WHEN DOES CLOTHING BECOME TEXTILE ARCHITECTURE? CREATING DYNAMIC QUALITIES IN ARCHITECTURE THROUGH THE POWER OF EMBODIED IDEATION TECHNIQUES

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ABSTRACT

Textile architecture bridges two distinct design practices that operate at different scales. The challenge of designing a soft and dynamic architecture has been widely addressed by architects and researchers. However, few of these projects adopt a textile design perspective. By proposing an embodied approach to textile architecture, this paper aims to contribute to new ways of designing textile architecture by means of transdisciplinary collaboration. Through a case study, we explore how the dynamic qualities of textiles in relation to body movement can inform new textile architectural design processes. The results show that the transformative nature of textiles, as a material that is adaptive, soft and dynamic, fosters a new understanding of textile architecture when coupled with the body. An embodied approach such as this addresses a perspective of power relations that is distributed across a relational network of agents and their capacity to perform as *enablers* and *disablers*, allowing architects and textile designers to work at the same level regardless of scale.

TEXTILE ARCHITECTURE

This paper presents an exploratory research project about the role of the body within the design process in the context of textile architecture. The term 'textile architecture' refers to the broad body of work at the intersection of the fields of textiles and architecture. It comprises an extensive account of projects that bridge both textile and architectural thinking from different perspectives.

The field of textile architecture was significantly advanced by Frei Otto during the 1960s, and today the field is experiencing a renaissance, with many projects combining these two fields: for example, the Elytra Filament Pavilion (Doerstelmann et al., 2015) the Textile Hybrid M1 (Lienhard et al., 2013) or the Hybrid Tower (Thomsen et al., 2015). However, the majority of these have evolved from an architectural point of view, rather than a textile designer's perspective. This investigation contributes to a new understanding of what textile architecture can be by exploring the potential of textiles in terms of its expressive and spatial qualities from a bodily perspective. This approach borrows from methods commonly used in interaction design and fashion design, in the work of Sietske Klooster (2005) or Jessica Bugg (2009), for instance. This paper explores notions of embodiment, materiality,

and choreography in relation to the creation of nuanced architectural expressions, and proposes an embodied approach to textile architecture. This embodied approach will allow architects and designers to engage with textiles in a more experiential way, thus enabling a first-hand understanding of the dynamic qualities of textiles in relation to space while providing new ways of collaboration between textile designers, architects *and* dancers.

The widely adopted computational approach to design practice allows the architect to control every single aspect of the process, from the generation of a digital form to the fabrication of the final prototype. However, as a result of this approach the majority of contemporary architectural projects offer a rather homogeneous digitally crafted aesthetic that abandons the materiality of architecture (Picon 2004). Acknowledging the multidimensionality of *matter* (Latour and Yaneva, 2008), the authors advocate the use of an embodied approach to textile architecture during the early phases of the design process, as it opens up different perspectives and concepts that can advance the field of textile architecture.

ARCHITECTURE AND CHOREOGRAPHY

There is a growing interest in the use of the body that directly relates the field of architecture and dance choreography. The work of Matteo Pacher (2015) takes a performative approach to architecture and proposes a tool for considering the body as the main element for architectural design. Salazar (2015) combines the representation of human motion with technology in an effort to explore kinetic space and its representation. Pallazi et al. (2009) designed a digital platform in which choreographed body movements are translated into abstract forms, volumes, digital visualisations and objects to explore 'what else' these movements could look like. All these works suggest that there is active interest in merging the worlds of architecture and dance choreography, and that such investigations have been widely explored by architects and dancers.

THE BODY AS A TOOL FOR ARCHITECTURAL DESIGN

The work of the architect Dimitra Stathopoulou (2011) and the fashion designer Inês Simoes (2013) acknowledge the potential of the use of the body within the design process. Stathopoulou focuses on the movement of the body as a starting point for designing an architectural form, sometimes using existing movement libraries, whereas Simoes' aimed to truthfully represent the body in action to allow the body to 'supply its own three-dimensional data' (Simoes, 2013, p.79) in creating tangible mannequins for blocking patterns to create mobile clothes.

In a different way, the interest of the present research in using the body as an early exploration for designing textile architecture relies on the potential of the textile-body schema – borrowing from what phenomenologists (Merleau-Ponty, 1962) have called the body-schema, referring to the experiential nature of the living body – to reveal architectural experiences shaped by the interaction between textiles and the body in movement.

