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A Human-Centered Analytical Framework for Investigating Daily Interactions with Multimorphic Textile-Based Artifacts

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Abstract

The emergence of multimorphic textile-based artifacts has transformed the conceptual and functional boundaries of interactive design, material experience, and human-centered technological systems. Unlike static textile products, multimorphic textile artifacts exhibit adaptive, responsive, and performative characteristics that reshape user interaction patterns in everyday contexts. This study proposes a human-centered analytical framework for investigating daily interactions with multimorphic textile-based artifacts by integrating theories from posthumanism, performativity, material agency, participatory design, emotional interaction, and experiential material studies. The research synthesizes existing scholarly work on textile performativity, wearable systems, adaptive materials, and user experience to construct a comprehensive analytical structure capable of evaluating how users interpret, negotiate, and emotionally engage with dynamic textile systems in domestic and social environments. The paper adopts a qualitative research methodology grounded in thematic synthesis and conceptual modeling based exclusively on the provided literature. Findings indicate that multimorphic textile artifacts function not merely as passive objects but as active mediators influencing emotional attachment, behavioral adaptation, sensory interpretation, and embodied interaction. The study further identifies critical tensions between usability and ambiguity, autonomy and control, and emotional engagement and technological complexity. The proposed framework contributes to interaction design research by establishing a multidisciplinary model for understanding evolving textile-human relationships within intelligent material ecologies. The study concludes by emphasizing the importance of adaptive materiality, experiential responsiveness, and participatory interpretation in future textile interaction systems.

Keywords: Multimorphic textiles; Human-centered design; Textile interaction; Material experience; Performative artifacts; Adaptive materials; Wearable technologies; Smart textiles; Posthumanism; Experiential design

1. INTRODUCTION

Background

The evolution of interactive technologies has increasingly blurred the distinction between material objects and computational systems. Contemporary textile artifacts are no longer limited to passive structural or aesthetic functions; instead, they operate as dynamic systems capable of adaptation, transformation, responsiveness, and performative interaction. Multimorphic textile-based artifacts represent a significant development within this transformation because they possess the ability to alter form, behavior, texture, or interaction patterns in response to environmental stimuli or user engagement. Such systems occupy an important position within emerging research areas related to smart materials, human-computer interaction, experiential design, and wearable technologies.

Traditional product interaction frameworks have often treated materials as static carriers of functionality. However, recent developments in material-centered

design research emphasize that materials themselves possess communicative and performative capacities influencing human behavior and emotional interpretation (Barad, 2003). The integration of responsive materials into textile systems has intensified scholarly interest in how users experience adaptive artifacts during everyday practices. These interactions involve emotional, cognitive, tactile, behavioral, and contextual dimensions that cannot be sufficiently explained through conventional usability-based frameworks alone.

Research concerning wearable technologies and textile-based interaction systems demonstrates that user experience is strongly shaped by embodiment, sensory engagement, comfort, and emotional resonance (Baskan & Goncu-Berk, 2022). Unlike conventional digital interfaces, textile artifacts remain in prolonged physical proximity to the human body, thereby generating continuous experiential relationships. This proximity creates opportunities for deeper emotional attachment while simultaneously introducing complexities regarding ambiguity, privacy, agency, and behavioral adaptation.

Theoretical perspectives derived from posthumanism and new materialism further challenge anthropocentric assumptions about design by emphasizing the active agency of materials and objects within human environments (Bennett, 2010; Forlano, 2017). From this perspective, multimorphic textile artifacts are not merely tools controlled by users but participants within relational systems where meaning emerges through ongoing interaction. Such perspectives are particularly relevant for multimorphic textile systems because these artifacts continuously negotiate between stability and transformation.

The present study addresses a critical research gap regarding the absence of an integrated analytical framework specifically focused on everyday interactions with multimorphic textile-based artifacts. Existing research often examines either technological functionality or isolated experiential dimensions without developing a holistic model capable of connecting performativity, emotional interaction, material agency, and everyday practice. Consequently, this paper proposes a human-centered analytical framework designed to investigate how users interact with adaptive textile systems within daily life contexts.

The objectives of this study are fourfold. First, the research synthesizes theoretical foundations related to performative materials, experiential interaction, and adaptive textiles. Second, it identifies the principal experiential and behavioral dimensions shaping human engagement with multimorphic textile artifacts. Third, it develops an analytical framework integrating material, emotional, contextual, and performative variables. Fourth, it evaluates the implications of the framework for future textile interaction design and human-centered technological systems.

