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The importance of haptics in sensory marketing

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I DEDICATE THIS DISSERTATION TO

THE BEST FAMILY EVER

Articles in this cumulative dissertation

Kühn, F. (2021). Analyzing the importance of need for touch in consumer behavior. Under review at *Journal of Business Research.*

Throughout this dissertation referred to as „Essay 1".

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Throughout this dissertation referred to as „Essay 2".

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Throughout this dissertation referred to as „Essay 4".

Changes regarding the published article, page numbers, and reference format are of cosmetic nature only in order to increase readability.

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List of abbreviations

Abbreviation	Long form / Definition
ACBC	Adaptive choice-based conjoint analysis
ACR	Advances in Consumer Research
AFFEC	Affective response
AMS	Academy of Marketing Science
aNFT	Autotelic need for touch
ANOVA	Analysis of variance
AVE	Average variance extracted
BYO	Build-you-own
Calm	Calmness
CBC	Choice-based conjoint analysis
ChVi	Cherry vine tomatoes
CI	Confidence interval
CR	Composite reliability
DFFITS	Difference in fits
DV	Dependent variable
Elst	Elstar (apple)
GrSm	Granny Smith (apple)
GoDe	Golden Delicious (apple)
H	Hypothesis
HOT	Houldout task
IFH	Institut für Handelsforschung
iNFT	Instrumental need for touch
IT	Interface type (direct vs. indirect touch interface)
JBR	Journal of Business Research
JCP	Journal of Consumer Psychology
JCR	Journal of Consumer Research
JM	Journal of Marketing
JR	Journal of Retailing
MDMQ	Multidimensional mood state questionnaire
Mod.a.NFT	Moderation through autoutelic need for touch

Mod.IT	Moderation through interface type
NFT	Need for touch
NP	None parameter
PE	Product evaluation
PI	Purchase intention
PiLa	Pink Lady (apple)
PIM	Price importance
Please	Pleasantness
PLS-SEM	Partial least squares structural equation modelling
PM	Psychology & Marketing
PRISMA	Preferred reporting items for systematic reviews and meta-analyses
QUAL	Quality concerns
RMSE	Root mean squared error of prediction
Roma	Roma tomatoes
SD	Standard deviation
SE	Study enjoyment
TI	Touch interface
Vine	Vine tomatoes
Wake	Wakefulness
WTP	Willingness to pay

Structure of the thesis

This doctoral thesis presents the results of comprehensive research in the field of sensory marketing. In particular, the thesis focuses on consumers' psychological processes in the contexts of online retailing, sensory product research, and quantitative market research. Referring to these topics, four essays highlight the importance of haptics and personality traits in consumer decision making. Although previous studies already identified the relevance of haptics in the context of consumer research (e.g., Klatzky & Lederman, 1992; Peck & Childers, 2003a), this research field is still under-developed.

Most notably, with technological advancements such as the triumphant march of touchscreens, the sense of touch takes a new position in society (Melumad & Pham, 2020). Specifically, the global market for touchscreens reached a value of $60,3 billion in 2020 and is about to grow by 66% within the next seven years (Research And Markets, 2020). Consumers interact with other individuals and purchase products online via direct touch interfaces (e.g., smartphones) wherever and whenever they want (Chung et al., 2018).

The issue becomes even more intriguing when considering that consumers differ in their personality traits, specifically in their need for haptic experience, conceptualized as a consumer's need for touch (NFT) (Peck & Childers, 2003a). NFT is defined as the "*preference for the extraction and utilization of information obtained through the haptic system*" (Peck & Childers, 2003a, p. 431). Consumers high in NFT actively seek for haptic input and possess a higher ability to assimilate it. They use sensory feedback in order to acquire more information about a product. NFT consists of two dimensions: instrumental NFT (hereafter: iNFT) and autotelic NFT (hereafter: aNFT). Individuals with a high iNFT use the haptic input in order to achieve a specific goal such as choosing the best option out of a variety of offered products (Pino et al., 2020). Haptic input provides them with specific information that cannot be gathered from other sensory inputs, such as visual examination (Jin, 2011). High aNFT individuals use haptic feedback for a hedonic purpose (Peck & Childers, 2006). The sensory input obtained through the haptic system generates satisfaction and enjoyment, leading to affective reactions (Peck & Johnson, 2011).

Against this background, the thesis "touches" two main topics in the field of sensory marketing. First, the identification and impact of consumers' characteristic trait NFT, and second, the importance of direct touch interfaces (e.g., smartphones) compared to indirect touch interfaces (e.g., computer mouse) in consumer decision making, involving online retailing, sensory product research, and market research techniques, such as conjoint analysis.

Concerning the first topic, in order to quantify individuals' differences in NFT, Peck and Childers (2003a) established the NFT scale. The scale consists of 12 items, whereas six items refer to iNFT and six items to aNFT. Including this scale in their experimental studies, previous authors identified that NFT impacts individuals' feelings (e.g., Cano et al., 2017; Peck & Childers, 2003b), their intentions (e.g., Choi & Taylor, 2014; Yazdanparast & Spears, 2013) as well as their actions (e.g., Nuszbaum et al., 2010; Streicher & Estes, 2016). This thesis examines the impact of NFT in two research fields that were previously neglected in this domain, namely, sensory product research and quantitative market research.

Concerning the second topic of varying interface types (i.e., direct vs. indirect touch), technological advancement has undoubtedly changed sensory marketing. Consumers have internalized purchasing products via direct touch interfaces such as smartphones and tablets compared to indirect touch interfaces such as a keyboard/computer mouse combo (Wang et al., 2015). In this context, Brasel and Gips (2015) indicated that touching a product via a touchscreen is, in fact, a metaphor for actual haptic product experience. The use of direct (vs. indirect) touch interfaces specifically leads to perceived object interactivity, which further increases the imagined haptic product information's vividness (Brasel & Gips, 2014). This thesis analyzes how the vicarious touch experience, which touchscreens provide, influences consumer decision making in product purchase situations (online retailing), sensory product research (tests for consumers' taste acceptance), as well as in new products and services evaluation (quantitative market research).

Essay 1 consists of a systematic literature review of studies that examine NFT in experimental consumer studies. This essay contributes to sensory marketing in three ways. First, the review acknowledges the increase of NFT research in marketing and psychology. Specifically, results point out 42 articles in top-tier journals that have focused on NFT in their research since 2003. Second, the systematic overview demonstrates the great relevance of the topic by clarifying that NFT matters in all four phases of consumers' decision making process. By applying the Rubicon model of action phases (Gollwitzer, 1990; Heckhausen & Gollwitzer, 1987), results illustrate that NFT influences consumer behavior in the predecisional, preactional, actional, and postactional phase. Third, based on this review, the study points out a variety of further research recommendations highlighting the emerging potential of NFT in sensory marketing. The most relevant research gaps are presented in the following:

(1) The increasing trend of direct touch interface usage compared to indirect touch interface usage, which affects consumers' attitudes, emotions, and actions.

(2) The importance of NFT in environments in which the haptic input is not available a priori, such as in online retailing.

(3) The relevance of touch surrogates such as videos that represent vicarious touch in order to compensate for consumers' missing haptic input in conditions without direct touch opportunities.

(4) The understanding that NFT is especially relevant for products that include specific characteristics. Some products such as clothes possess a higher touch diagnosticity (i.e., the extent to which touching an item is important during product evaluation) compared to others such as books that possess a lower touch diagnosticity.

(5) The limited number of studies analyzing the relevance of haptics in the market research process by examining the importance of touch for consumers' product and feature preferences.

Currently, essay 1 is in the revision process of the special issue "Systematic Literature Reviews in Consumer Behavior and Customer Behavior" in the *Journal of Business Research*.

The following three essays help to close the most relevant research gaps that have been identified in essay 1. Figure 1 presents which research gaps are adressed by which of the following essays.

Essay 1 Research gaps / Essay	**(1) Touch interfaces**	**(2) Online shopping**	**(3) Touch surrogates**	**(4) Product characteristics**	**(5) Market research**
Essay 2 The touchy issue of produce: Need for touch in online grocery retailing	direct vs. indirect	pre-purchase stage	video	high vs. low touch diagnosticity	
Essay 3 How touch feeds taste in online produce retailing	direct vs. indirect	post-purchase stage	touch interface		
Essay 4 Getting 'in touch' with your future customers: The influence of user interfaces in adaptive choice-based conjoint analysis	direct vs. indirect				adaptive choice-based conjoint analysis

Figure 1 Research contribution

Referring to Figure 1, all essays analyze the impact of direct (vs. indirect) touch interfaces on either consumers' affective response (essay 2), product evaluation and WTP (essay 3), or product preferences and price sensitivity (essay 4). Essay 2 additionally identifies the importance of haptics in online shopping in the pre-purchase stage. It also focuses on product characteristics referring to produce with high (vs. low) touch diagnosticity. Finally, essay 2 mentions that touch surrogates are especially relevant for high NFT consumers in the case of high touch diagnostic products. Essay 3 examines the importance of haptics in online shopping in the post-purchase stage after product experience. It highlights that using direct touch interfaces (vs. indirect ones) serves as a compensation method for the missing haptic input leading to a better product evaluation. Essay 4 focuses on the limited number of studies analyzing the relevance of haptics in quantitative market research. It demonstrates how haptic input via a direct touch (vs. indirect touch) interface impacts answering behavior in adaptive choice-based conjoint analyses (ACBC) (Johnson & Orme, 2007) and how consumers' NFT moderates this relationship.

Essay 2, across a lab-pilot study and two online studies, demonstrates the influence of NFT in online retailing. Specifically, results contribute to consumer research and marketing practice in at least five ways. First, analyses identify that NFT impacts consumers' cognitive and affective processes when evaluating produce (bell peppers and bananas) presented in an online shop. Results show that high NFT consumers possess higher quality concerns of online offered produce and a lower affective response, resulting in a lower intentions to consume and purchase products.

Second, the research highlights the economic consequences for online retailers. NFT significantly influences the price premium consumers are willing to pay (WTP) for offline over online offered produce. Higher NFT values go hand in hand with a higher price premium. This relationship is serially mediated by consumer's quality concerns and affective response. The current research, therefore, provides a plausible explanation for consumer differential adoption behavior in online grocery shopping.

Third, interestingly, using a direct (vs. indirect) touch interface diminishes the negative effect of NFT on affective response. Considering the recent shift towards increased utilization of direct touch interfaces, this finding is of particular importance.

Fourth, study 3 in essay 2 investigates different design features online retailers could utilize to overcome the quality concerns and negative behaviors of high NFT consumers. Presenting a video of hands that experience the produce haptically serves as a touch surrogate, suppressing the negative effect of NFT on WTP.

Finally, the essay highlights that the influence of NFT on WTP is highly product-specific. Produce with low touch diagnosticity (e.g., melons) seems to be unaffected by the negative consequences of high NFT values. The essay reveals NFT as a reason why some consumers still hesitate to buy high haptic important products online.

Parts of this paper were presented in 2019 at the *81st Annual Conference of the German Academic Association of Business Research* in Rostock as well as at the *22nd AMS World Marketing Congress* in Edinburgh (Kühn et al., 2020b). The full paper was published in the *Journal of Business Research* in 2020 (Kühn et al., 2020c). Finally, some of the findings were disseminated in the *Produce Business* magazine in 2020 (Kühn et al., 2020a).

Essay 3 replicates the findings of essay 2 concerning consumers' negative expectations towards online offered produce, which emerges through the inability to experience the products haptically. These negative expectations explain consumers' lower WTP for online products than products purchased from the usually preferred stationary store. Essay 3 extends the scope of research by analyzing how these negative expectations even impact the evaluation of produce after consumers tasted them in the post-purchase stage. More precisely, consumers who think they have received online (vs. offline, including haptic contact with the products) offered produce reported lower taste liking, were less willing to pay for them, and consumed less of the offered products in the studies that use a fake tasting test as a deception mechanism. In fact, both groups in the offline and online retailing condition of the lab experiments received randomly sliced apples and tomatoes. Thus, consumers rated the produce better because they just think they have experienced the produce haptically in the pre-purchase stage.

The second lab study clarifies that the devaluation of online (vs. offline) offered produce is likely due to missing haptic input in online retailing. Specifically, browsing an online shop via direct touch interfaces serves as a solution. Touching the products on a direct touch interface is mentally close to the action of actually touching the focal product. Using a direct touch interface (tablets) compared to an indirect one (computer mouse) helps to reduce consumers' negative expectations so that the adverse effects in the post-purchase phase disappear. First, the essay presents that consumers do not always learn adequately about products' quality from the product experience and that negative expectations from the missing haptic input spill over to the post-purchase stage. Second, with direct touch interfaces, the essay provides a solution for the missing haptic input leading to important managerial and practical implications for online retailers.

Findings of the research were presented at the *Research Colloquium at the University of South Florida* in 2018 and virtually at the *49th AMS Annual Conference* in 2020. The plan is to submit the full paper in *Psychology & Marketing* in the course of the year 2021.

Essay 4 finally broadens the scope of research by focusing on the importance of haptics in a quantitative market research process. It analyzes the impact of touch interface type on adaptive choice-based conjoint analyses (ACBC). In general, conjoint analysis is one of the most widely applied quantitative market research techniques (Schlereth & Skiera, 2017). Until now, research on touch interfaces' influences almost exclusively considers consumers' purchasing processes such as the consideration of goods in online retailing. To date, nobody has examined how the use of direct (vs. indirect) touch interfaces influences consumer responses when using market research techniques like conjoint analysis. Essay 4 presents a first endeavor to fill this research gap. Contrary to classical choice-based conjoint analysis (CBC), this essay uses ACBC to include more of the psychology behind consumer decisions (e.g., noncompensatory decision rules, idiosyncratic consideration sets). Drawing on a meta-analysis, an online study, as well as a lab experiment, the essay shows that the interface type (direct vs. indirect touch) influences ACBC's elicited estimates for consumers' WTP.

An initial meta-analysis of 12 ACBC studies involving various products and services and conducted in different countries by academia and industry stresses that the usage of direct instead of indirect touch interface leads to a higher estimation of WTP defined as the build-your-own (*BYO*) price in an ACBC. Put differently, consumers in the first stage of the ACBC interview flow compile more expensive ideal products/services, given specific feature prices when using a touchscreen vs. other interfaces.

A subsequent online ACBC study on mobile tariffs replicates this finding and additionally unveils that the interface type additionally impacts estimates of product demand and price sensitivity. The *BYO* price mediates these effects, leading to increased product demand and decreasing consumers' price importance when using a direct (vs. indirect) touch interface. Based on this study's results, a market simulation highlights that ACBC results obtained from consumers using a direct (vs. indirect) touch interface lead to higher anticipated revenue and market demand predictions.

The second study of essay 4 replicates the findings of study 1 under controlled conditions and points out an explanation for the influence of touch interface on *BYO* price. Consumers experience more enjoyment during the market research process (i.e., an ACBC interview) when using a direct as compared to an indirect touch interface. Interestingly, this explanation holds solely for high aNFT consumers who experience higher study enjoyment when completing the ACBC study. Thus, as conceptualized in the theory section of the essay, a moderated mediation model involving interface type as independent, study enjoyment as a mediator, aNFT as a moderator, and the *BYO* price as dependent variable is supported by the data. Therefore, the essay points out important practical implications. Market researchers should pay close attention to the dissemination of touch interface types in study samples when comparing different studies. Furthermore, market researchers should align the type of interface used in ACBC with the interface type actually used to purchase – at a later stage – the products under research.

The main findings of essay 4 were presented at the *50th AMS Annual Conference* in 2021. The complete paper is currently under review in the 2nd round in the *Journal of Consumer Psychology*.

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Essay 1

Analyzing the importance of need for touch in consumer behavior: A systematic literature review

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Abstract

This research presents a systematic literature overview of previous studies in top-tier journals that analyzed need for touch (NFT) in the marketing and psychology fields. The purpose of this paper is twofold. First, the literature research results in 42 articles that highlight the relevance of NFT in consumer behavior. This study emphasizes NFT’s importance in all psychological phases of consumer’s decision making process by applying the Rubicon model of action phases. By identifying the haptic conditions and the experimental settings used in NFT literature, one can categorize each article according to its decision making process. Second, with respect to the systematic overview, this paper establishes further research directions for NFT that are highly relevant for both research and practice.

Keywords: Experimental setting, Haptic condition, Need for touch, Rubicon model of action phases, Systematic literature review

Analyzing the importance of need for touch in consumer behavior:

A systematic literature review

1. Introduction

The importance of touch in consumer behavior has steadily increased, mainly due to evolving external factors such as environmental conditions and technological advancement. The rising use of direct touch interfaces (e.g., smartphone with a touchscreen) compared to indirect touch interfaces (e.g., keyboard/mouse combo) has changed consumers' retailing behavior (e.g., Chung et al., 2018; R. J. Wang et al., 2015). Consumers are able to evaluate and purchase products anytime and anywhere (e.g., McLean et al., 2018). Furthermore, the COVID-19 pandemic has influenced consumer behavior in both online and offline retailing. In general, the pandemic has increased online retailing as well as specific online services offered by physical stores, where haptic feedback is excluded a priori (Pantano et al., 2020). Additionally, due to the COVID-19 pandemic consumers' haptic experience in physical stores is restricted even further when trying to select the best product – defined as the "touch it, take it" policy (Bove & Benoit, 2020).

It is therefore particularly interesting that consumers' need for touch (NFT) differs during the decision making process. NFT is defined as the "*preference for the extraction and utilization of information obtained through the haptic system*" (Peck & Childers, 2003a, p. 431). Consumers with a high NFT have concerns about purchasing products without experiencing them haptically, which leads to a lower sense of wellbeing (Pantano et al., 2020). Referring to previous literature, which showed NFT's impact on consumers' feelings (Nuszbaum et al., 2014), attitude (Krishna & Morrin, 2008), and purchasing decisions (Spears & Yazdanparast, 2014), this systematic overview identifies the relevance of NFT in consumer behavior. The review results in 42 NFT articles, which are divided into one of the four action phases of the Rubicon model (Gollwitzer, 1990; Heckhausen & Gollwitzer, 1987). This division process shows that NFT impacts all four stages of consumers' decision making process highlighting the importance of NFT in consumer behavior. The paper extends the scope of research by presenting the haptic conditions and research settings of the articles. Results of the qualitative synthesis further stress that the field of NFT is still under-researched. This paper therefore systematically identifies new research directions for NFT that are indispensable in understanding consumer behavior.

2. Theoretical background

2.1. Haptic conditions in consumer behavior

Human beings' sense of touch is their most important sense, it is already developed in unborn babies and lasts longest in old age. Klatzky and Lederman (1988) defined consumers' hands as their "outer brain" used to experience three dimensional objects. Haptic input helps consumers define product specifications like texture, hardness, temperature, and weight, which is not possible through any other senses (Klatzky & Lederman, 1992). In order to structure the importance of haptics in consumer behavior, researchers mainly focused on four conditions: availability of touch (vs. no-touch), product characteristics, environmental salience, and compensation methods. The conditions are often interrelated so that researchers include more than one condition in their experimental studies. For the first condition, previous literature examined differences in consumers when haptic input is available compared to when it is not. Peck and Shu (2009) showed that touching a product leads to an increase in consumers' psychological ownership and to a higher valuation of product. It seems that consumers' attitude and feelings toward a product change when they are not able to experience the product haptically. Specifically, Peck and Wiggins (2006) pointed out that consumers' opinion of a product decreases when they cannot utilize haptic information.

While several researchers focused on the availability vs. unavailability of haptic input, products themselves differ in their haptic importance (e.g., Brasel & Gips, 2014). Some product categories such as clothes and fresh produce, have a higher touch diagnosticity compared to products such as technical devices and books, which do not require as much physical inspection (Jung et al., 2014; Kühn et al., 2020). Consequently, high material property products supply haptic information that is important in consumers' decision making process. Additionally, with the increased use of technology, researchers analyzed how products' technologically mediated haptic feedback impacts consumers' responses. Researchers identified that vibrational alerts on mobile phones increase consumers' physical performance (daily movement and healthy eating habits) (Hadi & Valenzuela, 2020).

When considering haptics in consumer behavior, the environment plays a substantial role (e.g., Imschloss & Kuehnl, 2019). Researchers studied consumers' reactions when a banner invited them to touch a product (Peck & Childers, 2006), as well as when an employee actively prohibited touch (Ringler et al., 2019). Another environmental factor is that of interpersonal touch, either accidently by a stranger (Martin, 2012) or on purpose by a salesperson or waiter

(Luangrath et al., 2020). Finally, the online environment also turns out to be important when discussing haptics, as sensory interaction during the retailing process is mainly limited to visual input (Petit et al., 2019).

In order to find touch surrogates, previous researchers focused on specific compensation methods (Peck et al., 2013). These methods range from psychological solutions such as haptic imagery (Peck et al., 2013) to technological solutions such as virtual reality (Petit et al., 2019). Other solutions like 3D pictures also compensate for the inability to touch (Choi & Taylor, 2014). Further, it seems that touch interfaces impact consumer behavior (Chung et al., 2018; R. J. Wang et al., 2015). When using a direct touch interface, such as a smartphone, touching the screen is similar to touching the actual product (Brasel & Gips, 2014), leading to higher engagement during the purchasing process (Chung et al., 2018).

2.2. Experimental setting in consumer behavior

To date, when analyzing the power of touch in an experimental setting, marketing and psychology literature has had a product-related context. Consumers with a high NFT receive a greater reward from touching a product than those with a low NFT. This transpires as more information is received through haptic input. When analyzing the impact of NFT within the decision making process, researchers put their participants in one of three experimental settings: product evaluation, product purchase, or product use. In some papers, the research setting is extended to include one of the other settings. For example, Krishna and Morrin (2008) questioned consumers' opinion in a product evaluation setting and, afterwards, analyzed consumers' willingness to pay (WTP) in a follow-up study. Kühn et al. (2020) asked consumers to evaluate the product quality within a product purchase setting.

According to product evaluation, numerous literature showed that high NFT individuals evaluate a product better when they are able to touch it (Peck & Childers, 2003b; Peck & Wiggins, 2006). Other research focused on specific product characteristics and the type of sensory feedback interacting with NFT. Grohmann et al. (2007) demonstrated that high NFT consumers evaluate a high quality product better than those with a low NFT. Besides directly focusing on product evaluation, numerous articles examined feelings which occur during the evaluation process. High NFT consumers are more frustrated when they cannot touch a product (Peck & Childers, 2003b). On the contrary, when using visual rotation and tactile simulation features on touch screens, consumers experience higher engagement during the product evaluation process (Cano et al., 2017).

Within the product purchasing setting, NFT impacts consumers' purchasing intention (Spears & Yazdanparast, 2014) and their WTP (Kühn et al., 2020). Peck and Childers (2006) presented that offline environmental silence of touch (with a purchase sign "feel the freshness") leads to more impulse purchases. Researchers highlighted that NFT impacts consumer behavior, especially before the online retailing process, so that high NFT consumers have a higher search intention (Aw et al., 2021) and use omnichannel commerce more often (Rodríguez-Torrico et al., 2017).

In particular, psychological research dealt with high NFT consumers in a product usage setting. Elhai et al. (2016) and Lee et al. (2014) pointed out that high NFT individuals use their smartphones compulsively because of the satisfaction they get when touching the screen (Lee et al., 2014). S. V. Jin and Phua (2015) focused on consumers' attitude toward in-gaming advertisements for car accessories when using a gaming device either with or without force feedback. The authors show that high NFT consumers have a better opinion of the brand when they use a device with no force feedback due to the non-diagnostic haptic cue.

2.3. Rubicon model of action phases

In a product-related experimental setting NFT impacts consumers' decisions. To examine in detail what the impact is, this study defines the psychological phases of a decision making process based on the Rubicon model of action phases (Gollwitzer, 1990; Heckhausen & Gollwitzer, 1987). The Rubicon model was established by Gollwitzer (1990) and presents four different phases of consumers' decision making process, starting with the individual's awareness of a specific need and ending with their evaluation of the action outcome. Today, researchers use the Rubicon model to analyze the psychological processes behind individuals' actions in different research fields such as business economics (Delanoë-Gueguen & Fayolle, 2019), international security (Johnson & Tierney, 2011), education (Netz, 2015), and healthcare (Barker et al., 2018).

An initial empirical study by Heckhausen and Gollwitzer (1987) identified a motivational and volitional state of mind which can be clearly differentiated. While the motivational mind-set asks, "*Why* do individuals behave like this?", the volitional one asks, "*How* an individual does a specific action?" The four action phases include these mind-sets and are defined as the predecisional motivational phase, the preactional volitional phase, the actional volitional phase, and the postactional motivational phase.

The predecisional phase focuses on consumers' motivation before even setting or striving for a specific goal to analyze their intention to start and perform a specific action (Gollwitzer, 1990). This phase is characterized by deliberating and wishing. Deliberating refers to weighting up an action's advantages and disadvantages because one has not yet decided which action to perform (Keller et al., 2020). The individual takes into account different ways to achieve the desired goal, the effort and time it will take (which often depends on the individual), their abilities, and the goal's achievability (Gollwitzer, 1990). Wishing refers to consumers' desire and anticipation to achieve the goal (Spiess & Wittmann, 1999). On the one hand, awareness of a desire can come about through intrinsic factors like personal knowledge and present mood (enjoyment, satisfaction). On the other hand, external environmental factors can awaken this desire in consumers.

When consumers' desire for action is high enough and the feasibility is understood, the wish changes into an intention, initiating the preactional phase (Gollwitzer, 1990). In this planning stage individuals clarify the action (Spiess & Wittmann, 1999). They try to answer the questions "*When* should I start the action?", "*Where* should I start the action?", "*How* should I manage the action?", and "*How* long does the action last?" (Gollwitzer, 1990).

Both the preactional and the actional phases include the volitional mind-set and it is not always easy to identify when one phase ends and the next begins (Gollwitzer, 1990). The individual's strength of volition and favorability for the action determines the actional phase's commencement. The strength of volition depends on individual factors such as characteristic traits (proactivity, impulsiveness) and personal experiences (desired outcome of past actions). The favorability of an action refers to their goal intentions, which may be achieved simultaneously. These intentions may not always be achieved at the same time and not when future action is expected to provide an even more favorable outcome (Gollwitzer, 1990). If a specific level of volition and favorability of the action holds, consumers overcome external factor obstacles and act to achieve the specific goal (Keller et al., 2020).

The postactional phase consists of the evaluation of the action as well as the consideration of future goal directions (Keller et al., 2020). Consequently, the individual identifies if the goal was reached successfully so that the entire decision making process comes to an end. Additionally, the individual might check, if the goal conforms with the previous expectation (Gollwitzer, 1990). If this is not the case and the observed outcome negatively disconfirms the expectations, the individual can either adapt future plans or their own expectations. Adapting future plans means learning from the observed outcome, which serves as a motivation for improving future planning processes. Adapting one's own expectations means lowering the individual benchmark to validate the observed and expected outcome (Gollwitzer, 1990).

3. Systematic literature review

3.1. Procedure

The study uses the PRISMA approach (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) to collect the appropriate data for a systematic literature review (Moher et al., 2009). The aim is to identify top-tier articles in consumer behavior that focus on NFT in their experimental research. For this purpose, the study first uses the marketing and psychology journals listed in the 1st quartile of the SCImago Journal & Country Rank in 2021 (SCImago, 2021). As a result, it focuses on 47 marketing journals and 65 psychology journals. Second, based on these journals, the study uses the key terms "need for touch" and "NFT scale" in Google Scholar and EBSCOhost database searches. In order to identify consumers' different need for haptic input, Peck and Childers (2003a) established the NFT scale. Previous literature presents other scales (e.g., need for tactile input (NFTI) (Citrin et al., 2003), comfort with interpersonal touch (CIT) (Webb & Peck, 2015)) in order to measure touch in consumer behavior, highlighting the increasing importance of this topic. Although there are other measurement approaches, this research looks at articles that use the NFT scale, as it is primarily applied in marketing and psychology research. The scale spans two dimensions (six items in each dimension): instrumental NFT (hereafter: iNFT) and autotelic NFT (hereafter: aNFT). High iNFT individuals have a specific intention. Their need for haptic information is goal oriented, as they use tactile information to choose their best option (Pino et al., 2020). The haptic input provides them with information that cannot be gathered from other sensory inputs, such as visual examination (S.-A. A. Jin, 2011). High aNFT individuals need haptic feedback for hedonic purpose (Peck & Childers, 2006). They need the tactile input for enjoyment and are engaged by exploratory variety seeking, which might lead to affective reactions (Peck & Johnson, 2011). Finally, the year of journal publication was restricted as the scale was only established in 2003 (Peck & Childers, 2003a).

Besides 275 database articles, the study also presents 252 articles from the journal websites. Following the PRISMA procedure and after removing duplications, the study identified 74 full-text articles that need to be reviewed. Figure 1 shows these 74 articles and emphasizes the increasing importance of NFT in consumer behavior. The graph presents the evolution (cumulative amount) since 2003.

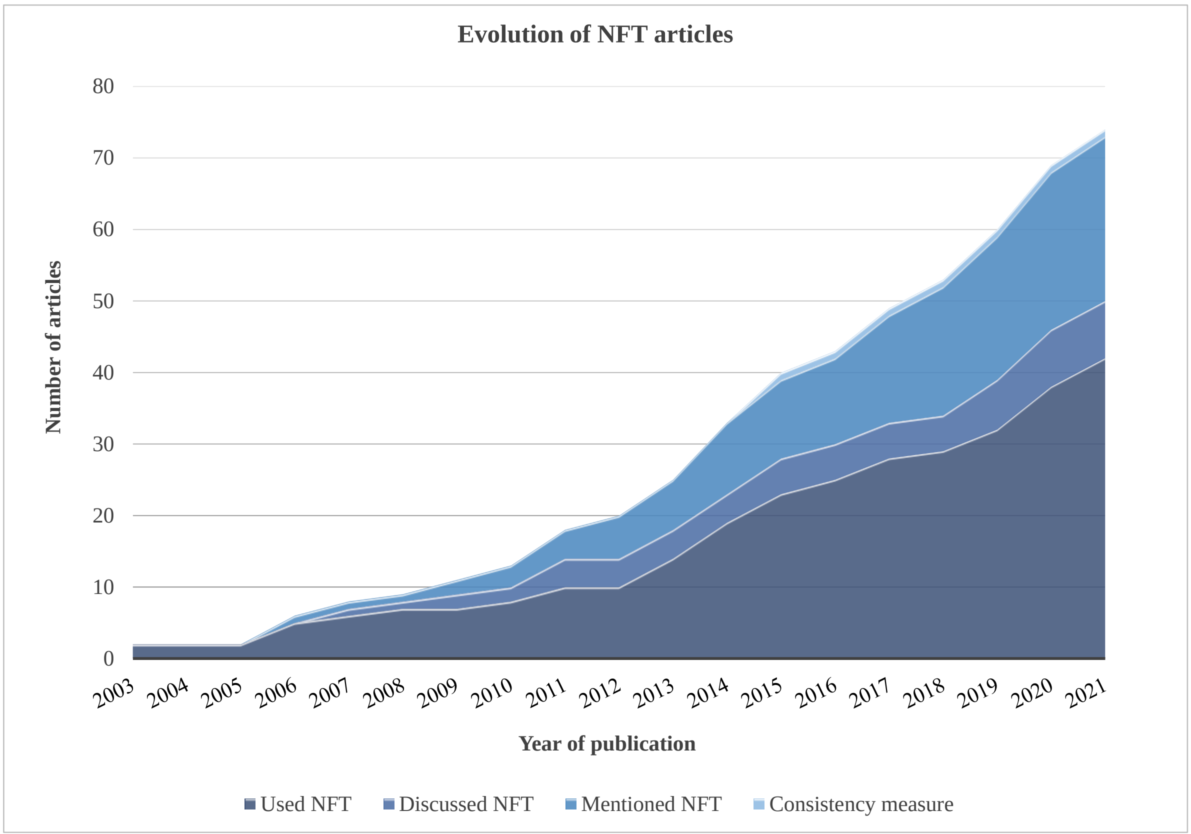

Figure 1 Evolution of NFT articles since 2003

Referring to these 74 full-text articles, 32 were further excluded for the final analysis as they do not use the NFT scale in their experimental research. 23 of these articles mentioned the NFT scale and remarked on the scale's promising research potential. They pointed out the importance of NFT when focusing on product properties (e.g., Krishna et al., 2017; Spence, 2012), virtual environments (e.g., Dholakia et al., 2010; Yadav & Pavlou, 2014), and touch interfaces (e.g., Chung et al., 2018; Mulcahy & Riedel, 2020). Eight articles discussed the NFT scale in detail. Three of them are review articles: one focused on sensory marketing (Krishna, 2012), and two on multisensory digital experiences (Petit et al., 2019; Spence & Gallace, 2011). The paper by Lurie and Mason (2007) extends this scope of research by presenting a framework in which NFT serves as a virtual world moderator. Two papers included NFT in their Fuzzy Set Qualitative Comparative Analysis (Aw, 2021; Santos & Gonçalves, 2019). The last two of the eight papers were experimental papers, but were also excluded from the qualitative synthesis as they did not use the NFT scale in their experiments (González-Benito et al., 2015; Peck & Shu, 2009). Finally, the paper of Webb and Peck (2015) was excluded as it used the NFT scale for consistency measurement but not during experimental studies.

Consequently, the analysis came up with 42 articles. Figure 2 shows the process of the PRISMA flow diagram, which started with a total of 527 articles.

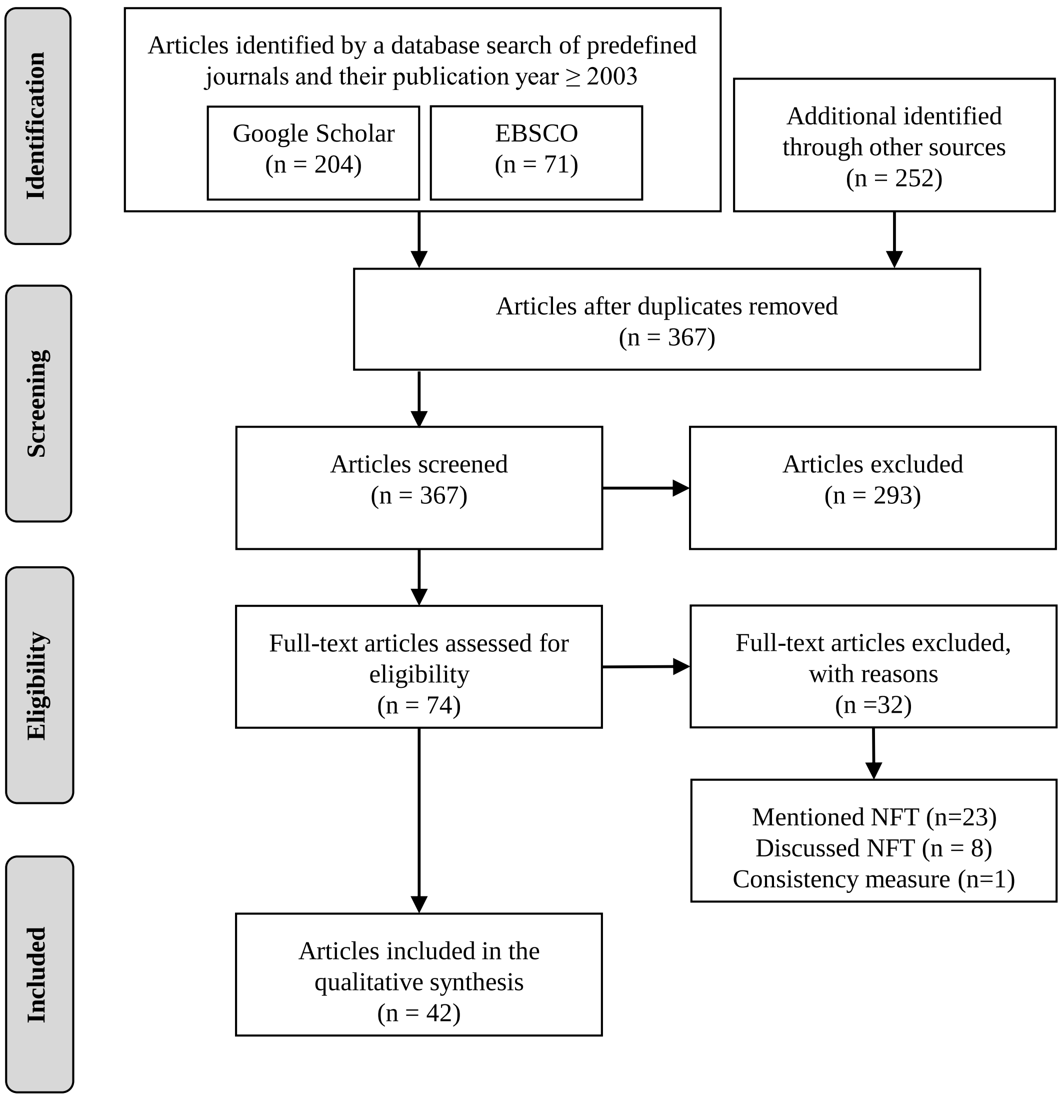

Figure 2 PRISMA flow diagram

Table 1 presents the 42 final articles used in this research according to their publication journal. Most articles are published in the *Journal of Business Research*, followed by *Psychology & Marketing* and *Computers in Human Behavior*.

