Connecting food consumers to organisations, peers, and technical devices: The potential of interactive communication technology to support consumers' value creation

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A R T I C L E   I N F O

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A B S T R A C T

Background: Consumers' possibility of connecting to the surrounding world has rapidly increased the use of interactive communication technologies in their daily lives. This constitutes a major trend in the food sector, which is worth investigating in order to improve the understanding of the influence of the technologies on consumers' value creation, understood as consumers' improved well-being, in relation to food.
Scope and approach: This paper focuses on consumers' value creation in the food domain. It defines value as a dynamic concept and develops a framework for categorising and discussing interactive communication technologies based on their potential to support consumers in their interaction with their surroundings. The aim is to provide an overview of how these technologies support consumers' value creation as well as to provide some critical reflections.
Key findings and conclusions: Interactive communication technologies can facilitate consumer interaction with organisations, peers, and technical devices. Value creation potential can be related to two processes: 1) the product development process improving products and assortments responding to consumer needs, or 2) the product usage process supporting dietary management, access to information, entertainment, sensory experience, and finally, more flexible social relational aspects. Critical reflections on consumers' use of these technologies, such as privacy concerns and the risk of misinformation influence, are provided. Finally, implications for the implementation of interactive communication technologies in the food domain as well as suggestions for future research are provided.

1. Introduction

Today's consumers live in a digital world (Lewis, 2018), and many of them are 'digital natives' typically referring to a generation born after 1983 that has been growing up with digital solutions (Page & Mapstone, 2010). Modern technology has created platforms for interaction that play an increasingly important role in consumers' lives (Labrecque, vor dem Esche, Mathwick, Novak, & Hofacker, 2013). Via these platforms, consumers connect to an array of organisations, peers, and technical devices. Typically, interaction is facilitated by technologies that allow for everything from simple transactions to more social information sharing (Verhoef et al., 2017).

Interactive communication technology (ICT) is more relevant in the food area than ever before and has changed the way consumers interact with their surroundings (Lewis, 2018). Consumers can interact with organisations, peers, and technical devices about food related issues online (Carr et al., 2015; Hilverda, Kuttschreuter, & Giebels, 2017; Närvänen, Saarijärvi, & Simanainen, 2013; Vidal, Area, Machin, & Jaeger, 2015; Vidal, Ares, & Jaeger, 2016). For example, it is increasingly common that consumers engage with peers in online discussions about questions on food choices and diets (Sneijder & te Molder, 2006), or take pictures of their food for sharing with their peers on social media platforms (Zhu, Jiang, Dou, & Liang, 2019). Or consumers may use ICT to interact with food organisations, for instance, about product related problems or ideas. Particularly noted is consumers' use of Starbucks' social media platform for expressing their interests online through votes
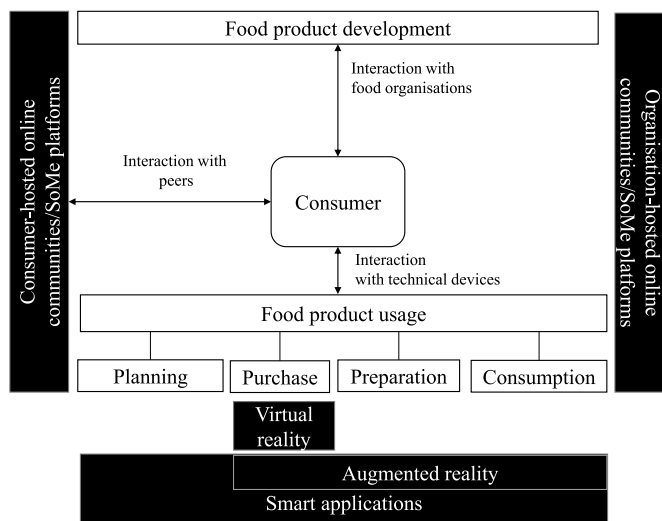

Fig. 1. Conceptual frameworkfor under standing interactive communication technologies.

and comments on products (Martinez-Torres, Rodriguez-Pinero, & Toral, 2015). Moreover, consumers use mobile smart applications (i.e. apps) for assistance in various food-related tasks such as shopping, meal preparation, and purchase (Mauch et al., 2018).

The use of ICT allows for personalisation of offers, use of alternative value chains, and information exchange, and it provides consumers with a tool for managing everyday activities around food. These new options are expected to support value creation, which is defined *'a process that increases [consumers'] well-being, such that the [consumer] becomes better off in some respect'* (Grönroos & Voima, 2013, p. 134), for consumers.

This paper contributes to the understanding of consumers' use of ICT by structuring the theme and propose how consumers' use of ICT can support their value creation at different stages from development of new food products to purchasing and consuming food products and food-related services. We propose a framework for understanding consumers' ICT based interaction with organisations, peers, and technical

devices (see Fig. 1). According to the framework, ICTs can be understood based on 1) how they facilitate interaction between consumers and organisations, peers, or technical devices, and 2) their relation to the product development or product usage process, respectively. It is based on the perception of value as a dynamic construct that can only be created by consumers themselves (Grönroos & Voima, 2013), and it points to the food specific perspective by including research and practical examples from the food industry. By using ICT, consumers can potentially improve their wellbeing by food related benefits such as personally relevant product information, improved product quality, and dietary management (see Table 1). Focus is on types of ICT that enable consumers to interact with food organisations, peers, and/or technical devices from food product development to consumers' food product usage activities (i.e. planning, purchasing, preparing, and consuming) (Fig. 1). We use the framework to critically discuss how these ICTs can potentially support consumers' value creation and reflect on the critical issues. Our findings provide insights to the food industry on how ICTs can offer possibilities for interacting with consumers and engaging them in activities related to product development or product usage and in this way support consumers' well-being in relation to food.

