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Textile And Fashion Design Considerations In A Digital Era

Technology Shifts through a Post-phenomenological Lens and Cross-Disciplinary Interactions

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ABSTRACT

Fashion and textile practice transitioned over the past decade from a physically engaged design practice into a screen-based design practice with textiles simulated on digital bodies. Digital designers use tangible interaction with textiles for post-phenomenological design considerations. Our research indicates a complementary relationship between tangible interaction and drape observation, which allows for new approaches when considering textile materials. The drape observation based on drape measurement methods developed in textile science equips designers with a deeper material understanding. As the flat textile is placed in the scientific setup, the deformation and the designer's experience co-shape design considerations. The physical-to-digital paradigm shift disconnects designers from the tangible interaction with the textile. Fashion designers' approach contrasts with textile science methods to measure textile properties (needed to simulate textiles) and drape. Equipping designers with this understanding of textile technology requires interdisciplinary developments to make combined tangible drape tools accessible in physical and digital design spaces. Understanding design considerations in physical-digital practices and material drape, utilizing simulated textile properties, is essential for this endeavor. Cross-disciplinary understanding of textiles and similar soft materials between fashion designers, design researchers, textile and computer researchers, and cultural heritage researchers seems valuable in reducing measurement hurdles and creating tools to increase relationships between the physical and digital textiles and improving visual analyses and assessment of textiles. Our reflection to sharpen the post-phenomenological lens and cross-disciplinary collaborations of our past and future research contributes to understanding physical-digital textile design considerations and required cross-disciplinary interaction.

Keywords: Material aesthetics, Textile drape, Measured textile properties, Perceived qualities.

1. INTRODUCTION: DIGITAL DESIGN CONSIDERATIONS

In the past decade, many fashion practitioners have adopted digital design. The digital design process (Figure 1) enables the visualization of design considerations inviting experimentation and exploration without physical textiles (Wiedenhof 2023). However, fashion designers use tangible interaction with physical textiles to develop design considerations (Petreca, Baurley, and Bianchi-Berthouze 2015). Digital design has a screen-based abstraction or "dis-embodiment" (Ornati 2023) that disconnects designers from tangible interaction with textiles, making a design process slider-based. For designers, touching and handling textiles, often when scientifically testing properties like drape, contributes to creating "design considerations for a digital material definition in digital design" (Kuijpers et al. 2024). Systemic change in fashion design currently urges a framework including

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"Aesthesis" which emphasizes the tangible and multisensory aspects of fashion, including touch, smell, sound, and taste, in addition to sight (Teunissen 2024). This signals a shift from the focus on visual appearance in mass production, resulting in a significant decrease in materiality understanding (Verbeek 2005, 209-210).

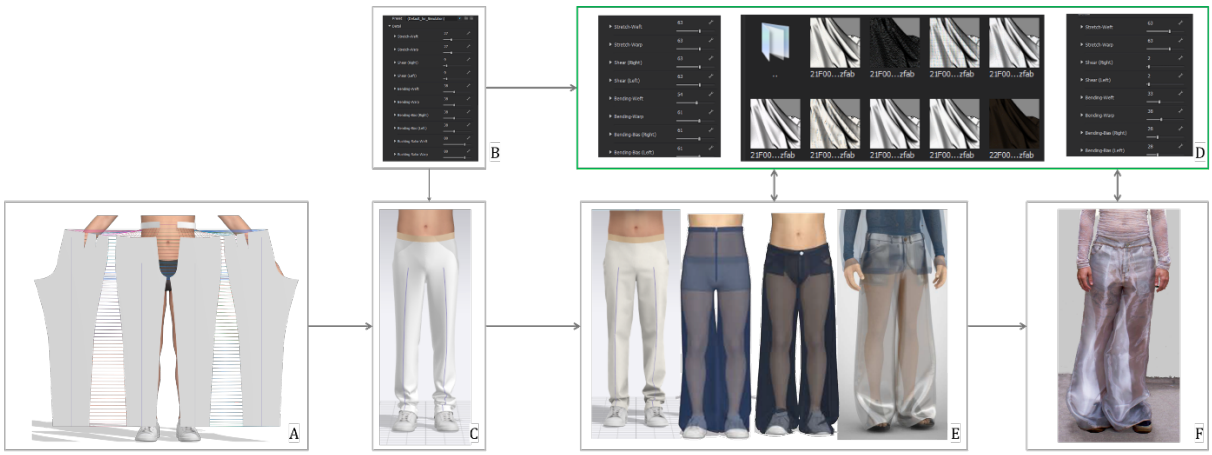

Figure 1. Digital fashion design process in CLO (CLO 2024): (A) archetypical concept block placed on avatar; (B) sliders and (C) garment of the default CLO simulation material; (D) digital textile files in CLO created with self-measured properties of the physical textiles ; (E) iterative design process; (F) photograph of final physical design. Source: (Kuijpers et al. 2024) .

