Good Vibrations: Consumer Responses to Technologically-Mediated Social Touch

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Device notifications are often administered with vibrotactile sensations (e.g. on mobile phones, wearables), yet little research has examined the psychological and behavioral implications of this haptic feedback. We explore how vibrotactile alerts can represent technologically-mediated social touch, and ultimately influence both performance and certain incidental judgments (e.g. sender attributions).

Never Out of Touch: New Insights from the World of Haptic Engagement

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Paper #1: Grip not to Slip: How Haptic Roughness Leads to Psychological Ownership

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Paper #2: Good Vibrations: Consumer Responses to Technologically-Mediated Social Touch

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Paper #3: Multisensory Integration of Touch and Vision During Product Evaluation and Choice

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Paper #4: It Feels Softer Than It Looked: Contrast-Priming Effects of Touch-Screen Users in Multi-Channel Shopping

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SESSION OVERVIEW

Research has demonstrated the fundamental role haptics play in shaping consumer outcomes (Holbrook 1983, Peck and Childers 2003). For example, studies have documented the influence of "mere touch" on product evaluations (Peck and Shu 2009) and the effect of haptic sensations on taste perceptions (Krishna and Morrin 2008). As a consequence, tactile considerations are becoming increasingly important in product design (Vanhemert 2015). However, haptic sensations vary in their characteristics and can be delivered through various different mediums. This suggests that the consequences of haptic engagement are by no means obvious in nature, and there are many complex mechanisms through which touch might exert its effects on consumer responses.

Our session advances research on haptics and consumer behavior by providing a nuanced understanding of how, when and why haptic cues might impact consumer responses. Across four papers, we document surprising responses to haptic cues in a wide range of behavioral contexts: in-store shopping, online browsing, and interpersonal communications. The papers examine various features of tactile cues, including texture (e.g. soft vs. rough), shape (e.g. round vs angular) and vibrotactile feedback (delivered electronically); and demonstrate that these haptic sensations can influence appraisals of the touched stimulus itself (in papers 1 and 4), but also impact incidental judgements (in papers 2 and 3). Accordingly, while each paper individually documents the importance of touch in a different consumer context, collectively the session demonstrates that the antecedents, behavioral outcomes and situational applications of haptic engagement can vary greatly.

In the first paper, Ruan, Peck, Tanner and Wang demonstrate that because rough (vs. smooth) objects are easier to grip, haptic roughness increases feelings of control, and accordingly leads to greater psychological ownership and prolonged interactions. In the second paper, Hadi and Valenzuela find that vibrotactile sensations (delivered through mobile phones and wearables) can represent technologically-mediated social touch, and ultimately influence both performance and certain incidental judgments (e.g. sender attributions). Streicher and Estes explore how haptic exposure to an object can facilitate visual processing and choice of other seen products. Finally, Chung, Chakravarti, and Zwick examine how online product research via different interfaces (e.g. desktops vs. tablets) can subsequently influence haptic judgements offline. All of these papers are in advanced stages of completion, with multiple studies run.

Importantly, these papers highlight that there are many different processes through which haptic cues might impact consumer responses. We accordingly draw upon various theoretical frameworks to explain the behavioral outcomes: psychological ownership (Ruan, et al.), mediated social touch (Hadi and Valenzuela), crossmodal fluency (Streicher and Estes), and contrast-priming (Chung et al.). By focusing on the underlying processes, we address calls to more critically examine the mechanisms through which sensory cues exert their effects (Krishna 2012). The progressive approaches and novel results are sure to induce a lively discussion, and are likely to appeal not only to haptic/sensory researchers but to a broader audience interested in product design, multi-channel retail, and consumer-technology interaction.

Grip not to Slip: How Haptic Roughness Leads to Psychological Ownership

EXTENDED ABSTRACT

In a series of studies, we found that haptic roughness leads to a greater perception of psychological ownership, and longer interactions, compared to smoothness. We conjecture that this is because rougher objects are easier to grip leading to more control, an antecedent of psychological ownership.

