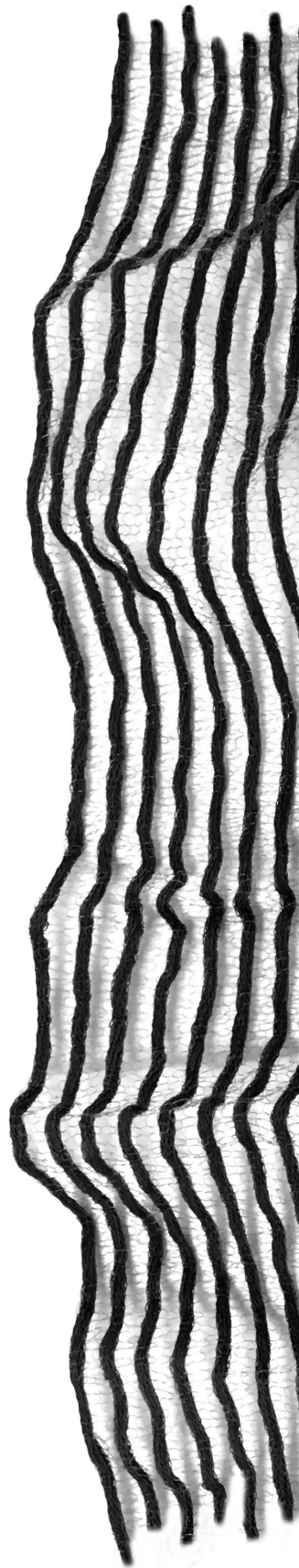


material discord

digitally crafting knitwear

BY MARINA DALEY

Exegesis
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ABSTRACT

This practice-led research explores the idiosyncratic materiality of knitted fabrications and investigates how identifying and analysing perceived redundancies in the making process has the potential to uncover new perspectives and processes that lead to innovative designs.

The project employs knitted textiles and garments, which have been developed using Shima Seiki digital knitting technology, with the textile as the lead component of the design outcome. In the course of the textile's transition from two to three dimensions, the material characteristics of the fabrication are challenged, and that results in new insights into the process for more creativity. The project's applied nature is demonstrated in its final artefacts that of knitwear garments, but the most valuable phase for research lies in the transient states – that is to say, distortions and transparencies – that arise during fabrication. These states suggest a sense of impermanence, dissolution and regeneration.

Working as a knitted textile designer-maker-technologist I have used a craft-based paradigm to illustrate an artisanal approach to digital knitwear design. Such an approach relies on the crafted aspects of irregularity and the spontaneous findings through the act of making, which gain machined effects when translated into the digital versions of themselves. However the serendipity of the crafted and hand-made inform the digital without which this final collection would not have maintained its aesthetic of decay and distortion. This communicates the importance of adopting a craft intervention and control model (Taylor and Townsend, 2014). Without being involved in designing, making and the technical aspects simultaneously, these 'failures' which informed the final aesthetic could have been overlooked.

These factors are discussed in terms of an iterative design process, which oscillates between structure, aesthetic and form, while considering a place for this practice in local industry.

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ATTESTATION OF AUTHORSHIP

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

SIGNED:

DATE: 21 May 2018

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DATE: 21 May 2018

INTRODUCTION

There is an enigmatic element to the work of knitwear design, stemming from difficulties that occur in the exchange of textile and form. These difficulties arise as a result of the characteristic force inherent in knitted textiles – and become apparent in alterations between yarn, stitch structure, tension, scale and placement of design. While the interplay between these fundamental components can cause limitations and challenges, it also has the potential to create outcomes that provide opportunities for innovation.

This project is informed by the knowledge gained through the practical experience of transitioning knitted textiles to garments, which will be expanded on further in chapter 2. Through these processes, a deeper understanding of the characteristic forces within knitted textiles and structures arises, as well as insights into the results of these forces when

approached with supporting or opposing technical methods. Anthropologist Tim Ingold's disruptive approach to the hylomorphic model of material agency (Ingold, 2010), and scientist Etienne Jules Marey's concept of movement (Dagognet, 1992), have been fundamental influences on research which explores such textile forces. Together these ideas influence an alternative approach to materiality and in particular to knitted textile development, while contributing to the project's concept, process and aesthetic features. In addition to Ingold and Marey's sentiments, this practice is inspired by the principles of Japanese design and the aesthetic of wabi-sabi, which celebrates the melancholy beauty "of things imperfect, impermanent and incomplete" (Koren, 2008, p.7)

Caroline Stephens explores interaction with knitted textiles whose "active and temporal properties" (Stephens,



2016) form a generative design process whilst also embracing these qualities. Stephens research was subject to the textile development, rather than the knitted textile transition to garment form. Research also exists in regard to craft approaches to digitally knitted garment form generation, however the key focus in research such as Yang 2010 and Smith 2013 is not generated by considerations of the aesthetic values of the textile design components. New Zealand has an identifiable gap when it comes to documentation of knitwear from the textile design aspect and of the place occupied in the industry by this kind of designer niche application. As a result, this project has drawn parallels with international knitwear designers in order to give examples of different perspectives and approaches, as well as local knitwear designers where possible. The researcher also explores these issues through two aspects of designer-maker practice: as a co-designer and as a sole designer. The former involves a collaboration with New Zealand fashion designer Jason Lingard. This collaboration offers an insight into the viability of producing garments with complex knitted textiles locally, adopting a linear design process. The term 'co-

design' is defined in this research as a means of active "social conversation", in order to understand the relevance and viability of such a design process in local industry. Ezio Manzini states that "co-design is more like a vast, multifaceted conversation among individuals and groups who set design initiatives rolling at the nodes of the networks they are part of" (Manzini, 2015)

Furthermore, the term 'collaboration' is defined by the knowledge and skill transfer between parties as well as the interaction of different initiatives in practice. Fang-Wu Tung discusses the collaborative team in a craft weaving project acting as a "mutual learning mechanism, where both sides exchanged knowledge to enhance their professional capability" (Tung, 2012). Further investigation is undertaken through a sole-designer experience, employing non-linear methods, which suggests ways in which an alternative approach could be placed and activated in this industry.

Within this research study, the aim is to examine the natural force, or forces, of the knitted textile through a two-dimensional and three-dimensional context, which considers juxtapositions



of fibre, form and traditional versus technological processes. This research aims to investigate how such juxtapositions can challenge the inherent qualities of the knit and if the inherent aspects of both are able to be produced into garments which have taken a crafted knitted textile swatch approach.

In this context the term 'craft' is being understood similarly to discussions by Dormer (1997), McCullough (1998) and Taylor and Townsend (2014), who describe it as having detailed control over a physical and iterative creative process while drawing from acquired theoretical and experiential knowledge. Through this engagement, craft knowledge is built upon and potential innovations are realized through problem solving and risk taking.

Using practice-led and craft methodologies I have approached this research as a knitwear designer, maker and technologist (Taylor and Townsend, 2014). This means the researcher is involved at each stage of the process

from concept to production, in order to carry out this study and as such relies heavily on acquired tacit knowledge.