The significance of the study lies in its contribution to interdisciplinary design scholarship by bridging textile design, interaction design, material studies, and human-centered computing. As adaptive textile technologies continue to expand into healthcare, fashion, domestic systems, and wearable interfaces, there is increasing need for analytical structures capable of evaluating human experiences beyond conventional functional metrics. The framework proposed in this paper provides a foundation for understanding how multimorphic textile systems influence everyday practices, emotional attachment, and embodied interaction within technologically mediated environments.

2. LITERATURE REVIEW

2.1 Material Agency and Posthumanist Perspectives

The conceptual foundation for multimorphic textile interaction research is strongly influenced by posthumanist and new materialist theories. Barad (2003) argues that matter is not passive substance but an active participant in the production of meaning and interaction. This theoretical shift repositions materials as agents capable of shaping human experience rather than simply enabling predetermined functions. Similarly, Bennett (2010) conceptualizes “vibrant matter” as possessing relational agency within socio-material networks. Such perspectives are essential for understanding multimorphic textiles because these artifacts actively respond, transform, and negotiate interaction patterns with users.

Bennett et al. (2010) extend this argument by examining ontology and agency within material systems, suggesting that design processes should recognize the co-constitutive relationships between humans and materials. Within textile interaction research, this perspective enables

scholars to examine adaptive textile artifacts not only as interfaces but as performative entities participating in behavioral and emotional dynamics.

Forlano (2017) further applies posthumanist perspectives to design studies by challenging assumptions of human dominance within technological systems. The implications for multimorphic textiles are significant because responsive textile artifacts increasingly operate autonomously within everyday environments. Rather than functioning as passive wearable technologies, these systems mediate human behaviors, sensory experiences, and social interactions.

2.2 Performativity and Adaptive Textile Systems

Performativity has emerged as a central concept within smart material and textile interaction research. Barati et al. (2018) examine how performativity is produced through interactions between designers, materials, and technological systems. Their work demonstrates that performative materials generate meaning through dynamic processes rather than static properties. This understanding is particularly relevant for multimorphic textile artifacts that continuously shift between forms and interaction states.

Buso et al. (2022) investigate animated textile forms and identify “textileness” as an evolving experiential quality emerging through movement, responsiveness, and user engagement. Their findings suggest that textile performativity is deeply connected to temporal interaction processes. In later work, Buso et al. (2023) explore performative woven textile-form interfaces and emphasize the importance of adaptability and embodied responsiveness within interactive textile systems.

The development of AnimaTo by Buso et al. (2024) provides a practical demonstration of multimorphic textile performativity. Their research highlights how adaptive textile artifacts create evolving relationships between users and responsive material systems. Importantly, these interactions extend beyond functional operation and involve emotional interpretation, behavioral adaptation, and sensory engagement.

Bergström et al. (2010) further contribute to performative material discourse by arguing that materials and practices co-evolve through interaction. Their work indicates that user practices influence how materials are perceived and utilized, while material properties simultaneously shape behavioral routines. This reciprocal relationship is particularly evident in everyday interactions with multimorphic textiles.

2.3 Emotional and Experiential Interaction

Emotional engagement represents a critical dimension within human-centered textile interaction research. Bang (2011) emphasizes the emotional value of textiles and argues that participatory approaches enhance user attachment and experiential depth. Textile artifacts are uniquely positioned to generate emotional resonance because of their tactile intimacy and prolonged bodily proximity.

Demir et al. (2009) examine emotional appraisal patterns within human-product interaction and demonstrate that user emotions emerge through contextual interpretation rather than purely functional evaluation. Their findings suggest that adaptive textile systems may evoke complex emotional responses due to ambiguity, unpredictability, and sensory transformation.

Camere and Karana (2018) propose experiential characterization approaches for materials, emphasizing sensory interpretation and embodied perception. Their framework is highly relevant for multimorphic textiles because adaptive materiality fundamentally alters user expectations and experiential engagement. Similarly, Elkhuizen et al. (2024) demonstrate that material experience significantly shapes user interaction with digitally mediated systems, reinforcing the importance of tactile and sensory dimensions within interactive artifacts.

Research on wearable technologies by Baskan and Goncu-Berk (2022) provides important insights into user experience differences between textile-based and accessory-based systems. Their findings indicate that textile-based technologies generate stronger experiential integration because textiles align more naturally with bodily movement and everyday routines. This study is particularly important for the present research because it demonstrates how textile embodiment influences usability, comfort, and emotional attachment. Furthermore, the research highlights the importance of designing wearable systems that balance technological functionality with human-centered experiential qualities (Baskan & Goncu-Berk, 2022).

