



A Conceptual Model of Dress Embodiment and Technological Mediation in Digital Fashion

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Abstract. Dress is an embodied, physical experience which the touch-deprived sensory affordances of today's screen technologies can only simulate. However, advances in haptic and virtual technologies suggest a re-embodied experience of dress might be possible in increasingly immersive digital fashion environments. These developments are explored through postphenomenology, which posits that technology mediates and co-determines relations between humans and the world, helping to shape the socio-cultural normative and value frameworks within which such phenomena occur. A model is proposed which conceptualizes these developments and serves as an interpretive framework of dress (dis)embodiment and technological mediation in digital fashion.

Keywords: digital fashion · technological mediation · dress embodiment · haptics · postphenomenology

1 Introduction: Fashion Digitalization

Digitalization has created new venues for fashion consumption and communication [1-4] but it has also mediated [5] and de-materialized [6] the embodied practice of dress [7, 8]. Digital fashion is accessed via personal computer, tablet or smartphone touchscreen interfaces, which afford a limited range of haptic, or active touch, interaction [9]. Hence, clothes are visually accessible online, but cannot be inspected and physically tried on; in fashion e-commerce, hand and on-body touch sensations can only be simulated using audio-visual means [10]. With the exception of finger or tool interaction on a screen the sense of touch is absent.

This tactile gap between the in-person retail experience and fashion e-commerce—and, more dramatically, between in-person and digitally mediated interaction in general [11]—was underscored by the recent COVID-19 pandemic, which accelerated the digitalization of business-to-consumer and business-to-business communications and sales [12-15]. The heightened need to enrich the digital sensorium has spurred investigation in sensory and haptic imagery [16, 17] and interactive visuals providing touch-related stimuli, both in apparel e-commerce and online shopping in general [18-20]. To my best knowledge, however, research into the mediating role played by the technologies

themselves—the ways in which device affordances may co-shape and co-determine the nature and meaning of dress embodiment as it is experienced in digital fashion—is, as argued in Sect. 3, limited. To address this gap, I propose a conceptual model of dress embodiment situated within two extremes, physical to virtual, and analyze it through the lens of postphenomenology, a recent branch of philosophy of technology which builds on both phenomenology and pragmatism [21–23].

2 Touch and Dress Embodiment

Touch is an integral part of the multisensory processes which inform our perception of the world [24, 25]. Touch affects emotions, thoughts, and actions, including our clothing choices [26, 27]. Touch is the only bi-directional modality: through touch, humans acquire and transmit information [28]. In fact, what we commonly refer to as the sense of touch is a complex *somatosensory* system distributed in the whole body (as the root *soma*, from the Greek word for body, suggests). Touch is kinesthetic: when pulling on a tight pair of jeans, information travels to the brain regarding the passive and active forces involved. Touch is also tactile: while slipping on a silk blouse, or a wool sweater, on-skin shear effects and thermal qualities are similarly relayed. In fact, touch affects the experience of garments in rich and complex ways, likely impacting psychological processes and behavioral tendencies, as enlatched cognition theory [29]—a line of research in grounded cognition studies—has argued.

Approaching touch from the perspective of fashion theory [30, 31] and fashion communication [1, 32, 33] allows one to reflect on the practice of dress (of donning garments and accessories) as a socially situated act of self-expression which is also a physical, on-body phenomena; and thus, to approach dress as an *embodied* experience, as theorized by J. Entwistle [7, 8]. Fashion, she writes, “is about bodies: it is produced, promoted and worn by bodies” [7] located within social, historical and cultural contexts which define what it means to be dressed. Her approach to fashion is informed by sociology and phenomenology, particularly the writings of Maurice-Merleau Ponty [34], who emphasized the importance of the body’s role in perception and the embodied nature of subjectivity.

