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AGENTIAL DIGITAL MATERIALS – A FASHION AND TEXTILE PERSPECTIVE

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The Neo-Couture project investigates the intersection of haute couture principles and emerging digital technologies. In this paper, we introduce a developing Neo-Couture framework, grounded in five key areas: Humanness, Interactions, Hierarchy, Material Agency, and Bespokeness/Rarity. Drawing upon the concept of 'intra-action' (Barad, 2007:33) from agential realism, the study explores how humans and computational tools mutually influence each other, offering fresh insights into creative processes in fashion and textiles. Where previous research has aimed to categorise AI tools; here, tools are considered 'material agents,' emphasising the emotional and agential aspects of Human-Computer Interaction (HCI). The concept of 'intra-action' is important in highlighting the co-creative dynamics between humans and digital agents. This study finds a nuanced interplay between human practitioners and computational tools. While participants experienced a range of emotions, from feeling in control to experiencing tension, the findings challenge the idea of universal tool design, advocating for bespoke, adaptable solutions. These insights are particularly relevant for interdisciplinary fashion and textile practice in conjunction with Human-Computer Interaction (HCI), digital design and AI fields, and hold potential for haute couture practice. Future research will be undertaken into user-centred experiences when working with digital tools, to examine the experiences of specialised groups of professionals in the fashion industry.

Keywords: Haute Couture; Digital Fashion and Textiles; Digital Agency; Human Computer Interaction (HCI)

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1. Introduction

The Neo-Couture project is a research project under the Laboratory for Artificial Intelligence in Design – a collaboration between the Royal College of Art (RCA) and the Hong Kong Polytechnic University (HKPU). The project aims to incorporate haute couture values with digital craftsmanship in fashion and textiles practice. This research intends to inform the development of user-centred digital tools in fashion and textiles, focusing on material manipulation, collaboration, and bespoke craftsmanship. The broader goal is to explore how AI and digital tools can enrich artisanal practices for the fields of fashion and textiles.

The term 'Neo-Couture' describes an interdisciplinary space comprising specific elements drawn from haute couture – derived from the fields of fashion and textiles – and 'neo' or new – relating here to computer science and advancing materials in the field of artificial intelligence (AI). In this paper, we propose a Neo-Couture framework based on key principles drawn from haute couture — Humanness, Interactions, Hierarchy, Material Agency, and Bespokeness/Rarity. The researchers, themselves, are located in the fields of fashion and textile design and employ this framework as a lens through which to inform an approach to interdisciplinarity, when examining the fields of Human-Computer Interaction (HCI), digital design and AI.

This paper directly addresses a gap in research regarding the creative application of digital tools in the context of fashion and textile design research, asking: how could haute couture values inform the development of HCI and digital tool use for fashion and textiles. This paper presents results drawn from a mixed-methods approach in order to explore human-computer interactions in the context of fashion and textiles, drawing upon the notion of 'intra-action' which Barad understands as a 'mutual constitution of entangled agencies' (Barad, 2007:33) as set out in their agential realist framework. This paper contributes to new understandings of interdisciplinary approaches by examining how employing digital tools from technoscientific disciplinary fields can provide insights for fashion and textile design research. This enquiry finds that there is a need for a tailored application of digital tools for fashion and textile design practitioners.

1.1. Theoretical Lens - 'Intra-action'

Underpinning this paper is the concept of 'intra-action' (Barad, 2007:33) derived from agential realism, as articulated by philosopher and physicist Karen Barad. Agential realism, the foundation of the notion of 'intra-action,' advocates for a relational understanding of the world's specific material configurations (Barad, 2007:178). Instead of viewing phenomena as isolated entities, agential realism posits phenomena as the basic ontological units. These units are continually reconfigured through interactions that define boundaries, properties, and meanings (Barad, 2003:828).

Critical to agential realism is the concept of 'intra-action' (Barad, 2007:33). In contrast to traditional models that treat agents as isolated entities, 'intra-action' emphasises the emergent agencies that arise from the relationships between things. Barad suggests that we focus on the dynamic state of matter not as fixed but as a 'substance in its intra-active becoming' (Barad, 2003:828). In the context of haute couture, we argue that the agents involved– be it the artisan, the material, or the digital technologies– do not merely interact but 'intra-act' (Barad, 2007:33). They mutually constitute and transform each other through these relational interactions, thereby aligning with Barad's philosophy. This concept is important for dissecting how fashion and textile practices differentiate or merge roles between human artisans, materials, and the development of future AI technologies. In this paper we apply the philosophical construct of 'intra-action' to the digital interactions of fashion and textile practitioners.

1.2. Haute Couture - A Brief Overview

Commonly seen as the pinnacle of fashion and textiles craftsmanship, haute couture is a realm where rare and unique materials meet meticulous hand craftsmanship (Nudelman, 2016). An haute couture garment is custom-made through multiple fittings in ateliers of highly skilled and specialised artisans (Business of Fashion, 2022). Haute couture's cultural significance emanates from its labour-intensive hand-finishing, the use of luxurious and bespoke materials, and its reputation for aesthetic influence (Nudelman, 2016, Bancroft, 2015). Haute couture, which translates from French as 'high dressmaking,' is rooted in a highly personalised engagement between client and couturier.

In this paper, drawing upon haute couture values offers a unique position from which to examine digital tools for fashion and textiles practice. As Arielli suggests, human creativity has its limits, and AI offers an opportunity to push past our own creative limitations (Arielli, 2021:7). If we are to consider how to extend creative capacities in fashion and textiles, AI could serve as a 'creative prosthesis,' augmenting human limitations and enriching aesthetic and expressive possibilities.

Here, it is important to draw a foundational understanding of the essential qualities of haute couture, and we define these as — Humanness, Interactions, Hierarchy, Material Agency, and Bespoke/Rarity. These elements lay the foundations for a developing Neo-Couture framework which incorporates traditional haute couture facets together with questions around how HCI, digital and AI may affect these facets. We detail haute couture values below, and a Neo-Couture framework in Section 3.

