
**The Role of Need for Touch in Online Shopping Cart
Abandonment: A Mediation Analysis with Product Uncertainty**

Inês Cristina Gonçalves Carneiro Costa

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Supervised by

Sandrina Teixeira

José Moreira

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Abstract

Online shopping cart abandonment (OSCA) is a significant issue for e-commerce retailers, with 2023 reaching the highest rate of cart abandonment since 2013. The main purpose of the present investigation was to contribute to the OSCA body of literature by exploring the influence of consumers' Need for touch (NFT) on the OSCA phenomenon. The model was enriched through the analysis of consumers' perceptions of product uncertainty, reassessing the role of this construct as a mediating variable in the OSCA outcome, within a different cultural background.

An online questionnaire was distributed, resulting in 214 responses from Portuguese consumers with online shopping experience. Given the proposed mediation model, data was analyzed using Hayes mediation model, through PROCESS macro tool for SPSS.

Results indicated that both the autotelic and instrumental NFT dimensions significantly predict higher levels of online shopping cart abandonment, suggesting that this individual feature could be identified as a precursor to online shopping cart abandonment, even in the absence of any mediating factors. Contrary to the hypotheses developed, the mediating effect of product uncertainty in the NFT – OSCA relationship was not supported, suggesting that while tactile needs influence shopping behavior, the impact of uncertainty on cart abandonment may be less pronounced than previously thought.

Findings contribute to the theoretical understanding of consumer behaviour, particularly by emphasizing the direct role of sensory experiences in online shopping outcomes. Practically, results suggest that online retailers should focus on improving sensory involvement for both autotelic and instrumental NFT consumers by integrating immersive technologies, as they could potentially enhance the shopping experience, address the needs of tactile-oriented consumers and reduce cart abandonment. Additionally, retailers should implement culturally sensitive strategies tailored to different regional markets, recognizing variations in uncertainty tolerance and shopping motivations across cultural contexts.

Keywords: Haptic Information, Need for Touch, Online Shopping Cart Abandonment, Product Uncertainty

Resumo

O abandono do carrinho de compras online (OSCA) surge como um problema significativo para os retalhistas em contexto online, tendo este abandono alcançado em 2023 a taxa mais alta desde 2013. A presente investigação teve como principal objetivo enriquecer a literatura existente sobre o abandono do carrinho de compras online, explorando a influência da Necessidade de Toque (NFT) dos consumidores neste fenómeno. O modelo incluiu ainda a análise das perceções de incerteza por parte dos consumidores relativamente aos produtos, reavaliando o papel desta variável como mediadora na análise do abandono do carrinho de compras online, num contexto cultural diferente dos anteriormente explorados.

A recolha de dados contou com a distribuição de um questionário online, que resultou em 214 respostas de consumidores portugueses e com experiência em compras online. Dado o modelo de mediação proposto, a amostra foi analisada utilizando o modelo de mediação de Hayes, através da ferramenta PROCESS para SPSS.

Os resultados indicam que ambas as dimensões da Necessidade de Toque, autotélica e instrumental, preveem significativamente níveis mais altos de abandono do carrinho de compras online, sugerindo que esta característica individual pode ser identificada como um precursor do abandono de carrinho online, mesmo na ausência de quaisquer variáveis mediadoras. Contrariamente às hipóteses desenvolvidas, o efeito mediador da incerteza do produto na relação NFT – OSCA não foi suportado, sugerindo que, embora as necessidades tácteis influenciem o comportamento de compra, o impacto da incerteza no abandono de carrinho pode ser menos pronunciado do que anteriormente considerado.

Os resultados contribuem para a compreensão teórica do comportamento do consumidor, enfatizando o papel direto das experiências sensoriais nas compras online. Do ponto de vista prático, os resultados sugerem que os retalhistas devem concentrar-se em melhorar o envolvimento sensorial tanto para consumidores com maior Necessidade de Toque autotélica como instrumental, integrando tecnologias imersivas que poderão melhorar a experiência de compra, atender às necessidades de consumidores orientados para o toque e reduzir o abandono de carrinho. Poderão, ainda, ser implementadas estratégias culturalmente adaptadas a diferentes mercados regionais, reconhecendo variações na tolerância à incerteza e nas motivações de compra em diferentes contextos culturais.

Palavras-Chave: Informação Háptica; Necessidade de Toque; Abandono de Carrinho de Compras Online; Incerteza relativamente ao produto

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List of Acronyms and Abbreviations

A_NFT	Autotelic Need for Touch
AR	Artificial Reality
I_NFT	Instrumental Need for Touch
OSCA	Online Shopping Cart Abandonment
PU	Product Uncertainty
VR	Virtual Reality

1. Introduction

Online shopping cart abandonment (OSCA) is among the concerns faced by e-commerce retailers and that arises from the virtual shopping experience (Wang et al., 2023). In 2023, approximately 70% of the online shopping carts around the world were left behind before completion of the checkout process, with online cart abandonment reaching a new high since 2013 (Statista, 2024). The Portuguese panorama is not different, with approximately 83.2% of the shopping carts being abandoned after items have been added to them (ECDB, 2024), turning Portugal into one of the European countries with the highest cart abandonment rates in 2023. Such evidence highlights the persistent barrier presented by the phenomenon when it comes to both national and international retailers, resulting in major consequences that involve disrupted channels and inventories (Wang et al., 2023).

Online shopping cart abandonment has been described over the years, in numerous ways, by various authors (e.g., Huang et al., 2019; Kukar-Kinney & Close, 2010; Song, 2019; Tang & Lin, 2019), in consequence of the attention it has gathered from the business sector and scholars (Wang et al., 2023). This study adopts Kukar-Kinney et al. (2022)'s definition, which describes OSCA as the customer's choice not to acquire the items disposed in the virtual cart by abandoning the online buying session.

Literature has so far recognized consumer motives for cart usage (Kukar-Kinney et al., 2022; Kukar-Kinney & Close, 2010), technology features (Kapoor & Vij, 2021), past experiences and other personal considerations (Cho, 2004), external factors including price and time (Cho, 2004; Kukar-Kinney et al., 2022; Kukar-Kinney & Close, 2010), risk perceptions and doubtness regarding the transactions (Cho, 2004; Huang et al., 2018; Kapoor & Vij, 2021; Rodrigues et al., 2022) to influence the probability of abandonment of the online cart. However, as the field is still considered relatively unknown, a deeper understanding of OSCA is required, providing valuable insights into the underlying motives and potential approaches (Wang et al., 2023). Future research is recommended to focus on the analysis of unexplored drivers of OSCA, to diversify the set of theories applied to comprehend it, and to expand the contexts in which OSCA-based research takes place, addressing the knowledge void concerning OSCA among consumers in different nations (Wang et al., 2023).

As evidenced by Wang et al. (2023), the effect of personal factors still has the potential to be addressed in future literature regarding shopping behaviours. A significant

suggestion falls on the concept of Need for Touch (NFT) which has been addressed both in the offline (e.g. De Canio & Fuentes-Blasco, 2021; Peck & Childers, 2003b; Peck & Johnson, 2011; Peck & Wiggins, 2006) and the online (e.g. Duarte & e Silva, 2020; González-Benito et al., 2015; Hermes et al., 2022; Kühn et al., 2020; Rathee & Rajain, 2019; Silva et al., 2021) contexts.

Expressing a preference for the collection of tactile information (Peck & Childers, 2003b, 2003a), NFT and its related dimensions are consistently found in the literature as factors able to impact consumer's affective and cognitive reactions towards the products. While NFT's influence has been explored regarding consumer's attitudes towards the merchandise (Pino et al., 2020), online shopping behaviours such as webrooming and showrooming (Rathee and Rajain, 2019), willingness to purchase (Hermes at al., 2022) or online purchase propensity (Duarte & Costa e Silva, 2020), the NFT construct has yet to be examined in its relationship with the OSCA phenomenon (Wang et al., 2023).

In online environments, lacking the availability of physical touch, NFT is described to diminish the appeal of online platforms for certain consumers (De Canio & Fuentes-Blasco, 2021; Kühn et al., 2020), essentially for those who rely on haptic information to mitigate uncertainty (Grohmann et al., 2007). Existing e-commerce literature (Dimoka et al., 2012; Hong & Pavlou, 2014; Kim & Krishnan, 2015; Pavlou et al., 2007) has highlighted uncertainty as a factor disrupting buying decisions, with uncertainty constructs having also been explored when analysing OSCA (Huang et al., 2018; Wang et al., 2022).

