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Article

When More Information Means Less Consumer Acceptance of Innovative Food Technologies

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Future of Food Marketing



When More Information Means Less Consumer Acceptance of Innovative Food Technologies

Many technological food innovations that offer desirable added value tend to be rejected by consumers. This study investigates explicit and implicit consumer acceptance and the role that information about innovative food products plays in consumer decision making. The results show that both explicit and implicit processes influence consumer acceptance.

Levke Walten, Prof. Dr. Klaus-Peter Wiedmann, Dr. Steffen Schmidt

Every period has social trends – currently, for example, sustainability and self-optimization (e.g., IBM, 2020; Mintel, 2021) – which also influence individual eating behaviors and thus the product development and marketing of the food industry. After decades of high demand for ready-to-eat and long-shelf-life products, which are often processed with various food additives with a technological or sensory function, demand has been changing to more natural and less processed products (Euromonitor International, 2019). To meet the resulting challenges, the food industry, like any industry, must regularly reinvent itself and develop new innovations (Aschemann-Witzel, Varela, & Peschel, 2019). Although innovations usually offer strong and obvious benefits for consumers, as well as further progress for society, the rate of novel food products that are rejected by consumers when launched on the market is very high (approximately 80%) (Aqueveque, 2015).

Specifically, many consumers are skeptical of products with food additives because they are generally perceived as unnatural or unhealthy, even though additives play an important role in the food industry and their safety is extensively tested (Bearth, Cousin, & Siegrist, 2014). In this context, studies have shown that information about a product plays a fundamental role in consumer perception and has a significant impact on the product evaluations of consumers (e.g., Lee, Lusk, Miroso, & Oey, 2016; Pereira, Honorio, Gasparetto, Lopes, Lime, & Tribst, 2019). Moreover, acceptance also tends to be greater when consumers understand what they are consuming, especially if they are not very familiar with the product (Deliza, Rosenthal, & Silva, 2003). In the food

sector, in particular, consumers react to a greater extent with mistrust or even rejection of technological innovations, often due to a lack of knowledge about such innovations (Siegrist & Hartmann, 2020).

Against this background, the present work aims to investigate consumer acceptance of innovative food additives in processed foods. An empirical study experimentally tests how different levels of information to increase consumer product knowledge affect consumer acceptance of innovative food additives for the purpose of better understanding consumer decision making.

Theoretical Conceptual Background

Risk and Benefit Perception as Drivers of Consumer Acceptance

Various aspects of consumer acceptance of new (food) technologies have been identified and discussed intensively in the existing literature (e.g., Connor & Siegrist, 2010; Frewer et al., 2011). Among the most frequently studied drivers of consumer acceptance of different food technologies, perceptions of risk and benefit are considered particularly relevant (Bearth & Siegrist, 2016). In this respect, the perceptions of experts and laypeople of risk and benefit in relation to food technologies often do not match; this can have potentially negative consequences for technology implementation due to an overlooked or misunderstood acceptance gap (Hansen, Holm, Frewer, Robinson, & Sandøe, 2003). Scientific experts dealing with food safety issues generally welcome the use of innovative food technologies due to the advantages that these innovations fundamentally offer (Bearth

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& Siegrist, 2016). Based on their many years of qualified experience, these experts have increased their explicit knowledge and can therefore reflect on and evaluate innovations in detail. In comparison, laypeople rely mainly on their implicit and less explicit knowledge and use mental shortcuts (heuristics) when making evaluations, especially under uncertain conditions when they have little or no knowledge about a product, e.g., a food innovation (e.g., Kahneman & Tversky, 1979). Evidence-based marketing communications must take into account the different levels of knowledge so that society in general, and consumers in particular, can benefit from the advantages of innovative technologies and not automatically reject them. For this reason, this study examines both the explicit and implicit information processing involved in consumer acceptance.