In this methodology the term tacit is being understood through a similar lens as Michael Polanyi describes it in "Personal Knowledge Towards a Post-Critical Philosophy" (1958). Tacit refers to knowledge gained through experience which is often difficult to transfer to another person through verbal or written contact. Knowledge is generally revealed in practice, especially when involved in a social network of practice.

The contribution of this research is situated within contemporary textile and knitwear design. It expands on current literature in New Zealand from a knitted textile design perspective and gives insight into the benefits of adopting an alternative craft-based approach when creating digitally knitted textiles and garments. This project will move through three main areas of inquiry, linked by iterative and reflective practice:

THE TACTILE - KNITTED TEXTILE DEVELOPMENT

Natural forces are examined as a metaphorical tool and physical structural	element to explore the concept of impermanence through the knitted form.
--	--

VISUALISATION - TWO-DIMENSIONAL AS THREE-DIMENSIONAL CONSTRUCT

Collage is used as a visualisation tool to analyse how the textile could be interpreted on the body as a dimensional construct. By viewing the textile through another lens (photography, reimaging), new perspectives are gained serendipitously.	This is because the textile often translates differently within this remediated approach – having changes to scale, placement and proportion – from how it is perceived or viewed in 'real life'.
--	---

THREE-DIMENSIONAL EXPLORATION OF TWO-DIMENSIONAL SURFACE

This section discusses the use of the fabric, its transitional changes when introduced to the body and the resulting simplistic silhouette used together to bring the two-dimensional fabric to a three-dimensional context. Here there is a realisation of constant oscillating between textile structure, the body and the garment shape. Drawing on	principles of a Japanese design aesthetic based on simplicity, imperfection, asymmetry and deconstruction (Kinney, Stanley, Plummer, Thompson & Rorah, 2016), simple silhouettes are used allowing the characteristics and aesthetic of the textile to inform the design outcome.
--	---

BACKGROUND / POSITIONING STATEMENT

This research is grounded by my experiences and practical knowledge with knitwear and textile design. These range from institutionally educated practice to a collaborative industry experience.

Fu, Wan and Hunter (2004) state that *"Decoration, modesty and protection are the three most fundamental reasons for people to wear clothing"*.

My interest in art and design developed while growing up in a creative environment, specifically in regard to clothing and costuming as seen in film and video games. The detail of the textile and ability to express imaginatively on a tactile canvas intrigued me. This informed my view of clothing design as a functional outlet for artistic self-expression. Animated

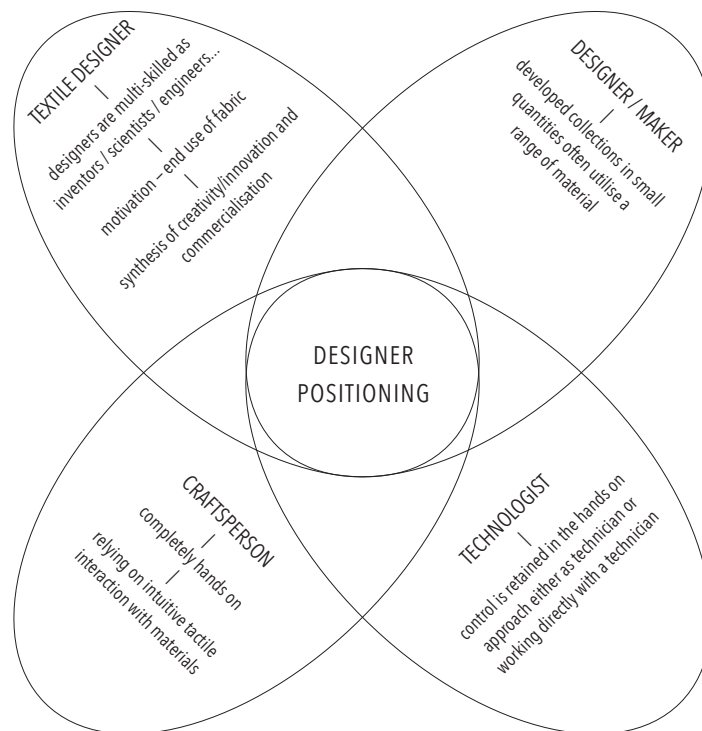


Figure 4. Designer Positioning Diagram (Daley, M. 2018)

by movement, a garment undergoes a transformation from 'article' or 'object' to a personification of its wearer.

My final undergraduate textile design project was a textile and clothing collection that focused on creating a point of difference in fashion. I did this by developing garments that utilised distinctive and innovative mixed-media textiles, explored through juxtaposing craft and technological processes. In this respect, the research here is an extension of previous exploration, but its aims are underpinned by added conceptual and methodological values.

My undergraduate work was achieved by applying experimental techniques to developing textiles. These techniques derived from such traditional practices as hand knitting, embroidery, devoré and felting. My aim was to push boundaries by bringing a modern approach to these traditional methods, while also adding tactile interest to the fabric through depth, texture and contrast. This aesthetic was further informed by an interest in a dark, monochromatic visualisation. This approach introduced depth, contrast and textural elements to these darker tones. Without these elements of design, or textural interest, black can often be visually flat. The

textiles that I developed were then translated into clothing that would work with, and express, the unique qualities of the materials and textural interest. I found that when working in this mixed media mode of textile design, often one piece would inform the other, resulting in a crossover of technique. These discoveries motivated me to further investigate ways in which handcrafted features can be translated into a digitally knitted format, forming the starting point and basis for this study.

One of the outcomes from this undergraduate project was an invitation to work on a knitwear collaboration with local fashion designer Jason Lingard. This involved developing two fabrics from my undergraduate collection into garments for his upcoming collection in 2017. Through this process of both collaboration and taking the knitted textiles into commercial designs, many insights, as well as limitations, were uncovered about the ways that fabrics need to be adapted and remediated to enable them to be translated into garments. This experience of collaboration with an active New Zealand fashion designer and the opportunity to undertake a knitwear design project in a commercial context



*Figure 5. Silent Chaos collection by Marina Daley at AUT Rookie.
Photo by: Annupam Singh. Reprinted with permission.*

forms part of this study and is discussed further in section 1.6.