Tang and Lin (2019) focus on the impact of consumer's uncertain expectations regarding the products through the product uncertainty variable. They find product uncertainty to partially contribute to OSCA, pointing out communication capacities as a solution for this type of uncertainty among consumers. However, the single cultural context in which the study takes place highlights the importance of expanding uncertainty investigation to other cultures (Tang & Lin, 2019). This holds particular significance when considering that existing literature has provided evidence suggesting that a distinguishing cultural dimension is the degree to which individuals in a certain country tolerate situations of uncertainty, ambiguity, or unstructured circumstances (Hofstede, 1993). Liu et al. (2023), for example, analyse the effect of touch on consumers' attitudes toward the products while considering cultural differences in uncertainty acceptance.

Additionally, comfort in managing uncertainty at the product level in online contexts, has been suggested by the current shopping patterns (Kim & Krishnan, 2015). Findings regarding product uncertainty assume an interesting value when confronted with consumer's decisions regarding online shopping and the product categories acquired (Kim & Krishnan, 2015). This, associated to the necessary reliance on technological transactions brought by the COVID-19 pandemic (Wang et al., 2023), justifies the interest to reevaluate the magnitude of uncertainty perceptions and their influence on the abandonment of the cart, while understanding to what extent such a post-pandemic technological dependence could be explored by retailers and marketers (Wang et al., 2023).

Recognizing the interest in examining the effect of a personality trait as NFT in the OSCA phenomenon (Hermes et al., 2022; Tang & Lin, 2019) and of reassessing product uncertainty as a mediator of OSCA in a different cultural background (Tang & Lin, 2019), the present investigation intends to contribute to the OSCA literature by exploring the link between the consumers' innate NFT, consumers' perceptions of product uncertainty, and the abandonment of the online cart.

For the purpose at hand, this investigation intends to answer to the following research questions (RQ):

RQ1: How does NFT impact OSCA?

RQ2: How does the mediating role of product uncertainty alter the relationship between NFT and OSCA relationship?

The structure of this dissertation is outlined as follows. In the following section, the literature review regarding the analysed constructs is provided, encompassing the relationship between NFT and OSCA, impacted by product uncertainty mediation. The main hypotheses of the study are delivered in accordance with the theoretical background explored. Section 3 provides an overview of the methodology employed, followed by the analysis of the respective results in Section 4. A general discussion of the findings can be found in Section 5, with Section 6 emphasizing the main theoretical and practical implications inferred from the results. Lastly, Section 7 provides the primary conclusions obtained from the conducted investigation.

2. Literature Review and Hypotheses Development

2.1. Touch and Consumer's Product Perceptions

Haptics has been described as the quest for information through tactile sensations, process in which the hands play a primary role (Peck & Childers, 2003b). Although object assessments might be built through a combination of senses' perceptions, with an emphasis on touch and vision, material characteristics are better evaluated through tangible experiences (McCabe & Nowlis, 2003). Therefore, in the presence of products with significant material properties such as hardness or weight (Peck & Childers, 2003b, 2003a), touch inputs assume an important diagnostic function, determining relevant cues regarding product performance (Grohmann et al., 2007) and serving as an auxiliary of the decision-making task (McCabe & Nowlis, 2003).

Peck and Childers (2003b) argue that product evaluation is in general conducted with more confidence and lower frustration levels when an opportunity to touch the objects is offered. Further, engaging in tactile contact has been confirmed to be a persuasive act, since being able to touch pleasurable-feeling objects induces positive affective responses toward the products (Peck & Shu, 2009). This result is also valid for messages, in the cases where touch elements are incorporated into requests and even when no product material features are communicated (Peck & Wiggins, 2006). Previous studies have also found touch to spur purchasing impulsiveness (Peck & Childers, 2006) and produce feelings of perceived ownership over a product, increasing their valuation and consumers' willingness to pay (Luangrath et al., 2022; Peck & Shu, 2009).

Notwithstanding the positive responses mentioned above, an extension of the research flow regarding haptics in product evaluation identifies situations in which the effect of touch is neutral or even negative (Liu et al., 2023b). Marlow and Jansson-Boyd (2011) report that when the assessed products are those usually handled for short periods of time, the role of visual cues is more significant than the role of haptic inputs. Further, products with noticeable geometric characteristics – and thus less touch diagnostic - might be less prone to be chosen (McCabe & Nowlis, 2003) and to benefit from accessible touch during evaluation (Grohmann et al., 2007). Findings also suggest that, when presented with more extensive choice options, buyers might experience lower levels of confidence and perceived possession from physically touching the objects (Liu et al., 2023a).

Acknowledging these ambiguous results, Liu et al. (2023b) add to the study of touch and consumer's product perceptions by examining the role of utilitarian and hedonic products. Delving deeper into the literature's inconsistent inferences, an individual trait – uncertainty avoidance tendency – and a situational circumstance – physical vs imagining touch – are also introduced as moderators. Results for the effect of touch on consumers attitudes were found to be generally positive (Liu et al., 2023b).

Liu et al. (2023b)'s model follows Peck and Childers' (2003b) Haptic Information Framework, that proposes product categories, situational contexts and consumer level traits to influence the necessity to explore tactile information, putting in evidence the importance of this types of constructs in the study of the touch effect on consumers' responses and product perceptions.

2.2. Consumer's Need for Touch

Once more referring to Peck and Childers (2003b)' Haptic Information Framework, the NFT concept is presented as an individual trait that assimilates the different preferences when gathering tactile information. The construct indicates that for buyers ranking higher in their NFT levels, haptic information is first considered (Peck and Childers, 2002) during the acts of detail acquisition, assessment and selection of the products (Duarte & Costa e Silva, 2020).

Some variables seem to explain the differences among people and their NFT levels. On the one hand, Rathee and Rajain (2019)'s study points out gender to interfere in consumer's disposition to use the sense of touch, as it is found that women exhibit higher levels of NFT. On the other hand, Duarte and Silva (2020) find Chinese consumers present higher NFT levels than the Portuguese consumers, uncovering that cultural background might also have a say in the preference for collecting product information and make purchase decisions.

Delving into the dimensions of the conceptualized term, differences are established between instrumental and autotelic NFT (Peck & Childers, 2003a). The autotelic level points to the motivation for touch being related to an amusement, pleasure and stimulation of the senses search (Peck & Childers, 2003a). On the other hand, the instrumental feature of NFT indicates a more aim-oriented experience, in which touch assumes a diagnostic function of the attributes or worth of the products, also ensuring certainty in the judgments made (Peck & Childers, 2003a).

The distinction between the two NFT dimensions, has given rise to different results in the literature. Peck and Childers (2006) find evidence that impulse purchasing acts are connected to the autotelic dimension, as these unplanned behaviours represent a lack of purchase aim and are linked to a more hedonic experience. It follows that these buyers are more prone to be persuaded by hedonic touch cues (Peck & Wiggins, 2006). On a different note, De Canio and Fuentes-Blasco (2021) explore the relationship between consumers' haptic characteristics and shopping motivations throughout channels, finding that the instrumental trait has a negative influence when online channels are observed, since it is the hedonic value that seems to drive purchases in the virtual environment. Such findings are consistent with evidence presented by Hermes et al. (2022), in which the pragmatic aspect of NFT exerted a negative influence on willingness to purchase online. However, the autotelic level was found not to be significant.

In general, research has supported the importance of the NFT trait in influencing the motivation to explore certain products through touch. Affective and cognitive responses, depending on the product category, vary according to the degree of this consumer level trait and might explain channel choice (De Canio & Fuentes-Blasco 2021, Manzano et al., 2016), lower online buying frequency (Rodrigues et al., 2016) and lower willingness to pay in online environments among certain consumers (Kühn et al., 2020).

2.3. Consumer's Product Uncertainty

As conceptualized by Dimoka et al. (2012), consumers' perceptions of product uncertainty, that for the sake of simplicity will be referred to as "product uncertainty", represents the challenge, faced by the consumer, to assess the features of the merchandise and predict its performance. It is depicted as a two-element concept, encompassing description uncertainty and performance uncertainty. The first refers to the inability of the retailer to communicate the product's conditions, while the latter relates to the seller's unawareness of those conditions.

Based on the previous authors, Hong and Pavlou (2014) suggest the distinction of two other dimensions for product uncertainty. One is the objective nature of the consumer's uncertainty, related to the exact quality of the merchandise – product quality uncertainty. The other encompasses the subjective aspect of uncertainty, linked to the consumers' individual preferences and the capacity of the products to match them – product fit uncertainty. Considering the proposed relationship between touch and product uncertainty in analysis,

Hong and Pavlou (2014)'s dimensions of the product uncertainty construct will be the ones considered from hereafter, as it considers not only the objective (Dimoka et al., 2012) but also the subjective (Kim & Krishnan, 2015; Pavlou et al., 2007) dimensions of consumer's perceptions.