The meaning that emerges from the encounter between the body, the textiles and the context embodies the subtle connection between textile thinking and architectural thinking. The dynamic aspect of textiles connects to the affordances (Gibson, 1979) and constraints that come into play when designing from an embodied interaction approach.[1] Such affordances and constraints operate as *enablers* and *disablers* of a set of associations and their power relationship. In this sense, this research offers a positive notion of power, understood as an influence in terms of materiality.

TOWARDS AN EMBODIED APPROACH TO TEXTILE ARCHITECTURE

Embodied design methods have been widely used within the context of both interaction design and fashion design. Embodiment relates to the notion of movement and performativity. Within the field of interaction design, many projects have addressed the topic of movement as material for designing interactive products or services (Antle et al., 2009; Loke and Robertson, 2010; Ross and Wensveen, 2010; Schiphorst, 2011; as cited in Loke and Robertson, 2011).

Wilde, Vallgarda and Tomico (2017) offer an extensive account of this concern, highlighting the diversity of the existing embodied methods and the challenge it presents when it comes to the transfer of that knowledge. They emphasise the importance of the felt experience in engaging with the myriad meanings that arise.

Borrowing from the relevance of the first-hand experience as a tool to inform the design process, the authors of this paper have pursued the adaptation of an embodied design ideation approach to the context of textile architecture. This approach comes with an important limitation: that is, the change in scale. Whereas the embodied methods mentioned above have been used to design from the body to the body, the present inquiry addresses the challenge of designing textile architecture by means of the body. To develop such an approach, collaboration between designers, dancers and choreographers is key in order to explore the potential of textiles and their capacity to embody a form, and subsequently a space, that emerges as a result of the interaction between the body and the material. To access the knowledge of dancers and choreographers as experts on body movement enriches and advances textile thinking in terms of the understanding of the potential spatiality of textiles.

[1] Norman (1988) advocated the use of *affordances* in the design field, and soon afterwards this was adopted by the field of human-computer interaction (HCI) and acknowledged by Dourish in his seminal work regarding the foundations of embodied interaction (2001).

The capacity of textiles to adapt to a surface or embody a form is connected to the idea of performativity, of something that behaves in a particular way (Salter, 2010). If we think of how a textile reacts when it is soaked in water, it might shrink, like cotton, or it might felt, like wool does when its fibres are rubbed against each other. This performative aspect is also shared by architecture. According to Salter (2010), architecture and performance have been connected through history in different ways. During the early twentieth century, there was a shift in architects' interest from building design to event design – seen, for example, in the work of Archigram, Gordon Matta-Clark and the Eventstructure Research Group (ERG). Architects from the 1960s such as Charles Eames worked on scenography for theatre production. This approach to architecture moves away from the static concept of what a building is, connecting with the notion of architecture as something temporary that embraces action over representation.

The main section of the paper describes, analyses and evaluates two workshops with different setups. Workshop 1 took place in a public outdoor area whilst Workshop 2 took place in interior spaces. Workshop 1 explores the body as a tool to shape the textile, focusing on material exploration from an embodied perspective. A textile artist, a textile designer (author 1) and two dancers took part in Workshop 1.

Workshop 2 identified the point at which textiles become space instead of clothing, offering results that indicate the potential nature of an embodied approach to textile architecture. A choreographer, two interaction design students, an interaction designer, a textile designer (author 1) and a design researcher (author 2) participated in Workshop 2.

Finally, in the conclusions, the authors reflect on the potential of the present approach and its implications within the field of textile architecture.

Author 1 deliberately chose to explore both exterior and interior contexts in order to test how environmental conditions would affect the choreographic experiences. In the following section, Workshops 1 and 2 are described and analysed.

WORKSHOP 1. HOW IS THE TEXTILE SHAPED BY THE BODY?

A series of explorations were carried out in order to find out how the textile, as a formless material, is shaped by the body in movement. Author 1 decided to perform with two different types of textiles, an elastic polyamide and a thick crêpe textile, in order to explore different properties, as the elastic polyamide can be stretched whereas the crêpe is inelastic and does not wrinkle.

Both edges of the elastic polyamide were folded and partially sewn to ensure that the textile remained on the body, covering part of the upper body and the heads of the dancers (Figure 1). Figure 1 shows the two dancers interacting with the elastic polyamide. While they were inside, the dancers could not see the outside, reducing the spatial experience to the interaction between the two bodies, mediated through the textile. However, from the outside an interesting play of shapes unfolded as the dancers moved inside in a process of negotiation between the textiles, the bodies and the space (Figure 2).

