beer during the week, and that happens more than before the pandemic. And [...] I would not drink at all without using media. If I weren't calling someone now, it would never occur to me to open a beer.*” The practice seems possible in particular due to the recent widespread adoption and use of web conferencing systems (Hacker et al., 2020).

5.4.3. The pandemic as an accelerator to change ideological food practices

It is remarkable that some interviewees seemed to think quite a lot about their past diet and tended to “radicalize” their dietary ideology during the pandemic. “*The pandemic made it easier for you because you were at home all the time, which means you had the most control over your food without being tempted to eat something else*” (I13). It occurred that two participants (I13, I15) who had eaten mindfully before but tended to order meat dishes in routine dining out practices, have now become vegans. Both actively use Instagram and also follow what Weber et al. (2021) call *influential food content creators*. I03, who in the last study stated his favorite food was beef steak, now reported to eat a vegetarian diet due to environmental sustainability concerns and declared that he had always eaten little meat in the past anyway, which is an example of a spotted recall bias (Hassan, 2005). Two other individuals (I15, I16) who had previously been occasional smokers stated that they had stopped because there were fewer opportunities to smoke due to the absence of parties (I15) or adverse health effects (I16). For I16, a Spotify podcast's frequent addressing and education about the effects of cigarettes on the body also played an important role in quitting smoking.

5.4.4. Technological non-use for intentional quality time during eating practices

Although we have covered a variety of technology use, there is still the practice of non-use of technology (Wyatt, 2003) during mealtimes. For example, some participants described avoiding using technology at all while eating, especially when eating together with their significant other, as expressed by the statement of I07: “*Media is usually taboo at mealtimes. So, eating is eating, my girlfriend and I have a conversation, and that's it.*” Such non-use situations (I04, I07, I10, I12) do not appear to be a reaction to the pandemic, but rather an unchanged practice from the times before the pandemic, as I06 puts it, “*That was also the case in the office before, when we ate lunch together and the smartphones had no place there.*” The exceptions in such practices are only spontaneous calls or urgent work-related tasks and requests, as described by I04: “*We try to avoid technology unless you are on your lunch break and have to look at your smartphone for work reasons.*”

5.4.5. Eating while using work-related technologies

The interviews show that 11 participants feel comfortable when using work-related media and technology during their mealtime. The use of work-related technology involves checking and, if necessary, handling e-mails (I06, I11, I14, I16), receiving calls from business partners or colleagues (I05, I16), eating during a remote meeting at lunchtime due to a tight schedule, or continuing to work on the laptop, so that break times and working hours sometimes blur (I05, I06, I09, I14). This is even partially true for the interviewees working partly on-site during the pandemic (I04, I05, I16) since they must eat alone at their place of work. An interesting aspect about eating in meetings and busy schedules is I05's comment about how eating in meetings is a subtle indicator of a busy schedule, “*if it's a business call with an external company, then of course I don't eat there (laughs), [...] if it's with the department, then that's perfectly okay, then it's more like that, then people know, 'ah okay, that boy was busy today, he has to eat something now.'*” On the other hand, there are only a few measures that address eating situations during work-from-home situations. For example, in a meeting guideline from I07's company, the request is made to mute the microphone when eating in a call. Furthermore, the same company allows employees to order pizzas (and covers the costs) to enable a similar atmosphere in regular remote sessions as it would otherwise have been the case in on-site sessions. Another practice was established in I14's company, in which a “Donut Chat” channel was created on Slack as part of internal company communication. Within this channel, employees can join and are assigned to a random person from the company. They then have the task to meet with the person remotely or on-site while having a coffee or other food. Thus, they will be able to better understand their coworker's projects and to foster informal communication.

6. Unveiling the underlying impact factors (The big picture) of food practices during the pandemic

Our empirical study outlined that there are only a few common trends in terms of food practices and related technology use. We uncovered many highly individual food practices and involved technology usages, despite the rather homogenous sample group. However, in some cases, there were major shifts in food practices and associated technology usages. These kinds of shifts were dominant in the interviews, such as the switch to vegan (I13, I15) or vegetarian diets (I05), regular grocery shopping via online platforms (I04), regular consumption of meal kits (I12), the practice of dumpster diving (I15), regular virtual social gatherings that include an after-work beer (I07), changed shopping and cooking practices due to new kitchen appliances (I09, I10), the quitting of smoking and work-related stress (I16), or the influence of pregnancy on eating practices (I09). There were also interviewees, especially I01 and I03, who did not seem to have changed food practices throughout the pandemic. Thus, we state that everyone has adapted their food practices quite differently during the pandemic. So far, we have always

stressed how food practices have changed. However, to see the pandemic as the one reason for these changes would be too short-sighted. In the interviews, we have tried to find out the underlying reasons or possible causes for these changed practices by further questioning (Table 2).

