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User experience design approaches for accommodating high "need for touch" consumers in ecommerce

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Abstract

Inability to touch physical products when shopping online may be an issue for consumers with a high "need for touch" (NFT), defined as preference for the extraction and use of haptic information. This study explores the inclusion of congruent auditory and visual haptic information in online product presentation videos as a user experience (UX)–design approach to compensate for the lack of touch in e-commerce. A between-subjects online experiment was conducted where participants ($N = 183$) evaluated variants in two product categories—kitchen knives and sweaters—in three conditions: static images, videos containing natural audio from the product interaction, and the same videos with a musical background. Product presentation was found to significantly affect perceived haptic properties (weight for the knives, softness for sweaters), perceived overall quality, perceptual discrimination and experienced task difficulty. Importantly, interactions between NFT and product category were identified: specifically, natural auditory haptic information improved the user experience of high NFT consumers in one product category (knives), but not the other (sweaters).

Practical applications

Overall, the present study demonstrates that auditory haptic information congruent with visual haptic information can improve the user experience of high NFT consumers in an online shopping context. However, the effectiveness of this UX-design approach may be dependent on the product characteristics, in particular the salience of the instrumental (vs. autotelic) dimension of touch.

1 | INTRODUCTION

1.1 | Haptics and the sense of touch in retail

Online retail has been steadily increasing in numbers during the last couple of decades, while physical stores have not increased significantly (Hansen & Larsen, 2019). The COVID-19 situation has pushed this tendency even further. For instance, a recent study conducted by UNCTAD (2020) reported that online purchases worldwide have increased by 6–10% points since the outbreak of COVID-19, and suggested that the changes are likely to outlast the pandemic.

Although e-commerce offers convenience and access to a plethora of products worldwide, not all consumers equally enjoy or partake in this form of shopping. Demographic variables have shown to be significantly related to consumers' preferences for online shopping (Girard, Korgaonkar, & Silverblatt, 2003). Age in particular is known to be a significant factor as data show that older consumers (age 55–74) in Europe shop 30% less frequently online than younger consumers (age 16–54), a gap which has been increasing since 2010 (Eurostat, 2021).

In contrast to demographics, the role of psychographic and personality traits has received less attention in the literature, specifically with regards to how these may affect consumer experience of and likelihood to engage in online shopping. A trait that is particularly topical is consumers stable preference for the extraction and use of haptic information, known as *need for touch* (NFT, Peck & Childers, 2003b).

Inability to touch products prior to purchase may prevent consumers with a high NFT to engage in and enjoy online shopping activities. Accordingly, studies have shown that high NFT consumers experience frustration and lack of confidence in their own judgments when deprived of this opportunity (physically touching products) in product evaluation situations (Peck & Childers, 2003a, 2003b).

Since the onset of e-commerce, several studies have highlighted that lack of touch may pose a challenge for high NFT consumers in online shopping environments (Childers, Carr, Peck, & Carson, 2001; Citrin, Stem, Spangenberg, & Clark, 2003; Peck & Childers, 2003a, 2003b). This challenge persists to this day: accordingly, San-Martín, González-Benito, and Martos-Partal (2017) reported evidence of a negative link between individual NFT and perceived quality of online products. Rathee and Rajain (2019) have even found that high NFT consumers generally prefer buying products in-store (as opposed to online), whereas low NFT consumers are comfortable buying in both in-store and online stores.

The growing field of sensory marketing has contributed to our understanding of the role of sensory inputs on consumer behavior. Sensory marketing has been defined as "marketing that engages the consumers' senses and affects their perception, judgment and behaviour" (Krishna, 2012, p. 333). Crucially, several studies have shown that the sense of touch plays a role in consumers' evaluation of products. The sense of touch enables us to obtain haptic information such as texture, hardness, weight, and temperature. Our skin receptors provide us with tactile sensations (pressure, pain, temperatures) while kinaesthesis (the sense of muscle movement) allows us to, for example, assess the weight of an object (Holt et al., 2012). Especially *weight* as an intrinsic product cue has been a subject of consumer research in this regard. For instance, a study by Gatti, Bordegoni, and Spence (2014) showed that the weight of containers containing liquid soap, influenced consumers' expectations of the soap's effectiveness. Soap in a heavier container was expected to be more effective. The weight of food and beverage containers has shown to influence expected satiety of yoghurt and pasta (Kampfer, Leischnig, Ivens, & Spence, 2017; Maggioni, Risso, Olivero, & Gallace, 2015), as well as perceived intensity of fizz in carbonated water (Maggioni et al., 2015). In terms of consumer electronics, a study by Swain (2003) showed preferential differences between whether consumers evaluated products based on only textual descriptions (reading pieces of text describing their weight) or based on direct haptic evaluation (touching the products with their hands). When presented only with textual descriptions of the products, consumers preferred heavyweight variants of, for example, mini coffee grinders, while light variants were preferred in terms for travel alarm clocks and cameras. However, when consumers were able to directly assess the haptic product information by hand (touching the products), heavier variants were preferred in all product categories. Lindstrom articulates this divergence: "although heavier weight intuitively feels more substantial, we like the convenience of small and light" (Lindstrom, 2005, pp. 87–88) and further adds that the consumer oftentimes "[…] makes her quality evaluation on the feel rather than the look" (Lindstrom, 2005, p. 88). Haptic product cues related to surface textures, such as smoothness and softness, have also received attention within consumer research. For instance, texture (smooth vs. rough) strongly affects consumers' perception of products' "personality" on dimensions such as excitement and sophistication, more so than the product's weight (Ranaweera, Martin, & Jin, 2020).

When considering haptic (and tactile) product cues such as weight and surface texture, one must discriminate between instrumental and autotelic touch (Peck, 2010), a distinction which pertains to the purpose of touching the product. "Instrumental touch" is goal-oriented and further subdivided into three categories: "touch to purchase," "touch to obtain non-haptic product information," and "touch to obtain haptic product information" (texture, hardness, weight, temperature) (Peck, 2010, p. 20) whereof the latter is the most relevant type of instrumental touch in sensory marketing. In contrast to the goal-driven instrumental touch, the "autotelic" dimension of touch relates to touch in and of itself, usually associated with a hedonic need (Peck & Childers, 2003a).

1.2 | Compensatory strategies for lack of touch

Touch is considered a *proximal sense* (Peck, 2010), meaning that it requires direct physical contact between the stimulus (e.g., the product) and the subject (e.g., the consumer). Therefore, the possibilities of providing this type of sensory stimuli, or imitate haptic product information, in an online context, are limited (Flavián, Gurrea, & Orús, 2017). As a result, user experience (UX) design approaches must seek to *compensate* for the lack of touch. Such strategies should, if employed in practice, provide a better user experience for the customer and, in turn, ideally a higher conversion rate for the online retailer. According to ISO 9241-2010:2019, the term *user experience* is described as "[the] user's perceptions and responses that result from the use and/or anticipated use of a system, product or service" (International Organization for Standardization, 2019). In this context, we use the term "UX-design approaches" to encapsulate design approaches which attempt to mediate the user experience of evaluating physical products (in an online setting) without being able to gain direct haptic feedback.

