Development of a Measuring Instrument to Understand the Impact of Mobile Product Information Systems on Consumers' Food Choice

Full Paper

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Abstract

Consumers' Food Choice has been researched in the past, but with the rise of mobile technologies such as barcode scanning, new possibilities of obtaining additional information at the Point of Sale (PoS) emerged. This raises the question about the impact of Mobile Product Information Systems (MPIS) on consumers' perceived food quality and thus their food choices. Since most MPIS are not provided by producers of the food product, there is a risk that consumers no longer base their decisions on information provided on the product packaging, but instead on mobile information of third party service providers. As a first step this study provides a conceptual model to identify relevant influencing factors of MPIS. Thereafter, an instrument measuring the impact of MPIS on consumers' food choice is developed and tested in a 3-round item-sorting task to ensure validity of the constructs. The instrument comprises a 33-item questionnaire based on 8 constructs.

Keywords

Mobile Product Information Systems, Consumers' Food Choice, Perceived Food Quality, Barcode Scanning

Introduction

Consumers' Food Choice and their quality perception based on different food attributes have been researched in the past (Brunsø et al. 2002; Lyerly and Reeve 2015; Steptoe et al. 1995). However, with the rise of mobile technologies such as smartphones and thereby enabled possibilities of barcode scanning and ubiquitous internet access, new opportunities of searching for additional information at the Point of Sale (PoS) emerged for the consumer. On the one hand consumers are often overwhelmed by the amount of product alternatives and advertising information they are confronted with (Eberle et al. 2011). On the other hand important information about ingredients, origin and production methods are often not available at the PoS or deceptive for the consumer. This may detain optimal buying decisions (Underhill 2009; Verbeke and Ward 2006). The reasons are missing transparency and an information asymmetry between the consumer and the producer. Therefore, consumers might have to make buying decisions under uncertainty, as most of the products cannot be experienced before buying (Reischach 2010). In general product information can be used for different purposes. In marketing for example, information is used to influence consumers' purchase decisions. Another purpose is to use product information in a more objective manner, to increase transparency and to help consumers to perform informed choices. Both approaches are used in the context of Mobile Product Information Systems (MPIS), which can be understood as mobile accessed information about a product (e.g. ingredients, price) by scanning a barcode on the product packaging. MPIS can be divided into two kinds of services. Services that are provided by the food producer itself, and services provided by third party service providers. Services of producers in most cases are characterized by additionally printed Quick-Response Codes (QR-Code) on the product packaging, while services of third parties normally occur as a mobile app that is used to scan

the traditional barcode of the product. MPIS gained a lot of attention in recent years. For example 43% of German smartphone owners access price information about products while in store several times a month (Eckstein and Halbach 2013). Widespread applications provided by 3rd party service providers are for example *redlaser* in the United States and *barcoo* in Germany. As 34% of German smartphone owners already access additional information about products via barcode or QR-Code while shopping, MPIS can be understood as a new and relevant factor of consumer's information gathering process (Eckstein and Halbach 2013). Since a vast majority of MPIS are not provided by producers itself, there is a risk for producers that consumers no longer base their decisions on information provided on the product packaging, but instead on mobile information of third party service providers.

To better understand the consequences caused by the use of MPIS, the purpose of this study is to (a) identify existing constructs and items explaining consumers' food choice and (b) to create a measurement instrument with the means to measure the impact of MPIS on consumers' food choices.

As a first step, this study conducts a conceptual model to identify relevant influencing factors. Thereafter, an instrument measuring the impact of MPIS on consumers' food choice is developed and tested in a 3-round item-sorting task (Anderson and Gerbing 1991) to ensure validity of the constructs.

Theoretical Background

Mobile Product Information Systems

In the beginning, mobile devices were defined by interactions between users and services without considering related objects and the context of use. Within the last years mobile interactions became more personal, more contextual and more integrated in our daily life. Therefore Rukzio (2006) defined the term Physical Mobile Interaction (PMI) to describe mobile interactions with things, places and people in the real world. In the context of this research, the physical part of PMI is a food product, which is identified with a barcode or QR-Code and the camera of a smartphone. However, for generalizability of the results, the developed measuring instrument was designed in a way, that it is independent of the identification technology.