According to Beareth and Siegrist (2016), acceptance is composed of two facets: active components and passive components. They postulate that asking consumers about their active and passive acceptance is likely to elicit different cognitive and behavioral decision-making processes. Therefore, the present study incorporates both acceptance facets. The passive component is defined here as consumer attitude (see Bohner & Dickel, 2011 for a detailed discussion about attitude) toward the product as a result of perceived risk and benefit, which in turn determines the general acceptance of the product (Ronteltap, van Trijp, Renes, & Frewer, 2007). This more passive general acceptance, in turn, influences the subsequent active component of acceptance – the willingness to buy (Rogers, 2010) – understood here as a positive product choice concerning the food innovation.

Impact of Information on Consumer Product Perception

Various aspects play a decisive role in consumers' product expectations prior to consumption. In this context, inherent cues that physically belong to the product, such as sensory properties, are often mentioned (Cardello, 2003). However, extrinsic cues, which are nonphysical elements associated with the product, such as price, origin and food safety, also influence consumer decision making to a substantial extent (Napolitano, Braghieri, Piasentier, Favotto, Naspetti, & Zanolli, 2010). In the recent past, consumer interest in non-sensory food attributes has increased, especially in terms of manufacturing methods (Deliza et al., 2003; FAO, 2015). Thus, consumers' information processing of product attributes can be significantly influenced not only by information about the product itself (e.g., quality) but

also about the manufacturing process (Deliza et al., 2003; Napolitano et al., 2010). Several studies have been able to show how targeted information influences consumers' evaluation of food, such as the effect of revealing the origin of food additives, which changed consumer attitudes toward these additives (Caporale & Monteleone, 2004). In fact, information related to a product, its ingredients or the manufacturing process can influence perceptions in such a way that consumers change their prejudicial opinions about certain aspects of the product and thus view it in a more positive light with an increased level of acceptance (Pereira et al., 2019).

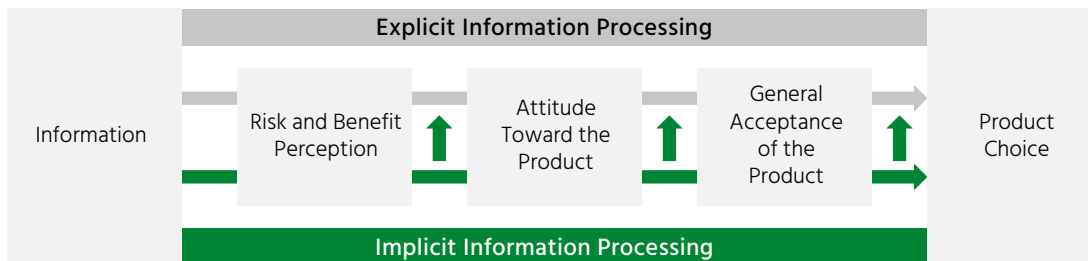
Conceptual Framework

A prerequisite for promoting the acceptance of innovative food technologies is, first, knowledge of consumer perceptions and, more importantly, an understanding of the influence of these perceptions on consumer acceptance of an innovative food technology at an implicit and explicit information processing level. Based on the above discussions and a critical literature review, the conceptual model shown in figure 1 was used to investigate consumers' acceptance of innovative food additives in processed foods.

To date, little research has involved dual-process theories of social cognition, which typically distinguish implicit (unconscious, fast, and automatic) information processes from explicit (conscious, slow, and deliberate) information processes (e.g., Evans, 2008), to explain consumer reasoning and behavior regarding innovative foods. Therefore, the present study focuses specifically on capturing (dual) implicit–explicit processes to understand consumer decision making more holistically (see Chaiken & Trope,

Management Summary

New measures to capture implicit and explicit information processing with respect to food acceptance were conceptually developed and successfully tested. The results show that both explicit and implicit processes influence consumer acceptance. Given the predictive power of the combined implicit–explicit method, marketing managers of food brands can use the presented approach to assess consumer acceptance of (innovative) food products.

Fig. 1: Conceptual Framework of Explicit and Implicit Consumer Acceptance

Source: Own illustration.