2. Theoretical framework: a consumer perspective on interaction and value creation

Value is a concept that has been widely debated in the literature (e.g. Grönroos & Voima, 2013; Ravald & Grönroos, 1996; Vargo & Lusch, 2004; Vargo, Maglio, & Akaka, 2008). Value creation is a dynamic concept (Grönroos & Voima, 2013) and in line with the provided definition, we treat it as the process where experience with food improves consumers' wellbeing, for example by improving food product quality in the market, inspiring healthy eating habits or more sustainable food choices, or providing personally relevant information (see Table 1). Importantly, value is treated as value-in-use, which implies that while surrounding actors such as companies, organisations, etc. can provide the facilities, consumers create value for themselves by using these facilities (Grönroos & Voima, 2013). In our case, ICT is the facility used by consumers in their value creation.

Considering ICT, interaction can be passive through technical devices that track, for instance, consumers' location, mood, or behaviour,

Table 1
Overview of interactive communication technologies, their support for consumers' value creation, and critical concerns.

Interactive communication technology	Support consumers' value creation by …	Critical concerns because of …
For consumer interaction with organisations		
Organisation-hosted online communities	• Improving the **product quality and assortment** in the market to correspond to consumers' needs and wants. • Providing **relevant information** on products (including potential risks), assortments, and recipes. • Providing **inspiration** for product use.	• Consumers' perception of **fairness** in how the benefits of the food product development process are divided.
For consumer interaction with peers		
Consumer-hosted online communities	• Improving **product quality and assortment** in the market to correspond to consumers' needs and wants. • Providing personally **relevant information** from fellow consumers as a credible source. • Supporting self-expression and connection to **social relations.** • Inspiring **healthy eating** habits.	• Consumers' concern about **data privacy.** • **Inaccurate information** or misinformation spreading between peers. • Information inspiring consumers to **eat unhealthy.** • **Biased data** leading to biased results.
For consumer interaction with technical devices		
Mobile smart applications	• Providing a convenient way to healthy and sustainable **food management.** • Providing personalised **nutrition information.**	• **Inaccurate information** or misinformation for the individual consumer. • Consumers' concern about **data privacy.** • Significant **effort** required from consumers to use the app.
Augmented reality	• Making the food experience **entertaining.** • Providing **product information** in an entertaining way. • Managing a healthy **diet.** • Improving the **sensory experience**	• Technical **complexity** lowering consumers' perceived ease of use. • Consumers' concern about **data privacy.**
Virtual reality	• Making the purchase situation **entertaining** and more realistic.	• Technical complexity lowering consumers' perceived **ease of use.** • **Lack of sensory-enabling features** decreasing the food experience.

or it can be active when consumers actively engage in communication (Verhoef et al., 2017). This paper focuses on the latter type of interaction. Interaction is therefore defined as *'situations in which the interacting parties are involved in each other's practices'* (Grönroos & Voima, 2013, p. 140). Consumers can interact with three main actors via ICT: organisations, peers, and technical devices. Organisations can include food producing companies as well as other institutions or interest organisations around the topic of food. Focus will be on online communities requiring active participation in the communication by both the organisation and the consumer. For consumer interaction with peers, focus is on online communities hosted by consumers themselves around topics of their interest. For technical devices we specifically focus on smartphone apps, including augmented reality applications, and virtual reality experiences requiring consumers' active involvement in the interaction and where the technical device responds to consumers' actions. Food producers or other service organisations typically provide these tools, but their involvement is not required in the direct interaction. Instead, we treat the technical device (not its provider) as an interactive partner with which the consumer directly interacts (Verhoef et al., 2017).

In our framework, we propose that consumers can use ICT for supporting their food related value creation by interacting with organisations, peers, and technical devices at various stages (see Fig. 1). Interaction with organisations particularly in form of food producers can happen already in the product development stage before the product is available to consumers in the market. The interaction can continue, also with other types of organisations, throughout the product usage stages. Interaction with technical devices becomes relevant when moving to the so-called product usage stages (Grönroos & Voima, 2013) including pre-purchase (i.e. planning), purchase, and post-purchase (i.e. preparation and consumption) (Lemon & Verhoef, 2016). Interaction with peers can support consumers' value creation in the product usage stages, and, indirectly, in product development as well.

In the following, we discuss the potential for ICT in supporting consumers' value creation in line with the framework presented (Fig. 1) with a focus on consumer interaction with organisations, peers, and technical devices. Following this, we point to critical issues worth considering (see Table 1) and derive some implications for the food industry as well as suggestions for future research (Table 2).

3. Consumer interaction with food organisations

By interacting with organisations during product development, consumers have the opportunity to affect the supply of products that are available on the market to be more in line with their needs and wants. In innovation and marketing literature, this has been addressed as co-creation, co-development, co-innovation, co-production, collaborative innovation, customer new product development etc. between consumers and companies (Greer & Lei, 2012). It is acknowledged that consumers can fulfil important roles throughout the innovation process resulting in better products for consumers in the end (Nambisan, 2002). Moving to the product usage, consumers can interact with organisations in order to gain product information and inspiration directly from the organisation concerning their individual interests and needs (Aspasia & Ourania, 2015; Ladhari, Rioux, Souiden, & Chiadmi, 2019).

