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Citation for published version:
Li, J, Cowan, K, Yazdanparast, A & Ansell, J 2024, 'Vibrotactile feedback in m-commerce: Stimulating perceived control and perceived ownership to increase anticipated satisfaction', *Psychology and marketing*, pp. 1-21. https://doi.org/10.1002/mar.22008

Digital Object Identifier (DOI):
10.1002/mar.22008

Published In:
Psychology and marketing

Received: 21 September 2023 | Accepted: 4 April 2024

DOI: 10.1002/mar.22008

RESEARCH ARTICLE

Psychology & Marketing WILEY

Vibrotactile feedback in m-commerce: Stimulating perceived control and perceived ownership to increase anticipated satisfaction

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Abstract

Consumers increasingly purchase through m-channels, including apps. Accordingly, marketers have enhanced immersive, sensorial aspects of m-channels, such as including vibrations while making in-app purchases. Given discrepant findings, it remains unclear whether adding such vibrotactile feedback affects consumer decision making. The present research addresses: (1) Whether adding vibrotactile feedback influences consumers' anticipated product satisfaction and purchase confidence, and (2) if so, how? Through an online pilot survey, two online experiments, and one lab experiment, this research finds that adding vibrotactile feedback to m-channels increases consumers' anticipated product satisfaction, but not purchase confidence. Moreover, perceived ownership mediates this effect, because the vibrations offer a sense of control over the product during the purchase process. This research makes several contributions. First, it documents that control elicited via vibrations offers an alternative means to psychological ownership, as opposed to imagining touch. Second, we offer this haptic route as a means to achieve the stimulation motivation driving perceived ownership, different from prior visual routes. Third, it potentially reconciles literature conflicts regarding the effect of vibrotactile feedback on consumer decision making.

KEYWORDS

anticipated satisfaction, haptics, m-commerce, perceived control, perceived ownership, technology-mediated touch, vibrotactile feedback

1 | INTRODUCTION

According to Statista's Market Insights, mobile commerce sales have reached $2.2 trillion in 2023, representing 60% of global e-commerce sales, with its share steadily increasing from 56% in 2018 to an expected 62% by 2027 (Buchholz, 2023). With the rise of m-commerce, retailer–consumer interactions have evolved (Huang et al., 2015). Consumers are increasingly drawn to mobile apps, as they are six times faster than mobile-friendly websites and deliver a more immersive experience (Wertz, 2022). Increasing competition in m-commerce motivates retailers to offer top-notch experiences within their apps. Some retailers fully embrace this, integrating technologies into apps, and heightening the shopping experience. Specifically, retailers captivate consumers by replacing sensory experiences in brick-and-mortar settings not accessible in m-commerce (e.g., IKEA's app allows consumers to visualize items in various spaces). Beyond visuals, there are more opportunities to enrich in-app sensory features.

Previous research in m-commerce has overlooked a significant sensory aspect—touch or haptic cues. Encouraging customers to touch a product leads to favorable responses toward a retailer, and thus, touch is fundamental to driving sales (Krishna et al., 2024). As a result, many companies invest heavily in designing products and devices to make the experience of physically holding something pleasurable. However, since physically touching products in digital environments is impossible, it is important to examine alternative haptic opportunities. Extant studies suggest that incorporating haptic information (Cowan et al., 2021; Yazdanparast & Kukar-Kinney, 2023) or providing vicarious touch situations (i.e., observing a hand in physical contact with a product; Luangrath et al., 2022) improve consumers' attitudes and purchase intentions. This occurs from touching the digitally represented product on the screen (e.g., swiping over it; Hattula et al., 2023) or, much like a mannequin effect, from feelings of ownership over another's body (e.g., Luangrath et al., 2022). While the former effect occurs specifically on touchscreen devices, the latter can occur within advertising more broadly. This begs the question of whether touch and feelings of product ownership can manifest in situations where there is no product to touch (imagined or vicarious) and/or when touchscreens are smaller, like mobile devices. More importantly, investing in creating "digital hands" is quite expensive. So, can alternative haptic cues provide a means to increase favorable responses toward retailers?

To examine this potential, we turn to vibrotactile feedback. Given the extensive usage of mobile phone vibration mode, our focus lies on this particular sensory cue, which we refer to as vibrotactile feedback—the vibrations experienced by users while engaging in activities on their mobile devices. Vibrotactile feedback entails the transmission of vibration stimulation to human skin, enhancing individuals' intuitive perception of the environment and promoting a higher level of interaction (Schätzle et al., 2010). Industry A/B tests have shown some initial promise when vibrations are paired with product information. For instance, when included with ads on mobile devices, engagement increases by 50% (Immersion, 2017). Despite the potential of exploring vibrations as a tool to provide haptic cues, with exceptions, research is scant. More specifically, extant marketing research on vibrotactile feedback, while insightful, is limited in various aspects.

First, while research suggests that more traditional haptic cues (e.g., haptic imagery, vicarious touch through a hand, touchscreen interface) consistently lead to positive downstream consumer responses, such as shopping basket total (e.g., Hampton & Hildebrand, 2020), purchase intention (e.g., Racat & Plotkina, 2023), and choice confidence (Hattula et al., 2023), among others, research focusing on vibrotactile feedback offers mixed findings. In particular, some research suggests vibrotactile feedback increases willingness to pay (e.g., Hampton & Hildebrand, 2020). Yet, others find the opposite (e.g., Manshad & Brannon, 2021). Still, recent evidence indicates that purchase amounts and intentions can be greater when vibrotactile feedback is present, but this is contingent upon vibration perception and consumers' need for touch (Racat & Plotkina, 2023). As such, does vibrotactile feedback have a positive impact on consumers' decision making, and if so, across what dimensions related to decision making? Aligned with this, other researchers have called for research investigating postchoice product satisfaction (Hattula et al., 2023). The present research aims to assess purchase confidence, which represents consumers' certainty with their choice, and anticipated satisfaction, an important but under-researched variable that shares a significant correlation with actual postconsumption satisfaction (Söderlund, 2003, 2006).

Second, research generally contends that perceived ownership, a sense of possessing an object (Pierce et al., 2003), explains why haptic cues increase decision-making responses in digital environments (e.g., Luangrath et al., 2022, etc.). Yet, it is unclear if this also manifests under conditions of vibrotactile feedback. In particular, vibrotactile feedback research either fails to test mediators (e.g., Hampton & Hildebrand, 2020; Manshad & Brannon, 2021) or explores the process in contexts other than online purchase (e.g., Hadi & Valenzuela, 2020), resulting in lack of specificity in understanding the underlying process within the m-commerce context. Moreover, research focusing on the underlying role of perceived ownership in remote shopping channels has been limited to studying vicarious touch (i.e., showing a hand touching a product via images, GIFs, and VR touching a product) rather than experiencing vibrations as a haptic cue (see Luangrath et al., 2022, for details of vicarious touch).

Building upon research in sensory marketing, particularly haptics, we hypothesize that vibrotactile feedback in m-commerce elicits a positive downstream consumer response. We attribute these effects to the concept of psychological ownership, caused by the sense of control experienced by consumers through vibrotactile feedback. In traditional retail settings, consumers can physically interact with a target product, placing it in their shopping cart (Pantano & Viassone, 2015). Physical control enhances feelings of psychological ownership (Furby, 1980; Rudmin & Berry, 1987) facilitated through touch. As such, we posit that vibrotactile feedback, delivered through a retailer's mobile app when consumers add products to their shopping carts, can trigger a sense of control, leading to a perception of ownership.

Our results demonstrate that vibrotactile feedback in m-commerce can enhance consumers' anticipated satisfaction but not purchase confidence. A survey (pilot study) and three experiments (Studies 1–3) confirm perceived ownership as the underlying mechanism given the role of perceived control experienced via vibrotactile feedback. The research offers several contributions. Further, our research is the first, to our knowledge, to document that psychological ownership can manifest as a result of vibrotactile feedback. Previously, this was only possible through imagining touch, such as via the interface or a virtual embodied hand (e.g., Hattula et al., 2023). In contrast, we document that this can occur through haptic stimulation (e.g., vibrations) because it signals greater control over the product, akin to manipulating the object in a physical retail environment. Second, the results outline a means to achieve the psychological ownership motivation of stimulation, the least researched motive related to psychological ownership (Peck & Luangrath, 2023). Accordingly, this has only been evidenced visually, as per Luangrath et al. (2022) through a virtual hand. However, we evidence that this also occurs from vibrotactile feedback given that vibrations are a form of stimulation (Eid & Al Osman, 2016; Penasso et al., 2023; Radhakrishnan et al., 2023). Third, the results evidence how vibrotactile feedback influences consumer decision making, potentially reconciling highlighted conflicts in extant literature (e.g., Hampton & Hildebrand, 2020; Manshad & Brannon, 2021), where these effects varied across product categories and individual differences in need for touch. The results highlight the nuances of vibrations, versus other haptic stimuli, such as imagery and touchscreen interfaces, affecting anticipated satisfaction with the product but not purchase confidence. Finally, the research offers practical contributions, highlighting the fact that as retailers invest in immersive technologies, vibrotactile feedback has greater potential for shopping experience integration.

