# Exploring a Place-Based Approach to Materials Design: Harakeke Nonwovens in Aotearoa New Zealand

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As the interdisciplinary field of materials design expands, pressing environmental, social and economic crises mean that the impacts of materials are more clearly perceived [1]. This presents a challenge to activate materials towards positive change. Design practices that are relational, place based and deeply attuned to justice and the Earth are needed [5]. What might such practices look like within the field of materials design? And how might they be informed by textiles practice? To address these questions, this paper presents and reflects upon a recent study into the development of harakeke (Phormium Tenax/New Zealand Flax) based nonwovens. The aim of the study was to support the re-establishment of harakeke based industry in Aotearoa New Zealand, which recent research suggests could address a range of environmental, social and economic problems specific to the region. [9]. The approach taken drew on notions of place-based design and textile thinking, and was underpinned by a collaboration between university based design researchers, an agricultural and a forestry/ biomaterials research institute, an independent designer and an expert in traditional harakeke weaving. An initial review of materials design, research and developments that are predicated on regionally specific resources and knowledge was undertaken. Processing trials were conducted that brought together knowledge from indigenous harakeke weaving practice, fine art practices, industrially based fibre processing techniques and biopolymer processing. The resulting new materials were qualitatively evaluated using emergent models of experiential characterization [11], which showed potential for the materials to be developed towards applications including architectural surfaces and packaging.

Additional Key Words: Harakeke, Nonwovens, Place-Based Design, Materials Design, Textile Practice, Textile Thinking, Natural Fibres

## 1 INTRODUCTION

Prompted by developments in materials science, computational methods and biology, and informed by an expanding understanding of the environmental, social, economic, cultural, and even political impact of materials, Drazin suggests that we may be witnessing a materials revolution: 'a moment of innovation and change in the diversity of materials available to us and the constitution of material that already surrounds us'. Further, they note that 'it is not only a revolution in science but a social and cultural revolution' [2]. As such materials not only give form and provide a means of thinking through making, but can be perceived as vehicles for action and agency that can catalyse positive change [3,12]. This necessitates increasingly interdisciplinary, and even transdisciplinary, research approaches that enable complex and multifaceted problems to be addressed. In regard to design more broadly, Arturo Escobar argues that in this context practices that are relational, place-based and deeply attuned to justice and the Earth are needed; practices in which different ways of being and knowing are embraced [5].

This presents designers with a challenge to activate materials towards positive impacts. Within this paper we look to explore the notion of a place-based approach to materials design, research and development, specifically within Aotearoa New Zealand (NZ), as a strategy towards facilitating environmental, social, economic and cultural impacts. We ask what such an approach might look like? And how it might be informed by textile practice and thinking? To begin to explore these questions, we will use a recent pilot study into the development of harakeke (*Phormium Tenax*/NZ flax) based composites and nonwovens, as a focus for reflection. As a pilot study, the scope of the work presented is limited to an initial exploratory study with the intention to create a platform for further research, extending discourse in this space. The aim of the ongoing work of which the study is a part of, is to support the re-establishment of harakeke based


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industries in NZ, which research suggests could address a range of environmental, social and economic problems specific to the region [9].

Before presenting the pilot study we provide some brief discussion to begin to connect ideas around materials, textiles, and place-based design. Our intention is not to provide a definitive description but rather to point to the ideas and principles that are informing the emergent approach used in this work.

## 2 TEXTILES, MATERIALS AND PLACE

Within current textiles practice, a deepening of relationship with the broader field materials and associated practices can be observed [13]. At the same time, the deep links that textiles have with certain places, and associated specialist skills, are being re-asserted and re-examined [14]. Such discourse draws attention to the value of textiles practice as a mode of connection with place and reveals the nature of textile materials as socially dynamic, communicative and active, with the capacity to influence how we live [14].

The natural and/or agricultural basis of many fibre-based products means that they are ecologically and culturally entwined with the specific places or regions of the world where the raw fibres are found, grown, cultivated, harvested and sometimes processed. As such, textiles practice and the thinking that underpins it, has the potential to be a key point of reference in the kind of interdisciplinary, and even transdisciplinary, working that is needed to realise the transformative practices that Escobar [5] talks of within the materials space. Whilst distinguishing between textiles and materials may seem unnecessary, as Drazin notes, "it is the notion of discreteness among types of matter that is often important" [4]. And, because problem-solving processes vary between fields and disciplines, the processes of designing and the resulting insights will be specific [15]. Hence, our explicit consideration of the role and value of textile practice and thinking within this materials study.

Tim Cresswell presents the idea that when we view the world through the lens of place we can perceive a 'rich and complicated interplay of people and environment' [16]. As such, place is central to several ongoing schools of thought around sustainability that focus on the close connections between a region and its ecosystem. This can be seen in movements such as: 'bioregionalism' [17]; approaches to environmental values that can be described as 'place-based' [18]; the notion of 'life-places' [19]; and design approaches that connect with localism [20]; and the transition movement [21]. In regard to fashion and textiles specifically, Kate Fletcher's insight that being locally rooted in our design process will foster a society that 'reflects the ideas, skills and resource flows of a local place' and 'will result in deep benefits in terms of economic resilience, cultural and aesthetic distinctiveness, and connectedness', is compelling [20]. Fletcher's insight has been particularly critical to the emergent approach of this work in its direction towards focusing on local resources; in this case harakeke. And most importantly in the fore fronting of matauranga Māori (Māori knowledge and wisdom) and partnering with Māori leaders in the harakeke space to collaborate towards realizing Māori aspirations for a renewed harakeke industry.