3.1. Organisation-hosted online communities

Given the increasing popularity of consumers to use online communities and social media platforms, organisations are adopting their marketing to the digital realities. Consumers thereby increasingly have the opportunity to interact with organisations about food related issues through so-called online communities (Gaber, Elsamadicy, & Wright, 2019).Online communities *'comprise a large, loosely knit, and geographically distributed group of individuals engaged in a shared practice of problem solving, knowledge exchange, or social interactions that mainly occur through*

computer-mediated communications' (Hsu, Chiang, & Huang, 2012, p. 73).

3.1.1. Organisation-hosted communities supporting product development

In the food industry, consumers can provide input to new product development (Filieri, 2013). Food organisations (especially producers) establish online communities for consumers to discuss and propose ideas or solutions to new products (Christensen et al., 2017). Whereas studies often take the organisation perspective by highlighting the integration of consumers in product development as a way to develop more successful products (Filieri, 2013; Nishikawa, Schreier, & Ogawa, 2013), we take the consumer perspective by proposing how their interaction in these communities can support the consumers' own value creation.

By interacting with organisations in online communities focused on product development, consumers can influence the outcome of food innovation processes and in this way support the market launch of products corresponding to their needs and wants. As an example of this co-creation process, consumers can contribute to innovation through commenting on and voting for innovative ideas through Starbucks' online interaction platform MyStarbucksIdea.com (Martinez-Torres et al., 2015). Based on consumer input, the Mexican Mocha was successfully introduced (Wang, Noble, Dahl, & Park, 2019). Other examples are consumers' possibility to design the perfect hamburger to be introduced in the menu by McDonalds (www.brandba.se, 2016) or choosing three new flavour variants of the Lays' potato chips (www.business-standard.com, 2013). However, co-creation does not necessarily centre on a specific product. By joining a co-creation process initiated by Vicky Foods, an international food company producing a range of food products for the wholesale industry, consumers can participate in the development of solutions corresponding to consumer trends in the market, such as sustainability (www.midulcesolidea.com, 2020). Also Filieri (2013) found that consumers provide their ideas not only for new products, but also for packaging and corporate social and environmental sustainability. All these examples indicate that consumers have the opportunity to interact with organisations in online innovation communities to develop new products and solutions corresponding to their needs and wants.

3.1.2. Organisation-hosted communities supporting product usage

Moving to the product usage, consumers can interact with various food organisations around their use of the product. A study by Ladhari et al. (2019) revealed that among consumers' motivations for interacting in food retailers' organisation-hosted online communities is the opportunity to obtain information on products and assortments and find food recipes – both activities that can support consumers in their product usage. In this forum, consumers can interact with the organisation behind the food product to learn, for instance, about a product's components, origin, labelling, and quality. An organisation-hosted online community can provide rich product information and provide answers to consumers' specific questions for product usage (Aspasia & Ourania, 2015). Also Gaber et al. (2019) conclude that consumers can use the organisation-hosted online communities to get an answer on specific product related questions from producers. Moreover, they can find inspiration for their own food preparation (Ladhari et al., 2019). Consumers may also turn to other interest organisations in their search for support during product usage. In their study on social media and food risk communication, Kuttschreuter et al. (2014) concluded that certain consumers are motivated to use social media as an additional information source on potential food risks. The organisations hosting such communities for interaction on food communication with consumers around issues such as healthy eating and food safety with the general public are often public and third party organisations (Panagiotopoulos, Shan, Barnett, Regan, & McConnon, 2015; Rutsaert et al., 2013).

4. Consumer interaction with peers

4.1. Consumer-hosted online communities

Online communities can exist independently from professional organisations. Consumer-hosted online communities are typically centred on consumers interacting with each other on consumption activities, products, or brands on social media platforms (Antorini, Muniz Jr, & Askildsen, 2012; Franke & Shah, 2003; Füller, Jawecki, & Mühlbacher, 2007).

4.1.1. Consumer-hosted online communities supporting product development

Via this type of ICT, consumers may indirectly create value for themselves in form of product quality and assortment, if organisations can acquire this information and use it to ideate and develop products responding to consumer needs. For example, Carr et al. (2015) investigated how social media can be used to spot new trends that have innovation potential among coffee consumers. In another study, Närvänen et al. (2013) used social media to understand how consumers talk about convenience food on an everyday basis. Results revealed that social media can be used in product development to identify consumer preferences and spot emerging trends in the area of convenience food. These examples show that by sharing their interests, opinions, questions, and concerns with peers in online communities, consumers may indirectly influence the product development by making their views available so organisations can turn the attention towards consumers' needs and wants.

Consumers do not necessarily express their interests related to food in a specific online community, but on more general social media platforms as well (e.g. Facebook or Twitter). Also in this regard consumers can, via their social media expressions, influence product development and, consequently, the products introduced to the market. For example, Vidal et al. (2015) analysed data derived from Twitter including eating situations (i.e. breakfast, lunch, snack, and dinner). The study concluded that data from social media platforms is useful for accessing consumer trends, but that it should be carefully assessed before use. In a more focused example, word frequency analysis from social media data across various platforms was used to understand how preferences for flavour combinations in beer pairings vary across four Latin American countries. This enabled the incorporation of cultural differences and similarities between countries in product development (Arellano-Covarrubias, Gómez-Corona, Varela, & Escalona-Buendía, 2019). Social media analysis makes it easier to conduct such cross-cultural studies reflecting the individual consumer cultures; thus, by being industrious in communication with their peer network, consumers may indirectly provide input for product improvements that target themselves as consumers (assuming that organisations gain and react to this information). Online opinion mining has long been a focus area in other fields, such as political science (Sobkowicz, Kaschesky, & Bouchard, 2012), and recently Danner and Menapace (2020) demonstrated that comments on news websites and forums can be analysed to compare and contrast beliefs regarding organic food consumption between German and U.S. consumers.