As one of the most important sensations, touch is prevalent in consumers' interactions with products. We touch a mouse when using computers; we touch its cover and screen when using a cell phone; we touch money or credit cards when consuming. It has also been well established by previous research that haptic sensation plays an important role in consumers' decisions and evaluations of products (e.g., Holbrook 1983; Peck and Childers 2003). However, in the domain of marketing and consumer behavior, most prior research on touch focuses on the individual aspect (e.g., Citrin et al. 2003; Martin 2012; Webb and Peck 2015), the comparison between the presence and absence of touch (e.g., Grohmann, Spangenberg and Sprott 2007; Peck and Shu 2009) and the valence of touch (e.g., Peck and Wiggins 2006). Limited research has explored the effect of different tactile attributes of products and the influence they may have on consumers.

In this research, we investigate the effect of haptic roughness on psychological ownership. We hypothesize that haptic roughness, compared to smoothness, would increase people's physical control over the product being touched, which would, in turn, lead to greater psychological ownership (Furby 1980; Pierce, Kostova and Dirks 2003). We next report three studies in which we find empirical evidence supporting our hypothesis.

In Study 1, we selected two sports bottles as stimuli, one of which has a textured surface and the other of which has a smooth surface, with all other attributes being the same. Participants were randomly given one of the two sports bottles and were told that they had three minutes to evaluate the bottle, after which they filled out a questionnaire asking their evaluations of the bottle including the measure of psychological ownership. Three items measuring psychological ownership—"I feel like this is my bottle," "I feel a very high degree of personal ownership of the bottle," and "I feel like I own this bottle"— each on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree) ($\alpha = .83$), were embedded in the questionnaire. We also included the valence of touch, the weight of the bottle, the appearance of the bottle, and how easy it was to hold. The results supported our main hypothesis that participants had greater psychological ownership towards the sports bottle with a textured surface than the one with a smooth surface (*M*s = 3.44 vs. 2.57; $F(1, 50) = 6.61$, $p < .05$), with no significant differences on all other attributes of the bottle (all *p*s > .10). We expected a difference in terms of the easiness to hold each bottle, as it was an indicator of physical control. Yet the results only showed the expected pattern, but with the difference being non-significant (*M*s = 4.04 vs. 3.71, $F(1,50) = .50$, $p > .10$). We suspect it was because the single item did not reflect all aspects of physical control and thus was not a good measure.

Study 2 sought to replicate and extend the findings of Study 1 using a behavioral measure. Specifically, we asked participants to view and evaluate commercial posters on the computer. They were required to view at least six ads. After six ads, they could continue to view more ads or stop at any time as they wished, as we told them in the instructions: "If you are enjoying the task, continue to view ads. If you are not enjoying the task, feel free to stop at any time after the first six ads." Participants were randomly assigned to one of the two conditions, which differed only in the computer mouse used. In one condition, we used a normal mouse with its surface being relatively smooth, whereas in the other condition, we used the same mouse but made its surface rough. Consistent with our hypothesis, compared to the smooth mouse, participants using the rough mouse viewed and evaluated more posters (*M*s = 21.77 vs. 15.29; $F(1, 146) = 5.27$, $p < .05$), and felt that they had more control over the mouse (*M*s = 5.87 vs. 5.29; $F(1, 146) = 6.17$, $p < .05$). However, we failed to find that control mediated the effect of roughness on the number of posters viewed.

Both Study 1 and Study 2 involved real touch. According to Peck, Barger and Webb (2013), however, even haptic imagery would increase perceived ownership. Therefore, we wanted to explore, in Study 3, whether the effect of haptic roughness would still hold when touch is imagined. In specific, participants were presented with a poster of a mug and were then asked to imagine they were holding and playing with the mug with their hands for approximately 30 seconds. At the end of study, participants indicated their perceived ownership toward the mug ($\alpha = .88$). The only manipulation was the verbal description on the poster: we described the mug as textured in the textured condition and smooth in the smooth condition. Consistent with our hypothesis, the results revealed a significant positive effect of haptic roughness on perceived ownership (*M*s = 4.21 vs. 3.17; $F(1, 42) = 5.82$, $p < .05$).