Table 1 Set of experimental full papers using the NFT scale

Journal of Marketing	***International Journal of***	***Journal of Retailing and***
Peck and Wiggins (2006)	***Research in Marketing***	***Consumer Services***
Schlosser et al. (2006)	Homburg et al. (2019)	Aw (2021)
Peck and Childers (2003)		Shankar and Jain (2021)
	Journal of Business Research	Silva et al. (2021)
Journal of Consumer	Manshad and Brannon (2021)	Duarte and e Silva (2020)
Research	Kühn et al. (2020)	Pantoja et al. (2020)
Krishna and Morrin (2008)	Pino et al. (2020)	
Peck and Childers (2003a)	Yoganathan et al. (2019)	***Computers in Human Behavior***
	Choi and Taylor (2014)	Rodríguez-Torrico et al. (2017)
Journal of Consumer	Rosa et al. (2014)	Cano et al. (2017)
Psychology	Peck and Childers (2006)	Elhai et al. (2016)
Streicher and Estes (2016)		S. V. Jin and Phua (2015)
Spears and Yazdanparast (2014)	***Marketing Letters***	Overmars and Poels (2015)
Brasel and Gips (2014)	Wang et al. (2020)	Lee et al. (2014)
Peck et al. (2013)		
	Psychology & Marketing	***Personality and Individual***
Journal of Retailing	Ranaweera et al. (2021)	***Differences***
Ringler et al. (2019)	Imschloss and Kuehnl (2017)	Tuncdogan and Ar (2018)
Herhausen et al. (2015)	Chylinski et al. (2015)	
Orth et al. (2013)	Yazdanparast and Spears (2013)	***Social Psychology***
Grohmann et al. (2007)	S.-A. A. Jin (2011)	Nuszbaum et al. (2014)
	Peck and Johnson (2011)	Nuszbaum et al. (2010)

In order to structure the sighted literature, the study identifies which haptic conditions previous researcher focused on. The study points out if the research examined if touching a product was an option (vs. not touching), specific product characteristics, the environmental salience, and/or compensation methods. Further, the research categorizes the articles based on their research setting (product evaluation, product purchasing, product usage). The study also presents the variables supposedly impacted by NFT, based on the researchers' suggestions. To create clarity, the study consolidates the wording of dependent variables which focus on the same content. The study assigned quality perception (Imschloss & Kuehnl, 2017), quality concern (Kühn et al., 2020), persuasion (Peck & Johnson, 2011), perceived texture (Chylinski et al., 2015), and product personality dimension (Ranaweera et al., 2021) to product evaluation, as well as webrooming intention (Aw et al., 2021; Shankar & Jain, 2021) to search intention. These steps enable the articles' allocation to the action phases of the Rubicon model: predecisional phase, preactional phase, actional phase, or postactional phase.

3.2. Results

Table 2 presents the 42 articles classified according to their research setting, ordered by year. The table points out the haptic conditions and the dependent variables that are either significantly impacted by NFT (black) or not impacted (red, italic). Table 2 indicates articles that only focused on one specific dimension (aNFT or iNFT).

Table 2 Overview of papers, research settings, haptic conditions, and action phases

Articles	Haptic conditions				Action phases			
	Availability of touch	Product characteristic	Environmental salience	Compensation methods	Predecisional	Preactional	Actional	Postactional
Product evaluation								
Peck and Childers (2003b)	X	X		X			frustration	confidence
Peck and Wiggins (2006)*	X	X					PE	donation, membership
Grohmann et al. (2007)	X	X					PE, *reaction*	*confidence, accuracy*
Krishna and Morrin (2008)*	X	X					PE, awareness, *thoughts*	WTP
Nuszbaum et al. (2010)	X	X					frustration	confidence, product choice
S.-A. A. Jin (2011)**		X		X			PE, hedonic attitide	brand-self connection
Peck and Johnson (2011)*	X	X					PE	donation, *attendance*
Peck et al. (2013)	X			X				physical control
Orth et al. (2013)			X				PE	
Choi and Taylor (2014)		X	X	X				revisit intention
Nuszbaum et al. (2014)			X				frustration	*confidence*
Rosa et al. (2014)		X					*PE*	
Chylinski et al. (2015)		X					PE	
Overmars and Poels (2015)			X	X			*PE*	
Streicher and Estes (2016)**			X					product choice
Cano et al. (2017)				X			engagement	
Imschloss and Kuehnl (2017)			X				PE	PI, WTP
Pantoja et al. (2020)*	X						*PE*	*PI*
Wang et al. (2020)		X		X			*PE*	
Ranaweera et al. (2021)		X					PE	WTP
Product purchase								
Peck and Childers (2003a)		X			haptic accessibility			
Peck and Childers (2006)*			X				impulse purchase	
Schlosser et al. (2006)			X			*PI*		
Yazdanparast and Spears (2013)			X			PI, confidence		
Brasel and Gips (2014)		X	X	X			endowment	
Spears and Yazdanparast (2014)**				X		PI		
Herhausen et al. (2015)			X		*search intention, service, risk*	*PI, WTP*		
Rodríguez-Torrico et al. (2017)**			X		omnichannel use			
Ringler et al. (2019)			X		reactance, evaluation, *retribution*			
Homburg et al. (2019)			X			PI		
Yoganathan et al. (2019)			X			WTP		
Duarte and e Silva (2020)			X		brand experience, *purchase propensity*			
Kühn et al. (2020)		X	X	X	PE, affective response	WTP		
Pino et al. (2020)**	X				ease of use	PI		
Aw et al. (2021)**		X	X		search intention, *shopping perception*			
Manshad and Brannon (2021)			X					*feeling of monetary loss*
Shankar and Jain (2021)**			X		search intention, utilitarian & *hedonic* value			
Silva et al. (2021)			X	X	*PE*	*PI*		
Product use								
Lee et al. (2014)*		X					product usage	
S. V. Jin and Phua (2015)*		X						brand trust, excitement & awareness
Elhai et al. (2016)*		X					product uage	
Tuncdogan and Ar (2018)					*promotion focus, materialism, neophilia*			

Note: * articles only using aNFT; ** articles only using iNFT; PE = Product evaluation; PI = Purchase intention, WTP = Willingness to pay

The systematic literature review highlights the importance of NFT in consumer behavior. NFT impacts consumers' psychological decision making process in each of the action phases. Figure 3 presents the articles that fall within the Rubicon model of action phases. It points out that NFT impacts the motivational and volitional phases: from the deliberating and wishing phase to the planning stage, to the action itself, then the evaluation of the action, and finally the motivation for future action.

The action phase impacted by NFT depends highly on the research setting, and the haptic conditions researchers focused on (Table 2). Focusing on the predecisional phase, eight articles analyzed how NFT impacts the deliberating process, and four articles analyzed how NFT impacts the wishing process. Only Tuncdogan and Ar (2018) demonstrated NFT's impact in a product usage setting in terms of its marginal impact on food neophilia by consumers' happiness-seeking through consumption. All other articles of the predecisional stage used a product purchase setting. Interestingly, environmental salience was most important for researchers when analyzing NFT in the deliberating and whishing phase. Seven articles examined how NFT impacts consumers' motivation to purchase a product in an online context. High iNFT consumers have a greater search intention (Aw et al., 2021; Shankar & Jain, 2021) that is mediated by utilitarian values but not by hedonic ones (Shankar & Jain, 2021). Rodríguez-Torrico et al. (2017) highlighted that high iNFT consumers use omnichannel processes more often when thinking about purchasing a product. On the contrary, Herhausen et al. (2015) found that NFT does not impact search intention, service quality, or perceived risks of the online store. Kühn et al. (2020) assayed how NFT impacts online products' evaluation which helps consumers decide if they want to purchase the product. Besides the deliberating process, NFT also impacts consumers' wishing process in the predecisional phase. Kühn et al. (2020) analyzed that when there is a high NFT, there is a lower desire to purchase and consume online products. When using a direct compared to an indirect touch interface for the online purchasing process, this effect is diminished. Contrary to an online setting, Ringler et al. (2019) showed that high NFT consumers experienced psychological reactance and devaluated the product and the employee when they wished to touch a product, but were prevented from doing so in an offline context. Apart from this, three articles about the predecisional stage focus on the availability of touch or product characteristics, rather than environmental salience, yet Pino et al. (2020) showed that high NFT individuals have a higher ease of use when they are able to touch the product. Peck and Childers (2003a) identified that high NFT consumers use haptic words earlier and more often during the predecisional phase of the purchasing process.

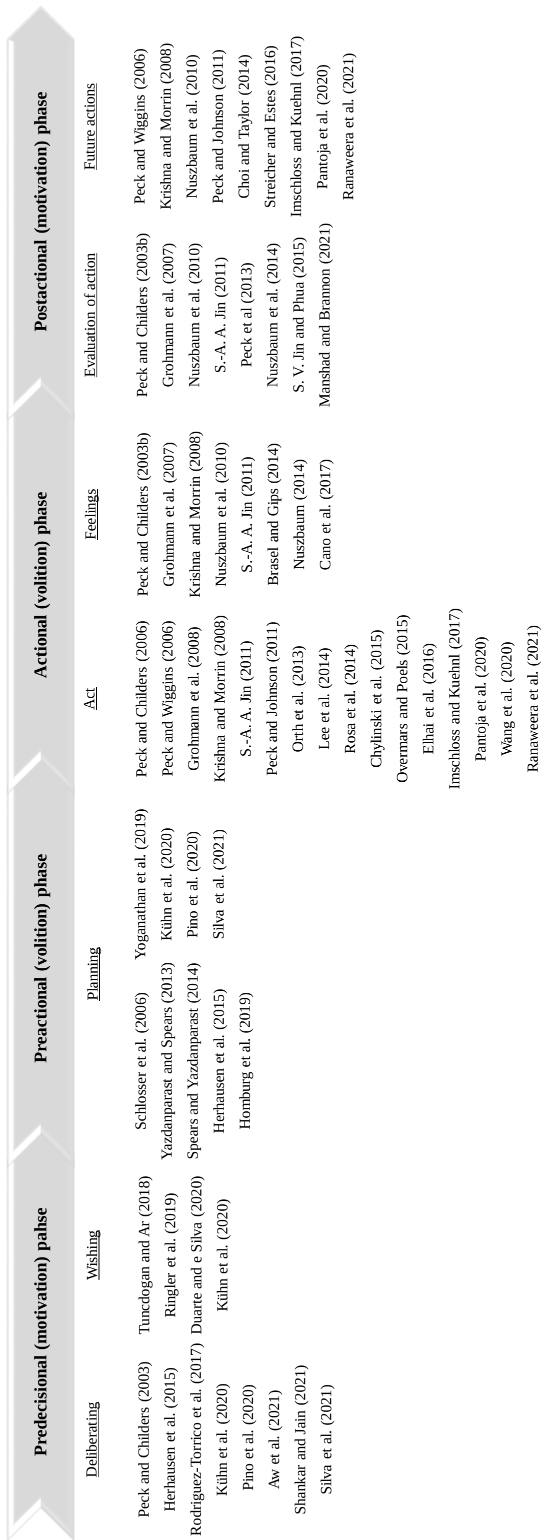

Figure 3 Articles within the Rubicon model of action phases

By moving from motivation to volition, individuals reach the preactional stage. All nine preactional stage papers used the product purchase setting to analyze consumers' purchase intention or their WTP. Six of the nine papers identified that NFT has a significant impact, four papers focused on purchase intention (Homburg et al., 2019; Pino et al., 2020; Spears & Yazdanparast, 2014; Yazdanparast & Spears, 2013), and two on WTP (Kühn et al., 2020; Yoganathan et al., 2019). Conversely, three papers could not identify a significant effect of NFT on consumers' purchasing intention (Herhausen et al., 2015; Schlosser et al., 2006; Silva et al., 2021) or on WTP (Herhausen et al., 2015).

All papers analyzed how NFT impacts consumers' purchases when touching was not an option. Interestingly, only Spears and Yazdanparast (2014) do not use an online retailing setting, but illustrated that an elaborative approach (thinking about the product properties in detail) helps high NFT consumers purchase a product that they cannot touch. Curiously, haptic imagery in an online retailing context does not interact with NFT (Silva et al., 2021). Regarding the other papers that use an online retailing setting, Homburg et al. (2019) used NFT to cluster consumers' online purchasing intention. Yazdanparast and Spears (2013) analyzed that intrinsic (mood, product expertise) and extrinsic (sales promotion) factors interact with NFT in the purchase decision making process. On the contrary, others showed that the NFT does not impact online purchasing intention (Herhausen et al., 2015; Schlosser et al., 2006) and WTP (Herhausen et al., 2015). Kühn et al. (2020) and Yoganathan et al. (2019) indicated that NFT impacts WTP during the online purchasing process. Compensation methods such as a video of hands examining high diagnostic products (Kühn et al., 2020) or tactile priming (Yoganathan et al., 2019) reduced the negative effect of NFT on WTP.

Within the action phase, individuals need to reach a specific volition strength in order to strive for the aimed goal. In this phase of the decision making process, 16 articles directly examine the action itself, how NFT specifically impacts consumers' product evaluation (e.g., S.-A. A. Jin, 2011; Manshad & Brannon, 2021; Orth et al., 2013), product purchases (Peck & Childers, 2006), and product usage (Elhai et al., 2016; Lee et al., 2014). In the actional phase, 13 papers inspected the impact of NFT on product evaluation, nine papers identified a significant impact, and four an insignificant impact. Concerning the latter, NFT does not moderate the negative gustatory perception of sweets when using a fork compared to when touching sweets directly (Pantoja et al., 2020). NFT does not impact consumers' product evaluation when the visual and tactile inputs of the product are manipulated (Rosa et al., 2014). In an online retailing context, Overmars and Poels (2015) showed that simulating a stroking gesture, by using the mouse pointer, increased high and low NFT consumers' evaluation of a scarf, and R. J. Wang et al. (2015) analyzed that product evaluation directly depends on direct vs. indirect touch interfaces regardless of NFT.

Concerning the nine papers that identify a significant effect of NFT on product evaluation, four of them indicated an improved product evaluation by high NFT consumers when they were able to touch the product (Grohmann et al., 2007; Krishna & Morrin, 2008; Peck & Johnson, 2011; Peck & Wiggins, 2006). All four papers emphasized specific product characteristics and their sensory feedback. When evaluating products, NFT interacts with product texture and weight (Ranaweera et al., 2021), as well as texture and color (Chylinski et al., 2015). Additionally, environmental factors impact high NFT consumers' product evaluation. Being touched by a waitress (Orth et al., 2013) or multisensory atmospheric incongruences (e.g., soft music and hard flooring or hard music and soft flooring) (Imschloss & Kuehnl, 2017) also interacts with NFT. Finally, in a field study Peck and Childers (2006) analyzed how environmental salience interacts with NFT, which leads to higher impulse buying.

Eight articles focused on consumers' feelings during the action process. Krishna and Morrin (2008) did not examine any negative thoughts, and Grohmann et al. (2007) did not identify any affective reactions during the evaluation process. Reversely, Peck and Childers (2003b) and Nuszbaum et al. (2010) indicated that high NFT consumers were more frustrated when they could not touch a product during the action process. Nevertheless, detailed, clearly written haptic descriptions, with instrumental material properties, helped high NFT consumers overcome negative feelings about the product (Krishna & Morrin, 2008; Peck & Childers, 2003b). In this context, other researchers focused on the effect of direct vs. indirect touch interfaces as a compensation method. When high NFT consumers use a direct touch interface, they are more engaged in the product evaluation process (Cano et al., 2017) and experience a higher affinity to the product in the purchasing process (Brasel & Gips, 2014). Two researches showed that especially high NFT consumers tend to compulsively use their smartphones (Elhai et al., 2016; Lee et al., 2014).

Within the postactional phase, eight articles focused on individuals' evaluation of the previous action, and nine on the motivation for further action processes. 14 papers used a product evaluation setting. Researchers showed that when high NFT consumers were able to touch the product, they had higher confidence in their assessment (Nuszbaum et al., 2010; Peck & Childers, 2003b). Oppositely, when using haptic imagery as a surrogate for touch, NFT does not affect feelings such as physical control (Peck et al., 2013), or the feeling of monetary loss, when using vibration feedback during mobile payment (Manshad & Brannon, 2021). Two papers examined the impact a force feedback controller has on high NFT consumers' brand attitude (S.-A. A. Jin, 2011; S. V. Jin & Phua, 2015).

Nine articles examined how NFT impacts consumers' next steps. Consumers' decision to invest money or time in a non-profit organization is influenced by NFT if the information comes with haptic sensory feedback (in a pamphlet) (Peck & Johnson, 2011; Peck & Wiggins, 2006). NFT also impacts consumers' intention to become a member of a museum (Peck & Wiggins, 2006), but not their intention to attend an event (Peck & Johnson, 2011). Two articles investigated how the interaction of NFT and the product's characteristics, such as its texture or weight, changed consumers' WTP (Krishna & Morrin, 2008; Ranaweera et al., 2021). Multisensory atmospheric congruence does not only change low NFT consumers' product evaluation, but also their WTP and purchasing intention after the evaluation process (Imschloss & Kuehnl, 2017).

Choi and Taylor (2014) pointed out that online product presentation (2D vs. 3D) impacts high and low NFT consumers, as they tend to revisit the website when geometric products (e.g., watches) are presented in 3D. Finally, two papers showed that the product choice of high NFT consumers is affected by the shape of a product the consumer has in the hand (Streicher & Estes, 2016) or the product package (pleasant vs. unpleasant to touch) (Nuszbaum et al., 2010).

4. Discussion

4.1. Research contributions

The main purpose of this paper is to present NFT's increasing importance in consumer behavior and to point out further research directions. The systematic literature review highlights three contributions to consumer behavior research. First, the review confirms the increase of NFT research in marketing and psychology by identifying 42 articles in top-tier journals that have focused on NFT in their quantitative research since 2003. Second, the paper verifies the relevance of the topic. NFT matters in all four phases of consumers' decision making processes. By applying the Rubicon model of action phases (Gollwitzer, 1990; Heckhausen & Gollwitzer, 1987), results illustrate that NFT influences consumer behavior in the predecisional, preactional, actional, and postactional phase. Third, the study illustrates the emerging potential of NFT in consumer behavior. Based on the results, the research derives interesting and novel recommendations for researchers.

4.2. Recommendations for further research

This study highlights research directions ordered by the Rubicon model of action phases. During the predecisional stage, researchers examined touch's importance in the online retailing context, where haptic input was missing beforehand. Touch surrogates, such as specific product descriptions, helped consumers overcome the missing haptic input (Yoganathan et al., 2019). Other compensation methods focused on visual cues, such as 3D illustrations (Choi & Taylor, 2014), and videos of hands haptically experiencing a product (Kühn et al., 2020). With technological advancement, researchers might also examine the effect a multisensory environment can have on high NFT consumers. In the beginning, e-retailing mainly focused on the sense of sight (identifying pictures) as the primary way of drawing attention to a product (Petit et al., 2019). However, today it has become vital to create an immersive product feeling to compensate for the lack of sensory input. Using technical devices like loudspeakers, touchscreens, and controllers addresses audition and haptic conditions (Petit et al., 2019). The multisensory environment is improved when virtual and augmented reality is used and is worth examining in future NFT research.

Recently, the impact of using a direct touch interface in the online decision making process was highlighted (Brasel & Gips, 2014; Kühn et al., 2020). Kühn et al. (2020) showed that direct touch interfaces diminish the negative effect of NFT on consumers' affective response. Researchers are encouraged to further examine the direct touch effect in consumer behavior, during the preactional phase of the decision making process. They should also assess the economic impact that direct touch interfaces have on high NFT consumers such as on their WTP. In line with this, other marketing areas such as market research processes, have less research on the interaction between NFT and touch interfaces. Researchers could examine the interaction between NFT and touch interfaces and how it might impact market research data's results, such as conjoint analysis results. Researchers can thus examine differences in consumers' product preferences and their price sensitivity when using a direct compared to an indirect touch interface.

Many actional phase NFT articles focused on NFT's product evaluation impact in situations where haptic input is unavailable or prohibited. But how does NFT impact consumers' reaction and product evaluation in the case of product contagion when they do not necessarily want to touch the products? Consumers devaluate packaged products that possess even only a moderate level of disgust (Morales & Fitzsimons, 2007). Further, consumers' attitude toward a product is different, if others have already touched it. Interestingly, while Argo et al. (2006) identified that consumers devaluate products that others have touched, Argo et al. (2008) examined positive product contagion if the product was touched by an attractive person. NFT might serve as an interesting moderator in positive and negative product contagion situations. Consumers' attitude might change significantly when referring to contagion and contamination, especially during the COVID-19 pandemic.

The systematic literature review points out that NFT literature used different terms when focusing on product characteristics, such as high and low salient material properties (Peck & Childers, 2003b), products with diagnostic or non-diagnostic haptic cues (Krishna & Morrin, 2008), high and low haptic importance (Brasel & Gips, 2014), and high and low touch diagnosticity (Kühn et al., 2020). Additionally, the articles present contradictory results when focusing on different products. While Grohmann et al. (2007) pointed out that high NFT consumers' product evaluation is lower when touching low quality products, Krishna and Morrin (2008) discovered that touching low quality, non-diagnostic haptic cue products does not affect high NFT consumers, but only leads to a lower product evaluation by low NFT consumers. Peck and Wiggins (2006) and Peck and Johnson (2011) presented that regardless of the congruency between the product and the presented content, sensory haptic feedback leads to a higher product evaluation from high NFT consumers. This is in line with S.-A. A. Jin (2011) who demonstrated that haptic sensory feedback increases product evaluation. When high NFT consumers use a controller with force feedback, it leads to higher self-brand connection (S.-A. A. Jin, 2011) and higher brand awareness (S. V. Jin & Phua, 2015), but to lower brand trust and excitement (S. V. Jin & Phua, 2015). The first two results are in line with Peck and Wiggins (2006) who present that positive sensory feedback leads to a higher affective response, while the latter supports the theory of Krishna and Morrin (2008) that high NFT consumers are less affected by non-diagnostic haptic cues. Further research could give a systematic overview of how high and low NFT consumers are affected by different product specifications in order to identify reasons for the contradictory results.

Besides, most of the actional stage studies analyzed NFT's interaction effects like touching a product (vs. no-touch) (e.g., Nuszbaum et al., 2010; Pantoja et al., 2020; Peck & Wiggins, 2006) or interacting with characteristics related to the product (Chylinski et al., 2015; Grohmann et al., 2007; Ranaweera et al., 2021). Therefore, numerous researchers did not present NFT's main effect on the dependent variables. This information should however be presented for future qualitative syntheses such as meta-analysis.

Referring to the interaction with NFT, consumers use more than one sense during the decision making process. Nevertheless, only a few researchers included NFT in their focus on cross-modal interactions. Some research examined the interaction of haptics and vision (Streicher & Estes, 2016), smell (Krishna et al., 2010), audition (Imschloss & Kuehnl, 2019), and taste (Chylinski et al., 2015), respectively. The impact of NFT on the cross-modal interaction research field is however underdeveloped.

In the field of product purchasing the differences between high and low NFT consumers in the actional and postactional phase are less known. Consumers' feelings and thoughts during the actual purchasing process and their evaluation of the process need additional empirical investigation. This study encourages researchers to use and look at real economic consequences. The review of Klein and Hilbig (2019) stressed that consumer research lacks real economic consequences, including "*both costs (losing a previously earned endowment) and gains (actually receiving what was chosen)*" (p. 68). Peck and Childers (2006) demonstrated in their field experiment how environmental salience leads to impulse buying of groceries, especially for high NFT consumers.

This review shows contradictory results when focusing on consumers' confidence in the postactional phase. While Peck and Childers (2003b) and Nuszbaum et al. (2010) identified a significant effect on high NFT consumers' confidence, Grohmann et al. (2007) and Nuszbaum et al. (2014) did not find this effect in their research. Future research is encouraged to examine NFT's importance when consumers assess their action in detail in the postactional phase. In the post-purchase stage, researchers might analyze consumers' confidence of an online (vs. offline) purchasing process. The fact that some consumers have experienced the product haptically during the purchasing process (offline), while others purchased products without haptic input (online), might impact how high and low NFT consumers evaluate the action. It would be interesting to discover if the retail channel (offline vs. online) had an effect at all on high NFT consumers' confidence, once they experienced and used the purchased products.

Additionally, the study presents recommendations which focus on how NFT literature collects and present data. First, due to the articles' subjective division into the framework, the results might lack internal validity. Verifying this process with further researchers will increase the results' internal validity.

Second, this systematic literature review uses the NFT scale to underline the importance of touch in consumer behavior. Other researchers are encouraged to extend the scope of this work by including other scales such as the "attitude toward touching" (Peck & Childers, 2006) or the "need for tactile input" (Citrin et al., 2003) scale. Researchers might even broaden the scope further by analyzing "emotional touch" which is especially relevant in branding (Moore & Homer, 2008).

Third, the study also presents contradictory results (significant or nonsignificant effects) when focusing on NFT's impact on product evaluation (Orth et al., 2013; Rosa et al., 2014), purchase intention (Pino et al., 2020; Silva et al., 2021), and WTP (Herhausen et al., 2015; Kühn et al., 2020). The authors highly recommend future research to report on significant as well as nonsignificant NFT results. Future researchers might examine which (haptic) conditions, and experimental settings are responsible for these differences. Reporting null results does not only improve the research quality and credibility, but includes benefits such as saving resources by avoiding replicate research, which has already been proven unsuccessful (Ioannidis, 2008). By reporting nonsignificant effects, researchers are prevented from analyzing phenomena that do not actually exist (Fanelli, 2012) and overestimating effect sizes in meta-analyses (Formann, 2008; Ioannidis, 2008).

Fourth, previous research focused either on the autotelic (e.g., S. V. Jin & Phua, 2015; Peck & Childers, 2006; Peck & Johnson, 2011) or the instrumental (e.g., Pino et al., 2020; Shankar & Jain, 2021; Streicher & Estes, 2016) NFT dimension. Nevertheless, results suggest that iNFT and aNFT data should be collected, even if the research focus relies on only one of the dimensions. Actually, when presenting significant effects of one dimension and nonsignificant effects of the other, researchers are able to point out exactly which dimension drives consumer behavior, namely either the goal-oriented, utilitarian part or the fun-oriented, hedonic part. Ranaweera et al. (2021) demonstrated that the haptic effect (in this case, texture and weight) on product evaluation for autotelic NFT consumers is significant, compared to those with a high instrumental NFT. Including both dimensions is also important when examining utilitarian and hedonic values because the instrumental dimension reflects utilitarian purposes, and the autotelic dimension reflects hedonic purposes. It is therefore not surprising that Shankar and Jain (2021) identified a significant effect of NFT on utilitarian, but not on hedonic values, as they only take iNFT into account.

In conclusion, this research expands the NFT literature in consumer behavior by systematically analyzing top-tier marketing and psychology journals. The paper not only stresses the current relevance of the topic, but advises consumer behavior researchers to carefully consider the power of NFT in their experiments. It further encourages researchers to choose and address one of the recommended research directions.

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Essay 2

The touchy issue of produce: Need for touch in online grocery retailing

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Abstract

Online grocery retailing lags behind other product categories in e-commerce. This article focuses on consumers' need for touch (NFT) as a psychological explanation for this issue. In two studies, consumers rate their perception of produce offered in an online shop. Specifically, consumers assess quality concerns, affective response, and willingness to pay (WTP) in offline versus online retail contexts. Results demonstrate that high NFT consumers express higher quality concerns and lower affective response to online offered produce. This negative influence of NFT is stronger if consumers use indirect compared to direct touch interfaces. Further, NFT influences WTP difference between offline and online offered produce. Online retailers therefore need to carefully manage quality concerns and negative perceptions that high NFT consumers express during online produce shopping. A third study proposes a solution through online videos as visual design features. Displaying haptic evaluations of high touch diagnostic produce by other consumers successfully negates NFT's negative influences.

Keywords: Need for touch (NFT), Online retailing, Online grocery shopping, Produce, Touch interface, PLS-SEM

The touchy issue of produce: Need for touch in online grocery retailing

"See and believe, and in order not to make a mistake, touch"

– Old Colombian Saying –

1. Introduction

Online retailing continues to grow rapidly worldwide (Statista, 2019b). In the US, e-commerce sales totaled $513.6 billion, a 14.2% increase from 2017 to 2018 (U.S. Census Bureau, 2018). Not surprisingly, European online retailing sales mirror these growth trends with a predicted annual rate of 9.1% until 2023, with more than 60% of Europeans already shopping online at least once a month (Ecommerce News, 2019; Statista, 2019a). Globally, adoption of online retailing is highly product category specific. For example, around 50% of German and 77% of American consumers buy clothing, music, or books online, yet only 1.5% of German and 4% of American grocery shopping occurs via the internet (Armstrong, 2019; Statista, 2019c, 2019d). Industry reports also predict a comparatively slow increase of online produce sales by 2030 (Nielsen, 2015), namely 5% in Germany and the US (IFH Köln, 2020; Wyman, 2018). Such slow adoption is problematic, since online grocery shopping could address society-relevant concerns of limited access to healthy and fresh products (Jürgen, 2018; Ploeg et al., 2015). Buying produce online represents one solution to these so-called food deserts, especially in countries with established e-commerce infrastructures like the US and Western Europe (Jürgen, 2018; Ploeg et al., 2015). Therefore, research needs to assess consumers' hesitation to adopting online grocery shopping and to further explain diverging online shopping behavior across product categories, especially for produce.

Sensory marketing offers potential explanations as previous research supports that sensory cues (e.g., brightness, softness, temperature) drive consumers' purchase decisions (e.g., Biswas & Szocs, 2019; Spence et al., 2014). Particularly touch-related elements gain in importance as a consequence to the prospering online market that does not provide immediate haptic information (Geuens et al., 2003; Peck & Childers, 2003a; Vries et al., 2018). Accordingly, consumers' innate need for touch (NFT) can lower the appeal of online grocery shopping (Brasel & Gips, 2014; Yazdanparast & Spears, 2013).

Peck and Childers (2003a) conceptualize NFT as a personality trait that governs consumers' preferential reliance on haptic information. The corresponding NFT scale measures instrumental and autotelic NFT (Peck & Wiggins, 2006). High instrumental NFT consumers purposefully use haptic information during a decision process to choose high quality items and to reduce uncertainty (Grohmann et al., 2007; Krishna & Morrin, 2008). In contrast, autotelic individuals experience an intrinsic hedonic satisfaction when touching objects and tend to engage in impulsive buying more frequently (Peck & Childers, 2006). Thus, consumers scoring high in instrumental NFT touch products to accomplish a specific task or goal such as selecting the best item, while consumers scoring high in autotelic NFT simply seek positive haptic feedback (Peck & Childers, 2003a; Pino et al., 2020). The present research uses NFT to explain consumers' hesitance to purchase produce online. It furthermore proposes a psychological process highlighting the negative consequences of NFT in online produce retailing. This unique approach expands prior research on online produce retailing that has not yet considered NFT's effects.

To explore NFT's role in this context, the present article's scope focuses on German grocery markets as one viable example. The pre-study assesses touch diagnosticity (i.e., the extent to which touching an item is important in the product evaluation process) of different produce. Three main studies then utilize a simulated online shop while studying NFT to explain differences in consumers' reactions toward online offered produce. Study 1 demonstrates NFT's negative influence on consumers' cognitive and affective responses to online offered produce. Additionally, shopping with an indirect touch interface (e.g., mouse or stylus input) rather than a direct touch interface (e.g., tablet and smartphone with a touchscreen) strengthens NFT's negative effects on consumers' affective response to online produce. Study 2 considers consumers' WTP for offline produce (purchased from supermarkets, grocery stores, etc.) and online produce simultaneously. Findings show that, in particular, high NFT consumers report lower WTP for produce sold online compared to offline. Study 3 replicates these results and offers a solution for NFT's negative effects on WTP difference: video clips as visual design features displaying haptic evaluations of a product. In addition, results highlight an important boundary condition, namely NFT does not negatively impact online produce with low touch diagnosticity. In sum, the present research contributes to the sensory marketing, online retailing, and touch interface literatures, while offering important implications for online produce retailers.

2. Theoretical background and hypotheses

2.1. Online grocery shopping

A discrepancy between asserted shopping motives and actual purchase behavior prevails in online grocery shopping. Considering American consumers, a majority still express an overall hesitation to engage in online grocery shopping as less than 4% of all groceries in 2018 are purchased online (Hartman Group, 2018). The same applies to German consumers, who also remain reluctant (1.5%) to buy groceries online (Armstrong, 2019). American and European consumers, therefore, express comparable online grocery shopping behaviors (Nielsen, 2015; Wyman, 2018).

These behaviors contradict studies on attitudes regarding online grocery shopping. For example, recent findings identify convenience, better-quality products, and fresher produce as common benefits that consumers associate with online grocery shopping (Hartman Group, 2018). According to Scott et al. (2019), Germans additionally welcome the flexibility of shopping online without facing time restrictions (especially on Sundays when stores generally remain closed due to retail law restrictions).

In contrast, frequently cited obstacles in the online grocery adoption process include loss of experiential aspects and sensory properties (e.g., Geuens et al., 2003; Ilyuk, 2018), which limit the engagement in the purchasing process (Nielsen, 2015). Another explanation proposes persisting consumer perceptions tied to brick and mortar stores offering fresher and lower priced products (Hartman Group, 2018). Furthermore, concerns of damaged, spoiled, or not fresh products and inability to assess products with all senses are also associated disadvantages (Nielsen, 2015).

These obstacles contribute to slower adoption of online grocery shopping, especially for certain product categories. This tendency is consistent among American and German consumers as less than 10% in both countries express willingness to purchase perishable produce online compared to snacks (US=35%; Germany=39%) or drinks/coffee and tea (US=34%; Germany=36%) (Hartman Group, 2018; Ipsos, 2017). Interestingly, Nielsen (2015) state that 47% of consumers engage in online grocery shopping for healthier and fresher alternatives, yet actual consumption statistics do not support these shopping motives. Thus, further research explaining the discrepancy between shopping motives and actual online grocery shopping behavior is needed – especially for perishable produce – to develop this still relatively sparse research stream (Ilyuk, 2018). We propose that issues revolving around consumers' NFT can explain a significant proportion of the identified discrepancy, in that NFT underlies negative perception of and reactions to online offered produce (see Figure 1 for our conceptual model).

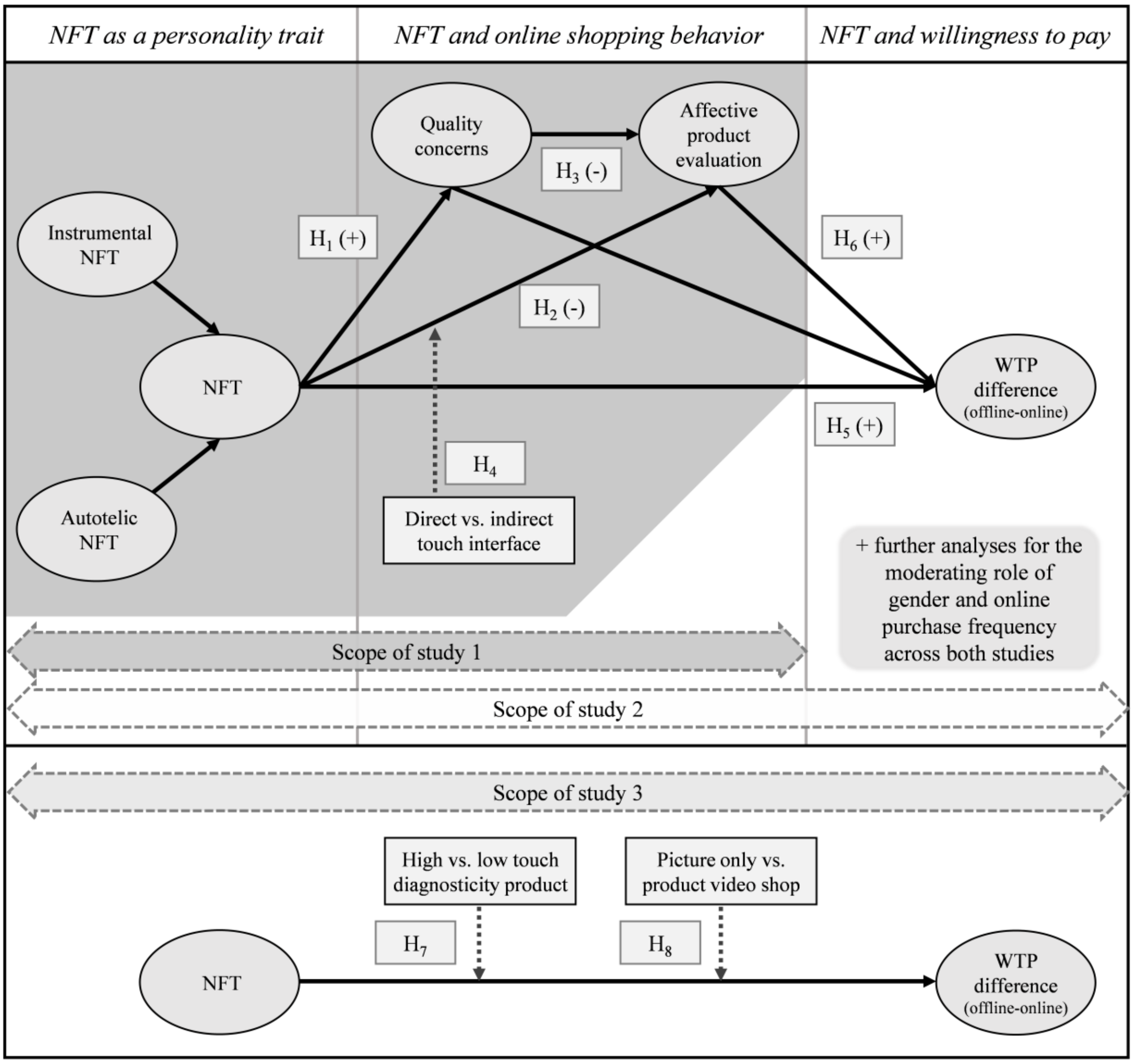

Figure 1 Proposed relationships across studies 1, 2, and 3

2.2. Need for touch in online produce shopping

Although various studies analyze NFT across different product categories within an online retailing context, including consumer electronics, fashion, and bags (e.g., Rodrigues et al., 2017; San-Martín et al., 2017; Yazdanparast & Spears, 2013), its effect in online produce retailing remains under-researched (see Appendix A for a comprehensive literature review). Nonetheless, some studies provide preliminary insights into NFT's role in online produce retailing.