Barcode scanning, sometimes also referred to as Mobile Tagging, describes the process of scanning, decoding and processing information stored in a barcode placed on a physical object using the camera of a mobile device (Hegen 2010). Thereby barcode scanning helps to close the gap between offline objects and digital services by acting as an access technology to the internet. For that purpose the two-dimensional QR-Code gained acceptance as de facto standard in Mobile Marketing (Kato and Tan 2007). Regarding products, the usage of barcodes also became important, since barcodes are printed on the product label anyway. In addition they enable the identification of scanned products with help of a database lookup and their distinct identifier, better known as Global Trade Item Number (GTIN). Existing research about QR-Codes is focused on the acceptance of QR-Codes and factors influencing the willingness to use the technology. Positively related factors influencing the usage are e.g. interactivity, perceived quality (Shin et al. 2012), involvement (Okazaki et al. 2011) and curiosity which Vidas et al. (2012) state to be the most relevant factor. Factors negatively related to the acceptance of QR-Codes are institutional trust (Atkinson 2013), social anxiety and perceived security risks (Vidas et al. 2012; Yin et al. 2013).

The term Extended Packaging was coined by the company Global Standards One (GS1), which is also responsible for the allocation of the GTIN and defined by Anarkat et al. (2008): "Extended Packaging is a standards-based approach to allow consumers to access additional information about products through their mobile phones." Although the term has already been used in research (Kowatsch et al. 2011; Simske and Sturgill Margaret 2009), more recent studies used the term MPIS (Hufenbach and Pousttchi 2013; Kallweit et al. 2014; Winkler von Mohrenfels and Klapper 2012). MPIS are defined as "a software for mobile devices that allows users to access information on a product (e.g. ingredients, price) by scanning a barcode or using other search mechanisms." (Hufenbach and Pousttchi 2013)

One major aspect of marketing has always been to influence consumers in their buying decision. Thereby product labels and the information provided thereon is a well-known tool to affect consumers during their buying decision process by providing indicators regarding the functionality and quality of the product (Grebitus et al. 2010; Verbeke and Ward 2006). As the space on product packaging is restricted, it is of interest which kind of information is mainly used by consumers and which has the most influence on their

buying decision. Banterle et al. (2012) conducted an empirical analysis of consumer preferences regarding food labelled information. Additional information not only influences the buying decision, but also the willingness to pay for a product. For example Mørkbak and Nordström (2009) showed that it has a positive effect on consumers' willingness to pay for chicken, if the information is available, that they were reared outdoors. Especially Mobile Product Information on organic ingredients and sustainable production can improve the perception of a brand and influence the willingness to pay (Winkler von Mohrenfels and Klapper 2012). Besides information, Jung et al. (2012) showed that also interactive content and entertainment has a significant impact on the use of QR-Codes. MPIS based on QR-Codes are an effective method to reach consumers with relevant, targeted and interactive information during a stage when they are ready to buy (Atkinson 2013). Thereby the individual search behaviour of consumers matters more than ever, as they have to initiate the pull-based process. As we know there is a potential risk to overwhelm the consumer with additional information (Kalnikaitė et al. 2012; Underhill 2009; Verbeke and Ward 2006). Therefore, one aspect of our research is to analyse how consumers perceive additional information of MPIS and learn if their impact is positively or negatively related to perceived food quality.

Perceived Food Quality and Consumers' Food Choice

Perceived food quality is a widely used approach in behaviorally-oriented analysis to research consumers' food choices. Over the years different ways to approach this concept evolved. Grunert (1997) contributed the distinction into four different approaches of food choice research: the economics of information approach (Nelson 1970, 1974); the multi-attribute approaches (Fishbein and Ajzen 1975; Olson and Jacoby 1972); hierarchical models (Cox 1967; Geistfeld et al. 1977; Grunert 1986) and means-end chain theory (Gutman 1982; Olson and Reynolds 1983; Zeithaml 1988).