A wide range of compensatory approaches for the lack of direct haptic feedback has been proposed in the literature. Strategies based on haptic imagery, that is, the presentation of haptic information using written descriptions, have shown to alleviate overall regret in online shopping (Park, Hill, & Bonds-Raacke, 2015), as well as to have a positive effect on consumers' purchase intentions and perception when shopping online (Rodrigues, Silva, & Duarte, 2017; Silva, Rocha, De Cicco, Galhanone, & Manzini Ferreira Mattos, 2021). Combining textual and visual product information has also shown to make it easier for the customer to remember product information (Blanco, Sarasa, & Sanclemente, 2017). This is consistent with earlier findings by Peck and Childers (2003b), who found that textual haptic information in combination with an image of the product increased respondents' confidence in their product evaluations (when deprived of direct touch) considerably more than when shown the same image with a product description, which was textually described without the use of words associated with haptic qualities.

Earlier studies on online presentation formats show that rich media, such as online product presentation videos (OPPVs), can reduce task complexity for online consumers and increase product understanding (Appiah, 2006; Jiang & Benbasat, 2007). A recent study by Kühn, Lichters, and Krey (2020) identifies that a sub-type of OPPVs, *online touch surrogate videos* (i.e., another person's hands haptically examining the product) have a positive effect on high NFT consumers' product evaluation experience. Though the study involved produce (fruits) as the product of investigation, product presentation videos of durable goods have too been found to have a positive effect on high NFT consumers (Flavián et al., 2017) in terms of attitudes and purchase intentions towards the product.

Much research on presentation techniques seems to share a common trait when it comes to compensating for the lack of touch; that is, leveraging the human ability of imagination. The notion of imagining sensory characteristics is known as mental imagery, which refers to the "[…] representations and the accompanying experience of sensory information without a direct external stimulus." (Pearson, Naselaris, Holmes, & Kosslyn, 2015, p. 590). Thus, in the context of online shopping where direct sensory stimulus is limited to very few modalities, mental imagery is particularly important for product experience (Schifferstein & Spence, 2008).

According to Orús, Gurrea, and Flavián (2016), OPPVs can facilitate consumers' use of imagination in evaluation tasks because of the vivid information they provide, which is generally associated with sensory breadth (Appiah, 2006), i.e., the more senses engaged, the more vivid the information. This corresponds to Liu, Batra, and Wang (2017), which points out that, in relation to the inability of touching products online, concrete mental representations, as opposed to abstract mental representations, increase consumers' willingness to buy and purchase intentions. The more sensory modalities engaged in the presentation of the product, the easier it is for the customer to imagine touching the product themselves.

Coupling sensory breadth with imagination should be seen in the context of the premise that product experiences are fundamentally multisensory (Schifferstein & Spence, 2008). If we accept this premise, along with the finding that engaging more sensory modalities can facilitate the consumers' creation of concrete mental representations of the product, it follows that one needs to not only consider the visual aspects of OPPVs (such as online touch surrogate videos), but also the *auditory* aspects. Touching, manipulating, and moving a physical object will inevitably cause sound waves. Detecting the sounds of the objects and surroundings around us is a fundamental part of orienting ourselves in the world, but what gets our attention is usually the sound-producing event (e.g., the movement of an object), rather than the sound itself. This is known as *everyday listening* as opposed to *musical listening* (Gaver, 1993a, 1993b). Auditory aspects of OPPVs have received little attention in the literature, but should be consequential due to *cross-modal correspondences* (Spence, 2011; Walker, Scallon, & Francis, 2017), i.e., the phenomenon by which people consistently match attributes or dimensions of a stimulus in one sensory modality with a that of a different sensory modality. As an example, people tend to match high-pitched sounds with small, bright objects located high up in space (Spence, 2011). In terms of everyday listening, cross-modal correspondences certainly have practical utility. For instance, they enable us to distinguish the sound of a heavy object from a light object falling to the ground. Objects' weight has been found to show cross-modal correspondence with auditory cues; i.e., heavier objects "correspond" to lower frequencies and vice versa (Walker et al., 2017). Furthermore, people have been found to be able to distinguish between different liquids' viscosities by the sound of it being poured (Spence & Wang, 2015), and also to auditorily distinguish between liquids of different temperatures (Velasco, Jones, King, & Spence, 2013). Thus, people seem to be able to, to some extent, acquire certain haptic information from auditory cues. As per the notion of everyday listening, auditory cues subtly aid us in orienting ourselves in the physical structures and objects surrounding us (Gaver, 1993a). In a product-related context, Wang and Spence (2019) note that a growing body of empirical research demonstrate that people's reactions and perceptions of everyday products can be pronouncedly affected by manipulating the sounds that people hear when touching and interacting with said products. Lastly, when speaking of cross-modal correspondences in relation to everyday listening, we are referring to *congruent* sensory cues. In sensory marketing, sensory congruency have been defined as "[…] the degree of fit among characteristics of a stimulus" (Krishna, Elder, & Caldara, 2010, p. 412). In terms of presenting a product through an online touch surrogate video, congruent sensory cues would be equivalent to a consistency between what can be seen (visual haptic information) and what can be heard (auditory haptic information) when the product is inspected. Congruent sensory cues have the potential to enhance consumers' processing fluency, meaning that they can more easily process new information about the product (Wang & Spence, 2019). Perhaps because of the collective sensory information being more coherent and vivid, it might lower the customer's cognitive load in online product evaluation situations, entailing a more pleasant user experience. Schifferstein and Spence (2008) note that, when a product cannot be experienced physically, for example, in an online store, cross-modal illusions may be created by providing a particular kind of sensory input in an available modality, as a means of compensating for the absent sensory stimulations. For instance, auditory cues can be used as part of a cross-modal illusion to facilitate mental imagery of a product's or surface's tactile attributes (Kitagawa & Spence, 2006; Spence & Zampini, 2006). These cross-modal illusions/phenomena may be considered cases of multimodal mental imagery (Nanay, 2018). That said, these types of perceptual illusions do not always occur, even when congruent sensory stimuli are present, as they are dependent on contextual factors and individual differences (Spence, 2011). Moreover, the degree of incongruency between sensory cues can also generate perceptual modulations due to expectation disconfirmation, whereby one's sensory perception is altered due to the discrepancy between what is expected and what is subsequently experienced (Piqueras-Fiszman & Spence, 2015).

1.3 | Hypotheses

Situated within this context, the purpose of this paper is to contribute with novel knowledge for UX-designers and online retailers to convey relevant haptic information about physical products in a digital context. Such strategies should, if employed in practice, provide a better user experience for the customer and, in turn, ideally a higher conversion rate for the online retailer.

On the basis of the literature reviewed until now, it is expected that customers shopping online can more easily form concrete and vivid mental representations regarding the haptic qualities of the product(s) they are evaluating, if they are presented with congruent visual and auditory haptic information, eventually leading to an improved user experience for the customer, especially those with high NFT. Put differently, we expect that online retailers can more effectively convey haptic product information by presenting the products through touch surrogate videos (visual haptic information), which include the natural audio of the product being haptically examined (auditory haptic information). The focus is on the natural audio, that is, auditory haptic information (congruent with visual haptic information), as this has not yet been examined in existing research.

Natural audio is defined as the real sounds of the product's interactions with itself or its surroundings, for instance the sounds of components scraping against each other, a person's hand patting the surface of the product, the sound of the product being placed in a surface, etc.