4.1.2. Consumer-hosted communities supporting product usage

In addition to product development, consumers' ICT based interaction with peers can potentially support their value creation in the usage stages. Consumers wish to gain valuable information from interacting with other consumers about their food interests (Jacobsen, Tudoran, & Lähteenmäki, 2017). They can use this interaction to acquire or share knowledge about products or organisations or to find alternative solutions for a potential problem (Närvänen et al., 2013) related to their food planning, purchase, preparation, or consumption. Social media are treated as a complementary information source especially for younger consumers to obtain information regarding, for example, food-related

risks (Kuttschreuter et al., 2014). Electronic word-of-mouth (i.e. information from social media peer communication) is typically perceived as more credible, timely, and easy to access compared to traditional peer communication (see Huete-Alcocer (2017) for a review) and can provide consumers with useful and immediate information related to the relevant stage in their product usage. For relatively complex experience products such as wine (Ashton, 2014), peer communication is especially valued by consumers (Kotonya, De Cristofaro, & De Cristofaro, 2018). Crowd-sourced wine ratings correlate highly with those given by wine experts (Smith, 2019). In line with this, Reyes and Cheng (2019) demonstrated that crowd-sourced ratings display equal or greater impact on consumers wine purchases compared to professional ratings indicating this peer interaction to be particularly relevant for consumers in the planning and purchase stages.

In the consumption stage, consumers increasingly share pictures or written content from their eating situation (Vidal et al., 2015; Zhu et al., 2019) providing an opportunity for self-expression and connection to social relations. Given the abundance of amateur food imagery on social media platforms such as Instagram and Pinterest, personalised curation of food photos offers consumers a way to craft their self-image (Holmberg, Chaplin, Hillman, & Berg, 2016; Lewis, 2018). Moreover, the act of sharing images with others supports creation of social connections given the importance of food rituals related to, for example, birthdays or religious celebrations (Lewis, 2018).

5. Consumer interaction with technical devices

5.1. Mobile smart applications

Many apps are developed to support activities across the food usage stages by focusing on meal planning, purchase, preparation, and consumption (Azar et al., 2013; Flaherty, McCarthy, Collins, & McAuliffe, 2018; Mauch et al., 2018). Apps have the potential to promote behaviour change (Coughlin et al., 2015; DiFilippo, Huang, Andrade, & Chapman-Novakofski, 2015; Schoeppe et al., 2016; Villinger, Wahl, Boeing, Schupp, & Renner, 2019; Q. J. Wang, Egelandsdal, Amdam, Almli, & Oostindjer, 2016; Zhao, Freeman, & Li, 2016) or to support consumers in improving their knowledge or overcoming perceived barriers (Samoggia & Riedel, 2020). Many apps incorporate theory-driven behaviour change techniques (BCT), such as norms, feedback, goal-setting, and emotion regulation (Bardus, van Beurden, Smith, & Abbraham, 2016; Flaherty et al., 2018; Mauch et al., 2018), although further research into the effectiveness of (combinations of) BCTs in inducing behaviour change is needed. A broad range of apps are available to support consumers' in achieving their goals such as living up to socially responsible and sustainable food practices (e.g. Hedin, Katzeff, Eriksson, & Pargman, 2019; Mu, Spaargaren, & Lansink, 2019) and healthy eating (e.g. Coughlin et al., 2015; Mauch et al., 2018; Villinger et al., 2019). The following concentrates on apps developed within these two areas of interest (sustainable and healthy food behaviour) as they are two key aspects of consumers' food quality perception and behaviour (Petrescu, Vermeir, & Petrescu-Mag, 2020), but it should be noted that apps can be developed for many other consumer interests.

In the area of food, apps focusing on the support of sustainable and healthy eating are available (Franco, Fallaize, Lovegrove, & Hwang, 2016; Hedin et al., 2019; Mauch et al., 2018; Nghiem & Carrasco, 2016). Apps can provide consumers with control over information, feedback on their goal achievement, vividness through sensory-rich settings, motivation to proceed their behaviour, and customization of content (Kim, Lin, & Sung, 2013). They can be developed by food organisations or other service providers, but do not require their active involvement in the communication. Therefore, in our study the app itself is treated as a technical device that consumers can interact with (Verhoef et al., 2017).

Several apps that aim to help consumers in the usage stages of healthy food for them and their families are popular and try to engage

consumers (Flaherty, McCarthy, Collins, & McAuliffe, 2019; Mauch et al., 2018). Features like meal planning and shopping lists or sharing content with other users were identified as promising to support consumers in their healthy food product usage (Mauch et al., 2018). Especially recipe-managing apps are popular among consumers (Mauch et al., 2018). Such apps can be efficient in changing consumers' planning-related behaviour to promote healthy eating (Gilliland et al., 2015; Mauch et al., 2018; Tonkin, Brimblecombe, & Wycherley, 2017).

Likewise, several apps aim to support consumers in their sustainable food usage through, for instance, reducing food waste, supporting animal welfare, keeping a climate-friendly diet, living up to certain fairtrade standards, eating organic, or by choosing a local supermarket (Hedin et al., 2019; Nghiem & Carrasco, 2016). However, despite the significant amount of research on sustainability promoting apps, there is a lack of evidence for their effect on actual consumer behaviour (Hedin et al., 2019).