2 | THEORETICAL BACKGROUND

2.1 | Haptic (vibrotactile) cues in digital environments

Research on vibrotactile feedback, and haptic cues more broadly, is rather scarce (see Table 1). While not intended to be comprehensive, Table 1 highlights issues in generalizing haptic research to all haptic cues, including our understanding of how vibrotactile feedback might influence consumer decision making. First, while research does show that, in general, haptic cues increase psychological ownership, explaining consumer decision-related responses, this is brought on because of imagining touching the product. This can occur via a vicarious hand, similar to how one would picture wearing clothing from a mannequin (e.g., Luangrath et al., 2022) or from vicariously touching the products through a touch-based interface (e.g., Hattula et al., 2023). When adding items to a basket (typically when vibrations occur in m-commerce), users would not be dragging items to a shopping cart, nor should the stimuli trigger imagining touching the product. Therefore, if vibrotactile feedback elicits more favorable retailer responses, it would occur through a different mechanism.

Second, extant research has important design limitations that could potentially contribute to inconsistencies in findings. For instance, Racat and Plotkina (2023) find that the *perceived* (not the physical) vibration increases purchase intention and willingness to pay. However, they indicated that relying on a noncontrolled environment in their main study could have affected their results. Further, Manshad and Brannon (2021) show that vibration feedback (experienced via a different device held in the nondominant hand of the participants rather than the device used for the purchase process) decreases participants' willingness to spend. In contrast, Hampton and Hildebrand (2020) indicate that vibration (experienced through the same device used for the purchase process) results in a higher number of items added to the shopping box. Further, the impact of vibrotactile feedback on purchase intentions has been found to vary due to various factors. For example, vibrotactile feedback increases purchase intentions only when individuals enjoy touching products (Racat & Plotkina, 2023) or experience specific vibration durations (Hampton & Hildebrand, 2020) or intensities (Manshad & Brannon, 2021).

Third, limited cases investigate how vibrotactile feedback influences consumer responses when timed alongside placing products in the shopping cart (the common practice in m-commerce). This is evidenced by a lack of focus on the context of studies, ranging from online payment processing (Manshad & Brannon, 2021) to consumer health and physical fitness (Hadi & Valenzuela, 2020) and psychological comfort from phones in general (Melumad & Pham, 2020) with very few focusing on vibrotactile feedback at the time of placing a product in the virtual shopping cart. Still, the downstream consumer responses are commonly focused on purchase-related variables, failing to examine other important consumer responses within consumer decision making despite extant research's emphasis on its significance (Stoyanova et al., 2015). As such, no research has investigated how vibrotactile feedback impacts anticipated product satisfaction, an important downstream response that can impact order cancellation and return intentions. As Court et al. (2009, p. 6) stated, "When consumers reach a decision at the moment of purchase, the marketer's work has just begun." Indeed, anticipated satisfaction can shape consumers' opinions for every subsequent decision in the category. Aligned with this, other researchers have called for research investigating postchoice product satisfaction (Hattula et al., 2023).

According to the consumer decision journey framework, the purchase stage, the most condensed phase, involves brand and product evaluations leading to purchase intent. Purchase intentions signify "the person's motivation in the sense of his or her conscious plan to exert effort to carry out a behavior" (Eagly & Chaiken, 1993, p. 168). During this phase, consumers experience the greatest motivation to process information deeply (Colicev et al., 2018). A related concept is purchase confidence, which reflects individuals' perceptions of being accurate in their evaluations (Grohmann et al., 2007), and this is a commonly used variable to examine haptic influences. In this study, we examine the purchase stage through purchase confidence, a variable recognized for its ability to enhance consumer purchase intent (Tan et al., 2022; Yazdanparast & Kukar-Kinney, 2023; Yazdanparast & Spears, 2013).

We also consider the role of anticipated satisfaction, given its high cognitive demands and usability as an important factor related to anticipating what will happen in the postchoice phase of the consumer journey. Given the gaps in extant research, it also provides a more compressive examination of how haptic cues affect decision making. More specifically, a focus on anticipated satisfaction is warranted for several reasons. First, Söderlund (2003) argues that

TABLE 1 Summary of research on haptic cues in digital marketing.

Cite	Haptic manipulation	Focal product stimuli	Haptic cue	Mechanism	Dependent variable	Findings	Gaps motivating the present research
Manshad and Brannon (2021)	Vibration Intensity Felt in the Hand × Location of the Vibration	Computer desk; Bags of chips	Vibrations using an external device	N/A	Willingness to Spend	Lower- (vs. higher- vs. control group) intensity vibration feedback reduces participants' willingness to spend as this represents a "pain" in payment.	1. Vibration feedback was triggered at the time of payment processing as opposed to placing the product in the shopping cart. 2. Vibration was experienced via a different device held in the nondominant hand rather than the device used for the purchase. 3. No underlying mechanism was examined. 4. Anticipated satisfaction was not examined.
Racat and Plotkina (2023)	Presence (vs. absence) of Haptic Feedback; Perceived Haptic Feedback (yes vs. no) × Product Type (hedonic vs. utilitarian); Autotelic Need for Touch; Instrumental Need for Touch	Textbook; Scarf	Vibrations within m-commerce at the point of the purchase decision	Serial Mediation (Haptic Pleasure—Reassurance—Psychological Comfort—Trust—Attitude)	Purchase Amount; Willingness to Pay; Purchase Intentions	Asking respondents to activate vibration mode made them more likely to focus on the vibration, and therefore the haptic feedback was more perceived. The presence (vs. absence) of the vibration increased the purchase amount (Study 1). The presence (vs. absence) of haptic feedback did not directly affect the purchase amount or willingness to pay. Rather the perceived feedback increased willingness to pay only. There were no differences across product types. Vibration presence (vs. absence) and also the perception of haptic feedback interacted with the autotelic need for touch, such that it	1. Relied on a noncontrolled environment for the main study, and thus, consumers may not have completed the study as expected despite the various checks. 2. Focused on the emotional and attitudinal factors underlying the effect of haptic feedback on downstream consumer responses. 3. Did not examine anticipated satisfaction.

TABLE 1 (Continued)

Cite	Haptic manipulation	Focal product stimuli	Haptic cue	Mechanism	Dependent variable	Findings	Gaps motivating the present research
						increased willingness to pay. Sequential mediation was supported such that pleasure, reassurance, psychological comfort, trust, and attitude affected purchase intentions (Study 2).	
Hattula et al. (2023)	Interface Type (direct-touch vs. traditional) × Instrumental Need for Touch	Videogame console	Physically touching the products on the screen (e.g., swiping)	Imagined Experience of Haptic Product Properties	Choice Confidence	Interface type influenced the imagined experience of haptic product properties, though no main effect of interface type appeared for purchase confidence. Instrumental need for touch moderated, such that individuals with a high instrumental need for touch reported greater purchase confidence and less purchase risk when using a direct-touch (vs. traditional) interface. The imagined experience of "haptic product properties" mediated the interaction of interface type and Need for Touch on choice confidence.	1. The interfaces used in the study were very different (Apple iPad vs. Bluetooth mouse). 2. Did not examine vibrotactile feedback. 3. Did not uncover the underlying factors causing touch to result in enhanced choice confidence. 4. Did not examine anticipated satisfaction.
Brasel and Gips (2014)	Interface Type (direct-touch vs. traditional) × Interface Ownership × Product Haptic Importance	Sweatshirt versus City tour; College sweatshirt versus Tent	Physically touching the products on the screen (e.g., swiping)	Psychological Ownership	Endowment	The touchpad (vs. touchscreen vs. mouse) increased endowment and psychological ownership. This effect was weakened for the low haptic importance product. Psychological ownership mediated the interaction of Interface Type and	1. Did not focus on vibrotactile feedback. 2. Did not uncover the process through which psychological ownership results in downstream responses.

(Continues)

TABLE 1 (Continued)

Cite	Haptic manipulation	Focal product stimuli	Haptic cue	Mechanism	Dependent variable	Findings	Gaps motivating the present research
						Product Haptic Importance on Endowment (Study 1). These effects were replicated in Study 2. Moreover, product haptic ownership moderated the effects, such that the difference in psychological ownership was greater for the tablet than the laptop.	
Luangrath et al. (2022)	Vicarious Touch (present vs. absent) × Diagnosticity of Hand Movements (diagnostic vs. non-diagnostic) × Need for Stimulation	Coffee cups; Knitted products; Consumer electronics; Shirt; Sweater, T-shirt;Blanket	Person's or Digital Hand Touching a Product	Body Ownership of the Digital Hand; Psychological Ownership of a Product	Product Valuation; Engagement	Vicarious touching from human others increases social media likes (Study 1) and psychological ownership of the product, because of felt body ownership of the hand touching the object (Studies 2–4). Nondiagnostic hand movement attenuated this effect (Study 5). When shopping in the VR store, the presence of a hand (touch present vs. absent) increased perceptions of body ownership compared to when a cursor was employed. Vicarious touch present (vs. absent) increased product evaluations and willingness to pay but not relative to the cursor condition. There were no differences in psychological ownership of the product across conditions. There was a	1. Did not examine vibrotactile feedback. 2. The results are not generalizable to situations where a hand touching a product is not present. 3. Body ownership was identified as the factor affecting psychological ownership. 4. Vicarious touch was not superior (vs. other condition[s]) in the VR study.