Knitwear has been a focus for this project because of its boundless opportunity for design innovation by fusing yarn, fibre and stitch combinations with a designer's knowledge, imagination and personal combinatorial approach. There is a sense of regulated chaos when working in this territory. The control that is exerted by essentially building the textile from scratch is often met with unpredictable reactions from colliding variables. But it is in this nexus – beyond imagined outcomes – that the source of innovation lies. When first introduced to knitwear design, my initial observations were that each method, whether hand, domestic or digital machine knitting, held its own specialised techniques,

which could produce varied and unique outcomes. This encouraged my curiosity about designed outputs in a process that fluctuated between hand and machine. With ongoing technological developments, the line between crafted by hand or machine has become increasingly blurred (Oakley, 2015). However, there is still an innocuous imperfection produced by the hand-eye coordination of hand knitting that cannot be recreated by a machine. As a result of observing this visual disturbance of the handmade, it became important in this project to continue with a focus on the influence that human agency can imbue in a knitted textile, through both physical and emotional connections, despite it being largely machine produced.

research project

context

1

CONTEXTUAL FRAMEWORK

"I will claim that a focus on life-processes requires us to attend not to materiality as such but to the flux and flows of materials."
(Ingold, 2010)

Perhaps one of the most fascinating aspects of knitwear design is the architectural nature of building a tactile form, often from a single thread. An entanglement of yarn by way of interlocking loops, results in simultaneous imposition of structure, form, pattern and texture. The thread becomes a pencil, drawing an abstracted line, and as knitwear design is a very tacit practice, this 'line' becomes characteristic to its 'author'; much like the singularity found in a person's handwriting or signature. Ingold refers to lines as interconnections in the world. Trajectories formed by our individual journeys through life. Our gestures, movements, memories and cultures meld with time and cross paths, in constant transition. Elements of a personal signature are among the aesthetic aspirations of this project.

"If we think of every participant as following a particular way of life, threading a line through the world..."
(Ingold, 2010)

However, this perspective is not subject only to living organisms, but also materiality. Ingold discusses Deleuze and Guattari's (2004) contention that *"the essential relation, in a world of life, is (...) between materials and forces"* (Ingold, 2010)

Through this ontological perspective, materials and objects cease to exist as inanimate. It is these crossing of paths between variables, and in turn their reactions, that gives them movement. It is with this divergence from material culture that this practice is approached. Ingold compares the process to that of the alchemist, the cook and the painter, who are all *"...in the business not so much of imposing form on matter as of bringing together materials and combining or redirecting their flow in the anticipation of what might emerge"*. (Ingold, 2010, pg.9)

Knitwear design can be considered in the same construct – the designer-maker mixes and experiments with fibre, structure and form. An entanglement of variables, moving together in a push and pull exchange of elemental properties with their reactions contributing to an expansive pool of structural and aesthetic applications. This is one of the most prolific aspects of knitwear design,

allowing room for endless innovation. However, this can also lead to frequent challenges when producing a garment, because even one slight change can disrupt its process, its development and the aesthetic and machined balance.

Although such unpredictability can be considered detrimental, this project chooses to embrace the textile's variables and idiosyncrasies, since their being in a state of flux allows for serendipitous opportunity for design development and innovation.

Therefore, while this project does have a final artefact (knitwear), the value of this research lies in the journey where these entanglements form, and builds a design process around these temporalities.

The following section will endeavour to discuss such a process, outlining the formation of tactile narratives centred on movement and materiality

as they are used as aesthetic drivers for the outcomes of this practice. As such a conceptual journey is used to contextualise the scope of the project, highlighting sensorial, tactile and haptic links as they move towards the creation of a collection of fabrics and garment outputs. The term 'haptic' is recognized in this methodology with reference to discussions by Pryterch and Jerrard (2003) and Paterson (2007) who describe it as a relation to the sense of touch, specifically how we perceive and interact with materials and objects using the sense of touch on an individual and pre-conscious level. Throughout this practice I use haptic inquiry which navigates how myself, the researcher responds to the handle of developing textiles and garments, and how that is then reflected in my work. This also pertains to the textiles characteristics, quality and potential application which are communicated to me via tactile sensations.

1.1 sensory mapping / the sensorial

As an initial method of inquiry, sensory mapping was investigated as a conceptual tool to navigate the symbiotic relationship between the body and knitwear. Aural narratives were explored through the textile by examining sensory connections with sound, language, vibration and physical matter.

Swiss scientist Hans Jenny coined the term 'Cymatics' in 1967. This refers to the process of pattern formation when melding physical matter with sound vibrations. Jennys extensive experiments with substances such as, water, resin and gas, led him to discover that these motifs were homogenous to that of many universal natural occurrences prompting his belief that all universal matter is connected through vibrational waves (Jenny, 2001).

This union of visual and aural senses inspired an investigation into sound and vibration through knitted textiles, adding a haptic level of enquiry, unifying the organic with the inorganic, as highlighted with soft fine cottons contrasted to hard metallic and nylon yarns. Human essence is translated to the knitted form through distorted phonic soundscapes, exploring identity and emotional links with how we view our clothing.

In this context the term 'human essence' refers to translating the unpredictable essence of human nature to the projects design elements. Human nature is complex in theory and difficult to define. As psychologist Judith Harris (2006) states "...the trouble is that having a theory of human nature doesn't get us

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copyright reasons.*

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copyright reasons.*

Figure 6. The Action of Vibration of Lycopodium Powder (Jenny. H, 1967)

Figure 7. A layer of glycerine excited by the oscillation of a membrane (Jenny. H, 1967)

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copyright reasons.*

*Figure 8. A downward stream of gas sub-
jected to acoustic irradiation (Jenny. H, 1967)*

*very far, because people don't all behave
alike.”(Harris, 2006)*

This unique irregularity of personalization is imposed through touch of the hand processes as the unpredictability of human engagement leads to unique design outcomes and innovations.

In the text “Binding Softness”, Maria Penata uses the idea of consciousness to demonstrate the complexity of binding our senses to a prosthetic device. She draws parallels with textiles and the body to discuss the role of a soft prosthesis and its potentials for communicating and enhancing the body’s spatial awareness.

*“bodies are soft, responsive,
perishable and conscious”
(interactivearchitecture.org, 2017)*

By exploring the body and knitwear in this way a clear symbiosis of characteristics between them becomes apparent. Valeriya Olkhova, who explores this concept of

emotional textiles through her second skin knitwear was also inspired by another conceptual influence on this research, that of a Wabi-Sabi aesthetic (Voft.eu, 2018).

*“Emotional Textiles are designed
to have a long life, evolving, but
remaining aesthetically beautiful.*

*Through the engagement and
cherishment, the design user builds
her/his own personal relationship to
the pieces, which increases/builds a
strong sentimental value.”*

(Valeriya Olkhova, 2018)

These ideals are similarly explored within this practice through a crafted approach that embraces movement, temporality and imperfection and translates a sense of consciousness to the knitted form.

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Figure 9. Second skin knitwear (Voft.eu, 2018)

1.2 movement

The *"imperceptible, the fleeting"* (Dagognet, 1992, pg.15) trajectories of life; moving, temporal and elusive to the naked eye, are what French physiologist Etienne Jules Marey aimed to capture in his chronophotographic studies of biomechanical motion. Recorded at 12 frames per second consecutively, they reduced men and animals to a spectral haze of lines. Marey approached movement as a concept, considering life's incessant fluctuations as the one constant in our existence (Dagognet, 1992.) Marey demonstrated the *"forces of life"* in his studies of animals, humans and elements such as air, monitoring air flow as foreign objects passed through a wall of smoke. He made *"visible what kept to the shadows"* and believed that *"we cannot study something based purely from information our senses gives us"*. (Dagognet, 1992, pg.15)

The comparison of natural vibrations to organic life in motion offers an alignment of the organic and inorganic, and a synthesis of the living and inanimate. It draws visual parallels

with this work's physical and emotive conceptual underpinnings and informs my own analysis, which derives from the properties of water. Transparent, neutral, universal, water is a vital fluid for most living organisms. The movement of water and that of the human form were used as a comparative metaphor to express the symbiosis of knitted textiles and the human body. The influence of water on this practice can be seen in the creation of textiles whose hazing fluidity illustrates an unpredictable sense of movement, even when using new technology that challenges the knit's inherent fluidity (see sections 2.2.3 & 2.2.4 for inlay developments). This is explored through the depth, transparency and distortion that is realised when tubular, jacquard, purl and plain knitting meet the reactive qualities of synthetic and natural fibres used together. Volume and texture is created, as well as contrast through the polarity of combined opaque and transparent yarns (see sections 2.2.1 & 2.2.4 for monofilament tubular and overlay pieces).