In discussing such emergent design practices within this space, Escobar notes that consideration of Epistemologies of the South will be valuable to their evolution [5]. Particularly in 'their determination to develop non-Eurocentric practices' [5]. Central to this is the acknowledgment, is valuing and fostering of the co-existence of multiple worlds or 'the pluriverse' [6]. In other words decolonial thinking that critiques dominant modernizing, capitalistic 'One World' frameworks [7]. The emergent approach presented through the pilot study that follows is aligned with these goals for design. As such, the motivations behind the work find resonance with Gutiérrez Borrero's suggestion that we need to begin the task of perceiving 'designs' from the south and letting ourselves as designers be '(re)designed' by them [8]. Through the ongoing work of which this study is part, we hope to illustrate the role that textiles practice and thinking can play in evolving placed-based, and indeed decolonial, design practices within the broader materials space.

## 3 HARAKEKE NONWOVENS PILOT STUDY

Fig. 1 Harakeke growing at Manaaki Whenua, Christchurch NZ (Photograph by Tanya Ruka, 2017)

### 3.1 Harakeke

Harakeke (*Phormium Tenax* or New Zealand Flax) is one of Aotearoa New Zealand's (NZ) most distinctive native plants and a taonga species (national treasure) (Fig. 1). The focus of the research, of which this pilot study is a part, is the reestablishment of a renewed harakeke industry[1] within Aotearoa New Zealand (NZ), with an emphasis on materials and more specifically nonwovens. The potential for a sustainable reestablished industry, based on harakeke fibres primarily from Phormium Tenax (Asphodelaceae or *New Zealand Flax*) indigenous to NZ and Norfolk Island, that has positive implications for social innovation and sustainable farming strategies has been identified [9]. As noted, harakeke is a taonga species for iwi, hapū and whanau (tribal and family communities). Values of kaitiakitanga (stewardship) and environmental sustainability, with strong connections to the land, to taonga species and to 'cultural taonga' feature strongly in Māori aspirations, in iwi development plans and Māori economic development plans [22]. The mātauranga (knowledge and wisdom) around harakeke sub-speciation, cultivation, traditional harvesting, processing and fibre and textile manufacture is also considered taonga. Key knowledge in this area is held by traditional weaving practitioners and Māori leaders in this field such as Rangi Te Kanawa of Muka Ltd., who has made significant progress, over several decades, in regard to establishing routes to realising a renewed fibre based industry. As such, this pilot project doesn't seek to claim new aspirations or knowledge in this space, but to collaborate towards moving forward the collective vision.

In 2006 a report was published by the Sustainable Farming Fund (SFF), 'Integrating New Zealand Flax into Land Management Systems', authored by Elizabeth McGruddy, as a result of research carried out between 2003 – 2006 [9]. It identifies the capability of harakeke to take a lead in establishing a new indigenous/exotic farming matrix in lowland NZ to address ongoing ecological needs in the transition zones between land and water, coast and sea [9]. The report discusses the potential to develop different harakeke based products including textiles and materials. It identifies the need to consider the comparative benefits of targeting development towards the low or high end of markets, noting the direct correlation with the type of harakeke fibre employed [10]: hard fibres being associated with low end applications, finding a niche in relation to properties of strength against low cost; and soft fibres being associated with high end products, finding value through branding around prestige and rarity [10]. Within this context, we set out to explore the potential of nonwoven processing.

### 3.2 Nonwovens

A nonwoven can be defined as "a manufactured sheet, web or batt of directionally or randomly orientated fibres, bonded by friction, and/or cohesion and/or adhesion" [23]. The processes, materials and qualities of nonwovens, link them to the textiles, felt, plastics and papermaking industries. As such they can be situated within a broad field of materials.

Their production can be described in three main stages; web formation, web bonding and finishing. There are a variety of manufacturing processes and technologies used at each of these stages, making it possible to 'design-in' specific performance properties, enabling the creation of materials with distinct properties suitable for a wide range of applications. Processing methods also offer opportunities to employ various sustainable design strategies in relation to product development [24]. Nonwoven production cuts out several processing steps in comparison with traditional textile production, making it potentially less resource and energy intensive. And, there is the opportunity to develop 'short life products' as a result of their reduced manufacturing costs and the ability to engineer properties such as biodegradability, as identified in and demonstrated by 'A.S.A.P Paper Cloth' a disposable nonwoven garment concept by Kate Goldsworthy and Kay Politowicz [25] and more recent paper like garments conceived during the Mistra Future Fashion project [26, 27]. Alternatively, 'longer-life' products with distinct aesthetics can be achieved, for example high-end wallcoverings as shown by companies such as Vescom [24]. From a sustainability perspective such products need further analysis.

### 3.3 Pilot study aims and objectives

The aim of the pilot study presented here was to explore the potential to: i) develop harakeke based nonwoven materials within NZ to contribute towards the reindustrialization of harakeke; and ii) begin to explore and articulate a place-based approach to materials development informed by textile practice and thinking. Based on the given context and in relation to the focus of the study, some of the objectives were to: assess current NZ fibre processing capability for harakeke fibre at the web-formation and bonding stages of nonwoven production; design and produce prototype harakeke nonwoven samples; and evolve, through practice, what might be described as a place-based approach to materials design.