Hong and Pavlou (2014) understand product uncertainty to be a challenge experienced across both offline and online markets. However, the physical separation between buyers, sellers and products, inherent to online shopping scenarios is responsible for informational asymmetries that are recognized by the consumer. These are not only prevented from partaking in the pleasure-oriented dimension of the tactile experience, but also from evaluating the products' features and functionality (Ruusunen et al., 2023). Such informational losses contribute to the informational asymmetries driving uncertainty perceptions, which are therefore intensified in the online context (Hong and Pavlou, 2014). While some other forms of accessible information, as is the case of product reviews, seem to help mitigate online information asymmetry concerns for some types of items, the same may not be true for other product categories and might depend on the consumers' personal characteristics (Nugroho & Wang, 2023).

2.4. Consumer's NFT and Product Uncertainty Perceptions

Since online contexts do not allow the possibility to touch retail offerings, information available to the consumer about more diagnostic products becomes scarcer (Grohmann et al., 2007). The established relationship between haptic inputs and confidence in product evaluations (Peck and Childers, 2003b) is put at risk, and the capacity to differentiate among various quality levels becomes impaired (Grohmann et al., 2007).

Further, for high NFT consumers, confidence in product evaluations and quality judgement should become more compromised than for low NFT buyers, when direct touch is not available (Peck & Childers, 2003b). This is in line with Rathee and Rajain (2019)'s findings, that report these buyers tend to favour offline purchases, whereas individuals with low NFT are at ease with both the virtual and physical context. Additionally, Kühn et al. (2020) find high NFT buyers to present increased concerns about the quality of produce available online. Therefore, when considering the relationship between NFT and product uncertainty, it becomes apparent that individuals with higher NFT levels, who rely more on tactile information, might experience greater uncertainty in online environments, due to the lack of physical interaction with the products.

It is, however, necessary to open the possibility for the different effects of the NFT dimensions on consumers' uncertainty perceptions, given the distinct results found in the literature when considering the autotelic and instrumental features. This remark is in line with Ruusunen et al. (2023), that highlight the necessity to examine the role of these two dimensions in the future, often overlooked in favour of the analysis of NFT in general terms. Similarly, Jha et al. (2020) point out that to comprehend the effects of haptic information processing, it is essential to consider the instrumental and autotelic dimensions of NFT.

Starting with the autotelic feature, Jha et al. (2020) analyse the effect of autotelic NFT on consumer's responses toward a product, finding it to positively influence affective but not cognitive responses. If autotelic NFT has no influence on cognition and, consequently, on the judgements made by gathering haptic information, it is not expected that autotelic consumers will have their uncertainties heightened at the product level in a no-touch scenario. We could be inclined to assume a non-significant link between both constructs. However, pursuing the objective of considering both NFT dimensions as individual constructs given their potential importance for haptic information analysis, further considerations must be pondered.

Autotelic NFT and its link with the overall positive feelings toward a product is implicit in other results found in the literature. Impulsive buying, for example and as mentioned, is positively related with this dimension (Peck & Childers, 2006), even when online channels are considered (De Canio & Fuentes-Blasco, 2021). This is in line with the description of autotelic NFT as an unplanned, experience-driven reason for the touch behaviour (Peck & Childers, 2003a). It might be, therefore, reasonable to consider that this could mean a capacity to forgo uncertainties regarding product features and quality in favour of spontaneity. In this case, higher autotelic NFT buyers would experience lower perceptions of uncertainty, as their preference for touch driven by impulsiveness could surpass the uncertainties generated by the impossibility to gather tactile information for assessment reasons. For hypothesis construct purposes, it is therefore considered that:

H1: Autotelic NFT is negatively associated with consumer's product uncertainty perceptions.

As for Instrumental NFT buyers, they present an oriented goal when engaging in the act of touching the merchandise, which is to formulate a confident evaluation of the products

quality and performance. Considering the utilitarian and reflective nature of the instrumental feature, it is logical to argue that it is connected to the consumers' cognitive responses toward the act of buying. For instance, Jha et al. (2020) discover that the instrumental feature, but not the autotelic dimension, enhances cognitive responses toward a product in a tactile environment.

It follows that cognition refers to the process by which consumers form judgments about a product's perceived qualities, drawing on the sensory information they experience Jha et al. (2020). Moreover, consumers exhibiting a high instrumental trait tend to feel more assured in their product evaluations in touch-based environments, as they can access the products attributes to form such judgements (Peck and Childers 2003b; San-Martín et al., 2017). Conversely, it would make sense to assume that under a no touch environment, instrumental NFT consumers will have a greater difficulty in forming confident judgements of the products objective (Dimoka et al., 2012) and subjective (Hong & Pavlou, 2014; Kim & Krishnan, 2015; Pavlou et al., 2007) quality and future performance (Grohmann et al., 2007), experiencing higher uncertainty perceptions than their lower instrumental counterparts, not as dependent on haptic information.

Therefore, it is proposed that:

H2: Instrumental NFT is positively associated with consumer's product uncertainty perceptions.

2.5. Online Shopping Cart Abandonment and Product Uncertainty

In a first approach, research has made efforts to gather the drivers of the online shopping cart abandonment phenomenon (Kukar-Kinney et al., 2022). Kukar-Kinney and Close (2010) indicate cart use purposes, such as the organizational, research and entertainment intents, to contribute to the abandonment of the cart. Behaviours related to these motivations, as the act of removing products from the virtual basket or engaging in an extensive search for product information, are later readdressed and concluded to have a positive association with cart abandonment (Kukar-Kinney et al., 2022; Xu and Huang, 2015).

Similarly, other authors have added to the field by examining OSCA related constructs. Examining the phenomenon in the scenario of mobile transactions, Huang et al.

(2018) find indecisiveness to result in consumer hesitation during the payment stage, consequently leading to mobile cart abandonment. These findings are in line with Peng and Chen (2021) that report ambivalence to guide consumers to abandon their online restaurant reservation, particularly when high risks are involved. Rodrigues et al. (2022) studies the effect of perceived risk on mobile transactions, finding a higher probability of shopping cart abandonment to arise from risks associated with the transaction and the consumed item.

Uncertainty constructs have also been featured in OSCA research. Hesitation at checkout (Wang et al., 2022; Huang et al., 2018) or the wait for lower prices (Kukar-Kinney et al., 2022; Wang et al., 2022) are examples of such variables. Observations point hesitation to have a negative influence on checkout intentions (Wang et al., 2022). Concerning the wait for lower prices, results demonstrate that the higher the probability that shoppers will hold out for a sale price, the more likely they are to leave their shopping carts without purchasing the items chosen. As mentioned, Tang and Lin (2019) add to the study of uncertainty regarding OSCA by focusing on the impact of consumer's uncertainty perceptions regarding the products on checkout actions. The respective product uncertainty construct, as conceptualized by Dimoka et al. (2012), is examined by the authors. In the study, the two aspects of product uncertainty – description and performance uncertainty - exhibit contrasting effects on the intention to checkout, which is impeded by performance uncertainty but remains unaffected by description uncertainty. However, it is recognized by the authors that the description uncertainty effect on OSCA may exist when used items or other non-standard merchandise are evaluated.

In general terms, literature has presented perceptions of uncertainty to have a negative influence on consumer's purchasing decisions. Pavlou et al. (2007) report consumer's product uncertainty to hinder their intentions of acquiring the products. Additionally, research reports product uncertainty to result in consequences regarding the fairness of the prices offered in online auctions, which might not reflect the merchandise's true quality (Dimoka et al., 2012). As for Hong and Pavlou (2014)'s study, it analyses product uncertainty and its influence on product returns, with general results demonstrating perceptions of uncertainty to be an obstacle for online markets. It is, therefore, reasonable to explore the possibility of a negative influence of consumer's uncertainty perceptions at a post-cart stage, as evidenced by Tang and Lin (2019), through OSCA.

According to Cho et al. (2006), purchases via virtual platforms seem to represent a risk, in the sense that their inherent deprivation of physical touch generates doubtful

prospects regarding product performance or expected fit and look – product uncertainty perceptions. These turn the outcome of the purchase into an unclear scenario (Lu & Chen, 2021) that could result in losses for the consumers (Tang & Lin, 2019). According to this, it is plausible to conjure that uncertainty perceptions toward the products may hinder consumers from completing their transactions. Such hesitation can occur even after consumers have placed items in their carts, following the search and selection process.

Through this, it is hypothesized that:

H3: Product uncertainty positively influences OSCA

3. Methodology

3.1. Research Model and Method of Analysis

The primary objectives of this investigation were to scrutinize the impact of the NFT's dimensions on OSCA, while assessing the product uncertainty mediating role in this relationship. Fig. 1 illustrates the proposed research model, built according to the hypothesized associations mentioned in the previous section. The NFT variable influences consumers' perceptions of product uncertainty, with its two dimensions proposed to impact the product uncertainty construct in opposite directions. Product uncertainty, in turn, plays a mediating role in the model, hypothesised to positively affect online shopping cart abandonment.