Thus, we propose the following first hypothesis to be tested through an experiment:

> **H1.** *Consumers' user experience associated with evaluating products' haptic properties in an online setting is improved by the addition of auditory haptic information congruent with visual haptic information.*

The construct *user experience* covers the consumer's experience of evaluating the product in an online setting. Thus, an *improvement* of this experience is considered an increase in the positive aspects (e.g., confidence) and/or a decrease in negative aspects (e.g., frustration/difficulties) related to this experience.

Secondly, we consider differences between high and low NFT consumers. Given that high NFT consumers are more sensitive to the presence/absence of haptic information, we expect that the addition of natural audio to convey product haptic information should differentially affect consumers with varying degrees on NFT, and in particular that the positive effect should be larger for high NFT consumers. Hence, the second hypothesis considered in this research is defined as follows:

> **H2.** *The effect of congruent auditory and visual haptic information is moderated by the consumers' level of overall NFT.*

2 | METHODS

2.1 | Experimental design

To test the proposed hypotheses, we conducted a between-subjects online experiment where consumers were randomly assigned to three experimental conditions. In each condition, the respondents were presented with *four consumer products* (same products across conditions), and asked to report their expectations about each product's haptic characteristics (e.g., how heavy it feels) as well as their confidence in their own expectations. In line with studies on NFT by Peck and Childers (2003b), the experiment encompassed two distinct product categories —kitchen knives and sweaters— representing, respectively, the instrumental and the autotelic dimension of touch. In each category, two product variants with noticeably different haptic characteristics were included: a heavyweight versus a lightweight knife, and a soft versus a rough sweater.

In order to observe the effect of auditory haptic information in particular, the independent variable across conditions was the media (i.e., the type of *sensory stimuli*) through which products were presented to the participant. The three conditions encompassed two control groups (Static Images; Music) and one experimental group (Natural Audio). The *Static Images* and *Music* conditions both represent common ways of presenting products online through the use of media. Having two control groups was done in order to observe the effect of congruent auditory haptic information (comparing the *Music* and the *Natural Audio* condition, by presenting non-product-related audio vs. product-related audio), as opposed to the effect of videos versus static images (comparing the *Static Images* and *Music* condition). Product presentation media for each condition was produced specifically for the experiment. *Static Images* condition each depicted one single product with two images; one image displaying the full product (the sweaters placed on a white surface, and the knives placed on a cutting board on a white surface) and a close-up depicting the weaving (sweaters) or the transition from handle to blade (knives). The music included in the *Music* condition was a royalty free Muzak-style track from the video editing software Adobe Premiere Rush, which was chosen due to it being a common type of background music in stores.

With regards to producing the touch surrogate videos, interactions with each product type were done specifically with a focus on capturing both visual and auditory haptic information (i.e., natural audio). The interactions with both product types were performed by a set of adult male hands examining the product thoroughly, displaying its haptic and tactile properties. Interactions with the sweaters included patting and creasing the fabric as well as lifting it and letting it fall to the surface. Interactions with the knives included patting the surface, tapping the handle with the tip of a finger, tapping the knife against a cutting board, and lastly placing the knife on the cutting board. The natural audio of the interactions with the products (patting, creasing, tapping, etc.) was recorded simultaneously with the video using high quality condenser microphones positioned in an

XY-position, in order to capture and mimic a 3D sound effect to facilitate sound localization (Clarkson, 2008). All media (images and videos) can be accessed through Mendeley Data: (folder "Presentation Media" located at this link https://data.mendeley.com/datasets/dpwj2bywgz/draft). The overall experimental design used in this research is summarized in Table 1.

The proposed hypothesis (H1) frames the *user experience associated with evaluating a product's haptic characteristics* as the dependent variable. The construct of user experience associated with product evaluation was decomposed to a total of four measurable dependent variables encompassing positive (p), negative (n), and objective/neutral (o) aspects of the product evaluation experience:

Three dependent variables related to the *experience* of assessing the products' haptic properties:

1. Confidence in expectations of the product's haptic properties (p), hereafter referred to as *Confidence in haptics (of knives/sweaters)*
2. Confidence in expectations of the product's quality as a derivative of its haptic properties (p), hereafter referred to as *Confidence in quality (of knives/sweaters)*
3. Experienced difficulty with evaluating the product (n), hereafter referred to as *Difficulty (with knives/sweaters)*

   One dependent variable related to the respondent's *perception* of haptic properties:

4. Degree of discrimination between same-category products variants' haptic properties (o). A calculated measure of the percentual change in score of, that is, "expected feeling of weight" between the lightweight variant and the heavyweight variant, hereafter referred to as *Discrimination (of knives/sweaters)*

All dependent variables developed for this study were measured using a 7-point rating scales. The questions are reported verbatim below:

a. Questions regarding expectations of the product's haptic properties
   i. Expected haptic properties
      1. Knives: "How light/heavy do you expect this knife to feel"
         Sweaters: "How rough/soft do you expect this sweater to feel?"—*Scales 1–7 (1 = very rough/light; 7 = very soft/heavy)*
   ii. Confidence in expectations (Dependent variable 1)
      1. Both categories: "How confident are you that your expectations are correct?"—*Scales 1–7 (1 = not very confident; 7 = very confident)*

b. Questions regarding expectations of the product's quality associated with those haptic properties
   i. Expected quality
      1. Knives: "What are your expectations with the knife's usability/functional quality (e.g., how the weight is distributed, etc.)"
         Sweaters: "What are your past expectations of the sweater's comfort (e.g., how pleasant it feels on the skin)"—*Scales 1–7 (1 = bad quality/not very comfortable; 7 = high quality/very comfortable)*
   ii. Confidence in expectations (Dependent variable 2)
      1. Both categories: "How confident are you that your expectations are correct?"—*Scales 1–7 (1 = not very confident; 7 = very confident)*

c. Question regarding experienced difficulty (Dependent variable 3)
   i. "How difficult was it for you to evaluate this product?"—*Scales 1–7 (1 = not very difficult; 7 = very difficult)*

2.2 | Product category selection

For the independent variable, three different product presentation medias were produced. Consequently, appropriate product categories were systematically selected, similarly to Kühn et al. (2020), in a preliminary study conducted with a convenience sample of Danish speaking respondents ($N = 64$). The respondents in the preliminary study were asked to assess the importance and rationale (usefulness and enjoyment) behind haptically assessing various consumer products. Using a 7-point Likert scale (1 = completely disagree, 7 = completely agree), the respondents were asked to state their level of agreement with four statements (e.g., "By examining the product with one's hands (touching, lifting, etc.), one may get a sense of the product's quality"). The full list of statements is given in the supplementary material (available at https://data.mendeley.com/v1/datasets/dpwj2bywgz/draft). A total of 16 different everyday product

TABLE 1 Experimental design used in the study

Variable	Presentation media (condition): Static images (control group 1)	Music (control group 2)	Natural audio (experimental group)
Visual stimulus	Static images presenting the product	Touch surrogate video presenting the product	Touch surrogate video presenting the product (identical to *Music* condition)
Auditory stimulus	None	Music track (natural audio muted)	Natural audio, enhanced, and high quality (no music track)
Congruency between visual and auditory stimuli	N/A	No	Yes

TABLE 2 Product category selection scoreboard (sorted by haptic diagnosticity, high to low)

