

Understanding the Adoption of Smart Textiles: Insights from Innovation Theory and Interpretative Phenomenological Analysis of Interactive Experiences [†]

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Abstract: This paper investigates the utilisation of smart interactive products by millennial consumers in the fashion industry and how their perceptions and experiences influence the adoption of such products. To achieve this, it employs a generational perspective. It utilises Midgley and Dowling's theory of predisposition to innovate as its theoretical framework, providing a comprehensive exploration of consumers' experiences with these products. To bridge the gap in understanding consumers' limited adoption of smart textile (ST) products, this research employs Interpretive Phenomenological Analysis (IPA). This methodological choice is driven by uncovering how real-life experiences impact consumer behaviour in this context. Expanding on previous work, the research comprised two separate qualitative studies utilising Interpretive Phenomenological Analysis (IPA). Participants interact with specific interactive smart textiles, namely, the Levi's Jacket by Google. Participant recruitment utilised the snowballing method, which was adapted due to the constraints imposed by the COVID-19 pandemic.

Keywords: smart interactive products; millennial consumers; fashion industry; perceptions; experiences; adoption; theory of predisposition to innovate; smart textile (ST) products; interpretive phenomenological analysis (IPA)



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1. Introduction

The evolution of smart textiles can be traced back to the 1960s with shape-memory materials and, in the 1970s, polymeric gels. The term “smart textiles” was introduced in Japan in 1989 by Ref [1], and the integration of smart materials into textiles gained momentum in the 1990s, culminating in the manufacture of textiles with electronic semi-conductive components in the early 2000s. Smart textiles, as defined by Ref [2], exhibit repeatable behaviours in response to stimuli such as strain or temperature change, and this behaviour can be integrated into the fabric or fibre structure classified as passive, reactive, or interactive.

Notably, not all materials labelled smart textiles possess “smart” properties, and some studies interchangeably refer to them as technical textiles. The literature on smart textiles, also known as smart garments, smart clothing, smart fabrics, or electronic textiles, categorises them into passive, active, and very/ultra-smart textiles [2–4].

While multiple definitions exist for smart textiles, commonly referred to as smart clothing, this research adopts the definition proposed by [2], where very smart textiles can react to multiple contextual information and are aware of their own status.

However, Ref. [1] distinguishes active fabrics as those capable of detecting environmental signals, such as temperature, light intensity, and pollution, to decide how to react using textile-based actuators like displays, micro-vibrating devices, LEDs, and OLEDs.

The embedded electronic devices can communicate wirelessly using databases or servers with artificial intelligence. For this research, this definition of active fabrics aligns with the concept of smart interactive products.

The redefinition of “wearable” within the “World of Wearables (WOW)” integrates technology to measure vital signs, maintaining a central focus on the functionality and practicality of clothing [5]. This updated definition mirrors the dynamic convergence of fashion and technology in the domain of wearable devices.

Highlighting the growing importance of wearable electronics, Ref. [6] emphasises their fabrication and application advantages, including flexibility, ease of customisation, and functional integration. Transparent electronics fabrication extends their utility in diverse applications while using stretchable electronics with buckling structures shows promise in healthcare systems.

By contrast, whereas Ref. [7] emphasises the potential of e-textiles in wearables to enhance health and quality of life, integrating electronics into clothing poses challenges. These challenges include complexities in the interplay between e-textiles, devices, design, and environmental considerations, impacting factors such as washability and sustainability.

Delving into another challenge related to wearable devices, aiming to develop a charging device for electromagnetic energy-harvesting textiles as highlighted by Ref [8], and, simultaneously, research on cybersecurity and data protection for wearable technologies reveals the perceived intrusiveness of these devices, posing a risk to users’ data. This underscores the urgent need to prioritise individuals’ data protection, aligning with consumers’ rights in the digital society [9].

Utilising wearable innovation technologies, other studies crafted the electric corset employing deconstruction and reconstruction in fashion theory [10]. Their project aimed to establish interdisciplinary methodologies for wearables innovation by integrating electronics into textiles within wearable concept design. Reflecting on the making process, the authors highlight the value of embodied making practices, emphasising the significance of a single archetype wearable. They address challenges related to the novelty of the technology and propose further testing, focusing on users’ improvisational interaction with the wearable product, offering insights into barriers to innovation in wearable technologies.

In contrast, a collaboration with Google ATAP on “Project Jacquard” Ref [11] introduced novel interactive textiles through the concept of “invisible, ubiquitous interactivity”. This approach enabled the inexpensive manufacturing of interactive textiles using weaving technology. The Levi’s Commuter X Jacquard project by Google Trucker Jacket arrived in 2016, marking the first generation of interactive wearable clothing. Subsequent iterations, such as the Levi’s Trucker Jacket with Google Jacquard technology launched in 2019, showcased advancements like Bluetooth-enabled tags for additional functionalities, illustrating the ongoing evolution and integration of computational systems into everyday products.

This project utilises two examples of interactive smart clothing, namely, the Levi’s Jackets by Google, as case studies to gain insights into the lived experiences of consumers while wearing these products. The key research questions are as follows:

1. RQ1: How does consumer experience influence interpersonal fashion style?
2. RQ2: How does adopting new technologies affect consumer buying behaviour?
3. RQ3: How does the predisposition to innovate influence young millennials’ identity?
4. RQ4: How individuals predisposed to innovations understand their identity development?