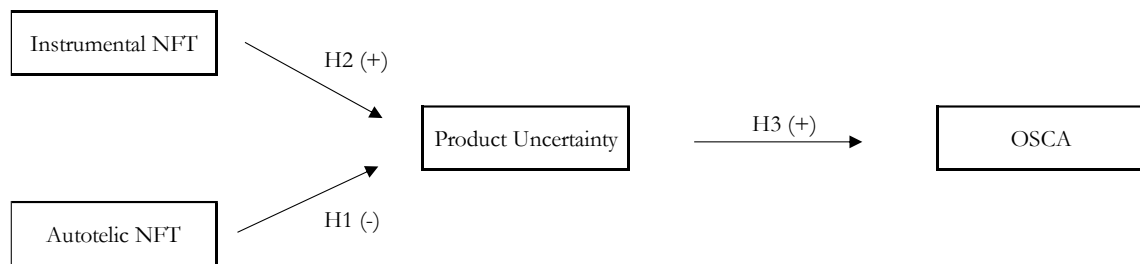


Figure 1 - Conceptual Research Model

The proposed connection between the independent variables (NFT dimensions) and the outcome (OSCA) was examined through regression analysis, employing the Ordinary Least Squares analytical tool. More specifically, and since a mediation relationship is introduced through the Product Uncertainty variable, a simple mediation analysis was conducted. It consists in a generally and frequently used mediation model which demonstrates how a variable's effect on an outcome can be divided into direct and indirect - mediated - effects between the antecedent and output, quantified using ordinary least squares (OLS) regression (Hayes, 2022). The conceptual model above identifies the mediated effect the literature has led us to consider.

It is important to notice that through Hayes mediation model, the conceptual model above is represented by the following equations:

$$3.1) PU = i_{PU} + a_1 A_NFT + e_{PU}$$

$$3.2) OSCA = i_{OSCA} + c'_1 A_NFT + b_1 PU + e_{OSCA}$$

And:

$$3.3) PU = i_{PU} + a_2 I_NFT + e_{PU}$$

$$3.4) OSCA = i_{OSCA} + c'_2 I_NFT + b_2 PU + e_{OSCA}$$

Where i_{PU} and i_{OSCA} are the constants of the regression and e_{PU} and e_{OSCA} are the errors in the Product Uncertainty (PU) and OSCA estimation. a_1 and a_2 are the coefficients of Autotelic NFT (A_NFT) and Instrumental NFT (I_NFT), while b_1 and b_2 correspond to the regression coefficients of PU given A_NFT and I_NFT, respectively. a_1 , a_2 , b_1 and b_2 coefficients are, therefore, representing the indirect path between the two NFT dimensions and OSCA, through product uncertainty mediation, which corresponds to the proposed relation derived from the literature and identified in the conceptual model.

As for c'_1 and c'_2 , they represent the direct path through which NFT might explain OSCA. While not considered in the conceptual model extracted from the literature, this direct effect is always automatically determined when using the simple mediation model tools. c' coefficients are used by the model to calculate the direct effect size between the antecedent and the outcome variable.

For the purpose of the present investigation, and using SPSS as the statistical software, the Hayes Process method for simple mediation was employed through the PROCESS macro tool (Hayes, 2022), considered appropriate due to its ability to analyse mediation models with varying levels of complexity (Hayes, 2022).

3.2. Research Data Collection and Measures

An online survey was chosen to collect the data required. The questionnaire focused on Portuguese individuals with experience in online shopping and was organized in different sections. A first part related to demographic measures, in order to profile the sample. Similar considerations have been present in prior studies investigating shopping cart abandonment (Huang et al., 2018; Kukar-Kinney et al., 2022; Mishra et al., 2021; Rodrigues et al., 2022; Tang & Lin, 2019). The subsequent sections relate to the constructs examined: Need for Touch, Product Uncertainty and OSCA. The developed and shared questionnaire can be

found in the final Appendix, both in its English and Portuguese versions. As the survey focused on Portuguese buyers, the Portuguese version was the one shared with the public.

Measures used were drawn upon previously published studies and pretested scales. The 12 NFT statements were addressed based on the scale by Peck and Childers (2003a). Participants were asked to select the option that best fitted their opinion, on a 7-point Likert scale, where 1 corresponds to totally disagree and 7 to completely agree.

As for product uncertainty measurement, it was adopted from Hong and Pavlou (2014), which also contains items adapted from Dimoka et al. (2012). Additionally, online shopping cart abandonment statements were the ones proposed in the scale provided by Kukar-Kinney & Close (2010). Sentences concerning both constructs were evaluated by the participants according to their opinion on the presented statements. A 7-point Likert scale was once again used, where 1 corresponded to totally disagree and 7 to completely agree.

3.3. Sample Statistical Tests

3.3.1 Sample Size Considerations

As a result of the questionnaire distribution, a sample of 214 ($N=214$) was obtained. Preacher and Kelley (2011) emphasize the importance of robust sample sizes for mediation models, particularly when estimating indirect effects. Moreover, they suggest bootstrapping, to be appropriate when dealing with sample sizes between 100 and 200, since the process of resampling the original observations (Hayes, 2022) allows for more accurate estimation of compared to traditional methods (Preacher & Kelley, 2011). While Hayes (2022) does not specify a fixed minimum sample size, which should depend on the analysis taking place, it is suggested that bootstrapping might work better with smaller samples with outliers than other methods, as it might be regarded as a more flexible approach in conditions where normality assumptions are more difficult to hold. Based on the exposed and considering that Hayes' PROCESS macro tool employs bootstrapping resampling method, the sample size of 214 was deemed adequate.

3.3.2 Normality Testing

The main descriptive statistics for the primary variables of interest in the study are summarized in Table 1 and include measures of central tendency, variability, and distribution shape, such as skewness and kurtosis. These last two measures are particularly important

when addressing one of the regression model assumptions, which is the normality of the sample distribution.

Variable	N	Mean	Median	SE	Minimum	Maximum	Skewness	Kurtosis
A_NFT	214	3.389	3.167	1.556	1.000	7.000	0.645	0.343
I_NFT	214	4.702	4.833	1.472	1.000	7.000	- 0.619	0.192
PU	214	4.709	4.556	0.748	3.560	7.000	0.754	0.099
OSCA	214	4.797	5.250	1.714	1.000	7.000	- 0.718	- 0.322

Note: A_NFT - Autotelic NFT; I_NFT - Instrumental NFT; PU - Product Uncertainty; OSCA - Online Shopping Cart Abandonment

Table 1 – Variables' descriptive statistics

Values of skewness and kurtosis for the PU and OSCA variables were considered at this stage of the analysis. The skewness of 0.754 of PU indicates a significant positive skew, suggesting that the distribution of PU is noticeably right-skewed. The kurtosis value of 0.099 is close to zero but still suggests a slight deviation from normality. To address the non-normality of PU, a square root transformation was applied. This transformation aimed to reduce skewness and make the distribution more symmetric.

As for the skewness of the OSCA variable, the - 0.718 value reflects a significant negative skew, indicating that the OSCA distribution has a pronounced left tail, with the kurtosis of -0.322 suggesting a relatively flat distribution. Initially, an inverse transformation was attempted to correct the non-normality, but this did not substantially improve the distribution. Consequently, a square transformation was applied, which helped to better approximate normality.

Skewness and Kurtosis of the A_NFT and I_NFT variables were considered moderate, indicating a distribution close to normal. Given these statistics, A_NFT and I_NFT were retained in its original form for analysis.

The new descriptive statistics can be found in Table 2. As it can be seen, the variable transformations applied to PU reduced its positive-skew while maintain a kurtosis value close to normality. As for OSCA, the square transformation significantly corrected its pronounced left tail, although with negative impacts for the kurtosis value. The square of the OSCA variable was, even so, considered closer to normality than its previous form.

Variable	N	Mean	Median	SE	Minimum	Maximum	Skewness	Kurtosis
A_NFT	214	3.389	3.167	1.556	1.000	7.000	0.645	0.343
I_NFT	214	4.702	4.833	1.472	1.000	7.000	- 0.619	0.192
PU_SQTR	214	2.163	2.134	0.169	1.890	2.650	0.586	-0.192
OSCA_2	214	25.933	27.563	14.695	1.000	49.000	-0.400	-0.908

Note: PU_SQTR - Product Uncertainty after square root transformation; OSCA_2 - Online Shopping Cart Abandonment after square transformation; A_NFT and I_NFT as defined per Table 1

Table 2 – Descriptive statistics after variable transformation

In the analysis that follows, and in the particular case of PU and OSCA, the variables considered were the ones to which the respective transformation was applied. Further on, and for simplicity reasons, they will continue to be solely addressed as PU and OSCA.