2. Haute Couture Values

2.1. Humanness in Haute Couture

The human body is central to the design of the couture piece, and the human hand central to the craft of its construction. As Montagna et al. (2018) detail, haute couture is a ‘highly individualised work process’ (Montagna et al., 2018:3) deeply rooted in ergonomics and human factors as well as meticulous attention to body measurements. Thus, the couture process is inherently dynamic, continually calibrating itself to the uniqueness of each individual, embodying what Armitage identifies as ‘human presence’ (2023:133), which he contends is rooted in intricate socio-cultural interactions among the couturier, client, and craftspeople.

2.2. Interactions - Multi-agent interactions in Haute Couture

Haute couture emerges from the dynamic interaction of a range of skilled craftspeople, clients, and the material itself. Montagna et al. (2018:3-6) describe this as a non-linear process with intricate, interlinked feedback loops among multiple agents—be it the client, the 'Première de Atelier', or the seamstresses known as 'Petites Mains'. This represents the vitality of the creative process of haute couture, as an ongoing evolution through client interactions and the construction of work shaped by multiple actors (Montagna et al., 2018:6).

2.3. Hierarchy in Haute Couture

Haute couture ateliers function within a well-defined hierarchical system, structured around specialised skills and roles (Steele, 2005; Montagna et al., 2018; Gwilt, 2012; Wilcox, 2008). Within these ateliers, roles such as 'Première d’Atelier,' 'Première Main,' and 'Petites Mains' are delineated

and hierarchised (Steele, 2005). There is a rigidity in the structural traditions found in haute couture ateliers.

2.4. Material Agency in Haute Couture

Couturiers have described how materials guide their creative processes. As Hubert de Givenchy articulated, 'I let the fabrics guide me, and my imagination goes to work as soon as I have put them down' (Wilcox, 2008:118). Geaney (2022) argues that fashion practitioners show 'a sensitivity and responsiveness to working with fabric and material' (Geaney, 2022:103). This view aligns with Givenchy's practice of allowing materials to influence design decisions. Thus, material agency involves a negotiation between fashion practitioners and materials. Material agency in haute couture is more than just an interplay of fabrics; it is a complex web that involves both human and nonhuman actors within a creative assemblage (Geaney, 2022:102-104; Barad, 2007:178).

2.5. Bespoke/Rarity in Haute Couture

Haute couture is distinguished by its bespoke nature, tailored to each client's unique dimensions, and its rarity of material (Montagna et al., 2018; Nudelman, 2016). Yet, the integration of AI and digital technologies introduces both opportunities and challenges. Faiers (2021:9) remarks that the digital sphere could dilute the uniqueness and rare expressions of identity that define haute couture. Rocamora (2016:8) adds that digital technologies may alter the very manner in which traditional crafts are approached.

3. Framework - Neo Couture

The Neo-Couture project is developing a dynamic framework rooted in both haute couture and digital design values, which takes and builds upon the key elements of the haute couture facets laid above in Section 2: Humanness, Interactions, Hierarchy, Material Agency, and Bespoke/Rarity. In comparison to the haute couture values, the Neo Couture framework is further informed by ongoing research into technoscientific areas including digital computational agency and AI. The Neo Couture tenets, as laid out below, account for the questions and future projections informed by the authors' ongoing research into digital and AI technologies for fashion. This framework is not viewed as static but as emergent and will be tested as part of the wider Neo Couture research project. In this paper, the developing Neo Couture framework is posed as an early framework, drawn upon in Section 6 to underpin a manual and iterative process of coding for thematic analysis, during data analysis. The purpose of this is to embed fashion and textile values as a lens for leaning out and exploring tools borrowed from other disciplinary territories, here the areas of HCI and digital design tools.

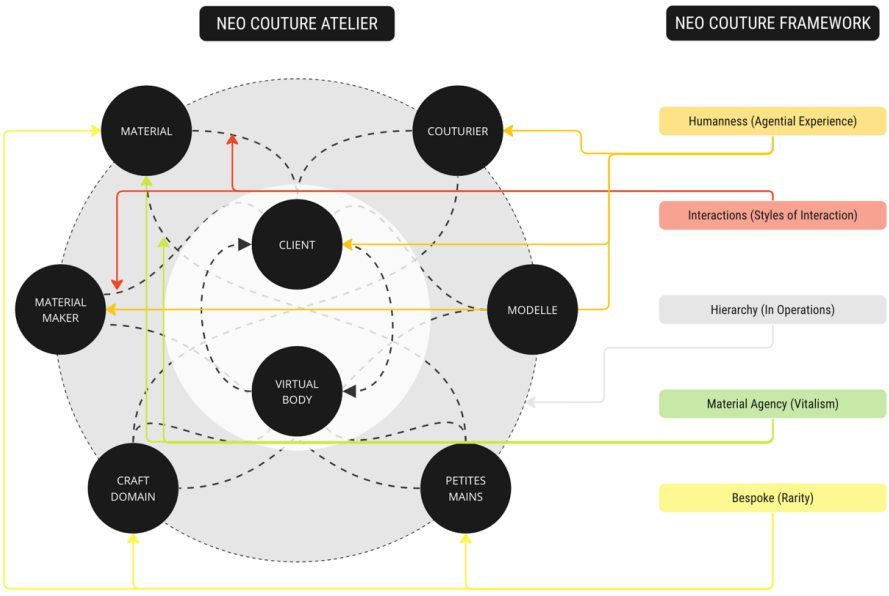

Figure 1. Neo-Couture Framework - Source: Authors own figure - This visually encapsulates the possible integration of AI, emphasising not just the technological but also the human dimensions within the framework.

3.1. Humanness in Neo Couture

The incorporation of AI poses questions regarding its potential to either enhance or disrupt the innate human-centric dynamics of haute couture. O'Mahony (2011) argues that the integration of technology with traditional craftsmanship propels haute couture aesthetics forward. Operating in an interdisciplinary space of HCI and digital tools for fashion and textiles, the digital challenges traditional human-centric practices and raises questions about how technology will augment the human hand and human body, for haute couture.