Such theoretical grounding further allows us to consider the effects digitalization may have on dress embodiment in *technologically mediated* business and consumer practices made possible by fast-evolving digital technologies. Until recently in the Western world, engagement with dress and fashion began at home, in front of one’s closet, or in a physical store. While retail remains a fundamental aspect of the fashion experience—as exemplified by the resurgence of in-store shopping after COVID-19 [35]—today one can dress virtually and shop electronically for a digital garment made on-demand; even traditional retail venues may incorporate such technologically-driven customer journeys [36]. The time and place of an embodied experience of dress, actively touched and felt on the body—and the perceptual, emotional, and cognitive effects it produces—has shifted together with technological innovation. From physical venues to immersive environments, digital technologies mediate, help shape and *co-determine* the experience and practice of dress and of fashion in general.

In order to explore this concept, the next section provides a succinct overview of technological mediation as theorized by postphenomenology.

3 Postphenomenology and Technological Mediation

Postphenomenology is a philosophy of technology which builds on the legacies of pragmatism and phenomenology. It was first introduced by American philosopher Don Ihde [37] and is increasingly being adopted as a method for investigating science and technology. Postphenomenology studies the nature of relations between human beings and technological artefacts, and the mediating role technology and technological innovation play in these relations. Postphenomenology does not focus on technology or technologies per se, but on the way “artefacts shape the relation between humans and the world” [38], both hermeneutically and existentially. As postphenomenology theorist Peter-Paul Verbeek (<https://ppverbeek.org/>) explains:

From a hermeneutical perspective, artifacts mediate human experience by transforming perceptions and interpretive frameworks, helping to shape the way in which human beings encounter reality [...] From an existential perspective, artifacts mediate human existence by giving concrete shape to their behavior and the social context of their existence [39].

By approaching technology through artifacts, the postphenomenological perspective “offers a rich and variegated picture of technology” which, unlike classical philosophy of technology, “does justice to its ambivalent status” [39]. Technologies *co-constitute* the subjectivity of users and the objectivity of the world these users experience: “subject and object are no pre-given entities, but get constituted in the technologically mediated relations that exist between them” [23]. Ultimately, technologies and technological developments are “mediators of human experiences and practices” [23].

To illustrate these concepts, authors Rosenberger & Verbeek discuss the example of the ultrasound, which “constitutes the unborn child as a potential patient and the expecting parents as those who are responsible for the health condition of their child” and thus, helps shape the parent-child relationship [23] but may also impact the normative and ethical frameworks concerned with the life of the fetus. To bring such concepts closer to the realm of digital fashion, let us consider the case of a consumer (the subject) whose relation to a fashionable garment (the object) she or he desires is—to some extent—shaped by the digital technology which mediates its experience; for example, a smartphone and the e-commerce site accessed by means of it. In this relation, technology affords a digital representation of the item’s physical counterpart, and the consumer must interpret a physical dress experience which is screened (quite literally) by the technology. Whilst the consumer’s emotional, cognitive, and behavioral processes will likely be affected by this, so will relations between him or her and the fashion provider, as well as the normative and ethical frameworks concerned with fashion production and consumption. The frameworks may be, for example, the norms and regulations governing processes and structures of ecommerce platforms, but also the values and meanings attached to concepts such as fashion sustainability [40, 41] or to notions of privacy and security in digital fashion [42]. “Agency,” as Rosenberg & Verbeek write, “is not an exclusively human property anymore: it takes shape in complicated interactions between human and non-human entities” [23].

As mentioned, a fundamental aspect of the postphenomenological perspective “is its focus on case studies of concrete human-technology relations to technologies” [23] such as imaging technologies, implants, mobile devices, and robotics. In the specific field of fashion, postphenomenology has been applied to the study of electronic wearables in fashion design [38] and augmented reality [43]. This suggests it is a suitable method to analyze the shifting states of dress embodiment in fashion contexts, increasingly mediated by digital technologies, and to conceptualize the implications this evolving phenomenon may have for businesses and consumer relations. Or, to paraphrase the title of Verbeek’s seminal book *What Things Do* [22], to investigate what technologies *do* to the embodied experience of dress in digital fashion.

In the next section we will address this question by discussing dress (dis)embodiment in the increasingly digitized, “real to virtual” experiences available to digital fashion consumers today.