It is also a result that highlights the visual and haptic as being equally important to this creative practice (Prytherch and Jerrard, 2003) and the importance of developing the two simultaneously. In Prytherch and Jerrard's view, haptic senses are at their most efficient when used at a

preconscious level. In an analysis of knitwear, by comparison, the tacit practice of simultaneously considering tactile, visual and temporal qualities, such as handle, aesthetic and tension, is prevalent in the development of the knitted textile's structure and translation into a garment.

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Clockwise from left:

Figure 10. Black suited subject – white lines and points to track movement (Marey, E.J. 1992)

Figure 11. Geometric chronophotography – shows oscillations of movement in the leg whilst running (Marey, E.J. 1992)

Figure 12. Technique applied to a horse walking (Marey, E.J. 1992)

1.3 natural forces, materiality and aesthetic influences

TENSION

The following outline some of the contextual aesthetic influences, which I have drawn from to create the visualisation developments for my knitted textiles. One of my key influences is Ingold's approach to materiality. This is approached within this project through the concept of impermanence; associating it with the natural forces and tensions encountered by human beings, nature and technology and the embrace of these transient states and the threads and traces of their collision.

This is explored in practice through counteracting forces, such as malleable, but defiant metal yarns, which strive to warp and go askew from the original loop structure. They are held in place by the machines' constraints, but once released immediately wants to morph and grow. However, when paired with a more stable fiber, a balancing shift in tension is created, therefore moving, but with structural stability (see sections 2.2.3, 2.2.4 & 2.2.6).

DECAY

Further aesthetic influences arise from the distress and liminality of architectural structures subject to such operations as the shrouding cloaks of vegetation, the play of shadow and light and the permeable force of time. A key example of this is the work of Axel Vervoordt (2010). He creates interior spaces, informed by natural

materials and nuanced by objects worn with time in an interpretation of the Japanese concept Wabi. The placement of archways, corners and alcoves in his spaces is mediated by use of a natural subdued colour palette, which is transformed and enhanced when met with shade and sunlight.

"Often beauty lies not in the thing itself but in the pattern of its shadow." (Vervoordt, 2010)

Vervoordt also discusses the influence of the Japanese Gutai art movement, whose central focus was a fascination with *"the patina that arises when things become distressed or decayed with age... (as) it was seen as revealing the inner truth of an object"* (Vervoordt, 2010). This influence inspires knitted layers of structural distortion, utilizing iridescent yarn to add subtle tonal contrast. These pieces become chameleon-like in certain lighting, displaying varied tones and a sense of illusion. This is expanded further in section 2.2.8.

'I used to wish I could draw time. I liked used clothes, things that are old and worn.' (Yamamoto in Japanese Fashion designers, 2011)

The force of time is further conveyed through clothes tattered by extensive wear, along with forgotten, dust-coated or moth-eaten garments. Yohji Yamamoto discusses how the time-worn appearance of an individual's clothes can convey their personality and journey in life, creating memory and meaning. *"I like old clothes, clothes are like old friends"* (Yamamoto in Chenoune 1993). He discusses the inspiration of German photographer

August Sander, who made photographs of people from all walks of life and was *"renowned for his ability to reveal the dignity of the poor"* (English, 2011). Tattered and faded workers' clothes *"exuded an honourable solemnity"* that inspired his work. This interest also links back to Olkhova's concept of emotional textiles and my own view that clothing acts as a personification of its wearer. This aesthetic is explored through knitted applications, which resemble the reductive distress of a *devoré* fabric, although without losing their structural integrity (see section 2.2.1 for soundscape knits)

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Figure 13. Gutai artist Kazuo Shiraga painting in Axel Vervoordt interior space (Vervoordt, A. 2010)

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Figure 14. Interior detail from Axel Vervoordt: Wabi Inspirations (Vervoordt, A. 2010)

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Figure 15. Interiors from Axel Vervoordt: Wabi Inspirations (Vervoordt, A. 2010)

1.4 digital craft / material discord

Visual aims that derive from the preceding topics have also been an influence on the path of design development. Erratic, unsystematic movement, like that of a decaying or dissolving surface, is explored through freehand drawing with the knit design software, as shown in sections 2.2.4 & 2.2.8. This enables an immediate connection between the hand and a digital process through pre-conscious movement, which retains the imperfection of the human hand.

Rei Kawakubo of Comme des Garçons also found an importance of communicating distortive handicraft processes to machine made pieces. Kawakubo would even loosen screws to create random flaws on computerised weaving looms, in an attempt to disrupt the monotony of mass production (English, 2011)

"I find beauty in the unfinished and the random...I want to see things differently to search for beauty. I

want to find something nobody has ever found... it is meaningless to create something predictable."
(Kawakubo 2004, in Japanese fashion designers, 2011)

The deliberate creation of distortion and flaws, connects and resonates with the Japanese Gutai movement as previously mentioned. An individualist art form, where artists would create pieces grounded by intuitive and performative processes. Child-like spontaneity emanated through their work; a reflection of their new found freedom in a post-war era Japan (Christies.com, 2015)

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Figure 16. Gutai artist Kazuo Shiraga (hundertmark-gallery.com)

1.5 knitwear industry

DIFFERENT APPROACHES

This section reviews a variety of knitwear designers and current practices in New Zealand, and internationally, in an attempt to gauge the viability of a crafted control approach to digital knitwear in New Zealand, once it is removed from a university environment.

Upon reviewing the current literature, the general consensus suggests that there is a separation in the knitwear industry between the roles of designer and technician. This is particularly noticeable at the stage where knitwear garments are developed (Evans-Mikellis, 2010). Innovation and design development are hampered by barriers of communication between these roles, which has occurred in part because of differences in interpretation as to their significance (Eckert, 1999).

The aims of this project are situated in the researcher's ability to understand, as well as access, design systems and

digital knitting machinery. These have allowed the researcher to test whether it might be possible to work from craft-based design that crosses to digital knit design outputs. Part of the development of the designed outputs was made possible by access to machinery and technical assistance, when needed, through the experienced technician at the Auckland University of Technology and the Textile Design Laboratory.