Within the economics of information product characteristics are divided into search, experience and credence attributes to evaluate product quality (Andersen 1994; Darby and Karni 1973; Nelson 1970, 1974). While search attributes can be ascertained before the purchase (e.g. price, size or color), in contrast, experience attributes can only be evaluated after experiencing the product (e.g. taste and ease of use). Credence attributes however, can never, not even after the purchase, become evaluated by the consumer and therefore are a matter of credibility and trust. Good examples of credence attributes are whether a vegetable has been produced according to organic principles or whether all parties involved in the production process benefit equally. These characteristics are not verifiable, but nevertheless become more and more important for consumers (Brunsø et al. 2002).

Multi-attribute approaches (Fishbein and Ajzen 1975) are quite similar to the economics of information, as both approaches share the opinion that subjective quality is of multi-dimensional nature. Thereby, the overall quality is explained as a combination of perceived attributes. Olson and Jacoby (1972) made some effort to take search, experience and credence attributes into account by contributing the distinction between intrinsic and extrinsic attributes, whereas intrinsic attributes describe all the attributes directly related to the physical product itself (e.g. ingredients, shape, taste, etc.) and extrinsic attributes describing all the rest (e.g. brand, price, etc.).

To include the interrelations between attributes, hierarchical models (Cox 1967; Geistfeld et al. 1977; Grunert 1986) have been applied to identify inferences from attributes to others. Means-end-chain theory goes one step further by implying that "consumers' subjective product perception is established by associations between product attributes and more abstract, more central cognitive categories such as values, which can motivate behavior and create interest for product attributes." (Brunsø et al. 2002) The idea is to infer abstract values from concrete product attributes by researching how concrete product characteristics are linked to self-relevant consequences (Gutman 1982; Olson and Reynolds 1983; Zeithaml 1988).

Grunert et al. (1996) proposed the Total Food Quality Model, which integrates the above approaches into a unified framework. Additionally the model integrates the explanation of consumers' purchase intention, as a trade-off between give and get components mainly based on Theory of Reasoned Action and the Theory of Planned Behavior (Ajzen 1991; Fishbein and Ajzen 1975), as well as a the explanation of consumers' satisfaction by dividing the perceived quality into an expected and an experienced quality.

What all of these approaches have in common, is the consumer as a final judge of food quality and his evaluation of food characteristics and attributes to create values, intentions and decisions. This research does not have the aspiration to fully understand or describe the purchase decision process of a consumer. Instead the research motivation is to understand how MPIS influences consumers' food choice based on the perceived food quality. Therefore, a literature review was conducted to identify which factors influence the perceived food quality. Thereby, the Food Choice Values (FCV) proposed by Lyerly and Reeve (2015) have been identified as major "factors that individuals consider when deciding which foods to purchase and/or consume." These factors either do relate to specific food attributes (e.g. taste, ingredients, price) or broader societal aspects (e.g. origin and fairness). Lusk and Briggeman (2009) come to a similar classification. They divide FCV into self-centred values (e.g. convenience, tradition) and societal-centred values (e.g. fairness and environmental impact). In 1995 Steptoe et al. (1995) developed a Food Choice Questionnaire (FCQ) consisting of 9 factors, which is widely used in academic literature and also the scientific basis for the FCV proposed by Lyerly and Reeve (2015). Both measures, the FCQ and the FCV, are used to understand societal (e.g., culture, geography, genetics, etc.) and individual (e.g., taste preferences, availability, beliefs, knowledge, etc.) factors that influence food choices (Lyerly and Reeve 2015)(Steptoe et al. 1995). Most studies based on the FCQ have the purpose to identify differences between socioeconomic groups (Inglis et al. 2009; Lawrence et al. 2009; Sealy 2010; Wiig Dammann and Smith 2009) or cultural environments (Eertmans et al. 2006; Milošević et al. 2012).

In research food values are typically used to identify which underlying core values motivate consumers' purchase intention (e.g. with the help of means-end-chain theory (Brunsø et al. 2002)) and to determine the relative importance consumers place on these values (e.g. with the help of best worst scaling (Lusk and Briggeman 2009)).

Within our research we want to learn more about the influence of mobile technologies at the PoS, and therefore make use of FCV to measure how the individual evaluation of a food product changes after using MPIS. FCV and the FCQ are the basis for most of our constructs and items.