5.1.1. Apps supporting planning, purchasing, and preparation

In the stages of planning, purchasing, and preparation, some apps aim to support consumers in making healthy choices by providing simplified nutrition information about food (Ahmed et al., 2020; Samoggia & Riedel, 2020). Consumers can use such nutrition information apps to improve their healthy eating as they are effective in increasing people's knowledge about and decreasing the perceived barriers towards healthy eating (Samoggia & Riedel, 2020). In these stages, a variety of branded or retail apps (launched by retailers or third party actors) aim to help consumers find information about products, to facilitate planning and shopping, or to engage with brands (Bellman, Potter, Treleaven-Hassard, Robinson, & Varan, 2011; Saarijärvi, Mitronen, & Yrjölä, 2014). Such apps may support consumers' value creation, but only some are aimed directly at promoting healthy eating.

Apps supporting sustainable behaviour are available for these stages as well. Consumers can use these apps for supporting their sustainable choice during food planning and purchasing. For instance, by scanning the product options available, consumers can assess the sustainability impact of their choice (Nghiem & Carrasco, 2016). In their systematic review of apps supporting consumers in their sustainable purchasing, Nghiem and Carrasco (2016) found that a majority of apps focuses on food products, including seafood and restaurants. Whereas some apps focused exclusively on food, others included a range of different products. Also in the preparation stage, consumers may use apps for supporting their sustainable behaviour (Hedin et al., 2019). For example, Oliveira, Mitchell, and May (2016) designed and evaluated a cooking assistant app for optimising the use of energy during food preparation. Consequently, consumers found it more likely to follow the required steps for energy reduction in cooking. Most of these studies on apps for sustainable food behaviour, however, concentrates on their use in reducing of food waste during the planning and preparation stages (Hedin et al., 2019).

Sometimes, apps combine the stages for the convenience of consumers. Gilliland et al. (2015) introduced an app offering consumer guidance that ranges from healthy eating advice (i.e. planning), to recipes based on this advice (i.e. preparation), and finally to vendors providing these foods (i.e. purchase).

5.1.2. Apps supporting consumption

In the consumption stage, some apps aim to promote consumption of certain healthy foods like fruit and vegetables (Mandracchia et al., 2019; Nour, Rouf, & Allman-Farinelli, 2018), dietary intake (Franco et al., 2016), or weight loss and management (Bardus et al., 2016). Most interventions using apps to affect fruit and/or vegetable consumption are effective according to a recent review (Mandracchia et al., 2019). In their analysis of popular dietary apps, Franco et al. (2016) concluded that consumers have a high interest in apps monitoring their diet for weight loss purposes, which is typically based on food intake diaries. These apps focus on keeping an optimal balance between calorie intake

and energy expenditure, but with no personalised recommendation of food planning. Instead, food intake is typically recommended based on generic plans (Franco et al., 2016). Recently, few apps have begun to offer personalised advice. For example, an app was developed to provide automated personal nutrition advice (Fallaize, Franco, Hwang, & Lovegrove, 2019).

Other apps focus on consumption issues related to sustainability. As an example, Mu et al. (2019) suggest an app development for making sustainable food choices when dining out. A crucial factor for supporting consumers' perceived usefulness would be that the app is integrated with other apps to ensure convenience and that the information provided is of high quality. Moreover, at the end of the consumption stage, there are apps supporting consumers' reduction of food waste. Consumers can either get food from eateries at a discounted price or engage in food sharing with others (Hedin et al., 2019; Mu et al., 2019; Schanes & Stagl, 2019).

Consumers may be mostly interested in food related apps; however, some apps take a broader approach to healthy lifestyles by tackling diet, physical activity, and/or sleep as these are considered to be interrelated. A recent review shows that such apps can be effective, although not many studies focus on more than one outcome, and of those that do, most commonly the focus is on physical activity and diet (Kankanhalli, Saxena, & Wadhwa, 2019).

5.2. Virtual and augmented reality

Virtual and augmented reality are two technology types used in creating consumer experiences during the product usage stages. Virtual reality (VR) is human-computer interaction in a computer generated environment where users can navigate and interact with sensory input, typically via a head-mounted display (Crofton, Botinestean, Fenelon, & Gallagher, 2019). Augmented reality (AR) is defined as a situation where virtual elements are overlaid upon the user's actual physical environment, typically via the screen of a mobile device or via glasses (Flavian, Ibáñez-Sánchez, & Orús, 2019). Despite its growing popularity, VR is still fairly constrained to site-specific installations. AR is easily incorporated into mobile applications (Flavian et al., 2019) especially used in smart packaging scenarios that consumers can use in the planning, preparation, and consumption stages. Packaging is a multisensory platform, which consumers can use to access a myriad of information not only via its visual appeal, but through touch, sound, and smell as well (see Krishna, Cian, and Aydinoglu (2017) and Velasco and Spence (2018) for reviews). With the link to AR, packaging is also a gateway to additional possibilities for consumers upon, for instance, QR code scanning (Dou & Li, 2008).

5.2.1. AR supporting planning and preparation

In the food planning and preparation stages, consumers can access more product information provided by food organisations based on AR incorporated in apps. For example, Heinz Tomato Ketchup features an AR app, which, upon scanning, offers the consumer a list of recipes overlaid on top of the bottle (Petit, Velasco, & Spence, 2018). Similarly, Bombay Sapphire has created an app, which showcases recipes and videos of cocktails being prepared while the user is serenaded with the sound of birds and bees harvesting fruit, flowers, and herbs presumably infused in the gin (www.zappar.com, 2020). Consumers can thereby generate information for learning about the optimal product use as well as being entertained during the planning and preparation stages. A number of ICTs incorporates AR to provide consumers with organisation and product information through storytelling with the aim of enriching their product experience. Treasury Wine Estates launched 19 Crimes, a series of wines with innovative labels, which, when observed through the associated AR app, features talking felons sharing their story of coming to Australia (www.tactics.studio, 2017). Consumers may thereby use the interaction via AR technology to gain information about the brand and product in an entertaining way. Heineken recently

launched the "Legendary 7" app showcasing the seven farmers from all over Europe producing sustainable barley and hops for Heineken beer (www.theheinekencompany.com, 2015). These examples propose that consumers may use AR based applications to get a better understanding of the product and its possibilities at the same time as gaining an entertaining product experience.