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Figure 17. Faster lingerie and hosiery by Mark Fast (chicsimplicity.blogspot)

<p>Luxury knitwear designer Mark Fast manufactures his collections entirely on domestic machines (Fast. net, 2013) in order to maintain personal design and have control over his process without the need for a technician (Taylor and Townsend, 2014). However, Fast has also developed a diffusion range called Faster, which translates his intricate lace-knit structures into commercially applied lingerie and hosiery. My research uses a domestic machine design process to generate initial design ideas to take to a digital platform, much like the Sweden-based designer Sandra Bucklund who also demonstrates a craft-to-technological approach in her work. Bucklund started her knitwear label in 2004 after graduating from Beckmans College of Design in Stockholm. She</p>	<p>created hand-knitted pieces which adopted a collage technique of attaching separate sections to form sculptural three-dimensional garments. In 2009, Bucklund was introduced to Italian knitwear factories and focused on developing her same structural aesthetic but in digital forms (Udale, 2014).</p> <p>While this allows for faster production of her garments, she still has an artisanal approach and does not adhere to the fashion industries' seasonal and trend expectations.</p> <p>While an industry of knitwear in New Zealand is still relevant today, many successful labels are conventional, producing staple garments with similar silhouettes and stitch structures throughout each season, chiefly focused on quality production and finishings. Tourism and the New Zealand story, where there is a focus on utilising our natural resources, such as luxury possum and merino fibres, are also key knitwear manufacturing areas, however are generally targeted at the tourist market sectors (Smith, 2013).</p>	<p><i>This image has been removed for copyright reasons.</i></p>
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Figure 18. Sandra Buckland hand crocheted piece created using the collage 'brick' technique. (collectiftextile.com)

Figure 19. Sandra Buckland 'control-c' collection; collaboration with Italian knitwear producer Maglificio Miles (offbeatism.files.wordpress.com)

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One designer label, which includes knitwear within its collections, and tends to step outside of the 'norm' with its designs is the iconic New Zealand label NOM*d. The label has maintained its "dark and wittily sombre" aesthetic since its inception in 1986. Individualist, yet classic and wearable, NOM*d is *"unaffected by trends and whims...adopting the cool, considered gaze of the fashion outsider"* (Nomdstore.com, 2016). These ideals are synonymous with what this project aims

to achieve through this research. While not a brand that is focused primarily on knitwear, it continues to create a few made in New Zealand pieces each season. Looking at the evolution of these pieces over the decades, it is clear that many are still relevant today. While aesthetically relevant to this practice, the focus of NOM*d's pieces is not largely textile-centric, which still begs the question of viability in producing said garments in New Zealand.

Left to right:

*Figure 20. Nom*D knitwear pre 1990s (nomdstore.com, 2016)*

*Figure 21. Nom*D knitwear 2009 (nomdstore.com, 2016)*

*Figure 22. Nom*d knitwear 2016 (apparelmagazine.co.nz, 2015)*

Another New Zealand-based knitwear designer, who has experience in both industrial designer roles and small artisanal practice is Nikki Gabriel (Gabriel, 2016). Originally she started her label in Melbourne in 2002, where she focused on machine-knitted garments and textile developments. However, the challenges she faced trying to find a balance between creativity and efficiency of production led her to focus on predominantly handicraft techniques, described more as an *“art practice and process driven studio”* (Udale,

2014). Gabriel discusses the familiar challenge of artisanally practiced digital knitwear as being difficult, because the *“accessibility of this facility is largely dependant on big production and repetition of units”*. In her current practice, Gabriel's focus is on hand-made production which allows her to make exclusive, individual products, where the slow process encourages carefully thought-out design and manipulation. *“I make less and produce for exclusivity.”* (Gabriel for Udale, 2014)

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Figure 23. Nikki Gabriel knitwear (nikkigabriel.blogspot)

1.6 jason lingard collaboration

One of the aims of this project was to reveal aspects of a knitwear designers role in New Zealand and compare to the potential of operating in the New Zealand environment through a niche/ designer approach, defined by English (2011) as *"designers who do not follow stylistic trends or directions"*. The initial method of enquiry was through a collaborative industry project with Jason Lingard using a linear design process. This was an opportunity to test my designs in a commercial market and through this collaboration with Jason to be able to gain a better understanding of the complexities of working as a knitwear designer producing a small designer collection. This collaboration also helped to gain a better understanding of the details of construction and production knowledge that needs attention when putting together a collection of garments.

This project required orchestrating the movement from knitted textile swatch to three dimensional garment

form, which uncovered insights into how the colliding variables such as stitch structure, garment shape, yarn qualities and machine capabilities can be managed within this process of transformation. This meant considerations of transferring the swatch to a sample garment for initial viewing by potential buyers. Despite the designerly level of the project, the requirement to make adjustments to the textiles for commerciality was prevalent early on with the need to switch the original monofilament yarn to a natural and more marketable fine cotton yarn. At this stage of showing the initial sample, a review of the garments was made based on comments and analysis from buyers. This meant making necessary adjustments to sizing and the 'designerly' trade-offs through adjusting the fabrics delicacy to enhance wearability and appeal to the target market, as well as considerations for transferring the sample to a production ready level. This includes adjustments to

the pieces to allow for ease of knitting and linking together for time and cost efficiency. These stages are expanded further in section 2.1 through a detailed

process that highlights knowledge gained which helped to inform my approach to transferring textile swatches to garments.



Figure 24. 'Scar' Sweater Tee from collaboration with Jason Lingard for his AW18 collection 'Nothing'. Photo by: Sacha Stejko. Reprinted with permission
Figure 25. 'Brain Cardigan' from collaboration with Jason Lingard for his AW18 collection 'Nothing'. Photo by: Sacha Stejko. Reprinted with permission

2

METHODOLOGY

2.1 methodological framework

OVERVIEW

The focal point of this project centers on analysing the natural force of knitted textiles through realisation into fabrics and garments, which is informed through making. As such, the overarching methodology within this framework is practice-led, approached through a craft based paradigm.

Shrivener & Chapman (2004) discuss the inseparability of the creative process and artefact created during said process in practice-led research. The artefact contextualises the work and directs the making, informing the scope of the research process. In regards to this practice, the 'process of formation' (Ingold, 2010) is the main point of value, however, the final artefact (knitwear) is also important in contextualising and guiding the research process and aims. A craft based approach is utilized in order to develop and innovate through trial and error (Yang,

2010) and translate human essence to a digital medium by retaining "*detailed control that is the consequence of craft knowledge*" (Dormer, 1997a). This approach highlights the need and use of tacit and haptic knowledge through actively generating and participating in and through an iterative and reflective design practice (Schon, 1983).

While the making of the artefact (knitwear) is a crucial point of research in this project, a supporting theoretical framework also holds great importance in validating and contextualizing the work (Mäkelä, 2007). The theoretical framework used that consists of the researchers background, conceptual underpinnings and a review of current literature helps to contextualise this work by creating a background to the project that informed the approach to materials and making, as well as underpins the need for a practice-led methodological

approach. Therefore, the evocative paradigm of practice-led research was used for this study because the research manifests in and through the materiality and emergence of the practice. It is through a continued exchange between concept, subject, practice and theory that the research resolves itself (Barrett

& Bolt, 2010). Collaborative/co-design was used as an informatory method of enquiry and knowledge gathering as a means of extending and understanding the scope of this project and its potential application to and in a commercial environment which utilizes a linear design process.