### 3.4 Approach

The approach to the study was underpinned by engagement with mātauranga Māori (Māori knowledge and wisdom) through ongoing korero (discussion) with an expanded group of researchers working in the harakeke space. And through learning from harakeke itself [15]. Mātauranga Māori and adhering to tīkanga Māori (methodology and procedures) are central to this work [15] as "this provides the key motivation for carrying out the research: exploring ways of sustaining papatūānuku (Earth Mother) through alternative material production" [28] . And, "it provides a platform for engagement where all parties retain their mana (authority) through manaakitanga (reciprocity) and carefully considered collaboration [28, 29].

The key collaborations that supported the study were between: university based textile design researchers Faith Kane and Angela Kilford, who belongs to Ngāti Porou and Ngāti Kahungunu; an independent artist, designer, researcher and activist Tanya Maree Ruka Te Miringa Te Rorarangi who belongs to Ngati Pakau, Nga Puhi, Waitaha ; an expert in traditional harakeke weaving Kurt Komene who belongs to Taranaki whānui; Peter Brorrens from AgResearch an agricultural research institute; and Marie-Joo Le Guen of Scion, and a forestry biomaterials research institute. Within this collaborative context, shared experience and knowledge of hands-on engagement with fibres, including traditional Māori and European fibre processing and weaving techniques, provided the main vehicle for the work Through a practical focus on this sampling the different knowledge bases brought by each researcher worked organically together. As such, the work could be described as textile practice-led, interdisciplinary and transdisciplinary[2]. Prior to the pilot study, and as part of the broader ongoing work in this area, the disciplinary areas that are brought together through textiles practice were considered in relation to harakeke as a taonga species [22, 29]. This is captured in Fig. 2.

The pilot study was undertaken over a six month period, which included: an initial literature review into materials developments that are predicated on regionally specific resources and knowledge with a focus on nonwovens, biomaterials and composites; processing trials focusing on the production of a small collection of nonwoven prototype materials; and qualitative evaluation of the materials using evolving models of experiential characterization.

[2] 'Interdisciplinary' is understood here to be defined as the synthesis of different disciplinary knowledge and practice. And 'transdisciplinary' as co-creating new knowledge beyond disciplinary perspectives to transcend disciplines (39).

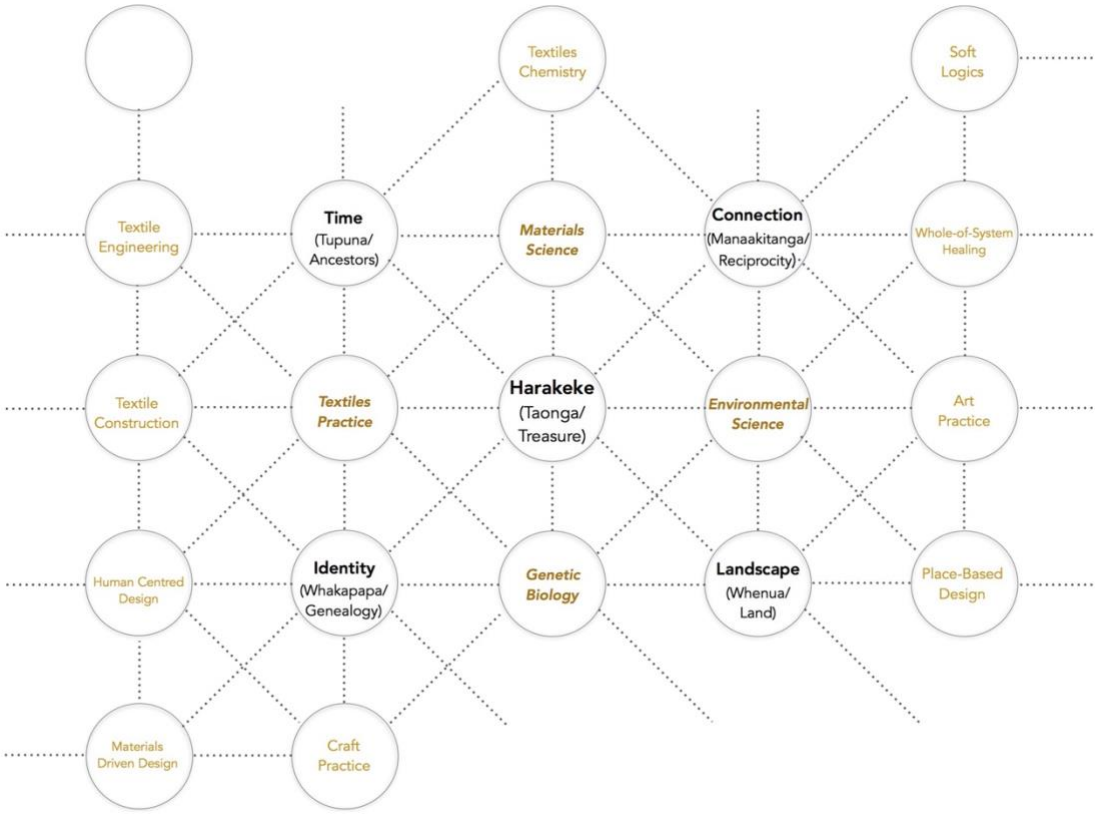



Fig. 2 Evolving network of knowledge for future harakeke textile design emerging from korero (discussion) between Rangi Te Kanawa, Faith Kane, Tanya Maree Ruka Te Miringa Te Rorarangi, Angela Kilford, Huhana Smith and an extended group of researchers including Katarina Tawiri, Xiaowen Yuan and Vaughan Simmonds; informed by discourse around 'textile thinking' [15] and with reference to 'materials driven design' [40]. First published in 'Learning from Harakeke' in *Nature and Design* [22]