Conceptual Model

The focus of this research is to develop a measurement instrument for perceived food quality. Nevertheless, the measuring instrument was developed from the viewpoint of understanding the impact of MPIS. Therefore, we researched the provided content of existing MPIS that could potentially have an impact on consumers' perceived food quality and chose the items of the measuring instrument accordingly. Therefore, we think that both, the research of MPIS and the research about perceived food quality are important for the development of the conceptual model and the measuring instrument.
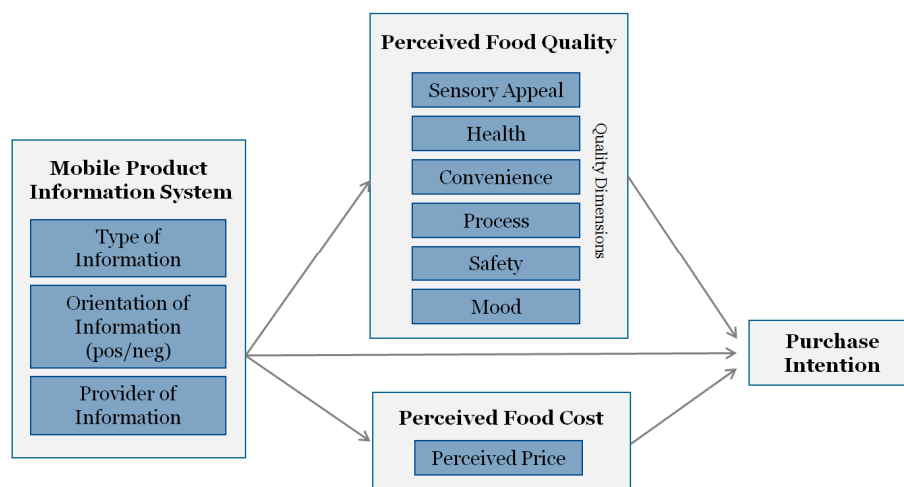

Figure 1: Conceptual Model

The impact of MPIS depends on different aspects. On the one hand, the MPIS itself can vary in the type of information it provides (e.g. customer ratings, price comparison), the orientation of the information (from positive to negative) and the provider of the information (e.g. producer or third party service provider). On the other hand, the perceived food quality is a multi-faceted construct which is composed of different quality dimensions (e.g. sensory appeal, health). The purchase intention is a construct that is based on a trade-off between perceived gain and perceived loss. We assume that the identified aspects of MPIS have an influence on consumers' perceived food quality, perceived food costs and the purchase intention. Consequently, we propose the following conceptual model (cf. Figure 1) that includes both the influencing factors of MPIS and the dimensions of perceived food quality.

Identifying Factors Influencing the Impact of Mobile Product Information Systems

As MPIS are a fairly new phenomenon and scientific research is sparse, we analysed both, scientific literature and practice. The factors influencing the impact of MPIS have been derived from existing literature about MPIS (Hufenbach and Pousttchi 2013; Kallweit et al. 2014; Winkler von Mohrenfels and Klapper 2012) and extended with information from reviewing the most used MPIS Apps in Germany. Hufenbach and Pousttchi (2013) made a good effort in describing the state of the art of MPIS in practice. They reviewed six different service providers of MPIS based in North America and Europe, namely barcoo, codecheck, GoodGuide, RedLaser and ShopSavvy. Thereby, they identified the most common types of provided information (e.g. product pictures, prices, reviews, etc.). Furthermore some service providers include data from other third parties such as seals of quality, test reports or food signal lights. By reviewing the most rated MPIS apps on the Apple App Store in Germany at the time of April 2015, namely barcoo with 22.217 ratings and codecheck with 4.089 ratings, we were able to confirm the results of Hufenbach and Pousttchi (2013). In addition product comparisons and suggestions for more healthy products were identified as most current features of the apps.