TABLE 1 (Continued)

Cite	Haptic manipulation	Focal product stimuli	Haptic cue	Mechanism	Dependent variable	Findings	Gaps motivating the present research
						significant interaction of vicarious touch and stimulation experienced on psychological ownership and willingness to pay relative to the cursor but not the no-touch condition (Study 6).	
Melumad and Pham (2020)	Stress (high vs. low); Device (smartphone vs. laptop); Device Ownership	N/A	Smartphone itself		Psychological Comfort, Stress Relief	Mobile phones' haptic benefits, portability, personal nature, and sense of privacy increase its reassuring presence, which increases psychological comfort, and thus use of stress relief (Study 1). When under high (vs. low) stress, individuals were likelier to seek out and use their smartphone (Study 2). Compared to a laptop, the smartphone helped to provide psychological comfort (Study 3), especially when the person owned (vs. borrowed) the smartphone (Study 4).	1. Did not focus on a purchase context. 2. Was limited to the pacifying effects of smartphones (i.e., psychological comfort).
Hampton and Hildebrand (2020)	Vibration Emitting Box (treatment vs. control) × Classical Condition (rewarding vs. not)	Grocery shopping task	Vibrations within m-commerce (through a game and at the point of the purchase decision)	Classical conditioning (learned association with positively valenced mobile events)	Items added to the shopping box	Participants added more items to the vibration-emitting (vs. control) box (Studies 1 and 2). This effect was mediated by how rewarding individuals found the task (Study 3).	1. Did not examine vibrations as a haptic cue but rather as a rewarding mechanism. 2. Did not examine anticipated satisfaction.
Hadi and Valenzuela (2020)	Message Alert (auditory vs. haptic vs. both)	N/A (focused on physical challenges)	Vibrations within a smartphone (Study 1, 3, 4)	Social presence	Performance	Vibrations or vibrations with audio (vs. audio) alongside an alert message increased task	1. The context was limited to the role of social presence in mediated communications.

(Continues)

TABLE 1 (Continued)

Cite	Haptic manipulation	Focal product stimuli	Haptic cue	Mechanism	Dependent variable	Findings	Gaps motivating the present research
			or Smartwatch (Study 2)			performance (Studies 1–3). Social presence was a mediator to this effect (Study 4).	2. Did not focus on a purchase context. 3. Did not focus on anticipated satisfaction. 4. Did not examine downstream consumer responses in a purchase context.

customer satisfaction can exist as a prospective state of mind. Second, different from prepurchase satisfaction, an emotional state predictive of an actual purchase (Simintiras et al., 1997), anticipated satisfaction involves extensive assessments regarding a likely evaluation (Shiv & Huber, 2000). Simintiras et al. (1997) provide a conceptual review and empirical evidence of these distinctions. For instance, prepurchase satisfaction includes assessments related to feeling pleased and satisfied, similar to Jessen et al.'s (2020) treatment of satisfaction and Parker et al.'s (2016) inclusion of decision comfort as an affective state. Anticipated satisfaction, notably, reflects prospective utility (Loewenstein, 1987) and anticipatory knowledge of what will likely occur in the future (Oliver & Winer, 1987). Third, empirically, anticipated satisfaction and current satisfaction share a significant amount of variance (Söderlund, 2003). For instance, Koenig-Lewis and Palmer (2014) find that anticipated feelings are highly and positively related to feelings postpurchase, such that actual purchase satisfaction is often highly related to that anticipated. Notably, both anticipated and current satisfaction equally correlate with future plans (Söderlund, 2003), reflecting the closure of the loyalty loop in the consumer decision journey (e.g., Court et al., 2009). Given that customers actively think about how satisfying a purchase will be, and often use this as a reason for purchase, we consider anticipated satisfaction as a variable relevant for the study.

2.2 | Vibrotactile feedback and the consumer decision journey

The consumer decision journey is increasingly enriched by haptic experiences, with touch serving as a particularly pleasurable sensory input that enhances decision making (Madzharov, 2019). In m-commerce, where digital interfaces are the norm, sensory technologies are becoming more accessible and utilized (Petit et al., 2019). Smartphones, akin to modern comfort objects, provide a sense of psychological ease. This comfort is derived, in part, from the haptic benefits offered by smartphones that allow these devices to provide a reassuring presence for owners (Melumad & Pham, 2020). Among the array of haptic features, vibration stands out as a technologically efficient solution, offering a compact and energy-saving method to deliver haptic feedback. This feature is particularly prevalent in small personal devices like mobile phones and smartwatches (Bark et al., 2008). Even large e-commerce platforms like Amazon have begun pairing mobile vibration with specific consumer actions on their app, such as adding products to the shopping cart (Hampton & Hildebrand, 2020). However, despite the growing use of vibrotactile feedback, surprisingly little research has explored consumers' psychological and behavioral responses to it. Only a few studies have examined how vibrotactile feedback influences consumer decision making (see Manshad & Brannon, 2021; Racat & Plotkina, 2023, for exceptions).

Research suggests that vibrotactile feedback allows users to convey and receive haptic information through technology (Hadi &

Valenzuela, 2020). Importantly, haptic cues, such as technology-mediated touch, can help consumers with product evaluations and purchase decisions (Hultén, 2012), facilitating psychological purchase comfort (Melumad & Pham, 2020) and easier information processing even when under high involvement (Cowan et al., 2021). Some findings indicate that vibrotactile feedback can result in hedonic satisfaction and increased perceived ease of use, perceived usefulness, and cognitive concentration in games among mobile gamers (Choe & Schumacher, 2015). Marketing research suggests that engagement with mobile touch-driven interfaces increases brand interactions (Pagani et al., 2019) and purchase intentions (Mulcahy & Riedel, 2020). Specifically, vibrotactile feedback accompanying the act of putting items into a shopping basket influences consumer choice and increases the overall basket amount, due to its rewarding nature (Hampton & Hildebrand, 2020).

Vibrotactile feedback could engage consumers in more cognitive evaluations supporting anticipated satisfaction, which could in turn reflect consumers' perceptions about what will happen in the postpurchase stage. According to Loewenstein (1987), anticipation, like consumption, is a source of purchase utility and requires considerable mental exertion. Racat and Plotkina (2023) somewhat support this assertion through their findings, indicating that vibrotactile feedback results in reassurance, psychological comfort, trust, and attitude, which could then affect consumer decisions. As such, vibrotactile feedback could trigger cognitive elaborations to increase anticipated satisfaction. Based on these arguments, we hypothesize that vibrotactile feedback can positively affect the purchase and postchoice evaluations of the consumer decision journey.

Hypothesis 1. The presence (vs. absence) of vibrotactile feedback increases (a) purchase confidence and (b) anticipated satisfaction.

2.3 | Perceived ownership as a mediator

Perceived ownership, a type of psychological ownership, refers to the sense of possession that occurs even in the absence of legal ownership (Pierce et al., 2003; Pierce & Peck, 2018). It is likely that both nature (genetics) and nurture (cultural factors) play a role in motivating humans to feel ownership over a target (Peck & Luangrath, 2023; Pierce et al., 2003). Generally, the desire for psychological ownership can be linked to motivations for ownership. The four key motives include (1) effectance (i.e., the desire to have agency and exert mastery over one's environment or objects), (2) signaling self-identity (i.e., the role of ownership in defining the self, expressing self-identity, and maintaining the continuity of the self over time), (3) home (i.e., the anchoring of self in time and space and feeling a sense of groundedness), and (4) need for stimulation (i.e., the amplified arousal experiences; Peck & Luangrath, 2023).

The sense of touch is intricately linked with enhancing perceived ownership (Peck & Luangrath, 2023). Touching an item, whether physically or digitally, imagining touch through haptic imagery (Peck et al., 2013), or even observing a virtual hand touching an object, can enhance one's sense of ownership over that item (Atasoy & Morewedge, 2018; Brasel & Gips, 2014; Peck & Shu, 2009). Therefore, even when touch is mediated through technology, the consequences of touch are still present. For instance, touch-based computing devices (e.g., iPads) compared to personal computers increase perceived ownership of a product (Brasel & Gips, 2014). Further, touchscreen (vs. traditional) devices enhance purchase confidence among consumers who chronically have a higher instrumental need for touch (Hattula et al., 2023). Beyond being merely pleasant, though, vibrations are highly arousing and stimulating (i.e., they naturally grab attention such as when receiving smartwatch alerts or vibration-mode phone calls). We contend that because of their stimulating qualities (Eid & Al Osman, 2016; Penasso et al., 2023; Radhakrishnan et al., 2023), vibrations provide a means to increase psychological ownership through the stimulation motivation.

Prior research offers ample evidence for the heightened evaluation of target objects due to perceived ownership (Feuchtl & Kamleitner, 2009; Peck & Shu, 2009; Pierce et al., 2003). More specifically, perceived ownership exerts a positive influence on various stages of the consumer decision journey (Van Dyne & Pierce, 2004). Within the purchase intent stage, perceived ownership enhances consumers' willingness to pay (Shu & Peck, 2011), purchase intention (Brengman et al., 2019), impulse purchase decisions (Peck & Childers, 2006), and evaluation confidence (Peck & Childers, 2003). Similarly, perceived ownership decreases perceived evaluation difficulty (Laroche et al., 2005). After deciding on what to purchase, perceived ownership is expected to result in higher product satisfaction, given its influence on product valuations (Luangrath et al., 2022). Indeed, research reveals that perceived ownership increases positive word of mouth about the product, an important subset of consumer satisfaction (Kirk et al., 2015).