3.2. Interactions in Neo Couture

Armitage (2023) stresses the importance of interactions between artisans and clients in haute couture. AI and digital technologies could transform the interaction dynamics between artisans and clients in haute couture and fashion and textiles more broadly. In this way, both human and machine-enabled interactions are integral to the evolution of haute couture praxes and become critical to HCI research viewed from the fields of fashion and textile design research.

3.3. Hierarchy in Neo Couture

As we transition into the era termed 'Fashion 4.0', as discussed by Särmäkari (2022), it is considered that the penetration of AI could affect traditional hierarchical frameworks. This suggests a paradigm shift from the designer as an isolated creator to one engaged in a fluid, interdisciplinary community, a shift that necessitates rethinking existing hierarchical norms (Särmäkari, 2022). By examining how designers co-create in environments augmented by digital technologies, we gain insights into the evolving concept of hierarchy in relation to existing structures already embedded in haute couture and fashion and textiles practice.

3.4. Material Agency in the Context of Neo Couture

Haute couture is a realm where human designers, materials, and the craft itself engage in a dynamic interplay (Montagna et al., 2018:6). Agency in Neo Couture refers to 'intra-actions' as inclusive of ‘iterative reconfiguring[s] of the materiality of human, nonhuman, cyborgian, and other such forms’ (Barad, 2007:178) - an interplay between the various human and nonhuman actors involved in a system (Barad, 2003:828). Material agency thereby encompasses the tangible and intangible materials, as well as the agential shifts between all participants in the creative assemblage (Geaney, 2022:49). Leveraging agential realism, we explore how both human and nonhuman agents (including materials and tools) form an 'intra-action’ with human agents, challenging traditional boundaries and broadening the concept of material agency in the Neo Couture framework. Nonhuman agency, previously linked to certain material experiences in haute couture, becomes a critical investigation area in our framework.

3.5. Bespoke/Rarity in Neo Couture

The integration of AI and digital technologies into Neo Couture poses crucial questions about how we value uniqueness and rarity in a digital age. While haute couture is inherently unique, not all pieces are strictly one-of-a-kind (Wilcox, 2008:77-80). Kovesi (2016) contrasts the constraints of real-world craftsmanship with the expansive possibilities of digital reproducibility. This divergence poses urgent questions about how to reconcile the rarity of haute couture with the scalability enabled by digital technologies. These questions open up interdisciplinary discussions on preserving these key characteristics that imbue uniqueness, while embracing technological innovation.

3.6. Summary

By focusing on these principles, we construct an outline approach for exploring Human-Computer Interaction (HCI) in fashion and textiles which draws and builds upon haute couture's distinct values (outlined in Section 2). In this paper, the Neo Couture framework is used to support thematic analysis - as a set of groupings in which to codify data findings derived through qualitative and quantitative design research methods (see Section 6). The Neo Couture facets are viewed here as a developing lens for looking out from the disciplines of fashion and textiles to explore other disciplines, here digital tools. As discussed, the Neo Couture framework itself is an early proposition and will be further elaborated on and refined as the wider research project continues.

4. Related Studies

4.1. Frameworks

Recent studies such as those from Rezwana and Maher (2022) and Guzdial and Riedl (2019) have developed frameworks for understanding the dynamics of co-creation with AI agents. Guzdial and Riedl (2019:3) assessed a wide range of human-AI co-creative tools and established three categories for them: (1) creative support tool, (2) autonomous generative system, or (3) co-creative system. Other works have also proposed similar frameworks for understanding human-AI creative interactions

(Grabe et al., 2022). While these works categorise interaction styles, they are less concerned with the human experience of these interactions.

Buschek et al. (2021) analyse existing AI creative applications and discuss potential pitfalls when designing AI-human co-creative systems, grouping them into three general areas: limited AI, too much AI, and beyond use. This framework is useful in identifying specific challenges that may be experienced by human-AI interactions however it is limited in that this is a speculative framework and was not tested against user experience. The framework is nonetheless useful in categorising potential HCI concerns or opportunities with AI tools.

NAME	AFFECTED ASPECTS	PROBLEM DESCRIPTION
LIMITED AI		
Invisible AI boundaries	model, creativity, exploration	AI imposes unknown restrictions on creativity and exploration
Lack of creative expression	usability, creativity, exploration	UI imposes bottleneck on creative use of AI
False sense of proficiency	trust, reliability	AI suggests answers or completions that cannot be verified or that create a false sense of proficiency
TOO MUCH AI		
Conflicts of territory	usability, UX, control	AI overwrites what the user has manually created/edited
Agony of choice	usability, UX, productivity	AI provides overwhelming amount of detail - too much choice
Time waster	usability, UX, productivity	AI distracts/Interrupts the creative task itself
BEYOND USE		
AI Bias	accountability, fairness, transparency	AI suggestions are biased in a certain way. W.r.t human values/meaning
Conflict of creation and responsibilities	creativity, responsibility, ownership	AI and user collaborate towards a certain output, ownership is unclear
User and data provacy	privacy, responsability	Private data may be exposed through the AI system and its training data

Figure 2. 9 potential pitfalls Ai/Human co-creative systems (Illustrated by authors). Source: Buscheck et al, 2021.

These frameworks, while not directly focused on the fashion or textile industry, offer valuable reference points that relate to the areas of humanness and the experience of digital interaction that we propose as important in the Neo Couture framework. We therefore tested Buschek et al.'s (2021) framework, adding a co-creative category drawn from Guzdial and Riedl (2019:3), and employed our thematic groupings from the Neo Couture Framework, laid out in Section 3. Combined, these aspects inform the questions and groupings used for thematic analysis, in Section 6 and categories for discussion in Section 7.