Product category	Haptic diagnosticity	Importance of haptically diagnosing the product prior to purchase
Shoes	5.92	5.78
Sweater[a]	5.31	5.28
Pants	5.28	6.07
Handheld kitchen tool (e.g., kitchen knife)[a]	5.26	4.74
Handheld tool (e.g., hammer)	5.01	3.84
Underwear	5.00	5.04
Blanket	4.77	4.57
Headphones	4.65	4.93
Cutlery	4.63	4.39
Cell phone	4.56	4.65
Socks	4.48	3.49
Writing utensil	4.43	3.72
Computer mouse	4.11	4.26
Bike helmet	4.06	5.03
Portable speaker	4.06	4.14
Dress	3.94	3.33

[a]Products selected for inclusion in the main study.

categories were included. Table 2 displays the resulting scores for each product (sorted from highest to lowest haptic score). Sweaters were chosen partly because of its high score, and partly because of them being a common item of investigation in NFT studies (Peck & Childers, 2003a, 2003b; Peck & Wiggins, 2006; Yazdanparast & Spears, 2013). Kitchen knives were chosen as they had the highest score of haptic diagnosticity among non-apparel-related items, as well as a relatively high score of importance of haptically diagnosing the product prior to purchase.

The specific knives used in the experiment are large kitchen knives with a steel blade and a wooden handle (bamboo for the filleting knife). The knives differ in weight by ~73%, which was deemed to be a sufficiently large difference for the experiment. The sweaters were carefully selected and bought for the purpose by visiting a thrift shop and browsing through their selection of sweaters in both the men's and women's section. It was attempted to find two different gender-neutral sweaters with notably differing tactile properties (subjectively assessed). An overview of the products used is given in Table 3.

2.3 | Procedures

The final design of the experiment was constructed as an online questionnaire using the survey tool Qualtrics. The experiment for a given respondent proceeded as follows: first, the respondent was given a general introduction to the experiment and its purpose; "How is our imagination and expectations for a product affected by the way a product is presented digitally?". Participants were herein informed that all responses collected would be treated anonymously and that no personal information was going to be collected during the experiment. Participants then explicitly gave their informed consent to participating in the experiment.

After giving their informed consent, the respondent was asked to perform an audio test using headphones, to ensure that the

TABLE 3 Overview and detailed descriptions of specific products used in the experiment

Dimension of touch	Category	Variant	Product and description
Instrumental (weight)	Kitchen knives	*Heavyweight* kitchen knife	Chef's knife: stainless steel blade, and maple wood handle. Weight: 161 g Brand: Fiskars Product name: Noor
		Lightweight kitchen knife	Filleting knife: stainless steel blade, bamboo handle. Weight: 93 g Brand: cool cooking Product name: N/A
Autotelic (softness)	Sweaters	*Soft* sweater	Furry sweater made from 100% polyester. Tactile/haptic description: feels like faux fur. Color: Gray Brand: N/A Product name: N/A
		Rough sweater	Knitted sweater made from 50% acrylic and 50% cotton. Tactile/haptic description: feels like a knitted dishcloth. Color: beige Brand: N/A Product name: N/A

respondent could hear all intended nuances of the natural audio, as well as to ensure the safety of the respondent's ears. After completing the audio test, the respondent was randomly assigned to one of the three conditions. Then, the respondent was presented with the four products one by one, in randomized order. Each product was presented with a non-haptic textual description, along with one of the three types of media. The respondent was asked to first observe the product, then give an assessment of his/her expectations of a specific haptic property of the product (knives = feeling of weight; sweaters = feeling of softness), followed by an assessment of how confident they felt with said expectations. Hereafter, the respondent was asked about their expectations regarding the product's quality, as a derivative of said haptic property. Again, this question was followed up with a question on the respondent's confidence in his/her own expectations. Lastly, on a separate page, the respondents were asked to rate how difficult they experienced the product evaluation task to be.

The dependent variables related to the two hypotheses were measured using rating scale questions, and were answered using a slider with two-decimal values ranging from 1 to 7 (numeric values were not displayed to the respondent), and scale anchors labeled with *not very confident(=1)* and *very confident (=7)*, while the middle of the scale was marked with an unlabeled vertical line, as a visual mid-point of reference.

At the end of the product evaluation tasks, consumers answered some questions about their own background. Since the scope of the paper deals with high NFT consumers in particular, the 12-item NFT questionnaire by Peck and Childers (2003a) was included (with written approval by Joan Peck). This allowed for measuring each individual respondent's level of NFT (instrumental, autotelic, and overall), and grouping the respondents in low and high NFT for the subsequent data analysis. A version of the NFT scale translated into Danish by the authors was used (Cronbach's $\alpha = 0.89$). The translated version of the scale is available in the supplementary material (Appendix B). Grouping was done through a median split of all respondents, based on overall NFT score (median = 10). Furthermore, questions were included regarding the respondent's preferences for shopping in online versus physical stores, as well as basic demographic questions. These were included to assess the homogeneity of respondents across the three conditions.

Randomization blocks were used to randomize the presentation order of the four products, and to randomize the order of the 12 items in the NFT questionnaire.

2.4 | Participants

Participants were recruited in three rounds through snowball sampling on social media (Facebook and LinkedIn) and through the online platform Prolific (www.prolific.co). The study was conducted in Danish language so the main inclusion criteria for the survey was that the respondent spoke Danish fluently and/or that it was their native tongue.

A total of 217 responses were collected. After removing incomplete and duplicate responses, a total of $N = 183$ unique responses were retained and analyzed. Table 4 reports the sample composition across the different experimental conditions.

Although the overall distribution of age and sex was somewhat skewed, the respondents were rather similar across NFT and across conditions. Likewise, there were no statistically significant differences across conditions in neither low nor high NFT respondents' preferences for buying knives (low NFT: $F_{(2,88)} = 0.75$; $p = .475$, high NFT: ($F_{(2,89)} = 1.46$; $p = .239$) and sweaters (low NFT: $F_{(2,88)} = 0.04$; $p = .960$, high NFT: ($F_{(2,89)} = 0.01$; $p = .989$) in online stores versus physical stores.

3 | RESULTS

3.1 | Results pertaining to H1—effects of product category and presentation media

A repeated measures ANOVA (Table 5) revealed significant within-subject main effects of the *Product Category* in the dependent variables *Confidence in Quality* and *Difficulty*. Statistically significant interactions between *Product Category*Presentation Media* were found in the following three dependent variables *Confidence in Haptics*, *Confidence in Quality*, and *Difficulty*.

Two-way ANOVAs (Table 6) showed statistically significant between-subject main-effects of *Presentation Media* in several of the dependent variables which represented the user experience associated with evaluation of products' haptic properties, as well as perceptual discrimination between same-category products variants' haptic properties.

For the knife category, the following dependent variables showed significant main-effects of the Presentation Media: Confidence in Haptics, Difficulty, and Discrimination.

For the sweaters category, the following dependent variables showed significant main effects: Confidence in Haptics and Confidence in Quality.

Statistically significant interaction effects between *Presentation Media*NFT* were also identified for Discrimination of knives, Confidence in Haptics of sweaters, Confidence in Quality of sweaters, and Difficulty with sweaters (Table 6).