Formally, we contend that perceived ownership mediates the relationship between vibrotactile feedback and consumer responses. Therefore, we hypothesize:

Hypothesis 2. Perceived ownership mediates the effect of vibrotactile feedback on (a) purchase confidence and (b) anticipated satisfaction.

2.4 | The sense of touch and perceived control as a facilitator of perceived ownership

Extant literature has identified the theoretical antecedents to perceived ownership. These antecedents are referred to as levers that can be manipulated to increase or decrease perceived ownership (Peck & Luangrath, 2023). According to Pierce et al. (2003), perceived ownership emerges when users have control over an object, when they come to know the object intimately, or when they invest themselves in the object. Recent work has proposed a fourth path, self-object congruity, referring to the object and the self's shared meaningful associations in memory (Morewedge, 2021; Peck & Luangrath, 2023). Out of the four paths, research indicates that touch typically works through the path of perceived control (Brasel & Gips, 2014; Peck & Shu, 2009), even when products are associated with more negative textures (Shu & Peck, 2011). In other words, control over a product is considered an antecedent to psychological ownership (Morewedge, 2021) when involving haptic stimuli.

The term "haptics" refers to the perceptions by the hands through the active seeking of information via touch (Gibson, 1966; Peck & Childers, 2003). Prior research in physiology (Gibson, 1962) shows that the sense of touch is distinct from other senses in terms of the nature of encoding information (i.e., the rate and range of sampling information) and the type of encoded information (i.e., material information properties). The haptic system is a slow modality that can explore a set of objects one at a time through a series of successive impressions. Since it works within a limited range around the body and can only interact with objects that are within reachable distance, the sense of touch is referred to as a near (or proximal) sense (Woods & Newell, 2004; Yazdanparast & Spears, 2012). This characteristic is integral to the experience of control over touched objects.

Within the product touch domain, touching a product by hand can have three roles, namely, touching for seeking haptic information (e.g., assessing the temperature of the surface of a product), touching for seeking haptic pleasure (e.g., enjoying the softness of a product), and touching for nonhaptic functional reasons (e.g., picking up a product to put it on the cash register). Being able to physically maneuver a product is a form of control, and the ability to control a target is an antecedent of ownership feelings (Krishna et al., 2024; Liu et al., 2023; Peck & Shu, 2009). This is related to the effectance motivation of psychological ownership where agency over one's environment can manifest or arise from feelings of control (Peck & Luangrath, 2023).

In traditional retail settings, consumers can physically interact with a target product, handling it and placing it in their shopping cart. This physical control over the product, in turn, enhances feelings of psychological ownership (Furby, 1980; Rudmin & Berry, 1987), facilitated through touch. However, this is not possible in digital channels without the illusion of touch (e.g., vicarious hand; swiping over a product on a touchscreen). Some research demonstrates that haptic imagery can mirror the effects of actual tactile engagement, which in turn increases feelings of ownership (Peck et al., 2013). Further, Luangrath et al. (2022) find that even when a hand touching a product is virtually displayed, perceived ownership can be experienced. We extend these insights by examining the effect of a specific haptic cue, vibrotactile feedback, that can mimic the experience of exerting control over products when placing them in the shopping cart in an m-commerce context.

Going beyond mere effectance, we posit that the experienced vibrotactile feedback should increase stimulation motives of psychological ownership because of the haptic simulation. "Need for stimulation relates to the effectance motivation as people become motivated under conditions in which arousal is possible," (Peck & Luangrath, 2023, p. 53). We contend that vibrotactile feedback should also stimulate motivation for psychological ownership stemming from control. Past research shows that vibrations increase task efficacy, such as balancing (Ballardini et al., 2020), task precision (Pena et al., 2019), and object manipulation (Stepp et al., 2012). Vibrations, a proximal cue, are effective at focusing attention because they are highly stimulating (Eid & Al Osman, 2016; Penasso et al., 2023; Radhakrishnan et al., 2023). In particular, former research investigating vibrations highlights control as a means to these benefits. Such findings hint that vibrotactile feedback can be a powerful tool in reinforcing the sense of control that underlies perceived ownership.

Moreover, sensory feedback in digital channels can make shopping appear more akin to real life. For instance, vibrotactile and haptic imagery enabled by augmented reality technologies can evoke a sense of control and self-explorative engagement, inducing sensory flow experiences (Huang & Liao, 2017), consumer empowerment (Marinova et al., 2017), and better decision making (Rafaeli et al., 2017). Given these findings, we propose that vibrotactile feedback, delivered through the retailer's mobile app when consumers add products to their shopping carts, can offer a sense of control, heightening perceived ownership. We also propose that perceived control serves as a serial mediator to affect purchase intentions and anticipated satisfaction, through perceived ownership. This aligns with prior research highlighting the focal role of perceived ownership in driving product valuations (e.g., Peck & Shu, 2009) and the role of the ability to control products in perceived ownership (Pierce et al., 2003). Drawing on these foundations, we argue:

Hypothesis 3. The presence (vs. absence) of vibrotactile feedback results in greater perceived control over the target product, thus leading to greater perceived ownership, increasing (a) purchase confidence and (b) anticipated satisfaction.

3 | OVERVIEW OF STUDIES

We empirically test our hypotheses across one pilot study and three experiments. The pilot study, conducted via a survey approach, is designed to preliminarily examine H1 and to identify any potential alternative explanations that could impact our findings. We provide the details of the pilot study in Supporting Information S1: Appendix A. Study 1 tests the main effects predicted by H1 and assesses the mediating role of perceived ownership (H2). To more robustly establish perceived ownership as a mediator, Study 2 adopts a process by moderation design, further examining H1 and H2 through a theater methodology. Finally, in Study 3, we seek to validate the serial mediation effect posited in H3 and extend the generalizability of our results across a diverse spectrum of consumer demographics, product types, and cultural contexts, while accounting for individual differences. Figure 1 shows the conceptual framework and organization of studies.

3.1 | Study 1: The effect of vibrotactile feedback on consumer purchases

The primary objective of Study 1 is to provide sound evidence supporting the impact of vibrotactile feedback on consumer responses in m-commerce (H1) and to test the previously supported

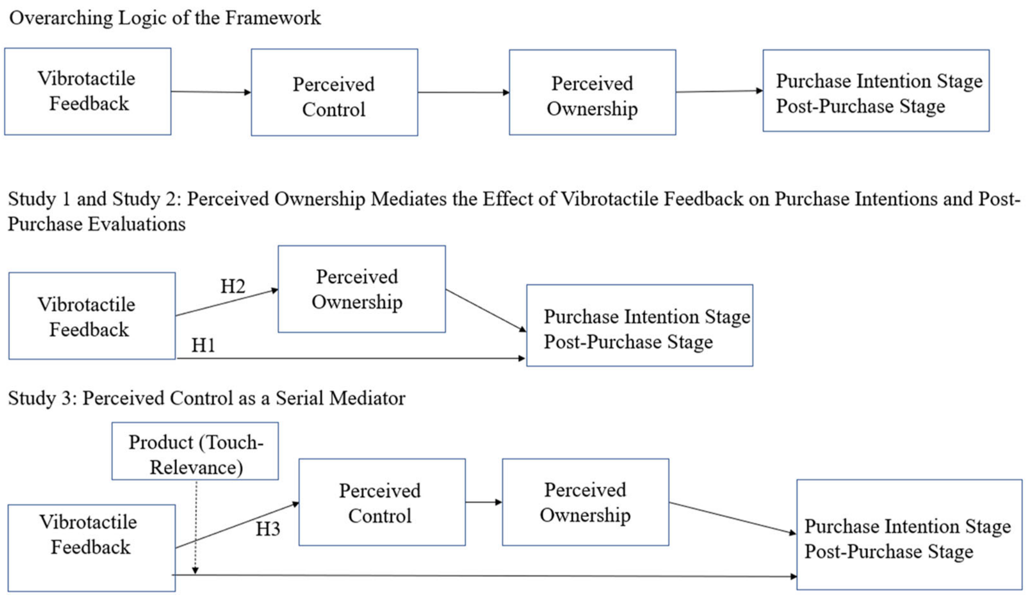

FIGURE 1 Conceptual framework.

mediator (H2). While the pilot survey offers external validity, this study seeks to establish causality. We expect that participants experiencing (vs. not) vibrotactile feedback will report higher purchase confidence and anticipated satisfaction (H1).