Known from research on conventional product labels, irrelevant or unwanted information can overwhelm the consumer even more, which may detain optimal buying decisions (Underhill 2009; Verbeke and Ward 2006). Hence producers and service providers alike are interested in providing exactly the information to the consumer that is relevant to support or influence the process of decision making. Besides the kind of information, the orientation of the provided information is relevant to measure the influence of MPIS. While it can be assumed that the information about food products provided on producer-driven services are probably only positive, the information provided by service providers may be both positive and negative about the product.

Identifying the Dimensions of Perceived Food Quality, Perceived Price and Purchase Intention

The dimensions of perceived food quality, perceived price and purchase intention have been adopted from different research streams such as the FCV (Lusk and Briggeman 2009; Lyerly and Reeve 2015), the FCQ (Steptoe et al. 1995), Consumers' Quality Perception (Brunsø et al. 2002) and research about food labelling (Banterle et al. 2012). When selecting and developing the quality dimension we have taken into account both, the results of existing research as well as our motivation to understand the impacts of MPIS on the food choice values. Table 1 summarizes the dimension we identified and the resources they are based on.

Sensory Appeal can be described as hedonic quality dimension which includes hedonic aspects of food quality like appearance, smell and especially taste. Most of the aspects of sensory appeal are considered to be experience characteristics, as they can be evaluated only after experiencing the product (e.g. taste) or opening the package (e.g. smell). Experience attributes are difficult to evaluate for consumers at the PoS. But even if the consumers are not in a position to judge for example the taste, they will form an expectation about it. Therefore the evaluation of sensory appeal often happens based on expectations derived from other attributes, which are available at the PoS (e.g. appearance of the product or the product package) (Brunsø et al. 2002). These expectations form consumers' perceptions, which consequently have an impact on their food choice. Most studies about food choice come to the result, that especially taste is one of the most important criteria for food choice (Roininen et al. 1999). Lusk and

Briggeman (2009) as well as Lyerly and Reeve (2015) describe Sensory Appeal as "the degree to which food is pleasing to the senses".

	Construct	Definition	Reference
Perceived Food Quality	Sensory Appeal	Degree to which food is pleasing to the senses	(Lusk and Briggeman 2009; Lyerly and Reeve 2015; Steptoe et al. 1995)
	Health	Degree to which food is perceived to positively affect health	(Banterle et al. 2012; Brunsø et al. 2002; Lusk and Briggeman 2009; Lyerly and Reeve 2015; Steptoe et al. 1995; Wilcox et al. 2009)
	Convenience	Degree to which food can be easily and quickly prepared and eaten	(Brunner et al. 2010; Candel 2001; Lyerly and Reeve 2015; Steptoe et al. 1995)
	Process	Degree to which food has been prepared or processed properly (in a preferable way)	(Banterle et al. 2012; Lusk and Briggeman 2009; Lyerly and Reeve 2015)
	Safety	Degree to which food is perceived safe and does not cause illness	(Grunert 2005; Lusk and Briggeman 2009)
	Mood	Degree to which food is perceived to have influence on mood	(Lyerly and Reeve 2015; Steptoe et al. 1995)
Perceived Costs	Price	Degree to which food is reasonably priced	(Steptoe et al. 1995)
	Purchase Intention	Degree to which food is considered to be bought	(Coyle and Thorson 2013; Dodds et al. 1991)

Table 1: Perceived Food Choice Dimensions,

based on (Brunsø et al. 2002; Lyerly and Reeve 2015; Steptoe et al. 1995)

Health describes the degree to which food is perceived to positively affect health. Because the impacts of food on health cannot be evaluated or judged by consumers themselves, health is a matter of invisible quality and therefore a credence attribute. The evaluation of this characteristic is based on credible communication instead of personal experience (Brunsø et al. 2002). In literature different approaches have been used to describe health. Besides positive related health aspects (e.g. nutrition, naturalness, diet and functional food), some studies also consider avoiding negative aspects (e.g. food that causes illness) as part of health (Brunsø et al. 2002), while other studies consider these aspects to be a discrete safety construct (Lusk and Briggeman 2009; Lyerly and Reeve 2015). Because Lusk and Briggeman (2009) identified safety to be one of the most important aspects of consumers purchase intention, we decided to follow the approach of treating safety as a construct on its own, being aware that those dimensions may be partly interdependent and have verse relationships. Also one major aspect of MPIS is to increase transparency and to reveal food scandals, we expect MPIS to have a strong influence on safety.