### 3.5 Literature review

The literature review that we have begun focuses on establishing a community of practice in regard to materials design research and development with a focus on: i) products that are predicated on regionally specific fibre sources and the associated knowledge and skills; and ii) products that were broadly related to nonwoven processing. This included practices and developments relating to harakeke, specifically.

Significant material innovations that we have identified as being particularly relevant to the study include: Pinãtex® by Ananas Aanam [30]; and Bark Cloth, BarkTex® and VegaPlac by BarkTex [31, 32]. Both products and the associated research provide key examples of materials design that could be considered as place-based and embodying several aspects of the type of transformative practice that Drazin and Escobar see possible for materials. They both are rooted within the regional communities where the fibres are sourced; draw on regional knowledge and expertise; take a holistic approach that looks to minimize environmental impacts in processing; look to catalyse social change through production; and provide what can be perceived as alternatives to the conventional products that operate in the application areas that they are associated with. However, whilst both have been points of inspiration in this study to date and have provided key precedents, their current articulation and documentation perhaps points to the need for further consideration of issues of indigeneity in regard to the use of regional resources and relationship between indigenous knowledge and material innovation.

In regard to material innovations using harakeke, as noted work has been progressing in this space for several decades in NZ. Notable work includes: ongoing research by Rangi Te Kanawa of Muka Ltd. with a focus on textiles; bioplastics work undertaken by research institutes in NZ including Scion AgResearch and

the Biopolymer Network; and developments in functionalized composites by research as Massey University. Results have included concepts for harakeke reinforced surfboards, lighting application [33] and to improve the properties of supercapacitors [34]. Significantly, with the exception of Te Kanawa's work, much of this work has been based on fibres extracted from harakeke using Victorian flax stripping technology, which is still in limited use, as opposed to 'muka' fibre: the fibre extracted from the leaf of the plant using traditional methods.

### 3.6 Nonwoven processing trials

As noted, nonwoven production involves three key stages: web formation; web consolidation; and finishing. In addition to this, fibre preparation can be seen as a critical step. Here we provide an overview of the various stages to realise an initial collection of prototype harakeke nonwovens samples. Processing trials were recorded and documented using photography, note-taking and report writing [35]. Reflection in and on these periods of practical work was undertaken individually and collectively through writing and informal discussion. Detailed fibre processing parameters are not provided due to the need to ensure that intellectual property is appropriately retained, especially in relationship to mātauranga Māori and innovations predicated upon it.

#### 3.6.1 Fibre preparation

Key to the approach taken to try and produce nonwoven materials using harakeke, was a focus on the use of muka fibre. As illustrated Fig. 3, Muka fibres are long, lustrous, of a beautiful pale cream colour, and reminiscent of but distinct to sisal, ramie and pineapple leaf fibres. And characterization of the mechanical properties of muka in relation to plant fibres such as European flax, ramie, jute, sisal, windmill palm and coir, show comparative qualities in several areas. [36]

Muka fibre extraction techniques are a taonga within kaupapa māori and have been practiced for centuries and are largely retained by iwi and hapu. And these techniques have been well understood in regard to the properties of the extracted fibres from a range of cultivars [37, 38]. It is important to note that muka fibres are distinct to harakeke fibres resulting from Victorian flax stripping technology. The driver to use muka fibre within this work, is based firstly on the superior properties of the fibres and secondly to align with the vision of Māori leaders in this space.

The muka used for this project was extracted by māori weaving practitioner Kurt Komene. The fibre was extracted from plants growing at Pukeahu where the School of Design is situated on the Massey University's Wellington campus. The fibre lengths extracted from the leaves using traditional techniques, were then mechanically processed using a technique informed by European flax processing methods. As a result of initial trials, muka/wool and muka/Polylactic acid (PLA) blends were employed to provide more efficient processing. These fibres also enabled a wider range of web consolidation techniques to be employed thermal bonding and wet-felting. And in addition, both fibres enables a level of biodegradability to be retained.

#### 3.6.2 Web -forming and consolidation

Following fibre preparation and drawing on wool processing techniques, several trials using carding equipment were conducted with the aim of creating a consistent muka web. Whilst this was to some extent successful in creating a pure muka web, to enable efficient processing and a more uniform web it was necessary to integrate fibres with properties more suitable for carding. Wool and PLA fibres were integrated, which also brought the potential for thermal bonding and wet-felting, The muka remained the dominant fibre in the blend, however, in order to retain as much as possible of its qualities in the final materials.

Following carding, the webs were layered by hand in a perpendicular manner to produce webs of different weights and thickness. These layered webs were then needle-punched to achieve initial consolidation. Some of the webs were then processed further to achieve samples with a range of qualities and properties. Drawing techniques used in biomaterials processing, webs containing PLA were further consolidated via thermal bonding using heat transfer pressing and compression moulding. And, a further trial using PBS to create a bonding layer was also carried out.