2.4 Ambiguity, Participation, and Everyday Practice

The relationship between ambiguity and interaction design is extensively explored by Gaver et al. (2003), who argue that ambiguity can function as a productive resource encouraging interpretation, exploration, and engagement. Multimorphic textile artifacts frequently operate within ambiguous interaction spaces because users may not fully predict or control adaptive behaviors.

Boon et al. (2018) extend this perspective by examining open-endedness within behavioral design. Their work suggests that ambiguity can support personalized interpretation and emotional engagement. However, excessive ambiguity may also reduce usability and generate confusion. This tension is particularly relevant within multimorphic textile systems where dynamic transformation may challenge user expectations.

Bredies (2008) critiques purely user-centered approaches by arguing that confusion and unpredictability can stimulate meaningful interaction. Such perspectives align with multimorphic textile design because adaptive artifacts often encourage exploratory behaviors rather than fixed operational routines.

Theoretical perspectives on everyday practice further enrich understanding of textile interaction. De Certeau and Rendall (1984) conceptualize everyday life as a space of negotiated practices where individuals continuously reinterpret material environments. Bourdieu (1990) similarly argues that habits and practices shape social interaction patterns. These theories suggest that multimorphic textile artifacts become integrated into daily routines through ongoing negotiation between user behavior and material responsiveness.

2.5 Sustainability and Long-Term Interaction

Sustainability considerations increasingly influence textile interaction research. Fletcher (2016) emphasizes post-growth fashion practices centered on durability, emotional attachment, and long-term use. Adaptive textile artifacts may contribute to sustainability by encouraging prolonged engagement through evolving interaction experiences.

Earley and Forst (2019) examine challenges in designing long-life garments and identify adaptability as a key factor supporting sustained user engagement. Multimorphic textiles potentially reduce disposability because their transformable characteristics allow artifacts to accommodate changing user needs over time.

At the same time, De Chaves and Benitti (2025) highlight privacy and ethical concerns within human-computer interaction systems. As textile artifacts become increasingly intelligent and responsive, questions regarding data collection, behavioral monitoring, and user autonomy become more significant.

2.6 Research Gap

Although existing literature provides valuable insights into performative materials, experiential interaction, wearable systems, and adaptive textiles, significant fragmentation remains across these domains. Most studies focus on isolated dimensions such as emotional interaction, material responsiveness, or usability. Few studies integrate these dimensions into a comprehensive analytical framework capable of examining daily interactions with multimorphic textile-based artifacts.

Furthermore, current research insufficiently addresses how users negotiate ambiguity, agency, embodiment, and performativity simultaneously within everyday contexts. Existing usability-centered models are inadequate for understanding adaptive textile systems because they fail to capture evolving emotional and experiential relationships. Therefore, there remains a need for a holistic human-centered analytical framework capable of synthesizing material, behavioral, emotional, and contextual interaction dynamics.

3. METHODOLOGY

3.1 Research Design

This study adopts a qualitative conceptual research methodology grounded in interpretive synthesis and theoretical integration. The research does not rely on empirical experimentation but instead develops an analytical framework through systematic examination of the provided literature. Such an approach is appropriate because the objective is not to measure isolated technological performance variables but to construct a multidimensional model explaining human interaction with multimorphic textile-based artifacts.

The methodological structure integrates perspectives from

material studies, interaction design, experiential research, and human-centered design theory. By synthesizing diverse conceptual traditions, the study establishes a framework capable of evaluating adaptive textile interactions within everyday life contexts.

3.2 Analytical Framework Construction

The proposed framework consists of five interrelated analytical dimensions:

Material Performativity

Material performativity refers to the capacity of textile artifacts to communicate, transform, and respond through dynamic material behaviors. This dimension draws heavily from Barad (2003), Bennett (2010), and Barati et al. (2018). Within multimorphic textiles, performativity emerges through movement, responsiveness, shape transformation, and tactile modulation.

The framework conceptualizes performativity as relational rather than deterministic. Users interpret textile behavior based on context, expectation, bodily engagement, and environmental conditions. Consequently, performative interaction is continuously renegotiated rather than fixed.

Embodied Interaction

Embodied interaction examines how textile systems integrate with bodily practices, sensory perception, and physical movement. Textile artifacts differ from traditional interfaces because they maintain intimate contact with the body. Research by Baskan and Goncu-Berk (2022) demonstrates that textile-based wearable systems produce more integrated user experiences than rigid accessory-based technologies.