Grohmann et al. (2007), for example, establish that consumers generally rely on haptic cues in offline settings to evaluate produce due to their high touch diagnosticity. Results further show that the devaluation of washcloths in a touch (physical interaction with product) versus no-touch condition (product displayed on computer screen yet not in an online shop) is mainly driven by consumers' NFT. González-Benito et al. (2015) implement a simulated online shop and find reputable, leader brands (e.g., Nike and Nivea) to be more important in online retailing to reduce consumers' uncertainty for products with high touch (e.g., backpacks) compared to low touch (e.g., sun lotion) diagnosticity. These findings suggest NFT to influence online produce shopping, which often lacks strong brands that otherwise could compensate for the missing haptic information (Y. H. Jin et al., 2008). In addition, results show that high NFT consumers rate the quality of high touch diagnosticity products lower than low NFT consumers. Rodrigues et al. (2017) also identify a negative relationship between NFT and purchase intention in a simulated online clothing shop. Recently, Pino et al. (2020) evaluate consumers' expected ease of use for calculators in touch versus no-touch conditions (consumers only engaged in a visual product inspection). The authors determine that especially consumers high in NFT report lower imagined ease of use in the no-touch condition.

Based on prior research on NFT and extrapolating findings of experimental no-touch conditions to online retailing, high NFT consumers express greater frustration and lower trust in product-related judgements compared to low NFT counterparts (Nuszbaum et al., 2010; Peck & Childers, 2003b). As a result, we propose that these problems are of major importance to fresh produce retailers as consumers routinely touch these products when shopping in physical stores (Krishna & Morrin, 2008). Suzuki and Gyoba (2008) further contribute to understanding NFT's negative influence in online produce shopping by identifying a cross-modal interaction between visual and tactile product evaluation. That is, consumers prefer haptic information for a product after observing it visually on a computer screen, a concept aligning with the "visual preview model" in psychology (Klatzky & Lederman, 1992). According to this model, visual assessment provides a quick overview of general product properties, which determines whether haptic evaluation is necessary and should be initiated (Klatzky et al., 1993). Recent studies grounded in this model highlight that consumers rely more on haptic information than initial visual assessment to detect internal defects (e.g., internal browning) for certain type of produce such as apples (Jaeger et al., 2018). Subsequently, online produce is different from other categories with high touch diagnosticity such as a couch that can be sufficiently evaluated based on the haptic assessment of one sample area due to the consistent nature of its textural elements.[1]

According to these previous studies, high NFT consumers should express higher quality concerns when cognitively processing online offered produce than low NFT consumers. Therefore, we hypothesize the following:

H_1: NFT influences consumers' quality concerns for online offered produce. Specifically, higher NFT leads to higher quality concerns.

Research further suggests that haptic input influences consumers' affective response to offered products. For example, increasing haptic cues through signs in a supermarket leads to significantly higher unplanned fruit purchases among high autotelic NFT individuals (Peck & Childers, 2006). Bushong et al. (2010) apply Pavlovian learning theory to further explain this phenomenon. According to this theory, the physical presence of the desired product (e.g., fruit) serves as an unconditioned stimulus that triggers positive affect. This positive feeling leads to a consummatory response, i.e. feelings and behaviors that foster consumption (e.g., hunger, purchase). Based on this process, the authors show that consumers express a greater desire to consume food items presented physically (analogous to offline retailing) than presented only visually (analogous to online retailing) (Bushong et al., 2010).

Consumers high in NFT have developed a preference for extracting and utilizing haptic information throughout their lifetime (Krishna & Morrin, 2008; Peck & Childers, 2003a). Therefore, under no-touch conditions, such as in online retailing, any affective response loses intensity for high NFT consumers. Subsequently, we propose that absence of the physical product in an online context will trigger a less pronounced positive affective response in these individuals.

H_2: NFT negatively influences the affective response to online offered produce. Specifically, higher NFT leads to less positive affective response.

Moreover, the preceding discussion suggests that not only NFT, but also quality concerns regarding online offered produce lead to lower consumers' affective response and intention to consume these produce (Chung et al., 2018; Vries et al., 2018). In support of this explanation, Wells et al. (2011) establish a negative effect of perceived product quality on

[1] For example, the German online retailer otto.de provides free fabric samples to prospective customers to let them evaluate the texture of the product.

online purchase intention for bags. Since NFT is proposed to influence quality concerns, these concerns should mediate NFT's impact on affective response:

H_3: Quality concerns mediate the negative influence of NFT on the affective response to online offered produce.

2.3. Need for touch and interface type

Online retailing is experiencing a shift in primary computer interface modality (Chung et al., 2018). Direct touch interfaces (i.e., touchscreens), as opposed to indirect touch interfaces (e.g., mouse/keyboard combo), are rapidly becoming the primary means of engaging with online shops (Brasel & Gips, 2014, 2015; Chung et al., 2018). This shift impacts consumer behavior. Brasel and Gips (2015) identify higher anticipated consumer satisfaction with online products when consumers interact with direct instead of indirect touch interfaces. Looking at consumer electronics, Chung et al. (2018) find that simply using direct (vs. indirect) touch interfaces can induce positive feelings that can lead to higher intentions to buy.

Similarly, Vries et al. (2018) report greater shopping enjoyment when customers browse an online shop using a direct compared to an indirect touch interface. This effect of interface type is even stronger for high NFT consumers. That is, high NFT consumers demonstrate a more positive response toward touch elements and, consequently, a more favorable attitude toward products, irrespective of whether or not haptic elements provide product-related information (Peck & Wiggins, 2006). Based on these findings, using direct touch interfaces should partially compensate for the less pronounced affective response high NFT consumers experience in the absence of haptic information. Thus, we hypothesize that interface type moderates the impact of NFT on affective response to online offered produce:

H_4: Interface type moderates NFT's influence on affective response to online offered produce. Specifically, use of direct touch interface mitigates NFT's negative influence on affective response.

Existing research, in contrast, does not suggest a relationship between interface type and cognitive evaluation process. Consequently, the present study does not include a moderation of interface type on NFT's influence on quality concerns.

2.4. Need for touch and willingness to pay

In the grocery context, Lim et al. (2018) identify consumers to be less willing to pay for online offerings as compared to traditional offline stores. This WTP difference between offline and online groceries deserves further investigation. The preceding discussion on quality concerns and affective response suggests that NFT is partially explaining the difference between offline and online WTP. Therefore, it is surprising that research has yet to incorporate NFT as an explanation. Previous studies, however, assess the relationship between NFT and WTP in offline touch and no-touch conditions (Peck & Wiggins, 2006; Shu & Peck, 2007). For instance, Peck and Wiggins (2006) confirm that high NFT consumers are willing to donate more to a charity when a promotional pamphlet includes a haptic element. Shu and Peck (2007) demonstrate that NFT drives this effect of product touch availability (vs. unavailability) on WTP.

One common explanation for higher WTP in touch conditions is psychological ownership (Ilyuk, 2018; Shu & Peck, 2007), i.e. feeling ownership for an object without actually owning it triggered by physical contact (Pierce et al., 2001). Interestingly, high NFT consumers develop more pronounced psychological ownership after touching products (Shu & Peck, 2007). As online retailers cannot offer product touch, they should face lower WTP from high NFT consumers who will miss essential haptic product experiences during online shopping (Grohmann et al., 2007). Thus, we suggest that NFT will influence a consumer's difference in WTP between offline and online retailing:

> **H_5:** High (low) NFT leads to greater (smaller) WTP difference between offline versus online offered produce.

Moreover, Bushong et al. (2010) observe a positive relationship between consumers' product evaluation, desire to consume, and WTP for food items. This relationship is stronger if products are presented physically and not only visually. However, the authors did not include NFT as a potential explanatory variable. The current study proposes that consumers' quality concerns regarding online produce and lower affective response serially mediate NFT's influence on consumers' WTP difference for offline versus online produce. As a result, we propose:

> **H_6:** Quality concerns regarding online produce and subsequent lower affective response serially mediate the influence of NFT on WTP difference between offline versus online offered produce (i.e. greater difference for high in comparison to low NFT consumers).

2.5. Need for touch and type of produce

One can reasonably argue that NFT is not equally important for all type of produce (Grohmann et al., 2007). For some produce, haptic evaluation is more important (e.g., mango) compared to others (e.g., lemon) since all product-relevant information is obtainable by visually observing the produce's surface. The visual preview model Klatzky and Lederman (1992) discussed earlier predicts that touch's importance will diminish for produce with low touch diagnosticity. In these situations, a consumer's NFT might not influence the proposed WTP difference. We therefore hypothesize:

H_7: Touch diagnosticity (high vs. low) of produce moderates NFT's influence on WTP difference between offline versus online offered produce.

2.6. Need for touch and touch surrogates

For non-produce products with a high touch diagnosticity (e.g., blankets), research suggests touch surrogates as a solution to overcome the lack of haptic input. For example, written haptic descriptions can stimulate haptic imagery and thus compensate for missing haptic information for these products (Peck et al., 2013). Additionally, for categories such as fashion and furniture, technical devices offer advanced features to portray haptic details in 3D-view or augmented reality (Choi & Taylor, 2014; Huang & Liao, 2017).

For produce, virtual representations of these products do not sufficiently overcome obstacles in online retailing contexts (Waterlander et al., 2015). Nevertheless, for online produce retailing, extant written descriptions and picture zooms are still common features. Prior research further suggests that human hands in visuals can act as touch surrogates (Pino et al., 2020). More precisely, these visuals enhance haptic imagery and thus trigger mentally simulated consumption experiences, ultimately compensating for missing haptic cues (Klatzky et al., 1991). Since consumers high in NFT express a preference for processing haptic-related information, induced imagination should be stronger for them. Therefore, the final hypothesis proposes a moderation of online touch surrogate (e.g., videos of hands evaluating produce) on the relationship between NFT and WTP difference offline-online (H_5):

H_8: Online touch surrogate (present vs. absent) moderates the relationship between NFT and WTP difference between offline versus online offered produce. Specifically, touch surrogate weakens the effect of NFT leading to lower WTP difference.

In case of absence of touch diagnosticity, NFT's effects decreases to an insignificant level. As a result, the moderation proposed in H_8 should lose significance as well.

3. Preliminary study

A pen and paper pretest with 35 employees and students at a German university ($mean_{age}$=20.69; SD=3.04; 65% females) assessed purchase frequency of 18 fruits and vegetables to identify suitable stimuli for subsequent scenarios (i.e., *"Which of the following products do you buy on a regular basis?"*). Further, participants rated the importance of haptic and visual diagnosticity during produce evaluation prior to purchase (1=not at all important, 6=very important). Figure 2 depicts the results.

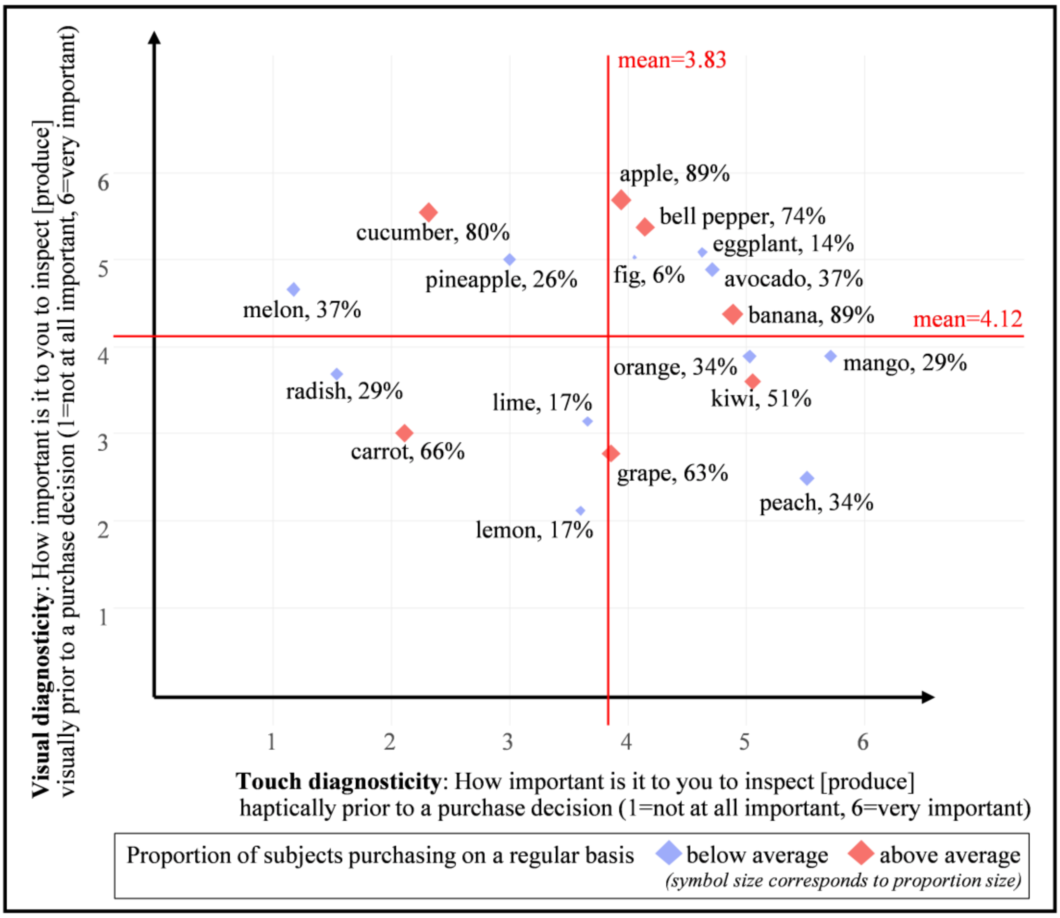

Figure 2 Purchase frequency, touch, and visual diagnosticity for different produce

The analysis identifies four frequently purchased produce with above average touch diagnosticity: apples, bell peppers, kiwifruits, and bananas. Additionally, apples, bell peppers, and bananas reflect above average visual diagnosticity. Including produce with above average touch, but below average visual diagnosticity (kiwifruit) as stimuli, could have led to exaggerated findings of NFT's influence. Therefore, the subsequent studies focus on apples, bell peppers, and bananas as produce with high touch and high visual diagnosticity. To highlight the limits of NFT's influence, study 3 includes melon as a category with low touch and high visual diagnosticity.

4. Study 1

4.1. Procedure, stimuli, and sample

The study sets out to survey potential online produce shoppers. Therefore, participants with online grocery shopping experience were recruited via German university newsletters and topic-related social media platforms (Facebook and Instagram). The survey featured a simulated online shop with a scenario of participants being invited to a party and asked to buy bell peppers to be consumed at the party (Appendix B). Given the short time frame, participants had to consider purchasing the produce from an online shop. The study excluded consumers who disliked or were allergic to bell peppers.

The layout and design of the online shop replicated an actual online shop to ensure realistic aesthetics, but it did not include brand or price details (Figure 3). After having answered the main questions, respondents indicated whether they completed the study using a direct or indirect touch interface and provided demographics.

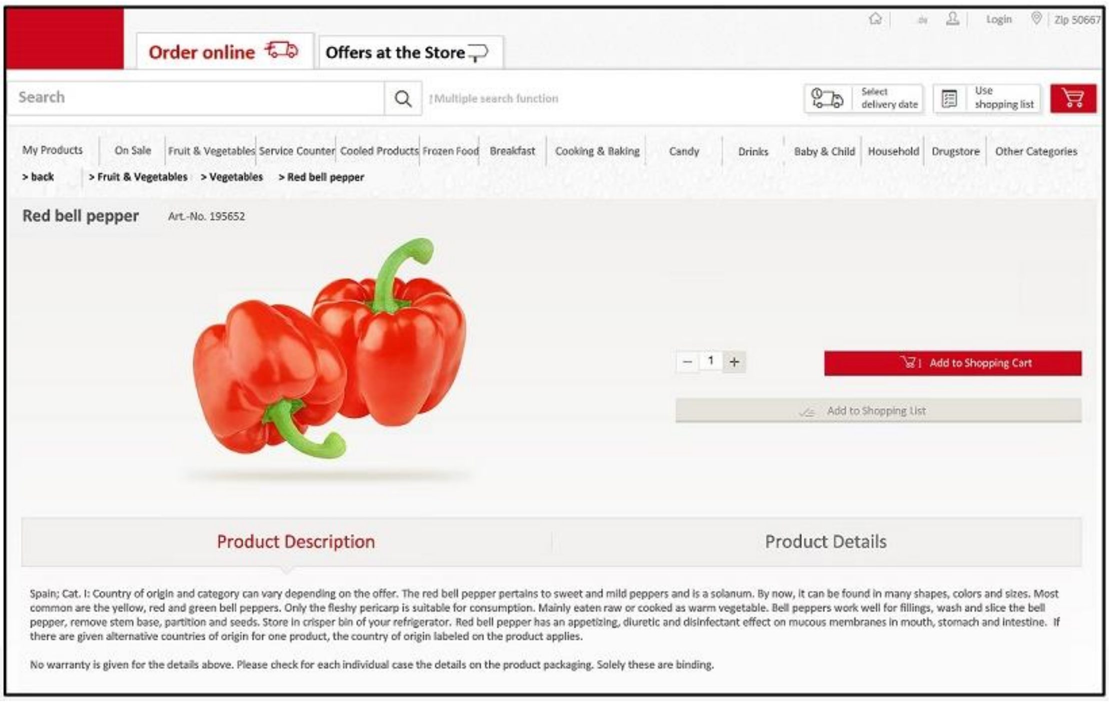

Figure 3 Simulated online shop for studies 1, 2, and 3

The final sample consisted of 199 participants who were all involved in the grocery purchasing process of their households ($mean_{age}$=28.52; SD=11.94; 68% females; average monthly grocery expenditure per person=€170/$189). Respondents predominantly used a direct touch interface (73%).[2]

4.2. Measures and operationalization

Analysis of hypotheses draws on partial least squares structural equation modelling (PLS-SEM) (e.g., Lohmöller, 1989). The model consisted of five latent constructs estimated with SmartPLS3 (Ringle et al., 2015). A German version of the 12-item NFT scale (Nuszbaum et al., 2010; Peck & Childers, 2003a) including six instrumental (iNFT) and six autotelic NFT (aNFT) items operationalized the higher order construct NFT. Implementing a repeated indicators approach in a reflective-formative hierarchical component model, iNFT and aNFT constituted total NFT (Hair, Gudergan, et al., 2017).

Two items adapted from Krishna and Morrin (2008) and Imschloss and Kuehnl (2017) captured consumers' cognitive processing in terms of quality concern (QUAL). Two items, adapted from Chylinski et al. (2015) and Imschloss and Kuehnl (2017) assessed consumers' affective response (AFFEC) to online offered produce. Appendix C summarizes all items and scale assessments. Appendix E contains descriptive statistics and item translations.

4.3. Results

4.3.1. Reliability and validity

The assessment first addressed the measurement model's quality in terms of internal consistency, indicator reliability, and convergent validity (see Appendix C) (Hair, Hult, et al., 2017). Internal consistency is reliable with Cronbach's alpha (α) and composite reliability (CR) values being greater than 0.7. Indicator reliability draws on average variance extracted (AVE) and supports convergent validity with all values being above 0.5.

We establish discriminant validity according to the Fornell-Larcker Criterion (Fornell & Larcker, 1981). A Heterotrait-Monotrait Ratio analysis further confirms discriminant validity as the confidence intervals for each construct relationship do not include 0.85 (Henseler et al., 2015). Table 1 summarizes discriminant validity results.

Finally, all items load highest on their allocated construct and corresponding loadings are significant ($p<0.001$). Overall, the model provides no reliability or validity concerns.

[2] Direct versus indirect touch interface users did not differ significantly in terms of NFT ($t_{(197)}$=-0.649; p=0.517).

Table 1 Discriminant validity results

	Study 1: Bell pepper				Study 2: Banana			
Construct	AFFEC	NFT	Mod.IT	QUAL	AFFEC	NFT	WTP_{diff}	QUAL
AFFEC	0.901	[0.201, 0.434]	[0.024, 0.246]	[0.521, 0.793]	0.883	[0.241, 0.483]	[0.350, 0.564]	[0.365, 0.686]
NFT	-0.256	0.713	[0.059, 0.251]	[0.178, 0.365]	-0.291	0.711	[0.077, 0.259]	[0.175, 0.394]
Mod.IT	0.097	0.046	1.000	[0.024, 0.246]	-	-	-	-
WTP_{diff}	-	-	-	-	-0.398	0.144	1.000	[0.086, 0.409]
QUAL	-0.496	0.196	0.042	0.878	-0.363	0.175	0.200	0.863

Notes: Main diagonal ($\sqrt[2]{\boldsymbol{AVE}}$) and lower triangular matrix (Pearson correlation) represent Fornell-Larcker criterion. Upper triangular matrix represents Heterotrait-Monotrait Ratio of correlations (95% confidence intervals). AFFEC=Affective response; Mod.IT=Moderation through interface type; NFT=Need for touch; QUAL=Quality concerns for online produce; WTP_{diff}=Willingness to pay difference offline-online.

4.3.2. Results and discussion

Figure 4 depicts all path coefficients including direct effects between constructs, as well as the interface type moderation between NFT and affective response. Table 2 details all total, direct, and indirect effects together with the corresponding test statistics.

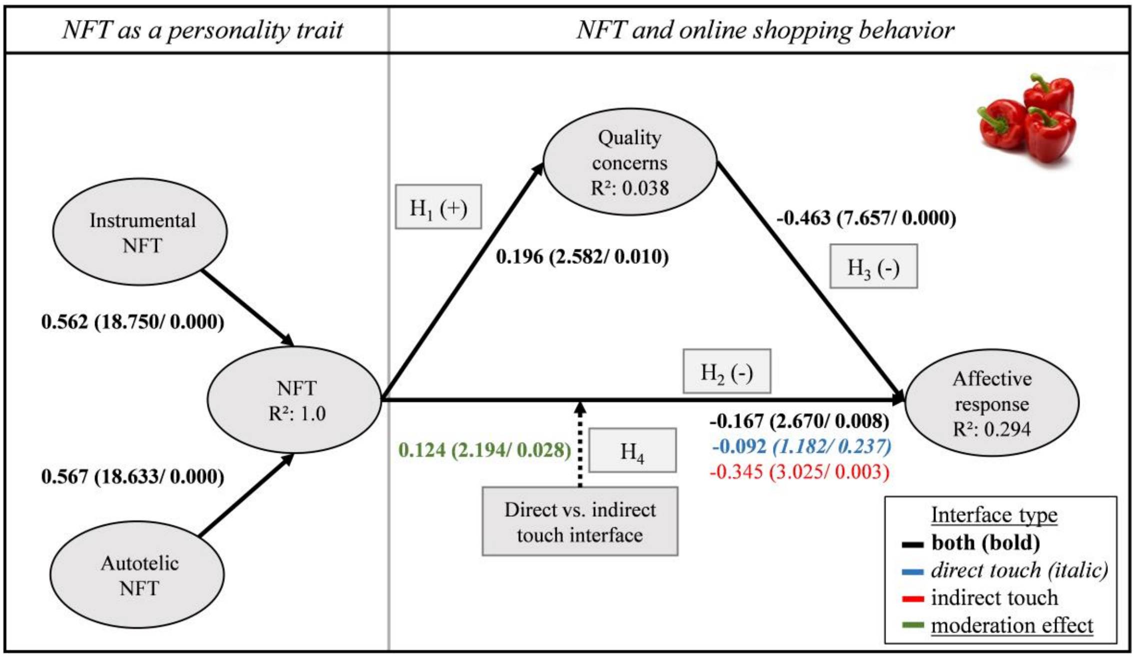

Figure 4 Estimated path model for bell peppers (direct effects, t-value/p-value by interface type)

Table 2 Bootstrapping results

	Study 1: Bell pepper			Study 2: Banana		
Path	Total effect	Direct effect	Indirect effect	Total effect	Direct effect	Indirect effect
iNFT → NFT	0.562 (18.750/0.000)	0.562 (18.750/0.000)	-	0.649 (21.222/0.000)	0.649 (21.222/0.000)	-
iNFT → QUAL	0.110 (2.459/0.014)	-	0.110 (2.459/0.014)	0.113 (2.381/0.017)	-	0.113 (2.381/0.017)
iNFT → AFFEC	-0.145 (3.328/0.001)	-	-0.145 (3.328/0.001)	-0.189 (4.229 /0.000)	-	-0.189 (4.229 /0.000)
iNFT → WTPdiff	-	-	-	0.094 (2.167/0.030)	-	0.094 (2.167/0.030)
aNFT → NFT	0.567 (18.633 /0.000)	0.567 (18.633/0.000)	-	0.479 (17.444/0.000)	0.479 (17.444/0.000)	-
aNFT → QUAL	0.111 (2.707/0.007)	-	0.111 (2.707 /0.007)	0.084 (2.639/0.008)	-	0.084 (2.639/0.008)
aNFT → AFFEC	-0.146 (3.901/0.000)	-	-0.146 (3.901/0.000)	-0.140 (4.440/0.000)	-	-0.140 (4.440 /0.000)
aNFT → WTPdiff	-	-	-	0.069 (2.170/0.030)	-	0.069 (2.170/0.030)
NFT → QUAL	0.196 (2.582/0.010)	0.196 (2.582/0.010)	-	0.175 (2.509/0.012)	0.175 (2.509/0.012)	-
NFT → AFFEC	-0.258 (3.616/0.000)	-0.167 (2.670/0.008)	-0.091 (2.492/0.013)	-0.322 (4.327/0.000)	-0.235 (3.415/0.001)	-0.056 (2.135/0.033)
NFT → WTPdiff	-	-	-	0.144 (2.184/0.029)	0.029 (0.432/0.666)	0.115 (3.440/0.001)
Mod.IT → AFFEC	0.124 (2.205/ 0.029)	0.124 (2.194/ 0.028)	-	-	-	-
QUAL → AFFEC	-0.463 (7.657/0.000)	-0.463 (7.657/0.000)	-	-0.322 (4.697/0.000)	-0.322 (4.697/0.000)	-
QUAL → WTPdiff	-	-	-	0.180 (2.134/0.033)	0.065 (0.766/0.444)	0.115 (3.994/0.000)
AFFEC → WTPdiff	-	-	-	-0.357 (5.934/0.000)	-0.357 (5.934/0.000)	-

Note: t-value/p-value in parentheses. AFFEC=Affective response; aNFT=Autotelic NFT; iNFT=Instrumental NFT; Mod.IT=Moderation through interface type; NFT=Need for touch; QUAL=Quality concerns for online produce; WTP_{diff}=Willingness to pay difference offline-online

Supporting H_1, higher NFT leads to stronger quality concerns regarding online offered bell peppers (b=0.196; p=0.010). Additionally, NFT exerts a significant negative direct effect on affective response (b=-0.167; p=0.010), supporting H_2. In line with H_3, quality concerns partially mediate NFT's negative effect on affective response (indirect effect: b=-0.091; p=0.012).

Further, NFT's direct effect on affective response significantly decreases when consumers use a direct touch instead of an indirect touch interface (b_{direct}=-0.092 vs. $b_{indirect}$=-

0.345; p=0.029 for moderation effect).[3] In line with H_4, interface type moderates the effect of NFT on affective response. Specifically, the direct effect of NFT on affective response is not significant for direct touch interface users (b=-0.092; p=0.237), but significant for indirect touch interface users (b=-0.345; p=0.003). Nevertheless, the total negative effect of NFT on affective response remains significant for direct touch interface users (b=-0.197; p=0.033) through a full mediation via quality concerns.

Results confirm that direct touch interfaces do not fully overcome the online environment's haptic disadvantages that high NFT consumers experience; those using a direct touch interface still express quality concerns toward online produce due to the absence of haptic information. Therefore, study 2 no longer assesses interface type. Instead, it focuses on consumers' WTP for offline and online offered produce to investigate a potential price difference based on shopping contexts.

5. Study 2

5.1. Procedure, stimuli, and sample

Study 2 followed the same procedures as study 1, yet replacing bell peppers with bananas broadening the scope to fruits (see preliminary study and Appendix B). The survey featured the same questions as before, followed by WTP questions regarding bananas offered at the participant's preferred local grocery store and the simulated online store. Lastly, participants reported online shopping frequency and demographic details.

The final sample comprised a total of 181 participants recruited by a German market research company. Participants ($mean_{age}$=25.99; SD=7.07; 71% females) reported involvement in the grocery purchasing process in their household, and an average monthly grocery expenditure of €163 ($181) per person.

5.2. Measures and operationalization

Constructs were consistent with study 1 (Appendix C and E). An additional two questions captured consumers' WTP for offline versus online retailing (Imschloss & Kuehnl, 2017; Krishna & Morrin, 2008). Here, a higher positive value for WTP difference represented a higher price premium a consumer is willing to pay for produce purchased in the offline grocery store. Additionally, the common market price for bananas (€0.76 to €2.20 per kg, i.e.

[3] The direct effect of interface type on affective response is not significant (b=-0.083, p=0.087).

$0.38 to $1.11 per lb) was provided (Krishna & Morrin, 2008). Finally, online purchasing frequency (weekly vs. less frequent) was measured.

5.3. Results

5.3.1. Reliability and validity

Internal consistency reliability approaches conventional levels with α and CR values close to 0.7 (lowest α=0.66; see Appendix C). With AVE values above 0.5, all constructs reflect sufficient convergent validity. All endogenous constructs exert discriminant validity. Also, items load highest on their corresponding constructs (all loadings: p<0.001). Thereby, the model provides sufficient reliability and validity.

5.3.2. Results and discussion

All total effects are significant and of expected direction (see Table 2). Figure 5 depicts the direct effects.

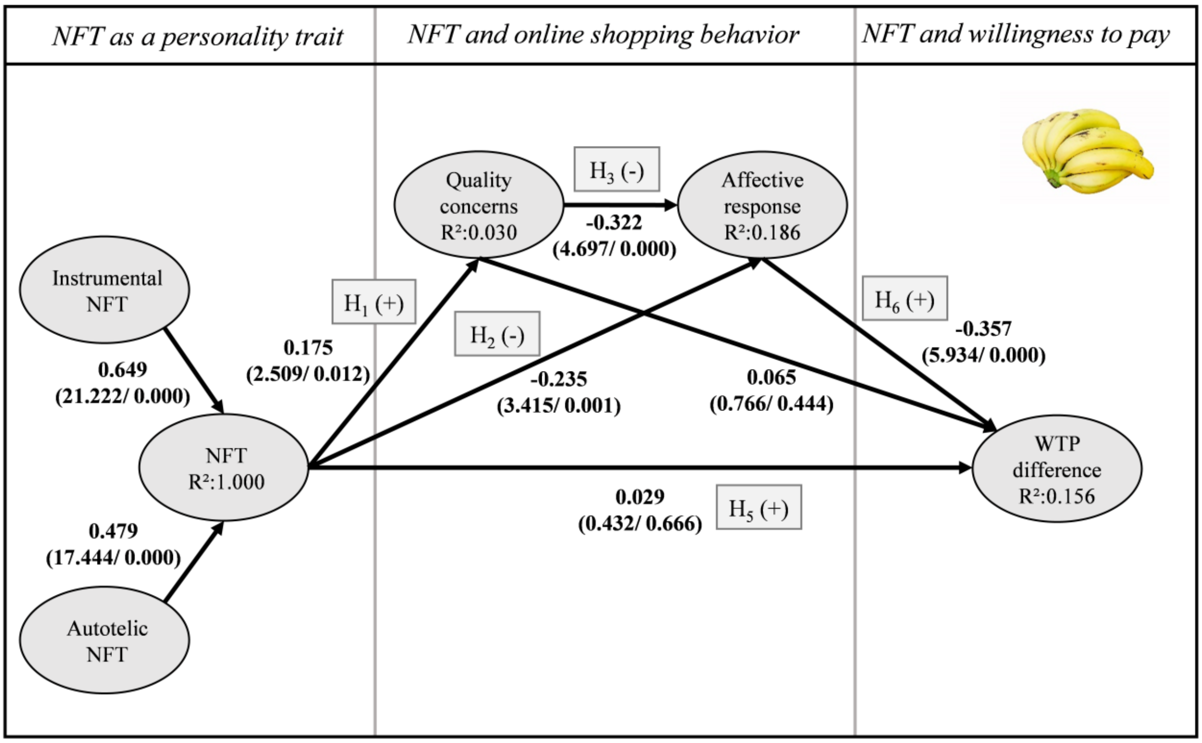

Figure 5 Estimated path model for bananas (direct effects, t-value/p-value)

Consistent with study 1 and H_1, higher NFT leads to greater quality concerns for online offered bananas (b=0.175; p=0.012). In line with H_2, NFT negatively impacts affective response (b=-0.322; p<0.001). Results also uphold H_3 as quality concerns mediate the negative influence of NFT on affective response (indirect effect b=-0.056; p=0.033). Both direct and indirect effects of NFT on affective response are significant, which supports complementary mediation. Although NFT's direct effect on WTP difference is not significant (b=0.029; p=0.666), the total effect including both quality concerns and affective response as serial mediators is significant (b=0.144; p=0.029). Similarly, the positive, indirect effect of the serial mediation is significant (b=0.115; p=0.001), supporting H_5 and H_6. Overall, results confirm NFT's impact on consumers' cognitive (quality concerns) and affective (affective response) processing.

Additionally, NFT influences the economically relevant WTP difference between offline and online offered produce. To illustrate, low NFT consumers (via median split) express a lower WTP difference for 1 kg (2.2 lbs) banana [WTP_{diff}=€0.13 ($0.15); WTP_{online}=€1.36 ($1.54); $WTP_{offline}$=€1.49 ($1.69)] than high NFT consumers [WTP_{diff}=€0.23 ($0.26); WTP_{online}=€1.29 ($1.46); $WTP_{offline}$=€1.52 ($1.72)]. This effect of NFT on WTP_{diff} is also significant when analyzing a simple correlation between both constructs (r=0.146, p=0.025). Therefore, the higher a consumers' NFT, the higher the price premium the consumer is willing to pay for bananas sold in local grocery stores. This effect is substantial given the common market price of bananas.

Consequently, online retailers should implement techniques to decrease WTP difference observed in study 2. Likewise, research should assess the robustness of the study's results across different type of produce. To address both aspects, study 3 focuses on different design options for online shops (H_7) and considers produce with high and low touch diagnosticity (H_8). Since study 1 and study 2 both establish the mediating role of quality concerns and affective response, study 3 exclusively considers the relationship between NFT and WTP difference.

6. Study 3

6.1. Procedure, stimuli, measures, and sample

Study 3 followed a 2 (online shop design: video absent vs. present) x 2 (touch diagnosticity: low vs. high) mixed factorial design. The online experiment manipulated touch diagnosticity within-subjects and online shop design between-subjects. Findings of the preliminary study identified melons as high visual and low touch diagnosticity produce and apples as high visual and high touch diagnosticity produce (see Figure 2). Therefore, melons and apples were suitable stimuli with diverging haptic qualities. During the study, consumers saw both produce in random order in-between other products that served as distractors. The design of the online shop was manipulated between-subjects; consumers saw either a design containing text and product picture (see study 1 and 2) or a design additionally presenting a product video (video absent vs. present).[4] These clips featured a model haptically evaluating the produce to induce imagination of product touch (vicarious touch), which is known to compensate the missing haptic input (Pino et al., 2020). Consumers only saw the hands and the produce to avoid potential confound due to model attractiveness, ethnicity, etc. (Pino et al., 2020). The sampling procedure as well as scenario closely resembled study 1. Consistent with study 2, consumers indicated WTP at their preferred local grocery store and simulated online store, NFT, and demographics.

A total of 104 participants (58: video absent; 46: video present; $mean_{age}$=27.89; SD=8.24; 70% females) who reported high involvement in the grocery purchasing process completed the study. The average monthly grocery expenditure was €130 ($145) per person.

6.2. Results

6.2.1. Preliminary analysis

First, we assessed comparability of both groups (video absent vs. present) (Lichters et al., 2016). The two subsamples do not significantly differ in age ($t_{(102)}$=0.08; p=0.943), gender (Fisher's exact p=0.667), income group (Fisher's exact p=0.119), monthly grocery expenditure ($U_{(n1=46;\ n2=58)}$=1263; p=0.632), or NFT ($t_{(102)}$=0.384; p=0.702). Further, the NFT scale indicates satisfying internal consistency (α=0.928).

6.2.2. Results

The analysis of moderating effects of touch diagnosticity (produce type, see H_7) and online shop design (H_8) on NFT's influence on WTP difference draws on Preacher and Hayes's PROCESS Model 1 with 5,000 bootstrapped samples (Hayes, 2017). NFT acts as the independent variable in two product-specific models and design factor (video absent [0] vs. present [1]) serves as the moderator. The standardized WTP difference between offline versus online retailing for both produce act as dependent variables to enable for model comparison.

For apples, the positive direct effect of NFT is significant (ß=0.034; SE=0.007; CI_{95}: [0.021, 0.048]), replicating study 2. Thus, higher NFT leads to a more pronounced WTP difference (H_5). Supporting H_7, results for melon are not significant (ß=0.010; SE=0.008; CI_{95}: [-0.005, 0.025]). For produce with low touch diagnosticity, NFT does not affect WTP

[4] For video excerpts see: https://osf.io/pg7dr/

difference. To statistically substantiate H_7, the analysis compares within-subject differences for NFT's direct effect coefficients ß in both models across the 5,000 bootstraps. As predicted, NFT's effect is significantly higher for apples than for melons (p=0.019).