3.1.1 | Method

To examine the effects of vibrotactile feedback on purchase confidence and anticipated satisfaction, this study used a between-subjects experiment manipulating two levels of a single factor (vibrotactile feedback: absent vs. present). One hundred participants (M_{age} = 30.84, SD = 7.96, 54% female) were recruited (all passed the attention test[1]) at a hotel located in China. Participants registered for the study and scheduled a one-to-one WeChat video appointment with the first author. A research assistant stationed at the hotel conducted the experiment and provided participants with an identical lab-specific iPhone equipped with the Amazon app installed. This requirement was put in place to standardize the experiment conditions and not necessitate participants to own an iPhone themselves. As device weight can influence the perception of vibration strength (Yao et al., 2009), we sought to keep this consistent. Likewise, Hampton and Hildebrand (2020) find that mobile vibrations can range from 25 ms to 3200 ms and that generally reward perception is increased by vibration length, until 400 ms. The Amazon in-app vibration lasts approximately 400 ms and automatically triggers vibration when consumers put offerings into their shopping cart (open vibration mode). Additionally, while most mobile devices tend to have vibration intensity between 130 and 180 Hz (Washburn, 2014), requiring all participants to use a lab-specific iPhone ensured identical vibration intensity. The research assistant randomly turned on (off) vibration mode for participants, without signaling this to participants, given that this instruction could heighten the effect of the vibrations on consumer responses (Racat & Plotkina, 2023). Next, individuals were provided with a list of electronic items (with links on Amazon), consistent with the pilot study. Then, participants selected a product to add to their shopping carts to simulate purchases. After doing so, participants completed items measuring purchase confidence ($\alpha = 0.88$; Berger & Mitchell, 1989; Grohmann et al., 2007), anticipated product satisfaction ($r = 0.84$, $p < 0.001$; Söderlund, 2006), positive mood ($\alpha = 0.90$; Roehm & Roehm, 2005), attention to product information ($r = 0.73$, $p < 0.001$; Coleman et al., 2017), and perceived ownership ($\alpha = 0.85$; Peck & Shu, 2009). After completing a manipulation check (e.g., "Do you recall the iPhone vibrating when you placed the item in the Amazon basket?" Yes/No), they provided their demographics. All participants successfully responded to the manipulation check (100%).

3.1.2 | Results

We used the same criteria as in the pilot survey to reduce and test for common method bias (e.g., questionnaire design, using validated scales, ensured anonymity, etc.). Additionally, following an exploratory factor analysis (EFA) with an unrotated factor solution, the variance extracted was below the threshold as per Podsakoff et al. (2003).

A multivariate analysis of variance (MANOVA) run with vibrotactile feedback as the independent variable (0 = absent, 1 = present) and both purchase confidence and anticipated satisfaction as dependent variables revealed a significant multivariate effect (Wilks $\lambda = 0.42$, $F_{1, 98} = 67.08$, $p < 0.001$, $\eta^2 = 0.58$). The analysis revealed no differences between the vibrotactile feedback absent

[1]Details in Supporting Information S1: Appendix B.

($M = 5.62$) and present groups ($M = 5.68$; $p = 0.753$; $\eta^2 < 0.001$) on purchase confidence. However, there was a significant difference for anticipated product satisfaction ($F_{1, 98} = 101.38$, $p < 0.001$; $\eta^2 = 0.51$). Specifically, anticipated satisfaction was higher when vibrotactile feedback was present versus absent ($M = 5.97$ vs. 4.24; SD = 0.91 vs. 0.81). The results of an analysis of variance with perceived ownership as the dependent variable provided a significant effect ($F_{1, 98} = 10.44$, $p = 0.002$; $\eta^2 = 0.10$), such that perceived ownership was greater in the vibrotactile feedback present ($M = 5.79$; SD = 1.24) than absent condition ($M = 5.04$; SD = 1.08).

Next, we investigated the mediating role of perceived ownership using PROCESS Model 4 with 10,000 bootstraps. Vibrotactile feedback was the independent variable, perceived ownership as the mediator, and anticipated product satisfaction served as the dependent variable. Vibrotactile feedback had a positive impact on perceived ownership ($b = 0.75$, $t = 3.23$, $p < 0.001$). Likewise, perceived ownership had a significant and positive impact on anticipated product satisfaction ($b = 0.42$, $t = 6.82$, $p < 0.001$). Given the significant indirect effect (effect = 0.32, BootSE = 0.10, 95%CI: 0.12, 0.53) and the still positive c′ path, the analysis supports partial mediation (see Figure 2 below). Additionally, PROCESS Model 4 with 10,000 bootstraps was utilized to assess the mediating roles of both attention to product information and positive mood. However, the results indicated that neither attention to product information (product: effect = 0.01, BootSE = 0.08, 95%CI: −0.13, 0.17; process: effect = 0.02, BootSE = 0.08, 95%CI: −0.15, 0.17) nor positive mood (product: effect = 0.01, BootSE = 0.09, 95%CI: −0.16, 0.19; process: effect = 0.01, BootSE = 0.10, 95%CI: −0.18, 0.21) was a significant mediator. Thus, we rule out attention to product information and positive mood as potential mediators.

3.1.3 | Discussion

Study 1 provides evidence that adding vibrotactile feedback enhances consumers' anticipated satisfaction through perceived ownership (H1b, H2b) while ruling out the effect of positive mood and attention to product information as alternative explanations. While we did not measure perceived vibrations or the intensity of the vibrations, participants confirmed that they felt vibration when placing the product in the shopping cart. However, given that individuals' perceptions can be different from objective reality and thus differently affect their purchase decisions (Racat & Plotkina, 2023), we acknowledge this as a limitation. This might explain why purchase confidence was not significant, as the perceived intensity of the vibration might have affected consumers' experiences differently. Likewise, it is also possible that product choice from a specific category played a role in the findings. Specifically, the choice among products could have dampened purchase confidence but not anticipated satisfaction. For instance, Liu et al. (2023) found that a greater (vs. less) assortment size dampens the effect of touch on purchase confidence. To better understand the underlying mechanism, our next study will employ a process-by-moderation approach.

3.2 | Study 2: Testing perceived ownership in a process by moderation design

The goal of Study 2 is to establish the underlying process more robustly (H2) while providing additional support for H1. As such, we further explore the impact of vibrotactile feedback on consumers' anticipated satisfaction and purchase confidence by manipulating perceived ownership. Another goal of this study is to control phone usage, so we adopt a theater methodology. The theater methodology assists us in addressing prior limitations (in the Pilot Study and Study 1) related to phone ownership. We again include the alternative explanations to further eliminate their role in the process.

3.2.1 | Method

To overcome limitations from Study 1, where participants were required to use an iPhone that was not their own, a theater methodology was employed. Theater methodology uses a videotape screenplay as the background to present a stimulus (Russell, 1999) and offers participants an efficient and flexible environment. Moreover, researchers have the freedom to experiment with alternative strategies and perspectives to test the validity of theories and opinions (Gallagher, 2011). Specifically, this methodology

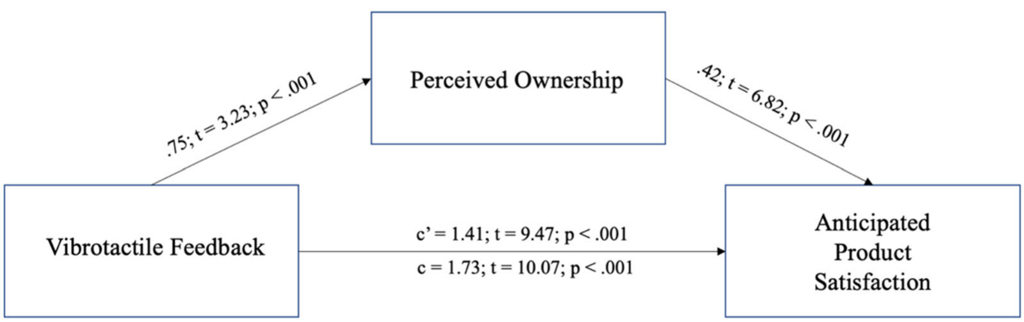

FIGURE 2 Mediation analysis in Study 1.

"increases the level of experimental control while providing an environment similar to the actual setting" (Russell, 2002, p. 309). Scholars demonstrate that the adoption of a theater methodology can reduce noise in the data and enhance experimental control (Balasubramanian et al., 2006). This methodology has been applied in marketing literature in many contexts, such as product placement (Marchand et al., 2015; Van Vaerenbergh, 2017) and brand advertising (Goldfarb & Tucker, 2011). Recently, theater methodology was applied to sensory marketing stimuli to simulate a virtual reality retail experience (e.g., Pizzi et al., 2019).

To check the feasibility of the theater methodology, we conducted a pretest involving 60 Chinese participants who owned their iPhones and indicated having the Amazon app downloaded (M_{age} = 27.24, SD = 0.48, 58.3% female). Participants were recruited in the same hotel as other studies and made a video WeChat appointment with the first author who oversaw the pretest. The study adopted a single factor between-subjects design (Methods: traditional method vs. theater method). The traditional method followed the same steps as in Study 1 except that participants used their iPhones. This time, they were required to turn on vibration mode and proceeded to the Amazon app to select a mug and place it in their shopping cart. Participants assigned to the theater method were asked to watch a video of the entire process of opening the Amazon App, browsing the mugs, adding a mug to the shopping cart, and experiencing the vibrotactile feedback. Given the prevalence of phantom vibrations, it is likely that hearing the feedback elicits similar feelings to actually feeling the feedback (Drouin et al., 2012). After randomly assigning participants to one condition, they responded to perceived ownership items ($\alpha = 0.88$). Results of a t-test indicated no significant difference between the groups ($M = 5.47$ vs. 4.93 and SD = 1.24 vs. 1.61 for theater method vs. traditional method; $t(59) = 1.47$; $p > 0.15$; $\eta = 0.01$) on perceived ownership. Thus, the pretest supports a theater methodology as producing similar effects.