3.3.3 Linearity Testing

Mediation models assume linear relationships between the independent variables, mediators and dependent variables. Pearson's correlation r was analyzed to assess linearity (Hayes, 2022). A high absolute value of r , close to +1 or -1, indicates a strong linear relationship. Results can be found in Table 3. While preliminary analysis indicated deviations from linearity, as identified by the relationship between A_NFT and PU ($r = -0.04$; $p = 0.558$) or PU and OSCA ($r = 0.007$; $p = 0.915$), this is not uncommon in practical research settings (Hayes, 2022). Hayes' PROCESS macro is robust to such deviations, once more due to the use of bootstrapping to mitigate the impact of non-linearity on the estimation of indirect effects (Hayes, 2018). However, deviations from linearity were recognized as a limitation of the sample.

	A_NFT	I_NFT	PU	OSCA
A_NFT	1.000	.718***	- 0.040	.381***
I_NFT		1.000	.261***	.264***
PU			1.000	.007
OSCA				1.000

Note 1: ***. Correlation is significant at the 0,01 significance level (p-value)

Note 2: Variables definition as defined per Table 1

Table 3 - Pearson's Correlation (r)

4. Data analysis

4.1. Data profile

As previously referred, the survey distribution resulted in a sample size of 214 (N=214). Questions regarding the demographics of the respondents allowed for the collection of the data shown in Table 4. Most participants were women (N = 133), and the main age group was composed by participants between 18 and 34 years old (N = 116). Most had completed a college degree (N = 125), followed by those who had completed secondary school (N=68).

	N		%
Gender	Feminine	133	62.15
	Masculine	81	37.85
Age	18 - 34	116	54.21
	35 - 54	82	38.32
	55- 64	9	4.21
	65 +	7	3.27
Educational Level	Basic School	4	1.87
	Secondary School	68	31.78
	College degree	125	58.41
	Master's	17	7.94

Table 4 - Participants Demographic Measures

Following Rathee and Rajain (2019)'s study that points out gender to interfere in consumer's disposition to use the sense of touch, an independent samples t-test was conducted to compare the NFT scores between men and women. Statistics in Table 5 corroborate the authors' findings that show women exhibit higher levels of NFT. In fact, in both the autotelic (Mean = 3.69, SE = 0.151) and instrumental dimension (Mean = 4.86, SE = 0.137), the feminine gender presented a higher NFT mean.

A t-test for independent samples was conducted to determine whether there were statistically significant differences between men and women regarding their levels of NFT in both its autotelic and instrumental dimensions. The difference between genders in the autotelic ($p < 0.001$, 95% CI [0.424, 1.167]) and instrumental ($p < 0.032$, 95% CI [0.037, 0.805]) dimension were found to be statistically significant.

It is also important to notice that men in the sample displayed higher levels of instrumental NFT (Mean = 4.44) in comparison to their autotelic ones (Mean = 2.90).

Another relevant finding is that, in general, Portuguese consumers seem to present higher levels of instrumental NFT than autotelic NFT, which is in line with previous results presented by Duarte and Silva (2020) when analysing NFT in the Portuguese context.

	Gender	N	Mean	Mean difference	p	LLCI	ULCI
A_NFT	Feminine	133	3.691	.795	<0.001	0.424	1.167
	Masculine	81	2.895				
I_NFT	Feminine	133	4.861	.421	0.032	0.037	0.805
	Masculine	81	4.440				

Note: Variables definition as defined per Table 1

Table 5 - NFT vs Gender Statistics

4.2. Model regression

A mediation analysis was conducted using the PROCESS macro tool for SPSS (Hayes, 2022). It aimed to examine the role of Product Uncertainty (PU) as a mediator in the relationship between two antecedents - Autotelic NFT (A_NFT) and Instrumental NFT (I_NFT) - and Online Shopping Cart Abandonment (OSCA). Default settings of the model were not altered, including the number of bootstrap samples used to estimate the confidence intervals for indirect effects (5 000) and the confidence level for the bootstrap confidence intervals (95% confidence level).

4.2.1 Mediation analysis using Autotelic NFT

Initially, the Hayes mediation model runs a regression analysis to determine the effect of Autotelic NFT on Product Uncertainty. As summarized in Table 6, it revealed a small R^2 of 0.002, indicating a low proportion of the variance in PU being explained by A_NFT. The coefficient for the antecedent was -0.0044 ($a_1 = -0.004$), and it was not statistically significant at the 95% confidence level ($p = 0.56$, 95% CI $[-0.02, 0.01]$), indicating that Autotelic NFT does not predict Product Uncertainty.

The model runs a second regression analysis to examine the impact of A_NFT and PU on OSCA. Results provided an R^2 of 0.15, meaning that 15% of the variance in OSCA is explained by A_NFT and PU. However, such variation is due to A_NFT's significant and positive effect ($p < 0.001$, 95% CI $[2.42, 4.80]$). In contrast, Product Uncertainty did not have a significant effect on OSCA: for every one-unit increase in PU, the OSCA variable

increases by 1.98 units, on average ($b_1 = 1.98$). Such results indicate that the direct effect of Autotelic NFT on OSCA was found to be significant, while the indirect effect of A_NFT on OSCA through Product Uncertainty was not significant.

Outcome Variable	Predictor	R ²	Coefficient	p	LLCI	ULCI
PU	Constant	0.002	2.178	0.000	2.124	2.233
	A_NFT		-0.004	0.558	-0.019	0.010
OSCA	Constant	0.146	9.421	0.444	-14.773	33.615
	A_NFT		3.609	0.000	2.424	4.795
	PU		1.978	0.722	-8.943	12.898

Note: Variables definition as defined per Table 1

Table 6 - Mediation Model using A_NFT

4.2.2 Mediation analysis using Instrumental NFT

The regression model conducted by PROCESS to predict Product Uncertainty from Instrumental NFT, resulted in the regression outcome values summarized in Table 7. An R² of 0.068 started by indicating that an approximate 6.8% variance in PU being explained by I_NFT. The estimated coefficient for I_NFT was 0.03 ($a_2 = 0.03$). It is concluded to be statistically significant ($p < 0.001$, 95% CI [0.015, 0.045]).

In the subsequent regression analysis assessing the influence of the predictors I_NFT and PU on OSCA, the model demonstrated an R² value of 0.074, indicating these variables to explain 7.4% of the variance in OSCA. The I_NFT coefficient is both positive and significant ($c_2 = 2.81$, $p < 0.001$, 95% CI [1.46, 4.16]). Conversely, the effect of Product Uncertainty on OSCA was not statistically significant. The coefficient of PU was - 5.75 ($b_2 = - 5.75$), not statistically significant ($p = 0.34$, 95% CI [-17.52, 6.07]), suggesting that PU does mediate I_NFT's effect on OSCA.

Outcome Variable	Predictor	R ²	Coefficient	p	LLCI	ULCI
PU	Constant	0.068	2.023	0.000	1.949	2.097
	I_NFT		0.030	0.000	0.015	0.045
OSCA	Constant	0.074	25.149	0.046	0.494	49.804
	I_NFT		2.813	0.000	1.462	4.164
	PU		-5.752	0.336	-17.520	6.017

Note: Variables definition as defined per Table 1

Table 7 - Mediation Model using I_NFT

4.3. Main results

Results ultimately call the attention for the direct impact of both NFT dimensions on OSCA. Autotelic NFT had a direct and significant positive effect on OSCA. However, the analysis showed that it did not significantly predict product uncertainty, and this construct, in turn, did not mediate the relationship between autotelic NFT and OSCA. As for instrumental NFT, results indicated that it significantly predicted product uncertainty, but the indirect effect through product uncertainty was not statistically significant. Instead, instrumental NFT had a direct and significant effect on OSCA.

5. General Discussion

The conceptual model derived from the literature hypothesized the relationship between an individual trait, Need for Touch, and the OSCA phenomenon, mediated by the Product Touch variable. Control dimensions were also accounted for, as is the case of gender, following previous studies' considerations and allowing for more extensive research on the influence of the NFT on consumer behaviour. Figure 2 confronts the conceptual model derived from the literature and the main results of the mediation model outcome.