4 Technological Mediation of Dress Embodiment

In a seminal paper by Milgram & Kishino [44] and Milgram & Colquhoun [45] the authors propose a taxonomy of real and virtual display integration intended to provide a terminology for the then “nascent fields” [45] of augmented and virtual reality. The authors begin their discussion by illustrating two parallel concepts. The first is a model of reality and of virtuality, positioned at opposite ends of a continuum. In the second model, which runs parallel to the first, the authors situate different technologies, based on the extent to which “knowledge is present in the computer about the world being presented” [45] and thus, the extent to which this world is modelled, or rendered¹, by the technologies in question. The authors then elaborate on the kinds of data and data juxtapositions needed to achieve such renderings, and provide a taxonomy which differentiates between them. Flavián et al. recently [47] expanded Milgram & Kishino’s model, proposing a more detailed version of the overlapping real to virtual states within the continuum, the types of technologies used, their degree of embodiment with regards to the user (from external to implanted devices) and their impact on the customer experience. Hence, for the purpose of this discussion, the reality to virtuality continuum concept provides a useful trajectory onto which we can situate consumers’ dress (dis)embodiment experience in digital fashion, and the technologies which mediate, help to shape, and co-determine both the experience and its significance.

4.1 Dress Dis-embodiment in Digital Relations

The digital fashion experience accessible to most consumers today can be situated somewhere in the middle of the reality to virtuality continuum, as discussed above. Devices commonly used to access the web, such as computers, tablets, and smartphones, afford limited touch sensation beyond vibration and pulse effects. The three-dimensional, material, textural properties of dress—conveniently at hand when a garment is physically

¹ It is important to note that the continuum is an engineering construct. Hence, it does not imply virtuality to be any less “real” than reality. For a discussion see Vial [46].

present—are represented behind a flat (to date) glass screen; they exist beyond the reach of touch and feel, their physical nature accessible via the visual sense only. Thus, the haptic and kinesthetic qualities of a garment represented digitally cannot readily be understood as they would be in a real (physical) setting, where the garment can be handled and worn on the body. In digital fashion, dress is, de-facto, *dis-embodied*.

However, the powerful electronics embedded in today's digital devices also enable rich two-dimensional—and even three-dimensional—audio-visual stimuli *suggestive* of embodiment. Thus, a fashion website which promotes and sells physical goods will most likely include standard features and functionalities purposely designed to convey useful information regarding the materiality of these items, from product components to bodily fit. Most fashion websites feature evocative haptic images, still and moving, of garments (either real or digitally rendered) worn on models (either real or avatars), accompanied by high-resolution zoom-in functionalities. These images are usually accompanied by textual product descriptions, and in some cases, narratives describing product use and customer comments providing hints on wearability, fit and on-body feel [48]. Additional features may include suggestive augmented reality applications which enable the projection of garments onto users' bodies, or VTOs—virtual try-on applications. Depending on the type of application, VTOs may leverage customers' sizing data, or even self-scanned body data, to suggest properly fitting garments draped on digital humans (or avatars) whose body types are similar to the customer's own [42].

Such embodiment narratives can also be found on digital-first websites and AI-generated fashion projects. Digital outfits commercialized by online venues such as DressX (www.dressx.com), Dematerialised (www.thedematerialised.com) or The Fabricant (www.thefabricant.com) are created using 3D design software [49] and promoted as a way to fashionably (and often, fantastically) dress one's avatar in different online venues, from social media to gaming; or, to sustainably shop for garments which will be produced on-demand with either commonplace or advanced bio-materials [50]. Recently, fashion looks created using generative AI programs such as DALL-E brought forth unexpected [51], albeit controversial [52] new ways to embody dress.