1999 for a detailed discussion of dual processes). Here, consumer acceptance of a (food) innovation, which drives product choice, is the consequence of activated attitudes toward the innovation, which in turn are influenced by the perceived risk and benefit level of the corresponding innovation. Perceived risk and perceived benefit are in turn influenced by the level of information that determines the consumers' knowledge about the innovation, i.e., what they have learned or experienced. Learning itself is a process that takes place at an implicit and explicit level of information processing (see Ellis, 2009 for a detailed discussion).

Methodology

Study Design and Material

With respect to the objective of the present study, an experiment was designed to evaluate the effects of different information conditions – low, medium and high degrees of information – considering the food additive used. A smoked ham processed with a natural smoke flavoring was used as the object of investigation. Participants were randomly assigned to one of three conditions and received the respective infor-




mation, including a picture of smoked ham, as illustrated in figure 2.

Measures and Data Analysis

The assessment of the participants' product-related risk and benefit perceptions as well as their attitudes toward and acceptance of the product

was conducted on an explicit and implicit information processing level. Specifically, an explicit self-report measure was used to capture an analytic-deliberative product assessment on a five-point Likert scale (1=strongly disagree to 5=strongly agree). Additionally, a response latency measure (BrandReact by eye square, 2020) was

Fig. 2: Experimental Stimuli for Each Condition

Low Information Condition	Medium Information Condition	High Information Condition
<p>This ham has been enriched with natural flavorings for the characteristic taste of the traditional smoking process.</p> 	<p>This ham has been enriched with natural flavorings extracted from the byproducts of food processing for the characteristic taste of the traditional smoking process.</p> 	<p>This ham has been enriched with natural flavorings extracted from the byproducts of food processing* for the characteristic taste of the traditional smoking process.</p> 

* The byproducts of food processing are substances that are not used in the food processing process but are still suitable for further processing.

Source: Own illustration.



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used as a qualified implicit measure of the consumers' spontaneous product assessment. This implicit measure is similar to the response latency approach used to capture human associative learning processes, as discussed by Craddock, Molet, and Miller (2012). The basic principle of this implicit technique is that participants are forced to decide whether a certain adjective fits a product (or brand) or not. For each adjective, two response indicators are recorded, namely the agreement rate ("yes" vs. "no" categorization) and the reaction time. Based on these response indicators, a single implicit score is calculated for each adjective, ranging from 0 (no spontaneous association) to 100 (very high spontaneous association). The items (adjectives) for the explicit and implicit assessment of risk (risky, dangerous), benefit (valuable, beneficial), attitude (great, good), and acceptance (commendatory, appreciatory) were developed as new scales, following the guidelines of Diamantopoulos and Winklhofer (2001) to ensure content specification, indicator specification, indicator collinearity, and external validity. To test the exter-

nal (here: convergent) validity of these measures, corresponding global items were used to measure participants' overall perceptions on a seven-point scale (risk and benefit) or an eleven-point scale (attitude and acceptance). External validity is given if the implicit and explicit measure correlates with the corresponding global measure.

Regarding product choice as a behavioral response indicator influenced by explicit and implicit information processing, a choice measure was used in which participants could choose among three product options with dif-

ferent specifications: regular smoked ham, smoked ham enriched with natural flavorings, or smoked ham enriched with natural flavorings derived from food processing byproducts. If participants chose the same smoked ham product that had been presented to them in advance (low information condition: choice of smoked ham enriched with natural flavorings; medium or high information condition: choice of smoked ham enriched with natural flavorings derived from food processing byproducts), then this was rated as a positive product choice, and vice versa.

Main Propositions

1. Perceived risk, in contrast to perceived benefit, is a less critical factor for a positive customer decision.
2. Except for explicit risk, all other variables exhibit at least an indirect effect on product choice.
3. Significant differences of the exposed information level are identified for implicit benefit and implicit acceptance.
4. Contrary to findings of previous research, a negative impact of presenting more information is revealed.