In Study 1, participants felt more ownership of the textured bottle compared to the smoother bottle. We expected this to be due to the increased physical control, an antecedent of ownership. However, this did not reach statistical significance. Study 2 revealed that using a rough mouse (compared to a smooth one) affords more control and participants viewed more ads when using the rough mouse. However, control did not mediate the relationship between texture and ownership as expected. In the final study haptic roughness increased ownership feelings, even when participants were not actually touching, but imagining touch. From our research, we conclude that a textured surface, compared to a smoother surface, encourages longer interaction and more ownership. However, while control may be increased with a textured surface, this may not be the only mechanism through which texture leads to more ownership. Further research is required to delve more deeply into the process by which this occurs.

Good Vibrations: Consumer Responses to Technologically-Mediated Social Touch

EXTENDED ABSTRACT

Device notifications are often administered with vibrotactile sensations (e.g. on mobile phones, wearables), yet little research has examined the psychological and behavioral implications of this haptic feedback. We explore how vibrotactile alerts can represent technologically-mediated social touch, and ultimately influence both performance and certain incidental judgments (e.g. sender attributions).

While gadget designers have traditionally focused on visual and auditory functions of user interfaces, increasing attention has turned to haptic considerations in technological product design (Vanhemert 2015). Vibration is by far the most widely used haptic feedback mechanism in small devices (e.g. mobile phones and wearables), because the technology is compact and relatively low in power usage (Bark et al. 2008). Yet despite the widespread use of vibrotactile feedback, surprisingly little research has examined consumers' psychological and behavioral responses to it. Some work has documented the attentional and efficiency-based benefits of vibrotactile feedback (e.g. vibrotactile warnings improve reaction times of fighter pilots, Sklar and Sarter 1999). However, in everyday consumer product applications, vibrotactile stimulation is often accompanied by a message, call notification, reminder, or other communications content. We suggest that in addition to performing the utilitarian function of alerting consumers, these vibrotactile sensations may also carry conceptual importance. Specifically, we propose that telecommunication content accompanied by a haptic alert might be perceived differently than the same content accompanied by alerts in alternative modalities (e.g. auditory). This hypothesized distinction is supported by research that suggests our sense of touch operates differently than other modalities, in that it represents our "most proximal" sense (Montagu and Matson 1979). That is, in contrast to visual, auditory, and olfactory cues, which might be perceived while a stimulus is at a distance, haptic cues typically require the stimulus to contact one's body (Jones and Lederman 2006, Peck 2010). This characteristic is especially important in a telecommunications context, where interpersonal correspondence transpires over a distance. We argue that because haptic sensations are so uniquely associated with immediate proximity and contact, telecommunications accompanied by haptic sensations should help make the exchange feel more personal and human-like.

Scholars in computer science indeed suggest that vibrotactile feedback technology can allow consumers the ability to "touch" each other in the distance, and have deemed this a form "mediated social touch," in that it allows users to convey and receive haptic information through technology (Haans and Ijsselsteijn 2006). This conceptualization implies that in certain instances, vibrotactile feedback may essentially function as a surrogate for interpersonal touch. Interpersonal touch itself has been shown to evoke a sense of closeness and human connection, and effectively influence people's social behavior (e.g. increasing compliance with requests, improving attitudes towards services, and strengthening bonds between people; see Gallace and Spence 2010 for a review), regardless of whether or not the tactile contact itself is remembered explicitly. In the current research, we argue that just as interpersonal touch can improve consumer responses, so can technologically-mediated social touch.

We hypothesize that vibrating alerts will lead consumers to perceive communications as more personal, and this technologically-mediated social touch should ultimately improve individuals' evaluation of the interaction and their performance on related tasks. Three laboratory studies provide support for our hypothesizing. In study 1, participants (N=60) received mobile phones set to either beep or vibrate upon receiving text messages. Participants received a series of text messages intended to provide encouragement (e.g. "You're doing great! Keep it up,") while attempting a physical challenge (balancing on one leg for 5 minutes). Binary logistic regression confirmed a significant main effect of message alert on performance (χ^2=4.29, *p*<.04), in that participants in the vibrotactile alert condition were more likely to successfully remain on one leg for the duration of the challenge than those in the auditory alert condition.