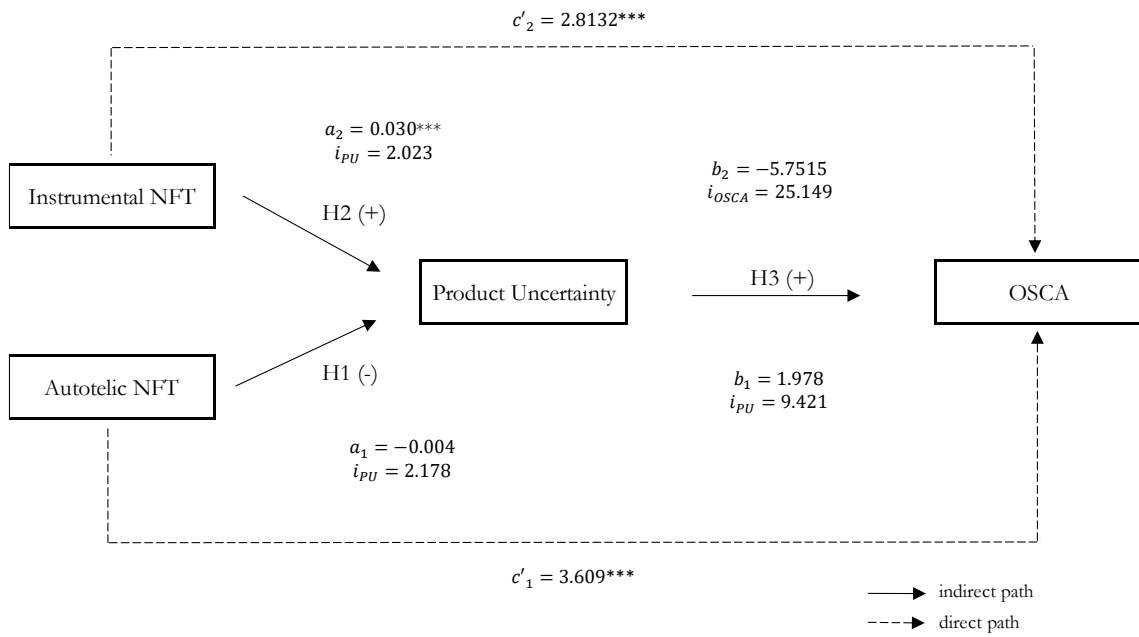


Figure 2 – Conceptual Model Results

Although not firstly considered in the conceptual model, results concerning the direct effect of autotelic and instrumental NFT on OSCA surge as the main output of the analysis. Even when product uncertainty mediation is not considered, the NFT dimensions, as analysed individually, present a positive and significant impact on OSCA, leading to the inference that this individual feature might be recognized as an antecedent of the online shopping cart abandonment outcome, even when no mediator construct is considered.

While the found link between autotelic NFT and OSCA has not yet been corroborated by the literature, it can be said that it aligns with research emphasizing the role of sensory inputs in consumer behaviour beyond the haptic information obtention (Peck &

Childers, 2003; Grohmann & Sprott, 2007; Yazdanparast, & Spears, 2013). Recent studies have shown that tactile cues enhance the overall shopping experience. When consumers with high autotelic NFT are deprived of the tactile involvement, they may feel that their shopping experience is incomplete and lacking the pleasurable part (Brasel & Gips, 2014). This leads to the idea that sensory deprivation of touch in online shopping signifies a diminished shopping experience that can increase the possibility of abandoning the shopping cart. On a different but also important note, Citrin, et al. (2003) had already contributed to the notion that online shopping heightens the psychological distance between the consumer and the product, leading to a lower emotional connection with the items. This might also be a crucial input, as this disconnection may exacerbate cart abandonment, especially for hedonically motivated consumers such as the autotelic ones.

As for instrumental NFT, the positive and significant direct effect on cart abandonment can be attributed to the functional need for tactile information that is unmet in online shopping environments (Peck & Childers, 2003a, 2003b). When the sensory requirement is not fulfilled in an online context, it often leads to notable dissatisfaction and frustration (Peck & Childers, 2003). Further, such feelings might once more result in a diminished sense of satisfaction and engagement. Moreover, the frustration stemming from the lack of tactile feedback may outweigh the benefits of convenience, perceived value and ease of access that might have firstly guided the instrumental NFT buyer and its utilitarian motivation to the online context, culminating in higher rates of cart abandonment when compared to those of their lower counterparts.

Proceeding with the analysis regarding the proposed conceptual model, the first set of hypotheses contemplated the link between the two NFT construct' dimensions, autotelic and instrumental NFT, and product uncertainty. It was proposed that these two features had an opposite influence on product uncertainty in online contexts. On the one hand, it was hypothesized that autotelic NFT would have a negative influence on the consumer's uncertainty perceptions. On the other hand, product uncertainty would be positively influenced by the instrumental dimension of NFT. Only one of the two propositions was supported.

Higher autotelic NFT levels could not be linked to lower perceptions of product uncertainty. The proposed relationship tried to explore the intrinsic features of autotelic touch, focusing on the pleasure-oriented motivation found to relate to impulsiveness (Peck & Childers, 2006; De Canio & Fuentes-Blasco, 2021). However, such impetuosity seems not

enough to reduce the consumer's perceptions of uncertainty towards the products displayed in the online store. In fact, according to the analysed results, the hedonistic enjoyment of the autotelic NFT buyer seems not to influence perceptions of product uncertainty in any capacity. H1 was, therefore, not supported.

On a second note, the mediation regression analysis demonstrated that consumer's instrumental NFT significantly predicts product uncertainty, supporting H2. Findings indicate that consumers who need to touch products to evaluate them tend to experience higher levels of uncertainty in online shopping. This observation aligns with prior research suggesting that consumers with high instrumental touch rely heavily on tactile experiences to reduce uncertainty and enhance their confidence in purchase decisions (Peck & Childers, 2003; Grohmann et al., 2007; Brasel & Gips, 2014; Krishna et al., 2016).

Additionally, the impact of product uncertainty on online shopping cart abandonment was evaluated. Interestingly, the effect of consumer's product uncertainty was found not to be a predictor of the OSCA phenomenon when both the instrumental and the autotelic dimensions of NFT are considered as antecedents. While the non-significance of the relationship with autotelic NFT as the antecedent might not surge as a surprise, given the absence of its influence on product uncertainty, results related to its instrumental counterpart were not expected. The analysis suggests that although Instrumental NFT leads consumers to experience higher perceptions of product uncertainty when faced with no-touch environments, this increased uncertainty does not impact the likelihood of cart abandonment.

Thus, the product uncertainty variable doesn't mediate the relationship between NFT and online shopping cart abandonment, as proposed in H3. Through the indirect effect of NFT on OSCA, it can be concluded that when instrumental and autotelic NFT are considered, the mediated effects are underscored by the direct effect of both NFT dimensions on the online cart abandonment outcome. H3 was not supported by the results.

These findings challenge the assumption of product uncertainty as a predictor of online shopping behaviour, explored in previous literature (Pavlou et al., 2007; Dimoka et al., 2012; Hong and Pavlou, 2014), where perceptions of uncertainty were reported to have a negative influence on consumer's purchasing decisions. Particularly, the collected evidence partially diverge from Tang and Lin (2019)'s conclusions when explicitly addressing OSCA as an outcome of uncertainty perceptions, revealing performance uncertainty, but not description uncertainty, to hinder the completion of online checkout.

Deviations from past research might be explained by differences in the sample. Tang and Lin (2019)'s investigation context focuses on a leading online platform in China, although the specific nationality of the participants is not identified. This study focuses on Portuguese consumers, who rank lower in uncertainty avoidance according to Hofstede et al. (2010) and as corroborated by Duarte and Silva (2020) in their comparison of the Portuguese and Chinese consumers' online purchasing propensity.

It must also be acknowledged that Tang and Lin (2019)'s work considers the two dimensions of product uncertainty, proposed by Dimoka et al. (2012). While this investigation is based on product uncertainty measures adapted from these authors, the current study considers the product uncertainty construct in general terms. This may justify why the results align more closely with those found by Tang and Lin (2019) for description uncertainty. In this scenario, the concept of product uncertainty stands out as multifaceted, and concerns about the product's functionality may not have the same impact on cart abandonment as those about the accuracy of product descriptions (Dimoka et al., 2012; Tang & Lin, 2019).

Results regarding the non-significant impact of product uncertainty on cart abandonment may also be explained by the consumers' motivation to purchase certain products. Research shows that when consumers have a strong intrinsic motivation to buy, their commitment to the purchase may override the uncertainty they feel (Hansen & Jensen, 2009). Therefore, even when in the presence of a consumer who experiences higher perceptions of product uncertainty, their commitment to completing the purchase may override the likelihood of cart abandonment.

In addition, decision-making' trade-offs should also be introduced in the light of the present investigation findings. Research highlights that consumers engage in complex decision-making processes, where factors like convenience, perceived value, and brand reputation can outweigh concerns related to uncertainty (Kukar-Kinney & Close, 2010). Accordingly, buyers might be inclined to proceed with a purchase if they believe the price is favourable or if the ease and suitability of the shopping experience outweighs the risks and uncertainty associated with the online transaction.

Moreover, an increased tolerance for uncertainty should be considered. According to Seth (2020), consumers who were once hesitant to shop online due to uncertainty or risk have become more accustomed to these platforms out of necessity, reducing the psychological barriers to online shopping. Laato et al. (2020) follow this line of thought and

highlight that during COVID-19, consumers faced a significant amount of uncertainty but still engaged in e-commerce at unprecedented levels. Frequent use of online channels in uncertain conditions helped build resilience and adaptability (Laato et al., 2020), possibly reducing the impact of uncertainty perceptions on decisions related to the completeness of the purchases in online contexts.