Figure 1: Dancers moving inside the elastic polyamide textile.

Figure 2: Sequence of dancers 1 and 2 moving inside the elastic polyamide textile

The form-giving process in Figure 2 could be used to inform an architectural process similar to the one proposed by Stathopoulou (2011) and Salazar (2015), in which they captured the movements of the body with kinetic sensors to design an architectural form. In this case, the sensors would capture the choreographic experiments and the textile could be read either as a unit together with the body or as a surface in which to explore the tensions of the textile. The resulting data could be digitally explored, enabling a hybrid system to design tensile architecture. A design scenario like this was tested in collaboration with the architect Daniel Suárez at a later stage of the present research (Castán and Suárez, 2017). Figure 3 depicts a sequence of movements mobilising a piece of crêpe textile performed by author 1 and textile artist. In this case the textile was not modified to be worn on the body, as the non-elastic property of the textile prompted us to perform a far to the body interaction. By holding the fabric at both edges of the longitudinal side and swinging it from side to side the textile is constrained by the body, and vice versa, as the body perceives a certain inertia from the textile, delimiting the space for the body to move around. The action of swinging the textile generates an airflow that results in the creation of a volume. The volume gradually takes form as the bodies move faster. The bodies operate as a scaffolding for the textile, creating a volume that only exists in movement (Figure 3). This interplay shows how all the components are interconnected within a power relationship that operates in terms of affordances and constraints.

Figure 3: Sequence of the crêpe textile swung by author1 and textile artist.

Each component acts either as enabler or disabler, by allowing for certain behaviour while preventing others. Figure 4 shows a volume that resembles a pneumatic structure, offering a smoother, cleaner surface. The surface of the crêpe textile changes when it is activated by the body. When it is not activated, the crêpe textile offers a rough, matt surface; *When the* crêpe *textile is activated by the body, the texture of the surface changes*. The body and the textile in motion create a whole unit that is temporary, soft, dynamic and embodied.

The explorations carried out in Workshop 1, opened the door to investigate the use of the body as a tool to explore when does clothing becomes architecture.

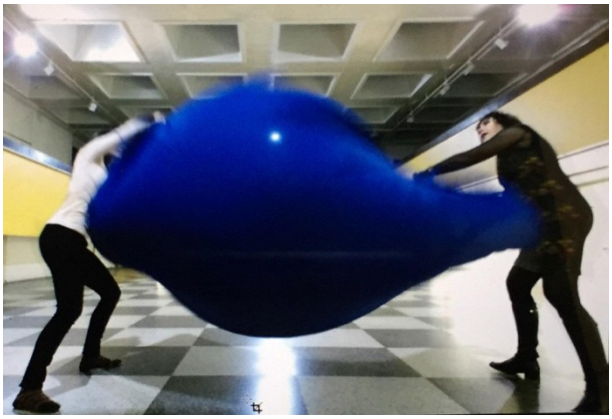

Figure 4: Crêpe textile mobilised by the upper bodies of textile artist and author 1.

WORKSHOP 2. WHEN DOES CLOTHING BECOME ARCHITECTURAL MATERIAL?

'When does clothing become architectural material?' was a collaborative exploration between a textile designer (author 1), a design researcher (author 2) and a choreographer. Two industrial design students and an interaction designer, participated in the workshop. The aim was to investigate how an embodied approach could provide a novel framework for designing textile architecture. The workshop used the 'choreography of interaction' method. According to Klooster and Overbeeke (2010), choreography of interaction is the framework for what they call 'design movement' (Klooster and Overbeeke, 2010, p.24). Design movement understands the embodiment of interaction as a choreography that concerns both the design process and the outcome, understood as a whole unit. This framework is based on three key aspects: *physical involvement*, *dynamic quality* and *expressed meaning*.

- *Physical involvement* relates to all the agents that take part in it: this means materials, people, objects and context. It also implies the characteristics and qualities of each.
- *Dynamic quality* comprises notions of spatiality, time and the play of forces.
- *Expressed meaning* is a notion related to the field of dance and refers to the meaning that is found in the interaction in each of the roles performed by different agents.