Consequently, touch surrogates (H_8) are solely relevant for produce with high touch diagnosticity such as apples. Here, the interaction NFT x design is significant (ß=-0.031; SE=0.011; CI_{95}: [-0.052, -0.009]). The negative moderation coefficient highlights that NFT's influence on WTP difference is stronger in the video absent compared to the video present condition. Conditional process analysis shows NFT's effect is significant in the video absent condition (ß=0.034; SE=0.007; CI_{95}: [0.021, 0.048]), but not in the video present condition (ß=0.004; SE=0.008; CI_{95}: [-0.013, 0.021]). Thus, implementing a video acts as a remedy for NFT's negative effect on WTP difference in support of H_8. Bootstrap analysis additionally confirms that the moderation term is significantly higher for apples than for melons (p=0.012). For melons, the interaction effect is not significant (ß=0.004; SE=0.010; CI_{95}: [-0.017, 0.023]).

Appendix F offers further analyses and robustness checks for consumer characteristics including gender and online shopping frequency across all three studies, as prior findings suggest an impact of these variables (e.g., Citrin et al., 2003; Overmars & Poels, 2015). The same Appendix also presents an assessment of predictive validity for the PLS-SEM models.

7. General discussion and implications

7.1. Summary and managerial implications

Based on consumers' haptic orientation, this research identifies significant differences between retail contexts, namely offline grocery stores and online grocery retailing. These differences entail consumer's perceived quality concerns and affective responses that the current study links to the personality trait NFT. Overall, our research confirms that absence of haptic information plays a major role in consumers' hesitation to adopt online shopping for perishable produce. Not only do online grocery retailers face negative perceptions concerning their products, but they also encounter lower consumers' intention to buy and to consume online produce. These relationships are directly influenced by NFT; as NFT increases, the effects become more pronounced.

The present study also reveals that negative consequences of NFT in online grocery shopping further intensify if consumers use indirect touch interfaces (e.g., mouse-keyboard) rather than direct ones (e.g., smartphone). These effects are even stronger for consumers engaging in online shopping less than once a week; therefore, direct touch interfaces can lower the negative impact of NFT particularly for infrequent online shoppers (see Appendix F).

Moreover, the current findings display that consumers report lower WTP for online than for offline produce. High NFT magnifies this difference. Further, quality concerns and low affective responses toward online offered produce serially mediate NFT's impact on WTP difference. Online retailers, consequently, need to identify techniques to overcome NFT's adverse impact, especially for high NFT consumers. In line with prior research utilizing touch imagery, our findings support the usefulness of touch surrogates in online grocery shopping. Video clips featuring human hands touching the product successfully offset the negative influence of NFT on consumers' WTP for online produce. Finally, the current research also introduces an interesting boundary condition: NFT exclusively impacts consumers when shopping for produce with high (instead of low) touch diagnosticity.

The above-mentioned findings present important implications for online produce retailers. First, regarding different touch interfaces, current consumer trends reflect a preference for direct touch interface usage (Brasel & Gips, 2015), which could indicate a diminishing importance of NFT in the future. However, the persistent, significant negative total effect of NFT in this research reveals that high NFT consumers do continue to experience negative consequences in online grocery shopping. Therefore, online retailers need to account for differences in consumers' personality.

Second, online retailers face lower WTP for produce compared to offline retailers. Therefore, a marketing strategy implementing consistent pricing across retail channels, without considering differences in consumer personality, is inappropriate. Third, considering heightened consumers uncertainty during online grocery shopping, retailers need to adjust online product display to overcome negative perceptions and affective reactions toward produce, in particular for high NFT consumers. We suggest video clips as visual design features displaying haptic evaluations of a product by individuals as a suitable compensation method. This tool is beneficial for high NFT consumers without negatively impacting other consumer segments. Consequently, this tactic is valuable to retailers even if consumer NFT levels are not quantified. Fourth, any investments made in optimizing product presentation in online retailing should prioritize products with high touch diagnosticity. Online retailers who sell products such as canned goods are less impacted by the preceding negative effects than online retailers who sell peaches.

7.2. Limitations and further research

The present research uses NFT to identify consumer preferences related to retail contexts for produce shopping. While respondents indicate hypothetical behavior, future research should investigate actual behavior by allowing participants to complete purchases. In addition, besides NFT other variables explain the price premium consumers are willing to pay for offline purchased produce. As suggested by Jayawardhena (2004), personal values including self-direction, enjoyment, and self-achievement can influence desire to browse, repatronage intention, and switching behavior. Thus, future research should consider personal values, consumers' experiences, and sensory characteristics among others to provide a more comprehensive assessment of online grocery shopping.

If online retailers seek insights into their customers NFT predisposition, administering the 12-item NFT scale (Peck & Childers, 2003a) might turn out to be unfeasible. Therefore, a future exploratory research might identify observable cues as surrogates based on consumers' preferences, browsing behavior, prior purchases, or search history. One might speculate that consumers who have never bought high touch diagnosticity products online (e.g., produce such as apples, furry pets, lingerie, computer mice), but otherwise express comparable consumption behavior to other consumers might be high in NFT. Likewise, a consumers' purchase history of appendix goods (e.g., pet food, leather care products) could infer the possession of products with haptic appeal, which in turn may indicate high NFT tendencies. These alternative NFT assessment techniques could provide retailers with an indirect method to better segment their customers.

Further, recent research demonstrates that consumers often switch from a mobile device to a non-mobile device during the final stage of purchase completion, especially for high risk product categories such as produce (Haan et al., 2018). However, the switch from direct touch to indirect touch interface terminates the touch-induced positive affect for high NFT consumers identified in the current study. Although one might reasonably predict that, in general, conversion rates are higher if consumers switch to indirect touch interfaces, this pattern should not emerge for high NFT consumers. Therefore, further research might identify higher conversion rates for high NFT consumers when switching from indirect touch to direct touch interfaces (e.g., starting to browse at the office on a desktop and finalizing the purchase on the way home on a smartphone).

This research focuses exclusively on produce, yet online grocery shopping behavior is highly product category specific (Vries et al., 2018; Waterlander et al., 2015). Thus, we encourage future research to examine different grocery categories. Beyond the grocery context, studies should also assess other products that provide additional sources of uncertainty that consumers usually address by touching. For example, consumer electronics’ unknown usability or surface creates a perceived risk that consumers seek to reduce through tactile evaluation (Lichters et al., 2016). NFT should be important here.

In conclusion, the current research contributes to the expanding literature on online grocery retailing by assessing consumer purchasing behavior for produce. Here, NFT explains the differences in consumer behavior across shopping contexts. Online retailers need to manage different retail channels accurately to overcome high NFT consumers’ quality concerns, less pronounced affective responses, and lower WTP. Providing product videos or implementing efficient pricing strategies for online produce are two tools online retailers can utilize to ensure success.

Appendix

A. Research contribution concerning NFT in online produce retailing

The literature review (see Table 3) focuses on the top 30 marketing journals according to Hult et al. (2009), and includes empirical studies (from 2003 to February 2020) administering the NFT scale (Peck & Childers, 2003a). We used the search terms 'NFT' and 'need for touch' in Google Scholar as well as Web of Science to identify a total set of 25 articles. The table gives an overview that highlights the prevailing research gaps related to online retailing of produce and NFT addressed in the current article.

According to Table 3, this research is the first to assess produce purchase behavior in an online retailing context while focusing on NFT. So far, Peck and Childers (2006) investigate produce only in a supermarket field study. Further, while previous research assesses NFT in online retailing contexts (e.g., Brasel & Gips, 2014; Schlosser et al., 2006; Yazdanparast & Spears, 2013), produce or groceries as product categories have not been studied.

The current research also identifies the moderating effect of interface type on NFT's effect on affective consumer processing. To date, research has identified higher engagement in the decision making process as well as increased enjoyment (Chung et al., 2018; Vries et al., 2018), yet no study has examined a significant interaction between touch interface type and NFT.

Lastly, this paper is the first to use WTP difference between offline and online offered produce (WTP_{diff}) for analyses, specifically for two main advantages. First, subtracting online WTP value from offline value allows researchers to compare consumers' WTP between two retail channels directly. Second, the new variable WTP_{diff} prevents potential confounding issues arising from participants' general budget constraints.

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Table 3 Literature overview

Number	Authors	Journal	Products	Produce considered	Online shop considered	Product presentation online	Direct touch vs. indirect touch interface	Cognitive consumer processing	Affective consumer processing	WTP_{diff} (offline-online)	Compensation method for absence of touch
1	Peck and Childers (2003a)	*JCR*	sweater, tennis racket					X			X
2	Peck and Childers (2003b)	*JM*	sweater, mobile phone,					X	X		X
3	Peck and Childers (2006)*	*JBR*	peaches	X					X		
4	Peck and Wiggins (2006)*	*JM*	pamphlet					X	X		
5	Schlosser et al. (2006)	*JM*	furniture		X	X			X		X
6	Grohmann, Spangenberg, and Sprott (2007)	*JR*	ballpoint pen, headband, key chain, pillow case, washcloth, flashlight			X		X	X		
7	Shu and Peck (2007)	*ACR*	slinky, keychain, mini-tape								
8	Krishna and Morrin (2008)*	*JCR*	flimsy and firm cup					X			X
10	Jin (2011)**	*PM*	controller					X	X		
11	Peck and Johnson Wiggins (2011)*	*PM*	pamphlet					X			
12	Krishna and Peck (2012)	*ACR*	koosh ball, blanket					X			X
13	Orth, Bouzdine-Chameeva, and Brand (2013)	*JR*	wine					X			
14	Peck, Barger, and Webb (2013)	*JCR*	koosh ball, blanket								X
15	Yazdanparast and Spears (2013)	*PM*	sweater, laptop		X	X		X			X
16	Brasel and Gips (2014)	*JCP*	sweater, city tour, tent		X	X	X	X			
17	Choi and Taylor (2014)	*JBR*	sweater, watch					X			X
18	Spears and Yazdanparast (2014)**	*JCP*	sweater			X					X
19	Chylinski, Northey, and Ngo (2015)	*PM*	dyed snacks, yogurt, chocolate flakes, pine nuts						X		
20	Webb and Peck (2015)	*JCP*	-								
21	Streicher and Estes (2016)**	*JCR*	bottle can, chocolate			X		X	X		X
22	Imschloss and Kuehnl (2017)	*PM*	wallet					X			
23	Santos and Gonçalves (2019)	*JBR*	-					X			
24	Yoganathan, Osburg, and Akhtar (2020)	*JBR*	teddy bear			X					
25	Pino et al. (2020)	*JBR*	digital camera, calculator, tablet computer					X	X		X
26	**Current study (2019)**	***JBR***	**bell pepper, banana, apple, melon**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**

Note: * only focuses on autotelic NFT; ** only focuses on instrumental NFT. ACR=Advances in Consumer Research; JBR=Journal of Business Research; JCP=Journal of Consumer Psychology; JCR=Journal of Consumer Research; JM=Journal of Marketing; JR=Journal of Retailing; PM=Psychology & Marketing

B. Scenarios for study 1 and study 2

It is Friday afternoon and some friends have invited you to a summer party tomorrow. The hosts ask you to bring

1 kg (2.2 lbs) of red bell peppers

as your contribution to the meal you will enjoy with friends.

Unfortunately, you do not have time to stop by a preferred local grocery store. Therefore, you decide to have a look at an online shop.

The produce you have been asked to bring to the party can be bought via an online shop, and it costs the same as at the local grocery store you usually go to.

The delivery is free and guaranteed to be on time. The online shop delivers to any address in your area.

Figure 6 Scenario study 1

It is Friday afternoon and some friends have invited you to a summer party tomorrow. The hosts ask you to bring

1 kg (2.2 lbs) of bananas

as your contribution to the meal you will enjoy with friends.

Unfortunately, you do not have time to stop by a preferred local grocery store. Therefore, you decide to have a look at an online shop.

The produce you have been asked to bring to the party can be bought via an online shop, and it costs the same as at the local grocery store you usually go to.

The delivery is free and guaranteed to be on time. The online shop delivers to any address in your area.

Figure 7 Scenario study 2

C. Wording and assessment of measurement results

Table 4 Reliability and validity results

Constructs and items	Factor loadings	
	Study 1: Bell pepper	Study 2: Banana
Need for Touch (Nuszbaum et al., 2010; Peck & Childers, 2003a) *(-3=not at all true, +3=exactly true)*		
1. I place more trust in products that can be touched before purchase.	0.743	0.855
2. I feel more comfortable purchasing a product after physically examining it.	0.775	0.885
3. If I can't touch a product in the store, I am reluctant to purchase the product.	0.828	0.765
4. I feel more confident making a purchase after touching a product.	0.741	0.867
5. The only way to make sure a product is worth buying is to actually touch it.	0.792	0.793
6. There are many products that I would only buy if I could handle them before purchase.	0.820	0.849
study 1 iNFT: α=0.874, AVE=0.614, CR=0.905; study 2 iNFT: α=0.914, AVE=0.700, CR=0.933		
7. When walking through stores, I can't help touching all kinds of products.	0.735	0.714
8. Touching products can be fun.	0.767	0.829
9. When browsing in stores, it is important for me to handle all kinds of products.	0.676	0.774
10. I like to touch products even if I have no intention of buying them.	0.684	0.734
11. When browsing in stores, I like to touch lots of products.	0.760	0.807
12. I find myself touching all kinds of products in stores.	0.765	0.802
study 1 aNFT: α=0.907, AVE=0.682, CR=0.928; study 2 aNFT: α=0.870, AVE=0.605, CR=0.901		
Quality concerns regarding online offered produce (Imschloss & Kuehnl, 2017; adapted from Krishna & Morrin, 2008) *(1=worse than pictured/better in online shop, 9=better than pictured / better in offline grocery store)*		
1. Do you think the quality of the ordered bell peppers/bananas complies with the pictured quality of the online shop? The quality of the delivered red peppers/bananas will be…	0.902	0.881
2. How do you evaluate the quality of the produce ordered from the online shop compared to the grocery store's produce?	0.854	0.845
study 1: α=0.705, AVE=0.771, CR=0.871; study 2: α=0.660, AVE=0.746, CR=0.667		
Affective response (adapted from Chylinski et al., 2015; Imschloss & Kuehnl, 2017) *(numeric value between 0 – 100%; 1=not at all, 6=definitely)*		
1. How likely would you buy the online offered bell peppers/bananas?	0.921	0.885
2. How much would you enjoy eating the online offered bell peppers/bananas?	0.882	0.882
study 1: α=0.771, AVE=0.813, CR=0.897; study 2: α=0.718, AVE=0.780, CR=0.876		
Interface type (direct vs. indirect touch) (adapted from Brasel & Gips, 2014) *(answer choices: direct or indirect touch interface)*		
1. Which technical device did you use to complete this questionnaire?		
Willingness to pay difference (offline-online) (adapted from e.g.,Imschloss & Kuehnl, 2017) *(difference in two numeric WTP values)*	1.000	
1. Price difference between consumers WTP for 1 lb bananas in an offline grocery store and online shop.		1.000

Note: iNFT=Instrumental NFT; aNFT=Autotelic NFT; AVE=Average variance extracted; CR=Composite reliabilityD. Key abbreviations

D. Key abbreviations

Abbreviation	Explanation
AFFEC	Affective response
AVE	Average variance extracted
aNFT	Autotelic need for touch
CI	Confidence interval
iNFT	Instrumental need for touch
Mod.IT	Moderation through interface type (direct vs. indirect touch interface)
WTP_{diff}	Willingness to pay difference offline-online retailing
QUAL	Quality concerns regarding online offered produce
IT	Interface type (direct vs. indirect touch interface)

E. Scale items and descriptive statistics

Table 5 Item wordings and translations NFT scale

Construct	Item	English wording	German wording
iNFT	1	I place more trust in products that can be touched before purchase.	Ich vertraue stärker auf Artikel, die man vor dem Kauf anfassen kann.
	2	I feel more comfortable purchasing a product after physically examining it.	Beim Kauf eines Artikels fühle mich wohler, wenn ich diesen vorher durch Anfassen eingehend geprüft habe.
	3	If I can't touch a product in the store, I am reluctant to purchase the product.	Wenn ich einen Artikel im Geschäft nicht anfassen kann, möchte ich diesen nur ungern kaufen.
	4	I feel more confident making a purchase after touching a product.	Beim Kauf eines Artikels fühle ich mich sicherer, wenn ich diesen zuvor anfassen konnte, weil ich dadurch etwas über die Qualität des Artikels erfahren kann.
	5	The only way to make sure a product is worth buying is to actually touch it.	Um herauszufinden, ob es sich lohnt einen Artikel zu kaufen, muss man diesen angefasst haben.
	6	There are many products that I would only buy if I could handle them before purchase.	Es gibt eine Vielzahl von Artikeln, die ich nur kaufen würde, wenn ich sie zuvor auch in die Hand nehmen kann.
aNFT	1	When walking through stores, I can't help touching all kinds of products.	Wenn ich einkaufen gehe, muss ich alle möglichen Artikel anfassen.
	2	Touching products can be fun.	Es macht Spaß, alle möglichen Artikel anzufassen.
	3	When browsing in stores, it is important for me to handle all kinds of products.	Wenn ich mich in Geschäften umsehe, ist es wichtig für mich, alle möglichen Artikel in die Hand zu nehmen.
	4	I like to touch products even if I have no intention of buying them.	Auch wenn ich einen Artikel nicht unbedingt kaufen will, mag ich es ihn anzufassen.
	5	When browsing in stores, I like to touch lots of products.	Beim Stöbern in Geschäften mag ich es einfach alle möglichen Artikel anzufassen.
	6	I find myself touching all kinds of products in stores.	Beim Einkaufen ertappe ich mich immer wieder dabei, dass ich alle möglichen Artikel anfasse.

Note: Original items in English by Peck and Childers (2003a), German translation and validation of NFT items by Nuszbaum et al. (2010)

Table 6 Item wordings and translations of endogenous constructs

Construct	Item	English wording	German wording
QUAL (study 1 and 2)	1[a]	Do you think the quality of the ordered bell peppers/bananas complies with the quality pictured in the online shop? The quality of the delivered bell peppers/bananas will be…	Denken Sie, die Qualität der gelieferten Paprika / Bananen wird der im Online-Shop dargestellten Qualität entsprechen? „Die Qualität der gelieferten Paprika / Bananen wird … sein“
	2[b]	How do you evaluate the quality of the ordered products of the online shop compared to the products of the offline grocery store?	Wie schätzen Sie die Qualität der gelieferten Produkte aus dem Online-Shop im Vergleich zur Qualität der Produkte im Laden ein?
AFFEC (study 1 and 2)	1[c]	How likely would you buy the online offered bell peppers/bananas?	Wie wahrscheinlich würden Sie die im Online-Shop dargestellte Paprika / Bananen kaufen?
	2[d]	How much would you enjoy eating the online offered bell peppers/bananas?	Wie gerne würden Sie persönlich die im Online-Shop dargestellte Paprika/ Bananen essen?
WTP_{diff} (study 2 and 3)	1[e]	Price difference between consumers WTP for 1 kg (2.2 lbs) bananas in offline grocery store and an online shop (offline-online).	

Table 7 Descriptive statistics for measured items

		Study 1: Bell pepper		Study 2: Banana		Study 3: Apple and Melon	
Construct	Item	Mean	SD	Mean	SD	Mean	SD
iNFT*	1	0.010	1.607	1.707	1.394	1.346	1.480
	2	1.291	1.502	1.801	1.340	1.471	1.414
	3	1.352	1.516	0.326	1.698	-0.577	2.061
	4	-0.020	1.662	1.967	1.179	1.663	1.492
	5	1.246	1.574	0.436	1.715	1.212	1.799
	6	1.543	1.395	1.155	1.724	-0.260	2.086
aNFT*	1	-0.824	1.828	1.249	1.530	-0.154	1.965
	2	-0.322	1.912	0.558	1.646	-0.019	2.029
	3	-0.241	1.924	0.575	1.689	0.337	1.919
	4	-0.754	2.011	-0.845	1.880	-0.115	1.992
	5	-0.080	1.924	-0.215	1.922	0.202	1.808
	6	-0.276	2.044	-0.425	1.939	0.087	1.833
QUAL	1[a]	6.970	1.521	6.773	1.460	-	-
	2[b]	6.462	1.523	6.398	1.554	-	-
AFFEC	1[c]	43.447	32.625	39.044	32.660	-	-
	2[d]	3.402	1.566	3.348	1.579	-	-
IT	1[e]	0.734	0.442	-	-	-	-
WTP_{diff}	1[f]	-	-	0.182	0.420	apple: 0.087 melon: 0.195	apple: 0.222 melon: 0.739

Note: * all items are measured with a 7-point Likert scale ranging from -3 (*not at all true*) to +3 (*exactly true*)
[a] 9-point scale ranging from +1 (*worse than pictured*) to +9 (*better than pictured*)
[b] 9-point scale ranging from +1 (*better in online shop*) to +9 (*better in offline grocery store*)
[c] Numeric value between 0 and 100%
[d] 6-point scale ranging from +1 (*not at all*) to +6 (*definitely*)
[e] Answer choice of direct touch interface (*touchscreen*) or indirect touch interface (*mouse, keyboard, stylus, other*)
[f] Difference in two numeric WTP values (offline-online)

F. Further analyses and predictive validity of PLS-SEM models

Further analyses focus on gender and online shopping frequency. Existing research suggests that female consumers have higher preference for tactile input than male consumers, which is of particular relevance in online grocery retailing given that female consumers tend to complete most of the online food purchases (e.g., Citrin et al., 2003). Similarly, consumers with greater online shopping experience express higher purchase intentions, thus, online shopping frequency can impact online produce consumption (Yazdanparast & Spears, 2013).

A multi-group analysis assesses potential differences between male and female consumers in study 2 (Hair, Hult, et al., 2017). Results show a significant gender effect for the total effect of NFT on WTP difference (b_{diff}=-0.344; p=0.018). Surprisingly, NFT has a higher influence for men (b=0.289) than for women (b=-0.055). This gender difference is not confirmed for either study for the influence of NFT on quality concerns (study 1: b_{diff}=-0.157; p=0.347; study 2: b_{diff}=-0.106; p=0.434) and on affective response (study 1: b_{diff}=0.048; p=0.751; study 2: b_{diff}=0.127; p=0.209). Additionally, the direct effect of gender on WTP difference is not significant in study 2 ($t_{(173)}$=0.969; p=0.334) or in study 3 (apple: $t_{(102)}$=-0.879; p=0.382; melon: $t_{(40.47)}$=-1.264; p=0.213). Finally, no interaction between NFT and gender emerges in study 3 (apple: ß=0.004; SE=0.003; CI_{95}: [-0.005, 0.017]; melon: ß=0.011; SE=0.010; CI_{95}: [-0.009, 0.032]).

Further, multi-group analysis for online shopping frequency (weekly vs. less frequent online shopping) does not show any significant effect for the influence of NFT on affective response in study 2 (b_{diff}=0.186; p=0.196). In study 2 and in study 3 the online shopping frequency does not directly affect WTP difference (banana: $t_{(179)}$=0.138; p=0.890; apple: $t_{(102)}$=0.363; p=0.717; melon: $t_{(6.26)}$=-0.480; p=0.647). Finally, there is no interaction between NFT and online shopping frequency in study 3 (apple: ß=-0.002; SE=0.005; CI_{95}: [-0.107, 0.008]; melon: ß=0.028; SE=0.016; CI_{95}: [-0.004, 0.059]).

In study 1, however, for direct touch interface users the relationship between NFT and affective response is stronger for less frequent online shoppers (b_{diff}=-0.369; p=0.002). Thus, consumers engaging in e-tailing less frequently, profit more from using a direct touch interface.

A final analysis assessed the predictive validity of the two PLS-SEM models applying PLSpredict (Shmueli et al., 2016). Both models demonstrate predictive validity as all final endogenous constructs' items exert smaller root mean squared error of prediction (RMSE) values for the PLS-SEM method than for analogous linear regression models (see Table 8).

Positive 10-folded mean (Q^2) values further support the models' out-of-sample predictive power.

Table 8 PLSpredict results

		Study 1: Bell pepper			Study 2: Banana		
		RMSE			RMSE		
	Item	PLS	LM	Q^2	PLS	LM	Q^2
QUAL	1	1.510	1.515	0.020	1.492	1.478	0.011
	2	1.511	1.571	0.021	1.553	1.608	0.016
AFFEC	1	32.001	32.332	0.043	31.159	32.504	0.073
	2	1.535	1.588	0.050	1.523	1.567	0.039
WTP_{diff}	1	-	-	-	0.421	0.449	0.006

Note: AFFEC=Affective response; LM=Linear model (ordinary least squares); PLS=Partial least squares; RMSE=Root mean squared error of predictions; Q2=Mean value in PLSpredict; QUAL=Quality concerns for online produce; WTP_{diff}=Willingness to pay difference offline-online

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Essay 3

How touch feeds taste in online produce retailing

Authors

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Abstract

Recent research sheds light on consumers' negative expectations of online (vs. offline) offerings during the pre-purchase stage when browsing for perishable products such as produce. In online produce retailing these negative expectations are often driven by the missing haptic information one would otherwise receive when shopping offline. The present article broadens this scope by incorporating the retail channel's influence (online vs. offline) on consumers' produce experience in the post-purchase stage (i.e., consumption of produce). Following two preliminary online studies, two lab experiments evaluate how expectations form later product taste, willingness to pay (WTP), and consumption amount when browsing in different retail channels. Results from the first experiment highlight that there is negative spill-over originating from bad product expectations in the case of online (vs. offline) retailing to the post-purchase stage of products. Specifically, consumers who believe that they tasted online (vs. offline offered) produce report lower WTP, worse taste evaluation, and actually consume less. Regardless of the actual product quality, consumers devaluate produce sold online even after the product consumption because of the negative expectation of online retailing channel. We propose that the nature of these expectations is rooted in missing haptic input. The second experiment supports this suggestion in that using a direct (i.e., touchscreen) instead of an indirect (e.g., computer mouse) touch interface when browsing through an online grocery store mitigates the identified negative effects of the missing haptic input in online retailing. The vicarious touch triggered by touching the products on a touchscreen serves as a touch surrogate in the pre-purchase stage, which, therewith, effects the product experience in the post-purchase stage.

Key words: Consumer expectation, Haptic input, Online retailing, Product evaluation, Tasting, Touch interface

How touch feeds taste in online produce retailing

1. Introduction

E-commerce sales have increased by 27.6% in the last year, reaching a value of $4,28 trillion worldwide (Cramer-Flood, 2021). Even if consumers mention saving time and convenience as online shopping's perceived benefits (e.g., Al-Debei et al., 2015), consumers express negative expectations of online (vs. offline) offered products (Huang & Oppewal, 2006; Kim et al., 2019). These negative expectations are primarily relevant for specific product categories such as high involvement products (Kim et al., 2019) or experience goods (Chocarro et al., 2013). One explanation for consumers' negative expectations of specific online product offerings can be found in sensory marketing research. Researchers identified the missing haptic input as one factor for consumers' reluctance to purchase specific product categories via the Internet (Kühn et al., 2020). In particular, consumers hesitate to buy experience goods (compared to search goods), like fresh food, online (Chocarro et al., 2013). While consumers are able to evaluate the attributes of a search product prior to purchase or use, an experience product cannot be fully evaluated prior to consumption (Chiang & Dholakia, 2003; Chocarro et al., 2013). Consumers therefore personally want to feel and inspect the experience product (Chiang & Dholakia, 2003; Hurgobin et al., 2020). This, however, is not an option in online retailing.

Previous literature showed that when no haptic feedback is available, consumers' preference for and attitude toward a product decreases (Krishna & Morrin, 2008). Recently, Ringler et al. (2019) demonstrated that consumers experience a psychological reaction when they are actively kept from touching a product, lowering the likelihood that they will purchase them. It seems that the inability to experience a product haptically, as in an online retailing context, adversely influences consumers' feelings and attitude, which then results in a negative expectation towards product offerings. Contrary, if consumers have the opportunity to touch the product, such as in a physical store, they evaluate it better and feel more confident about their decision (Grohmann et al., 2007). In line with this, researchers additionally focused on consumers' innate need for touch (NFT), defined as the "*preference for the extraction and utilization of information obtained through the haptic system*" (Peck & Childers, 2003a, p. 431). Consumers with a high NFT require the haptic input in order to evaluate the product properly (Peck & Childers, 2003b) resulting in a higher purchase intention (Pino et al., 2020). Additionally, Kühn et al. (2020) identified that consumers' NFT increases negative expectations when considering goods, like produce, retailed online, which leads to a lower consumption desire.

Although previous research examined consumers' negative expectations of products that cannot be touched in a pre-purchase stage, no research analyzed if this expectation still affects the post-purchase stage. The current research fills the gap by investigating if consumers devaluate the products sold online (vs. offline) after product experience in the post-purchase stage.

The current research further underpins our explanation concerning the missing haptic input by emphasizing the importance of vicarious touch in online retailing. Vicarious touch implies that consumers imagine touching the product (Pino et al., 2020). Recent research highlighted its importance in situations where haptic input is impossible (Kühn et al., 2020; Pino et al., 2020). This touch imagination can be generated via a direct touch interface (e.g., touchscreen of a tablet) because touching the product on a touchscreen relates to touching the product itself (Brasel & Gips, 2014). So far, research found that using a direct compared to an indirect touch interface (e.g., keyboard/mouse combo) enhances consumers' psychological comfort (Melumad & Pham, 2020), increases their buying intention (Chung et al., 2018), and impacts their product choice (Shen et al., 2016) in the pre-purchase stage. Extending the underlying rational to online retailing, using a direct (vs. indirect) touch interface can make an important difference in consumers' expectations and later product evaluation. The design of the present study allows for assessing whether an induced haptic input via direct touch interfaces compensates for the otherwise absent input in online shopping in the post-purchase stage after the product experience. To date, no research has assessed the interplay of consumers' evaluation of online products in the post-purchase stage, and the various touch interfaces consumers use to access these online offerings prior to consumption.

A first pre-study's results found that frequently bought produce usually involve high touch diagnosticity (i.e., the extent to which touching a product is important in the pre-purchase evaluation process). These results are pertinent to further studies as individuals want to inspect produce haptically prior to their purchase decision (González-Benito et al., 2015; Grohmann et al., 2007; Kühn et al., 2020). A second online pre-study highlighted consumers' negative expectations of online (vs. offline) offered produce within the pre-purchase stage. The results emphasized that consumers had lower expectations and willingness to pay (WTP) for products sold online. In two subsequent lab experiments, we show that – even after product consumption – consumers who think they have received produce sold from an online (vs. offline) retail channel devaluate the products. Specifically, consumers reported that produce ostensibly ordered online (vs. offline) tasted worse and that they exhibited less WTP for it. Ultimately, consumers in the online condition consume less produce than their counterparts in the offline condition. In the offline experimental condition, we used a deception procedure in that consumers believe that they are tasting the produce they have inspected haptically, such as in a physical grocery store. Allowing consumers to think they consumed produce obtained from an online store (vs. letting them supposedly experiencing the products by using their hands in the pre-purchase stage) is apparently enough to induce these adverse consequences.

Consequently, the retail channel possesses severe impact on consumers' product experience. In particular, consumers base their evaluation solely on their expectations in the pre-purchase stage and miss to learn from the product experience that the products of the online shops are of the same quality as of a physical store. With this insight, the research helps to derive useful marketing strategies for online grocery retailing. If consumers only possess a limited learning effect from the product experience, then marketing strategies such as free samples fail to convince consumers using their online shop.

The second experiment provides an additional solution for online retailers. Using a direct instead of an indirect touch interface during the purchasing process mitigates the retail channels' effects on consumers' product evaluation, taste, WTP, and the consumption amount. These results are highly relevant for online retailers because they justify to align online campaigns specifically on direct touch interfaces or develop appropriate apps to decrease consumers' negative expectations.

2. Background and hypotheses

A major problem online grocery retailers face is consumers' resistance to shop for produce online (Armstrong, 2019; Hurgobin et al., 2020; Kühn et al., 2020). Since the absence of a physical store prevents consumers from comparing products' quality, size, and appearance haptically (Bonetti et al., 2018). Consumers do not have "*the possibility of touching and feeling products before purchasing them to reduce uncertainty*" (Herhausen et al., 2015, p. 311) and, as a result, experience a high degree of frustration (Kawaf & Tagg, 2017; Peck & Childers, 2003b) and quality concerns (Kühn et al., 2020). Thus, despite the perceived advantages (e.g., convenience, time saving), online retailing experiences substantial disadvantages compared to traditional offline shopping.

To shed light on the matter, it is worth referring to research on how consumer behavior differs between conditions in which consumers are able to touch products vs. no-touch conditions (e.g., online retailing) in the pre-purchase stage. In the absence of haptic input, consumers are less confident of their product judgments (Peck & Childers, 2003b), which results in lower product evaluation (Grohmann et al., 2007), decreased liking of taste (Madzharov, 2019), and less WTP (Heller et al., 2019; Hurgobin et al., 2020). Touching products is considered a fundamental part of product expectation (Jansson-Boyd, 2011; Schifferstein & Spence, 2008). Consumers form specific expectations based on the haptic input, which lead to different behaviors compared to no-touch conditions (e.g., based on different oral haptics, consumer form specific nutritional perceptions leading to differences in consumption) (Biswas et al., 2014). Further, in the absence of haptic input, consumers seem to have specifically negative expectations of the product (Kühn et al., 2020; Peck & Wiggins, 2006). Using this information, Lee et al. (2006) showed that, in general, negative product expectations color actual product experience, especially product taste, negatively. The authors demonstrated that inducing specific expectations of a beer (i.e., the claim that a beer contains vinegar) is powerful enough to influence consumers' taste evaluation negatively. Announcing a particular ingredient of a food item prior to consumption can therefore make a significant contribution to our taste expectation, irrespective of whether the information is true or not (see Litt and Shiv (2012) for similar findings). Siegrist and Cousin (2009) further highlighted the power of expectation by showing that expectations remain in consumers' product evaluation and that consumers' do not negate these expectations based on learning from actual product experience. In their study, the participants gave wine a significantly lower rating, after tasting it, if they received negative (vs. positive) product information prior to consumption. Specifically, participants received the product evaluation from a well-known wine critic, who ostensibly rated the wine with either 72 (only average) or 92 (very good). This effect also influenced consumers' WTP for the wine.

In further seminal studies, other authors showed that providing consumers with brand information prior to product experience, often influences the perceived product taste. Hoyer and Brown (1990) provide a fine example in which the taste of different peanut butter samples is positively influenced when consumers were told a priori that the sampled product is of a superior brand and vice versa. Other research pointed to the neuro-physiological roots of this placebo marketing effect (McClure et al., 2004). Specifically, Plassmann and Weber (2015) highlighted that consumers with a strong need for reward and cognition and a low somatosensory awareness are more prone to these expectation-based effects.

To summarize, in conditions without direct touch possibilities, consumers form negative expectations about product properties, influencing their product evaluation and their desire to consume the product (Bushong et al., 2010). Given the above, consumers might also have negative expectations of produce’s quality when these are sold online (vs. offline). This is in line with Kühn et al. (2020) who showed that consumers expect produce of lower quality to be sold online (vs. offline) and that they are less willing to purchase and consume these products. Hurgobin et al. (2020) focused on consumers’ WTP for apples in an online and offline shopping context. They identified a significantly lower WTP for apples purchased online, compared to those bought at a physical market. This effect is significant for the total sample, as well as for the identified clusters of *price sensitive consumers, offline consumers,* and *organic consumers,* confirming the suggestions that, in general, consumers resist buying fresh produce online.

Given this conclusion, the implications are manifold. In particular, online vs. offline retailing research should then incorporate the findings of previous consumer research on the power that expectations have on product experience.

Given the above, it is clear that a variety of product information (e.g., ingredients, advertising, brands) first forms our product expectations and transitively our product experience. Particularly, information on the product source, in terms of online vs. offline retailing, influences how these expectations are formed. As previous sensory marketing studies have identified, these differences are to a great extent due to missing haptic input in online retailing (e.g., Heller et al., 2019; Kühn et al., 2020; Overmars & Poels, 2015). Specifically, we propose that exposure to produce sold online (vs. physical offline) causes negative expectations (Kühn et al., 2020) due to the missing haptic input, and these sedimentary expectations persist in consumers’ product experience, especially in their product evaluation after consumption. Thus, even if the product quality is objectively the same in online and offline retailing, consumers do not only use their consumption experience to judge the products. In particular, they unjustifiably express negative attitudes and behaviors toward the same produce sold online (vs. offline) even after experiencing them. We therefore posit:

> **H_1:** After product consumption experience of produce of the same quality, the announced online retail channel (vs. offline) still negatively influences consumers’ (a) overall evaluation, (b) taste, (c) willingness to pay, and (d) consumption.

Recent research suggests that using a direct instead of an indirect touch interface provides vicarious touch experience (Kühn et al., 2020; Shen et al., 2016). Since the research argues that the adverse influence of online vs. offline retailing stems from the former channel's missing haptic input, it is plausible to assume that the type of interface influences the extent to which differences between the retail channels unfold. Today, consumers mainly use two kinds of interfaces in online shopping: direct vs. indirect touch interfaces (Brasel & Gips, 2014; Shen et al., 2016). Direct touch interfaces rapidly become consumers' preference when shopping online (Brasel & Gips, 2014, 2015; Chung et al., 2018). Brasel and Gips (2015) indicated that touching a touchscreen is in fact a metaphor for choosing a product directly. The use of direct touch vs. indirect touch interfaces specifically leads to perceived object interactivity, which further increases the imagined haptic product information's vividness (Brasel & Gips, 2014). This perceived interactivity makes consumers feel that the direct touch interfaces are part of their extended self (Hein et al., 2011).

This, in turn, leads to higher product purchases (Chung et al., 2018; R. J. Wang et al., 2015) and better product evaluation (Kühn et al., 2020; X. Wang et al., 2020). Moreover, Vries et al. (2018) already demonstrated that the shopping experience is perceived as more enjoyable while browsing an online grocery store with a direct (vs. indirect) touch interface, resulting in a higher product valuation (in this case sausage and milk). Additionally, Kühn et al. (2020) pointed out that using a direct (vs. indirect) touch interface mitigates the negative effect of consumers' need for touch, as an innate human trait (Peck and Childers, 2003a), on their likelihood to buy and consume produce sold online. A direct touch interface therefore seems to compensate for the missing haptic input consumers experience in the online shopping process.