Table 1: Coefficient of Determination (R-Squared Value) and Average Simulated Direct Effect

IV** ↓	→ DV**	Implicit Attitude (R ² = 0.44)	Implicit Acceptance (R ² = 0.50)	Explicit Risk (R ² = 0.23)	Explicit Benefit (R ² = 0.28)	Explicit Attitude (R ² = 0.56)	Explicit Acceptance (R ² = 0.65)	Product Choice (R ² = 0.42)
Implicit Risk		-0.14*	-0.01	0.52*				-0.11
Implicit Benefit		0.69*	0.34*		0.56*			0.06*
Implicit Attitude			0.25*			0.35*		-0.04
Implicit Acceptance							0.09*	0.22
Explicit Risk						0.04	-0.07	-0.47
Explicit Benefit						0.31*	0.49*	-0.20
Explicit Attitude							0.23*	0.07*
Explicit Acceptance								0.31*

* significant average simulated direct effect (significance level of $p < 0.10$)

** IV= independent (explaining) variable, DV = dependent (explained) variable

Source: Own illustration.

Sample and Procedure

Participants from across Germany were recruited using opportunity sampling. Invitation links for active participation in the online survey were distributed on selected social networks and via e-mail. Participants were randomly assigned to one of the three experimental conditions. After participants had answered questions about their general food consumption behavior, the respective information about the food additive with which the ham was processed was shown. Next, subjects had to perform the implicit measurement test and then the explicit measurement test to evaluate their product associations. Finally, participants were asked to identify their preferred processing option for the ham product.

A total of 304 completed questionnaires from participants who regularly consume ham products was used for the further data analyses (females = 46.1%, males = 52.6%, no gender answer = 1.3%; average age: 31.98 years; low information level: $n = 110$, medium information level: $n = 96$, and high information level: $n = 98$).

Results

Empirical Findings

All explicit and implicit multi-item measures reached satisfactory values in terms of item reliability, namely, factor loading (value range: 0.829 to 0.934) and average variance extracted (value range: 75% to 89%), and internal consistency, namely, Cronbach's alpha (value range: 0.663 to 0.872) and composite reliability (value range: 0.920 to 0.986). Additionally, the results indicate both convergent (value range of Spearman's rank correlation: 0.272 to 0.679) and discriminant validity (value range of Spearman's rank correlation: 0.431 to 0.610), suggesting that the correspon-

ding implicit and explicit measures refer to related but different facets of the respective construct, which is in accordance with implicit cognition research (Nosek & Smyth, 2007). Overall, the results suggest that the quality of the newly developed implicit–explicit measurement instrument is adequate.

Against the background of the conceptual model, the estimated model

Sometimes “less is more”:
i.e., less information may lead to better
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parameters show a satisfactory level of predictive performance of the applied universal structure modeling approach (Buckler & Hennig-Thurau, 2008; Turkyilmaz, Oztekin, Zaim, & Demirel, 2013) when using the causal analytics software Neusrel (2020). In particular, the explanatory power with respect to the coefficient of determination

(R-squared value) for the difficult-to-estimate product choice (intention), calculated as a 0/1 binary variable, reaches a remarkable level of 0.42. In contrast, an alternative partial least squares (PLS) approach revealed an R-squared value of .08 for the product choice estimate, indicating no explanatory power.

Product choice is directly affected by the implicit benefit, explicit attitude and explicit acceptance, as shown in Table 1. However, except for explicit risk, all other variables exhibit an indirect effect via explicit acceptance. The highest total effect on product choice, as measured by the overall explained absolute deviation (OEAD), is indicated for implicit benefit (OEAD: 0.23) and explicit benefit (OEAD: 0.21), both showing a medium effect size with an OEAD considerably above 0.15. The other significant variables show a small-to-medium effect, with an OEAD ranging from 0.02 to slightly above 0.15 (implicit risk: 0.13, implicit attitude: 0.13, implicit acceptance: 0.14, explicit acceptance: 0.17).