4.2. Digital Materiality and User Needs/ Emotional impact AI Tools

Our position in this study is to examine the simulation tool as a type of material. Joseph (2017:106) expresses the need to explore digital software as a type of material substrate in fashion and textile research. We examine how users engage with these tools and their corresponding emotional reactions (Limerick et al., 2014; Shank et al., 2019). Our investigation centres on the user experience when interacting with digital interfaces that possess some form of agency. Mahmud et al. (2022) found that many users feel discomfort with current AI tools, advocating for more adaptive solutions to cater to specific user groups.

This resonates with Bertola and Colombi (2021) and Varra (2021), who emphasise the need to improve digital competencies, including HCI skills, in fashion both professionally and educationally. Studies like Limerick et al. (2014) and Shank et al. (2019) highlight the emotional reactions users have towards HCI, ranging from perceived loss of control to various kinds of agency attributions. The significance of understanding these emotional layers becomes apparent, particularly when considering the

development of more user-friendly tools in fashion and textiles. As Joseph (2017) suggests, we too consider the digital tools as a form of material, examining how they interact with the human operators.

4.3. Agency and Vital Materiality

Political theorist Jane Bennett (2009) and Anneke Smelik (2018) discuss the vital materiality of both physical and digital agents in design. While there is established discourse on the agency of physical textiles (Winters, 2017; Piñeyro, 2019), the agency of digital materials and tools remain underexplored (Igoe, 2018). This study reflects further on exploring the sense of agency between users and the simulation tool, considering the tool as a type of material and interaction agent (Joseph, 2017) and its intra-active potential in an HCI engagement (Barad, 2007).

4.4. Agency and Intra-Action Across Domains

Fizek (2017), McKeown (2019) and Janik (2021), collectively question the human-centric approach in game studies, introducing the concept of 'intra-action' from Baradian theory (2007). These scholars propose that agency arises from the interplay between the player and the game interface, suggesting a shift from focusing solely on the human element to a more mutualistic relationship.

Through these studies, we can reflect on the creative affordances of game-like interactions and we propose that similar perspectives could be applied to digital textile research, to consider computational agency in the software space of fashion and textiles as a means to engage, challenge and co-create with human users. Rutz (2016) and Frauenberger (2020) extend the idea of intra-action to Human-Computer Interaction (HCI) within creative computation. Their work suggests a movement towards studying the performative dynamics between humans and machine agents, rather than isolating these elements. Oh et al. (2018) emphasise the complexity of human perceptions when interacting with AI, pointing out users' desires for control and transparency.

In fashion and textiles discourse, Tepe and Koohnavard (2023) add valuable justification for engaging with other digital design domains, arguing that fashion practitioners need to comprehend the technical nuances and socio-dynamic aspects unique to digital realms. This is significant for fashion and textiles, where a broader understanding of digital tools is imperative for innovation (Tepe & Koohnavard, 2023).

4.5. The Current and Future State of understanding AI agency in Fashion and Textiles

Though some studies, such as Zou et al. (2019), explore AI as co-creative interfaces in fashion, the focus on the agential experiences of fashion practitioners is minimal. Castán Cabrero (2019) focuses her study towards material agency in textile architectures. In contrast, Geaney's recent work (2022) suggests a growing need to focus on the agential aspects of human and nonhuman interactions, particularly pertinent as AI technologies continue to evolve in the sector. Thiel also proposes an anti-disciplinary approach (2017:164) that opens avenues for such explorations in line with Tepe and Koohnavard (2023) in their proposition for expanding outwards into other digital domains to draw learnings about how digital concepts in fashion and textiles could be approached differently.

4.6. Summary

By reflecting on these varied domains, we gain an understanding of how haute couture principles can be explored in the digital arena, in order to develop tools that are tailored to the artisanal nuances of fashion and textile practitioners. We reflect on these varied insights towards a Neo-Couture

framework, where we adopt a multifaceted approach to understanding computational agency and intra-action in relation to fashion and textiles practice and haute couture principles. This allows for a richer appreciation of how haute couture principles can be transposed into digital paradigms.

5. Methodology

This paper focuses on the findings of the first in a series of studies, informing the wider Neo Couture research project. In this paper, we investigate the experience of fashion and textile practitioners using a digital drawing tool developed by the research team. The research design employs a range of specific methods selected for this study: the selection of a digital design tool and its testing with fashion and textile practitioners; workshop design, hosting and facilitation; participant questionnaires; and thematic data analysis using both qualitative and quantitative methods, first through drawing on the frameworks of Buschek et al. (2021) and Guzdial and Riedl (2019:3), and then further grouped under the thematic categories as set out under the Neo Couture framework (Sections 6.3, 6.4 and 7). Results are derived using quantitative methods, such as employing a Likert scale to derive the mean and standard deviation (SD) and qualitative data methods, including direct questionnaire responses. This mixed-methods approach allows for the study of both for quantitative data results as well as for further feedback and elucidation from participants on their thoughts and feelings around utilising digital tools. This approach is employed to enable for more detail and specificity of user responses, as well as to understand broader statistical trends, in order to centre the user group's needs when considering the development of digital tools for fashion and textile practitioners.

The research design is iterative and is understood to build and develop over the course of the Neo Couture project. The workshop design, here, concentrates on the human as subject, framing the participants' sense of agency and shared agency through the lens of 'intra-active' phenomena (Barad, 2007). Drawing on Montagna et al. (2018) and Joseph (2017), we explored multi-agent interactions in haute couture, while treating the digital tool itself as a type of material. A one-day workshop at HKPU involved both questionnaires and a workshop activity, serving as critical initial steps in developing user-centred AI tools for fashion and textile practitioners.

5.1. Description of the Digital Design Tool

Building on protocols by Noy et al. (2012) and Yuval Hart et al. (2017), our tool was a tile-based drawing activity implemented using JavaScript and the library Three.js. Unlike previous adaptations, our tool removed constraints on tile numbers and allowed for more free-form drawing. Hosted on GitHub Pages, the software presented a 16x16 grid for creative exploration. Users could freely draw and erase their inputs using either the erase tool or the 'reset' tool. A save function was incorporated so that users could save their inputs to a gallery. Its dual functionality enabled both solo drawing and a collaborative activity featuring a randomization algorithm as a creative agent. A clear delineation of colour was used so that users could see their inputs in relation to the computer-generated inputs as indicated in Figure 3.