### 3.7 Results and analysis

Fig. 3 Muka fibre and prototype Harakeke Nonwoven Materials (top left - Material 3, top right - Material 2, bottom right - Material 1)

The hands-on processing methods employed resulted in a small collection of initial prototype, which provide a starting point for further creative exploration and design development. As seen in Fig. 3, we were able to achieve a range of material qualities from smooth surfaces with lustre (Material 2) to a more fibrous, textured materials (Material 1). Some of the materials could be described as bioplastics or composites, as much as a nonwovens (Material 3).

### 3.7.1 Experiential characterization

In terms of analysis, at this stage we have focused on a design-led approach to analysis, focusing on emerging models of 'experiential characterization' [11]. This approach aims to ensure a human-centred approach in that the experiential qualities of materials are probed and mapped alongside their technical properties and performances. And to guide the design process within collaborative research contexts [11]. Due to the scope and timeframe of the pilot study, we have not yet been able to extend the analysis and evaluation of the materials beyond what is described here. As such, what is presented only provides one perspective.

Serena Camere an Elvin Karana propose an evolving toolkit, called 'Materials-to-Experiences at four levels', for such characterization [11], which is based upon the evaluation of materials from four different perspectives sensorial, interpretive, affective and performative. It offers four different exercises, each focusing on a different 'level', which participants undertaken in order to provide a qualitative data for analysis. As part of the pilot study, we conducted the four exercises with a group of five designers from different practice background including, textile, fashion, furniture and product design. Based on three of the material porotypes emerging from the processing trials.

The interpretation of the responses to each exercise needed to be related to the specific needs of this research project to define a focus. As such, this pilot evaluation is based on the simple question - how does the materials experience differ between the three materials? And further, what application potentials do you see? In addition we wanted to consider this tool as part of the evolving place-based approach. The responses to the materials that were gathered through the analysis have all been catalogued in a uniform and easily accessible format, which can be interpreted by other researchers and designers as necessary. An example of the results from each exercise is provided here, including a brief summary of some areas of convergence and divergence between the responses of the participants in relation to the four levels of inquiry. Whilst these results are based on a small sample size, they give an indication of the type of responses gathered using this tool enabling some initial reflection and iteration of the approach as the research develops. As such we have not provided a detailed analyses of the results at this stage.

*Sensorial*

Each participant was asked to plot their response to each material between sets of two descriptors, as indicated in the Table 1. Responses to the sensorial scale are summarized in the table. As such, a higher

number leans further to the right of the scale (i.e. the second column). Some of the items produced disagreement from the participants which may be a result of them interpreting the question or the descriptors differently, or simply different perspectives. Some results, however, are more conclusive. For example, all of the materials are perceived to be warm, strong, fibred, non-sticky and of a mild colour.

Table 1: Mean scores of the five responses to the sensorial scale.

| | | Material 1 | Material 2 | Material 3 |
|---|---|---|---|---|
| Hard | Soft | 4.2 | 2 | 1.5 |
| Smooth | Rough | 3.9 | 3.1 | 1.2 |
| Matte | Glossy | 1.8 | 1.4 | 2.4 |
| Not reflective | Reflective | 2.6 | 2 | 2.1 |
| Cold | Warm | 4.2 | 4.1 | 3.8 |
| Not Elastic | Elastic | 1.2 | 1.8 | 1.2 |
| Opaque | Transparent | 4.2 | 1.2 | 3.2 |
| Tough | Ductile | 3.8 | 1 | 2.8 |
| Strong | Weak | 2.2 | 1.2 | 1.4 |
| Light | Heavy | 1 | 2.6 | 1.6 |
| Regular texture | Irregular texture | 3.3 | 4 | 3.2 |
| Fibred | Not Fibred | 1.2 | 1.6 | 1.4 |
| Brittle | Unbreakable | 4.3 | 4.4 | 4.2 |
| Dampened | Resonant | 2.2 | 3 | 3.8 |
| Dense | Hollow | 3.8 | 1.8 | 2.2 |
| Odourless | Fragrant | 2.4 | 2.1 | 2.5 |
| Scratchy | Not scratchy | 2.4 | 4.4 | 4.8 |
| Stiff | Flexible | 4.6 | 1 | 3.1 |
| Sticky | Not Sticky | 4.8 | 4.4 | 5 |
| Mild colour | Intense colour | 1.4 | 1.6 | 1.8 |

*Interpretive*

Participants were given a list of words, as suggested by Camere and Karana [4]. They were asked to indicate which they felt described each material. The responses from the interpretive level are deeper insights based around the descriptors in Table 2. Participants felt that all three materials were natural. This was related to their fibrous quality and mild colour. Material one felt calm mainly because of its warm colour which reflects nature. While four of the five participants felt that material four was manufactured, this was because of its consistent regular structure. Interestingly, this manufactured quality did not stop the material feeling natural. More detailed qualitative insight is available depending on the specific research or design questions you wish to pose.