The main effects of product category can be seen by comparing the figure pairs 1–3, as well as the pairwise comparisons reported in Table 7. It can be seen that the sweater category, compared to the knife category, was associated with higher confidence and lower difficulty in the Static Images condition. The direction of the effects of Presentation Media, differing by product category, can be seen by comparing Figures 1–4. In the knife category, natural audio affected all three aspects (positive, negative, neutral) of the user experience in a positive direction (increased confidence, decreased difficulty, increased discrimination). By contrast, in the sweater category, natural audio had a slightly negative effect on one single aspect of the user experience (decreased confidence).

Subsequent pairwise comparisons by Tukey HSD (Table 7) revealed, for several dependent variables concerning both product

TABLE 4 Descriptive statistics pertaining to participants' distribution by experimental condition and NFT group

		Condition		
		Static images ($n = 63$)	Music ($n = 61$)	Natural audio ($n = 59$)
Sex	Female	29%	30%	36%
	Male	71%	70%	64%
NFT group	Low NFT	46%	52%	51%
	High NFT	54%	48%	49%
Age	18–30	76%	77%	61%
	31–44	13%	11%	32%
	45–56	6%	7%	7%
	57+	5%	5%	0%
		NFT group		
		Low NFT ($n = 91$)	High NFT ($n = 92$)	
Age	18–30	68%	75%	
	31–44	19%	18%	
	45–56	10%	3%	
	57+	3%	3%	
Sex	Female	23%	39%	
	Male	77%	61%	

TABLE 5 Statistically significant ANOVA results—within-subject effects

	df	F	p	η_p^2
Product category				
Confidence in expectations of quality	1,177	6.82	.010	0.04
Experienced difficulty	1,177	16.50	<.001	0.09
Product category × presentation media				
Confidence in expectations of product's haptic/tactile properties	2,177	13.61	< .001	0.13
Confidence in expectations of product's quality	2,177	8.88	< .001	0.09
Experienced difficulty	2,177	11.61	< .001	0.17

categories, significant differences in overall estimated marginal means between *Music* and *Natural Audio* condition, differences which, due to the experiment design, can be attributed to the presence/absence of auditory haptic information congruent with visual haptic information.

3.1.1 | Knives—overall estimated marginal means

The effect size seen in Discrimination ($\eta_p^2 = 0.06$) on Figure 4a suggests that congruent auditory and visual haptic information contributed with a significant increase (Mean difference: +37.91%; $p = .006$) in the respondents' perception of the weight difference between two same-category product variants, compared to visual haptic information alone.

As seen in Table 7, the higher perceived weight differences were accompanied by a significantly higher mean confidence in one's own expectations of haptic properties ($p < .05$) along with a significantly lower experienced difficulty ($p < .05$), indicating an improvement of the user experience associated with evaluating the products' haptic properties. However, the confidence regarding expectations of the products' quality did not increase significantly.

3.1.2 | Sweaters—overall estimated marginal means

Table 7 shows that, for the autotelic product category, the two measures of confidence both significantly decreased in the condition of congruent auditory and visual haptic information compared to the music condition (Confidence in Haptics, Mean difference: −0.63; $p < .001$ and Confidence in Quality, Mean difference: −0.50; $p = .010$). However, Discrimination was not significantly affected. Furthermore, the Difficulty was not significantly affected either.

3.2 | Results pertaining to H2—low versus high NFT

The low and high NFT groups exhibited identical trends when comparing the Static Images and Natural Audio conditions, that is, an increase or a decrease in the dependent variables. However, the interaction effects between *Presentation Media*NFT* become evident when observing differences between the Music condition and the Natural Audio condition, that is, differences attributable to the absence/

TABLE 6 Statistically significant ANOVA results—between-subject effects

	df	F	p	η_p^2
Presentation media				
Confidence in expectations of knives' haptic/tactile properties	2,360	4.21	.016	0.02
Experienced difficulty of evaluating knives	2,360	3.73	.025	0.02
Degree of discrimination between same-category products (knives) variants' haptic properties	2,177	5.84	.003	0.06
Confidence in expectations of sweaters' haptic/tactile properties	2,360	8.38	<.001	0.04
Confidence in expectations of sweaters' quality	2,360	6.42	.002	0.03
Presentation media × NFT				
Degree of discrimination between same-category products (knives) variants' haptic properties	2,177	3.25	.041	0.03
Confidence in expectations of sweaters' haptic/tactile properties	2,360	6.28	.002	0.03
Confidence in expectations of sweaters' quality	2,360	3.83	.022	0.02
Experienced difficulty of evaluating sweaters	2,360	7.19	<.001	0.04

TABLE 7 Overall estimated marginal means and standard deviations

		Presentation media		
		Static images	Music	Natural audio
Product category	Dependent variable	Mean *(SD)*	Mean *(SD)*	Mean *(SD)*
Knives	Confidence, haptic properties	$4.6^{b,*}$ *(1.6)*	$4.6^{b,***}$ *(1.6)*	5.0^{a} *(1.6)*
	Confidence, quality	4.5 *(1.6)*	4.4 *(1.6)*	4.7 *(1.6)*
	Difficulty evaluating	$4.0^{a,*}$ *(1.7)*	$4.0^{a,*}$ *(1.7)*	3.6^{b} *(1.7)*
	Degree of discrimination	$55.6^{b,*}$ *(116.0)*	$46.9^{b,**}$ *(117.9)*	84.8^{a} *(119.9)*
Sweaters	Confidence, haptic properties	$4.9^{a,***}$ *(1.5)*	$4.7^{a,*}$ *(1.6)*	4.3^{b} *(1.6)*
	Confidence, quality	$4.7^{a,*}$ *(1.6)*	$4.7^{a,**}$ *(1.6)*	4.2^{b} *(1.7)*
	Difficulty evaluating	3.7 *(1.7)*	3.6 *(1.8)*	4.0 *(1.8)*
	Degree of discrimination	51.7 *(113.6)*	42.4 *(115.4)*	66.8 *(117.4)*

Note: In each row, means that do not share superscript letters are statistically significant (Tukey $p < .05$). The level of significance for the different pairwise comparison is also indicated ($^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$).

presence of congruent auditory haptic cues. In subjective assessments of the user experience (confidence and difficulty) of evaluating the knives, high NFT individuals did not report considerable differences between Music and Natural Audio, as both conditions resulted in equally increased confidence and decreased difficulty relative to the Static Images (Figures 1a and 3a). By contrast, low NFT individuals experienced negative effects of the Music condition, and positive effects of the Natural Audio condition.

Observing the objective/neutral dependent variable, *Discrimination of Knives* (Figure 4a), a contrasting pattern emerged. As shown in Table 8, the High NFT group exhibited a significant ($p < .001$) increase in the perceived weight difference when given the Natural Audio condition, while a significant decrease was seen when given the Music condition. In comparison, the low NFT group exhibited a slight nonsignificant gradual increase as more sensory modalities were involved.

Furthermore, in the Static Images condition, high NFT generally showed lower confidence and/or higher experienced difficulty in product evaluations compared to their low NFT counterparts (Figures 1b, 2b, 3a, and b).