Typically, fashion designers work with digital textiles available in the software library, for which the relation with physical material is often missing. Designers use intrinsic knowledge to adjust the software sliders of digital textiles (Kuijpers et al. 2024). In a "constructive intentionality" (Verbeek 2008), the software's and designers' intentionality co-create a digital textile 'disconnected from the physical material. This results in a realistic, non-existent visual representation (Verbeek 2008). This is challenging because, as is often seen in science, intentionality is object-related from data-translated images "that become candidates for human interpretation" (de Boer, Te Molder, and Verbeek 2021).

Fashion design, design research, textile science and computer science share a cross-disciplinary interest in textile understanding, but approaches differ. The textile properties used to simulate textiles are measured with instruments developed by textile science. The required equipment and knowledge are often beyond everyday (design) practice (Kuijpers et al. 2024) which would "help to shape the specific ways in which scientists are directed at reality and develop an understanding of the phenomena they are studying" (de Boer, Te Molder, and Verbeek 2021). Yet, to disciplines outside textile science, the measured properties communicate little tangible information(Wiedenhof 2023).

In this paper, we will explore what a post-phenomenological view of Verbeek teaches us about using textiles, specifically his view on material aesthetics. Our research contributes to the understanding of incorporating material aesthetics into a digital fashion design process and the required cross-disciplinary interaction and understanding. We relate post-phenomenological concepts to inform researchers and practitioners who work with textiles (e.g., fashion, textile, design research, cultural heritage, computer graphics).

2. PERCEIVED QUALITIES VS MEASURED PROPERTIES

Fashion designers' considerations include aesthetics, comfort, and functionality (Petreca, Baurley, and Bianchi-Berthouze 2015). They unfold the relationship of textiles within construction, wear, durability, and expressivity. In textiles, tangible interaction involves implicit knowledge based on experiences, known as skill. However, textile material understanding is intensified through testing such as drape. Fashion designers use drape and touch to make design considerations more explicit, questioning and reflecting upon their textile choices (Kuijpers et al. 2024). Experienced fashion textile practitioners use craftsmanship as intrinsic knowledge to understand textile properties from only

grey-scale drape images, but this comes from embodied experience (Kuijpers 2017, 91). Software attempts to abstract this relationship with slider-based interactions. Still, it very often fails to communicate the measured properties of the physical material, making it hard to develop the necessary intrinsic knowledge that is required(Kuijpers et al. 2024). The interplay between the textile's physical behavior, a phenomenon of study in textile science (Kuijpers 2017, 36-42, 54, 98-115), and the tangible interaction appear to be linked and vital to design considerations.

Within tangible interaction, designers directly perceive the qualities of a textile (e.g., stretch in warp, weft and bias, thickness, cover, weight, and strength). Designers pleat, fold, and hold textiles (often on their bodies) to see how the material reacts to manipulation, sewing, and draping (hang) to experience the design potential (Petreca, Baurley, and Bianchi-Berthouze 2015). The perceived qualities are essential for designers to relate a material to design considerations, (Kuijpers et al. 2024) (Figure 2). Conversely, in textile science, properties such as drape are measured with equipment (e.g. drape meter), to quantify and visualize how the textile hangs and folds. This can compare and verify how textiles, both physical and digital, drape (Kuijpers 2017, 54-68, 116-128). Drape along with other measured textile properties (e.g. bending, elongation, and shear)(Figure 2) are used to create digital textiles from physical counterparts. Rarely is the digital used to manufacture the physical, which holds much opportunity. Unfortunately, software uses a large variation of measurement systems, from ISO standards to proprietary kits leading to confusion and non-scientific practice among designers seeking to elaborate their design considerations digitally. (Kuijpers et al. 2024).