In study 2 (N=86), we explored the impact of vibrotactile alerts in a different product category (smartwatches) and a different task (a "steps challenge," where participants marched to get as many steps as possible in five minutes). Participants again received a series of encouraging text messages. Messages were accompanied by one of three alerts: auditory vs. vibrotactile vs. auditory+vibrotactile. Adding the third condition allowed us to test whether Study 1 effects were driven by the inclusion of vibrotactile sensation or by the absence of auditory cues. Pedometers on participants' smartwatches recorded the number of steps achieved, and ANOVA results confirmed a significant main effect of message alert on the steps achieved by participants (*p* <.02). Planned contrasts demonstrated that while there was no difference in performance between the vibrotactile vs. auditory+vibrotactile conditions, subjects in both these conditions outperformed those in the auditory condition, suggesting that improved performance was driven by the inclusion of a vibrotactile cue.

Study 3 (N=56) was similar to study 2, but in addition to measuring performance, we collected several potential process measures: sender attribution ("Who do you think was sending the text messages?" rated on by whether attribution was to an automated system/machine or a human source), message evaluation (e.g. "The text messages were nice,"), and self-reported arousal. Further, we measured overall technological competence as a potential moderator, since previous research suggests low competence should exaggerate the value of haptic feedback. ANOVA results confirmed a significant positive effect of vibrotactile alerts on the number of steps participants performed (p<.02). While there was a marginal effect of vibrotactile alerts on arousal (p<.07), this did not mediate the effect on performance, and the impact of vibrotactile alerts on performance was still significant when controlling for arousal (p<.04). We used a sequential mediated moderation model to examine the mechanism through which a message alert x technological competence interaction might influence task performance. The sequential mediation analysis (Hayes 2013, model 6) supported our hypothesized path: Message Alert x Technological Competence interaction → Sender Attribution → Evaluation of Messages → Task Performance (95% CI excluding zero). This suggests that especially for those low in technological competence, the positive effect of the vibrotactile alert on task performance was due to increased human attribution and evaluation of the communication respectively.

In sum, our studies support that vibrating alerts lead consumers to perceive communications as more human-like. This technologically-mediated social touch improves individuals' evaluation of the interaction, contingent on their level technological competence, and, subsequently, their performance on related tasks. These findings have important implications for consumer compliance in multiple domains such as health or physical performance training.

Multisensory Integration of Touch and Vision During Product Evaluation and Choice

EXTENDED ABSTRACT

Touching a product affects evaluation of that product. Here we demonstrate for the first time that grasping one product increases choice of another haptically similar product, and that this effect is mediated by visual fluency and moderated by the visual density of the product display.

Touching a product affects perception and evaluation of that product (Grohmann et al., 2007; Krishna, 2006; Peck & Childers, 2003; Streicher & Estes, 2015). Shape perceptions from touch activate a corresponding shape representation in the visual cortex (Masson et al., 2015; Snow et al., 2014), and hence haptic exposure to a familiar object facilitates visual recognition of that object (Reales & Ballasteros, 1999; Pesquita et al., 2013). Can haptic exposure to an object facilitate visual processing and choice of *other* seen products of the same shape and size? This would be important because consumers often visually evaluate products while grasping some other object (e.g., another product, a cell phone, etc.).

Grasping a Red Bull slim can should increase the *visual fluency* of other slim cans, because the haptic exposure activates a visual shape representation, which then visually primes recognition of objects with that shape. And given that fluency improves product evaluations (e.g., Janiszewski & Meyvis, 2001; Lee & Labroo, 2004), we predicted that grasping a product increases choice of another product that is haptically similar but spatially distant (**H_1**), and that this effect is mediated by visual fluency (**H_2**).

As visual perception becomes less reliable (e.g., blurred), haptic perception assumes a greater role in object recognition (Ernst & Banks, 2002; Pesquita et al., 2013). One marketing factor that may influence the reliability of visual information is the density of the product display: Relative to sparse displays, crowded displays reduce the visual focus on any given product. We therefore predicted that the effect of haptic exposure on product choice is larger among crowded product arrays than among sparse arrays (**H_3**).