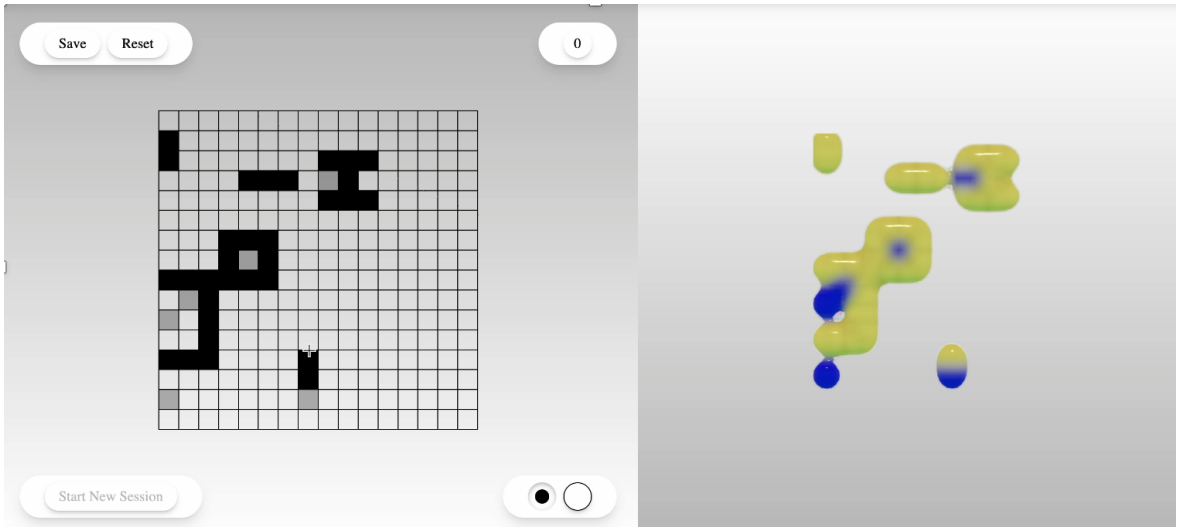

Figure 3. Screenshot of the workshop tool Source: Authors own - This image shows the digital interface from the second activity with the 'computer agent', to the left is the drawing canvas, where workshop participants place their marks. To the right is the visualisation canvas. Computer inputs are delineated in light grey on the drawing canvas and blue on the visualisation canvas. To the top left, a toolbar holding a 'save' and 'reset' function are available to users.

This tool was chosen as a simplified way of understanding interaction dynamics between a human user and a digital tool. Rafner et al. (2022) discuss, in their review of similar gamified interaction tools, that relatively limited exercises like these can offer important insights into user experiences when working with digital tools. The tool comprises two types of functionality, one for solo drawing and one for a collaborative activity, that utilise a randomisation algorithm as a form of creative agency to interact with during the activity. In this study, we tested the tool with fashion and textile practitioners in order to understand whether there may be important divergences and nuances in experiences with digital tools in this user group. More broadly, this allowed for insights into whether there are other requirements that need to be taken into account when developing digital tools specifically for fashion and textile users.

5.2. Participant Selection

The fashion and textile department at HPKU was utilised for participant recruitment as we are looking to uncover preliminary insights into the specific needs of fashion and textile users when interacting with digital tools. The relatively early stage careers of this user group was deemed appropriate as it was felt that they would be more familiar with many digital tools and already use them actively in their creative activities. The digital familiarity of the participants was enquired on in the workshop pre-activity questionnaire (discussed further in Section 6.2).

5.3. Time Allotment

The workshop consisted of five activities spread over 2 hours:

Activity 1. Introduction to Neo Couture: 30 minutes
Activity 2. Pre-activity questionnaire: 30 minutes
Activity 3. Solo Digital Tool Activity: 20 minutes. Participants design shapes or patterns using a browser-based tool. Multiple designs can be saved to the gallery.
Activity 4. Tandem Digital Tool Activity: 20 minutes. Participants collaborate with a computer agent to create and save designs.
Activity 5. Post-activity questionnaire and image selection: 30 minutes.

Participants had the freedom to create multiple designs in both solo and tandem activities, and the option to save their works to a gallery.

5.4. Data Collection

We employed a game format commonly used in creativity assessment studies. Pre- and post-activity data was gathered as questionnaires on Google Forms and saved digital sketches, in line with methods employed by Rafner et al. (2022).

5.5. Data Analysis

For the analysis, we focused on thematic examination of questionnaire responses. We juxtaposed these findings against both the proposed Neo-Couture framework and aspects drawn from Bushkek et al. (2021) and Guzdial and Riedl (2019:3) frameworks, aiming to offer a nuanced understanding of the experience and utility of AI tools in fashion and textile practices. From initial questions on digital receptivity to reflections on AI interaction, participants' responses revealed diverging views on the role of AI in fashion and textiles. We used a Likert scale ranging from 1 (Not Important) to 10 (Very Important) to derive the mean and standard deviation (SD) to assess responses where the question format used this scale. The written responses were then thematically grouped first against an adaptation of the framework proposed by Bushkek et al. (2021) and Guzdial and Riedl (2019:3) as discussed in Section 4.1, and then under the Neo-Couture framework which includes five key value areas—Humanness/Agency, Hierarchy, Interactions / Engagement, Material Agency/Vitalism, and Bespoke/Rarity. We derived percentage frequencies from a synthesis of these responses.

Throughout Section 6, direct quotations are included aiming to provide a more holistic view of the participant's experiences and expectations. This is to support the key intention of this paper in understanding the importance of user-centred tools through directly including the voices and perspectives of the users, here fashion and textile participants.