Convenience is the degree to which food can be easily and quickly prepared and eaten. This dimension can be characterized as a mix of both experience and search characteristics. On the one hand consumers can evaluate how convenient a product is by reading the preparation information if existing, on the other hand a lot of food can be prepared in different ways and therefore the real convenience might be only experienced after preparing the product. Brunner et al. (2010) identified concerns about naturalness, nutrition knowledge, and cooking skills as strong predictors for consumers' convenience food choice. One could assume that MPIS for example by providing easy recipes could be able to decrease consumers' doubts about their cooking skills and thereby increase the perception of convenience of a specific food product.

The construct of process has been adopted from Banterle et al. (2012) and updated with items from (Lusk and Briggeman (2009) such as origin, fairness and environmental impact. This dimension describes the degree to which food has been prepared or processed properly. Similar to health, process characteristics are almost exclusively credence attributes, as the consumers in most cases do not have the possibility to examine the production process and cannot determine determining whether the food product has the promised process qualities (Brunsø et al. 2002).

The dimension of safety is based on Lusk and Briggeman (2009) and describes the degree to which food is perceived safe and does not cause illness. Regarding the evaluation of consumers, food safety can be understood as risk perception. This risk can be distinguished between issues that already have caused illness (e.g. BSE, pesticides, Salmonella) and issues that are perceived to be unsafe such as the usage of advanced technologies like genetically modified organisms (GMOs) (Brunsø et al. 2002). Banterle et al. (2012) identified a high interest of consumers for the presence/absence of GMOs and for pesticides.

Mood describes the degree to which food is perceived to have influence on consumers' mood. This includes products that can help the consumer to relax, to be happy or to cope with stress. Mood was originally identified by Steptoe et al. (1995) and is also included in the FCV of Lyerly and Reeve (2015).

Price is considered to be a search attribute as consumers are able to get the information before they decide to buy a product. Furthermore the price is the perceived cost of a food product and is in contrast with the perceived benefits. Nevertheless, it also has been found to be an indicator of quality when consumers do not have other adequate information about intrinsic quality cues (Zeithaml 1988).

Intention describes an individual's subjective likelihood of performing some certain behavior (Fishbein and Ajzen 1975). In our case purchase intention is the degree to which food is considered to be bought. The likelihood of the purchase intention is considered to be a trade-off between costs (measured through price) and benefits (measured through perceived quality). The items used for the purchase intention are based on Coyle and Thorson (2013) and Dodds et al. (1991).

Instrument Development

To measure the perceived food quality, a measurement instrument was build based on the conceptual model described in the previous section. We followed the procedure proposed by O'Leary-Kelly and J. Vokurka (1998) to assess the validity of the measurement instrument. Construct validation is a necessary and important step in building measurement instruments to ensure that the intended concepts is sufficiently measured by the proposed constructs of the conceptual model (O'Leary-Kelly and J. Vokurka 1998). Further, ensuring construct validity counters corrupting elements embedded in measures like e.g. measurement errors. The validation of constructs requires the empirical assessment of the suitability of the proposed measure. This is ensured by the unidimensionality, reliability and validity of the deduced constructs of the conceptual model. We followed the three stages suggested by Moore and Benbasat (1991) to comply the requirements regarding the unidimensionality, reliability and validity.

The first stage requires the identification of existing items or the creation of new ones to be consistent with the definition of the related constructs of the conceptual model. For our measurement instrument we derive items from existing measures for food choice (Lusk and Briggeman 2009; Lyerly and Reeve 2015; Steptoe et al. 1995), Consumers' Quality Perception (Brunsø et al. 2002) and research about food labelling (Banterle et al. 2012) and adapted them to our specific scope (cf. table 2). The second step includes the assessment of construct validity as well as the identification and refinement of ambiguous items. This was done in parallel to the item sorting task described in the following. In the final and third stage, an instrument testing and factor analysis needs to be performed. Opposed to the previous two stages this cannot be done prior to the data collection and is therefore not part of this evaluation, but will be carried out in future.