Table 2: Sum on the responses to the interpretive descriptors provided.

| | Material 1 | Material 2 | Material 3 |
|---|---|---|---|
| Natural | 4 | 3 | 4 |

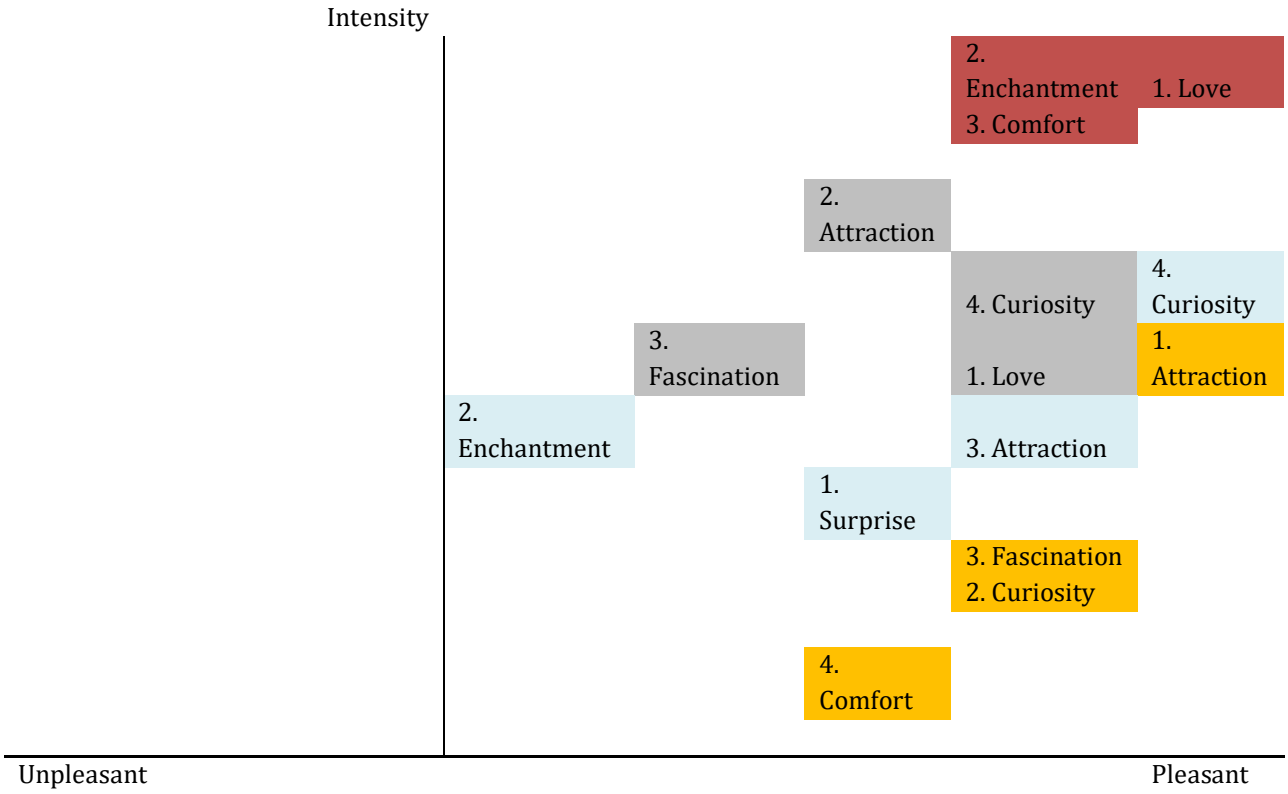
| | | | |
|---|---|---|---|
| Professional | 1 | 2 | 2 |
| Elegant | 2 | 1 | |
| Nostalgic | 1 | 1 | |
| Handcrafted | 1 | | |
| Cosy | 1 | 1 | |
| Calm | 4 | 3 | 2 |
| Frivolous | 1 | | |
| Futuristic | | 1 | 1 |
| Strange | | | 2 |
| Aloof | | | |
| Manufactured | | 1 | 4 |
| Ordinary | | 1 | |