5.6. Transparency and Ethical Considerations

This study adhered to the Royal College of Art's ethical guidelines. Participants were informed about the study's objectives and gave voluntary consent to participate. Data was anonymised and securely stored on RCA servers, accessible only to the research team. The ethical aspects were reviewed and approved by RCA's Ethical Review Board.

6. Results

6.1. Participant Demographics

A total of 13 participants, with a mean age of 25, were recruited from the fashion and textile departments at HKPU. To form the study group, participants predominantly comprised fashion and textile students, at both Masters (MA) and PhD level, alongside one senior lecturer and one data scientist.

6.2. Data From Pre-Activity Questionnaire

Prior to the workshop, in order to gain understandings of digital receptivity and readiness, a pre-activity questionnaire was employed to probe the participants' comfort and reliance on digital tools

by asking: ‘how important is the digital in your practice?’ A mean score of 7.9 (SD 1.9) was reported suggesting a comparatively high importance in the use of digital tools to this group.

Participants were also asked for their views on the future of fashion and textiles with AI involvement. Responses were categorised as positive (46.2%), negative (15.4%), or neutral (38.5%). Generally, the group expressed largely positive expectations for AI in the future of fashion and textiles. Positive responses included those who believe that AI will lead to increased efficiency in design processes, unlock new creative possibilities, and democratise the field of fashion and textiles, for example: ‘all the process[es] of fashion and textiles design will accelerate with the help of AI. Designer[s] can have more time to focus on their inspiration, innovation and design.’

Neutral responses suggested that the impact of AI will depend on how it's implemented, managed, and regulated: ‘it will become a trend for the industry to involve AI in different designing process[es]. Someone will appreciate while someone will [be] against.’ Negative responses centred on concerns such as AI potentially diminishing the role of the human designer, ethical concerns about data usage or AI biases, and fears about a lack of transparency in AI systems:

> For me personally, I feel it opens up concerns about our human values and ethics, as there is not enough transparency within the digital [...] Will we as humans need to compromise [...] in parts or sacrifice our intrinsic values, principles and ethics that are significant in a human to human exchange/relationship[...]?

6.3. Drawing Upon Buschek et al. (2021) and Guzdial and Riedl (2019) Frameworks

Following the workshop, participants were asked to reflect on their interactions with AI. Responses were classified according to Bushek et al.'s (2021) categories: Too Much AI, Limited AI, Beyond Use (AI Unclear), and a category termed Co-Creative derived from Guzdial and Riedl (2019:3) - as discussed under Frameworks in Section 4.1. We saw the addition of co-creative as important in a study which understands human and nonhuman relations as ‘intra-actions’, as the framework proposed by Buschek et al. (2021), although useful, is limited in purely looking at characteristics that inhibit the human experience of creating with AI tools. We present the results below:

Too Much AI, made up 29.41% of responses, indicating issues of control and agency:

> The first time, it makes me feel so free and [able to] concentrate on creating the pattern I want. But [...] the second time, when [...] I worked with [the] computer agent, because the blue point came up so random[ly], I need[ed] to spend more time [in] conflict[...] with it. Sometime[s] it make[s] me frustrated because it did not [come] up [in] the right places I want[ed].

Limited AI, constituted 26.47%, focusing on perceived inadequacies in the tool's capabilities: 'I wonder if the human is able to determine what levels of input/collaboration they want from the computer? Could the AI have different levels of behavio[u]r or given various degrees of freedom?' Beyond Use/AI Unclear, represented 11.76%, where participants expressed a desire to understand more about the tool: 'the computer settings limit my creativity in creating new pieces.'

Co-Creative, accounted for 32.35%, where responses indicated a co-creative or symbiotic experience:

> In the second activity, I[t] was like competing with [a] computer. The computer would take up some places in the grid and I would take the rest like a competing game. Also it's more interesting to me as it's like debating questions on Quora. The computer would throw a simple question and then I['d] get motivated to answer.

6.4. Data From Post-Activity Questionnaire

Table 1. Post-activity questionnaire results*

Survey questions	Mean (SD)
Humanness/Agency	
How important is your agency in your design process?	7.7 (1.6)
How comfortable were you when asked to work on your own in the first activity?	7.8 (2.2)
How comfortable were you when asked to work with the 'computer agent' in the second activity?	7.2 (2.7)
Interactions / Engagement	
How creatively engaging did you find working with the initial tool in the first activity?	6.6 (2.4)
How creatively engaging did you find working with the 'computer agent' in the second activity?	7.1 (2.3)
How frustrated were you by the decisions in placement made by the computer agent?	5.5 (3.2)
Hierarchy	
In the second activity, how much conflict was there between you and the 'computer agent'?	6.9 (2.7)
In the second activity, how often did the 'computer agent' distract or interrupt you?	6.9 (2.8)
Bespoke/Rarity	
How different do you feel the outputs made with the 'computer agent' were compared to your solo outputs?	7.3 (2.2)

**Material Agency is not included as responses for this value were derived using qualitative methods.*

Thematic Grouping

Using a manual process of coding, findings were grouped under the five key value areas of the Neo-Couture framework. We argue that this offers a useful method for thematic grouping for this study into digital fashion and textile discourse, as it relates the inherent values of haute couture to the developing space of digital fashion and textiles.