We ensured construct validity by a pretest assessment of the substantive validities of the measures in order to predict the performance of the measures (Anderson and Gerbing 1991). Substantive validity is requisite for the validity of a construct. An item-sorting task was performed to assess the substantive. To do so, we asked representatives of the population to assign each element of the list of item to the construct that, in their judgment, is the intended one. The participants received an excel sheet with all the items in a randomized order on the left side and the constructs and their definition on the top in separate columns. By marking the cell in the intersection participants assigned each item to a specific construct.

Based on the aggregated feedback of all participants the substantive validity was assessed. Two indices were used to analyze the data across all replies. First, the index of the *proportion of substantive agreement*, P_{sa}, calculates the proportion of substantive agreement and indicates the extent to which an item reflects its intended construct. Second, the *substantive validity coefficient*, C_{sv}, reflects to which extent the representatives assign an item to the intended construct more than to any other construct. The

value for P_{sa} ranges from 0.0 to 1.0 and for C_{sv} the range is from -1.0 to 1.0. For both indices the recommended threshold is 0.5 and the larger the value the greater the substantive validity is.

Construct		Item	Round 1		Round 2		Round 3	
			P sa	C sv	P sa	C sv	P sa	C sv
Convenience	CO1	The product is easy to prepare.	0,90	0,81	0,82	0,64	0,94	0,88
	CO2	The product can be consumed without investing much time to think about a recipe.	1,00	1,00	0,95	0,91	0,94	0,88
	CO3	The product can be prepared quickly.	0,95	0,90	0,86	0,77	0,94	0,88
Health	HE1	The product is nutritious.	0,95	0,95	0,91	0,86	0,94	0,88
	HE2	The product contains a lot of calories.	0,86	0,76	0,82	0,73	0,69	0,56
	HE3	The product contains a lot of fat.	0,86	0,76	0,86	0,82	0,69	0,56
	HE4	The product contains a lot of sugar.	0,86	0,76	0,86	0,77	0,69	0,56
	HE5	The product helps me to stay healthy and improves my physical well-being.	0,95	0,90	0,95	0,91	1,00	1,00
	HE6	The product helps me to control my weight.	0,95	0,90	0,95	0,91	1,00	1,00
	HE7	The product contains natural ingredients.	added		0,82	0,64	0,88	0,75
Mood	MO1	The product helps me to reduce stress.	0,52	0,24	0,82	0,64	0,69	0,44
	MO2	The product helps me relax.	0,86	0,76	0,77	0,59	0,88	0,81
	MO3	The product keeps me awake.	0,48	0,10	removed			
	MO4	The product cheers me up.	0,86	0,71	0,86	0,77	1,00	1,00
	MO5	The product makes me feel good.	0,90	0,81	0,82	0,64	0,88	0,75
Price	PC1	The product is expensive.	0,86	0,76	0,95	0,91	1,00	1,00
	PC2	The product is cheap.	0,90	0,86	0,86	0,77	0,94	0,88
	PC3	The product is good value for money.	0,76	0,62	0,86	0,73	0,81	0,63
Purchase Intention	PI1	I will purchase this product today.	0,67	0,52	0,95	0,91	0,94	0,88
	PI2	I am willing to buy this product during the next month.	0,86	0,76	1,00	1,00	1,00	1,00
	PI3	I will purchase this product the next time I need a product of that category.	0,86	0,76	0,95	0,91	1,00	1,00
	PI4	I would prefer this product to competitive alternatives.	0,57	0,14	0,82	0,68	1,00	1,00
	PI5	Suppose that a friend asks for your advice in his/her search for a product of that category; I would recommend him/her to buy the product.	0,81	0,67	0,91	0,86	0,94	0,88
Process	PR1	The product was prepared with great care and is subject to strict quality standards.	0,57	0,19	0,55	0,14	removed	
	PR2	The product contains natural ingredients.	0,10	-0,57	moved to Health (HE7)			
	PR2	The product is manufactured in a natural way and without the use of advanced technologies (e.g. genetically modified organisms).	added		0,86	0,82	0,81	0,69
	PR3	The food production and processing happened in a country/region that I prefer for this food category.	0,71	0,43	0,68	0,45	0,75	0,63
	PR4	All parties involved in the production of the product benefit equally.	0,90	0,86	0,82	0,77	0,81	0,69
	PR5	The product is grown or produced in an environmentally friendly way.	0,95	0,90	0,77	0,68	0,94	0,88
	PR6	The manufacturing process of the product is comprehensible and transparent.	added		0,82	0,73	1,00	1,00
	PR7	The product is manufactured in a natural way and without the use of advanced technologies (e.g. genetically modified organisms).	added		0,86	0,82	0,81	0,69
Sensory Appeal	SA1	The product tastes good.	0,95	0,90	1,00	1,00	1,00	1,00
	SA2	The product smells good.	1,00	1,00	1,00	1,00	1,00	1,00
	SA3	The product looks appealing.	1,00	1,00	1,00	1,00	1,00	1,00
Safety	SF1	The product is subject to strict safety controls.	0,71	0,48	0,95	0,91	0,94	0,88
	SF2	The product can be consumed without any doubts.	0,86	0,76	0,82	0,68	0,88	0,75
	SF3	The product does not contain harmful ingredients that could cause illness such as dioxins, pesticide or residues.	0,81	0,62	0,64	0,27	0,88	0,75
		∑ Items	33		35		34	
		∑ Errors	6		3		1	