This framework therefore prioritizes tactile comfort, bodily adaptability, movement synchronization, and sensory responsiveness as critical evaluative variables. Embodiment is understood as both physical and emotional integration within everyday routines.

Emotional Resonance

Emotional resonance refers to affective responses generated through interaction with multimorphic textile systems. Drawing from Bang (2011) and Demir et al. (2009), the framework identifies attachment, curiosity, comfort, surprise, intimacy, and trust as primary emotional variables.

Importantly, emotional engagement is not treated as secondary to functionality. Instead, the framework positions emotional resonance as a central determinant of long-term interaction quality and sustained user adoption.

Contextual Adaptability

Contextual adaptability evaluates how textile artifacts respond to environmental, behavioral, and social conditions. Adaptive textile systems operate within dynamic contexts involving movement, temperature, social interaction, and routine practices.

This dimension incorporates everyday practice theories from De Certeau and Rendall (1984) and Bourdieu (1990). The framework argues that successful multimorphic textile systems must accommodate evolving behavioral patterns rather than impose rigid interaction structures.

Interpretive Ambiguity

Interpretive ambiguity examines the balance between openness and usability within adaptive textile interactions. Inspired by Gaver et al. (2003) and Boon et al. (2018), the framework recognizes ambiguity as both an opportunity and a challenge.

Moderate ambiguity can stimulate curiosity, personalization, and exploratory interaction. However, excessive unpredictability may reduce trust and usability. The framework therefore evaluates how adaptive textile systems negotiate interpretive flexibility without compromising interaction coherence.

3.3 Framework Application Process

The framework is designed for application across multiple contexts involving multimorphic textile artifacts. Analytical evaluation occurs through four sequential stages.

First, researchers identify the artifact's adaptive properties and performative capacities. Second, user interaction patterns are analyzed in relation to bodily integration and sensory engagement. Third, emotional and interpretive responses are examined within contextual environments. Fourth, interaction outcomes are evaluated regarding

usability, attachment, adaptability, and sustainability.

This process enables multidimensional analysis extending beyond conventional usability metrics.

3.4 Hypothetical Use Scenario

To illustrate framework functionality, consider a multimorphic textile garment capable of altering shape and thermal properties according to user movement and environmental temperature. Traditional usability analysis might focus exclusively on technical efficiency and comfort metrics. However, the proposed framework evaluates broader experiential dynamics.

Material performativity would assess how the garment communicates adaptive transformation through tactile and visual changes. Embodied interaction would examine bodily synchronization and movement integration. Emotional resonance would analyze user feelings regarding intimacy, trust, and attachment. Contextual adaptability would evaluate how the garment responds across domestic, social, and outdoor environments. Interpretive ambiguity would investigate whether adaptive behaviors encourage engagement or generate confusion.

Through this multidimensional analysis, the framework captures experiential complexities often ignored by conventional design evaluation models.

4. RESULTS/FINDINGS

The conceptual analysis reveals that multimorphic textile-based artifacts fundamentally alter the structure of human-material interaction by transforming textiles from passive surfaces into adaptive relational systems. Five major findings emerged from the analytical framework.

First, performative materiality significantly influences user interpretation and engagement. Users perceive adaptive textile systems as interactive entities rather than static objects. Shape transformation, movement responsiveness, and tactile modulation contribute to heightened sensory awareness and emotional curiosity. This finding aligns with performativity theories emphasizing material agency within interaction systems.

Second, embodiment functions as a primary determinant of interaction quality. Textile artifacts integrated closely with bodily movement produce stronger experiential continuity compared to rigid technological systems. Research concerning wearable technologies demonstrates that textile-based interfaces facilitate more natural interaction because they align with everyday bodily practices (Baskan & Goncu-Berk, 2022). The framework therefore confirms that bodily integration enhances long-term engagement and emotional acceptance.

Third, emotional resonance emerges as a central factor supporting sustained interaction. Users are more likely to maintain engagement with multimorphic textile artifacts when systems evoke comfort, attachment, surprise, and interpretive participation. Emotional interaction is intensified by tactile intimacy and adaptive responsiveness, reinforcing the importance of experiential design within textile technologies.

Fourth, contextual adaptability influences user trust and usability. Textile systems capable of adjusting according to environmental and behavioral conditions demonstrate greater experiential relevance. However, adaptive complexity also introduces uncertainty regarding predictability and control. Successful systems therefore balance autonomy with user comprehension.