To the viewer, the rich visual information gleaned from the applications described above, and the devices used to access them, may indeed *suggest, or help imagine*, embodied dress states. As discussed in perception literature, sensory marketing, grounded cognition theory and neuroscience, visual stimuli may trigger sensory integration and substitution mechanisms [53], mental simulation [54, 55], and re-enactment [56] processes, and evoke knowledge accrued through the viewer's past experiences with physical garments. Hence, by means of a device's primarily *visual* affordances, individual viewers may form a highly personal interpretation of the *kinesthetic and tactile* properties of embodied dress. However, this perception is co-determined, or mutually constituted, by both the user (one's personal history, sensitivities, culture, and so on) *and* the technology (or rather, device affordances) through which dress is accessed. "Within these human-technology relations, transformations of perception occur," writes P.-P. Verbeek [22]. Dress is disembodied (it is not worn, nor felt on the body), but its embodiment is understood via *other* means, because "technologies help to shape *what counts as 'real'*" [22]. In other words, by co-shaping a digitally-mediated dress experience *and* existence, the screen devices, 3D scanning, and generative AI technologies described

above co-constitute new relations between consumers and business, helping to redefine the frameworks within which dress—and hence, fashion—is given meaning.

4.2 Dress Re-embodiment in Extended Digital Relations

Technological innovation and convergence suggest that in the future, some form of dress embodiment might indeed be enjoyed in digital fashion. The integration of haptic, visual, auditory and even olfactory [57] functionalities in technological devices—visors, gloves, suits, and so on—might enable new kinds of multisensory experiences [58]. These may be situated in purposefully crafted hyperreal (that is, blending digital experiences *into* physical contexts²) or fully virtual [47, 59] environments.

As discussed in the previous section, fashion brands are already showcasing and promoting digital goods in virtual gaming and in the so-called metaverse [60], where consumers can view and buy digital fashion products to dress their avatars with. These experiences are still primarily visual—co-shaped by the sensory affordances of the virtual reality devices currently available on the mass market. This may change when lightweight, wearable haptic interfaces delivering force, temperature, and texture feedback, compatible with commercially available VR platforms³, will be affordably priced; and when ad-hoc kinesthetic and tactile effects will be programmed into existing or newly designed virtual environments. “As the actual and the digital blur further with technologies [...] we could even end up possessing clothes that clad our corporeal and virtual selves in tandem” seamlessly transitioning from physical to digital fashion [61].

In these extended digital relations between consumers, businesses, and technologies, I expect the latter to mediate and co-determine—as posited by postphenomenology—an altogether different experience and meaning of dress (re)embodiment as compared to what emerges from today’s practices. The implications such developments may hold for fashion industry sustainability [62, 63], marketing management [64] and digital fashion marketing [65, 66], are only beginning to be discussed and investigated. To frame these concerns, I propose a model representing the evolving states of dress embodiment and of the technologies mediating these states between consumers and businesses.

5 A Conceptual Model

The model illustrated in Fig. 1 summarizes the ideas put forth so far. The model conceptualizes the experience of dress as situated within Milgram & Kishino’s physical to extended reality continuum [44], represented vertically and from top to bottom. Situated along this axis are the three states of dress embodiment posited by this paper: *dress embodiment* (the on-body, tactile and kinesthetic experience of the physical world: handling and trying on clothes in a fashion store or at home); *dress dis-embodiment* (the off-body, visually rich but touch-diminished interaction available through screen devices); and *dress re-embodiment* (the multisensory dress experiences which converging haptic and other VR technologies might enable in the future).

² For a very recent development in hyperreal environments see: <https://www.outernetglobal.com/>.

³ See, for example, WeArt’s TouchDiver glove: www.weart.it.