Table 2: Substantive validity pretest

In the case of items that did not have both indices over the threshold, action was required to improve the item. After that another round was conducted until all indices were over the threshold in the case of all tested items. 3 rounds, with 16 to 22 participants each, were carried out. After the first round the item MO3 (the product helps me awake) was removed because it didn't reflect the intended construct mood and we realized that it is only relevant for very specific food, what wasn't aligned with our intention to create a measure instrument for various food categories. Furthermore we identified weaknesses especially for the construct of process. Therefore we had to move one item from process to health (natural ingredients) and added three more items for the construct to cover all the relevant aspects of the food production process. In addition several items were slightly rephrased to make them more clearly for the participants. After the second round the number of errors went down from 6 to 3, but one of the items we rephrased (PR1 - The product was prepared with great care and is subject to strict quality standards.) still was confusing for the participants as we could see from the substantive validity coefficient. Therefore we deleted that item and rephrased the others once more. After the third round only one error remained and

we decided to delete this item (MO1 – The product helps me to reduce stress), because participants were confused if stress is related to mood or health.

As displayed in Table 2, the number of items that do not reach the threshold of 0.5 decreased from round to round. In the final round, the indices of all items except MO1 passed the threshold so that after deleting MO1 no further modification was required. The high values of both indices, P_{sa} and C_{sv}, within the third phase (c.f. Table 2) indicate that a high measurement performance of the items is ensured. Finally, the result was a 33-item instrument that operationalizes the conceptual model for the experiment.

Conclusion

In the conducted research, it was considered how MPIS influence consumers' perception of food and thus their purchase intention. Based on an extensive literature review on MPIS as well as consumers food choice, a so far unexplored area of research has been identified by combining these research streams. In the first step these results have been transferred into a conceptual model to understand the influencing factors of MPIS on consumers' food choice. To be able to measure the impact of MPIS on specific dimensions of consumers food choice (e.g. health, safety, price) a measurement instrument was built based on the conceptual model. The measurement instrument passed a multistage process during which successful tests for substantive validity of the constructs have been applied.

In future research, a within-subject field experiment will be conducted using the described measuring instrument to compare consumers' perceived food quality before and after using a MPIS of specific food products. To increase generalizability, we designed the measuring instrument to be independent of the identification technology. However, our future research will be limited on barcode scanning, which is suitable for conducting a field experiment, but might be a limitation for the expected results.

Further research could be conducted by comparing different providers of services to identify if MPIS provided by third parties (e.g. barcoo, redlaser, codecheck) are a threat for the relationship between consumers and food producers at the PoS.

Despite the fact, that managerial implications are not expected until the complete data collection is performed, this research included insights from practice whenever possible and raised relevant questions for service providers of MPIS as well as producers of food products alike.

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