The results comprehensively understand consumers’ motivations and acceptance for using interactive athleisure products. The study applies the theory of predisposition to innovativeness Ref [12], exploring participants’ experiences and personal identity, as Ref [13] outlined.

2. Materials and Methods

This research uses a qualitative approach and interpretative phenomenological analysis (IPA) as its methodological lens. As highlighted by Ref [13], phenomenological research

incorporates elements of philosophy and psychology. It involves an inquiry where the researcher provides a detailed account of participants' lived experiences and the phenomena conveyed by those participants [14]. According to Ref [15], IPA serves as a mechanism for in-depth exploration into how participants construct meaning in their personal and social worlds, primarily centred around their experiences.

This approach is pivotal for the project, as IPA captures participants' perspectives and perceptions while engaging with smart interactive clothing. It yields authentic insights into consumers' expectations, emotions, and understanding during interactions with smart wearables. These invaluable insights are crucial in guiding the future development of smart textile clothing.

Interpretative Phenomenological Analysis embodies "the notion of people as self-interpreting beings" [16]. Thus, the process involves the interpretation of their surroundings and the events they engage in. Positioning IPA securely within the realm of psychology, they observe that fostering meaningful discussions across various traditions contributes to the ongoing debate on what constitutes a viable mode of inquiry for psychology.

The chosen approach is analytical, meticulously examining participants' lives to understand their motivations for using smart interactive clothing. It seeks to explore personal experiences, focusing on an individual's subjective perception or account of an object or event.

In alignment with this perspective, the researcher scrutinised each participant's experience in detail when interacting with smart interactive textiles. The goal is to comprehend how participants' personal experiences are influenced by their perception of innovation exposure. In this case, the focus is on understanding individuals' views and perceptions while wearing a Levi's Commuter Jacket's first and second generation.

The study comprised 14 in-depth interviews, adopting the interpretive phenomenological analysis (IPA) method supported by Ref [17]. Each interview for both studies consisted of four distinct phases, spanning approximately one and a half hours. The transcripts underwent IPA coding, encompassing descriptive and linguistic stages, with subsequent development of themes and subthemes. Another critical stage involved crafting a narrative for each case to enhance the comprehensive understanding of individual accounts. The findings emphasise that the adoption is intricately linked to individuals' relationships with others, their identity shaped by a predisposition for innovation and their inherent inclination toward seeking uniqueness.

3. Results and Discussions

The empirical research findings from this chapter contribute to the understanding of the consumer adoption of smart technologies and wearables, using the theory of predisposition to innovativeness [12] through the lens of their own experiences and personal identity [13]. The findings aim to bridge a gap in knowledge by providing insights into how these factors, predisposition to innovativeness and personal identity, play a pivotal role in shaping consumers' decisions to adopt smart technologies and wearables. By examining these aspects through the lens of individuals' experiences, the research aims to contribute valuable knowledge to the field that may have been underexplored or overlooked in previous studies.

The impact of technology on the participants' social interaction is multifaceted, presenting both positive and negative aspects. A positive effect of technology has proven to be a facilitator of social connectivity in various themes. Whether through comments on products or envisioning their integration into daily life, technology has enabled individuals to establish and maintain relationships marked by curiosity and eagerness for technological advancements.

The study identified that millennial users of interactive smart textiles perceived their experiences as positive or negative, contingent upon their prior interactions with other technologies. The research revealed that if users regarded their past encounters as negative or disappointing, it significantly impacted their confidence and trust in utilising the product.

This, in turn, indirectly hindered the adoption process. The findings confirmed that human intentionality and garment intentionality intertwined and directly influenced users' perceptions. Cognitive experiences encompassed aspects of the technological product's design and functionality, influencing how users perceived, comprehended, and utilised the product during their trial phase.

The research findings suggest that the individuals' cognitive experiences were closely tied to their perception of product aesthetics. This encompassed factors such as visual appeal, intuitiveness of use, and how well the design aligned with consumer expectations. Cognitive experiences underscored that each individual could positively or negatively influence adoption. It became apparent that comprehending consumer perceptions about their interactive experiences was pivotal. Some individuals perceived technology as detrimental to their social interactions, whereas others viewed it as an enabler, facilitating social connections, product exploration, and communication regarding innovations.

Furthermore, the study highlighted technology rejection as a prominent negative consequence of using smart textiles among millennials. This rejection stemmed from technophobia, driven by concerns related to data privacy. Trust issues emerged due to product reliability, user-friendliness, and the adverse effects of malfunctions and unresponsiveness of the products, ultimately leading to rejection. Additionally, the cost and affordability of interactive smart textiles emerged as another significant factor contributing to consumer rejection. Manufacturing smart textiles incurs substantial costs, rendering them inaccessible to many consumers.

4. Conclusions

In conclusion, this study underscores that millennials' adoption of interactive smart textiles is heavily influenced by their prior technology experiences, which can either enhance or impede their confidence and trust in these products. Moreover, cognitive experiences, encompassing design, functionality, and aesthetics, significantly shape perceptions and thereby impact adoption. The research also highlights technology rejection, driven by data privacy, trust, and cost concerns, particularly for millennials. Overall, this study provides valuable insights for manufacturers seeking to improve the adoption of smart interactive products among millennials. It emphasises addressing user experiences, design, trust issues, and affordability to engage this demographic in the rapidly evolving technological landscape effectively.

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