6. Theoretical and Practical Implications

6.1. Theoretical Contributions

The present investigation contributes to the growing body of OSCA literature by introducing the Need for Touch construct as a variable into the OSCA research domain. Although previous studies have explored external (Kapoor & Vij, 2021; Cho, 2004; Kukar-Kinney et al., 2022; Kukar-Kinney & Close, 2010) and consumer related constructs (Cho, 2004; Kukar-Kinney et al., 2022; Kukar-Kinney & Close, 2010), as far as it was possible to investigate, there was no direct research specifically linking NFT and OSCA. Further, by assessing how individual tactile preferences influence cart abandonment decisions, the present investigation addresses the research gaps identified by Wang et al. (2023) concerning the need to analyse unexplored drivers of OSCA, while introducing a new personality trait into OSCA's research models (Hermes et al., 2022; Tang & Lin, 2019).

NFT's research domain is enriched by the endeavour to understand how its two distinct dimensions influence OSCA. Although both the autotelic and instrumental NFT constructs presented a positive influence on the OSCA outcome, their individual analysis promotes upcoming exploration of how sensory experiences, or their absence, specifically shape online consumer behaviour beyond simple product evaluations. Moreover, as NFT is supported as an antecedent of OSCA in the proposed and tested model, the potential to reframe its influence as a direct predictor in consumer decision-making and, specifically, in the OSCA phenomenon is recognized. The emphasis might shift from how NFT interacts with other factors (Hermes et al., 2022; Pino et al., 2020; Rathee & Rajain, 2019) to how it directly shapes consumer behaviours and decisions. A similar attempt to assess NFT as an antecedent of consumers' attitudes - instead of a moderator - has been introduced in Kühn et al. (2020)'s investigation, which explores the direct path between NFT and consumer's differences in willingness to pay online and in-store.

While trying to understand to which extent product uncertainty alters the link between NFT and OSCA, the present study also expands the theoretical dialogue on the product uncertainty variable, questioning its assumed role as a key determinant of consumer behaviour and particularly OSCA (Dimoka et al., 2012; Tang & Lin, 2019). As findings reveal that product uncertainty does not mediate the relationship between NFT and OSCA, it becomes reasonable to admit that uncertainty perceptions may not be as influential in driving cart abandonment behaviour as once thought (Tang & Lin, 2019). It may also advocate for

the validity of the ideas presented by previous authors when expanding on the role of the pandemic in the shift of routines and tolerance levels (Laato et al., 2020), questioning the universality and timelessness of risk and uncertainty perceptions and their influence.

Lastly, the present study adds to the literature by contextualizing product uncertainty within a Portuguese cultural background, addressing the call for research across different cultural contexts (Tang & Lin, 2019). While the current findings fail to support the relationship between product uncertainty and OSCA, deviating from past research (Tang et al., 2019), it might be implicitly suggested that cultural differences in uncertainty tolerance (Hofstede, 1993; Liu et al., 2023) may have to be considered. Overall, existing frameworks that link uncertainty with consumer decision-making are deepened, encouraging future research to reconsider the impact of product uncertainty in varying cultural and technological contexts, especially post-pandemic (Wang et al., 2023).

6.2. Practical Contributions

The findings suggest that online retailers should develop targeted strategies to mitigate the negative impact of sensory deprivation for both autotelic and instrumental NFT consumers. As product uncertainty was found not to be a significant player in the model linking NFT and OSCA, the study's results underscore the importance of enhancing the overall shopping experience rather than solely focus on addressing uncertainty.

High autotelic NFT consumers usually pursue pleasurable and hedonic experiences during their shopping journey (De Canio & Fuentes-Blasco, 2021). As approached by Quinones et al. (2023), a primary retailer's approach to benefit from consumers shopping involvement should encompass the use of technology to enrich the hedonic aspects of shopping and create personalized and memorable interactions for consumers. Therefore, high-quality visuals, interactive features, and even virtual reality elements could be introduced, focusing on enhancing the sensory richness and pleasurable experience of the online environment (Quinones et al., 2023). Virtual reality (VR), for example, can offer immersive experiences that simulate in-store environments, being therefore found in the literature to enhance mental simulation (Zhang et al., 2024). This, in turn is linked to the emotional impact and potential happiness brought by the transaction (Skard et al., 2021) and heightened purchasing intentions (Skard et al., 2021; Zhang et al., 2024).

However, and as pointed out by Moore et al. (2022), it is important to make consumers aware of the hedonic benefits of such digital solutions, as this feature is often

overlooked by consumers in favour of the technologies' practical and informational application. Retailers are, therefore, advised to emphasize the hidden and possibly unexpected enjoyment element when launching innovative solutions aimed to enhance the online consumer shopping experience.

Regarding instrumental NFT consumers, the present study still identifies a significant linkage between these pragmatic customers and higher perceptions of product uncertainty. Retailers are encouraged to address the insecurity and lower confidence brought by the no-touch environment. Detailed product descriptions, artificial reality, and improving visual and descriptive cues, that cater to the functional demands of instrumental NFT consumers, could help reduce the frustration stemmed from absence of touch. Silva et al. (2021), for example, comprehend vivid haptic text descriptions on website pages to be a simple and a cost-effective way to enhance haptic imagery, improving perceptions of product quality and increasing the likelihood of purchase. Artificial reality (AR), on the other hand, is specifically found to increase the consumers probability to select a product and commitment to completing the purchase (Heller et al., 2019). It not only suggests the potential of this tool to increase confidence in the purchase but also to diverge consumers from abandoning their shopping carts.

Notwithstanding the possibility of higher levels of product uncertainty felt by instrumental NFT consumers, it should remain important for retailers to focus on different aspects of their shopping journey. On the one hand, the above technological strategies might still fall short in providing the high-level NFT consumer the full sensory experience that physical touch offers (Van Kerrebroeck et al., 2017). Moreover, the study's findings suggest that the non-significant impact of product uncertainty on OSCA may be a result of consumers becoming more accustomed to online shopping and its inherent uncertainty (Laato et al., 2020). Therefore, sellers are also encouraged, to capitalize on the instrumental customers' goal-oriented drive and on the increased consumer adaptability, optimizing the online shopping experience to focus on convenience, value, brand trust and other value-added services (Duarte et al., 2018; Quinones et al., 2023). Solutions involve close examination of consumers' reasons for initially selecting the online channel, while identifying key sources of satisfaction, such as accessibility, service quality, product evaluation, attentiveness, and transaction efficiency (Duarte et al., 2018). Monitoring online customers' expectations and satisfaction would help retailers to identify and continuously highlight the

specific conveniences of online shopping throughout the buying journey, keeping consumers engaged despite any lingering uncertainties.

Lastly, considering the potential differences in uncertainty tolerance presented in the literature, online retailers operating in diverse markets should adopt culturally sensitive strategies. This could involve localized data collection to better understand consumer's individual NFT features and related shopping motivations, culturally relevant messages, and customer service practices that resonate with the specific concerns of consumers in different regions (Duarte & Silva, 2020).

7. Conclusions

The present investigation set out to explore the relationship between consumers' individual trait Need for Touch and online shopping cart abandonment, mediated by product uncertainty, within the Portuguese context. By addressing an underexplored area of research, this study aimed to contribute to the growing body of OSCA, within the e-commerce behaviour, particularly in relation to the tactile needs of consumers and their impact on online shopping outcomes. It followed the appeals made by Hermes et al. (2022), Tang and Lin (2019) and Wang et al. (2023) to explore the impact of an alternative personality trait on the OSCA phenomenon, while re-evaluating product uncertainty as a mediator of OSCA within a different cultural context (Tang & Lin, 2019).

Findings provided valuable insights regarding the extent to which NFT influences the OSCA phenomenon. Both autotelic and instrumental dimensions showed a positive impact on OSCA, positioning NFT as a direct predictor of online shopping cart abandonment. Previous investigation, as far as the present research is concerned, had not yet explored the direct relationship between the two constructs. Therefore, even though not considered in the model derived from the literature, the unmediated link between NFT and OSCA arises as the main contribution of the conducted analysis, supporting the introduction of an unexplored construct in the OSCA research models.