All these studies only focused on the pre-purchase stage (e.g., purchase intention, WTP), but the current research enhances existing literature by also evaluating the post-purchase stage of consumer behavior within the online shopping context. Specifically, we propose that the positive effects of direct touch interfaces will mitigate the negative expectations consumers may have of the product source (online vs. offline retailing channel), improving consumers' consumption experience.

> **H_2:** Compared to retailing produce offline, using direct (vs. indirect) touch interfaces when shopping online mitigates the adverse consequences of missing haptic input.

3. Study overview

A first preliminary study assesses different produce's touch diagnosticity. The study identifies products with a high touch diagnosticity that consumers regularly buy in order to use them in all subsequent parts of this research. A second preliminary study replicates the basic premise underlying H_1: due to negative consumer expectations, offering produce online (vs. offline) is related to quality concerns and a lower WTP. In Study 1's experiment, consumers rated produce under the guise of a tasting. The experiment comprises of two conditions. In one condition consumers thought they were evaluating apples which they had experienced haptically during the pre-purchase stage, as if in an offline grocery store. In the second condition, consumers sampled products that were supposedly bought from an online grocery store through which they had browsed. Unbeknown to them, the study applied a deception mechanism (Smith et al., 2009) in which all products were actually supplied by a local physical retailer. In both conditions consumers evaluated the products in terms of overall evaluation, taste expectation, and WTP (H_1). Study 2 closely follows Study 1 but implements an additional third condition to evaluate H_2 using tomatoes as product stimuli. In total, this study has one offline condition and two online shopping conditions. In one of those conditions, consumers browsed through a simulated online store using a mouse/keyboard combo (indirect touch). In the second online condition, consumers used a tablet (direct touch). Study 2 also tracks participants' mood before and after the shopping process (i.e., self-selection in the offline condition and browsing the online grocery store with the online conditions), as well as the amount of produce the participants consumed during the tasting. The data sets of the studies are provided under

https://osf.io/ecw89/?view_only=56e6ef0fcd03482995101fc8dbcaeaa8.

4. Preliminary study 1

4.1. Methodology and sample

An online study presents 20 common fruits and vegetables to n = 72 participants (63% female, $mean_{age} = 21.81$ years, SD = 9.46), who rated the importance of being able to haptically and visually evaluated produce prior to purchase (Kühn et al., 2020). Participants also indicated which produce they buy regularly. Appendix A presents the exact wording and scales of the questions used. Finally, respondents also provided their demographic information.

4.2. Results and discussion

As depicted in Figure 1, kiwis, apples, and tomatoes are suitable stimuli for the subsequent studies, as they show a high purchase frequency (kiwis = 60%, apples = 85%, tomatoes = 75%) and possess a high touch diagnosticity ($mean_{kiwis} = 5.04$, $SD = 2.02$; $mean_{apples} = 4.81$, $SD = 1.20$; $mean_{tomatoes} = 4.28$, $SD = 2.21$). Specifically, these products have significantly higher touch importance compared to the mean across all products ($mean_{all} = 3.84$; $SD = 1.19$; one-sample t-tests: kiwis: $t(71) = 5.01$, $p < 0.001$, $r = 0.29$[1]; apples: $t(71) = 4.10$, $p < 0.001$, $r = 0.23$; tomatoes: $t(71) = 1.68$, $p = 0.097$, $r = 0.09$). Although tomatoes are just significant at the 10% level, analysis identified tomatoes as vegetables with the highest touch diagnosticity. In other words, consumers prefer to inspect kiwis, apples, and tomatoes haptically before purchasing them.

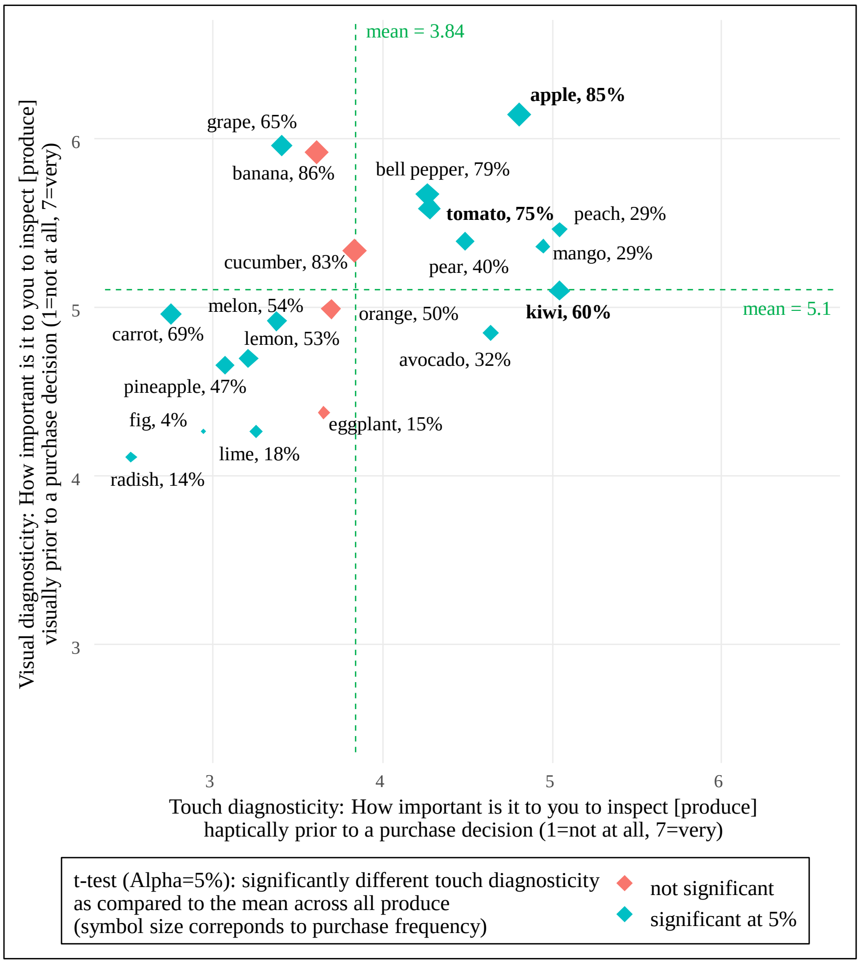


Figure 1 Pretest identifying produce for subsequent studies

[1] This research provides the effect sizes r for all analyses.

5. Preliminary study 2

5.1. Methodology and sample

This study supports the previous suggestion that consumers' quality expectations of online produce and their WTP for these items score below comparable offline offerings. In total n = 175 participants (71% female, $mean_{age}$ = 25.99 years, SD = 7.09), recruited by a German market research agency, saw kiwis in a simulated online store. Besides providing demographic information, participants evaluated the quality of the kiwis and specified what they were willing to pay for them online (WTP_{online}), as well as at their preferred local grocery store ($WTP_{offline}$) (see Appendix A for wording and scale information).

5.2. Results and discussion

Consumers reported having significantly lower quality expectations of kiwis sold online (vs. offline) (mean = 3.60, SD = 1.56, one-sample t-test: $t(174) = -11.89$, $p < 0.001$, $r = 0.41$). They also exhibited a significantly lower WTP for six kiwis online ($mean_{online}$ = €1.71, SD = 0.77) vs. offline ($mean_{offline}$ = €1.93, SD = 0.78) (paired sample t-test: $t(174) = -4.46$; $p < 0.001$, $r = 0.14$). Lower quality expectations of online (vs. offline) produce, thereby, correlate with a lower WTP_{online} ($p = 0.014$, $r = 0.19$). Based on the previous, consumers would like to pay 12% less for kiwis sold online than for those sold in their preferred offline store.

Next, study 1 examines if these negative expectations impact product evaluation and WTP even after product consumption experience (H_1). The underlying logic is that, in principle, consumers should objectively evaluate the product quality as being the same, if they are not influenced by their expectations of the retail channel modality.

6. Main study 1

6.1. Methodology and sample

Study 1 evaluates $H_{1a\text{-}c}$ within a 2 x 4 mixed-factorial design, comprising one between-subject factor (announced retail channel: online vs. offline), and one within-subject factor (types of apples: Granny Smith, Golden Delicious, Elstar, Pink Lady). As a pretext, participants thought the study aimed to optimize a grocery retailer's product assortment. Participants in the offline condition chose one apple of each type from baskets, as it is common in physical supermarkets. Participants believed that these apples were sliced for a subsequent tasting, but study assistants actually served them randomly sampled pieces of apple. Participants therefore falsely assumed that the product samples they received were those that they had carefully preselected themselves, as if in a normal supermarket. The offline condition was deliberately designed to isolate the effects originating from participants' expectations of the products without objectively higher quality because they self-selected products. Participants in the online condition used a PC to view the relevant apples in an unbranded, simulated online grocery store without prices. They were informed that they would sample the four types of apples shortly (see Appendix B for screenshots of the online store). During the sample preparation time, participants provided their demographics.

To rule out any systematic bias in the apple evaluation based on position, sequence, and first-order carry over effects (Moskowitz et al., 2012), participants evaluated the four products in an individualized sequence derived from a Williams design (Williams, 1949) compiled with the help of the software Qi Statistics (2019). After sampling each apple, participants gave an overall evaluation of the fruit and the taste on Jones et al.'s (1955) nine-point hedonic scale, which has become standard in sensory product research (e.g., Cohen et al., 1997; Elder & Krishna, 2010; Lichters et al., 2021), followed by their WTP (see Appendix A for further scale information, descriptive statistics, and correlations). Appendix C illustrates the tasting procedure.

All participants (1) regularly consume apples, (2) do not have impairment taste, (3) are non-smokers, and (4) do not have apple allergies/intolerances. In total, n = 93 participants (26% female, $mean_{age}$ = 25.25 years, SD = 10.35) were randomly allocated to either the offline (n = 47) or the online (n = 46) group. All participants were approached during a German university's open day, but received no compensation for participating. The experimental groups did not differ in terms of gender, age, online shopping frequency or grocery purchase responsibilities (smallest p = 0.122).

6.2. Results and discussion

Analyses drew on repeated measures ANOVAs (four products per participants, see Lichters et al. (2021)). After tasting, participants who thought they had chosen the apples themselves (offline) provided an overall better evaluation of the produce than those browsing the online store ($mean_{offline}$ = 6.65, SD = 0.97; $mean_{online}$ = 6.15, SD = 1.33; F(1; 91) = 4.23; p = 0.042, r = 0.21), supporting H_{1a}. In support of H_{1b}, participants stated that the apples tasted significantly better in the offline ($mean_{offline}$ = 6.62, SD = 0.95) than in the online

($mean_{online}$ = 6.15, SD = 1.16) condition ($F(1; 91) = 4.56$, $p = 0.035$, $r = 0.22$). Moreover, participants in the offline condition were willing to pay more for one kg of the same type of apple in the future, than those in the online condition ($mean_{offline}$ = 2.02€, SD = 0.38; $mean_{online}$ = 1.85€, SD = 0.36; $F(1; 91) = 4.93$; $p = 0.029$, $r = 0.23$), therefore supporting H_{1c}. The interaction effect between the retail channel and the type of apple was neither significant for participants' overall evaluation ($F(3; 245) = 1.92$, $p = 0.134$, $r = 0.14$) nor for the taste ($F(2; 234) = 1.66$, $p = 0.183$, $r = 0.13$), but was significant in terms of their WTP ($F(3; 273) = 2.68$, $p = 0.047$, $r = 0.17$).[2]

To summarize, the mere belief that one can directly evaluate produce in the pre-purchase stage, is enough to enhance actual product experience and future WTP for produce. As can be expected, consumers' negative expectations of produce offered online, identified in preliminary study 2, remain after tasting the produce and continue to affect the evaluation process. When comparing the differences in consumers' WTP for offline and online produce across preliminary study 2 (12%) and study 1 (9%), consumers still falsely perceive a difference in quality even after experiencing the product.

As this research argues, part of consumers' negative product expectations when considering produce sold online is due to the absence of haptic evaluation opportunities. Consequently, if using a direct compared to an indirect touch interface, it can metaphorically compensate for actual haptic input (Brasel & Gips, 2015) through vicarious touch (Pino et al., 2020), and should make a difference in online retailing. Strictly speaking, if consumers are using a touchscreen (instead of a keyboard/mouse combo) to shop for produce online, there should be less room for negative expectations. As proposed by H_2, study 2 addresses this issue.

In addition, the study checks for affective factors like participants' mood during the shopping process that might influence consumers' decisions after the tasting. The research supports the explanation that the retail channel, characterized by the (missing) haptic input, forms quality expectations that are responsible for evaluation differences, even after consumers had experienced the product. The research further analyzes if vicarious touch, from a direct touch interface, compensates for the missing haptic input. Study 2 therefore strives to exclude factors that might affect and be responsible for consumers' product evaluation after the experience.

[2] Appendix D, in a bar plot, shows that the WTP in the offline condition is descriptively higher than in the online condition in terms of all types of apples.

7. Main study 2

7.1. Methodology and sample

Study 2 replicates study 1, but additionally focuses on H_{1d} (consumption amount) and H_{2a-d} (touch interface types). This study implements a 3 (announced retail channel: offline vs. direct touch online vs. indirect touch online) x 3 (type of tomatoes: Cherry Vine, Vine, Roma) mixed-factorial design, with the retail channel as a between-subject, and the type of tomatoes as a within-subject factor. The procedure follows study 1 closely, but uses a paper and pen test instead of a computerized survey after tasting the vegetables. The study design allows for assessing whether an induced haptic input via direct touch interfaces can compensate for the otherwise absent input in online shopping. If compensation occurs in the form of enhanced product evaluation, this underlines the significance of the missing product haptics in online produce retailing.

All participants, recruited from a German university, (1) regularly consume tomatoes, (2) do not impaired taste, (3) are non-smokers, and (4) do not have tomato allergies/intolerances. In the end, nine participants were excluded because they failed to answer the attention check question correctly (by clicking on *1 = totally disagree*). The final sample consists of n = 196 participants (47% female, $mean_{age}$ = 21.77 years, SD = 2.45), who were randomly allocated to either the offline (n = 67), the direct touch online (n = 67), or the indirect touch online (n = 62) condition. As in the first study, we found no significant difference in gender, age, online shopping frequency, and grocery purchase responsibility between the groups (smallest p = 0.235). In study 2, participants also indicated their income and how hungry they were. There was no significant group difference in either of the variables (smallest p = 0.208). The offline condition mirrors that of study 1. In the direct touch online condition, participants browsed an unbranded online grocery store without price information (see Appendix B) on a tablet with a touchscreen (Microsoft Surface Pro 6 with Microsoft Windows 10 Pro operating system). In contrast, in the indirect touch online condition, participants used a PC with a keyboard/mouse combo. Additionally, participants also rated their mood before and after shopping allowing us to identify their mood change during the shopping process. In order to do so, participants filled out the 24-item multidimensional mood state questionnaire (MDMQ) consisting of three mental state dimensions (pleasantness, wakefulness, calmness) (Steyer et al., 2003, see Appendix A for detailed scale information). Participants also indicated their demographics. After the tasting, participants again indicated their overall product evaluation, rated product taste, and shared their WTP for a tomato of each type, using the same scales as in study 1 (see Appendix A for detailed scale information, descriptive statistics, and correlations). Without participants' knowledge, their actual consumption amount in grams was determined by means of a pre- and post-measurement of the samples' weight (Biswas et al., 2014; Lefebvre & Biswas, 2019). Appendix C illustrates the tasting procedure.

7.2. Results and discussion

7.2.1. Hypotheses tests

To assess H_{1a-c}, the online conditions (direct and indirect touch) were pooled. Supporting H_{1a}, participants who thought they had chosen their own tomatoes (offline condition) reported a better product experience ($mean_{offline} = 6.48$, SD = 1.03), compared to the pooled data of both online conditions ($mean_{online} = 6.17$, SD = 1.22) although, in reality, they receive randomly drawn tomatoes ($F(1; 194) = 3.14$; $p = 0.078$, $r = 0.13$). Further, consumers in the offline condition ($mean_{offline} = 6.11$, SD = 1.10) indicated a significantly better taste ($F(1; 194) = 6.08$; $p = 0.015$, $r = 0.17$), compared to the online conditions ($mean_{online} = 5.63$, SD = 1.39), therefore supporting H_{1b}. The same holds for WTP ($mean_{offline} = €0.21$, SD = 0.06; $mean_{online} = €0.19$, SD = 0.06, $F(1; 193)$[3] = 4.95; $p = 0.027$, $r = 0.16$), which supports H_{1c}. Interestingly, consumers in the offline condition consumed even more produce ($mean_{offline} = 22.32$, SD = 13.32) than their counterparts ($mean_{online} = 17.92$, SD = 9.69), showing the significant effect the retail channel has on the amount consumed ($F(1; 186)$ [4] = 6.76, $p = 0.010$, $r = 0.18$), which supports H_{1d}.

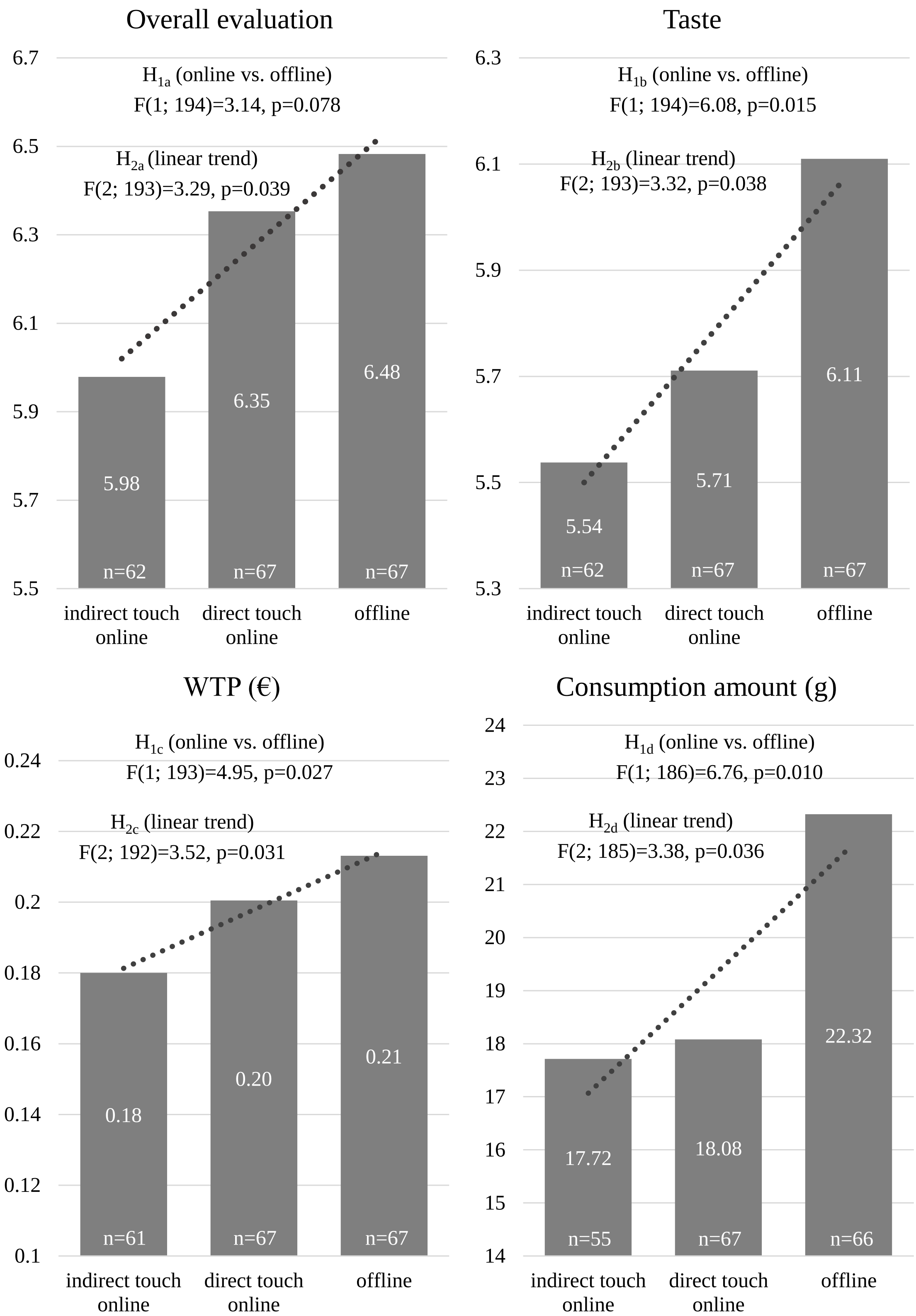
The interaction effect between the retail channel and the type of tomato is not significant for consumers' overall evaluation $F(2; 388) = 0.48$, $p = 0.618$, $r = 0.04$), liking taste ($F(2; 388) = 0.44$, $p = 0.645$, $r = 0.04$), and WTP ($F(2; 386) = 0.81$, $p = 0.445$, $r = 0.06$), but is significant for consumption ($F(2; 372) = 7.97$, $p < 0.001$, $r = 0.20$).[5]

H_2 proposes that the direct touch online condition should take an intermediate position between the offline and the indirect touch conditions. This is also in line with the observation that differences between online and offline retailing are noticeably less pronounced in study 2 than in study 1, with the latter not implementing a direct touch online condition. Linear

[3] Owning to missing response, N = 195 observations are available for this analysis (offline n = 67; direct touch online n = 67; indirect touch online n = 61)
[4] Owing to weighting problems, N = 188 observations are available for this analysis (offline n = 66; direct touch online n = 67; indirect touch online n = 55).
[5]Appendix D, in a bar plot, shows that the consumption in the offline condition is descriptively higher than in the online condition for all types of tomato.

contrasts (e.g., Madzharov et al., 2015) within the repeated measure ANOVAs with the three retailing conditions, offline, direct touch online and indirect touch online, were applied to evaluate $H_{2a\text{-}d}$. Results indicated that the retail channel had a significant linear main effect on the overall evaluation ($F(2; 193) = 3.29$, $p = 0.039$, $r = 0.18$). The overall evaluation progressively improved from the indirect touch online (mean = 5.98, SD = 1.23) to the direct touch online (mean = 6.35, SD = 1.18), and then to the offline condition (mean = 6.48, SD = 1.03), supporting H_{2a}. Further, participants indicated a significantly better taste in the offline condition (mean = 6.11, SD = 1.10) followed by the direct touch condition (mean = 5.71, SD = 1.34), and then the indirect touch condition (mean = 5.53, SD = 1.44), supporting H_{2b} ($F(2; 193) = 3.32$, $p = 0.038$, $r = 0.18$). The same linear effect holds for WTP ($F(2; 192) = 3.52$, $p = 0.031$, $r = 0.19$), in that participants were willing to pay more for the tasted product in an offline condition (mean = 0.21, SD = 0.06) than in a direct (mean = 0.20, SD = 0.07) or indirect (mean = 0.18, SD = 0.05) touch online condition, supporting H_{2c}. Finally, the consumption amount was higher in the offline condition (mean = 22.32, SD = 13.32) than in the direct (mean = 18.08, SD = 10.77) and indirect (mean = 17.72, SD = 8.28) touch online condition. Again linear contrasts support the direct touch effect ($mean_{diff} = 3.26$, SD = 1.44, $F(1; 185) = 3.38$, $p = 0.036$, $r = 0.19$), supporting H_{2d}.

Figure 2 depicts these key findings.



Note: g = Gram, H2 through linear contrasts

Figure 2 Results of study 2

7.2.2. Further analyses

Based on these results, the question arises of whether the use of direct (instead of indirect) touch interfaces in the produce shopping consideration stage can completely compensate for the differences between online and offline retailing in consumers' product experience? To explore this question, the research additionally applied a post-hoc test, which demonstrates that the differences between the offline and direct touch online conditions are not significant for the overall evaluation ($mean_{diff}$ = 0.13, SE = 0.20, p = 1.000, r = 0.06), the taste ($mean_{diff}$ = 0.40, SE = 0.22, p = 0.233,r = 0.16), and the WTP ($mean_{diff}$ = 0.01, SE = 0.01, p = 0.645, r = 0.08). Only the consumption amount points out significant values at the α = 10%-level ($mean_{diff}$ = 4.24, SE = 1.93, p = 0.087, r = 0.17).

In addition, a final analysis checks if participants' mood (pleasantness, wakefulness, and calmness) before and after the shopping process had an effect, specifically the haptic experience of produce in the offline condition and the browsing process in the online conditions. Regression analysis shows that participants' affective reaction does not explain the differences in their evaluation after product experience. Participants' change in mood (pleasantness, wakefulness, and calmness) is calculated by subtracting the mood before the shopping process from the mood after the shopping process.

Results clarify the significant effect the retail channel (offline vs. direct touch online vs. indirect touch online) possess on the overall evaluation of produce (b = 0.25, t(195) = 2.46, p = 0.015, r = 0.23), while mood changes of pleasantness (b = 0.09, t(195) = 0.30, p = 0.763, r = 0.08), wakefulness (b = -0.13, t(195) = -0.47, p = 0.641, r = -0.09), and calmness (b = 0-0.17, t(195) = -0.62, p = 0.490, r = -0.11) remain insignificant. The same effect holds for taste, WTP, and consumption amount. Table 1 presents the detailed regression results of overall evaluation, taste, WTP, and consumption.

These results highlight two contributions. First, they stress that the product evaluation after the product experience depends, like the retail channel, on cognitive aspects; this is contrary to affective reactions like the mood states. Second, the vicarious touch of a direct touch interface seems to compensate for the missing haptic input in the pre-purchase stage of online produce retailing. This compensation then leads to enhanced product evaluations after the actual product experience.

Table 1 Regression analyses for overall evaluation / taste / WTP / consumption amount

Predictor	B	SE	β	t	p	r
constant	5.78 / 5.22 / 0.17 / 14.77	0.22 / 0.25 / 0.01 / 2.26		25.86 / 20.71 / 15.28 / 6.53	0.000 / 0.000 / 0.000 / 0.000	
difference in pleasantness	0.09 / 0.18 / -0.01 / -0.38	0.30 / 0.34 / 0.02 / 2.96	0.03 / 0.05 / -0.04 / -0.01	0.30 / 0.51 / -0.36 / -0.13	0.763 / 0.607 / 0.721 / 0.897	0.08 / 0.10 / -0.09 / -0.06
difference in wakefulness	-0.13 / -0.04 / 0.00 / 3.06	0.27 / 0.30 / 0.01/ 2.65	-0.04 / -0.01 / -0.01 / 0.11	-0.47 / -0.14 / -0.05 / 1.16	0.641 / 0.890 / 0.957 / 0.250	-0.09 / -0.06 / -0.06 / 0.16
difference in calmness	-0.17 / -0.14 / 0.01 / -0.61	0.25 / 0.28 / 0.01 / 2.43	-0.06 / -0.05 / -0.07 / -0.02	-0.69 / -0.51 / -0.78 / -0.25	0.490 / 0.609 / 0.438 / 0.800	-0.11 / -0.10 / -0.12 / -0.07
retail channel	0.25 / 0.29 / 0.01 / 2.30	0.10 / 0.12 / 0.01 / 1.02	0.18 / 0.18 / 0.19 / 0.16	2.46 / 2.49 / 2.68 / 2.25	0.015 / 0.014 / 0.008 / 0.025	0.23 / 0.23 / 0.24 / 0.21

8. General discussion

To the author’s best knowledge, this study is the first to show that during the consumers’ product consideration stage, different retailing channels (online vs. offline), as well as the type of interface used (indirect touch vs. direct touch), significantly influence consumer behavior in the product experience’s post-purchase stage. When consumers believe they have inspected their products (apples and tomatoes) haptically and have chosen them themselves, their overall evaluation of the produce and their taste is better, and they are willing to pay more and consume more than in a situation where consumers think produce were ordered online. Consequently, negative consumer expectations – due to missing haptic input in online retailing – are obviously carried over to the web site checkout page. This lower evaluation of online produce, which transits to the post-purchase stage of product tasting, demonstrates that consumers’ ability to objectively evaluate online produce’s quality is limited. The negative spill-over from the pre- to the post-purchase stage therefore hinders consumers from realizing that online produce might be of the exact same quality as traditional offline produce. This is in line with the assimilation and contrast effect by Sherif et al. (1958). The expectations consumers have of offline and online produce are so different that they do not change their opinion about the online products even after consumption.

Interestingly, the study identifies direct touch interfaces as a compensation method for the missing haptic input in online produce retailing. Apparently, using a direct touch interface leads to an assimilation of consumers’ negative expectations of online offered produce (Sherif et al., 1958). A direct touch interface thus helps to reduce consumers’ negative expectations of shopping online for fruits and vegetables, resulting in better product evaluation after product consumption. We can explain this effect by consumers’ vicarious touch on a direct touch interface, which decreases consumers' need for haptic input during the purchasing process. In order to support this explanation, the study clarifies that affective reactions, such as consumers' pleasantness, wakefulness, and calmness, do not affect product evaluation after product experience.

9. Implications for practice and future research avenues

This research has several practical implications. First, due to consumers' lack of objective evaluation, retailers should not focus on free trials to counteract consumers' online shopping expectations, but rather invest in strategies that improve their expectations before the purchasing process (e.g., enhanced image, reputation) (Biswas & Biswas, 2004; Yazdanparast & Spears, 2013). For example, Kühn et al. (2020) presented evidence that a close-up video showing hands touching a product with high touch diagnosticity like an apple, reduces consumers' negative expectations because mental simulation initiates a symbolic type of touch experience, such as a vicarious haptic inspection (Pino et al., 2020). Online retailers should therefore focus on techniques that reduce consumers' uncertainty toward online retailing channels, especially when offering groceries high in touch diagnosticity.

Second, as a result of direct touch interfaces' positive impact, online retailers might actively push direct touch usage when consumers shop online. Rodríguez-Torrico et al. (2019), for example, identified stimuli that lead to a higher percentage of customer mobile usage. Based on their research, online retailers should enhance website navigation including, visual appeal, interactivity, and personalization, as well as perceived safety through reputation and guarantees. This also leads to a higher degree of satisfaction that increases the intention to continue using a direct touch interface (Chiu et al., 2019).

Third, online retailers should invest in mobile apps in order to increase customer relations and therefore decrease customer uncertainty and frustration (Alnawas & Aburub, 2016; Hsu & Lin, 2015). Alnawas and Aburub (2016) pointed out that using an app leads to hedonic, social, and personal benefits that enhance consumers' confidence, resulting in a higher purchase intention of online offered products.

Additionally, this study points to promising future research directions. The present research focuses on how the retail channel impacts consumers' produce evaluation in the post-purchase stage of product experience. Future research may include other factors that influence consumers' post-purchase evaluation such as a product's first physical impression based on the package design (Moreau, 2020), or the fact that the purchase of specific consumable products is irreversible (Bonifield et al., 2010). Others might examine whether consumers' evaluation also depends on previous experiences, so that their price expectation of the online offered produce complies with the average prices paid in the past (Santana et al., 2020).

Study 2 focuses on differences between direct and indirect touch interfaces. It seems that touch interfaces diminish the spill-over of consumers' negative expectations to online products after evaluating and experiencing them. Although previous research has already analyzed the power of direct touch interfaces in online retailing (Shen et al., 2016; X. Wang et al., 2020), this research field is less developed. Researchers are therefore encouraged to further focus on the direct touch effect.

Besides direct touch interfaces, we encourage future research to make use of the technological advance to identify other compensation methods. For example, Heller et al. (2019) used augmented reality to increase consumers' decision comfort and, consequently, their WTP when shopping online. Nevertheless, the authors pointed out that augmented reality applications are at an early stage and need further research. Likewise, Overmars and Poels (2015) used a hand when making use of interactive simulation to integrate haptic cues into online shopping.

This study focuses on fruits and vegetables as experience products of high haptic importance. Researchers might focus on other grocery categories such as dairy products or beverages (Vries et al., 2018), other experience products like clothing (Chocarro et al., 2013), or examine other interesting product categories in online shopping that are of high haptic importance (e.g., carpeting) (McCabe & Nowlis, 2003).

In conclusion, the paper points out consumers' uncertainty as one of the main disadvantages in online retailing. Further research should therefore analyze the potential of channel integration. Herhausen et al. (2015) showed that providing access and knowledge about an offline store online (online-offline channel integration) generates synergies instead of cannibalization, and leads to customers' higher perceived quality. In line with this, Shakir Goraya et al. (2020) identified that channel integration leads to higher perceived empowerment, assortment, and benefits, resulting in a higher consumer purchase intention for online and offline stores.

Appendix

A. Wording and assessment of the measurement

Table 2 Item wordings and translations

Question	English Wording	German Wording
Preliminary study 1		
importance of haptic produce inspection[a]	How important is it to you to inspect [produce] haptically prior to a purchase decision?	Wie wichtig ist es Ihnen, [Produkt] vor dem Kauf anzufassen?
importance of visual produce inspection[a]	How important is it to you to inspect [produce] haptically prior to a purchase decision?	Wie wichtig ist es Ihnen, [Produkt] vor dem Kauf näher anzuschauen?
regular purchase	Which of the following products do you buy regularly?	Welche der folgenden Produkte kaufen Sie regelmäßig ein?
Preliminary study 2		
expected quality[b]	How do you evaluate the quality of kiwis presented online compared to those with which you are familiar in your preferred grocery store?	Wie schätzen Sie die Qualität der gelieferten Produkte aus dem Online-Shop im Vergleich zur Qualität der Produkte im Laden ein?
WTP_{online}	The fair market value for 6 kiwis ranges between €0.54 and €2.94. What are you willing to pay for 6 kiwis of the presented online store?	Der übliche Marktpreis für 6 Kiwis liegt aktuell zwischen 0,54€ und 2,94€. Was wären Sie persönlich bereit, für die 6 Kiwis im dargestellten Online-Shop maximal zu bezahlen?
$WTP_{offline}$	The fair market value for 6 kiwis ranges between €0.54 and €2.94. What are you willing to pay for 6 kiwis in an offline store?	Der übliche Marktpreis für 6 Kiwis liegt aktuell zwischen 0,54€ und 2,94€. Was wären Sie persönlich bereit, für die 6 Kiwis in einem Laden maximal zu bezahlen?
Main study 1 and 2		
overall evaluation[c]	How do you evaluate the product as a whole (taking into account all characteristics such as smell, appearance, taste, etc.)?	Wie beurteilen Sie das Produkt insgesamt (unter Einbezug aller Eigenschaften wie Geruch, Aussehen, Geschmack etc.)?
taste[c]	How do you rate the taste of the product?	Wie beurteilen Sie insbesondere den Geschmack des Produktes?
Main study 1		
WTP_{apple}	The fair market value for 1 kg of apples ranges between €1.49 and €2.99. How much are you willing to pay for 1 kg of this type of apple in your favorite supermarket?	Der übliche Marktpreis für 1 kg Äpfel liegt zwischen 1.49€ und 2.99€. Bitte teilen Sie uns mit, wieviel Sie in Ihrem bevorzugten Lebensmittelmarkt für 1 kg Äpfel dieser Sorte bereit sind, zu bezahlen.
Main study 2		
$WTP_{tomatoes}$	The fair market value for a tomato ranges between €0.25 and €0.69. How much are you willing to pay for this type of tomato in your favorite supermarket?	Der übliche Marktpreis für eine Tomate liegt zwischen 0,25 € und 0,69 €. Bitte teilen Sie uns mit, wieviel Sie in Ihrem bevorzugten Lebensmittelmarkt für eine Tomate dieser Sorte bereit sind, zu bezahlen.
weight difference	Consumption of produce in gram.	
difference in pleasantness (MDMQ)	Difference between consumers' pleasantness before and after the shopping process (offline and online). (Scale items: Right now I feel…content, bad (R), great, uncomfortable (R), good, unhappy (R), discontent (R), happy.[d])	Unterschied der Konsumentenfreundlichkeit vor und nach dem Einkaufsprozess (offline und online). (Skalenelemente: Im Moment fühle ich mich…zufrieden, schlecht (R), gut, unwohl (R), wohl, unglücklich (R), unzufrieden (R), glücklich.')
difference in wakefulness (MDMQ)	Difference between consumers' wakefulness before and after the shopping process (offline and online). (Scale items: Right now I feel…relaxed, worn-out (R), tired (R), energetic, sleepy (R), alert, fresh, exhausted (R).[d])	Unterschied der Konsumentenwachheit vor und nach dem Einkaufsprozess (offline und online). (Skalenelemente: Im Moment fühle ich mich…ausgeruht, schlapp (R), müde (R), munter, schläfrig (R), wach, frisch, ermattet (R).)
difference in calmness (MDMQ)	Difference between consumers' calmness before and after the shopping process (offline and online). (Scale items: Right now I feel…restless (R), composed, uneasy (R), relaxed, at ease, tense (R), nervous (R), calm.[d])	Unterschied der Konsumentengelassenheit vor und nach dem Einkaufsprozess (offline und online). (Skalenelemente: Im Moment fühle ich mich… ruhelos, gelassen, unruhig (R), entspannt, ausgeglichen, angespannt (R), nervös (R) ruhig.)