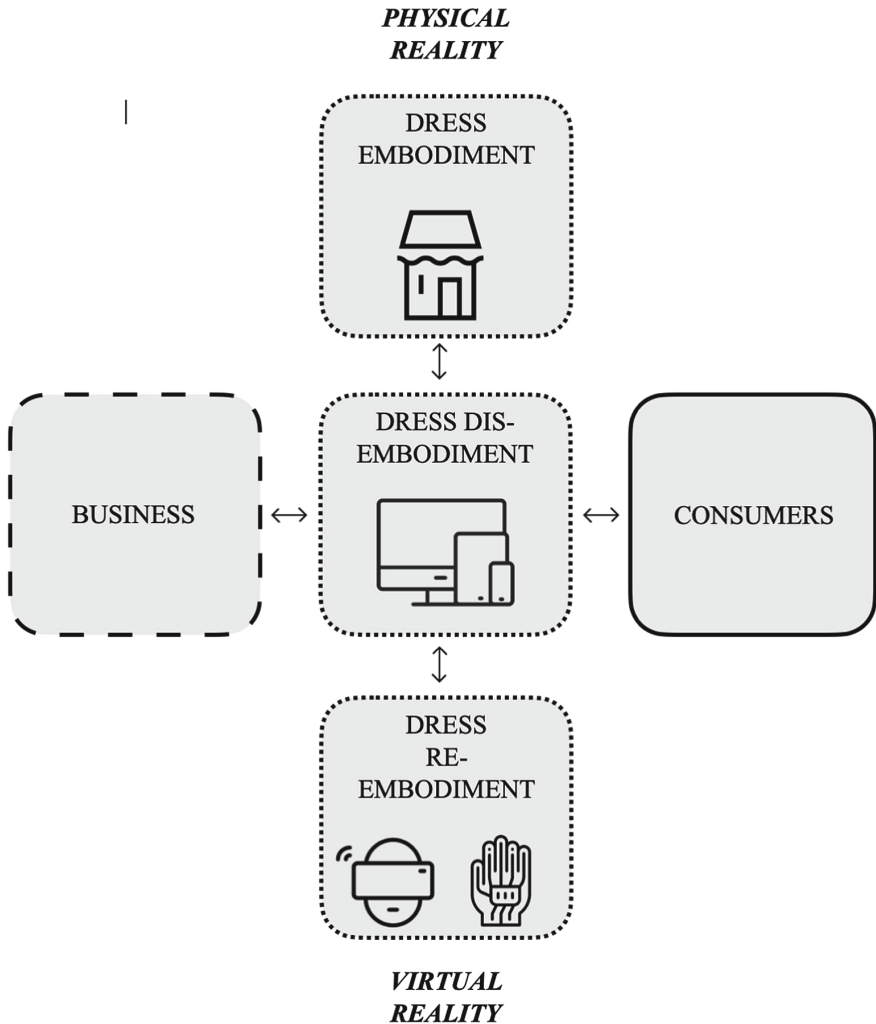


Fig. 1. Conceptual model of digital dress (dis)embodiment, from physical (top) to extended reality (bottom). Icons by C. Njoo and R. Schmitzer, *The Noun Project* (www.thenounproject.com).

These diverse and evolving dress states are intersected horizontally, on the one side, by *business* (fashion firms preoccupied with value creation) and on the other, by *consumers*, who influence, and in turn are affected by, fashion business strategies. In the center are the technologies—illustrated symbolically and without pretense of exhaustiveness—which, as suggested by postphenomenology, mediate these relations, and co-determine the individual and collective experience of dress in evolving techno-social contexts and frameworks of understanding. By applying prior conceptualizations of real to virtual experiences to the fashion domain, I believe the model can serve as a framework for current and future research of touch and dress embodiment in digital fashion.

6 Conclusion

The digital acceleration of fashion and luxury brought about by the COVID-19 pandemic has underscored the touch-deprived, disembodied nature of the online dress experience; when shopping online, products can be seen but cannot be *handled* and *felt on the body*. By approaching this phenomenon through the lens of postphenomenology, we can understand the crucial role which available screen technologies play in mediating interaction and co-determining an experience of dress. The latter relies heavily on multisensory integration, memory, and mental imagery to be actionable and meaningful. However, in the future, haptics—together with other augmented and virtual technologies—might ultimately provide complementary or alternative ways of dress (re)embodiment in both physical and digital environments. Evolving forms of techno-human relations may, in turn, create new socio-cultural frameworks in which dress (and hence, fashion) is experienced, interpreted, and valued. I am confident the conceptual model of technological mediation proposed herein will prove useful when thinking through such developments.

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