Further, the mediation model proposed was not validated by the results, as no significant mediation effect of product uncertainty in the relationship between the two NFT dimensions and OSCA was found. Findings revealed that Instrumental NFT significantly predicts product uncertainty, supporting the notion that consumers who rely on tactile input to evaluate products experience higher levels of uncertainty in online shopping environments. However, and contrary to expectations, this increased uncertainty does not directly translate into higher rates of cart abandonment. As for autotelic NFT, driven by the pleasure of tactile experiences, it is found not to influence product uncertainty. Consequently, product uncertainty does not impact OSCA when this dimension is considered as an antecedent. The different effects of instrumental and autotelic NFT on product uncertainty emphasize Ruusunen et al. (2023)'s remark that these two dimensions should continue to be explored individually in future research, broadening the understanding of their impact on consumer behaviour.

In summary, the main contribution of the current study to the literature on OSCA corresponds to the introduction of NFT as a key factor influencing online shopping cart abandonment, highlighting its two dimensions as direct predictors in decision-making while reframing NFT's part beyond its usually moderating role.

In general, the unsupported mediating role of product uncertainty suggests that this construct does not alter the found relationship between NFT and OSCA. Such results highlight that the frustration arising from unmet tactile needs for product evaluation may have less impact on the final purchase decision than previously believed. Additionally, sensory deprivation in online shopping can lead to a less fulfilling experience, contributing directly to cart abandonment even in the absence of increased uncertainty.

While the present investigation makes significant contributions to both theory and practice, its limitations should be considered. It is important to notice that while this study aimed to explore the specific Portuguese context, the characteristics and size of the sample may have still fallen short on appropriately representing this cultural setting. Moreover, efforts were made to ensure the validity of the regression assumptions, though some deviations from linearity were noted and considered as limitations of the study. Future research should seek to replicate the study and its methodology, further examining how variations in sample composition might influence the results, while continuing to situate the investigation within the Portuguese cultural framework.

It should also be acknowledged that the model derived from the literature was intentionally designed with simplicity to focus on introducing the NFT construct as an antecedent to the OSCA phenomenon and re-examining the role of product uncertainty in cart abandonment. Therefore, the lack of significance of the mediator highlights the need for further exploration of the proposed variables or the introduction of new variables within this relationship.

Upcoming research could, on the one hand, maintain product uncertainty as a mediating construct, but investigate it through its two distinct dimensions: descriptive uncertainty and product uncertainty. This approach could provide different and deeper insights into how these specific dimensions influence the NFT-OSCA relationship. On the other hand, new models could build upon the direct relationship found between NFT and OSCA and introduce new constructs with a moderating role. Drawing from Peck and Childers' (2003b) Haptic Information Framework, specific product categories or other situational contexts, such as haptic information availability or technology use, could be

introduced as potential moderators in the model. Certain product categories may require more tactile feedback, suggesting that for high-tactile products, NFT may have a stronger impact on OSCA. Additionally, for haptic information availability or technology use, their exploration as moderators could deepen our understanding of these tools and their potential to mitigate the need for physical touch and consequently reduce cart abandonment for both instrumental and autotelic buyers.

The introduction of such constructs in the model would hold particular importance given that the study's findings emphasize the need to improve the overall shopping experience rather than concentrating solely on addressing uncertainty. Online retailers are, therefore, called to enhance sensory experiences for autotelic and instrumental consumers through immersive technologies or other culturally sensitive strategies that can further reduce cart abandonment among these consumers. It should also be acknowledged that these strategies should be adapted according to the different regional differences in uncertainty tolerance and shopping motivations. While the application of the model to the Portuguese context as led to results that emphasize the role of tactile preferences and discard the influence of product uncertainty perceptions on online shopping cart abandonment, the same may not apply to other cultural contexts.

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Appendix

Appendix 1: Questionnaire (English Version)

Gender

- Female
- Male
- Other

Age

- Under 18 years
- 18-34 years
- 35-54 years
- 55-64 years
- 65 years or older

Highest Level of Education Completed

- Primary Education
- Secondary Education
- Higher Education – Bachelor's Degree
- Higher Education – Master's Degree
- Higher Education – Doctorate Degree

NFT - Measures proposed by Peck and Childers, 2003.

Scale from 1 to 7, where: 1= strongly disagree and 7=strongly agree

Autotelic need for touch

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.

Instrumental need for touch

1. I place more trust in products that can be touched before purchasing them.
2. I feel more comfortable purchasing a product after physically examining it.
3. If I can't touch a product in the store, I am reluctant to purchase the product.
4. I feel more confident making a purchase after touching a product.
5. The only way to make sure a product is worth buying is to actually touch it.
6. There are many products that I would only buy if I could handle them before purchase.

(Items measured on a 7-point Likert scale with anchors ranging from 1= strongly disagree to 7=strongly agree)

Product Uncertainty – Measures proposed by Hong and Pavlou (2014) with items adapted from Dimoka et al. (2012)

Scale from 1 to 7, where: 1= strongly disagree and 7=strongly agree

Product Quality Uncertainty

1. Based on the description of the products, I am sure they are genuine.
2. I am concerned that the products will look different in real life from how it looks on the website description.
3. I am concerned that the product will not function as well as it is introduced on the website.
4. I am certain that the product will perform as I expect it to perform.

Product Fit Uncertainty

1. I am not certain the product will match my requirements.
2. I am certain that the product will match my tastes.
3. I am certain that the product will fit my preference.
4. I am not certain the product with specific characteristics is what I am looking for.
5. I fear that product attributes (such as color size, texture, style, type or content are not what I wanted.

Online shopping cart abandonment – Measures proposed by Kukar-Kinney and Close (2010);

Scale from 1 to 7, where: 1= strongly disagree and 7=strongly agree

1. How often do you leave items in your online shopping cart without buying them?
2. How often do you place an item in the online shopping cart, but do not buy it during the same Internet session?
3. How often do you close the webpage, or log off the Internet before you buy the item(s) in your online shopping cart?
4. How often do you abandon your online shopping cart?

Appendix 2: Questionnaire (Portuguese Version)

Informações Pessoais

Género

- Feminino
- Masculino
- Outro

Idade

- Menos de 18 anos
- 18-34 anos
- 35-54 anos
- 55-64 anos
- 65 anos ou mais

Nível de Educação (mais elevado que completou)

- Ensino Básico
- Ensino Secundário
- Ensino Superior - Licenciatura
- Ensino Superior - Mestrado
- Ensino Superior – Doutoramento

Necessidade de Toque – Proposto por Peck and Childers, 2003

Escala de 1 a 7, onde: 1 = Discordo Totalmente e 7 = Concordo Totalmente

Necessidade Autotélica de Toque

1. Ao caminhar pelas lojas, não consigo evitar tocar em todos os tipos de produtos.
2. Tocar em produtos pode ser divertido.
3. Ao caminhar pelas lojas, é importante para mim tocar em todos os tipos de produtos.
4. Gosto de tocar em produtos mesmo que não tenha intenção de os comprar.
5. Ao caminhar pelas lojas, gosto de tocar em muitos produtos.
6. Acabo por tocar em todos os tipos de produtos nas lojas.

Necessidade Instrumental de Toque

1. Confio mais em produtos nos quais posso tocar antes de os comprar.
2. Sinto-me mais confortável em comprar um produto depois de examiná-lo fisicamente.
3. Se não posso tocar num produto na loja, tenho relutância em comprá-lo.
4. Sinto-me mais confiante em fazer uma compra depois de tocar num produto.
5. A única maneira de garantir que um produto vale a pena comprar é tocar-lhe.
6. Há muitos produtos que só compraria se pudesse tocar-lhes antes da compra.

Incerteza relativamente ao produto – Proposto por Hong and Pavlou (2014) com itens adaptados de Dimoka et al. (2012)

Escala de 1 a 7, onde: 1 = Discordo Totalmente e 7 = Concordo Totalmente

1. Com base na descrição do produto, tenho a certeza de que o produto é autêntico.
2. Preocupo-me que o produto pareça diferente na vida real do que parece na descrição do site.
3. Preocupo-me que o produto não funcione tão bem como é introduzido no site.
4. Tenho a certeza de que o produto funcionará como espero.
5. Não tenho a certeza se o produto atenderá aos meus requisitos.
6. Tenho a certeza de que o produto combinará com os meus gostos.
7. Tenho a certeza de que o produto se adequará às minhas preferências.
8. Não tenho a certeza se o produto e as suas características são o que estou à procura.
9. Receio que os atributos do produto (como a cor, tamanho, textura, estilo, tipo ou conteúdo) não sejam o que eu quero.

Abandono do Carrinho de Compras Online – Proposto por Kukar-Kinney and Close (2010);

Escala de 1 a 7, onde: 1 = Discordo Totalmente e 7 = Concordo Totalmente

1. Com que frequência deixa produtos no seu carrinho de compras online sem os comprar?
2. Com que frequência coloca um produto no carrinho de compras online, mas não o compra durante a mesma sessão online?
3. Com que frequência fecha a página ou sai da Internet antes de comprar o(s) produto(s) no seu carrinho de compras online?
4. Com que frequência abandona o seu carrinho de compras online?