COLLABORATIVE DESIGN/CO-DESIGN

Jason Lingard Collaboration Process

This collaborative undertaking can be considered as preposition to this research project. This informed methods of approach to making when interacting with swatch development and the translation to garments for the main component of this research. Figures 29-31 show the progression of the 'scar sweater' for this collaboration, from original fabric swatch through each stage of development. The change in transparency to a semi-sheer contrast is apparent through looking at the development as a shift through commercialisation as a comparison. This highlights the considerations and alterations that can be required with making something commercially viable or to fit within a specific target market.

Changes that needed to be made led to further experimentation and sampling of garments. Trying to achieve transparency and strength with black yarn proved very difficult. However, tests with yarn, tension and finding the correct way of washing the fabric, so to allow the loops to remain loose enough to have a semi-sheer appearance, needed to be established through a compromise of aesthetic and wearability.

Through the process of taking the fabric to a sample, and then to production, came a realisation of the difficulties with producing knitwear as a small scale operation and at a digital knitted level. It became apparent that digital access can be problematic and not easily accessible for an independent label with no knitting factory attached to it. The AUTextile and Design Laboratory

operates a small manufacturing facility which was used for the final production of the garments. However, they do not operate facilities for finishing garments, which meant outsourcing the linking and leading to higher production costs. In order to produce anything through a factory, we would have had to either do everything in house (develop the textile from scratch with them or relinquish control and have a technician translate the design} or have planned a lot further in advance to allow enough time for a proper collaboration with a factory. Many knitwear factories in New Zealand produce their own knitwear labels, therefore generally only have the facilities to take on a select few external designers to produce for. It was also found that many of the skilled workers that do jobs such as linking/ technician are in decline which makes this technique of finishing expensive and hard to find.

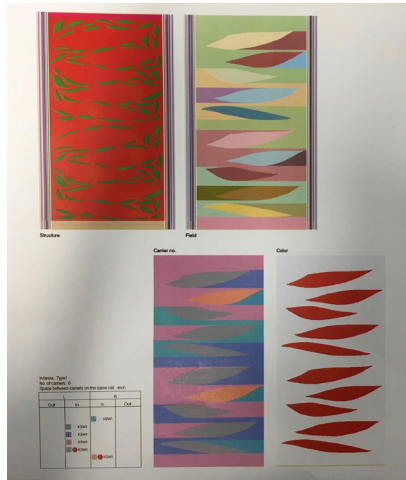
After doing a cost analysis of the project the knitwear was found to have a smaller profit margin than Jason's usual garments, which concludes this particular process was not viable for making the same profit as the labels usual amount per garment. This was due to the long knitting time in conjunction with having the garments put together using an outsourced facility. While some retailers in New Zealand do sell knitwear at the price range that these garments were costed at, they are usually made from luxury fibers such as possum, merino and/or silk. However the point of difference through this collaborative knitwear was the custom textile design and a completely made in New Zealand product. Therefore while there does need to be some work on getting production time and costs down, there perhaps also needs to be a shift in knowledge on the consumer side to gain understanding of the true costs of producing individual knitwear ethically made in New Zealand.



Clockwise from left:

Figure 26. Brain cardigan front piece before make up (Daley, M. 2018)

Figure 27. Textile swatch knitting information pre garment development (Daley, M. 2016)



Clockwise from left:

Figure 28. Original swatch using monofilament yarn (Daley, M. 2016)

Figure 29. Textile swatch knitting information pre garment development (Daley, M. 2016)

Figure 30. First toile of scar sweater (Daley, M. 2018)

Figure 31. Scar sweater in production at the Auckland University of Technology Textile & Design Lab (Daley, M. 2018)

2.2 methods of practice

This section discusses the methods and tools, which are situated within the practice-led methodology. For this project conceptualising was used through the investigation into cymatics, vibrations and sensory mapping. This led to an ideation process through visualisations such as, mood boards and mind mapping. Leading from this was the initial making. Sample swatches were then used for development and consideration of further visual research through photography, illustration and photoshop rendering. Re-imaging and layering techniques were used to view an image from a different perspective. This was also achieved when viewing said imagery through a micro and macro proportional scale. This inspired and leads to the next stage of the initial sampling through development of knitted swatches. This phase goes through an iterative process that involves constant exchange between making and reflection, utilizing tacit knowledge and

haptic senses.

This is supported by Donald Schon's theories of reflective practice (Schon, 1983). It is also in these stages that innovatory developments are prevalent through 'trial and error' (Yang, 2010). Following this comes a point of refinement, where selected fabrics are chosen to develop for further sampling, upon which again there comes a point of refinement to select fabrics which will be realised as garments. Also within this is the visualisation of the two dimensional textile as a three dimensional garment through illustration and collage techniques. Throughout these stages, the continual consideration and interchanging of the previously mentioned methods enabled constant development and innovation. The following section will discuss these methods in relation to the research project, as well as indicating relevant approaches and sub-methods used within this research.

OVERARCHING AESTHETIC DEVELOPMENT

This project underwent a journey of conceptual development, highlighting movement, impermanence, dissolution and regeneration as the main aesthetic drivers for achieving texture, distortion and transparency in knitted textiles. Initial knit swatches are made in response to these developing themes.

Movement is explored initially through investigating Hans Jenny's Cymatic photography, vibration and sensory mapping, leading to emotive driven experiments with distorted phonic soundscapes as mentioned in section 1.1. Extensive layering was used in photoshop to distort and gradually