5.2.2. VR and AR supporting purchase

In the purchase stage, immersive ICT can be a welcome addition to online shopping, as greater sensory interaction creates a more positive virtual shopping experience (Jin, 2009); it has been used to a large extent, for example, in the fashion industry (Beck & Crié, 2018; Ho, Russ, Scott, Lynne, & Spence, 2013; Huang & Liao, 2017). When VR headsets become more prevalent for consumers to use at home, VR based shopping malls with diverse offerings could become reality. For example, Lee and Chung (2008) provided initial evidence that consumer satisfaction is greater in a VR compared to an ordinary shopping mall in the case of mobile phone purchasing.

Besides VR, AR has been acknowledged to generate enjoyment and more positive purchase intentions compared to conventional e-commerce sites (Yim, Chu, & Sauer, 2017). In the area of food purchasing, however, such immersive ICTs are currently not implemented to the same extent, presumably because it is challenging to evaluate the sensory characteristics of food remotely. One notable exception is the food company Kabar, that has developed an AR platform enabling consumers to see virtual 3D food at their dinner table, whether in the restaurant or when ordering online (Velasco, Obrist, Petit, & Spence, 2018). ICTs emphasising the role of touch in the (online) food purchase context may improve consumers' shopping experience, as the use of a touch screen (compared to a mouse) and the ability to rotate a product improve the feeling of psychological ownership and shopping enjoyment (de Vries, Jager, Tijssen, & Zandstra, 2018; Overmars & Poels, 2015) as well as support consumers in their product choice (Shen, Zhang, & Krishna, 2016).

The ultimate solution for implementing consumer interaction with technical devices in the online food purchasing situation would be the digital delivering of smell and taste to consumers at home. There has been attempts to accomplish this, but the field is in its infancy and faces many challenges (Kerrusih, 2019; Ranasinghe et al., 2018; Spence, Obrist, Velasco, & Ranasinghe, 2017; Velasco et al., 2018).

5.2.3. AR supporting consumption

In the consumption stage, consumers can use ICT based packaging incorporating AR to improve their sensory experience. For example, the ice cream company, Häagen-Dazs, provided tubs of ice cream which, when viewed through their "Concerto Timer" AR app, featured a holographic violinist or cellist sitting above the container playing a two-minute piece of music (Wang & Spence, 2018). This is apparently the time it takes for the ice cream to soften, in order to reach the creamy consistency for optimal consumption (Varela, Pintor, & Fiszman, 2014). Another example is the prestige champagne house, Krug, who has implemented music in their marketing campaigns. By scanning a unique ID on the back of each bottle, consumers can improve their consumption experience by enjoying music pairings specifically (if idiosyncratically) chosen by musicians to match the champagne. Beyond providing a more pleasant listening experience, music has been found to increase the liking of wine (Spence et al., 2013) as well as alter the sensory aspects of the wine itself (see Spence & Wang, 2015, for a review).

Extending the consumption experience, several AR research prototypes have been developed to help consumers modify their food intake with a health purpose. Narumi, Ban, Kajinami, Tanikawa, and Hirose (2012) developed an augmented satiety system that changes the apparent food size via a head-mounted display. The rationale behind the system is that by enlarging the food via AR, consumers feel they have eaten a larger portion than in reality thereby feeling more satiated. Another example is the development of the ServAR app overlaying an image of a standard serving size of specific food items over the physical plate. This ICT aims to support healthy food consumption by guiding consumers to correctly estimate the serving sizes of food (Rollo, Bucher, Smith, & Collins, 2017).

6. Value creation potential for consumers and critical concerns

The literature presented indicates that ICT have the potential to support consumers' value creation in different ways depending on the individual consumer's preferences. Specifically, we propose that ICT can influence consumer experiences through interaction with organisations, peers, and technical devices in the product development or product usage stages (see Fig. 1). While ICTs are developed for supporting consumers' value creation by providing, for instance, product information, better product experiences, support for consumer goals in relation to healthy or sustainable choices, or a consumer voice in organisations' product development, potential negative side-effects must be considered as well (see Table 1).

In the interaction with food organisations during product development, consumers can articulate their unmet needs and wants. Consumers' input can result in development of new food products or variants that consumers find more in line with their wishes. Despite being emphasised as an activity of value for consumers, co-creation can hamper consumers' value creation if the consumer has negative experiences in the process. Perceived fairness in the relationship between the organisation and consumers is an important aspect of consumers' perception of co-creation (Franke, Keinz, & Klausberger, 2013). Consumers tend to believe that organisations engage in co-creation solely out of commercial instead of consumer interests, which can make them less likely to trust organisations (Gebauer, Füller, & Pezzei, 2013). According to Faullant, Fueller, and Hutter (2017), consumers need to feel unbiased and fairly treated, which implies a value distribution not only favouring the organisation, but also the consumers (Franke et al., 2013). This points to critical issues related to transparency of the exchange and use of data derived from ICT based consumer-organisation interaction.