*Affective*

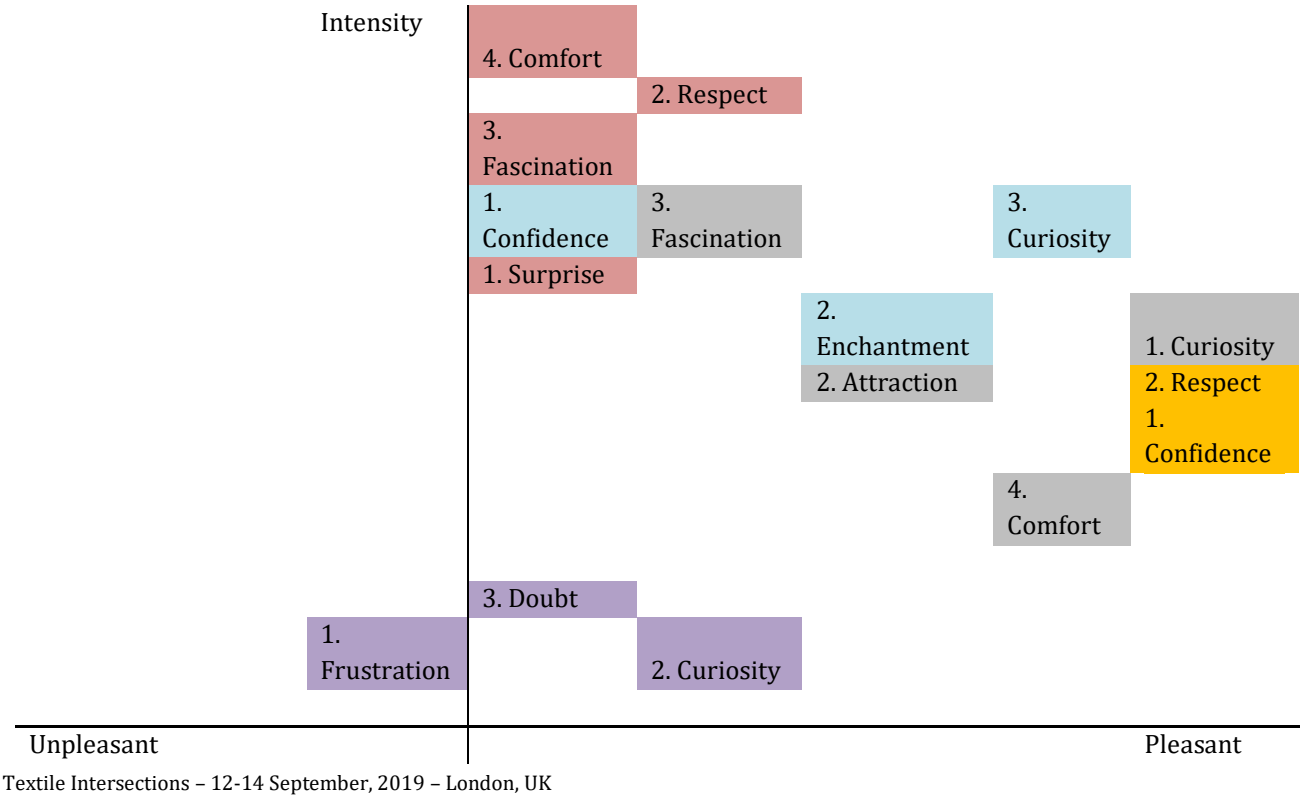
Responses to the affective level exercise, in which participants were asked to provide words that captured their emotional response to the materials, and to plot the strength of that emotion are shown in Table 3. The able shows the affective responses plotted for all three materials. The responses show an overwhelming positive response to material one and three with a more modest reaction to material two. This is reflected in the choice of descriptors with material two being less comforting and more fascinating than the other two materials.

Table 3: Overview of responses to the affective level exercise.