[a] 7-point scale ranging from 1 (not at all important) to 7 (very important)
[b] 9-point scale ranging from 1 (higher in the offline store) to 9 (higher in the online store)
[c] 9-point scale ranging from 1 (dislike extremely) to 9 (like extremely)
[d] 5-point scale ranging from 1 (not at all) to 5 (very)
R = reversed item

Table 3 Descriptive statistics and correlations for measured items study 1

		Overall evaluation				Taste				WTP			
		GrSm	**GoDe**	**Elst**	**PiLa**	**GrSm**	**GoDe**	**Elst**	**PiLa**	**GrSm**	**GoDe**	**Elst**	**PiLa**
Overall evaluation	**GrSm**	5.991 (2.114)	0.032	0.301	0.167	0.760	-0,048	0.386	0.186	0.382	-0.115	0.017	-0.029
	GoDe	0.145	5.773 (2.162)	0.151	0.235	-0.111	0.873	0.111	0.197	-0.110	0.506	-0.011	-0.067
	Elst	1.183	0.607	6.927 (1.861)	0.253	0.169	0.113	0.820	0.212	0.204	0.094	0.485	0.107
	PiLa	0.588	0.849	0.787	7.100 (1.670)	0.020	0.173	0.207	0.904	-0.087	0.029	-0.015	0.300
Taste	**GrSm**	3.357	-0.501	0.656	0.071	5.936 (2.091)	-0.146	0.244	0.046	0.600	-0.096	0.054	0.028
	GoDe	-0.222	4.154	0.462	0.636	-0.674	5.791 (2.201)	0.123	0.164	-0.087	0.582	0.006	-0.066
	Elst	1.413	0.416	2.646	0.600	0.884	0.470	7.055 (1.734)	0.187	0.233	0.137	0.507	0.135
	PiLa	0.679	0.733	0.682	2.602	0.167	0.622	0.558	7.036 (1.724)	-0.060	0.056	-0.010	0.329
WTP	**GrSm**	0.420	-0.123	0.197	-0.076	0.653	-0.100	0.210	-0.054	1.830 (0.520)	0.269	0.481	0.312
	GoDe	-0.134	0.603	0.096	0.027	-0.111	0.706	0.131	0.053	0.077	1.746 (0.552)	0.388	0.286
	Elst	0.019	-0.012	0.470	-0.013	0.059	0.007	0.458	-0.009	0.130	0.112	2.051 (0.521)	0.526
	PiLa	-0.032	-0.076	0.104	0.262	0.031	-0.076	0.122	0.297	0.085	0.083	0.144	2.061 (0.523)

Note: The main diagonal represents the mean and the standard deviation (in the brackets) of the items, the upper triangular represents the correlation between the items, the lower triangular represents the covariance between the items. Type of apples: GrSm = Granny Smith, GoDe = Golden Delicious, Elst = Elstar, PiLa = Pink Lady

Table 4 Descriptive statistics and correlations for measured items study 2

		Overall evaluation			Taste			WTP			Weight difference			Mood difference		
		ChVi	Vine	Roma	ChVi	Vine	Roma	ChVi	Vine	Roma	ChVi	Vine	Roma	please	wake	calm
Overall evaluation	ChVi	6.862 (1.561)	0.180	0.196	0.802	0.140	0.090	0.554	0.061	0.133	0.389	0.145	0.081	0.003	0.020	0.089
	Vine	0.460	6.173 (1.639)	0.336	0.088	0.806	0.295	0.008	0.578	0.114	0.081	0.176	0.088	-0.009	-0.096	-0.143
	Roma	0.542	0.978	5.801 (1.773)	0.119	0.318	0.811	0.051	0.202	0.583	0.040	0.049	0.150	-0.057	-0.018	-0.073
Taste	ChVi	2.252	0.260	0.381	6.597 (1.799)	0.119	0.090	0.593	0.084	0.110	0.303	0.091	0.049	0.043	0.052	0.098
	Vine	0.437	2.645	1.129	0.429	5.566 (2.003)	0.346	0.018	0.698	0.163	0.125	0.233	0.155	-0.006	-0.078	-0.112
	Roma	0.281	0.968	2.879	0.323	1.386	5.214 (2.001)	0.052	0.248	0.633	-0.045	0.008	0.106	-0.005	0.044	-0.020
WTP	ChVi	0.073	0.001	0.008	0.090	0.003	0.009	0.222 (0.085)	0.317	0.347	0.214	0.025	0.069	-0.042	0.032	-0.054
	Vine	0.007	0.069	0.026	0.011	0.101	0.036	0.002	0.193 (0.072)	0.400	0.098	0.140	0.130	-0.066	-0.114	-0.159
	Roma	0.016	0.015	0.081	0.016	0.026	0.099	0.002	0.002	0.186 (0.078)	0.038	-0.003	0.145	-0.074	-0.048	-0.011
Weight difference	ChVi	7.406	1.621	0.869	6.639	3.003	-1.089	0.220	0.086	0.036	19.111 (12.143)	0.642	0.637	-0.003	0.050	0.004
	Vine	2.988	3.773	1.139	2.156	6.088	0.198	0.027	0.133	-0.003	102.379	18.667 (13.140)	0.691	0.085	0.140	0.009
	Roma	1.655	1.935	3.542	1.178	4.182	2.869	0.078	0.128	0.152	104.927	120.797	20.135 (13.542)	0.032	0.099	0.039
Mood difference	please	0.002	-0.006	-0.040	0.031	-0.005	0.004	-0.001	-0.002	-0.002	-0.014	0.442	0.175	-0.014 (0.395)	0.627	0.597
	wake	0.013	-0.063	-0.012	0.037	-0.062	0.035	0.001	-0.003	-0.002	0.241	0.733	0.538	0.099	-0.008 (0.393)	0.440
	calm	0.058	-0.098	-0.054	0.073	-0.093	-0.017	-0.002	-0.005	0.000	0.020	0.050	0.222	0.098	0.073	0.056 (0.417)

Note: The main diagonal represents the mean and the standard deviation (in the brackets) of the items, the upper triangular represents the correlation between the items, the lower triangular represents the covariance between the items. Type of tomatoes: ChVi = Cherry Vine tomatoes, Vine = Vine tomatoes, Roma = Roma tomatoes, mood difference between, before, and after the shopping process: please = Pleasantness, wake = Wakefulness, calm = Calmness

B. Simulated online shop

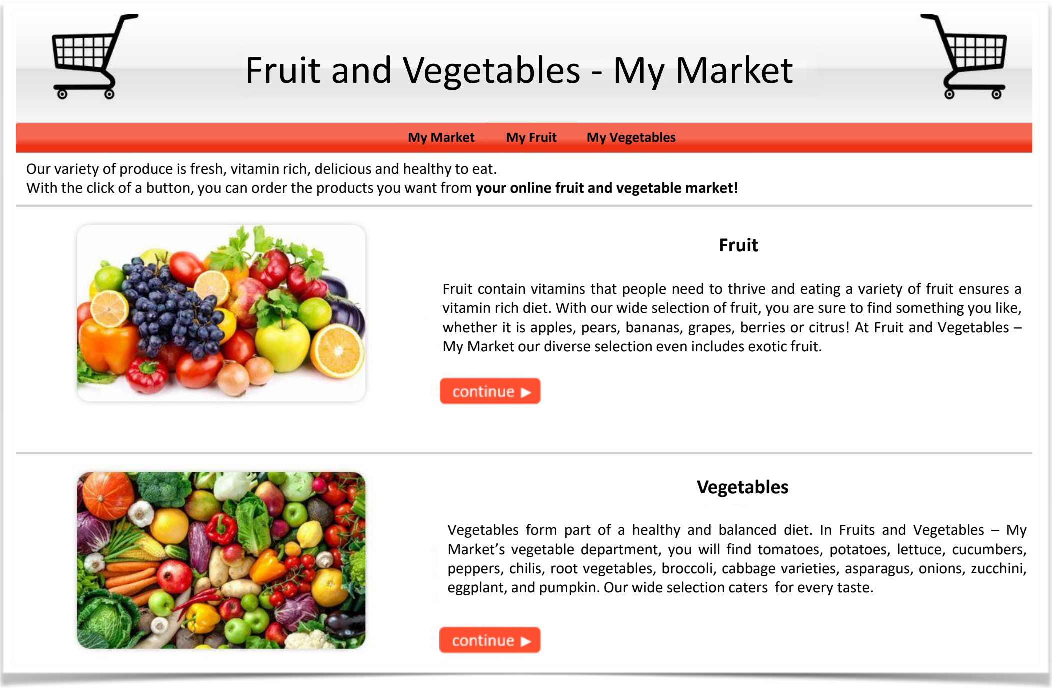


Figure 3 First page of the online shop

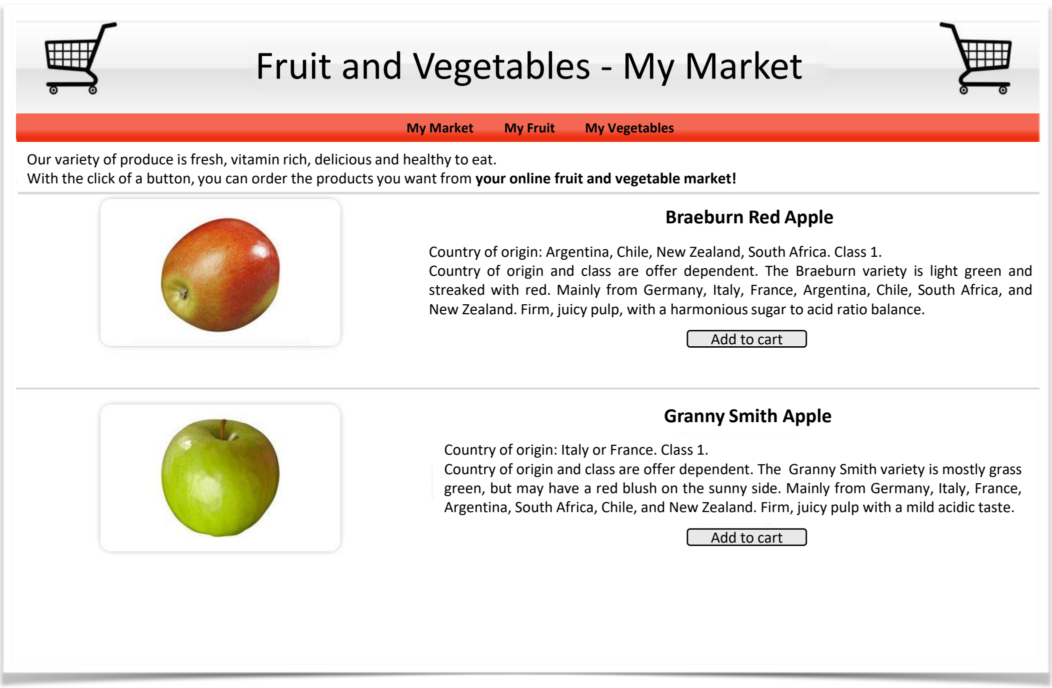


Figure 4 Apples in the online shop - study 1

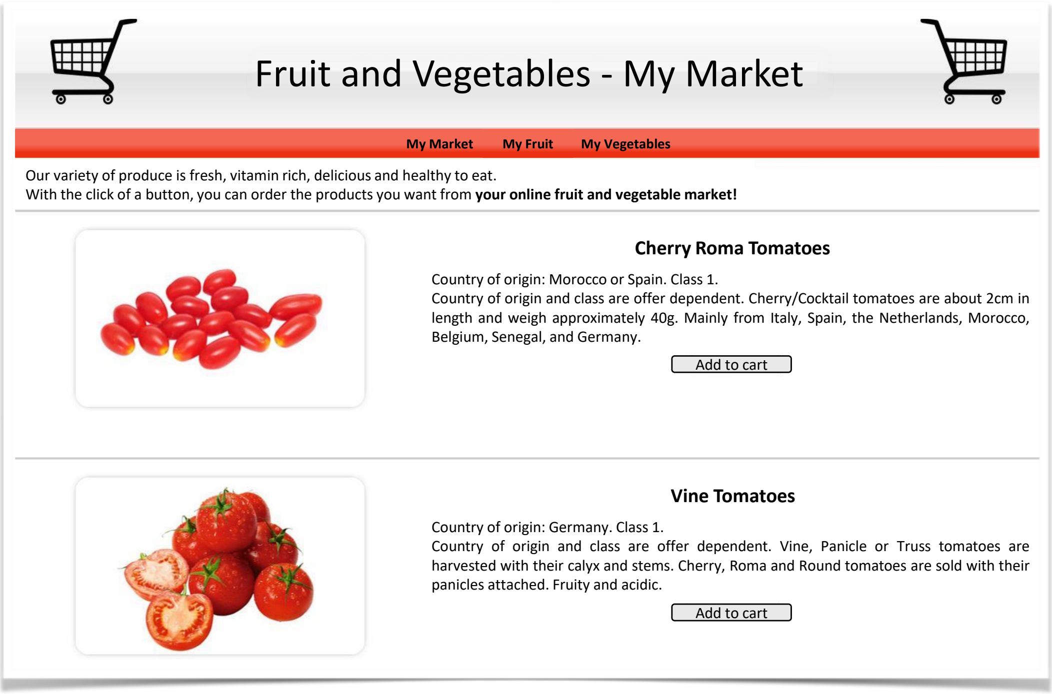


Figure 5 Tomatoes in the online shop - study 2

C. Tasting procedure

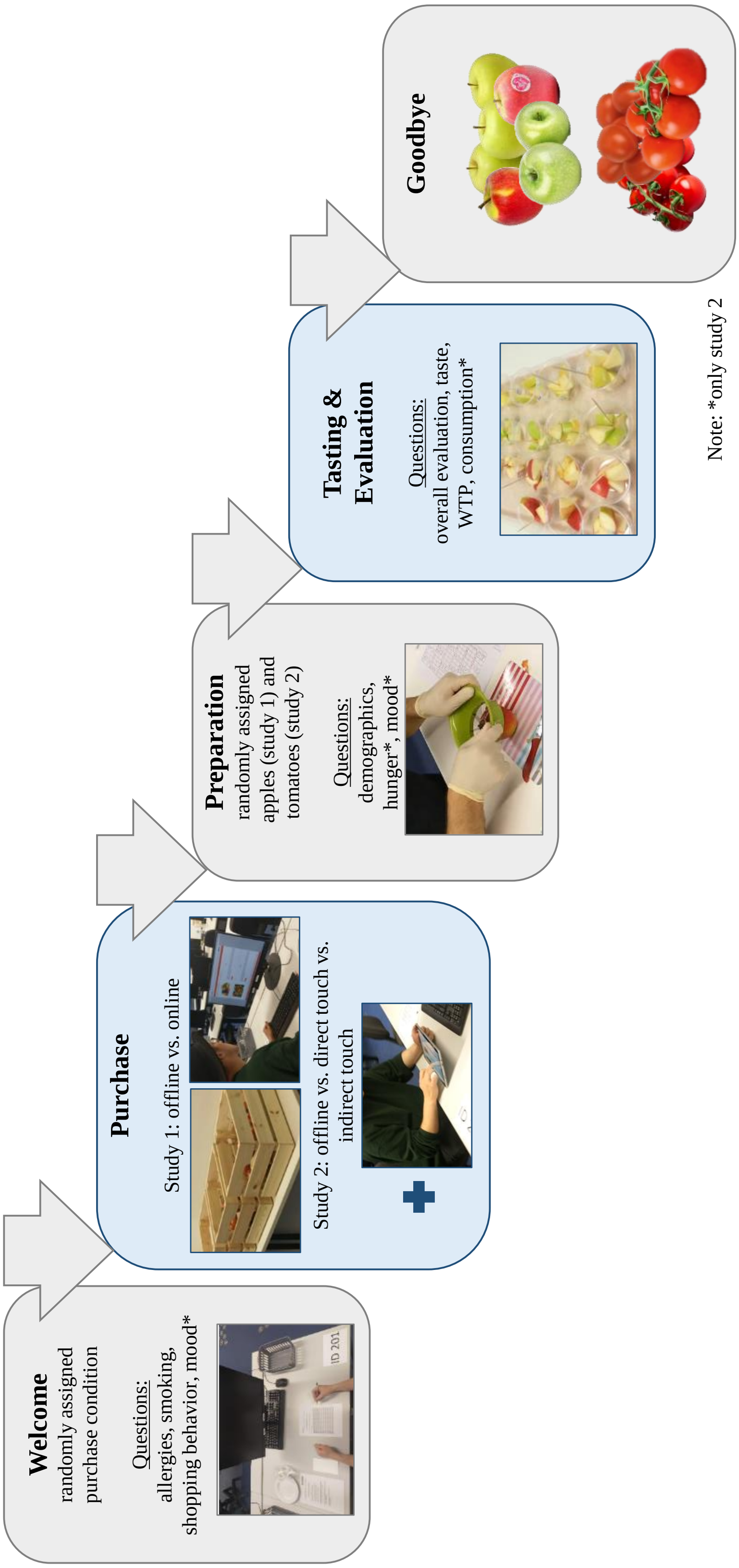


Figure 6 Tasting process

D. Detailed analyses of significant interaction effects

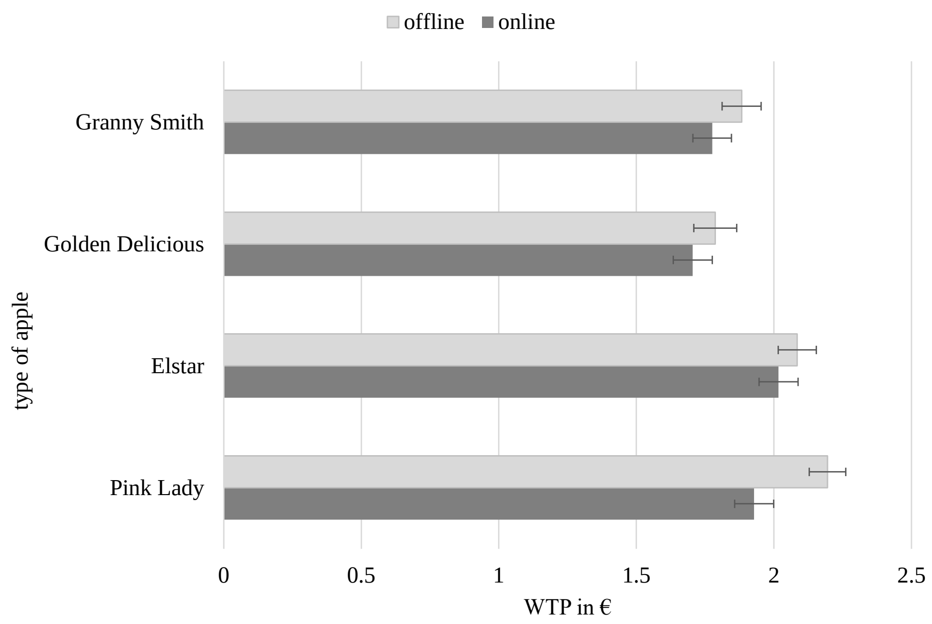


Figure 7 Bar plot of the WTP for each apple type in the retail channels

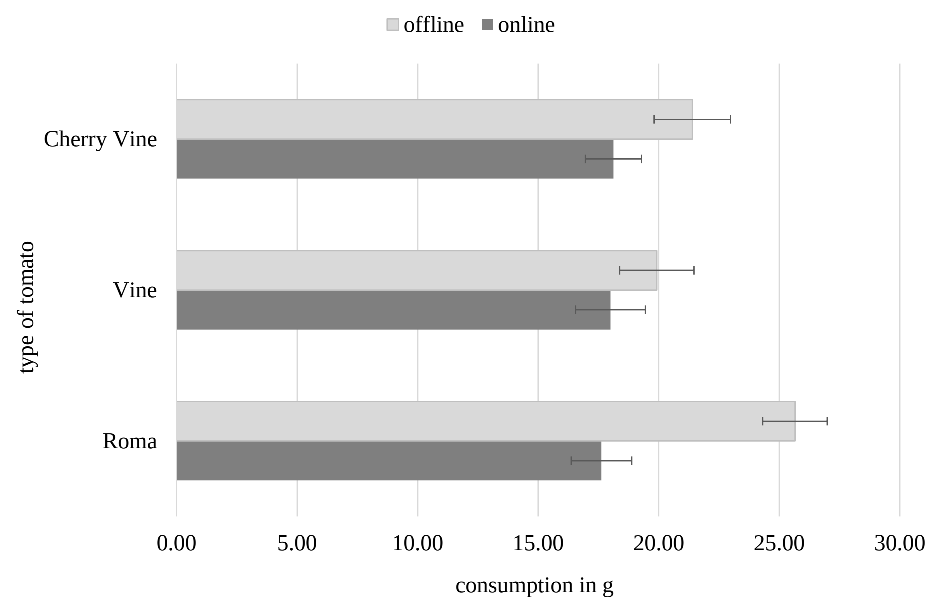


Figure 8 Bar plot of the consumption amount for each tomato type in the retail channels

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Essay 4:

Getting 'in touch' with your future customers: The influence of user interfaces in adaptive choice-based conjoint analysis

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Abstract

Market research has advanced dramatically with the rise of smart mobile technology. Currently, survey respondents increasingly participate by using direct touch (e.g., touchscreens) instead of indirect touch (e.g., trackball, mouse/keyboard combo) interfaces. More interestingly, although previous research focused on the effect of interface type on consumers' purchase decisions, to date no research has examined the influence of interface type on market research studies. The present research fills this void by relying on a meta-analysis, an online study, and a lab experiment. These studies show that the use of direct (vs. indirect) touch interfaces in adaptive choice-based conjoint analysis (ACBC) systematically inflates estimates of willingness to pay (WTP) and general product demand, while simultaneously decreasing price sensitivity. Consumers' perceived study enjoyment and their inert autotelic need for touch (aNFT) propose a psychological process explanation of these effects. As conjoint analysis is one of the most widely applied market research techniques, and researchers increasingly apply machine learning-flavored ACBC studies, they should align respondents' interface type with those that future customers will use when purchasing the focal product.

Keywords: Adaptive choice-based conjoint analysis (ACBC), Market research, Need for touch, Touch interface

Getting 'in touch' with your future customers: The influence of user interfaces in adaptive choice-based conjoint analysis

1. Introduction

During the past two decades, technological growth has unequivocally changed market research. Currently, consumers respond to surveys by using technical devices ranging from notebooks and stationary computers to tablets and smartphones. Actually, consumers increasingly access surveys via direct touch interfaces, such as touchscreens built into smartphones, tablets, convertibles, etc., instead of computers and laptops that rely on indirect touch interfaces (i.e., trackball, mouse/keyboard combo) (Skeie et al., 2019; Wells et al., 2013). Although considerable attention has been paid to the interface type's influence on consumer behavior in a shopping context (Chung et al., 2018; Kühn et al., 2020), there is a notable neglect of the role that direct (vs. indirect) touch interfaces play in the performance of market research. Choice-based conjoint analysis (CBC) is one of the most widely applied market research methods (Chakravarti et al., 2013; Horsky et al., 2004; Longoni et al., 2019; Voleti et al., 2017). CBC interviews, developed in mathematical psychology (Luce & Tukey, 1964), require consumers to complete a series of choice tasks compiled in accordance with statistical design routines (Louviere & Woodworth, 1983). The goal is to elicit consumers' nuanced utility functions after they indicate their preferences within choice tasks, similar to their product decisions in the marketplace (Pena-Marin & Yan, 2020). Recent research on machine learning has discarded the principle of static choice-set construction in favor of adaptively chosen choice tasks, resulting in an upgraded version of CBC, namely adaptive choice-based conjoint analysis (ACBC) (Huang & Luo, 2016; Johnson & Orme, 2007; Wackershauser et al., 2018).

ACBC has received massive attention from academia and market research practice (Johnson & Orme, 2007; Salm, 2017), and is increasingly used in lieu of CBC (Sawtooth Software, 2020).

Compared to its static CBC predecessor, ACBC promises higher efficiency, the incorporation of non-compensatory decision rules, and the higher predictive validity of results (Bauer et al., 2015; Huang & Luo, 2016; Johnson & Orme, 2007). Academic literature advances different approaches on how to integrate adaptive designs with CBC. ACBC, introduced by Johnson and Orme (2007), is by far the most prominent variant in terms of impact (Clarivate Web of Science impact scores 2019). To illustrate, Figure 1 presents the results of the first

1,000 Google Scholar hits (as of December 2020) in terms of accumulated impact on varying adaptive CBC approaches, sorted by the year of their introduction.

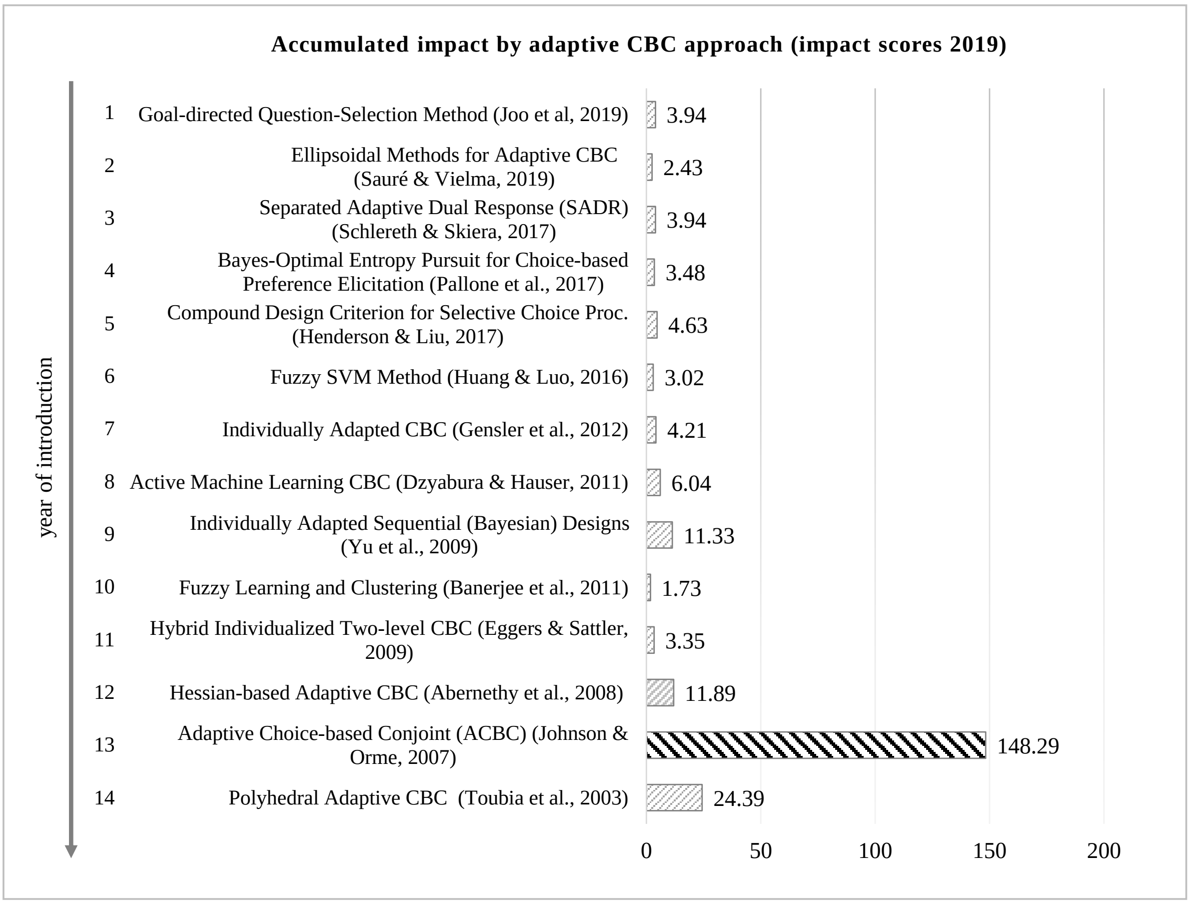


Figure 1 Impact of adaptive CBC approaches

As established by Johnson and Orme (2007), ACBC – by default – incorporates three mandatory stages to uncover respondents' utility parameters (see Figure 2 for screenshots of study 2).

Respondents first engage in a *Build-Your-Own (BYO)* stage, which requires them to compile their ideal product/service given certain feature prices. Thereafter, a second *Screening* stage identifies respondents' consideration sets by adaptively offering products that deviate only slightly from the specified *BYO* product. In respect of each product, the respondents decide whether or not it is worth buying. Finally, in a third *Choice Tournament* stage, all products that are part of a respondent's idiosyncratic consideration set move on to choice tasks.

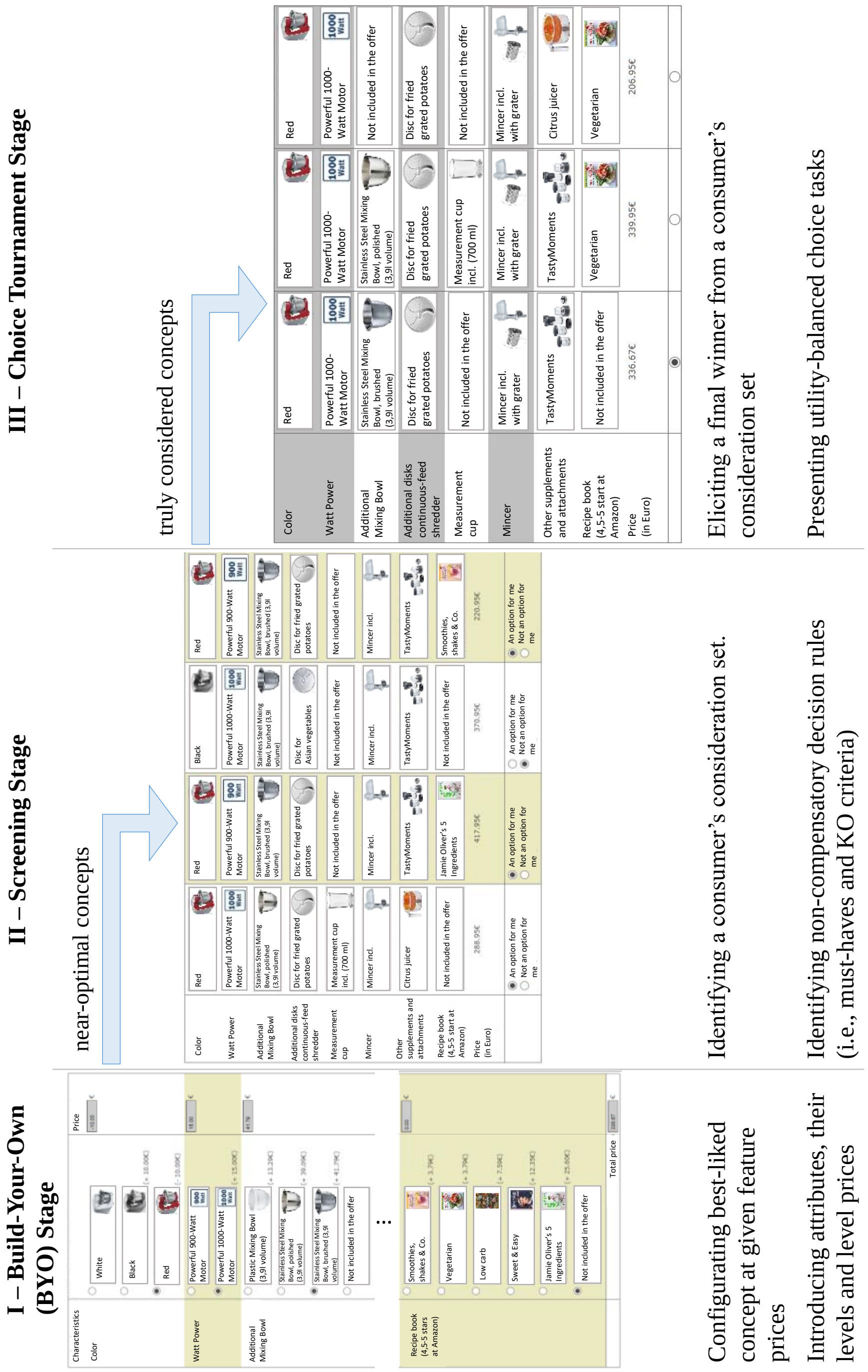
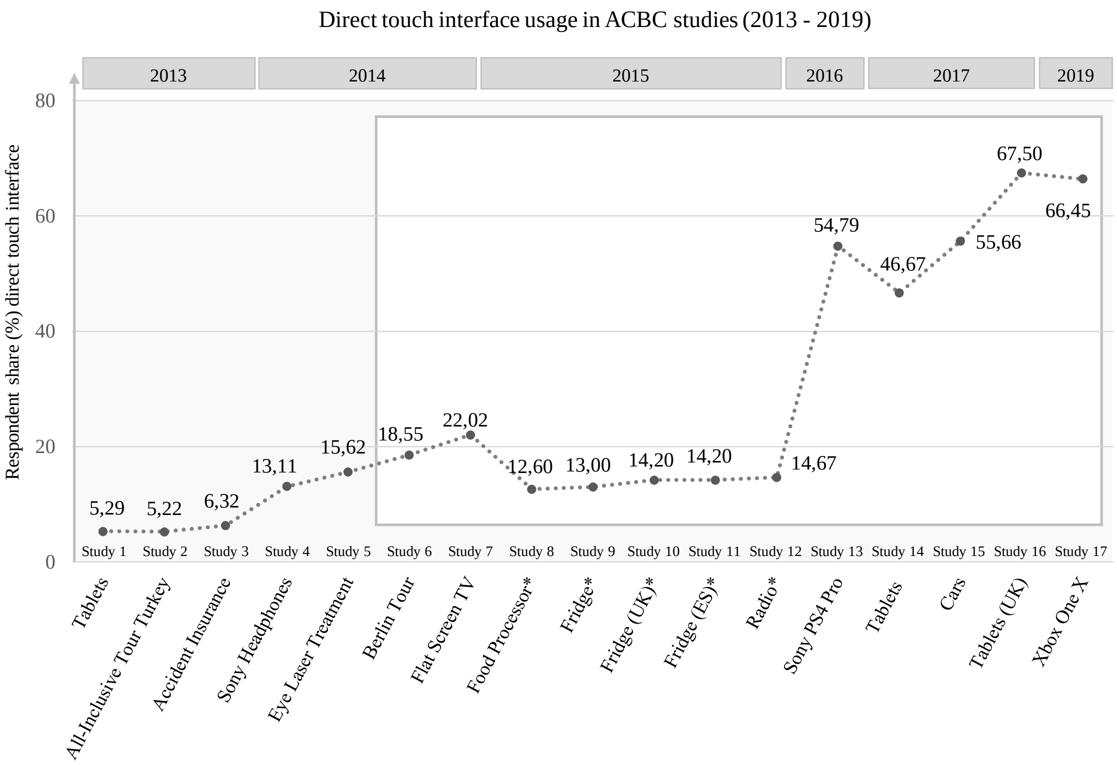


Figure 2 The three mandatory stages of ACBC according to Johnson and Orme (2007)

This stage represents a forced-choice knockout tournament that requires respondents to select their most preferred product until, in a final stage a particular product is identified as the tournament winner (Groot et al., 2012; Orme & Chrzan, 2017, p. 55). In essence, all three ACBC stages are interrelated and allow efficient learning about consumer preferences by providing the consumers with tailor-made product offerings close to the ideal product they initially configure (Orme, 2019, p. 133). Since the ACBC interview journey begins with the *BYO* stage, this stage – in particular – is of pivotal importance for ACBC's results. As we will emphasize throughout the article, results obtained from the *BYO* stage depend on the respondents' user interface type (i.e., direct vs. indirect touch interface). To underline the importance of this, Figure 3 portrays the extent of direct touch interface usage in 17 ACBC studies over time. This set of ACBC datasets includes both, studies in academia and industry.[1]

While only 6% of ACBC respondents used a direct touch interface in 2013, this proportion has increased continuously to exceed the two-thirds by 2017. On closer inspection, this development reflects the unfolding of an interesting phenomenon: direct and indirect touch interface users systematically differ in their ACBC response behavior. Specifically, we observe a discrepancy in their specified *BYO* products. Considering the 12 most recent ACBC studies (Study 6 to Study 17), 11 of them indicate that the configured *BYO* products of the direct as opposed to the indirect touch interface users have a higher mean price (binomial test $p < .003$).[2]



Note: brackets indicate studies from non-German-speaking areas (UK: United Kingdom, ES: Spain) * commercial market research studies

Figure 3 Proportion of direct touch interface users in ACBC studies (in %)

[1] We thank Management Tools AG (Switzerland), as well as isi GmbH and myOnlinePanel GmbH (both Germany) for providing the listed industry ACBC datasets in anonymized form.

[2] These ACBC studies covered at least 20 respondents in both groups of interface users and therefore allowed the evaluation of both groups' response structures (surrounded in Figure 3).

Thus, direct (vs. indirect) touch interface users express a willingness to spend more money during the first ACBC stage. To systematically shed light on this issue, we applied an additional meta-analysis (Borenstein et al., 2009).

The results of a fixed-effect meta-regression ($n = 3{,}319$) on Hedges' g (Hofer & Chen, 2020; Viechtbauer, 2010) reveal that the interface type's effect is systematic and significant (weighted Hedges' $g = 0.21$, $z = 4.49$, $p < .001$, Figure 4[3]). Consequently, the influence of direct vs. indirect touch interfaces has a strong potential to distort the ACBC results. This, in turn, can misdirect managerial implications.