The result is a variety of influencing factors that we used to form overarching groups (see Fig. 1). This figure does not go into detail about each individual influencing factor. We instead aimed to point out that there are several underlying influencing factors behind current changes in food practices that might be related more, less, or not at all to the pandemic.

7. Discussion

With our study, we have uncovered current food practices as well as related associated technology use and identified the underlying drivers and influencing factors. However, based on the current state, it is difficult to pinpoint a handful of relevant design spaces as design implications. We have therefore chosen to rather contextualize the underlying influencing factors for a large number of identified food practices and thus ensure the clarity and relevance of the (un-)changed practices, regardless of pandemic time horizons. Our framework of underlying influencing factors as well as the described practices are intended as starting points to selectively explore these individual practices.

We also plan to repeat the study with the participants at a time sufficiently distant from the pandemic to gain knowledge about any new practices, to reflect with the participants on their changed and unchanged practices, and to hear about the underlying motives. This would allow us to better assess whether some of the practices described here have become established in everyday life and, if so, how they were adapted over time. This knowledge, processed as design implications, would likely be helpful to reflect on in the design of human-to-food practices.

Regarding the current state, however, our study provides an opportunity to complement existing quantitative studies about the impact of the pandemic on food practices (e.g., Ceccaldi et al., 2020; Janssen et al., 2021; Nuijten, 2020; Schlegl et al., 2020), with qualitative narratives and explanations, thereby providing more insight into the effects of the pandemic on food practices. We think it is important to analyze recent HFI research conducted during the pandemic to explore whether there are certain academic foci (e.g., Researching digital commensality (e.g., Alhasan et al., 2022; Ceccaldi et al., 2020; Ye et al., 2021)). After all, it was evident from our study that despite various efforts to try out new practices of digital commensality (e.g., virtual co-cooking and virtual co-drinking), they often failed to establish themselves, especially when the organizational effort and the demand on technical equipment/set-ups seems to be substantially higher (e.g., co-cooking vs. co-drinking).

We would also like to emphasize that not even one asynchronous food practice was described within our empirical study. This calls into question the everyday suitability of any asynchronous intervention (e.g., Nawahdah and Inoue, 2013; Ye et al., 2021) for experiencing digital commensality – at least when living in the same time zone. Instead our study reported actions to make cooking, eating, and drinking practices synchronous and as lifelike as possible to experience while keeping the technical setup minimalistic. Additionally, moments of experienced commensality with family or friends were also reported, as more frequent remote work resulted in lunch breaks sometimes being taken together. Our interview study revealed how much the relationship between work practices and eating practices has changed during the pandemic. Instead of a shared lunch break with colleagues, most interviewees have lunch with other members of their household, eat alone in front of online media, or continue to work while eating.

Especially against the backdrop that several interviewees shared the view that working from home is routine: As I12 expressed, “[...] a typical

Table 2
Identified shifts in regular practices, reasons for the changes and underlying influencing factors.

HFI themes	Shifts in changed regular practices	Main reasons for the changed practices	Identified underlying influencing factors
Growing and Disposing Practices.	Using Instagram to raise awareness, discuss and document dumpster diving	Encourage public discourse on why dumpster diving is illegal in Germany	Ideological attitude changes towards food (Individual-personal influence)
	More use of food delivery services	Compensating for fewer restaurant visits	Changed supply of food delivery services (Site-specific influences)
	Increase in Online grocery shopping	Stressed while working at home, motivated to spontaneously prepare a meal at noon, no desire to go grocery shopping.	Changed supply of food delivery services (Site-specific influences)
Buying/ Shopping Food Practices	Reduction in impulsive, spontaneous grocery shopping	Grocery shopping is perceived as less fun or safe than before the pandemic	Face mask mandates in public places, Social distancing measures (Social-cultural influences)
	Increase in impulsive, spontaneous grocery shopping	A welcome relief to enjoy other sensations after daily remote work, less stress, and more spare time	Decreased occupational stress, Changes due to remote work (Work-related influences)
	Increased contactless payments	Hygienic reasons, easy to use, faster payment process	Social distancing measures (Social-cultural influences)
Cooking and Food Preparation Practices	Stronger focus on (technology-assisted) cooking practices	More affordable, low perceived quality of delivery food, tired of frozen food	Changed degree of willingness and resources to spend money on food, Changes to the kitchen equipment and interior (Financial-material influences), Ideological attitude changes towards food, Changes due to pregnancy (Individual-personal influences)
	Co-working with joint breakfasts and lunches	Remote work enabling friends to work, cook and eat together locally	Changes due to remote work (Work-related influences)
Eating Practices	Increase of solitary screen-based eating	Reduction of meals eaten with work colleagues	Changes due to remote work (Work-related influences)
	Virtual co-drinking evenings	Spatially separated friends become easier to reach	Wider adoption and use of web conferencing systems (Social-cultural influences)
	Acceleration of changes to Ideological Food	Full control over what you eat, breaking up of	Ideological attitude changes towards food,