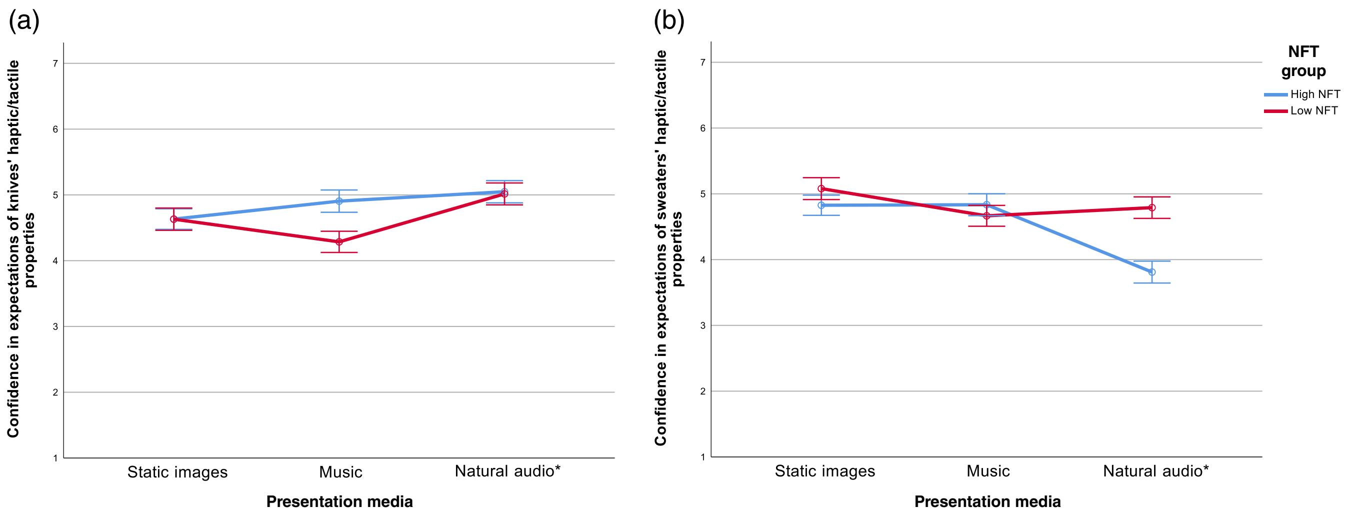

FIGURE 1 Confidence in expectations of knives' (a) and sweaters' (b) haptic/tactile properties—estimated marginal means. Error bars represent ±1 SE. Asterisk (*) denotes a statistically significant ($p < .05$) difference in overall means

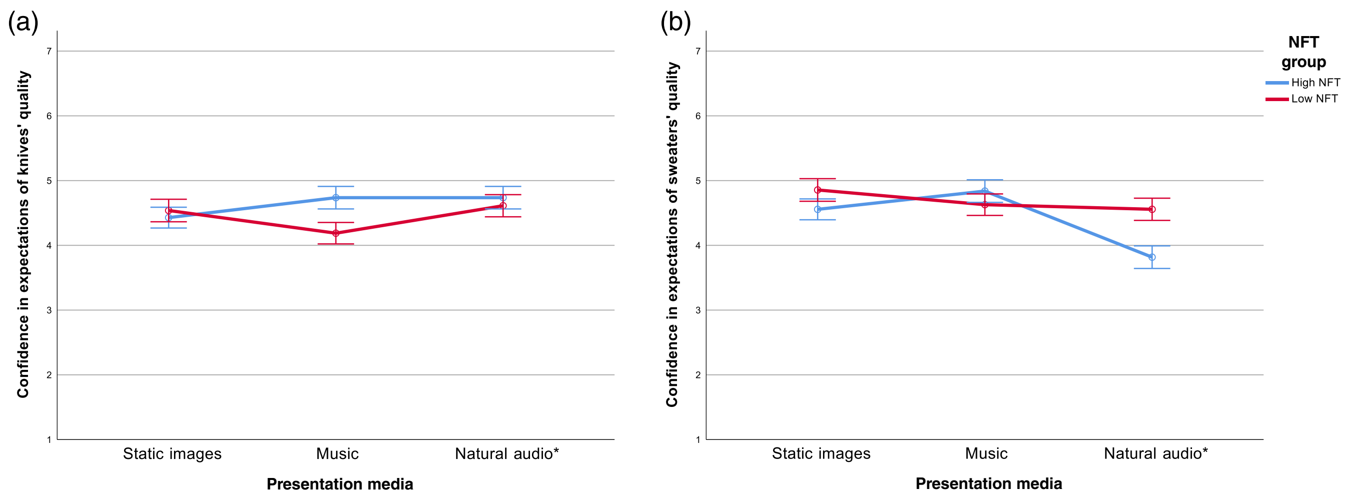

FIGURE 2 Confidence in expectations of knives' (a) and sweaters' (b) quality—estimated marginal means. Error bars represent ±1 SE. Asterisk (*) denotes a statistically significant ($p < .05$) difference in overall means

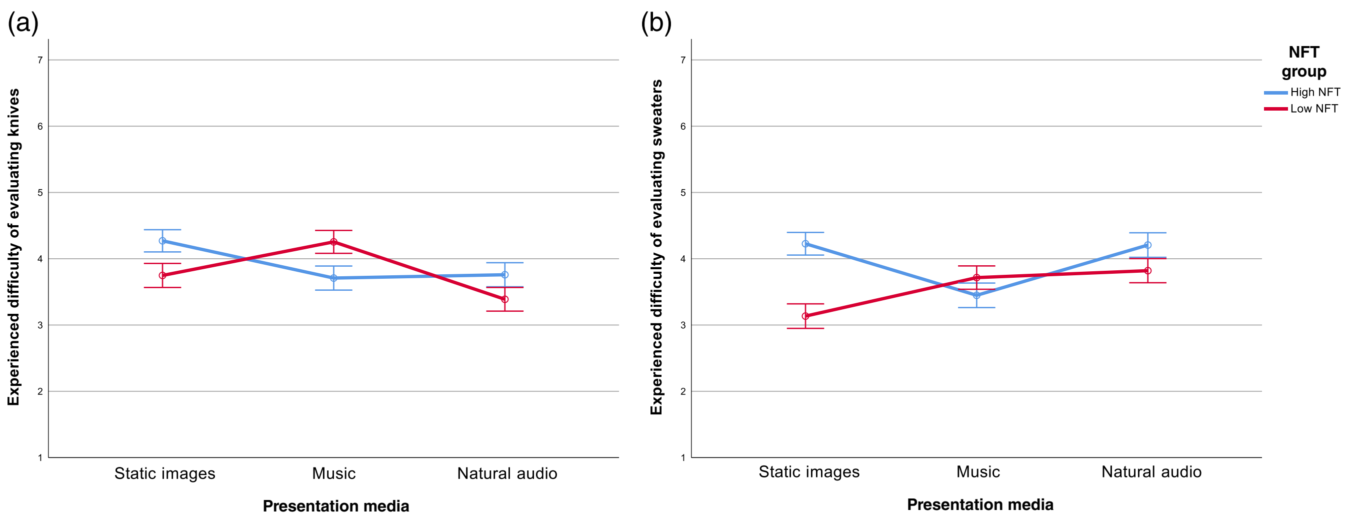

FIGURE 3 Experienced difficulty of evaluating knives (a) and sweaters (b)—estimated marginal means. Error bars represent ±1 SE. Asterisk (*) denotes a statistically significant ($p < .05$) difference in overall means