Interaction with peers may indirectly support consumers' value creation by providing information to new product development and thereby contributing to better product assortments in the market, even if the information was not originally intended for innovation use. However, it is essential to realise that social media imposes its own inherent bias focusing on the young, tech-savvy, and affluent population (Arellano-Covarrubias et al., 2019). In that sense, the interaction with peers in online communities and on social media platforms can potentially support value creation through product development mainly for those consumers who are more active in sharing their food-related opinions and experiences. Moreover, consumers may be concerned about privacy issues, if the use of their data is not transparent and clearly defined. One example could be organisations using this data to for launching personalised marketing initiatives (Lewis, 2018). Such privacy concerns could hamper consumers' trust in ICT if they feel their data is exploited by organisations for commercial purposes.

Consumers can potentially create value directly by interacting with peers through exchanging ideas and finding information tailored to their interests in the product usage from planning and purchase to disposal. The peers as a crowd can share food experiences, potential risks, recommendations, and information about producers. In interaction with peers, reviews play a crucial role in influencing consumers' perceptions (e.g. Bickart & Schindler, 2001). However, these reviews can be biased. Rouliez, Tojib, and Tsarenko (2019) concluded that reviewers posted more negative reviews when exposed to prior negative reviews. Furthermore, some consumers are more likely than others to engage in discussions online (Wiertz & de Ruyter, 2007). Due to these biases, consumers may not receive the most valuable information and may even end up being misinformed.

Information posted by peers can have positive or negative effects on the consumer experience. Looking at food pictures can influence the

desire for consumption (Boswell & Kober, 2016; Spence, Obrist, Velasco, & Ranasinghe, 2016), and, depending on the type of food, positively as well as negatively influence the healthiness of a diet (Petit, Cheok, & Oullier, 2016). There is a mounting discussion in wider society on the role of social media in exercising peer pressure resulting in problematic eating and negative impact on body satisfaction (Holland & Tiggemann, 2016).

In their interaction with technical devices, consumers can use ICT in the form of apps to manage especially planning, purchasing, and preparation. Many are directed towards management of sustainable consumption and health/nutrition diets including, to some extent, personalised nutrition information. With a particular focus on value creation in the form of entertainment, especially AR is incorporated into apps. ICT based consumer interaction with technical devices thus has a number of positive aspects. However, some studies emphasise potential drawbacks, for instance, for apps designed to support consumers' food provisioning. Some apps require a significant effort from consumers (Flaherty et al., 2018). For example, consumers may stop using health related apps due to high data entry effort, (hidden) costs, or because they lose interest (Krebs & Duncan, 2015). Moreover, the accuracy of information provided by some apps can be inadequate, and even the sources used in the apps may be biased (Braz & Lopes, 2019; Chen, Cade, & Allman-Farinelli, 2015; Flaherty et al., 2018). These drawbacks can misinform, but consumers have limited possibilities of assessing the information quality. In their systematic review of apps supporting sustainable consumption, Nghiem and Carrasco (2016) found that a limited amount of apps provide transparency around their sustainability assessment criteria. Since consumers are typically under time pressure in, for example, the purchase situation, they may not have the time to critically process the information (Nghiem & Carrasco, 2016). However, if consumers realise that they have been misinformed, they may lose trust in the information itself as well as in its communicators.

Another important issue concerning the use of various apps relates to data privacy being a significant concern for consumers as they run the risk of unintended disclosure of their personal data (Hsu & Lin, 2018; Menard & Bott, 2020). Finally, as with all other technologies (Davis, 1989), apps must be easy to use. For certain consumer segments this ease of use is more important than for others (Kim & Lee, 2018), but generally perceived ease of use is an important predictor of whether consumers will perceive a technology as useful (Dishaw & Strong, 1999). Individual differences between consumers regarding their technology readiness should, of course, be acknowledged (Lin, Shih, & Sher, 2007) as the perceived complexity of an app depends on the individual.

7. Implications for management of ICT in the food industry

This study addresses how certain ICTs can potentially support consumers' value creation by establishing consumer interaction with organisations, peers, and technical devices. The food industry can use ICT as a way of engaging consumers in various activities supporting their value creation.

7.1. Implications related to food product development

The food industry should embrace the opportunity of including consumers in their innovation process in a convenient way, but at the same time be aware of the potential dangers. Successful integration of consumers in the innovation process requires that consumers provide information that is relevant for the product developers. In organisation-hosted innovation communities the task may be very clear, but the topic must be one that consumers can and will voice an opinion about in online communities. We recommend that organisations be very open about their use of consumer data in order to create trust and limit the concern about fairness perception. Innovation communities should not be an easy way to exploit consumer data but rather be a way of engaging consumers in a respectful way by being honest. This is more challenging

when accessing and using data from peer communication in online communities or social media platforms, as these consumers are not aware of their data being used in the development of food products. The use of social media data for commercial (and research) purposes is debated widely in terms of ethical concerns (Lunnay, Borlagdan, McNaughton, & Ward, 2015), and organisations must handle the privacy concern carefully in order not to shatter consumer trust in the food industry.

7.2. Implications related to food product usage

Managers need to have a clear idea of the stages in which the ICT is supposed to support consumers, and how it can be implemented to the best advantage. As consumers often use ICTs for gaining information on healthy eating and sustainability related issues, it is important to understand what type of information is relevant for consumers and ensure that they find it trustworthy, correct, and fact based. This can be a challenge especially if the ICT relies on peer interaction where inaccurate information can spread widely. Despite the limited control over the information, it may be worth constantly monitoring what kind of information is circulating in these communities and platforms, and to take necessary actions if consumers are misinformed. Currently, the majority of apps does not provide personalised information or recommendations, which may convey inaccurate information to individual consumers. Managers must therefore consider, and potentially improve, the extent to which personalised information can be provided to fit the individual consumer's needs without increasing required costs and effort from consumers considerably. At the same time, managers must be honest and make sure that consumers understand the potential bias in information provided by, for instance, apps.