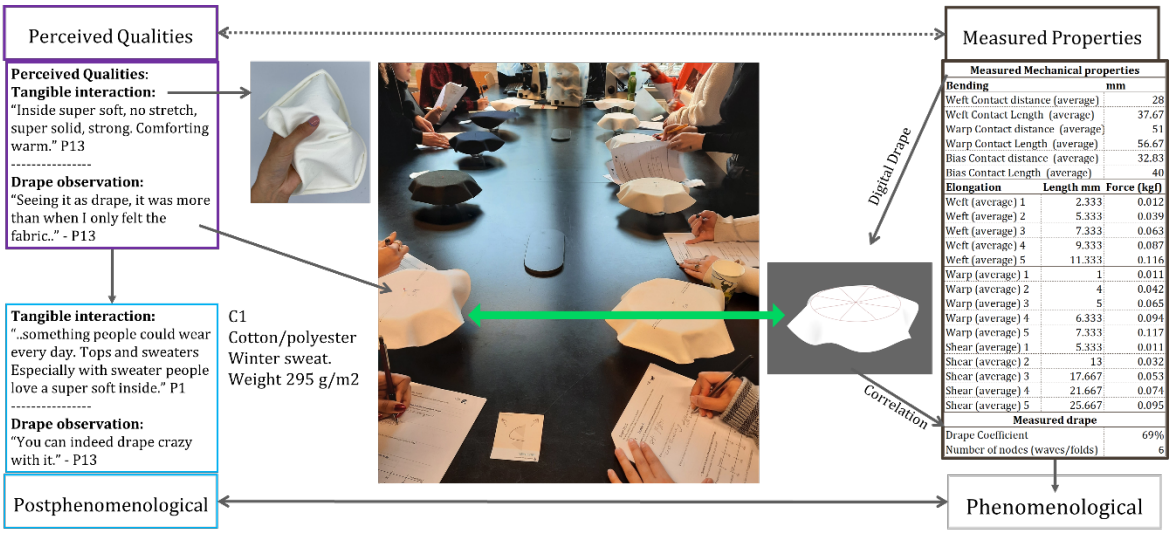

Figure 2. Relationship physical-digital drape: Design considerations based on Perceived Qualities (left); Measured Properties required to simulate textile, and drape properties (right).

While science commonly develops instruments to generate "knowledge through technologies" (Ihde 1997), practices such as fashion design have a complex relationship with the sciences and humanities of the wearer and society. Textile scientists minimize interaction with textiles while measuring properties, as numerical expressions to, understand, compare, and relate textiles. The measured properties are analyzed, correlated, and interpreted to predict touch, performance, and drape (De Boos and Tester 1994; Cusick 1965; Kawabata 1980). But can this phenomenological understanding of textiles allow fashion designers to transform perceived qualities into post-phenomenological design considerations? Verbeek emphasizes the importance of postphenomenology for "rethinking of artifacts and materiality" (Verbeek 2005, 10) and for developing new perspectives on the existential and hermeneutic view on technology. Mediation, the essential concept in postphenomenology (Verbeek 2005, 11-12), "consists in a mutual constitution of subject and object" (Verbeek 2005, 130). Our past research has shown that scientific drape observation intensifies fashion designers' textile understanding, allowing fine-tuning of design considerations (Kuijpers et al. 2024). The scientific drape observation mediates how textiles drape. Mediation is about human-technology

relations where artifacts codetermine and co-shape human perception and action, enabling understanding and interpretation of relationships (Verbeek 2005, 235-236).

3. TANGIBLE LIMITATIONS AND MATERIAL AESTHETICS?

The "Fold, Stand, and Drape approach" (Kuijpers et al. 2024) shows a mutual construction of subject and object to co-shape (Verbeek 2005, 129-130) design considerations: 1) the designer through folding, pleating, pulling, and the textile through its weight and mechanical properties resistance to force; 2) the scientific drape meter set up visualizes the textile drape and the designer relates the new insights to elevate their interpretation of the textile. In addition, the scientific drape meter set up co-determines the deformation of the textile in a relatable constitution. From the mediated scientific post-phenomenological viewpoint, material aesthetics can expand to include ethics, senses, durable design, attachment, transparency, and engagement as technological artifacts co-shape experience and existence in a material aesthetics design process (Verbeek 2005, 235). "The necessity of a materially oriented design approach" (Verbeek 2005, 232) is crucial in digital-physical relationships in the design process to go beyond the visual-only aesthetics of a disembodied slider-based design process. If we look at current uses of digital materials, designers are missing: 1) a relatable understanding to interpret physical drape; 2) a relatable framework to interpret and understand the digital-physical drape relationships; 3) familiarisation and craftsmanship with textile science.

4. SCIENCE-TECHNOLOGICAL MEDIATION THROUGH TEXTILE DRAPE

At the heart of this challenge is the software itself. In the 3D digital design software mechanical properties are represented in a particle spring mesh, often as quadrangular and triangular mesh types Figure 3). The mesh size depends on the particle distance and influences the simulation and computation time. A mesh of 20 mm is mostly used during design and decreased to see the result. The mesh translates the measured properties into a digital textile and mediates the designers' interpretation.