Humanness/Agency

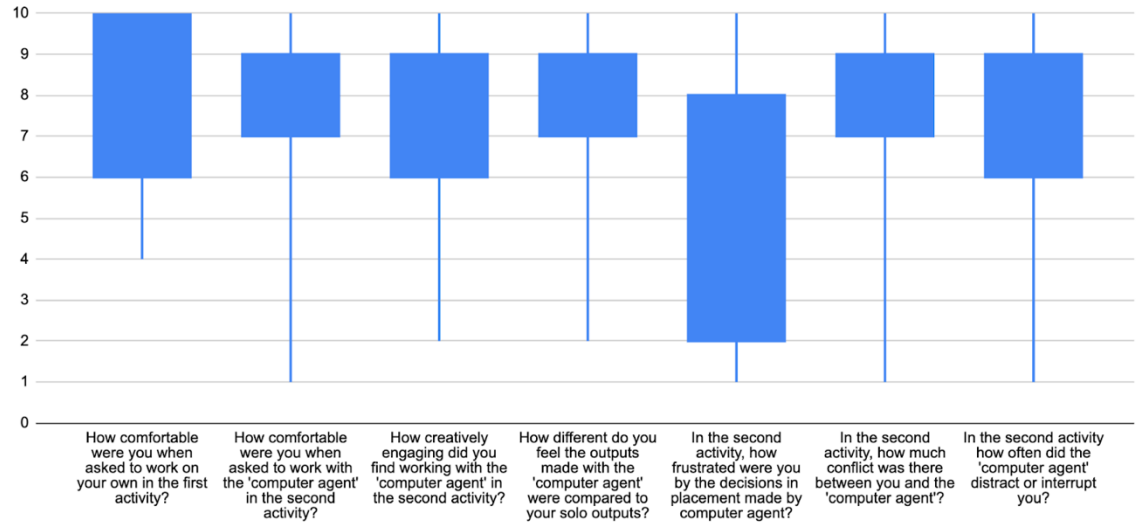

Figure 4. Post-Activity Questionnaire Results, shown here plotted on the Likert scale.

To evaluate this value area, we focused on four key questions from the survey which can be found in Table 1 grouped under Humanness/Agency where all participants reported a high score on the Likert scale. Participants predominantly felt extremely comfortable when asked to use the tool independently, with a mean score of 7.8 (SD 2.2). Participants felt slightly less comfortable when asked to work on the activity with the computer agent with a mean score of 7.2 (SD 2.7). When we assessed their perspectives on materials with agency, (for example, materials that behave, act, and adapt), the following responses were shared by the participants: (on agency in creative expression) 'I think it is a good tool for me to stimulate my creative desire and ideas'; (on assistive agency) 'I think it may be helpful for creative material[s] for people to play with. Also, I think it's important to solve problems like stability, safety, and so on'; and (on variety in agential interaction) 'it's interesting. It could be a breakthrough and challenge towards more options in silhouette and other aspects of design.'

Interactions / Engagement

In addition, we explored Interactions/Engagement using the questions outlined in Table 1. Overall, participants reported slightly higher engagement experiences when working with the computer agent, although the experiences varied widely (Table 1). Many participants enjoyed the unpredictability and were curious to understand what its logic was. Finally, the responses suggest that the experience of working with the digital simulation tool was mixed for participants. While some found it frustrating or limiting, others found it to be a source of inspiration or motivation.

Hierarchy

We further evaluated Hierarchy by grouping questions related to this theme (Table 1, Figure 4). Overall, the responses were quite mixed with a relatively high deviation in experiences. Some

participants found it distracting when the agent's decisions did not match their desired placements, while others liked to work with the agent in a competitive or collaborative manner.

Material Agency/ Vitalism

For the Material Agency/Vitalism value we synthesised the written responses to the four questions relating to the participants experiences of the interaction with the computer agent. These were:

> 1. How different do you feel the outputs made with the 'computer agent' were compared to your solo outputs?
> 2. In the second activity, how much conflict was there between you and the 'computer agent'?
> 3. In the second activity, how frustrated were you by the decisions in placement made by the computer agent?
> 4. In the second activity, how often did the 'computer agent' distract or interrupt you?

Overall, 32.35% of participants indicated a co-creative experience with the tool. Users either allowed the tool to influence and inform their decisions, or were motivated competitively by the interaction. Additionally, in some of the responses participants ascribed anthropomorphic qualities to the computational tool. This is shown as one participant discusses below trying to understand the computer agent and its 'mind':

> The machine [has] got its own mind. However, the interesting thing is that the generated spots made by [the] computer agent is something I wanted to follow and even wanted to cover them all, or just being covered [it is] like playing game[s] with a robot, which is really inspirational.

Bespoke/Rarity

As shown in Table 1, under Bespokeness/Rarity, participants expressed that working with materials with agency might enhance some attributes in a design process, such as by encouraging variation. This could be viewed by participants as a means to challenge an existing design process and to bring more options to users. This is shown as a difference in outputs and was measured with a mean score of 7.3 (SD 2.2). Generally, participants saw their joint creative outputs with the computer agent as distinct from their solo efforts.

7. Discussion

The principal objective of this research is to explore the complexities of user experiences among fashion and textile practitioners. Their interaction with computational tools, particularly those exhibiting automated agency, necessitates scrutiny. These findings contribute to the discourse in developing bespoke digital solutions tailored to industry-specific demands - here, the fashion industry. Our mixed-methods approach utilises both qualitative and quantitative methods, sourcing data from pre- and post-workshop questionnaires and real-time digital tool interactions. The conceptual foundation for this analysis relies on the idea of 'intra-action' (Barad, 2007:33), as a way of understanding the simultaneous agential phenomena of humans, materials, and tools acting together.

7.1. Humanness

While Limerick et al. (2014) and Shank et al. (2019) focus on emotional impacts, our paper focuses on the expression of agency that recognizes both human and machine as agents in a mutually influencing 'intra-action' (Barad, 2007:33). Contrary to existing research (Mahmud et al., 2022), our study suggests that participants felt they retained control while interacting with the computational agent. Notably, the manner in which participants interacted with the computational agent significantly affected their sense of agency. Participants expressed emotional tensions and conflict when working with the computational agent, extending the views by Limerick et al. (2014) and Shank et al. (2019) about emotional impact. Alongside this we discovered that 29.41% of our study's participants perceived an excessive imposition of AI, as categorised against a framework developed by Buschek et al. (2021). This observation can inform the development of AI tools in fashion and textiles, particularly in how designers perceive their agency in the creative process.