Focusing on the *expressed meaning* of the choreography of interaction, the dynamic qualities of textiles, such as stretchability, transparency and lightness, were explored through a series of choreographic experiments. The experiments sought to identify which spatial scenarios could potentially inform new architectural processes, with the aim of addressing three questions. Firstly, how can textiles enhance the action of choreographing a space? Secondly, what do textiles bring in terms of space, movement, shape and time? Lastly, how can improvised choreography inform new ways of designing textile architecture?

Each participant started by individually trying out each of the textiles, inhabiting them intuitively, letting the body and the textile interact and eventually challenge each other. Tomico and Wilde note that 'exploring materials on, with and through the body in context allows meaning to emerge directly from interaction with the material' (Tomico and Wilde, 2016, p.13). After each individual exploration, they reflected on what was interesting in terms of spatial or architectural qualities: what was different from being in a soft space as opposed to being in a static one.

THE ARCHITECTURE OF BLOWING SOFT SPACES

Inhabiting a lightweight textile (Figure 5 and 6) revealed an *architectural quality that is expressed in the moment the body mobilises the textile,* giving it a shape by walking towards the direction of the wind, generating an airflow that results in different shapes and volumes. At the same time the wind intervenes in this action by blowing the textile to different degrees. Thinking through the material, being aware of the qualities of textiles in relation to the inside and the outside by inhabiting them, fosters an architectural experience from which to think of possible applications for architectural design.

Author 1 pointed out that the perception of the space from the perspective of the wearer offers a concave appearance that moves less in comparison with the outside, which shows a spherical convex volume that is constantly moving. Author 2 and choreographer saw the potential for choreographing the entrance of a store, where the street door is situated, as a way to create a temporary, soft, pop-up space. Author 1 suggested exploring collectively the experience of inhabiting the textile as a way of responding to the limitations of scale. Author 2 argued that if architecture is designed for a large number of people, the action of exploring the

possibilities for textile architecture on the body should equally be tested collectively.

The piece of textile was three metres in length and width. The shape of the volume in motion was determined by the position of the textile on the body, attached to the wrists and the ankles, and the body moving backwards and taking advantage of the wind direction, while extending the limbs to help the textile move. The *affordance* triggered by the wind, in relation to the materiality of the lightweight polyester and the body movement, yielded the possibility of enacting a temporary soft space that is always in motion. The power of the body relies on its ability to produce space, becoming a *spatial body*, a 'site of gestures', where the space is not projected but enacted (Borden, 2012, p. 188).

Figure 5: Lightweight polyester seen from outside.

Figure 6: Lightweight polyester textile attached to the wrists and ankles of author 1 through elastic strips.

In the next iteration, all participants performed simultaneously. To do so, several pieces of the lightweight polyester were connected in order to offer a large-scale textile to interact with; this was intertwined through the bodies and attached to specific parts of the body with elastic strips. (Figure 7) The limitations of the increase in scale became evident. In terms of the act of choreographing, the experience of inhabiting collectively a large piece of textile requires planned, or semi-planned, choreography. The improvised choreography used for the individual explorations (Figures 5 and 6) did not work as well when the action of designing with the body became a group activity. As Figure 7 shows, the large-scale textile dominates the body, making it very difficult to keep a balanced interaction between the body, the textile and the context. The individual explorations with the lightweight textile resulted in a meaningful understanding of the relation between the material, the body and the context, connecting the creation of volumes to the body movement and the air flow of the environment.

Figure 7: Sequence of the lightweight polyester mobilised collectively by all the participants.

THE ARCHITECTURE OF FOLDING SOFT SPACES

Inhabiting a piece of scaffolding netting revealed the possibility of devising a space based not only on the immediate space around the body but also on the context. The dynamic quality of transparency of scaffolding netting mediated *the relationship between the wearer and the context, helping the wearer to design a space.* Figures 11 and 12 give a sense of how that *extended* space is perceived from the inside of the textile. The power relationship distributed across all the components unfolds as the materiality of the netting – its transparency, weight and pliability, together with the bamboo sticks – create the possibility of devising an extended space, activated by the body.

Figure 8: Scaffolding netting mobilised by the choreographer with bamboo sticks, using the upper body.

Figure 9: Scaffolding netting mobilised by the choreographer with bamboo sticks, using the upper body.

The action of opening and closing up the textile using the bamboo sticks creates a kind of origami appearance from the outside, like an envelope shape that shifts from one direction to another, providing a directional orientation in each layer of the fabric that was folded and unfolded. From the inside, the layering process created a gradient of transparency, from very clear to almost opaque. In Figures 8 and 9, the choreographer explores the *dynamic quality of transparency* of a five-metre by two-metre piece of scaffolding netting. As soon as participants inhabited the textile they realised that it was rather heavy, and author 1 and choreographer suggested using bamboo sticks to help the wearers when moving inside.