Considering potential differences in the information processing among the three experimental groups, one-way ANOVA showed significant group differences for implicit benefit ($F = 4.108$, $p < 0.05$) and implicit acceptance ($F = 5.412$, $p < 0.01$), while no differences were identified at the explicit level. Based on a subsequent Wilcoxon rank-sum test, a medium effect size difference with an r value above 0.30 was observed between the low and medium information conditions ($\Delta M = 3.709$, $p = 0.001$, $r = 0.317$) and between the low and high information conditions ($\Delta M = 8.928$, $p = 0.001$, $r = 0.381$) regarding the perceived implicit benefit, with a higher value for the low condition. In contrast, no substantial difference between the medium and high information conditions was identified ($\Delta M = 5.219$, $p = 0.371$, $r = 0.064$). With

reference to implicit acceptance, a medium effect size difference was revealed between the low and medium ($\Delta M = 7.302$, $p = 0.001$, $r = 0.387$) and between the low and high information conditions ($\Delta M = 10.135$, $p = 0.001$, $r = 0.417$), again with higher acceptance values for the low information condition and no observable difference between the medium and high conditions ($\Delta M = 2.833$, $p = 0.994$, $r = 0.01$).

In terms of product choice as the key indicator of a positive behavioral response, the low information condition group shows a preference value of 13.64%, almost twice as high as that of the medium information condition

group with 7.29% ($\Delta M = 6.344$, $p = 0.001$, $r = 0.291$) and the high condition group with 8.16% ($\Delta M = 5.473$, $p = 0.001$, $r = 0.248$), which corresponds to a small-to-medium effect size.