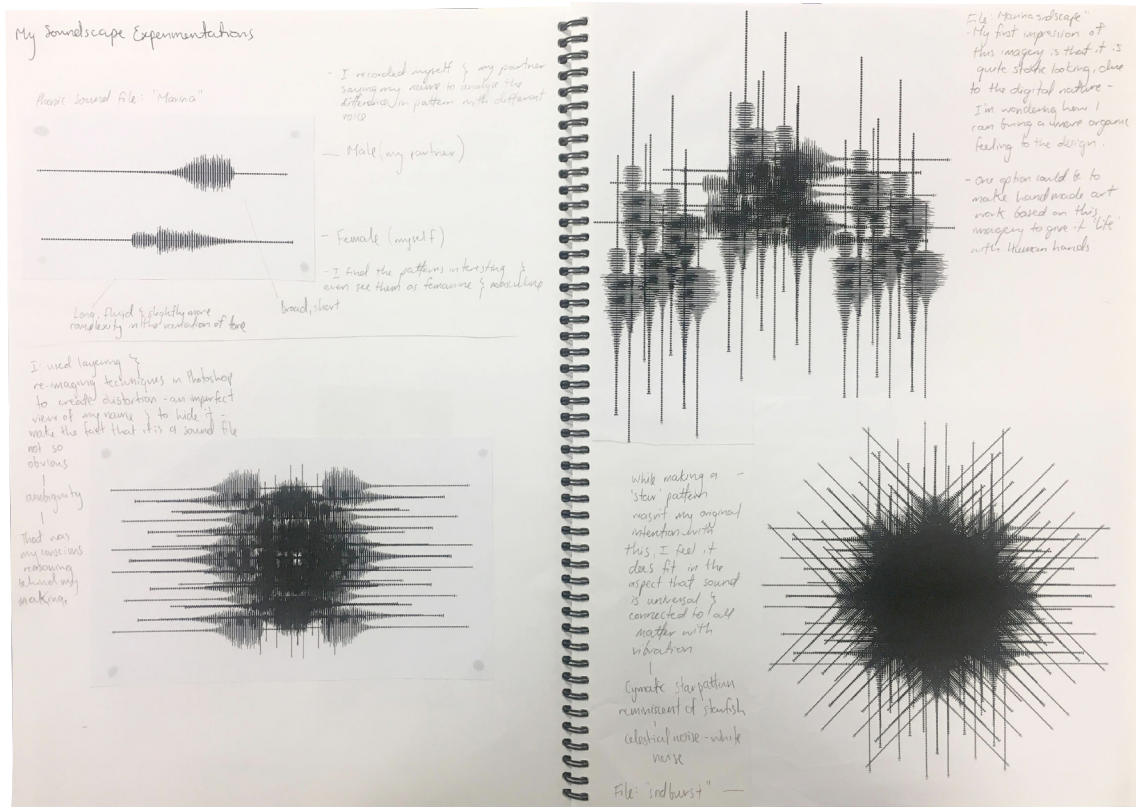


Figure 32. Phonic Soundscape file experimentation as shown in workbook (Daley, M. 2017)

Further experimentation lead to analysing the work of Etienne Jules Marey comparing this work to my own experiments with water as mentioned in section 1.2. Ink was added to water to view how they both react together in motion as well as noting similarities with cymatics and other organic patterns. I photographed these in different lighting, as well as macro and micro viewpoints. This imagery was applied into photoshop, then rendered with the invert tool which explores the detail

through positive and negative space. Following this, detergent was applied to the water and ink, and paper was laid across the water's surface to make a relief print of the patterns, again viewing these formations through another lens. Extending from this, a tubular overlay technique was used with cotton and monofilament contrast in an attempt to translate depth and fluidity, like water. This is expanded and developed further in section 2.2.4.



Figure 34. Snapshot of work book during water, ink and marbling experimentations (Daley, M. 2017)

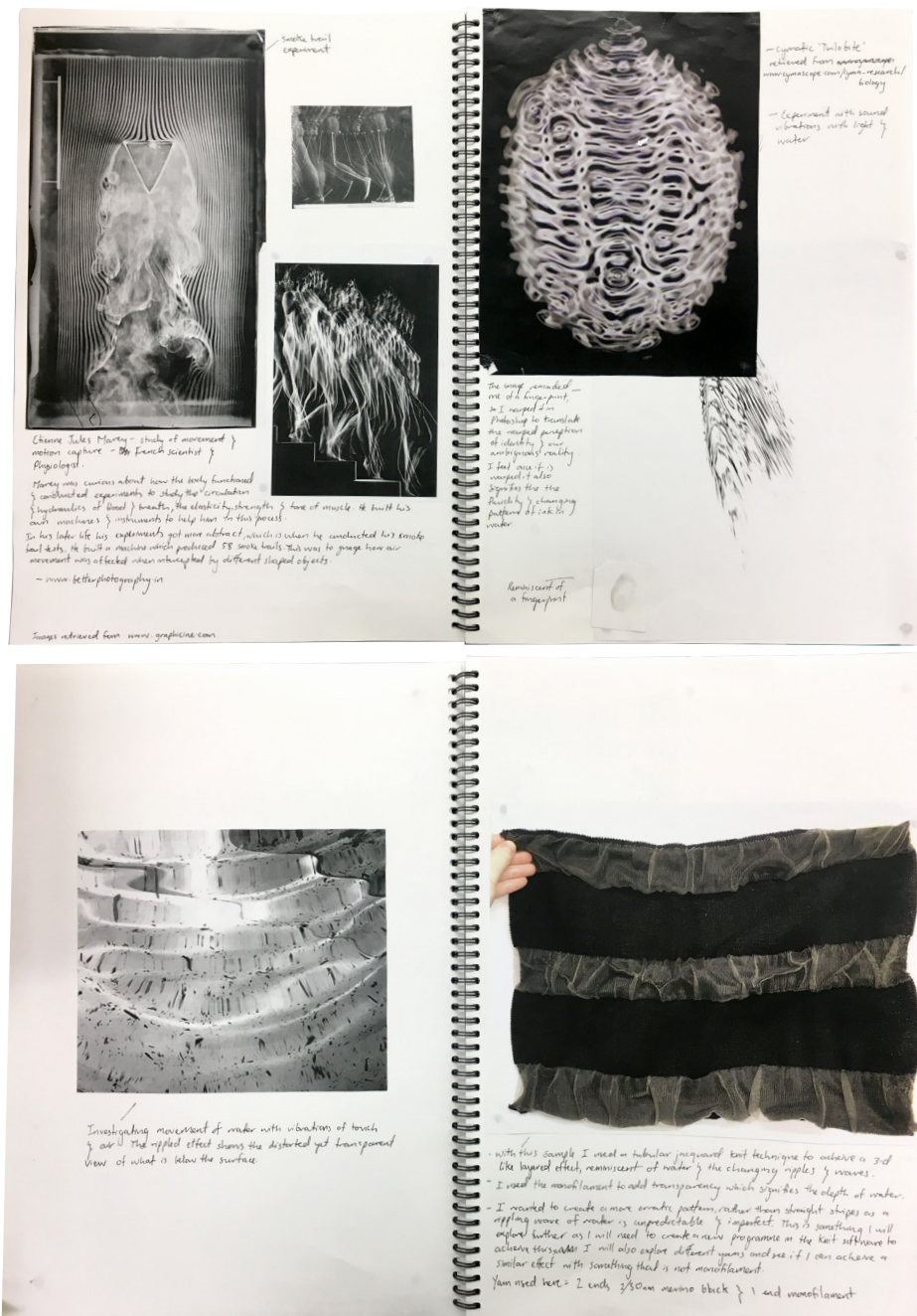


Figure 35. Snapshot of workbook showing inspirational imagery of Etienne Jules Marey chronophotographic studies (left) cymatic water pattern retrieved from www.cymascope.com compared to my distorted fingerprint (right). (Daley, M. 2017)

Figure 36. Photograph of water ripple as reaction from finger touching the surface (left) compared to tubular overlay technique inspired by said photograph (Daley, M. 2017)

MOODBOARDS

Mood Boards are used in this project as visualisation tools for collating and communicating conceptual and aesthetic influences. Figure 38 shows a moodboard in early stages of the

project, where similarities were drawn between life's trajectories through cymatics, movements of the body, air and vibrations with water. In knitwear design, these sources of inspiration