The recognition of mutual agency between designer and computational tool in our study could be explored further in haute couture, which has traditionally prioritised human artistry. The findings serve as a basis for discussing how digital tools can be better received at a human level for fashion and textiles. Our data adds to the debate by offering a nuanced perspective: we argue that HCI research in fashion and textiles should focus on exploring the ways digital tools can be collaborative, co-existing with human creativity without necessarily eroding human agency. Our findings may suggest that some fashion and textile practitioners actively negotiate the agency between themselves and their tools, however further research would be required in order to support this.

7.2. Interaction Styles (Engagement and Interactivity)

While existing literature offers generalised insights into human-computer interactions, such as Oh et al. (2018), Mahmud et al. 2022, and Rafner et al. (2022), our study specifically isolates the nuances in the fashion and textile domain. Users expressed a variety of sentiments regarding the level of engagement with the digital tool. The term 'intra-action' (Barad, 2007:33) is crucial here as it emphasises not just how humans interact with machines but also how they are mutually constitutive. This has parallels with insights into the intra-active phenomena of other fields such as games studies, where player and game are shaped simultaneously. As discussed earlier in this paper, in haute couture a couturier's relationship with materials and tools is sometimes complex. Our paper suggests that tool design in the fashion industry should accommodate this mutual shaping of user and tool. We also underline the need for adaptive levels of computer involvement, emphasising that a one-size-fits-all approach is insufficient for the diverse user needs.

7.3. Hierarchy (Operational Dynamics)

Our results reveal that participants had varied responses to the hierarchy of agency between themselves and the computational agent. The absence of uniformity in perspectives across participants in our study adds a layer of complexity that challenges previous findings by Oh et al. (2018). Here, we emphasise the need for transparent tool actions, as participants sought to understand the behaviour or intentions of the computational agent. In haute couture, the negotiability of agency could pave the way for a more collaborative design process with AI tools. Therefore a consideration of creative preference, where a distribution of creative agency between tool and user can be adapted in line with their unique creative style, may be critical in the development of future digital tools for fashion and textiles.

7.4. Material Agency (Vitalism in Tools and Intra-action)

As discussed earlier in this paper, an understanding of a sensitivity towards the agency of materials found in fashion, textiles and haute couture has grounding, but predominantly in the tangible experience of materials (Winters, 2017; Piñeyro, 2019). However, more recent discussions into digital materials and tools remain underexplored (Igoe, 2018). Joseph (2017) extends the concept of material to digital tools themselves. This research found that 32.4% of the participants acknowledged some form of agency in the computational tool, as well as a willingness to let the tool influence their decisions. This points to an expression of 'intra-action' as proposed by Barad (2007) where human agency and that of the tool mutually inform one another. The attribution of agency to a digital tool as well as how this impacts user experience, is therefore worth exploring further in fashion and textile disciplines as it directly informs how we approach developing digital tools.

7.5. Bespoke Interactions (Individuality and Rarity)

The haute couture industry is defined by its focus on individuality and bespoke designs. Our study indicates that when it comes to digital tool use, fashion practitioners also prefer an individual approach. Participants reported diverse experiences, ranging from feeling restricted to finding new avenues of creativity. These diverging levels of creative frustration build upon studies on collaboration dynamics (Rosenberg et al., 2022). This indicates that there is a critical need for bespoke, user-centred tool designs in computational systems, that are also adaptable to user needs. This study highlights a polarity in the acceptance of shared agency with computational tools. The majority of participants in this study were all comfortable and familiar with digital technology, yet the acceptance of shared agency divided the group. Flexible boundaries between human creativity and machine functionality appears essential to the receptivity of a digital tool with fashion and textile practitioners.

8. Limitations

This study has several limitations. Firstly, our sample of fashion and textile students lacked the expertise of seasoned haute couture practitioners. Secondly, the digital tool we developed was basic in comparison - unable to replicate the complexities of haute couture techniques (Montagna et al., 2018; Armitage, 2023).

In our study, the behaviour of the digital tool was also limited. The randomisation algorithm used was simple, possibly affecting user experience. The age and technology familiarity of participants, principally around 25 years old, could have also skewed results. Future research should incorporate skilled, and more mature fashion and textile practitioners.

Lastly, our focus was on user experience of digital tools and not on participants' design outcomes. Design outcomes will be studied in future research. Despite these limitations, the study contributes to understandings into how HCI in fashion, textiles and can be approached with a value system derived from haute couture practices. This study is the first experimental iteration of the wider Neo Couture project and we intend to bring insights found here to future workshops, working with more specialised practitioners in haute couture.

9. Summary

The principal objective of this paper was to explore the complexities of user experiences, specifically among fashion and textile practitioners, in their interaction with a digital tool exhibiting automated agency. Our research expands upon the existing academic discourse of user-tool interactions in fashion and textile design research. The focus on 'intra-action' (Barad, 2007:33), drawn from agential

realism, provides a nuanced interpretation allowing for understandings of shared agential relations in fashion, textiles and HCI, laying the groundwork for the future development of bespoke computational solutions tailored to the intricate demands of the fashion and textile industry.

Incorporating the developing Neo Couture framework as a lens for grouping and interpreting data has enabled a way in which to encounter the results of a study into digital tools through a fashion and textile lens. This resonates with the themes of agency, individuality, and complexity identified in our study, making it a fertile theoretical scaffold for future research in HCI from and through the fashion and textiles fields. By drawing values into the digital from haute couture, we intend that this inquiry challenges existing paradigms in the digital expression of fashion and textiles.

Further investigation involving a more diverse cohort within haute couture is needed to validate and extend our conclusions. Nonetheless, our study serves as an important contribution to ongoing dialogues, particularly in its expansion of the 'intra-action' concept into digital interaction and HCI in conjunction with fashion and textiles, thereby providing a multifaceted understanding of how digital tools are evolving and could be better adapted for the fashion and textile industries.

This research, therefore, contributes meaningfully to existing academic discussions, substantiating the complex relationship between agency and digital tool-use for fashion and textile practitioners. Furthermore, it broadens the applicability and relevance of 'intra-action' as a lens through which to understand digital tool interactions in fashion and textile design research.

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