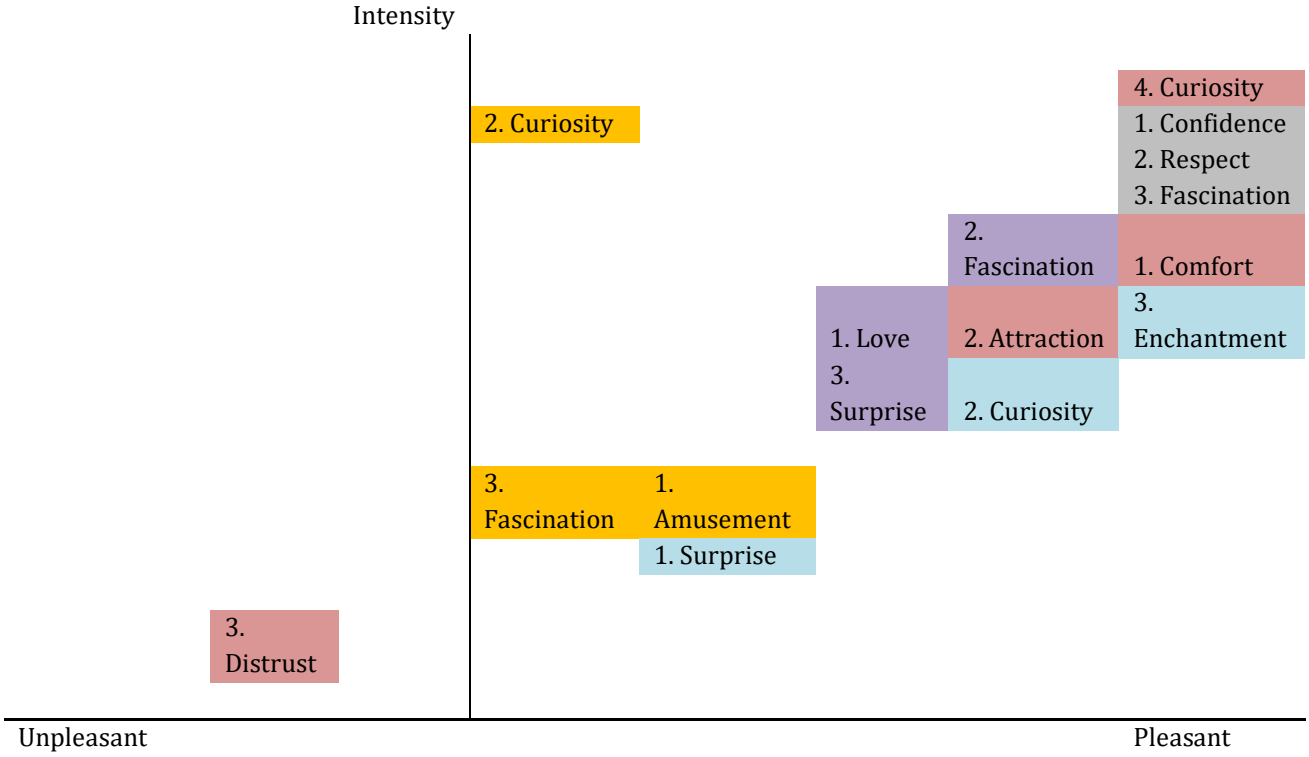
Material 1




Material 2



Material 3




*Performative*

Participants were asked a series of questions, as indicated in Table 4, and asked to select a word from a given list tat best captured their response. Again, responses to this level show different responses between materials. Some actions suggest ways of learning information, for example, most of the participants 'rubbed' all of the materials. However, as material one is soft participants were more likely to 'caress' it than the other two materials. The most significant areas of variance between materials is related to the ability of the material to bend or fold. Participants enjoyed folding material one and lifting material two.

Table 4: Sum of responses to the performative descriptors as related to the questions shown in the table.

| | Material 1 | Material 2 | Material 3 |
|---|---|---|---|
| How do you touch the material? | | | |
| Pressing | 0 | 0 | 2 |
| Rubbing | 5 | 5 | 4 |
| Grazing | 2 | 3 | 1 |
| Compressing | 1 | 1 | 1 |
| Poking | 0 | 0 | 0 |
| Caressing | 4 | 2 | 1 |
| Fiddling | 1 | 0 | 2 |
| Pounding | 0 | 0 | 0 |

| | | | |
|---|---|---|---|
| Pushing | 0 | 1 | 1 |
| Scratching | 1 | 1 | 1 |
| How do you move the material? | | | |
| Folding | 4 | 0 | 1 |
| Lifting | 2 | 5 | 2 |
| Weighing | 1 | 2 | 1 |
| Bending | 5 | 0 | 5 |
| Flexing | 2 | 1 | 4 |
| Picking | 1 | 1 | 0 |
| Squeezing | 0 | 1 | 0 |
| Smelling | 4 | 2 | 2 |
| How do you hold the material? | | | |
| Holding | 4 | 5 | 5 |
| Seizing | 0 | 0 | 0 |
| Pinching | 2 | 0 | 1 |
| Grabbing | 0 | 1 | 0 |
| Grasping | 0 | 1 | 1 |

In regard to eliciting ideas about how the materials might be applied, we asked participants to simply note ideas associated with each sample on post-it notes. Ideas included interior and architectural surfaces, lighting, packaging and as a replacement for fiberglass in products such as snowboards and skis.

## 4 REFLECTIONS AND CONCLUSIONS

### 4.1 Reflections

In reflecting on the results of the work, both in terms of the material outcomes and the approach undertaken there have been both material and immaterial outcomes.

The results of the work show an opportunity to develop appealing new materials from muka fibre using nonwoven processing techniques as a starting point. The ability to engineer specific material properties and performance advantages, theoretically offered by the processing techniques used, suggests a potentially wide scope in terms of development towards several of the potential applications noted. This could be further extended by considering various material finishing routes and/or specific functional properties relating to the end product. Considered within the context of Māori aspirations around harakeke, innovations developed from the material porotypes achieved could form the basis of new enterprises.

As well as building on materials processing knowledge, these could draw for example, on the health and well-being benefits of working with native plants that have known medicinal qualities in addition to the appealing functional and aesthetic properties of such materials. Knowledge of such properties is passed down via oral tradition to Rongoā Māori practitioners, who have used harakeke within their wholistic medicinal practices, over generations. There is the potential to revitalize this knowledge network and create materials that intrinsically carry and facilitate benefit. And thus furthering the agentic potential of harakeke in facilitating social, environmental and economic change on both individual and collective levels through extending the cultivation, harvesting and processing through design.

The experiential characterization toolkit used was effective in generating initial insights on how each material was perceived by designers from different backgrounds and thus indicating the potential of the materials. However, it felt as though we needed to develop the application of it with more regional

specificity to keep the overall approach place-based. As such, future research should review the toolkit through the lens of mātauranga Māori, adapting both form and content through collaboration between different stakeholders. Further the development of a framework with which to evaluate the effectiveness of the 'place-based' aspect of the approach is needed. However, the most significant outcomes of the place-based approach that we have aspired are the formation of new connections, partnerships, collaborations, understanding, friendships, and the opportunity to share different forms of knowledge. Key to this approach has been the fore fronting local resources and mātauranaga Māori in relationship to textile practice and thinking. Through reflecting on the study as a whole, the approach was in many ways facilitated by a shared understanding of fibre processing gained through the various experience, expertise and hands-on know how of each of the researchers. This, although not empirically analyzed, provided the central means of connection, common ground and shared interest.

### 4.2 Conclusions

Through this paper we have aimed to consider what a place-based approach to materials design might look like. And, how it might be informed by textiles practice and the thinking. Central to this has been the drive to activate materials towards positive change and to perceive and develop design practices in this space that are fundamentally relational, transitional and engaged beyond what can be described as one world frameworks. To begin to explore this, we have reported on a recent pilot study into the development of harakeke (*Phormium Tenax*/New Zealand flax) based nonwovens, to provide an example of emerging and evolving practice in this space. The study has resulted in both prototype material samples and insights about the evolving approach. There is still much to do in terms of developing the prototypes towards functional and applied materials, and in regard to more fulsome exploration and articulation of the evolving approach.

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