In contrast, when performed in groups of two (Figure 10, 11 and 12), the perception of the space changed significantly, as the almost translucent quality of the textile gives the wearer the feeling of being outside.

Figure 10: Choreographer and author 1 moving inside the scaffolding netting.

Figure 11: Interior view of the scaffolding netting.

Figure 12: Interior view of the scaffolding netting.

THE ARCHITECTURE OF DEFORMABLE SOFT SPACES

The experience of inhabiting a textile that is elastic revealed a transitional quality that relates to the transparency of the material. Figures 13 and 14 show a collective choreographic event in which one student, author 2 and choreographer inhabit a textile two metres by one and a half metres. By pushing the textile upwards, they could control the amount of light that passed through it. (Figure 15)

Figure 13: Lycra spandex textile explored by choreographer, student and author 2.

Figure 14: Lycra spandex textile explored by choreographer, student and author 2.

Figure 15: Student 3, author 1 and choreographer 6 pushing forward the lycra spandex textile.

Figure 16: Different degrees of transparency from the inside of the lycra spandex textile.

Figure 17: Different degrees of transparency from the inside of the lycra spandex textile.

The architectural experience of interacting with the elastic textile suggested a soft, deformable roof or window, or even a wall between rooms, that could be personalised to control the amount of light or how much of the outside one would like to see. The power relationship between the textile, the body and the context unfolds as the elasticity of the textile operates as an *enabler* for the body to push it, allowing it in turn to personalise the outside.

The perception of the space is a completely different one from that experienced in the example in Figure 1, in which dancers could not see the outside because of the opacity of the elastic polyamide. In Figures 16 and 17, the wearers not only can not only see each other but the outside as well, allowing for a different process of negotiation between the bodies, the textile and the context, as the interaction between wearers becomes less relevant while the connection to the outside gains interest.

Different architecture possibilities emerged from the explorations carried out in Workshop 2:

- Architecture of blowing soft spaces
- Architecture of folding spaces
- Architecture of deformable soft spaces.

THE TRANSFORMATIVE NATURE OF AN EMBODIED APPROACH TO TEXTILE ARCHITECTURE

The small number of textile architecture projects that acknowledge the perspective of the textile designer within the field was the main motivation to conduct the research presented in this paper.

By collaborating with textile designers, interaction designers, dancers and choreographers, the authors have proposed an embodied approach to textile architecture that allow designers and architects to engage with materials in a more intuitive way, by means of dance choreography.

The concept behind the choreographic events challenges the notion of architecture as something that is static and permanent (Latour and Yaneva, 2008).

The experiments showed that the power relationship distributed across all the agents of the network mentioned earlier (textiles, body and context), as enablers and disablers, are relevant for designing at the early boundaries of two different disciplines (textiles and architecture). In doing so, the body plays an important role, as it becomes at the same time a tool to design and to reflect (Overbeeke and Hummels, 2011).

Three architectural qualities were identified through the choreographic explorations: the architecture of blown soft spaces, the architecture of folding soft spaces and the architecture of deformable soft spaces. Each of these offers opportunities for designing textile architecture based on processes of transformation. The first enables the experience of what it is like *to inhabit a soft volume in motion*, how the textile behaves when activated by the body in context. The second shows how the subtlety of a transparent textile *allows the wearer to devise a space that is inside and outside* at the same time. The last relies on the concept of a transitory state in relation to the transparency of the textile, allowing the wearer to think of deformable soft spaces that can be personalised by stretching the textile and revealing the outside.

Regarding the collaborative aspect, the authors did not include collaboration with architects during the workshops since they consider it is necessary to investigate first what an embodied approach would mean in order to be able to work with architects.

The authors foresee significant value in continuing to explore further how the architectural qualities of textiles, triggered by the body, can inform the design of textile architecture. By exploring the use of the body with other dynamic qualities of textiles, new architectural qualities can be discovered. Moreover, new textile qualities can be designed: for instance, cutting or pleating the surface of a textile in certain way would modify its behaviour and, therefore, its behaviour on the body. Likewise, the use of other elements as an extension of the body would help to negotiate an increase in scale. In this sense, the experimentation of manipulating the surface of a textile and its position on the body would advance the application of an embodied approach to textile architecture.

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