A total of 428 participants were recruited via the WeChat channel to take part in the main study. After deleting 28 invalid responses (failed attention check[2] or missing data), 400 participants (M_{age} = 29.25, SD = 0.49, 64% female) completed the 2 (perceived ownership prime: absent vs. present) × 2 (vibrotactile feedback: absent vs. present) between-subjects experiment. After reading the instructions, and following the theater methodology, participants were randomly assigned to watch one of the two versions of a video about the shopping process on the Amazon app. For those in the vibrotactile feedback present condition, they viewed the same video as in the theater methodology pretest. Those in the vibrotactile feedback absent condition watched an identical video but the feedback was absent. Next, participants were exposed to the perceived ownership prime. Following Peck et al. (2013), individuals responded to a question, with a timer set for 1 min before they could proceed. Participants in the perceived ownership prime present condition were asked to "imagine taking the mug home with you. Where would you keep it? What would you do with it?". For participants in the perceived ownership prime absent condition, questions asked them to use the minute to evaluate the mug. Next, participants responded to the same items as earlier, including purchase confidence ($\alpha = 0.76$), anticipated product satisfaction ($r = 0.37$, $p < 0.001$), positive mood ($\alpha = 0.82$), attention to product information ($r = 0.48$, $p < 0.001$), perceived ownership as a manipulation check ($\alpha = 0.87$), and vibration presence ("Do you recall the iPhone vibrating when you placed the item in the Amazon basket?" Yes/No), followed by demographics. All (100%) correctly answered the manipulation check.

3.2.2 | Results

We used the same criteria as in the Pilot Survey and Study 1 to reduce and test for common method bias. Following an EFA with an unrotated factor solution, the variance extracted was below the threshold as per Podsakoff et al. (2003).

To check the perceived ownership manipulation, the prime was included as the independent variable (0 = absent, 1 = present), with perceived ownership as the dependent variable. The t-test revealed a significant difference between groups ($t(399) = 3.28$, $p < 0.001$; Cohen's $d = 0.33$). Specifically, individuals in the prime present condition reported greater perceived ownership ($M = 5.47$, SD = 1.08) than those in the prime absent condition ($M = 5.07$, SD = 1.33). It is noteworthy, though, that both groups reported higher than average perceived ownership values. This is in line with Brasel and Gips (2014) finding that touchscreen interfaces can increase perceived ownership, especially when the devices are self-owned. Further, mugs are frequently used and maneuvered manually, and this might have resulted in higher ownership perceptions across the conditions. As a posttest, we also re-ran this manipulation outside of the in-app context to address these potential effects and found that when a touchscreen device was not used, the average perceived ownership was generally lower, with the control condition reporting significantly lower values than the primed condition (Supporting Information S1: Appendix B).

To assess H2, a two-way MANOVA was run with the perceived ownership prime (0 = absent, 1 = present) and vibrotactile feedback (0 = absent, 1 = present) as independent variables and anticipated product satisfaction, and purchase confidence as dependent variables, revealing a significant multivariate effect (Wilks $\lambda = 0.98$, $F_{1, 398} = 3.32$, $p = 0.037$, $\eta^2 = 0.02$). Main effects from the perceived ownership prime were present only for anticipated product satisfaction ($F_{1, 398} = 4.48$, $p = 0.038$; $\eta^2 = 0.01$), such that the presence of the prime increased anticipated product satisfaction (present: $M = 5.52$, SD = 0.79; absent: $M = 5.34$, SD = 0.62). For the main effect of vibrotactile feedback, anticipated product satisfaction increased when the feedback was present ($M = 5.63$, SD = 0.62) versus absent ($M = 5.28$, SD = 0.75; $F_{1, 398} = 26.09$, $p < 0.001$; $\eta^2 = 0.06$). The results yielded a significant interaction for anticipated product satisfaction ($F_{1, 398} = 5.80$, $p = 0.016$; $\eta^2 = 0.01$). The two-way interaction on

[2]Details in Supporting Information S1: Appendix B.

purchase confidence (Supporting Information S1: Appendix B) was not significant ($p > 0.3$).

Planned contrasts indicated that when vibrotactile feedback was present, there was no difference in anticipated product satisfaction across the prime present ($M = 5.62$, $SD = 0.69$) and absent conditions ($M = 5.64$, $SD = 0.55$; $p = 0.821$; $\eta^2 < 0.01$). However, when vibrotactile feedback was absent, anticipated product satisfaction increased when the prime was present ($M = 5.43$, $SD = 0.87$) versus absent ($M = 5.12$, $SD = 0.58$; $F_{1, 398} = 8.76$; $p = 0.003$; $\eta^2 = 0.04$). Analyzed differently, planned contrasts within the perceived ownership prime absent conditions revealed an increase in anticipated product satisfaction when vibrotactile feedback was present ($M = 5.64$, $SD = 0.55$) versus absent ($M = 5.12$, $SD = 0.58$; $F_{1, 398} = 41.36$; $p < 0.001$; $\eta^2 = 0.17$). With the prime present, there was no effect from vibrotactile feedback ($p = 0.10$). Figure 3 below illustrates these relationships. For analyses of alternative mediators (all non-significant), see Supporting Information S1: Appendix B.

3.2.3 | Discussion

Following a process by moderation approach (Spencer et al., 2005), Study 2 provides further evidence supporting H2b, demonstrating perceived ownership as a mediator. In the absence of vibrotactile feedback, the prime for perceived ownership increases anticipated satisfaction. However, it is crucial to clarify the timing and context in which vibrotactile feedback occurs. In our study, consumers feel the vibration when they place a product in the shopping cart, which happens after selecting the product. This sequence is vital to understanding why vibrotactile feedback does not significantly influence purchase confidence, addressed in H2a. Purchase confidence, the belief that the chosen product is the right one is formed at the moment of selection (i.e., before placing the item in the cart and experiencing the vibrotactile feedback). So, again, we find that vibrotactile feedback does not affect purchase intent, given the lack of support for H2a (purchase confidence). However, the vibrotactile feedback occurs postchoice (H2b). The findings underscore vibrotactile feedback's impact on anticipated satisfaction via perceived ownership.

While we also continued to rule out alternative explanations, we did not control for other factors, such as individual need for touch or differences in purchase involvement and imagination vividness. Likewise, for products used in Studies 1 and 2, touch plays a moderate to strong role in influencing product evaluations. As such, we address these remaining limitations in Study 3, testing the full proposed model highlighted in Figure 1.

3.3 | Study 3: Offering further evidence of the hypothesized effect

The main objective of Study 3 is to strengthen the findings from previous studies. First, we manipulate the product category by including products varying in sensitivity to whether the product itself is haptically relevant. While some products are naturally highly relevant to touch-related cues (e.g., feeling a blanket texture), others are less relevant. Second, we include additional measures to control

FIGURE 3 Moderating effect of ownership imagery/perceived ownership on the vibrotactile feedback—anticipated product satisfaction relationship in Study 2.

and account for individual differences in imagery abilities, product purchase involvement, and need for touch. Third, we conduct the study in a Western country with a different culture to provide greater generalizability of prior results. Finally, we measure perceived control to further support the role of vibrotactile feedback in enhanced perceived ownership experiences of individuals (Pierce et al., 2003), testing our full conceptual model and H3. We expect the results of the two-way interaction to be nonsignificant, revealing only a main effect of vibrotactile feedback.

3.3.1 | Method

In Study 3, 216 participants in the United Kingdom participated in a 2 (touch-relevance to product category: high vs. low) × 2 (vibrotactile feedback: absent vs. present) between-subjects lab experiment. Individuals were recruited on the campus of a large business school in the United Kingdom. After removing 18 participants from the data set (failed the attention test[3] or missing data), 198 usable responses (M_{age} = 27.02, SD = 7.03, 56.6% female) remained for analysis. Pretest 2 (Supporting Information S1: Appendix B) supported blankets as high touch-relevant and desk lamps as low touch-relevant product categories. Participants were randomly assigned to one of the product categories and instructed to shop for the product using the Amazon app on an iPad located in the lab, as controlled by the research team. Vibrotactile feedback was turned on or off, with conditions alternating each day. Next, participants answered the questionnaire, including the same dependent variables as in earlier studies (purchase confidence [α = 0.94], anticipated product satisfaction[4] [$\alpha = 0.88$], and perceived ownership [$\alpha = 0.93$]). We also measured perceived control, inspired by Pierce et al. (2003), using a three-item scale ($\alpha = 0.84$). These items are reported in the supporting information document. Additionally, participants responded to 7-point measures including imagery vividness ("vivid/vague," "clear/unclear," "distinct/indistinct," "sharp/dull," "intense/weak," "life-like/lifeless"; $\alpha = 0.86$; Ruzeviciute et al., 2020), product purchase involvement ($\alpha = 0.82$; Mittal, 1995), and need for touch ($\alpha = 0.91$; Peck & Childers, 2003), followed by demographics. Since the vibrotactile feedback variable is isomorphic with its operationalization (presence or absence), a manipulation check is unnecessary (Khan, 2011).