Study 1 tested **H_1** and **H_2**. Participants (N = 140 students) extended their right arm directly out to the right while viewing a computer display straight ahead. Some participants had a 0.5-litre plastic bottle or 0.33-litre aluminum can of Fanta placed into their hand (*visuo-haptic* group), whereas others viewed the display without grasping anything (*visual-only* group). Simultaneously with placement of the product in the hand (or not), original-size images of a Fanta bottle and can appeared on the computer display straight ahead. Because the right arm was extended laterally while the gaze was directed ahead, participants were unable to see the haptic stimulus. The haptic stimulus was always the container appearing on the right position of the display. Participants rated the visual fluency of both products (adapted from Labroo et al., 2008), and chose one of them to have as reward for participating.

A product (left, right) × group (visual-only, visuo-haptic) ANOVA on visual fluency ratings indicated an interaction, $F(1, 138)$ = 4.57, p < .05: Whereas the left product was equally fluent across groups, p > .3, the right product was more visually fluent in the visuo-haptic group than in the visual-only group, $t(138)$ = 2.33, p < .05. The right product was also chosen significantly more often among the visuo-haptic group (60.0%) than among the visual-only group (42.9%), χ^2 (1) = 4.12, p < .05, thus supporting **H_1**. Visual fluency ratings mediated that effect of haptic exposure on product choice (95% *CI* of indirect effect = .0848–2.622), supporting $\mathbf{H_2}$.

Study 2 tested $\mathbf{H_3}$. Participants ($N = 205$) stood with their eyes closed and extended their right arm backward. An experimenter placed one of three chocolates (i.e., 50-gram bar, a 60-gram square, or an egg) in the participant's hand, and participants then viewed a product arrangement on a table. The *sparse display* group saw one chocolate bar and one chocolate square on the table, whereas the *crowded display* group saw 18 replicates of each. In the *haptic match* condition, participants grasped either the chocolate bar or the chocolate square, whichever was presented on the right of the display. In the *haptic mismatch* condition, participants grasped the chocolate egg. An experimenter then removed the haptic stimulus and product arrangement, and participants chose one of the previously seen products as reward for participating.

A logistic regression with haptic exposure (mismatch = 0, match = 1), visual density (sparse = 0, crowded = 1), and their interaction as predictors, and with product choice (left = 0, right = 1) as the criterion, revealed a main effect of haptic match, *Wald* $\chi^2 = 4.15$, $p < .05$. Participants were more likely to choose the product on the right of the display while grasping something of the same shape than while grasping something of a different shape. The interaction was also significant, $\chi^2 = 5.73$, $p < .05$, revealing a stronger haptic effect with crowded displays ($\chi^2 = 9.99$, $p < .01$) than with sparse displays ($\chi^2 = 3.52$, $p = .06$). In sum, grasping one product increased choice of another haptically similar product, especially with crowded visual displays, thus supporting $\mathbf{H_3}$.

Discussion. Prior studies had shown that grasping a product can affect consumer behaviors toward that grasped product (e.g., Grohmann et al., 2007; Peck & Childers, 2003; Streicher & Estes, 2015), and neuroscientists speculated that haptic exposure to one object may facilitate visual processing of another object (Gephstein et al., 2005). The present research provides the first evidence that grasping one product can affect the visual processing and choice of another product that is haptically similar but spatially distant. Moreover, our experiments controlled both conceptual fluency (because the product choices were always of the same brand and product) and motor fluency (because the haptic matches and mismatches entailed the same body posture and motor action) while targeting a specific perceptual modality (i.e., vision), thus isolating the processing mechanism to visual fluency. Another novel contribution is to demonstrate the compensatory relationship between vision and touch in product evaluation. When visual information is somehow degraded (e.g., by decreasing clarity), then haptic information assumes a greater role in object recognition (Ernst & Banks, 2002; Pesquita et al., 2013). Consequently, we showed for the first time that the effect of touch on product choice is accentuated by crowded product displays, which may overload the visual system and hence increase reliance on haptic information.

It Feels Softer Than It Looked: Contrast-Priming Effects of Touch-Screen Users in Multi-Channel Shopping

EXTENDED ABSTRACT

In multi-channel retailing, very little research has examined the impacts of webrooming (researching product options online) on subsequent offline retail experiences. In this study, we examined (1) whether webroomers evaluate physical products differently from single-channel shoppers and (2) whether computer device types moderate webroomers' product evaluations.