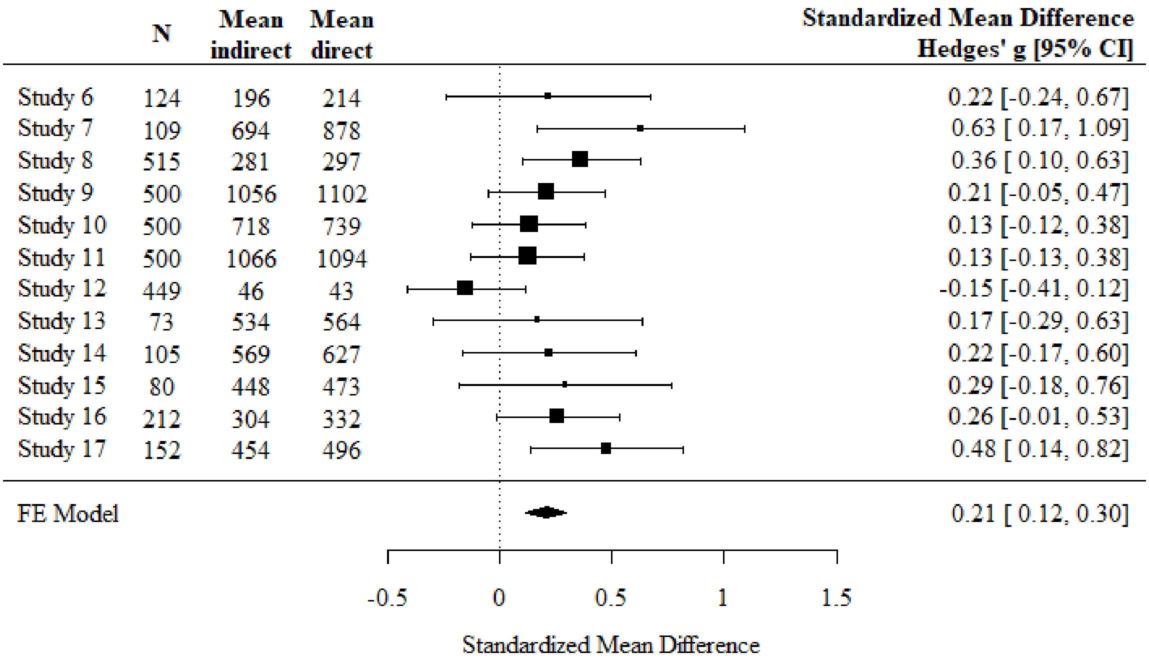


Figure 4 Meta-analysis of the difference in mean *BYO* price comparing direct vs. indirect touch interface users

The present article gets to the bottom of the interface type's effect – as found in the aforesaid meta-analysis – by evaluating its replicability, actual graveness, and potential drivers. It is organized as follows: The next section summarizes the relevant literature pertaining to interface types and ACBC and derives the hypotheses. The remainder of the article presents two ACBC studies. Study 1, as an online study, replicates the effect of the interface type on

[3] A random-effects approach yielded comparable results (standardized mean difference = 0.21, $z = 4.25$, $p < .001$, 95% CI = [0.11, 0.31]). Appendix A provides a full assessment of the reported meta-analysis.

respondents' specified *BYO* product prices and subsequently analyzes the graveness of the effect in terms of its influence on utility estimates obtained from ACBC (i.e., the price sensitivity and the none parameter). An additional simulation illustrates the extent to which differences in utility estimates result in biased forecasts of market demand, revenue predictions, and willingness to pay (WTP).

Study 2, going beyond the first, tests an explanation for the interface type's influence in ACBC.

Relying on a lab experiment in which the user interface is manipulated rather than observed, this study replicates the interface type's effect on respondents' *BYO* prices and utility estimates. Furthermore, the study includes respondents' study enjoyment and autotelic need for touch (hereafter aNFT, see Peck and Childers (2003a) to elaborate on the interface type's effect origin as a psychological process explanation. Simultaneously, we exclude alternative accounts for the observed effects based on cognitive elaboration and instrumental need for touch (hereafter iNFT, see Peck and Childers (2003a)). We provide annotated data for the meta-analysis and both studies in the open science framework (OSF):

https://osf.io/g5xz9/?view_only=0d1048dcf08b4baaba56388c62c0fb21.

2. Theoretical background and hypothesis development

The 'direct touch evolution' has changed consumers' e-retailing web behavior (e.g., Chung et al., 2018; Kühn et al., 2020; Mulcahy & Riedel, 2020), consumer feelings (e.g., L. Shen et al., 2019; Vries et al., 2018; Zhu & Meyer, 2017), and product choice (e.g., H. Shen et al., 2016; Xu et al., 2017; Zhu & Meyer, 2017). Considering online shopping, previous research has demonstrated that consumers spend more when using a direct instead of an indirect touch interface (Chung et al., 2018; Xu et al., 2017) – i.e., the direct touch effect (H. Shen et al., 2016). Specifically, Skeie et al. (2019) show that consumers possess a higher WTP for an environmental purpose when using a direct instead of an indirect touch interface (in this case, preventive measures to avoid oil spills resulting from maritime accidents and the associated loss of ecosystem services).

Furthermore, Wang et al. (2015) indicate that the interface type affects both order rates (number of orders placed per year) and order sizes (value of the order in dollars) when shopping online. Direct touch interface users order online more often and also order higher volumes than others.

Despite these studies on the direct touch effect in consumer behavior, research is nonexistent on its influence on market research techniques. While previous research already identified an enhanced acceptance and use of direct touch interfaces in web surveys (Revilla et al., 2016), the literature lacks analyses of the differences between the survey results of direct and indirect touch interfaces, respectively. To the best of our knowledge, only Hildebrand and Levav (2017) focused on the direct touch effect during a product configuration process, which came close to ACBC's *BYO* stage. They showed that direct touch interface users assemble significantly more feature-rich, higher-priced cars than indirect touch interface users. They subsequently proposed an appealing psychological process explanation: consumers construe a product configuration task as more experiential and less instrumental while using a direct instead of an indirect touch interface. The downstream consequences of this are manifold and include a greater receptiveness to hedonic product features relative to utilitarian ones, which ultimately drives increased expenses. Consumer psychology supports Hildebrand and Levav's findings in that the use of direct touch interfaces (vs. indirect ones) results in higher consumer spending. Specifically, consumers seem to process the haptic feedback that touchscreens provide as vicarious touch experience of the product itself (Brasel & Gips, 2015; Pino et al., 2020). This gives rise to an automatic processing style, with the result that they behave more affectively (H. Shen et al., 2016). Stated differently, the share of System I processing increases in comparison to System 2 (Dhar & Gorlin, 2013; Kahneman, 2003).

Consequently, affect-driven consumers are willing to pay more (Kahneman et al., 2000; Kazeminia et al., 2016) which, in the case of ACBC, leads to higher-priced configurated *BYO* products.

Encouraged by the aforesaid research and our initial meta-analysis, we thus hypothesize that – in the first ACBC stage – direct (vs. indirect) touch interface users compile more expensive *BYO* products:

> **H_1:** The use of a direct compared to an indirect touch interface in ACBC leads to a higher *BYO* price.

It is reasonable to assume that the systematic difference in respondents' *BYO* prices should also unfold as a difference in respondents' utility estimates. The reason is that the information from the *BYO* stage points the way through all subsequent ACBC stages. When generating product concepts for the subsequent screening tasks, ACBC's algorithm assures the creation of products that are close to the configured *BYO* profile (incorporating a component of random alteration from the *BYO* product). Therefore, higher (vs. lower) selected *BYO* prices result in higher-priced (vs. lower-priced) product concepts presented in the *Screening* stage, which – in turn – form the basis of the *Choice Tournament* that follows (Johnson & Orme, 2007; Orme & Chrzan, 2017, p. 92). Given that respondents' product evaluations are relative evaluations, where a judgment of the focal option is based on its performance relative to the other options presented (e.g., Bettman et al., 1998; Bhargava et al., 2000; Simonson & Tversky, 1992), the absolute price levels considered as 'too expensive', as identified within the *Screening* stage, may thus strongly differ between respondents who compiled a higher-priced as opposed to those compile a lower-priced *BYO* product.

In other words, the two respondent groups may specify different, unacceptable price thresholds during their evaluations in the *Screening* stage, with those generally evaluating more higher-priced products specifying higher thresholds than those evaluating lower-priced products. These differences should, in turn, unfold as differences in individuals' relative price importance and none parameter (i.e., threshold in subjective utility of a product, which has to be exceeded in order to predict a consumer to purchase a product instead of opting for a no-buy (Wlömert & Eggers, 2016)).

Based on this line of argumentation, we hypothesize that the use of direct (vs. indirect) touch interfaces leads to a lower estimated utility for the option not to buy (i.e., none parameter), as well as to a lower relative importance of the price attribute when compared to other included attributes (i.e., a lower price sensitivity). We furthermore expect individuals' *BYO* prices to serve as a mediator of the interface type's effect.

> **H_2:** The use of direct compared to indirect touch interfaces in ACBC leads to (a) a lower none parameter and (b) a lower relative price importance. Consumers' *BYO* prices thereby mediate the interface type's effects.

As outlined above, Hildebrand and Levav (2017) argue that using a direct touch interface in product configurators diverts consumers from an instrumental focus to an experiential mindset. Research on interface types in online retailing additionally suggests a more nuanced explanation that highlights the role of an induced, positive, affective feeling of enjoyment while, e.g., browsing through an online shop. In this respect, research demonstrates that online shoppers experience more enjoyment when using a direct instead of an indirect touch interface (L. Shen et al., 2019; Vries et al., 2018; Zhu & Meyer, 2017).

Zhu and Meyer (2017) point out that, apart from the above-discussed vicarious touch experience, directly touching the interface generates enjoyment that activates an affective and experiential (e.g., emotional, immediate, low effort) instead of a rational thinking style (e.g., logical, sequential, high effort). Most notably, increased enjoyment evoked via the use of a direct touch interface has been found to explain consumers' higher shopping expenditures (Chung, 2016; Naegelein & Spann, 2017; Xu et al., 2017). Importantly, the haptic cues of direct touch interfaces do not similarly affect all consumers in an equal manner (Brasel & Gips, 2014; Kühn et al., 2020; Vries et al., 2018). Researchers specifically highlight that individual's need for touch (NFT) is a significant moderator inert in a consumer's personality (e.g., Krishna, 2012; Peck & Childers, 2003a; Streicher & Estes, 2016). Peck and Childers (2003a) conceptualize NFT as a trait that governs consumers' preferential reliance on haptic information and also their haptic processing capabilities. NFT spans two dimensions, i.e., the instrumental and the autotelic need for touch (Peck & Childers, 2003a). While consumers high in iNFT purposefully use haptic information during a decision process to reduce product-related uncertainty (Grohmann et al., 2007; Krishna & Morrin, 2008), those high in aNFT instead experience an intrinsic hedonic satisfaction when touching objects. The latter group of consumers seeks haptic input in the marketplace and tends to engage more frequently in impulse buying (Peck & Childers, 2003a).

The moderating role of aNFT is documented in the literature. For example, high aNFT individuals using an interface with image interactivity to simulate stroking gestures are, compared to the use of a static interface, specifically inclined to generate more positive feelings about and a favorable attitude toward an online offered product (Overmars & Poels, 2015). Vries et al. (2018) further demonstrate that high aNFT consumers, in particular, experience more enjoyment compared to low aNFT consumers when using a direct instead of an indirect touch interface while browsing products online. This finding aligns with recent studies demonstrating stronger positive affective reactions to online offered products for direct (vs. indirect) touch interface users, but only for high aNFT consumers (Kühn et al., 2020). Although these findings were extracted in the context of online shopping, it is plausible that they also generalize to ACBC-related market research. Enjoyment in this context expresses how positive respondents feel about the study procedure (Johnson & Orme, 2007). Based on the aforesaid reasoning, we expect moderated mediations as illustrated in Figure 5.

In this model, study enjoyment acts as a mediator of the relationship between touch interface type and an individual's *BYO* price, while aNFT should moderate the effect of the touch interface type on study enjoyment. This mechanism drives the serial mediations involving study enjoyment and *BYO* price, accounting for the relationship between the touch interface type and the none parameter and price importance, respectively.

> **H_3:** aNFT moderates the touch interface type's influence on study enjoyment. For high aNFT consumers, in particular, study enjoyment mediates the effect of the touch interface type on the BYO price, which ultimately leads to direct touch interface users having (a) a smaller none parameter and (b) a smaller relative price importance.

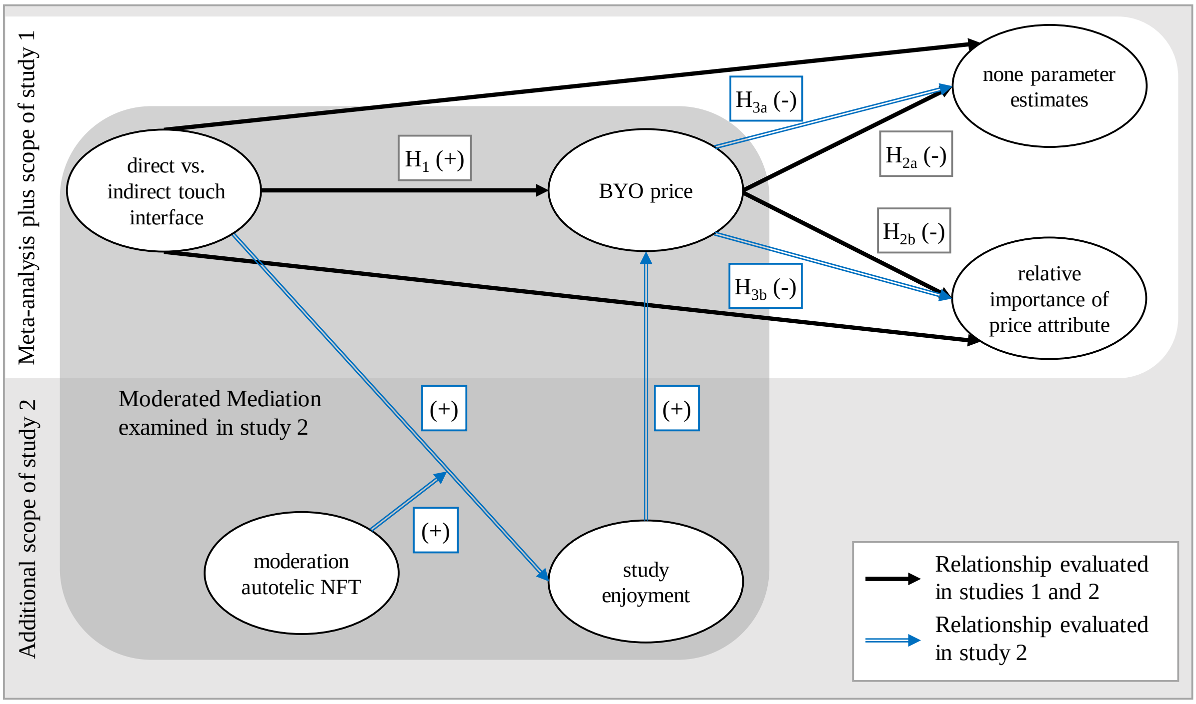


Figure 5 Proposed relationships across studies 1 and 2

As a first step, in the discussion that follows, study 1 – an online survey – replicates the effect of touch interface type on *BYO* price as found in the initial meta-analysis (H_1). In addition, it also broadens the scope of the model to include utility estimates extracted from ACBC using the *BYO* price as a mediator (H_{2a} and H_{2b}).

As a second step, in an additional simulation part, study 1's results showcase how strongly the effect of touch interface type affects managerial-relevant predictions in terms of demand, expected revenue, and WTP for certain product features. Thereafter, study 2 – a lab experiment – evaluates the proposed moderated mediation effects (H_{3a} and H_{3b}).

3. Study 1

3.1. Method and materials

Study 1 draws on an online ACBC on mobile tariffs. The use of this category is justified as it often served as a research object in conjoint studies (Iyengar et al., 2008; Natter et al., 2008). The present study includes German providers that have contracts with a minimum contract period of one month in their portfolio. Regarding the market in December 2019, eight attributes were selected to constitute the conjoint study: service provider (congstar; klarmobil; maXXim; mobilcom debitel; O2; otelo; winSIM), data volume (1 Gb; 3 Gb; 5 Gb; 8 Gb), speed (21 Mbit/s; 50 Mbit/s; 100 Mbit/s), free minutes (none; 100; 300; flat), free text messages (none; 100; 300; flat), data roaming in the European Union (not included; included), contract period (monthly; 24 months), and price (summed price function in ACBC; see Appendix B).

After compiling their ideal mobile tariffs in the first *BYO* stage, all respondents then worked on eight *Screening* tasks, each of which provided them with four tariff offerings. Thereafter, the *Choice Tournament* presented them with choice tasks, each comprising three options (depending on the number of concepts that passed the preceding stage, with a maximum of eight tasks).

For the purpose of validation, we furthermore provided respondents with a holdout task (HOT) covering ten products, along with the option not to purchase any product (i.e., chance level of predicting correctly of 9%, see Appendix C). We compiled the HOT by relying on an orthogonal design with level-balance to approach zero-correlations between all attributes (Huber & Zwerina, 1996; Zwerina et al., 1996). After evaluating respondents' predictions, we found that both touch interface groups' utility estimates perform comparably well at a very high level. [4] As the final part of the survey, all respondents provided information on their demographics and the type of interface used for study participation.

3.2. Participants

The survey was shared on thematic online forums and social networks. An initial screening process ensured that all respondents (1) owned a mobile, (2) were willing to spend about 15 minutes on a subsequent online survey, and (3) were at least 16 years of age. A net sample of

[4] Both direct and indirect touch interface groups achieved a HOT hit rate above 50% (direct: 52.87%, indirect: 51.61%, exact Fisher's p = 1.000). The mean hit probability values were 41.70% and 44.39%, respectively (U(87,31) = 1,254, p = 0.565).

118 respondents completed the study ($mean_{age}$ = 26.91, SD = 9.79, 55% females, 63% with a monthly net income < €1,000), of whom 87 participated via direct touch and 31 via indirect touch interfaces. The subsamples' characteristics did not differ in terms of gender, age, income, and product interest (smallest p = 0.240).

3.3. Results and discussion

3.3.1. Tests of hypotheses

In line with the initial meta-analysis and H_1, the mean *BYO* price (i.e., monthly tariff fee) for direct touch interface users is €13.67 (SD = €6.42), and it exceeds that of the indirect touch interface users, which is €9.95 (SD = €4.22). Accordingly, respondents' preferences within the first ACBC stage substantially differ between the users of direct as opposed to indirect touch interfaces (Welch's $t(81) = -3.64$, $p_{one\text{-}tailed} < 0.001$).

We further hypothesized that systematic differences in respondents' ACBC behavior should result in discrepancies between the two groups' utility estimates. Specifically, we expected respondents' none parameter and their relative price importance to be significantly lower in the direct touch as opposed to the indirect touch interface group (H_{2a} and H_{2b}). We therefore expected the *BYO* price to serve as a mediator.

To evaluate both hypotheses, we estimated the individual part-worth utilities based on an Hierarchical Bayes Multinomial logit analysis that included a single multivariate normal distribution and uninformative priors (Allenby & Ginter, 1995; Chakravarti et al., 2013; Lenk et al., 1996).[5] First, we find a significant difference in the mean none parameter between the direct touch (mean = 7.58; SD = 2.13) and the indirect touch interface users (M = 8.56; SD = 2.18; $t(116) = 2.20$, $p_{one\text{-}tailed} = 0.015$). Second, the mean relative price importance increases from 43.23% (SD = 16.34%) in the direct touch interface group to 52.78% (SD = 11.71%) in the indirect touch interface group (Welch's $t(74) = 3.49$, $p_{one\text{-}tailed} < 0.001$).

Applying the PROCESS Model 4 of Hayes (2017) with 5,000 bootstrap samples, we furthermore find that the *BYO* price fully mediates the touch interface's effect on individuals' none parameter (indirect effect: b = -0.57, 90%-CI = [-0.87; -0.28]), and on the price importance (indirect effect: b = -6.39, 90%-CI = [-9.40; -3.48]). Figure 6 depicts the mediation models. In sum, the results support H_{2a} and H_{2b}.

[5] A linear term for the price attribute was negatively constrained. Hierarchical Bayes involved 120,000 warm up iterations, followed by 80,000 draws of which every 100th step was averaged to build an individual's point estimate.

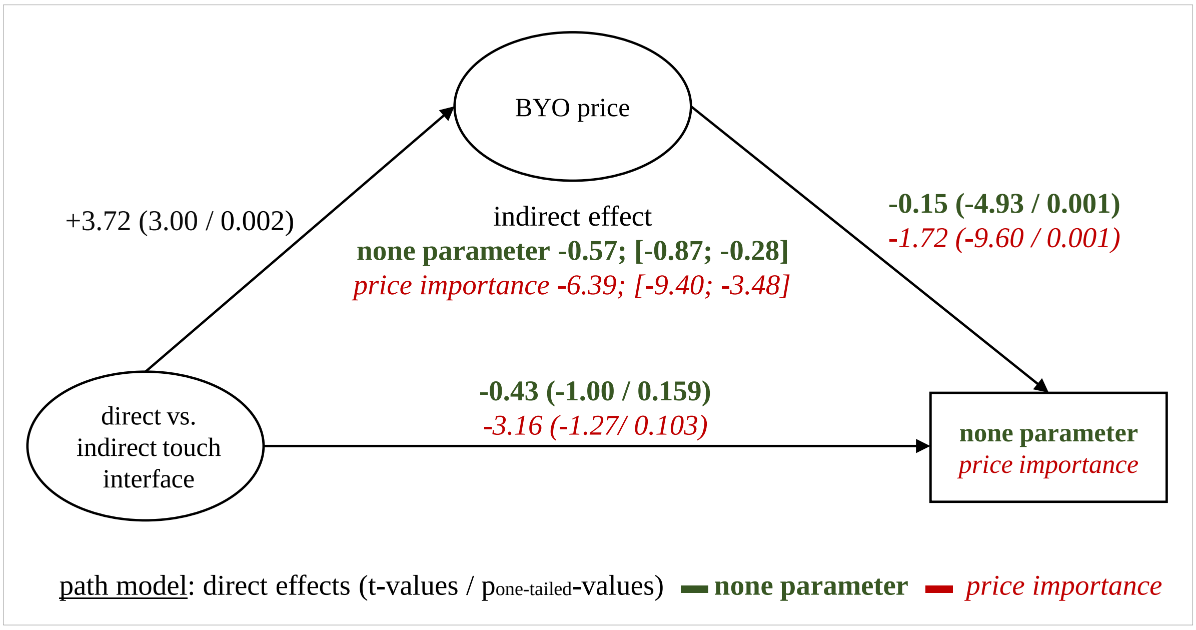


Figure 6 Estimated path models for study 1

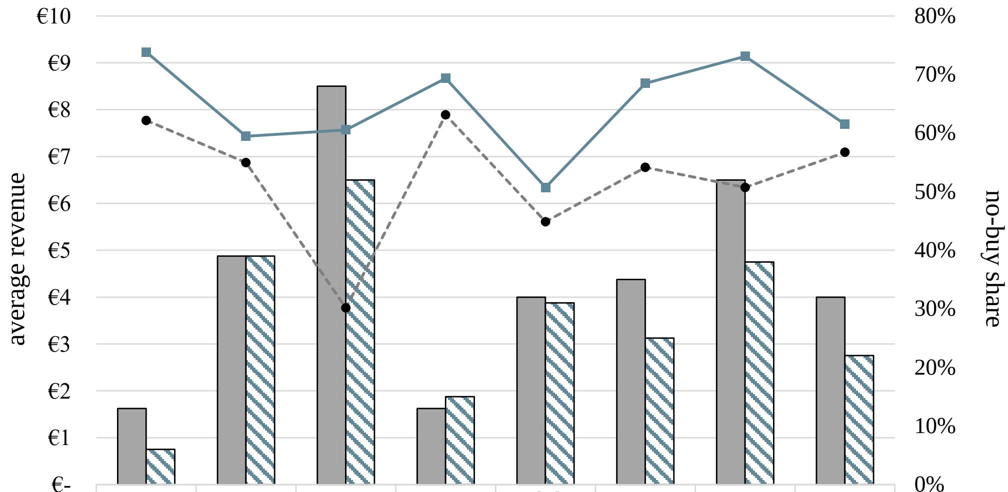
3.3.2. Exemplary market simulation

We conducted two market simulation sets to emphasize the managerial consequences from the diverging ACBC results based on the respondents' interface types. The market simulations were based on the individual hierarchical Bayes utilities using the share of preference simulation method (Orme, 2019, p. 81). The first set of simulations focused on the differences between the two interface user groups regarding no-buy shares, as an indication of market demand (i.e., higher no-buy shares indicate lower market demand) and sales forecasts to predict the market actors' revenue. This type of information is commonly used to inform management decisions (e.g., Dotson et al., 2017; Hauser et al., 2019; Schlereth & Skiera, 2017). The second set of simulations focused on estimated WTP. Here, the analysis showcases how strongly mean WTP estimates for upgrading the data speed of a tariff from 21 Mbits/s to 100 Mbits/s diverge between the two interface user groups. We exemplarily chose the WTP for higher data speed because, when conducting the study, new tariffs with higher speed were about to be introduced into the market.

For the first set of simulations, to design a provider-specific choice scenario, we gathered information on the contracts offered by each of the seven providers included in the study. In addition, the HOT acted as a scenario that combined offers from all providers. Appendix C provides detailed information on the eight scenarios.

Averaged across all scenarios, the direct and the indirect touch interface groups were compared in terms of predicted no-buy share and mean revenue. Accordingly, the former parameter indicates the fraction of respondents who are predicted to defer their choice in the given scenario, whereas the latter uses the price of each respondent's predicted mobile tariff choice[6] and separately calculates the average total monthly expenditures for the direct and indirect touch interface users, respectively. To evaluate the differences between the two interface groups, we separately applied a mixed-effects model for each parameter. In each model a random intercept accounted for the variability of simulation scenarios. The interface type served as a fixed effect (0 = indirect, 1 = direct).

Figure 7 portrays the main results, highlighting that for six of the eight simulations the direct touch interface group's no-buy share falls below that of the indirect touch interface group. Results from a mixed-effects binary logit model (DV: 0 = product choice prediction, 1 = no-buy prediction) thereby confirm a significantly lower no-buy share for direct touch interface users ($\beta = -0.36$, $z = -2.17$, $p = 0.030$). At the same time, all eight simulations demonstrate higher mean revenue in the direct touch interface, compared to the indirect touch interface group. A generalized mixed-effects model (DV: revenue in €) demonstrates a significant difference ($\beta = 1.57$, $t_{(117)} = 3.78$, $p < .001$).



	HOT	congstar	klarmobil	maXXim	mobilcom	O2	otelo	winsim
no-buy share indirect	13%	39%	68%	13%	32%	35%	52%	32%
no-buy share direct	6%	39%	52%	15%	31%	25%	38%	22%
average revenue indirect	€7.77	€6.87	€3.77	€7.89	€5.61	€6.77	€6.34	€7.09
average revenue direct	€9.23	€7.43	€7.57	€8.67	€6.34	€8.56	€9.14	€7.69

Figure 7 Simulation results

For the second set of simulations, we turned our attention to WTP estimates (Miller et al., 2011; Schlereth & Skiera, 2017) in order to exemplarily analyze how much direct touch

[6] A price of 0,00€ if the simulation predicts opting for the no-buy option.

interface consumers are willing to pay more for a specific mobile tariff when upgrading data speed, compared to those using an indirect touch interface. We used the HOT scenario including the seven providers, which reflects a realistic selection of market offerings. More specifically, in this base-case scenario, we first simulated the market share for congstar's tariff (5 GB data volume, 21 Mbits/s speed, flat for calls and SMS, EU roaming, a contract period of 24 month, at a monthly fee of €10.99). Thereafter, in a second scenario, we replaced congstar's tariff with a similar tariff that provides faster data speed at 100 Mbits/s. In this scenario, we raised the price of the new 100 Mbits/s tariff to ensure that it received the same forecasted market share as the congstar tariff with 21 Mbits/s did in the first scenario. The difference between the monthly fee of the 100 Mbits/s tariff and the price of the 21 Mbits/s tariff serves as an estimate of the mean WTP for the faster speed of 100 Mbits/s.[7] After simulating the share of congstar in the base-case HOT scenario (21 Mbits/s) it was evident that the results aligned well with the aforesaid findings, with a prognosed market share of 28.1% for direct touch and only 13.3% for indirect touch interface users. Solving both groups' WTP for 100 instead of 21 Mbits/s speed culminates in an optimal price of €18.14 for the direct touch interface group and only €13.57 for the indirect touch interface group. Thus, direct touch interface users are willing to pay an additional €7.15 (€18.14 - €10.99) for an increase in data speed, whereas the estimated additional WTP is €2.58 in the case of indirect touch interface users.

Therefore, our analysis reveals 2.8 times higher WTP for the tariff enhancement for direct touch interface users than indirect touch interface users. In essence, the results emphasize that interface-related differences in respondents' choice behavior, as discovered in a wide range of ACBC studies, have serious consequences for research practice, substantially influencing predictions of market shares, sales forecasts, and WTP.

4. Study 2

4.1. Method and materials

Study 2 incorporates an ACBC on electric food processors, based on the information provided by a European producer of home appliances on past conjoint studies in this domain. The lab experiment randomly allocated participants to either a direct touch interface or an indirect touch interface condition. While the former group underwent the ACBC via tablet, the

[7] This approach utilizes the common assumption that a consumer is willing to pay for a product as long as the corresponding total utility increases the choice between other options (Kohli & Mahajan, 1991). If this assumption is violated, a consumer switches to competitors or to the no-buy option (Orme, 2019, p. 95)

latter group used a computer with keyboard and mouse. In study 2, the allocation of respondents to interface types was exogeneous, thus ruling out any hidden selection biases in interface choice that might explain why respondents participate in the ACBC study via direct instead of indirect touch interface (Wang et al., 2015).

The final selection of attributes and levels for the ACBC included color (white; black; red), power (900 watt; 1000 watt), additional mixing bowl (none; plastic; stainless polished; stainless steel), additional disc for continuous shredding (none; fried grated potatoes; Asian vegetables; both), measuring cup (none; included), mincer (none; included; included with a shortbread biscuit attachment; included with a grater), additional attachments (none; citrus juicer; blender attachment; ice maker; multifunctional crushers; blender), recipe book (none; Smoothies, Shakes & Co.; vegetarian; low carb; sweet & easy; Jamie Oliver's 5 Ingredients), and price (summed price function in ACBC; see Appendix B).

The ACBC setup closely followed study 1 but included a maximum number of 12 choice tasks in the *Choice Tournament* stage. After performing the ACBC study, respondents in sequence answered questions on their study enjoyment, NFT, cognitive effort, and demographics. We identified participants' study enjoyment based on items from two scales. The first stems from literature on the influence of touch and the second from conjoint literature. The first items, specifically, were adapted from Kubiniec Mayerberg and Bean (1974) and Vries et al. (2018), who asked respondents about their survey perception on a 7-point bipolar semantic differential scale with three items ('*The study was…*', 1 = "*not interesting, not enjoyable, not funny*" to 7 = "*interesting, enjoyable, funny*"). Three further items requested an evaluation on a 7-point Likert scale ranging from 1 = "*totally disagree*" to 7 = "*totally agree*" (Johnson & Orme, 2007: (1) "*The survey was at times monotonous and boring*" (R), (2) "*The way the food processors were presented made me want to slow down and make careful choices"*, (3) "*I'd be very interested in taking another survey just like this in the future*"). A Cronbach's α of .83 reflects the reliability of study enjoyment. Next, respondents provided information about their NFT based on 12 items on a 7-point Likert scale ranging from 1 = "*totally disagree*" to 7 = "*totally agree*" (Nuszbaum et al., 2010; Peck & Childers, 2003a). Six items of the total NFT scale measure aNFT (Cronbach's α of .92): (1) *"When walking through stores, I can't help touching all kinds of products"*, (2) "*Touching products can be fun"*, (3) "*When browsing* in *stores, it is important for me to handle all kinds of products"*, (4) *"I like to touch products even if I have no intention of buying them"*, (5) *"When browsing in stores, I like to touch lots of products"*, (6) *"I find myself touching all kinds of products in stores"*).

Finally, we not only wanted to exclude an alternative explanation for the interface type's influence on the *BYO* price, but also more specifically the possibility that direct (vs. indirect) touch users simply spend more cognitive effort and that iNFT might act as a moderator in this relationship. Thus, in addition, we collected data on consumers' cognitive effort with four items adapted from Cooper-Martin (1994) (Cronbach's α of 0.76). Appendix D provides the translations of all items.

4.2. Participants

Study 2 took place at a major German university in the form of a lab experiment. The participants gained extra credits for a marketing course. Similar to study 1, an initial screening process ensured that all the participants (1) could afford a food processor, (2) were willing to spend about 15 minutes on a subsequent online survey, and (3) were at least 16 years of age. The final sample comprised 192 respondents ($mean_{age} = 22.17$; $SD = 2.52$; 47% females; 79% possess a monthly net income < €1,000) with $n = 100$ belonging to the direct touch and $n = 92$ to the indirect touch interface condition). The groups did not differ regarding their gender, age, income, and product interest levels (smallest $p = 0.449$).

4.3. Results

4.3.1. Measurement models

Because of the model's complexity, we applied partial least squares (Smart PLS 3) (Hair et al., 2017) to analyze the data. We ran two models, including the individuals' none parameter (H_{3a}) or their relative price importance (H_{3b}) as the alternating endogenous construct, respectively.

The other four constructs were identical across both models with (1) touch interface as the independent variable, (2) study enjoyment and (3) the *BYO* price as mediators, and (4) aNFT as the moderator of the touch interface's effect on study enjoyment (c.f., Figure 5).

A check of the measurement models' quality indicated that internal consistency is reliable with a Cronbach's α and composite reliability (C.R.) higher than 0.7 (smallest value = 0.83). Furthermore, both models show sufficient convergent validity with an average variance extracted (AVE) above 0.56. Additionally, discriminant validity is given as tested with the Fornell-Larcker criterion (Fornell & Larcker, 1981), as well as with the Heterotrait-Monotrait Ratio analysis (Henseler et al., 2015), indicating that the bootstrapping confidence intervals for each construct-to-construct relationship do not include 0.85 (closest CI = [0.69; 0.80]; see Appendix D for discriminant validity details).

A final analysis using PLSpredict (Shmueli et al., 2016) further confirmed the models' predictive validity. Specifically, all final endogenous constructs possess smaller root mean squared errors of prediction (RMSE) values for the PLS-SEM model than for the analogous linear models (see Appendix D for predictive validity details). Overall, both models do not raise any reliability or validity concerns.

4.3.2. Tests of hypotheses

Figure 8 portrays all direct effects in the PLS structural models, including the moderating effect of aNFT. Table 1 presents all total, direct, and indirect effects supplemented by test statistics.

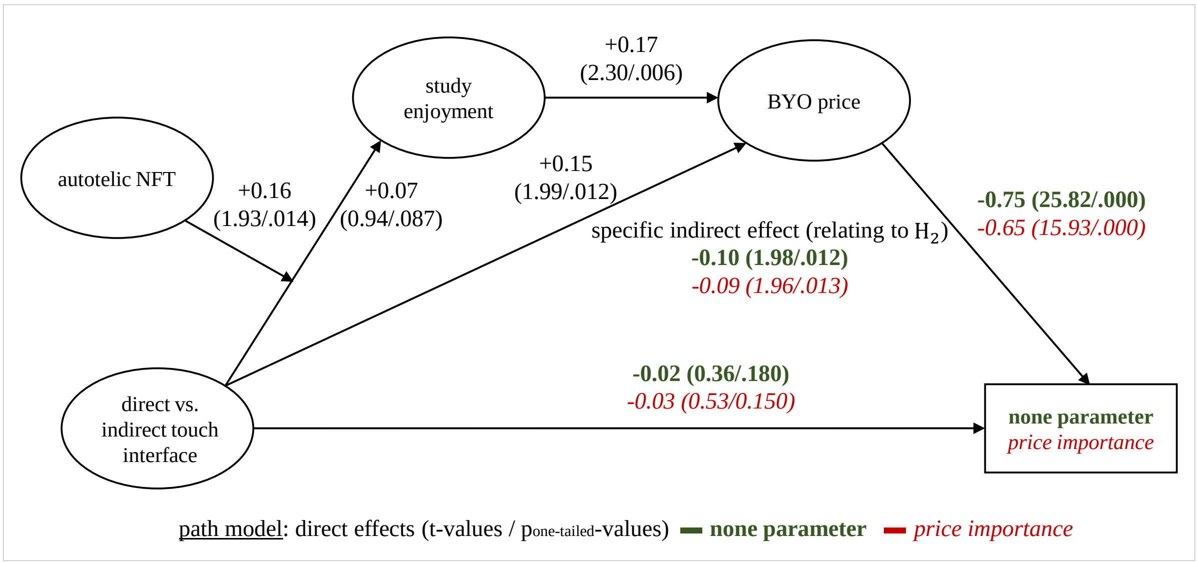


Figure 8 Estimated path models for study 2

Replicating Study 1's results, a positive influence of direct (vs. indirect) touch interfaces emerges on respondents' *BYO* price (b = 0.15; $p_{one\text{-}tailed}$ = 0.008). Supporting H_1, the direct touch interface group configures a higher *BYO* price ($mean_{direct}$ = €262.51, SD = €47.96) compared to its indirect touch counterpart ($mean_{indirect}$ = €246.43, SD = €59.81). Supporting H_{2a}, the use of direct (vs. indirect) touch interfaces leads to a lower none parameter ($mean_{direct}$ = 8.04, SD = 2.76 vs. $mean_{indirect}$ = 8.77, SD = 2.94, total effect: b = -0.13; $p_{one\text{-}tailed}$ = 0.016). Specifically, the *BYO* price fully mediates the effect of touch interface type on individuals' none parameter (specific indirect effect: b = -0.10; $p_{one\text{-}tailed}$ = 0.012). As proposed by H_{2b}, the results reveal the negative effect of the use of a direct instead of an indirect touch interface on the relative price importance ($mean_{direct}$ = 49.59%, SD = 17.89% vs. $mean_{indirect}$ = 54.03%, SD = 17.36%, total effect: b = -0.13; $p_{one\text{-}tailed}$ = 0.017). Again, the *BYO* price fully mediates the effect of touch interface on price importance (indirect effect: b = -0.09; $p_{one\text{-}tailed}$ = 0.013).