3.3.2 | Results

We used the same criteria as prior studies to reduce and test for common method bias. Following an EFA with an unrotated factor solution, the variance extracted was below the threshold as per Podsakoff et al. (2003).

To assess H1, a two-way MANOVA was run with the touch-relevant product category (0 = low, 1 = high) and vibrotactile feedback (0 = absent, 1 = present) as the independent variables and anticipated product satisfaction, and purchase confidence as the dependent variables. The multivariate effect was not significant for the interaction (Wilks $\lambda = 0.99$, $F = 1.27$). As expected, the results yielded a nonsignificant interaction for purchase confidence ($F_{1,194} = 1.12$, $p = 0.29$; $\eta = 0.01$). Likewise, none of the main effects were significant for the touch-relevance of the product category ($p > 0.4$). the multivariate effect only occurred for the vibrotactile feedback condition (Wilks $\lambda = 12.96$, $F_{1,194} = 12.96$, $p < 0.001$, $\eta^2 = 0.12$). For vibrotactile feedback ($F_{1,194} = 16.36$, $p < 0.001$; $\eta^2 = 0.08$) the feedback presence resulted in greater anticipated product satisfaction ($M = 5.56$, SD = 0.95) than feedback absence ($M = 4.91$, SD = 1.29). The main effect was not significant for purchase confidence ($p > 0.7$). Rerunning the MANOVA with the covariates replicated the findings (see Supporting Information S1: Appendix B for a full analysis). Of the covariates, only vividness ($p = 0.008$) and product involvement were significant ($p < 0.001$).

To test H2 and H3, we ran Process Model 6 for serial mediation with 10,000 bootstraps. In the first model, we included vibrotactile feedback as the independent variable, perceived control as the first mediator, and perceived ownership as the second mediator in the sequence and included purchase confidence as the dependent variable. The indirect effect of the serial model was not significant (effect = 0.07, BootSE = 0.04, 95%CI: −0.003, 0.164), rejecting H3a. In the second model, we kept the same independent variable and serial mediators but included anticipated product satisfaction as the dependent variable. The effect of perceived control on perceived ownership was significant ($b = 0.81$, $t = 13.23$, $p < 0.001$). More importantly, the indirect effect of the serial model was significant (effect = 0.11, BootSE = 0.07, 95%CI: 0.007, 0.255). Given that the relationship between vibrotactile feedback and anticipated product satisfaction was still significant when including the mediators in the model, partial mediation is supported. All paths are provided in Figure 4 below.

Rerunning the serial mediation Model 6 with the covariates revealed a similar but nonsignificant indirect effect at the 95% confidence level (effect = 0.08, BootSE = 0.05, 95%CI: −0.003, 0.184). The significant covariates included Need for Touch (NFT) ($b = 0.11$, $t = 2.42$, $p = 0.02$) and product purchase involvement ($b = -0.13$, $t = -2.42$, $p = 0.02$). The indirect effect from perceived ownership remained significant even with the covariates (effect = 0.13, BootSE = 0.07, 95%CI: 0.01, 0.28). At the 90% confidence level, serial mediation is supported even with the inclusion of the covariates (90%CI: 0.01, 0.17).

3.3.3 | Discussion

Study 3 supports H2b and H3b that the presence (vs. absence) of vibrotactile feedback triggers greater perceived control over a target product, which increases perceived ownership, and thus anticipated

[3]Details in Supporting Information S1: Appendix B.

[4]See Supporting Information S1: Appendix B for measures of both anticipated satisfaction scales.

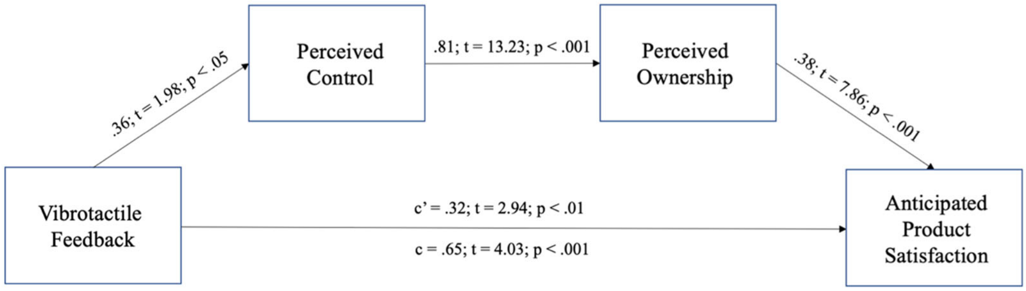

FIGURE 4 Serial mediation model in Study 3.

product satisfaction. After considering covariates (including imagery vividness, NFT, and product involvement), we further support H2b and H3b. Introducing vibrotactile feedback in the online shopping process can act as an arousing sensory cue, which signals a sense of control over the product, akin to in-store shopping experiences where consumers select items and place them in their carts. Such a sense of control can lead to feelings of ownership toward the target product and positively impact the anticipated satisfaction of the product in the postchoice stage of purchasing.

It is noteworthy, though, that purchase involvement and NFT are significant covariates, suggesting that these factors contribute to anticipated product satisfaction. More specifically, product purchase involvement decreased anticipated product satisfaction. This could be associated with the perceptions of risk involved with high purchase involvement situations and the concerns over the consequences of making a wrong choice. On the other hand, individual need for touch (NFT) seems to have contributed toward anticipated product satisfaction. As defined by Peck and Childers (2003), high NFT individuals appreciate the presence of haptic information and feel frustrated that such sensory information is not present. Thus, vibrotactile feedback, as a haptic cue, could result in more positive perceptions for these individuals and contribute to anticipated product satisfaction.

4 | GENERAL DISCUSSION

Through one pilot survey and three experimental studies, our research offers consistent evidence indicating that the integration of vibrotactile feedback significantly enhances consumers' anticipated product satisfaction in the context of in-app purchases. The pilot study utilized an online survey to investigate the theoretical mechanisms through which vibrations might influence consumers' decision journeys, ultimately impacting their purchase confidence and anticipated satisfaction. Three follow-up experiments were conducted to assess the impact of vibrotactile feedback on purchase and postpurchase evaluations. The results suggest that while vibrotactile feedback does not significantly affect purchase confidence, it does increase anticipated product satisfaction, a prospective measure of potential product satisfaction. Importantly, positive mood and attention to product information were ruled out, highlighting perceived ownership as the underlying mechanism. Study 3 adds generalizability by using a different cultural sample, including more control measures for individual differences, and testing the effects across product types. It plays a pivotal role in our research by illustrating the complete chain of effects from vibrotactile feedback to anticipated satisfaction, mediated by perceived control and perceived ownership. Importantly, the study also shows that vibrotactile feedback increases perceptions of control, which triggers psychological ownership. Overall, our research underscores the potential of vibrotactile feedback to enhance consumer experiences and perceptions of in-app purchases.

4.1 | Theoretical contributions

This research makes several theoretical contributions. First, the present research is the first, to our knowledge, to show that vibrotactile feedback can elicit high perceived product ownership, explaining more favorable consumer responses. Our research advances understanding of the effect of haptic cues experienced through vibrotactile feedback emitted from shopping apps. Specifically, the results contribute to the sensory marketing literature by documenting how vibrotactile feedback can enhance perceived control over the products in an online purchase context and result in desirable downstream consumer responses through enhanced perceived ownership. While haptic cue research, that uses different means (e.g., haptic imagery, vicarious touching with a hand, swiping on a touchscreen) also documents how haptic cues can increase psychological ownership, the means by which they are evoked differ. Specifically, we document the process whereby vibrotactile feedback increases psychological ownership as manifesting through increased perceived control over the object. In contrast, prior research investigating haptic cues identifies this through imagined touch, either through imagining that the virtual hand is "their" hand (Luangrath et al., 2022), or swiping across the touchscreen such that they touch the digitalized product vicariously (Hattula et al., 2023), and so forth. As such, vibrotactile feedback leads to a different psychological process of ownership. This is particularly interesting, as it reveals that even though the vibrotactile feedback experienced in this context is nondiagnostic (i.e., does not help in assessing the haptic properties of the product) and merely mimics the experience of placing a product in the shopping cart in the physical environment, it can result in enhanced anticipation product satisfaction because of enhanced perceived ownership.

Since touch is absent in online shopping, with exceptions, few studies have explored methods to increase perceived ownership to positively affect the postpurchase stage. Predominantly these approaches have taken a haptic imagery perspective (e.g., Cowan et al., 2021; Spears & Yazdanparast, 2014; etc.) despite advances in technology which enable more sensorial haptic senses. Likewise, other research in digital channels suggests that enhanced sensory information provides a sense of control, which helps consumers evaluate products (Klein, 2003). As such, we bring these two areas together and complement existing literature by showcasing vibrotactile feedback as another means to enhance perceived control, and thus perceived ownership. Interestingly, in the context of m-commerce with an inherent touch interface (see Hattula et al., 2023), our results suggest that vibratory stimuli can amplify the interface's impact on perceived ownership, expanding our understanding of how sensory cues can influence consumers' psychological responses in the absence of physical touch.