Before purchasing a product, consumers often compare product options in multiple retail channels by switching between online stores and brick and mortar stores. One of these multi-channel phenomena is called *webrooming*, which involves extensive online product comparisons followed by visits to a brick and mortar store (Stilson, 2014). In 2014, about 88% of consumers said that they webroomed, in that they regularly researched products online before purchasing from a physical store (Interactions, 2014). In this paper, we examined whether webrooming influenced consumers' final product evaluations and how the evaluations differed by computer device type.

Research has found that repeated exposure to a trait activates the meaning of the trait, and the meaning further primes or activates closely associated trait categories (Higgins, Rholes, & Jones, 1977). This assimilation/contrast effects are visible in retail environments. Consumers tend to make judgments that either assimilate or contrast to the primed trait of a salesperson (Stafford, Leigh, & Martin, 1995). When primed to a positive brand, consumers evaluate other brands negatively (Levin, 2002). When primed to price, consumers choose a more affordable product considering price over quality (Mandel & Johnson, 2002). It is likely that webroomers encounter similar priming experiences because they browse multiple products with similar properties. For example, when they view multiple blankets, they are repeatedly exposed to the softness of blankets. However, very little research has examined the impacts of extensive online browsing on subsequent offline retail experiences even though webrooming has been one of the common shopping trends for the last few years. In this study, we examined (1) whether multi-channel shoppers (webroomers) evaluate physical products differently from single-channel shoppers and (2) whether computer device types moderate the impacts of webrooming on product evaluations.

Experiment 1

We used a 2 (objects: soft vs. firm) x 2 (devices: touch interface vs. mouse) between-subjects design. Participants were randomly assigned to four different conditions, which differed by the type of object and device. Eighty university students participated in the experiment.

We conducted the experiment in a behavioral research lab. The touch-interface conditions used a tablet PC, and the mouse conditions used a desktop computer with a mouse, a keyboard, and a desktop monitor. In each device condition, twenty browsed soft objects only while the other 20 interacted only with firm object. After viewing similar *firm* products online, participants evaluated a physical target object as being *softer* than those who had been primed to softness. After viewing *soft* products, they evaluated the same target as being *firmer* than those exposed to firmness. However, this effect was statistically significant among mouse users only ($p < .001$), and the device type did not differ from each other ($p > .05$).

Experiment 2

To compare product evaluations between multi-channel and single channel shoppers, we added a single channel condition to the previous design, using 2 (objects: soft vs. firm) x 3 (channels: touch interface vs. mouse vs. no device) between-subjects design. The no-device condition (single channel) did not have online sessions prior to examining a set of physical products while the two other conditions (multi-channel) browsed either soft or firm products online using either a touch interface or a mouse. We conducted this experiment in the same lab where we conducted the first experiment, and 213 university students participated.

We found a significant interaction effect between channels and products on product texture evaluations ($F(2, 207) = 33.66$, $p < .001$). Both multi-channel conditions (touch interface and mouse) evaluated the same products they saw online as being firmer than the single channel condition, indicating significant contrasting effects. In the soft-object conditions, touch-interface users (vs. mouse) evaluated the same products as being firmer ($p < .03$), but the device effect was not significant in the firm conditions ($p = .12$). Attitudes toward the same physical products were more positive in the single-channel conditions than in the multi-channel conditions ($F(2, 207) = 10.63$, $p < .001$), and this difference was significant in the soft-object conditions only.

Overall, the findings of this study contribute to marketing research and practitioners in several ways. First, our study is one of the first studies on webrooming behavior and fills the gap in the multi-channel retail literature. Second, this study provides strong evidence that webrooming behavior affects consumers' product evaluations at brick and mortar stores. Third, this evidence suggests that practitioners should better capture an integrated analysis of their customers' activities in both online and offline channels in order to reduce the gap between webroomers and single-channel shoppers. Lastly, the findings highlight the role of computer input devices in multi-channel shopping experiences and suggest that consumers are more likely to find the texture of physical products different from what they see online if they use a touch interface (vs. mouse).

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