(continued on next page)

Table 2 (continued)

HFI themes	Shifts in changed regular practices	Main reasons for the changed practices	Identified underlying influencing factors
	Practices (becoming vegan, quitting smoking)	eating routines, no/less group pressure to follow a certain eating or consumption behavior	Influences due to worsened physical well-being (Individual-personal influences)
	Meal times and working hours tend to blur together more	Few rules regarding the regulation of break times, few guidelines regarding eating during remote work/meetings, willingness to use the break efficiently	Changes due to remote work, Changes to the design of the workplace, Increased occupational stress (Work-related influences)

workday; it's actually become very routine due to all the working from home.", it seems worth investigating further to see whether the blurring boundaries between leisure and work have negative influences on well-being and, if so, to explore suitable everyday life interventions for the non-use of technology in these situations.

Furthermore, we would like to point out to technology with the purpose of behavior change, which seems to have potential through nutrition tracking (Casas et al., 2018) or nudging (Bomfim et al., 2020; Khot et al., 2021), but rarely found relevance in the everyday life of our participants. The exception to this is in tracking the shopping expenditures of some participants. However, our study also showed that social media can similarly influence behavior (e.g., starting dumpster diving due to Instagram or quitting smoking after listening to podcasts).

The acquisition of technical devices to support food practices was rarely evident, with the exception of *Thermomix* devices. Here, it is important to further investigate how these new technical devices, which fundamentally change cooking practices (e.g., by influencing meal planning through recipe recommendations through companion apps), can be further embedded into other food practices. Another question should focus on why technology is not being introduced to enable other food practices, e.g., for the creation of digital commensality.

Overall, we understand the practices we identified (Chapters 5 and

6) to be a starting point to investigate them further in detail in order to (non-)design technological interventions around them.

8. Limitations and future work

The major limitation of this paper is its focus on food practices and technology use by a demographically quite homogeneous user group (age: 24 to 30, well educated, the majority live in a two-person household, mostly working from home, all from Germany with one exception (I08), who lives in Austria). It would be interesting to qualitatively investigate the (un-)changed food practices with a focus on technology use of other groups (e.g., elderly people, families with children, people with eating disorders, people from other cultural backgrounds, families living in different time zones) to get a more holistic picture and to derive design spaces for a diverse population.

Another limitation to be mentioned is that we did not have the chance to interview everyone from our previous study again (16 of the original 29 interview participants). It could be that those struggling with depression, anxiety, eating disorders, or financial insecurity were unwilling to participate in the study. It is important to point out here that recent studies have shown that mental health varies greatly from person to person during the pandemic (Kelly et al., 2021; Mooney and Becker, 2021, 2021; hlund, 2021) and that eating disorders have generally increased (Zhang, 2021). Although we do not assume that for most of them, as most of them declined us politely with sound reasons (such as a lack of time, since the interviews had to be carried out within a narrow time span). Nevertheless, we cannot reliably exclude the possibility that people who tended to do better during the pandemic were more likely to be interviewed.

In addition, we would like to point out the effect of the recall bias (Hassan, 2005), which could have led people to incorrectly recall their past food practices and thus wrongly reporting or forgetting (un-)changed practices. Compared to many of the quantitative studies on the effects of the pandemic, this effect might be smaller in the present study design, as we had already conducted an empirical interview study on eating practices and technology usage with all the participants interviewed here prior to the pandemic. In the case of dubious statements, we were able to "verify" them with the previous interview material if the statements did not add up or even contradicted each other, which was quite the exception. With regard to the methodology used, it should also