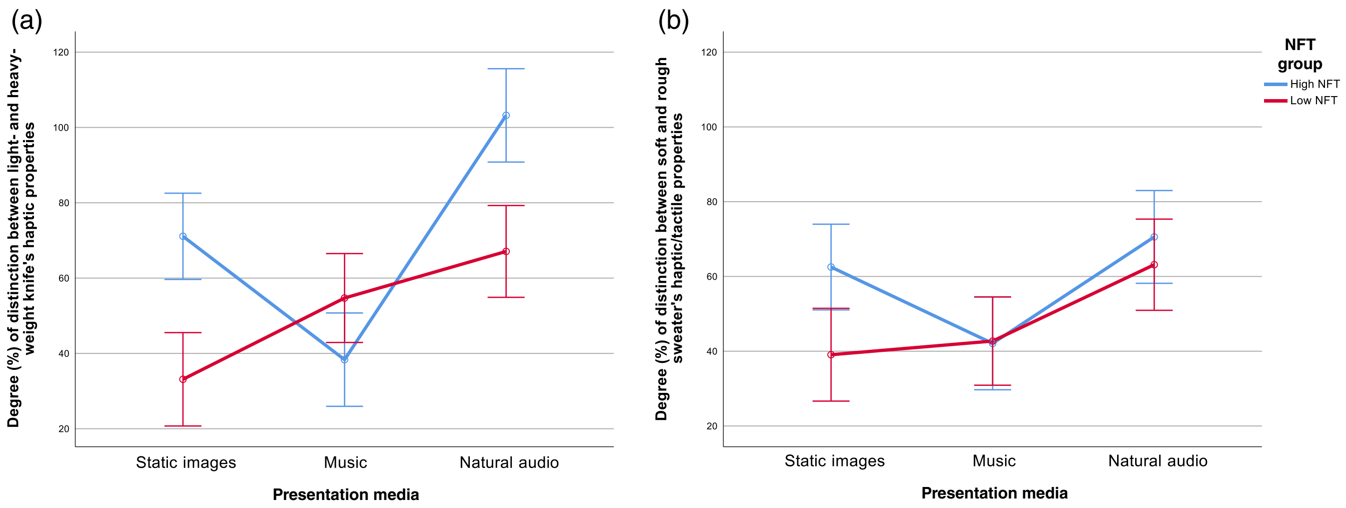

FIGURE 4 Degree (%) of discrimination between knives' (a) and sweaters' (b) haptic/tactile properties—estimated marginal means. Error bars represent ±1 SE. Asterisk (*) denotes a statistically significant (p < .05) difference in overall means

TABLE 8 Overall estimated marginal means and standard deviations by NFT level

		Low NFT			High NFT		
		Static Mean (*SD*)	Music Mean (*SD*)	Natural Mean (*SD*)	Static images Mean (*SD*)	Music Mean (*SD*)	Natural audio Mean (*SD*)
Knives	Confidence, haptic properties	4.6^{a,b} *(1.3)*	4.3^{b,**} *(1.4)*	5.0^{a} *(1.2)*	4.6 *(1.4)*	4.9 *(1.5)*	5.0 *(0.8)*
	Confidence, quality	4.5 *(1. 2)*	4.2 *(1.4)*	4.6 *(1.3)*	4.4 *(1.5)*	4.7 *(1.3)*	4.7 *(0.9)*
	Difficulty evaluating	3.7^{a,b} *(1.4)*	4.3^{a,**} *(1.5)*	3.4^{b} *(1.3)*	4.3 *(1.5)*	3.7 *(1.3)*	3.8 *(1.1)*
	Degree of discrimination	33.1 *(39.7)*	54.7 *(82.7)*	67.1 *(65.5)*	71.1^{a,b} *(63.1)*	38.3^{b,***} *(38.7)*	103.2^{a} *(91.5)*
Sweaters	Confidence, haptic properties	5.1 *(1.1)*	4.7 *(1.3)*	4.8 *(1.3)*	4.8^{a} *(1.2)*	4.8^{a} *(1.1)*	3.8^{b,***} *(1.2)*
	Confidence, quality	4.9 *(1.3)*	4.6 *(1.3)*	4.6 *(1. 1)*	4.6^{a,*} *(1.5)*	4.8^{a,***} *(1.5)*	3.8^{b} *(1.1)*
	Difficulty evaluating	3.1^{b,*} *(1.5)*	3.7^{a,b} *(1.5)*	3.8^{a} *(1.3)*	4.2^{a} *(1.2)*	3.4^{b,**} *(1.5)*	4.2^{a,**} *(1.3)*
	Degree of discrimination	39.1 *(73.9)*	42.7 *(62.6)*	63.1 *(83.3)*	62.5 *(65.3)*	42.1 *(43.9)*	70.6 *(65.3)*

Note: In each row, means that do not share superscript letters are statistically significant (Tukey p < .05). The level of significance for the pairwise comparisons is also indicated (*p < .05, **p < .01, ***p < .001).

4 | DISCUSSION

This study evaluated the effect of including congruent auditory and visual haptic information in online product presentation videos, as a UX-design approach to compensate for the lack of touch. Two hypotheses were specifically considered. The first was that the user experience of evaluating haptic properties in an online setting would be improved by adding auditory haptic information congruent with visual haptic information (H1). The second hypothesis was that the effect would be moderated by consumers' NFT, and specifically that addition of congruent auditory and visual haptic information would produce a larger effect on high (vs. low) NFT consumers (H2).

The two hypotheses were quantitatively tested through a randomized, between-subjects online experiment, measuring the effect on participants' experience of evaluating products' haptic properties when manipulating the sensory modalities engaged in the presentation of the product. The construct of user experience associated with product evaluation was decomposed into measures of positive (confidence), negative (difficulty), and objective (perception) dimensions.

Overall, the results show that auditory haptic information congruent with visual haptic information can improve the user experience of both high- and low NFT consumers in an online shopping context, supporting H1. However, the effectiveness of this UX-design approach seems to be dependent on the product characteristics, in particular the salience of the instrumental (vs. autotelic) dimension of touch.

In the Knife Category, salient in instrumental touch, all three dimensions were convergently affected, and the effect directions clearly indicated an improvement of the user experience (Figures 1–3) consistent with the prediction of H1. In contrast, in the sweaters category, salient in autotelic touch, only one dimension (confidence) of the user experience was affected by presentation media as a main effect (Table 6). This indicates some effect on the autotelic-salient product category as well, stemming from the natural audio, but not on the user experience as a multidimensional construct.

The premises and results concerning H1 are consistent with a study by Flavián et al. (2017), in which they observed an effect size (Cohen's *d*) of .526 in terms of *Ease of imagining the product* when comparing conditions where products were presented with a static image + objective product presentation text versus presented through a demonstration product presentation video (somewhat similar to a touch surrogate video). Earlier findings by Peck and Childers (2003b) also aligns with the observed significant role of product characteristics in terms of need for touch, as their study showed that product characteristics affect the consumer's motivation for obtaining haptic information.

One may assume that a main cause for the effects seen in the knives category of this experiment can be found in the sounds of the knives' impacts with the chopping board, for example, when being put down, due to variations in pitch depending on the weight and density of the different knives (Walker et al., 2017). The current body of literature regarding cross-modal correspondence does not provide any empirical evidence of correspondence between tactile sensations of softness and auditory cues, whereas correspondence between weight and auditory pitch has been documented, as described in the theoretical section of this paper. Perhaps a product's softness cannot easily be communicated through sound—a partial explanation could also relate to consumers' processing fluency. The usefulness of congruent sounds in an online shopping scenario might depend on the extent to which the consumer is actually able to make use of the sounds they hear. Consumers might not be familiar with the close-up sounds of sweaters as compared to the close-up sounds of interactions with kitchen knives, which might explain the product category-moderated effectiveness of congruent auditory haptic information and visual haptic information we observed in the present study. Nonetheless, this experiment adds to the body of literature on multimodal mental imagery (Nanay, 2018) with a commercial outlook as well.