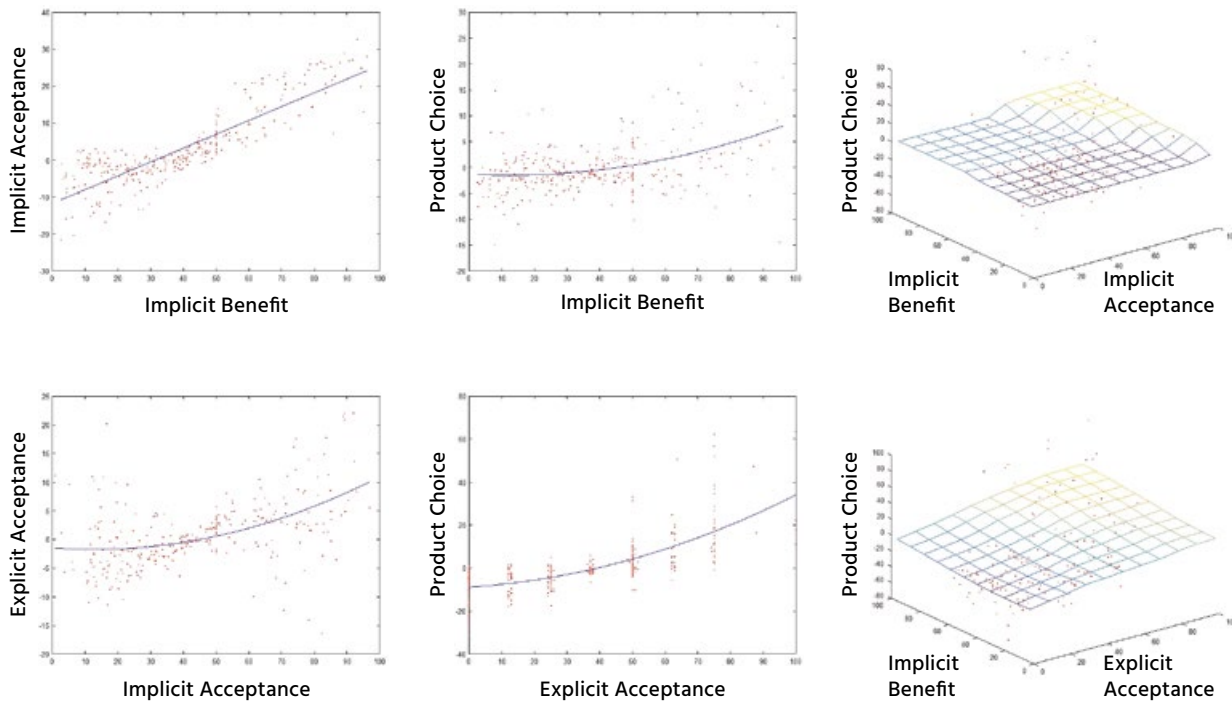
Discussion

The results of the experimental investigation show a significant effect of the level of information on the implicit benefit perception and the implicit acceptance but not on the other implicit and explicit measures. In contrast to the results of previous studies (e.g., Lee et al., 2016; Pereira et al., 2019), the present study reveals a negative impact of providing more information on consumers' product assessment. In the low information condition, the product was assessed highest in terms of implicit benefits and implicit acceptance, while in the medium and high information conditions the products were evaluated similarly but significantly less positively. A possible explanation for this effect may be the mentioning of byproducts, the applications of which are still quite unknown in Germany. Presumably, the naming of byproducts as the origin of flavor in the stimulus led to confusion rather than a better understanding among the participants, with the latter being a critical aspect in regard to the acceptance of novel foods (Deliza et al., 2003). Thus, future research should examine this aspect more carefully and in more detail.

Figure 3 provides further insights into selected direct effect pathways and interaction effects to better understand the mechanism behind the analyzed decision-making processes. Several nonlinear relationships with increasing effects are observed, e.g., higher values of implicit benefit are associated with significantly higher product choice intention. Similar effects can be observed

Lessons Learned

1. Marketing managers can use the implicit-explicit approach to identify essential prerequisites to avoid limited consumer understanding that might otherwise lead to consumer rejection of innovative food products.
2. The knowledge of this prerequisite also enables the development of targeted communication strategies aimed at educating the public to increase the societal acceptance of innovative food technologies.
3. Regarding different information levels, sometimes "less is more"; i.e., less information may lead to better product evaluations and to higher product acceptance, depending on the information context.

Fig. 3: Selected Direct Effect Pathways and Interaction Effects

Source: Own illustration.

for the influence of implicit acceptance on explicit acceptance and of explicit acceptance on product choice. Additionally, implicit benefit shows interaction effects with both acceptance dimensions with regard to product choice. Concretely, product choice intention is significantly greater when implicit benefit, explicit acceptance and implicit acceptance reach high levels. These findings stress the relevance of ensuring spontaneous (i.e., implicit) strong association activation regarding the perceived benefit for positive customer decision making in the context of innovative food products. At the same time, the results of the present study provide empirical evidence that perceived risk, as a counterpart of perceived benefit, is a less critical factor for a positive cus-

tomers decision with reference to the byproducts of innovative food processing, both on an implicit and explicit information processing level.

Conclusion


The present work provides valuable contributions and significant insights for science and business practice. First and foremost, new measures to capture implicit and explicit information processing with respect to food acceptance were conceptually developed and successfully tested. From a scientific point of view, a conceptual model was derived and presented that emphasizes the existence of two information processing pathways, an explicit and an implicit pathway, when consumers come

into contact with information about (innovative food) products. The model provides an initial frame of reference to further investigate explicit and implicit information processing related to (food) consumption in future research.

Given the predictive power and practicality of the combined implicit-explicit method, food brand marketing managers can use the presented approach to assess consumer acceptance of food, in general, and of food processed with innovative technologies, in particular, to ensure an evidence-based management foundation. Capturing the perceived implicit benefits of a food product seems to be an essential prerequisite to avoid a limited consumer understanding that could otherwise lead to, for example, the over- or underestimation

on of both the opportunities and threats of the development and launch of a product. Knowledge of this prerequisite also enables policy makers to develop communication strategies and materials

aimed at educating the public, thereby indirectly increasing the overall societal acceptance of innovative food technologies by addressing this predictive factor. Additionally, the findings regarding dif-

ferent information levels in the sense of "less is more" (i.e., less information may lead to a better product evaluation and thus to higher product acceptance) should be taken into account. 

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