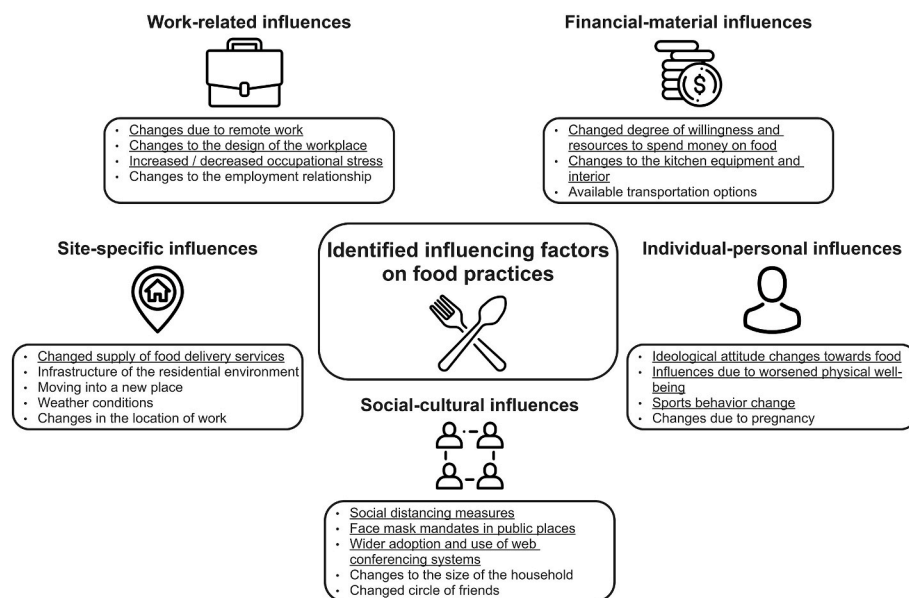


Fig. 1. Identified underlying influencing factors on food practices (underlined are those influences that were directly associated by at least one of the participants in relation to the pandemic).

be mentioned that we were not aware of any underreporting during the online interviews and speculate that the video calls may even have led to participants more freely bringing up intimate stories and food practices, which is in line with the study of Novick (2008) about the bias of telephone interviews.

In the future, it would certainly be exciting to conduct another follow-up study with the same people in two to five years; when the pandemic lies (hopefully) “in the past” (or at least we figured out to live with the pandemic in a more “normal” way), so that eating out is possible again without any restrictions, and see to what extent the food practices and the role of technology and media have changed in these situations. In the meantime, the identified practices and the underlying influencing factors can serve as a starting point for the development of hypotheses for quantitative studies and to build further qualitative studies upon them. We would also like to mention that our derived framework was derived iteratively from our interview data only. It could be an interesting starting point for future work that combines related frameworks, such as a conceptual framework about potential factors related to changes in food consumption (Janssen et al., 2021) or the Culinary Interactions Framework and latent needs of food experiences (Park et al., 2017).

9. Conclusion

It is undeniable that the COVID-19 pandemic has greatly changed, at least in the short term, how we work, learn, play, and socialize, but also eat. We documented with this work the (un-)changed food practices and understood technology’s role in them. Other publications about altered technology use and food practices during the pandemic already identified scattered and occasional trends and practices of interest, which we synthesize here and extend this knowledge significantly through our own interview study. The interplay between technology usage and food practices has not been studied to the extent it is here. Other notable characteristics of this paper are that the prior food practices of the participants in the interview study were already known from a previous empirical study and, in addition, the study was conducted a year after the onset of the pandemic, both allowing us to conclude why some practices were more likely than others to become established in the daily lives of the participants.

Our work highlights important departure points for HCI/HFI practitioners and researchers moving forward. By identifying and portraying the impact of work-related, site-specific, financial-material, individual-personal, and social-cultural influences on food practices, we provide not only pertinent inspiration for future (further) development of HFI interventions but also sharpen our understanding of the underlying drivers that lead to behavior change.

Implications for gastronomy

In our work, we show which problems and hurdles currently still exist in the digital ordering of food and groceries. Our work highlights important departure points for HCI/HFI practitioners and researchers moving forward. By identifying and portraying the impact of work-related, site-specific, financial-material, individual-personal, and social-cultural influences on food practices, we provide not only pertinent inspiration for future (further) development of HFI interventions but also sharpen our understanding of the underlying drivers that lead to behavior change. Thus enabling the design of more needs-oriented applications and technical interventions within the gastronomy sector.

Author statement

Philip Weber: Conceptualization, Methodology, Formal analysis, Investigation, Writing - Original Draft, Writing - Review & Editing. **Thomas Ludwig:** Conceptualization, Methodology, Validation, Investigation, Writing - Original Draft, Writing - Review & Editing,

Supervision, Funding acquisition. **Lea Katharina Michel:** Validation, Investigation, Writing - Original Draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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