The significant interaction effect between *Presentation Media* and *NFT* supports H2, although a divergence was seen between the subjective (positive and negative) and objective (perception) measures. The results suggest that, compared to low NFT consumers, high NFT consumers' objective perception of products' haptic properties is highly sensitive to information presented in visual and auditory modalities, whereas low NFT consumers' objective perception is only marginally affected. In comparison, the results suggest that the type of audio (music vs. auditory haptic information) in touch surrogate videos significantly affects low NFT consumers' subjective product evaluation experience in respectively a negative or positive direction compared to static images, whereas high NFT consumers' subjective experience of the two types of touch surrogate videos (with/without natural audio) is equally better than static images alone.

This study contributes to recent findings demonstrating the positive effect of touch surrogate videos for high NFT consumers in online shopping (Kühn et al., 2020) by showcasing that including congruent auditory haptic information in such videos can additionally improve the experience for said consumer segment, without negatively influencing their low NFT counterparts' experience.

Earlier studies have too described differences in high and low NFT consumers response to changes in sensory stimuli in the context of product evaluation. Peck and Childers (2003b) measured the effect of low- and high NFT respondents' confidence in evaluating products (without touching) in a 2×2 factorial design haptic textual information versus non-haptic textual information and picture versus no picture. In that study, low-NFT respondents' self-reported confidence significantly increased (by $\sim$180%) when presented with a picture accompanying the textual description. In comparison, high NFT respondents' confidence also increased, but not to a statistically significant extent.

4.1 | Managerial implications

The study shows that, depending on the type of product, congruent auditory and visual haptic information have the potential to improve the observer's perception and evaluation of products' haptic properties. Thus, congruent auditory–visual haptic information might be an effective UX-design approach to better accommodate high NFT consumers in e-commerce, possibly limited to product categories salient in instrumental touch. Congruent auditory–visual haptic information could easily be integrated into online stores in the shape of online touch surrogate videos with natural audio. It is not uncommon for online stores to have videos along with product images, so including an online touch surrogate video with natural audio on a website would not be technically difficult, nor would it be unfamiliar to the customer.

Given the fact that the results are product category-specific, online retailers might be able to selectively apply this UX-design approach on specific product categories, allowing the retailer to focus these marketing efforts only where it is actually needed and where it is significantly effective.

This way, the retailer could both improve the user experience associated with problematic product categories (for high NFT consumers in particular) while avoiding excess processing (one of the eight types of waste associated with LEAN principles (Ohno, 1988) of nonproblematic product categories, and/or product categories where congruent auditory–visual haptic information is simply not effective with regards to conveying haptic information.

4.2 | Limitations and further research

Grouping respondents by high- and low NFT was done by doing a median split. In this study, the median had a value of 10 similar to other NFT-related studies (known median values: 9, 11.5). Although median splits are common practice in previous NFT-related studies (Ha, 2019; Kühn et al., 2020; Peck & Childers, 2003a, p. 435, 2003b; Yazdanparast & Spears, 2012, p. 418), it implies that high or low NFT will be dependent on the specific sample of respondents, not an agreed-upon or well-defined mid-level point from a normative sample. Moreover, respondents on each side of, but very close to, the median will be in each their "extreme" category (i.e., high and low), while in fact their NFT score may only differ very little in absolute sense. Future studies with larger sample sizes could therefore consider dividing respondents into three equal groups; low, mid, and high NFT—leaving out the middle group to better compare low and high NFT.

Participants in our study were predominantly young (in all three conditions, ≥61% of participants was aged 18–30) and male (≥64%). Although the literature does not generally support a systematic effect of gender and age on NFT and online shopping behavior (e.g., Cho & Workman, 2011; Hernández, Jiménez, & Martín, 2011), future studies are still advised explore the effects of the proposed strategies in other demographics, in particular in older age groups because, as mentioned in the introduction, age is significant factor with respect to online purchase frequency. Additionally, all consumers came from one country (Denmark). There are well known structural differences among countries with respect to technological readiness, popularity of e-commerce, cash circulation, etc. (Babin, Feng, & Borges, 2021; Pantano, Pizzi, Scarpi, & Dennis, 2020). As such differences determine the prevalence of online versus physical retailing in a particular country, it is likely that consumers in different countries will respond differently to the same UX strategies. Therefore, cross-cultural extension of the present work is a relevant direction for future research.

Likewise, the experiment covered a rather limited range of products, and we found differences between the two product categories. Therefore, future studies on additional product categories should confirm whether the results extend beyond the specific product types (knives vs. sweaters), to the dimensions of touch (instrumental vs. autotelic), or the specific products used (the variants of knives and sweaters). Moreover, the screening criteria for product categories should take into account not only the salience of haptic properties, but also the salience of auditory properties as a diagnostic cue. In our study, we did not conduct a pretest of the sounds to see if people associate it with the focal tactile attributes (light/heavy and soft/hard). Finally, when including product categories such as apparel, the screening process should also take into account whether the specific items of clothing could elicit a gender bias, hence introducing a confound.

Having only the given three conditions might pose limitations as well. It would be beneficial to include a condition in which the presentation media comprise touch surrogate videos with no auditory stimuli at all. This would allow for observing the pure effect of static images versus moving images, as well as comparing muted moving images to respectively videos with arbitrary auditory stimuli (music) and videos with congruent auditory stimuli (natural audio).

5 | CONCLUSION

Online shopping is on the rise, especially during the COVID-19 pandemic. Although the world of e-commerce provides consumers access to a plethora of physical products, consumers with high need for touch may be challenged in a crucial step of the buying process, namely when evaluating products and product alternatives. Based on existing UX-design approaches and auditory–visual cross-modal correspondence, this paper has hypothesized that the presence of natural audio in online touch surrogate videos can facilitate online customers' ability to imagine how it would feel to touch the product themselves.

In an online experiment, we found statistically significant effects of auditory haptic information congruent with visual haptic information (in the form of touch surrogate videos) on the participants' perception of, and user experience associated with evaluating, consumer products' haptic properties (weight and softness). Significant interaction effects associated with the product category and participants' level of NFT were also identified. Specifically, the presence of natural auditory haptic information improved the user experience of high NFT consumers in one product category (kitchen knives), but not the other (sweaters).

Overall, the present study demonstrates that auditory haptic information congruent with visual haptic information can improve the user experience of high NFT consumers in an online shopping context but that the effectiveness of this UX-design approach may be dependent on the product characteristics, in particular the salience of the instrumental (vs. autotelic) dimension of touch. The results present fertile soil for further research on the effects of congruent auditory and visual haptic product information in the context of UX design and accommodating high NFT consumers in e-commerce.

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CONFLICT OF INTEREST

No conflict of interest has been declared by the authors.

DATA AVAILABILITY STATEMENT

All raw data associated with this paper can be accessed at Mendeley Data through this link https://data.mendeley.com/datasets/dpwj2bywgz/draft.

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