Fifth, ambiguity operates as both a productive and problematic interaction factor. Moderate ambiguity encourages exploratory engagement and personalization, whereas excessive unpredictability weakens usability and emotional trust. This finding indicates that adaptive textile systems require carefully calibrated interaction structures balancing openness with interpretive coherence.

Overall, the findings demonstrate that multimorphic textile interaction cannot be adequately evaluated through purely functional or usability-centered approaches. Instead, effective analysis requires multidimensional consideration of material agency, embodiment, emotional engagement, contextual responsiveness, and interpretive negotiation.

DECLARATION

The findings indicate that multimorphic textile-based artifacts represent a significant departure from conventional product interaction paradigms. Traditional interaction models typically prioritize efficiency, control, and predictability, whereas multimorphic textile systems emphasize relational adaptability, sensory engagement, and performative interaction. This transition reflects

broader theoretical shifts within posthumanist and material-centered design research.

The study demonstrates that material performativity fundamentally reshapes human interaction processes. Rather than functioning as passive tools, adaptive textile artifacts actively participate in meaning production and behavioral negotiation. This perspective supports arguments proposed by Barad (2003) and Bennett (2010), who conceptualize matter as possessing relational agency. Within multimorphic textiles, performativity emerges through continuous transformation and responsive behavior, thereby redefining the boundaries between material object and interactive system.

Embodied interaction also emerges as a critical theoretical and practical consideration. The close bodily integration of textile artifacts differentiates them from conventional digital technologies. Findings related to wearable systems confirm that textile-based interfaces support more natural interaction patterns because they align with bodily movement and sensory practices (Baskan & Goncu-Berk, 2022). This suggests that future human-centered technological systems should prioritize material intimacy and bodily adaptability rather than purely visual or screen-based interaction structures.

The discussion further reveals important tensions concerning ambiguity and usability. While ambiguity can encourage emotional engagement and interpretive exploration, excessive unpredictability may undermine user trust. This finding complicates simplistic assumptions that adaptive systems should maximize autonomy or openness. Instead, successful multimorphic textile design requires calibrated responsiveness balancing surprise with coherence.

The study also highlights sustainability implications associated with adaptive textile systems. Long-term emotional attachment generated through performative interaction may reduce disposability and encourage prolonged artifact use. This aligns with post-growth fashion perspectives emphasizing durability and experiential value rather than rapid consumption cycles.

Despite these contributions, the framework possesses several limitations. The study relies on conceptual synthesis rather than empirical experimentation, limiting direct behavioral validation. Additionally, multimorphic textile technologies remain an emerging field characterized by rapid technological evolution. Consequently, future developments may introduce new interaction variables not fully captured within the present framework.

Another limitation concerns contextual diversity. Everyday interaction patterns vary significantly across cultural, social, and environmental settings. Although the framework incorporates contextual adaptability, empirical studies are necessary to examine how multimorphic textile experiences differ across user populations.

Future research should therefore apply the framework within empirical design studies involving real-world user interaction scenarios. Comparative studies examining domestic, healthcare, wearable, and fashion applications would further refine understanding of adaptive textile engagement. Longitudinal studies could also investigate how emotional attachment and interpretive practices evolve over time.

CONCLUSION

This study proposed a human-centered analytical framework for investigating daily interactions with multimorphic textile-based artifacts. By synthesizing theories from performativity, posthumanism, material studies, experiential design, and wearable technology research, the paper developed a multidimensional structure capable of evaluating adaptive textile interaction beyond conventional usability metrics.

The findings demonstrate that multimorphic textile artifacts operate as performative relational systems influencing sensory engagement, emotional attachment, bodily integration, and contextual interaction. The study further established that embodiment, emotional resonance, contextual adaptability, and interpretive ambiguity constitute central dimensions shaping user experience.

Importantly, the framework contributes to interaction design scholarship by challenging purely functional approaches to adaptive technology evaluation. Textile-based systems require analytical models capable of recognizing material agency, experiential complexity, and evolving human-material relationships. The research therefore positions multimorphic textile interaction as an interdisciplinary field integrating materiality, design,

embodiment, and technological responsiveness.

The study also contributes practical insights for designers developing adaptive textile systems. Successful multimorphic artifacts must balance responsiveness with interpretive clarity while supporting emotional engagement and contextual adaptability. Textile interaction design should therefore prioritize sensory intimacy, behavioral integration, and experiential sustainability.

Future research should empirically validate the framework through observational studies, participatory design experiments, and longitudinal interaction analysis. As adaptive textile technologies continue expanding across healthcare, fashion, domestic environments, and wearable systems, the need for comprehensive human-centered evaluation models will become increasingly significant.

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