Second, our results suggest that vibrotactile feedback might trigger the psychological ownership motivation of stimulation, related to effectance. In explaining various motives for psychological motivation, Peck and Luangrath (2023) argue that stimulation is the least researched of all motivations and cite Luangrath et al. (2022) as the single piece of research exploring stimulation, though their research only does so in a single study using virtual reality. They find that the stimulation experienced from VR heightened perceived ownership because of the stimulation from the environment (e.g., no differences across three conditions). Vibrations, in particular, are a form of arousing stimulation that leads to similar effects (Eid & Al Osman, 2016; Penasso et al., 2023; Radhakrishnan et al., 2023). As such, we contend that stimulation might not only be motivated visually (e.g., virtual reality) but also from haptic inputs (e.g., vibrotactile feedback) and so contribute to this literature.

Third, these findings potentially reconcile conflicts in extant literature about the effect of vibrotactile feedback on responses: some suggest a negative effect (e.g., Manshad & Brannon, 2021), some a positive effect (e.g., Hampton & Hildebrand, 2020), and others attributing it to certain conditions (e.g., Racat & Plotkina, 2023). Further, while previous literature explored the effects of vibrations on consumer responses in health domains (Hadi & Valenzuela, 2020) and affecting the purchase stage (e.g., Manshad & Brannon, 2021), we provide evidence of its consequences in a retailing context affecting anticipated satisfaction. These effects might occur because we used preexisting mobile device settings, which have been designed to be pleasant, rather than manipulate vibration modes. Additionally, our research enhances literature from other touchscreen devices, suggesting that vibrotactile feedback can enhance the touch-mediated benefits already inherent in touching a device (e.g., Hattula et al., 2023). Studies across Chinese and UK samples show consistent effects across individuals and products. Findings highlight the unique impact of vibrations compared to other haptic stimuli like imagery and touchscreen interfaces.

Furthermore, our research simplifies prior literature by showcasing the main effect of vibrotactile feedback on evaluations. Specifically, extant research includes various contingencies for demonstrating the effect of vibrotactile feedback on consumer evaluations. For example, prior research has argued that vibrotactile feedback increases purchase intentions only when individuals perceive vibrations (Racat & Plotkina, 2023) or experience specific vibration durations (Hampton & Hildebrand, 2020) or intensities (Manshad & Brannon, 2021). While our research also hints that contingencies may be necessary at the purchase intentions stage, the findings highlight a simplified effect of the presence of these vibrations on postchoice evaluations (e.g., anticipating expected satisfaction arising from a purchase). Our research identifies that current device vibration modes have a pronounced, direct influence on postchoice evaluation through perceived ownership, based on facilitating perceived control.

4.2 | Practical contributions

The research offers practical implications for retailers and brands. We recommend incorporating vibrotactile settings that allow consumers to experience feedback when adding items to their shopping cart. Importantly, mobile users consider the quality of the vibration motor important for their device (Lucks, 2021) and so vibration modes have a prominent role in consumer use of their mobile devices. As such, the vibration mode can enhance perceived ownership and anticipated satisfaction, contributing to more positive postpurchase evaluations. The incorporation of vibrotactile settings is expected to be easily possible for online retailers, as it does not require changing how the product is presented (e.g., it does not require demonstrating a hand touching a product) as suggested by previous research (see Luangrath et al., 2022), which also may appear less natural if all products have hands touching them.

The research also expands the potential scope where "touching" might induce psychological ownership. In previous studies, research has focused on products where imagined touch has a prominent role. However, because vibrations do not need to pertain to product touch, perceived ownership might extend beyond physical products to include services. For example, a beauty retailer might include vibrations within in-app purchases when individuals place a salon service in their shopping cart. Given that services are inherently intangible, vibrations might offer a means to make consumers feel more in control of their purchase, which should increase perceived ownership over the service.

It is noteworthy that while these vibrations may not directly address abandoned shopping carts, they can positively influence anticipated product satisfaction, which is crucial as consumers tend to evaluate their purchases less over time. Especially when ordering online, canceling an order is easy for customers to do, which means that vibrotactile feedback might provide a solution for retailers. While we did not research other contexts, we believe that these effects can also translate to other domains, such as donations on social media or even logging dietary or exercise activities. Both of these activities can contribute to positive well-being and prosocial behaviors.

For offline retailers and brands, we include a few considerations. For more traditional brick-and-mortar retailers, we suggest self-checkout/purchase devices to facilitate consumer buying and enhance perceptions. For instance, supermarkets could implement devices that allow users to scan items as they add them to the shopping cart, each addition accompanied by a vibration to reinforce the purchase decision. Similarly, retailers like Amazon Go, which eliminate the checkout phase through artificial intelligence, could employ vibrations on consumers' mobile devices to improve satisfaction with purchases. For example, upon exiting an Amazon Go store, consumers might feel a small vibration. For less traditional brick-and-mortar stores (e.g., made-to-order furniture stores, high-end clothing rentals), where consumers may not have an object to take home immediately or may not touch the product that they will possess, integrating vibration-enabled technology during the purchase process could promote postpurchase satisfaction.

4.3 | Limitations and future research

We acknowledge the limitations of the current research. First, we recognize the scope of our research is confined to mobile-app shopping contexts. Given that prior research finds that touch interfaces themselves (e.g., iPads, iPhones) increase perceived ownership and purchase confidence (Hattula et al., 2023), it would be worthwhile to confirm how vibrations add to or reinforce the perceived ownership effect. Particularly, we encourage future researchers to test multiple haptic cues (e.g., haptic imagery on top of touch interface) and various wearable devices to identify whether these cues have a compounding or reinforcing effect. Along these lines, we also encourage future research to consider how in-person purchasing experiences are affected by vibrations.

Second, our research tests the effects of vibrotactile feedback on consumer outcomes, aiming for generalizability. As such, we did not control for other factors or elements in a realistic shopping experience. Other studies, though, consider moderators such as individual self-control (e.g., Madzharov, 2019), maximizing mindsets (e.g., Liu et al., 2023), or even the product experience and emotions (e.g., Huang et al., 2023). We advocate for future researchers to examine boundary conditions, such as individual differences, motives, and experience dimensions (e.g., services). Moreover, we encourage other researchers to test a more comprehensive model examining all stages of the consumer decision journey to map out the cognitive versus affective routes to each stage. While our research adopted a more cognitive information processing perspective, similar research (Racat & Plotkina, 2023) has considered the effect, testing Melumad and Pham's (2020) process by which mobile devices can increase purchase comfort and decrease risk.

As mentioned in the second limitation, another noteworthy limitation of our study is the individual variability in the perception of vibrotactile frequencies. Sensory perception, particularly that of tactile stimuli, is subject to a range of physiological, neurological, and psychological factors that can differ from person to person (Cholewiak & Collins, 2013). For instance, the density of mechanoreceptors in the skin, neurological processing capacities, and even cognitive interpretations based on past experiences can all influence how vibrotactile feedback is perceived (Goodman & Bensmaia, 2018). Importantly, these perceptions are important when considering consumer decision making (Racat & Plotkina, 2023). This variability presents a challenge in standardizing haptic feedback in consumer electronics. While our study treated the vibrotactile stimulus as a uniform input, future research could explore these individual differences more deeply. It could, for example, examine how factors like age, tactile acuity, and even cross-modal sensory integration contribute to the subjective experience of haptic cues. Furthermore, personalized haptic feedback, which adjusts the intensity or pattern of vibration according to the user's sensory profile, could be an intriguing avenue for technology developers. Such customization might enhance the user experience and the effectiveness of haptic feedback in consumer interfaces.

Fourth, it is important to recognize that our research design included stringent controls over the experimental apparatus, particularly in terms of the devices used and their vibration settings. While this approach was instrumental in ensuring consistency and reliability in the experiment, it potentially introduced a limitation. Specifically, participants were required to use devices that were not their own in Studies 1 and 3, which might have impacted their comfort and ease of use. This deviation could have influenced their interaction with the experimental setup, thereby affecting their responses. Recognizing this, future studies may consider allowing participants to use their own devices or incorporating a familiarization period with the experimental devices to mitigate this potential source of discomfort or bias.

Finally, we call for a broader range of vibration application scenarios and tools. Our research is limited in that it only examines m-commerce activities even though many devices can provide vibrotactile feedback (e.g., smartwatches, smart glasses, and other wearable devices). Other portable devices might provide different outcomes as they have different purposes. For instance, if a smartwatch were to vibrate while sending a personalized coupon, would the same effects as the current studies exist? Or, because smartwatches are designed more around efficiency and performance, would they fail to evoke the same responses? It could also be the case that more utilitarian devices (e.g., smartwatch) versus hedonic might influence decision making differently depending on the context (e.g., experience vs. product) or even the consumer mindset and motivation (e.g., browsing vs. searching). Similarly, we encourage other researchers to consider prosocial and well-being contexts, such as donations and food-logging.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Li, J., Cowan, K., Yazdanparast, A., & Ansell, J. (2024). Vibrotactile feedback in m-commerce: Stimulating perceived control and perceived ownership to increase anticipated satisfaction. *Psychology & Marketing*, 1–21. https://doi.org/10.1002/mar.22008