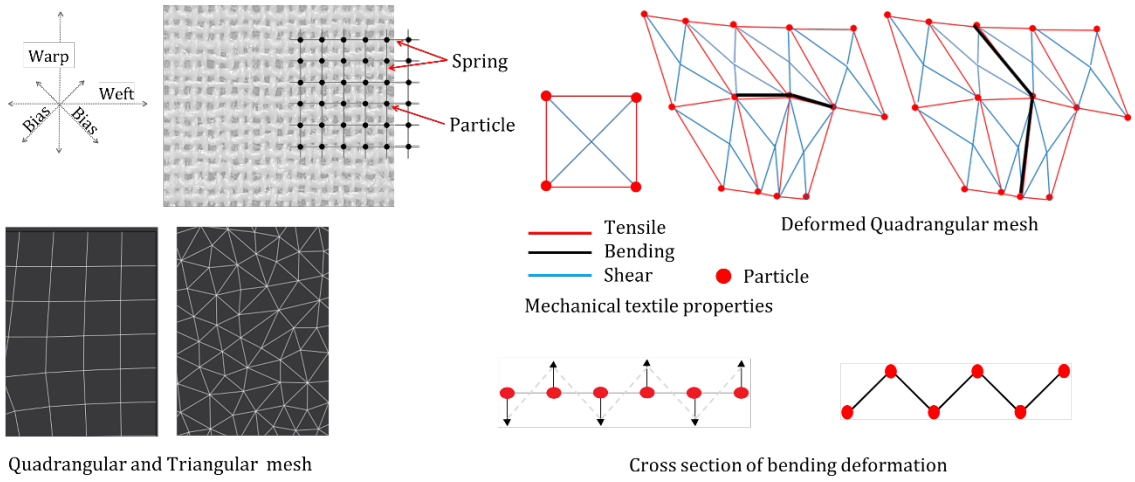

Figure 3. Mesh types, and representation of the mechanical textile properties in a mesh. Adapted from source: (Kuijpers 2017, 43).

In textile science, a drape meter is often used to verify and compare digital vs physical textiles based on drape measurements, designers do this often through observation. In textile research comparing and verifying physical and digital drape requires equal positioning of the artifacts in both environments. They include grainlines (warp, weft, bias) on the drape and supports, which are important for placement and comparison (Kuijpers 2017, 59-68), but also for design practitioners to understand the digital and physical textile relationships (Figure 4). The lack of correspondence within these systems inhibits the development of design considerations due to unneeded complexity within the design process.

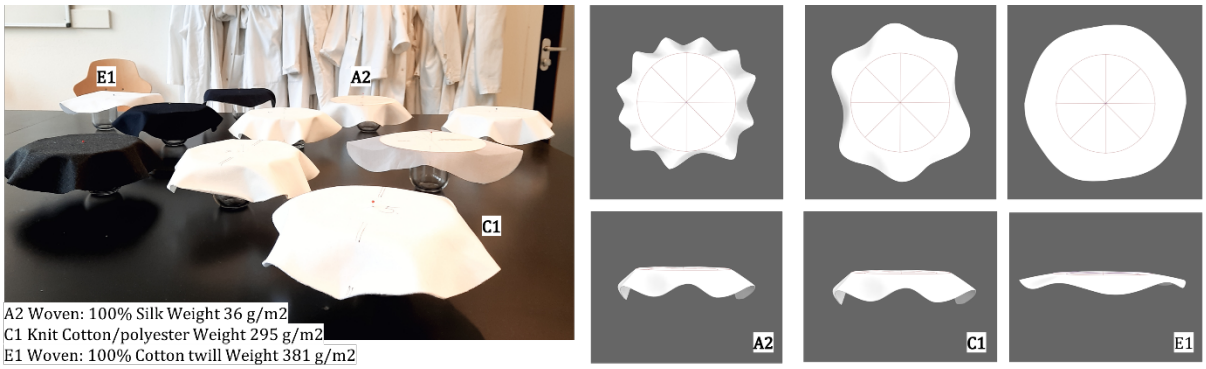

Figure 4. Photo of physical draped textiles (left) and digital textiles simulated based on their measured mechanical properties (without the visual characteristics, with indicated grainlines).

5. CONCLUSION AND FUTURE RESEARCH FOCUS

To fully benefit from the possibilities of digital fashion software and to reduce textile complexity, it is crucial to implement a post-phenomenological *materially oriented design approach* as introduced by Verbeek A materially aesthetic concept is necessary to overcome the visual-dominated paradigm of aesthetics in digital fashion design. To achieve this, tools following norms must be developed to enable a relatable understanding that effectively co-shape the physical and digital textile drape in the mind of the designer. Understanding and interpreting digital-physical textile relationships requires a relatable drape framework developed through unfolding textile science methods within the design considerations of fashion designers. Cross-disciplinary textile understanding and interaction are vital to our future research in implementing post-phenomenological tools within a material aesthetic digital design process.

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