Various examples in the food industry show how especially AR have the potential to improve the consumption experience in an entertaining way. From a marketing perspective this offers opportunities for providing information about a product and its consumption. Our examples demonstrate this opportunity for food producers, but other organisations such as health authorities may consider the use of AR based consumer interaction with technical devices to provide information in an engaging way. Considering food as a low involvement product (Hamlin, 2010), this approach to product communication may be more persuasive (Petty & Cacioppo, 1986). Moreover, as the sensory aspect is especially important for food products, ICTs can be a way to improve the product usage experience through sensory features in an entertaining way.

8. Future research

Our study indicates that generally, more research is needed with a focus on consumers' interaction with organisations, peers, and in particular technical devices. ICT is a fast-moving area and it is therefore challenging to conduct research keeping up with how consumers use ICT in a real time context. An overview of more specific recommendations for future research appears in Table 2 and are further outlined in the following.

ICT's role in facilitating consumer interaction with organisations and peers, has been studied on several online food communities around well-known big brands such as Ferreo Rocher's Nutella brand (Cova, Pace, & Wright, 2006) and Starbucks (Martinez-Torres et al., 2015). Considering that the majority of the food industry consists of small and medium sized enterprises (SMEs) (FoodDrinkEurope, 2020), it would be worth exploring whether ICT could be used by these smaller food organisations. As online community management requires organisational resources, research is needed to assess the feasibility of using online communities by SMEs (Braojos-Gomez, Beneitez-Amado, & Llorens-Montes, 2015) and minor brands. Smaller organisations may lack not only the financial resources, but also the organisational capabilities to manage online communities (Braojos-Gomez et al., 2015;

Table 2
Overview of suggestions for future research.

ICT area of interest	Suggestions for future research
Consumer interaction with organisations	• Consumers' interest in getting involved in product development communities for (low involvement) food products. • Possibility to build organisation-hosted online communities around SMEs, minor brands, and utilitarian food products. • Consumers' risk and fairness perception of engaging in organisation-hosted online communities.
Consumer interaction with peers	• Possibility to build consumer-hosted online communities around SMEs, minor brands, and functional food products. • Factors influencing information and source credibility in peer networks on social media. • Similarities and differences between information perception and usage between online and offline networks.
Consumer interaction with technical devices	• Consumer involvement in passive communication technologies based on, for instance, sensors and GPS tracking. • Potential to use Virtual Reality in modifying food-related perceptions and behaviour. • Relationship between apps and (long-term) food related consumer behaviour

Shenfeng, van der Velde, Chatzakis, McStea, & Smith, 2016). However, ICT may provide SMEs and minor brands an opportunity to interact directly with consumers, and it would be interesting to conduct more research in this area. A key barrier for small organisations is perceived risk (Rana, Barnard, Baabdullah, Rees, & Roderick, 2019) which again points to the importance of improving our knowledge about how these technologies are optimally designed to support consumers' value creation.

Extant literature indicates a better market performance of products that are developed based on consumer input, which indicates an increased value for consumers. Food, as a product category, is considered to be a low involvement product (Hamlin, 2010), which may deter consumers' willingness to participate in online activities. Moreover, distinguishing between food product categories may be important. Research on online brand communities (e.g. Cova et al., 2006) shows that consumers are interested in interacting with organisations around strong and hedonic food brands, but more research is needed on whether consumers are interested in interacting with less well-known as well as utilitarian or healthy food brands. Moreover, low fairness perception can be a potential threat to value creation (Franke et al., 2013), and future research should investigate its determinants.

Regarding consumer interaction with peers, our focus was on online communities and social media platforms, which are increasingly used by consumers as a credible source of food information. Therefore, it is critical to gain a deeper understanding of how consumers determine the credibility of information and the credibility of peers. Credibility of marketing communication has been studied (e.g. Dou, Walden, Lee, & Lee, 2012; Eisend, 2004), but more knowledge is required on the underlying aspects of this construct in consumer-hosted online communities centring on food, including differences between online and offline settings. Interacting with peers online has both positive and the negative consequences for consumers, but these consequences may differ between those who are 'digital natives' (Mandel & Johnson, 2002) surrounded by a digital world and those with less fluency in using digital tools. More research is needed to understand how to optimally balance the consequences for consumers interacting with peers depending on online skills.

Consumer interaction with technical devices is a broad topic, and this review has focused on those technical devices requiring active consumer involvement devices that are based on passive, sensor-based consumer involvement (Verhoef et al., 2017). In the light of consumer

trust and perceived risk being important drivers of technology acceptance (Pavlou, 2003), it would be interesting to explore how the degree of control and trust versus convenience affects consumers' value creation. Moreover, despite its potential for influencing consumers' purchase and food consumption, little research has so far focused on the opportunities that VR offers in food-related settings. Further research could explore the potential of VR to modify consumer behaviour.

9. Conclusion

Overall, ICT can support consumers' value creation and food-related well-being (indirectly and directly) in various ways from product development and better product assortment to product usage. Use of ICT in interaction with organisations, peers and technical devices can result in 1) improved products and product experiences, 2) easy access to personally relevant product information, and 3) support for own goals in relation to healthy or sustainable choices. However, there are critical concerns as well. These are related to a) transparency in organisations' data use and data privacy issues, b) whether or not the information provided to consumers or exchanged among consumers is accurate and not biased, c) possible negative social influence on consumers' dietary habits, and d) complexity and lack of features that could enable focus on taste, touch, and smell, which are crucial senses in the food experience.

Author contributions

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