Table 1 Bootstrapping results

Path	Total effect	Direct effect	Specific indirect effect		Total indirect effect
Panel A: Structural relationships that both models share					
touch interface → study enjoyment	0.07 (0.94/0.087) [-0.03; 0.17]	0.07 (0.94/0.087) [-0.03; 0.17]	-		-
study enjoyment → BYO price	0.17 (2.30/0.006) [0.08; 0.27]	0.17 (2.30/0.006) [0.08; 0.27]	-		-
touch interface → BYO price	0.15 (2.14/0.008) [0.06; 0.24]	0.14 (1.99/0.012) [0.05; 0.23]	0.01 (0.79/0.108) [0.00; 0.03]		0.01 (0.79/0.108) [0.00; 0.03]
moderation aNFT → study enjoyment	0.16 (1.93/0.014) [0.11; 0.26]	0.16 (1.93/0.014) [0.11; 0.26]	-		-
moderation aNFT → BYO price	0.03 (1.37/0.043) [0.01; 0.05]	-	0.03 (1.37/0.043) [0.01; 0.05]		0.03 (1.37/0.043) [0.01; 0.05]
Panel B: Structural relationships in model 2 (none parameter)					
Path	Total effect	Direct effect	Specific indirect effect		Total indirect effect
touch interface → none parameter	-0.13 (1.87/0.016) [-0.22; -0.04]	-0.02 (0.36/0.180) [-0.08; 0.04]	incl. BYO price: -0.10 (1.98/0.012) [-0.17; -0.04]	incl. study enjoyment and BYO price: -0.01 (0.78/0.109) [-0.02; 0.00]	-0.11 (2.12/0.009) [-0.18; -0.06]
study enjoyment → none parameter	-0.13 (2.24/0.007) [-0.20; -0.06]	-	-0.13 (2.24/0.007) [-0.20; -0.06]		-0.13 (2.24/0.007) [-0.20; -0.06]
BYO price → none parameter	-0.75 (25.82/0.000) [-0.78; -0.71]	-0.75 (25.82/0.000) [-0.78; -0.71]	-		-
moderation aNFT → none parameter	-0.02 (1.35/0.044) [-0.04; -0.01]	-	-0.02 (1.35/0.044) [-0.04; -0.01]		-0.02 (1.35/0.044) [-0.04; -0.01]
Panel C: Structural relationships in model 2 (relative price importance)					
Path	Total effect	Direct effect	Specific indirect effect		Total indirect effect
touch interface → relative price importance	-0.13 (1.83/0.017) [-0.22; -0.04]	-0.03 (0.53/0.150) [-0.10; 0.04]	incl. BYO price: -0.09 (1.96/0.013) [-0.15; -0.03]	incl. study enjoyment and BYO price: -0.01 (0.78/0.110) [-0.02; 0.00]	-0.10 (2.08/0.010) [-0.16; -0.04]
study enjoyment → relative price importance	-0.11 (2.31/0.005) [-0.18; -0.05]	-	-0.11 (2.31/0.005) [-0.18; -0.05]		-0.11 (2.31/0.005) [-0.18; -0.05]
BYO price → relative price importance	-0.65 (15.93/0.000) [-0.71; -0.60]	-0.65 (15.93/0.000) [-0.71; -0.60]	-		-
moderation aNFT → relative price importance	-0.02 (1.37/0.043) [-0.04; -0.01]	-	-0.02 (1.37/0.043) [-0.04; -0.01]		-0.02 (1.37/0.043) [-0.04; -0.01]

Note: path coefficients (t-values (absolute)/ $p_{one\text{-}tailed}$-values) [90%-CI]; touch interface [0 = indirect touch | 1 = direct touch]; the total indirect effect includes the moderation of aNFT and the combined, specific indirect effects.

H_{3a} and H_{3b} also propose study enjoyment as a mediator between interface type and *BYO* price, as well as aNFT as a moderator influencing the effect of interface type on study enjoyment. In line with these hypotheses, aNFT positively moderates the effect of touch interface on study enjoyment (b = 0.16; $p_{one\text{-}tailed}$ = 0.014), leading to a significant moderated mediation on the *BYO* price with aNFT as a moderator and study enjoyment as a mediator (b = 0.03; $p_{one\text{-}tailed}$ = 0.043).[8] Indeed, for individuals with below-median values on aNFT, the interface type does not influence study enjoyment (b = -0.07; $p_{one\text{-}tailed}$ = 0.149). Conversely, for above-median aNFT individuals, the interface type significantly influences study enjoyment (b = 0.19; $p_{one\text{-}tailed}$ = 0.024).

The total indirect effect (including aNFT as the moderator), ranging from the interface type to both the none parameter (b = -0.02; $p_{one\text{-}tailed}$ = 0.044) and the relative price importance (b = -0.02; $p_{one\text{-}tailed}$ = 0.043), therefore supports the relationships proposed by H_{3a} and H_{3b}. Stated differently, the total negative effect of interface type on the none parameter/the relative price importance is significantly more pronounced for individuals high in aNFT.

Finally, an alternative PLS-SEM includes cognitive effort as a mediator between the consumers' touch interface type and the *BYO* price. Additionally, iNFT serves as a moderator between both constructs. The analysis, however, highlights that this approach does not serve as an explanation for direct (vs. indirect) interface users' differential response behavior in ACBC studies. Specifically, both the mediation through cognitive effort (indirect effect: b = 0.01; $p_{one\text{-}tailed}$ = 0.161) and the moderation involving iNFT (b = -0.08; $p_{one\text{-}tailed}$ = 0.161) are not significant, leading to insignificant moderated mediation on the *BYO* price (b = 0.01; $p_{one\text{-}tailed}$ = 0.183).

5. General discussion

5.1. Summary of findings

The present research illuminates, from a market research perspective, the effects of direct touch as opposed to indirect touch interface usage. Direct touch interfaces, provided by mobiles and tablets, have not only made online research convenient, but also allow researchers to access large samples whenever and wherever they prefer (Daley et al., 2003; Vries et al., 2018). However, Couper (2005) notes that "*each new technology enhances and extends the range of*

[8] An alternative analysis strategy based on a moderated mediation model in PROCESS (model #7 involving interface type, study enjoyment, aNFT, and *BYO* price) likewise results in a significant Index of moderated mediation (90%-CI = [0.13; 3.82].

possibilities and opportunities for survey research but also often introduces new challenges and issues for further research." (p. 487).

In this vein, the present study is the first to identify differences between direct and indirect touch interface usage in preference elicitation studies that rely on an adaptive choice-based conjoint approach (ACBC) (Johnson & Orme, 2007). The meta-analysis and two ACBC studies (an online study and a lab experiment) demonstrate that direct as opposed to indirect touch interface users, on average, configurate more expensive products in a *BYO* exercise as the first stage of ACBC. The interface type's effect further unfolds as a systematic influence on respondents' utility estimates. Accordingly, the direct touch interface users exhibit lower estimated preferences for the option not to buy (i.e., lower none parameter) and smaller relative price importance (i.e., less price sensitivity) than do the indirect touch interface users. These results confirm that the *BYO* price mediates the touch interface type's effect on respondents' utility estimates. Study 1 furthermore illustrates that market researchers can extract a higher (or lower) market demand estimate, depending on the use of a direct (or an indirect) touch interface by participating consumers. Additionally, the use of direct (vs. indirect touch) interfaces results in higher derived WTP estimates for selected product features. Study 2 focused on the explanation of the interface type's influence. The results confirm a moderated mediation, with study enjoyment acting as a mediator of the interface type's influence on ACBC outcomes, and aNFT as a moderator of enjoyment in the relationship between interface type and the *BYO* price. Overall, for high aNFT respondents, the touch-induced enjoyment experienced during the study mediates the effect of interface type on ACBC outcomes. Apparently, using a direct touch interface in a market research study is highly enjoyable for individuals high in aNFT. Finally, the data did not support an alternative explanation based on a moderated mediation involving iNFT and consumers' cognitive effort.

5.2. Implications and future research avenues

The present study lays the foundation for more research on the influence of interface types, as seen from a market research perspective. To further analyze the role of the interface type's effect, and by taking varying external validity measures into account, researchers are welcome to replicate our findings. Future research might even identify which interface type is more promising in terms of deriving product choice predictions in an online vs. an offline context.

From a market research perspective, and within their own ACBC studies, investigators should further track the use of different interface types. Results emanating from a particular study wave (or country) might be barely comparable with others, due to differences in the extent of the dissemination of direct touch interfaces among respondents.

We further recommend that market researchers relying on ACBC should first determine whether products in the focal product categories are purchased using direct or indirect touch interfaces. This could help to establish a correspondence between the interface type used in market research studies and the type typically used when actually buying the final product. Research, for example, highlighted that consumers prefer to shop for products that involve a low risk (e.g., books) by using mobile devices, which often comes with a direct touch interface. By contrast, products perceived to involve risky decisions are often shopped using stationary devices that seldom provide a direct touch interface (Haan et al., 2018).

Moreover, study 1's simulation highlights the difference between direct and indirect interface users' WTP when upgrading a specific product attribute. Market researchers should therefore be aware of the fact that a product upgrade can lead to a relatively high WTP for participants using a direct (vs. an indirect) touch interface during their ACBC interview.

Thus, when focusing only on direct touch interface users, an upgrade in a product attribute (including a higher price for the product) might reduce the product choices for consumers using an indirect touch interface.

In addition, we also recommend testing for our results' robustness by altering the conjoint method. Future studies can accordingly analyze the effect of different interface types by adopting a static choice-based conjoint approach, which does not rely on an initial *BYO* exercise to tailor its subsequent choice tasks (Louviere & Woodworth, 1983). Other recent conjoint variants can simultaneously incorporate elements that can lead to the same interface-induced differences as identified in our studies. For example, Gensler et al. (2012) introduced their own ACBC approach, referred to as the *individually adapted choice-based conjoint*. In the course of their interview flow, an algorithm continuously adapts prices upwards as a respondent selects a product alternative and downwards as the respondent selects the no-buy option. Thus, if consumers are willing to pay more at the outset, WTP estimates could differ depending on whether respondents complete the study with a direct touch interface or with an indirect touch interface. Likewise, Park et al. (2008) introduced an *Upgrading Method* to elicit consumer preferences. When applying this variant, respondents see all levels of an attribute and are asked to state their WTP to upgrade from a bare-bone level to each of the desired levels of the attribute. It is easy to speculate that, in this case, differences in interface types will also be decisive.

Furthermore, future research should consider implementing incentive-aligned conjoint procedures (e.g., Ding et al., 2005). Previous results have shown that these procedures can reduce biases in preference estimates by including the economic consequences of the respondents' decisions during the study.

They thus provide the researcher with more realistic and predictive utility estimates (e.g., Ding, 2007; Ding et al., 2009; Horsky et al., 2004; Toubia et al., 2012). Therefore, it would be interesting to see whether (or not) incentive alignment can also reduce differences in the results stemming from different interface types.

The products (mobile tariffs and food processors) of our two studies are utilitarian products "*whose consumption is more cognitively driven and goal-oriented*" (McCabe & Nowlis, 2003, p. 433). However, previous research by McCabe and Nowlis (2003) showed that the missing haptic input, in particular, affects hedonic products (also see Kühn et al., 2020). Likewise, Brasel and Gips (2014) demonstrated that effects arising from the use of a touchscreen are even stronger in respect of products with a high level of haptic importance. Additionally, Hildebrand and Levav (2017) demonstrated that higher-priced product configurations for direct touch interface users can be explained by consumers' tendency to increasingly select hedonic product features. Researchers might therefore find even stronger effects when they use a hedonic product made of pleasing material, e.g., a couch (Brasel & Gips, 2014; McCabe & Nowlis, 2003) or when presenting a product with more hedonic product features (Hildebrand & Levav, 2017).

Finally, future studies should also manipulate the information that accompanies the presented products (McCabe & Nowlis, 2003; Peck & Childers, 2003b; Spears & Yazdanparast, 2014). Spears and Yazdanparast (2014) demonstrated that missing haptic product information in an online shop prevents consumers from imagining purchasing the product. This effect is particularly strong for individuals high in NFT. In addition, McCabe and Nowlis (2003) showed that detailed descriptions of a product's material reduce consumers' resistance to buy in the absence of touch possibilities.

Therefore, we encourage other researchers to analyze – in future – the impact of haptic vivid descriptions in ACBC studies, especially their influence on the *BYO* price and, more specifically, the none parameter. These descriptions could then be added to the list of necessary craftsmanship in conjoint studies (Hauser et al., 2019).

Appendix

A. Details on the meta-analysis of interface types in ACBC

A.1. Model selection

Most of the following analyses use the R package “metafor" (version 2.4.0) (Viechtbauer, 2010). We provide annotated data for the meta-analysis in the open science framework (OSF): https://osf.io/g5xz9/?view_only=0d1048dcf08b4baaba56388c62c0fb21. We conducted a fixed-effect meta-analysis on Hedges’ g with mean effect sizes weighted by the inverse of their variance (Hofer & Chen, 2020; Viechtbauer, 2010). The results reveal that direct touch interface users configurate more expensive products/services in the *BYO* stage of ACBC, compared to indirect touch interface users (standardized mean difference = 0.21; z = 4.53, p < 0.001; 95% CI = [0.12. 0.30]; see Figure 4 in the main article). A random-effects approach using the Hedges estimator (Viechtbauer et al., 2015) yields similar results (standardized mean difference = 0.21; z = 4.25; p < 0.001; 95% CI = [0.11. 0.31]). Importantly, a likelihood-ratio test indicates that the random-effects model does not fit significantly better than the fixed-effects model (LRT = 0.48; df = 1; p = 0.490). In line with this result, a nonsignificant Cochran’s Q-test for heterogeneity (Hedges & Olkin, 1985) indicates that there is only neglectable variance between studies not accounted for by the fixed-effects model (Q = 15.04, df = 11, p = 0.181). Specifically, only I^2 = 26.87% of the total variability in the effect size estimates can be attributed to heterogeneity among studies (Higgins & Thompson, 2002); a value often regarded as low (Pigott, 2012). The remainder is sampling variability. Therefore, the fixed-effects meta-analysis does not explore the role of moderator variables.

A.2. Model diagnostics

The analysis continues by assessing influential data points (i.e., studies that are outliers and that simultaneously exert a pronounced influence on model estimation). Table 2 presents different influence statistics (Cook & Weisberg, 1982).

In the current meta-analysis, a study exerts adverse influence if at least one of the following conditions is met: (a) the absolute DFFITS value exceeds $3\sqrt[2]{\frac{1}{12-1}} = 0.90$; (b) the lower tail area of a ${\chi^2}_{df=1}$ distribution cut off by the Cook’s distance is larger than 50%; and (c) the hat value exceeds $3(\frac{1}{12}) = 0.25$ (Viechtbauer, 2010). Study 12 meets these criteria. However,

Figure 4 in the main article illustrates that this study is the only one to disclose a negative influence when using a direct (vs. an indirect touch) interface on the *BYO* price. Thus, an upward bias in the evaluation of the direct touch interface's effect would result if study 12 is excluded from the meta-analysis.

Table 2 Influence statistics of the fixed-effects meta-analysis model

Study	Studentized residual	DFFITS values	Cook's distance	Covariance ratios	Cochran's Q if deleted	Diagonal of hat matrix	Weight (%) in model fitting
6	0.037	0.007	0.000	1.041	15.041	0.039	3.946
7	1.815	0.362	0.131	1.040	11.750	0.038	3.827
8	1.252	0.460	0.212	1.135	13.476	0.119	11.917
9	0.035	0.013	0.000	1.135	15.041	0.119	11.922
10	-0.639	-0.245	0.060	1.148	14.634	0.129	12.862
11	-0.687	-0.264	0.070	1.148	14.571	0.129	12.864
12	**-2.824**	**-1.030**	**1.060**	**1.133**	**7.066**	**0.117**	**11.734**
13	-0.163	-0.032	0.001	1.040	15.016	0.038	3.808
14	0.057	0.014	0.000	1.058	15.039	0.055	5.491
15	0.359	0.070	0.005	1.038	14.914	0.037	3.675
16	0.391	0.137	0.019	1.123	14.890	0.110	10.968
17	1.606	0.440	0.194	1.075	12.464	0.070	6.985

To gain further insights, we applied leave-one-out estimation to repeatedly fit the model, omitting one study at a time (Viechtbauer, 2010). Table 3 presents the results.

Table 3 Leave-one-out estimations results of the fixed-effects model

Study	Effect of direct vs. indirect touch interface	Std. error	z-value	p-value	Lower 95% CI	Upper 95% CI	Cochran's Q	p-value for Q
6	0.208	0.047	4.429	< .001	0.116	0.300	15.041	.131
7	0.191	0.047	4.084	< .001	0.100	0.283	11.750	.302
8	0.187	0.049	3.816	< .001	0.091	0.283	13.476	.198
9	0.208	0.049	4.236	< .001	0.111	0.304	15.041	.131
10	0.219	0.049	4.454	< .001	0.123	0.316	14.634	.146
11	0.220	0.049	4.471	< .001	0.124	0.317	14.571	.148
12	0.255	0.049	5.220	< .001	0.160	0.351	7.066	.719
13	0.210	0.047	4.471	< .001	0.118	0.301	15.016	.131
14	0.207	0.047	4.387	< .001	0.115	0.300	15.039	.131
15	0.205	0.047	4.374	< .001	0.113	0.297	14.914	.135
16	0.202	0.049	4.141	< .001	0.106	0.297	14.890	.136
17	0.188	0.048	3.941	< .001	0.094	0.281	12.464	.255

The results confirm that influential data points do not adversely affect the main findings. More specifically, in each fold of this analysis the effect of direct vs. indirect touch interfaces on the *BYO* price is still positive and significant at $p < 0.001$. Furthermore, the Cochran's Q-test for heterogeneity remains nonsignificant (smallest p-value = 0.131) in each fold. In conclusion, there is no evidence in the reported meta-analysis that individual influential studies exert adverse effects.

A.3. Assessment of publication bias

Any assessment of a publication bias (Ling et al., 2014) in the present meta-analysis cannot be understood as a publication bias in a classical sense (Rosenthal, 2010), i.e., *"studies that report relatively large effects for a given question are more likely to be published than studies that report smaller effects for the same question"* (Borenstein et al., 2009, p. 278). Several characteristics lead to this conclusion. First, none of the reported studies have been published. Second, the market research companies that provided some of the studies are 'blind to' the effects under research (i.e., the influence of direct vs. indirect touch interfaces in ACBC). Third, had they been familiar with the research question, these commercial companies would instead have had an incentive to present evidence that the interface type does not influence ACBC results. Nevertheless, a selection bias regarding the included studies could have introduced a bias in the present case.

We combined multiple test strategies (Ling et al., 2014; Viechtbauer, 2010) to evaluate the potential bias. First, a visual inspection of the funnel plot does not support the notion of a pronounced asymmetry (see Figure 9, Panel A).

Furthermore, the plot does not reveal any studies in the bottom-left area, in which rather small effect sizes, along with small standard errors are observed. This indicates a deeper analysis. Second, we implemented different versions of Egger's regression method to assess – quantitatively – funnel plot asymmetry (Egger et al., 1997) for the following predictors: the standard error of effect size, the sampling variance, the sample size of the studies, and the inverse of sample size (Viechtbauer, 2010). None of these tests indicate a significant deviation from the assumption of plot symmetry (smallest p-value = 0.105), thus supporting an absence of bias. Finally, we implemented Duval and Tweedie's "trim and fill" method (Duval & Tweedie, 2000a, 2000b), which delivers an unbiased estimate of the effect size. The procedure iteratively removes the most extreme small studies from the positive side of the funnel plot, then re-computes the effect size at each iteration until the funnel plot is symmetric about the (new) effect size, and finally feeds the original studies back into the analysis and imputes a mirror image for each of them (Borenstein et al., 2009, p. 286). Panel B of Figure 9 presents the resulting funnel plot. An analysis of the trimmed and filled model indicates that the main effect of the interface type (direct vs. indirect touch) on the *BYO* price remains significant (standardized mean difference = 0.11, z = 2.77, p = 0.006, 95% CI = [0.03. 0.19]). Therefore, the conclusion is that the presented meta-analysis does not suffer from a selection bias.

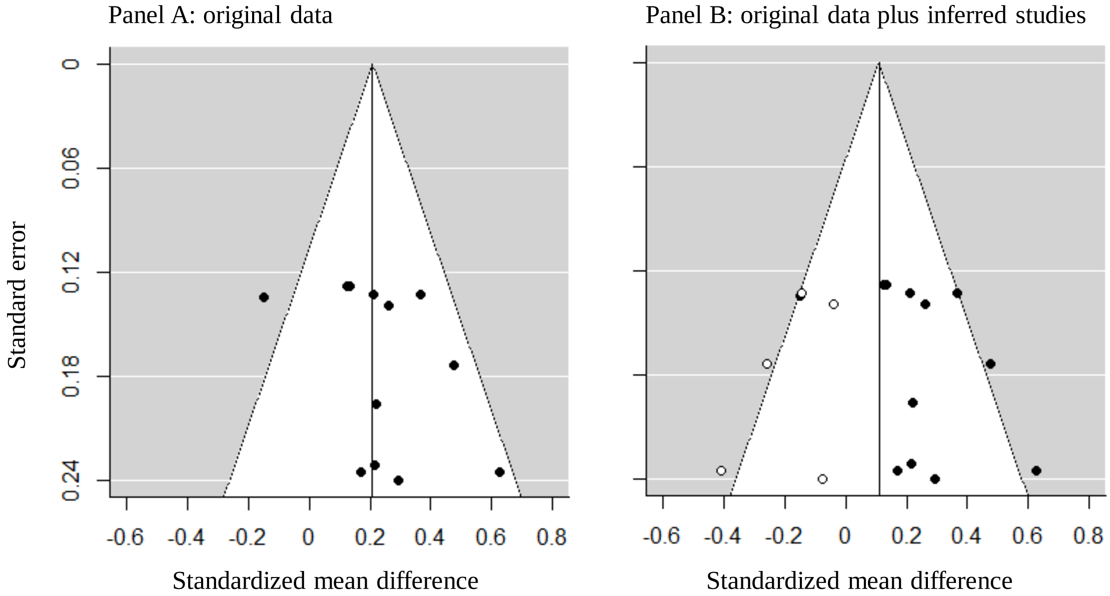


Figure 9 Funnel plots for the original set of studies (Panel A) and for the trim and fill data augmentation technique (Panel B)

B. Attributes, attribute levels, and price increments

Table 4 Study 1 on mobile tariffs

	Attribute	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
1	**Contract provider**	congstar **+8€**	klarmobil **+8€**	otelo **+0€**	mobilcom debitel **+3€**	winSIM **+0€**	maXim **+0€**	O2 **+3€**
2	**Data volume**	1 GB **+1€**	3 GB **+3€**	5 GB **+8€**	8 GB **+10€**			
3	**Data speed**	21 Mbit/s **+0€**	50 Mbit/s **+1€**	100 Mbit/s **+6€**				
4	**Minutes included**	none **+0€**	100 **+0.5€**	300 **+1€**	flat **+1.5€**			
5	**SMS included**	none **+0€**	100 **+0.5€**	300 **+1€**	flat **+1.5€**			
6	**EU roaming**	included **+1€**	not included **+1€**					
7	**Contract termination**	monthly **+2€**	24 months **+0€**					

Note: In this study, the product concepts do not include a base price.

Table 5 Study 2 on electric food processor

	Attribute	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
1	**Color**	white **+0€**	black **+10€**	red **-10€**			
2	**Power**	900 watt **+0€**	1000 watt **+15€**				
3	**Additional mixing bowl**	none **+0€**	plastic **+13.29€**	stainless polished **+39.09€**	stainless steel **+41.79€**		
4	**Additional disc for continuous shredding**	none **+0€**	fried grated potatoes **+9.20€**	Asian vegetables **+12.35€**	both **+22.55€**		
5	**Measuring cup**	none **+0€**	included **+11.35€**				
6	**Mincer**	none **+0€**	included **+39.45€**	included with a shortbread biscuit attachment **+51.99€**	included with a grater **+64.59€**		
7	**Additional attachments**	none **+0€**	citrus juicer **+15.09€**	blender attachment **+23.09€**	ice maker **+50.29€**	multifunctional crushers **+55.10€**	blender **+56.05€**
8	**Recipe book**	none **+0€**	smoothies, shakes, etc. **+3.79€**	vegetarian **+3.79€**	low carb **+7.59€**	sweet & easy **+12.35€**	Jamie Oliver`s 5 Ingredients **+25.60€**

Note: In this study, the product concepts include a base price of 160.99€.

C. Choice scenarios for the exemplary market simulations in study 1

Table 6 Scenario 1 – holdout task (HOT)

Options	Contract provider	Data volume (GB)	Data speed (Mbit/s)	Minutes included	SMS included	EU roaming	Contract termination	Price (€)
1	maXim	8	50	none	none	included	24	12.99
2	winSIM	3	21	100	none	included	monthly	5.99
3	klarmobil	1	21	300	300	included	24	7.99
4	otelo	3	50	100	none	included	monthly	8.99
5	winSIM	5	50	100	100	included	24	10.99
6	mobilcom debitel	5	21	300	none	included	monthly	15.99
7	maXim	3	21	flat	none	included	monthly	7.99
8	O2	3	100	none	300	included	24	9.99
9	congstar	5	21	flat	flat	included	24	10.99
10	mobilcom debitel	1	50	flat	100	included	24	8.99

Table 7 Scenario 2 – congstar

Options	Contract provider	Data volume (GB)	Data speed (Mbit/s)	Minutes included	SMS included	EU roaming	Contract termination	Price (€)
1	congstar	5	25	flat	flat	included	24	20.00
2	congstar	3	25	flat	none	included	monthly	10.00
3	congstar	3	25	flat	50	included	monthly	11.00
4	congstar	5	25	flat	none	included	monthly	15.00
5	congstar	5	25	flat	flat	included	monthly	16.00

Table 8 Scenario 3 – klarmobil

Options	Contract provider	Data volume (GB)	Data speed (Mbit/s)	Minutes included	SMS included	EU roaming	Contract termination	Price (€)
1	klarmobil	2	21	flat	flat	included	24	9.99
2	klarmobil	2	50	flat	flat	included	24	14.99
3	klarmobil	6	21	flat	flat	included	24	14.99
4	klarmobil	6	50	flat	flat	included	24	19.99
5	klarmobil	1	25	300	100	included	24	7.99
6	klarmobil	1.5	25	300	100	included	24	9.99

Table 9 Scenario 4 – maXXim

Options	Contract provider	Data volume (GB)	Data speed (Mbit/s)	Minutes included	SMS included	EU roaming	Contract termination	Price (€)
1	maXim	2	50	flat	flat	included	24	6.99
2	maXim	2	50	flat	flat	included	monthly	8.99
3	maXim	3	50	flat	flat	included	24	7.99
4	maXim	3	50	flat	flat	included	monthly	9.99
5	maXim	5	50	flat	flat	included	24	12.99
6	maXim	5	50	flat	flat	included	monthly	14.99
7	maXim	1	50	50	flat	included	24	5.99
8	maXim	2	50	100	flat	included	monthly	9.99
9	maXim	3	50	100	flat	included	24	12.99

Table 10 Scenario 5 – mobilcom debitel

Options	Contract provider	Data volume (GB)	Data speed (Mbit/s)	Minutes included	SMS included	EU roaming	Contract termination	Price (€)
1	mobilcom debitel	3	21	flat	flat	included	24	7.99
2	mobilcom debitel	5	21	flat	flat	included	24	10.99
3	mobilcom debitel	2	21	50	50	included	24	4.99

Table 11 Scenario 6 – O2

Options	Contract provider	Data volume (GB)	Data speed (Mbit/s)	Minutes included	SMS included	EU roaming	Contract termination	Price (€)
1	O2	6	100	flat	flat	included	24	12.49
2	O2	6	100	flat	flat	included	monthly	29.99
3	O2	3	100	flat	flat	included	24	9.99
4	O2	3	100	flat	flat	included	monthly	24.99

Table 12 Scenario 7 – otelo

Options	Contract provider	Data volume (GB)	Data speed (Mbit/s)	Minutes included	SMS included	EU roaming	Contract termination	Price (€)
1	otelo	5	50	flat	flat	included	24	14.99
2	otelo	7	50	flat	flat	included	24	19.99
3	otelo	1.5	21	300	none	included	monthly	7.95
4	otelo	4	21	300	none	included	monthly	14.95

Table 13 Scenario 8 – winSIM

Options	Contract provider	Data volume (GB)	Data speed (Mbit/s)	Minutes included	SMS included	EU roaming	Contract termination	Price (€)
1	winSIM	1	50	flat	flat	included	24	6.99
2	winSIM	3	50	flat	flat	included	24	7.99
3	winSIM	5	50	flat	flat	included	24	12.95

D. Wording and assessment of the measurement

Table 14 Descriptive statistics and correlations for measured items

	BYO	SE1	SE2	SE3	SE4	SE5	SE6	TI	NP	PIM	aNFT1	aNFT2	aNFT3	aNFT4	aNFT5	aNFT6
BYO	254.802 (54.273)	0.154	0.117	0.156	0.130	0.115	0.133	0.148	-0.748	-0.658	0.051	0.025	-0.013	0.004	-0.052	0.071
SE1	0.154	4.505 (1.411)	0.175	0.468	0.559	0.548	0.452	0.063	-0.158	-0.090	0.141	0.035	0.005	-0.003	-0.029	0.022
SE2	0.117	0.175	4.474 (1.392)	0.433	0.316	0.167	0.186	-0.025	-0.112	-0.004	0.085	0.089	0.120	-0.023	0.000	0.028
SE3	0.156	0.468	0.433	4.792 (1.626)	0.546	0.522	0.490	0.031	-0.188	-0.102	0.077	0.007	-0.002	-0.091	-0.075	-0.018
SE4	0.130	0.559	0.316	0.546	4.979 (1.362)	0.606	0.561	0.123	-0.207	-0.118	0.189	0.099	0.098	-0.021	0.074	0.062
SE5	0.115	0.548	0.167	0.522	0.606	4.208 (1.414)	0.742	0.016	-0.193	-0.097	0.238	0.226	0.141	0.052	0.112	0.081
SE6	0.133	0.452	0.186	0.490	0.561	0.742	3.922 (1.450)	0.013	-0.202	-0.125	0.203	0.156	0.059	-0.008	0.061	0.073
TI	0.148	0.063	-0.025	0.031	0.123	0.016	0.013	1.521 (0.500)	-0.128	-0.125	-0.030	-0.127	-0.130	-0.159	-0.141	-0.157
NP	-0.748	-0.158	-0.112	-0.188	-0.207	-0.193	-0.202	-0.128	8.389 (2.856)	0.773	-0.048	0.014	0.011	-0.009	0.013	-0.082
PIM	-0.658	-0.090	-0.004	-0.102	-0.118	-0.097	-0.125	-0.125	0.773	51.718 (17.689)	-0.013	0.023	0.060	0.002	0.072	0.001
aNFT1	0.051	0.141	0.085	0.077	0.189	0.238	0.203	-0.030	-0.048	-0.013	3.760 (1.757)	0.724	0.683	0.462	0.566	0.557
aNFT2	0.025	0.035	0.089	0.007	0.099	0.226	0.156	-0.127	0.014	0.023	0.724	3.797 (1.846)	0.622	0.603	0.635	0.659
aNFT3	-0.013	0.005	0.120	-0.002	0.098	0.141	0.059	-0.130	0.011	0.060	0.683	0.622	3.469 (1.759)	0.575	0.656	0.636
aNFT4	0.004	-0.003	-0.023	-0.091	-0.021	0.052	-0.008	-0.159	-0.009	0.002	0.462	0.603	0.575	3.057 (1.818)	0.769	0.698
aNFT5	-0.052	-0.029	0.000	-0.075	0.074	0.112	0.061	-0.141	0.013	0.072	0.566	0.635	0.656	0.769	3.156 (1.900)	0.802
aNFT6	0.071	0.022	0.028	-0.018	0.062	0.081	0.073	-0.157	-0.082	0.001	0.557	0.659	0.636	0.698	0.802	3.260 (1.927)

Note: The main diagonal represents the mean and the standard deviation (in the brackets) of the items. SE = Study enjoyment; TI = Touch interface; NP = None parameter; PIM = Price importance; aNFT = Autotelic need for touch

Table 15 Reliability and validity results, item wordings and translations

Construct	Item	Loading	English wording	German wording
Study enjoyment *AVE[d]=0.555* *α=0.832* *C.R.[e]=0.879*	1[a]	0.701	The survey was at times monotonous and boring. (R)	Die Umfrage war zeitweise eintönig und langweilig. reversed item. (R)
	2[a]	0.467	The way the food processors were presented made me want to slow down and make careful choices.	Die Art und Weise. wie die MUM5-Angebote präsentiert wurden. hat mich dazu veranlasst meine Wahlentscheidungen langsam und sorgfältig zu treffen.
	3[a]	0.762	I'd be very interested in taking another survey just like this in the future.	Ich wäre sehr daran interessiert, in Zukunft erneut an einer Befragung wie dieser teilzunehmen.
	4[b]	0.821	The study was not interesting/ interesting.	Die Befragung war uninteressant/ interessant.
	5[b]	0.849	The study was not enjoyable/ enjoyable.	Die Befragung war nicht unterhaltsam / unterhaltsam.
	6[b]	0.804	The study was not funny/funny.	Die Befragung war nicht spaßig / spaßig.
aNFT *AVE=0.645* *α=0.915* *C.R.=0.915*	1[c]	0.919	When walking through stores. I can't help touching all kinds of products.	Wenn ich einkaufen gehe, muss ich alle möglichen Artikel anfassen.
	2[c]	0.883	Touching products can be fun.	Es macht Spaß, alle möglichen Artikel anzufassen.
	3[c]	0.827	When browsing in stores, it is important for me to handle all kinds of products.	Wenn ich mich in Geschäften umsehe, ist es wichtig für mich. alle möglichen Artikel in die Hand zu nehmen.
	4[c]	0.640	I like to touch products even if I have no intention of buying them.	Auch wenn ich einen Artikel nicht unbedingt kaufen will, mag ich es ihn anzufassen.
	5[c]	0.755	When browsing in stores, I like to touch lots of products.	Beim Stöbern in Geschäften mag ich es einfach alle möglichen Artikel anzufassen.
	6[c]	0.762	I find myself touching all kinds of products in stores.	Beim Einkaufen ertappe ich mich immer wieder dabei, dass ich alle möglichen Artikel anfasse.
BYO price *single item*	1	1.000	Price of the first ACBC stage as a result of participants' decisions when compiling their ideal electric food processors.	
None parameter *single item*	1	1.000	Threshold in subjective utility of the electric food processor, which has to be exceeded in order to predict that a consumer will purchase instead of opting for a no-buy (an indirect measure – estimated via Hierarchical Bayes).	
Price importance *single item*	1	1.000	The relative importance of the price per individual electric food processor (an indirect measure – estimated via Hierarchical Bayes).	

[a] 7-point Likert scale by Johnson and Orme (2007) ranging from 1 (totally disagree) to 7 (totally agree)
[b] 7-point bipolar semantic differential scale adapted from Kubiniec Mayerberg and Bean (1974) and Vries, Jager, Tijssen, and Zandstra (2018), and ranging from 1 (not interesting. not enjoyable. not funny) to 7 (interesting. enjoyable. funny)
[c] 7-point Likert scale by Peck and Childers (2003), with the German translation by Nuszbaum, Voss, Klauer, and Betsch (2010), and r from 1 (not at all true) to 7 (exactly true)
[d] AVE = Average variance extracted
[e] C.R. = Composite reliability

Table 16 Discriminant validity results

Model 1: None parameter

Construct	BYO price	Study enjoyment	None parameter	Touch interface	Mod.aNFT	aNFT
BYO price	1.000	[0.070. 0.348]	[0.692; 0.800]	[0.018; 0.292]	[0.034; 0.215]	[0.038; 0.172]
Study enjoyment	0.176	0.745	[0.126; 0.396]	[0.047; 0.215]	[0.095; 0.309]	[0.121; 0.290]
None parameter	-0.748	-0.241	1.000	[0.012; 0.271]	[0.039; 0.234]	[0.036; 0.173]
Touch interface	0.148	0.051	-0.128	1.000	[0.000; 0.000]	[0.053; 0.297]
Mod.aNFT	0.071	0.160	-0.080	0.000	0.832	[0.000; 0.000]
aNFT	0.032	0.178	-0.024	-0.107	0.000	0.803

Model 2: Price importance

Construct	BYO price	Study enjoyment	Price importance	Touch interface	Mod.aNFT	aNFT
BYO price	1.000	[0.072; 0.349]	[0.582; 0.730]	[0.016; 0.292]	[0.034; 0.215]	[0.037; 0.165]
Study enjoyment	0.176	0.745	[0.050. 0.285]	[0.049; 0.213]	[0.094; 0.308]	[0.121; 0.290]
Price importance	-0.658	-0.124	1.000	[0.010; 0.266]	[0.033; 0.174]	[0.034; 0.177]
Touch interface	0.148	0.051	-0.128	1.000	[0.000; 0.000]	[0.052; 0.298]
Mod.aNFT	0.071	0.160	-0.080	0.000	0.832	[0.000; 0.000]
aNFT	0.032	0.178	-0.024	-0.107	0.000	0.803

Note: Grey main diagonal ($\sqrt[2]{AVE}$) and lower triangular matrix (Pearson correlation) represent Fornell-Larcker criterion. Upper triangular matrix represents Heterotrait-Monotrait Ratio of correlations (95% confidence intervals). Mod.aNFT = Moderation through aNFT; aNFT = Autotelic need for touch

E. Summary statistics for the predictive relevance of latent constructs

Table 17 PLSpredict results

Construct	Item	Model 1: None parameter			Model 2: Price importance		
		RMSE		Q^2	RMSE		Q^2
		PLS	LM		PLS	LM	
Study enjoyment	1	1.432	1.501	-0.020	1.429	1.480	-0.016
	2	1.393	1.475	0.007	1.394	1.476	0.007
	3	1.644	1.698	-0.010	1.642	1.708	-0.010
	4	1.357	1.409	0.015	1.356	1.404	0.018
	5	1.390	1.415	0.043	1.388	1.421	0.048
	6	1.451	1.517	0.009	1.449	1.512	0.013
BYO price	1	54.145	55.879	0.016	54.084	55.567	0.016
None parameter	1	2.857	2.941	0.010			
Price importance	1				17.763	18.361	0.002

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