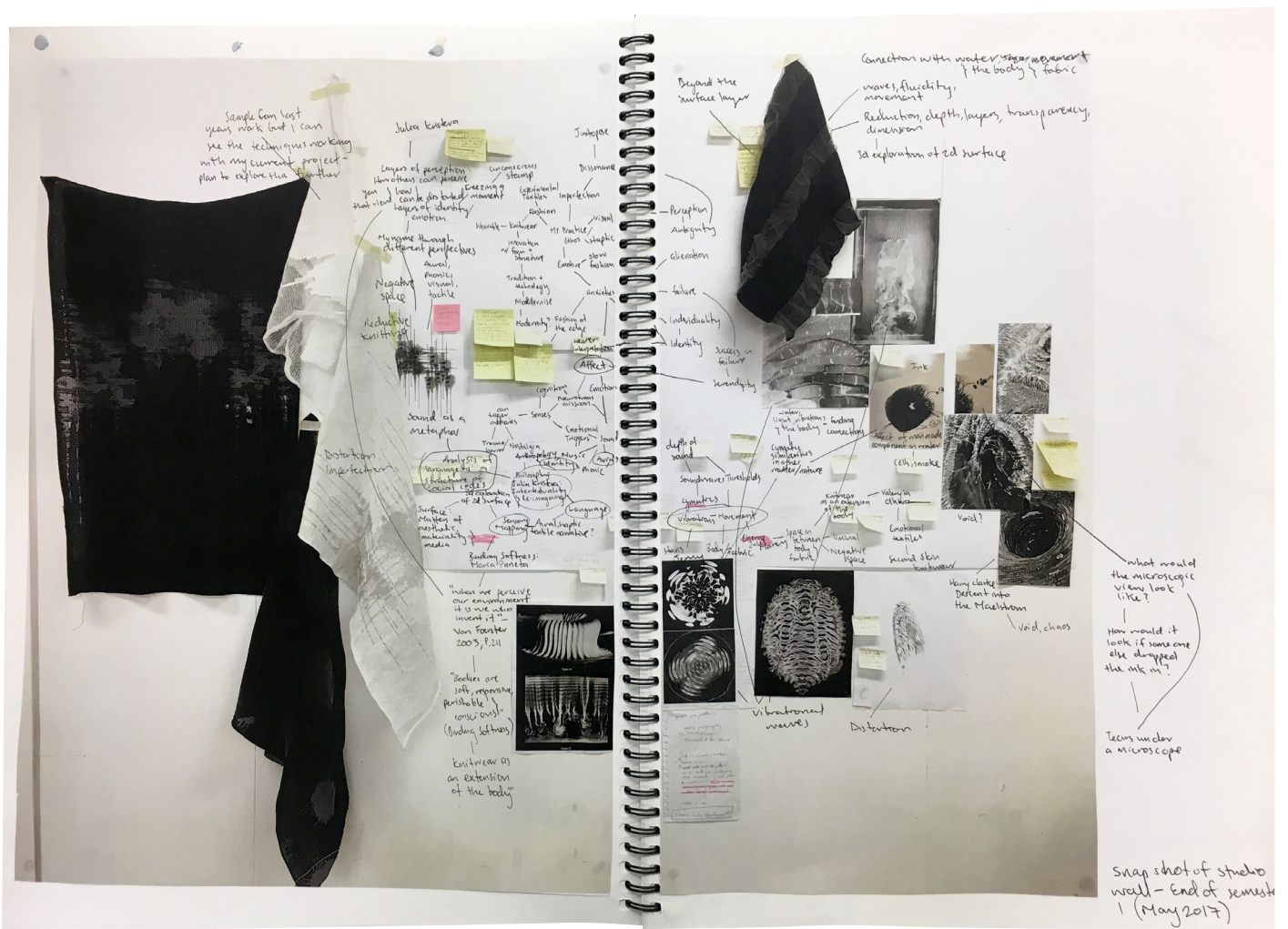


Figure 37. Snapshot of studio wall in workbook, showing conceptual and practical developments (Daley, M. 2017)

(moodboards) are especially recognized in communicating latest moods, designs and aesthetic values between designers (Eckert & Stacey, 2000). They are also noted as stimulates for “*perception and interpretation of more ephemeral*

phenomena such as colour, texture, form, image and status” (Garner & McDonagh-Philp, 2002).

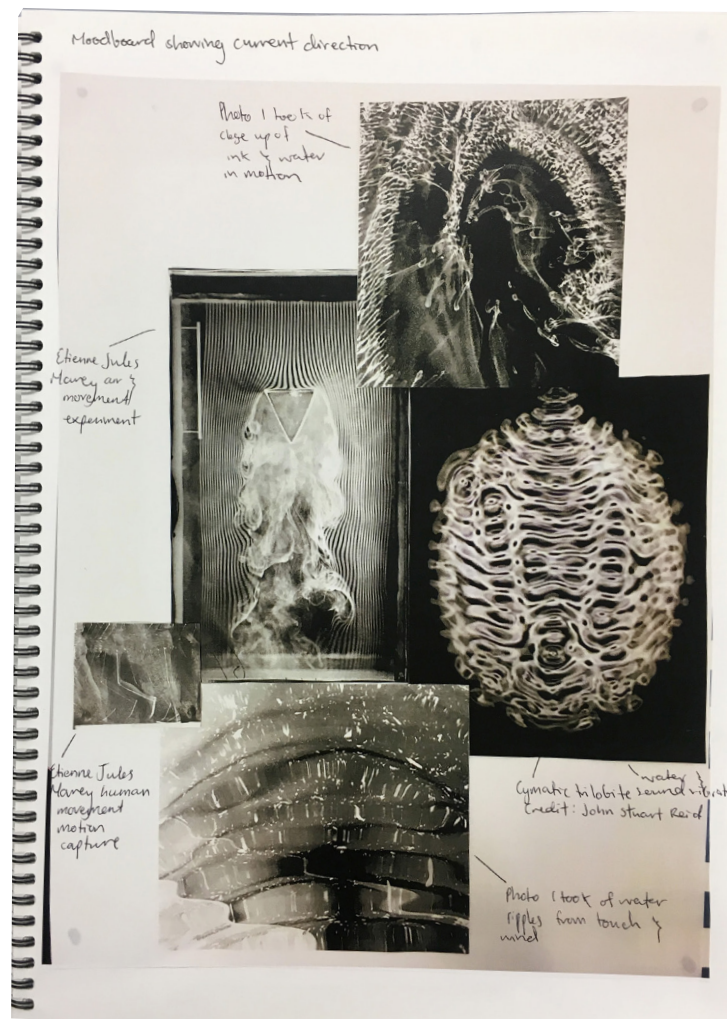


Figure 38. Moodboard as shown in workbook collating current concepts (Daley, M. 2017)

DRAWING AND VISUAL NOTE TAKING – TECHNICAL AND AESTHETIC

Prior to knitted swatch developments, drawing can be referred to in this practice as visual research through image formation and developments using abstract mediums such as the ink

in water, then photography to capture it, as seen in section 2.2.1. Further 'drawing' can be considered through photoshop rendering. Following this, drawing can be considered during the

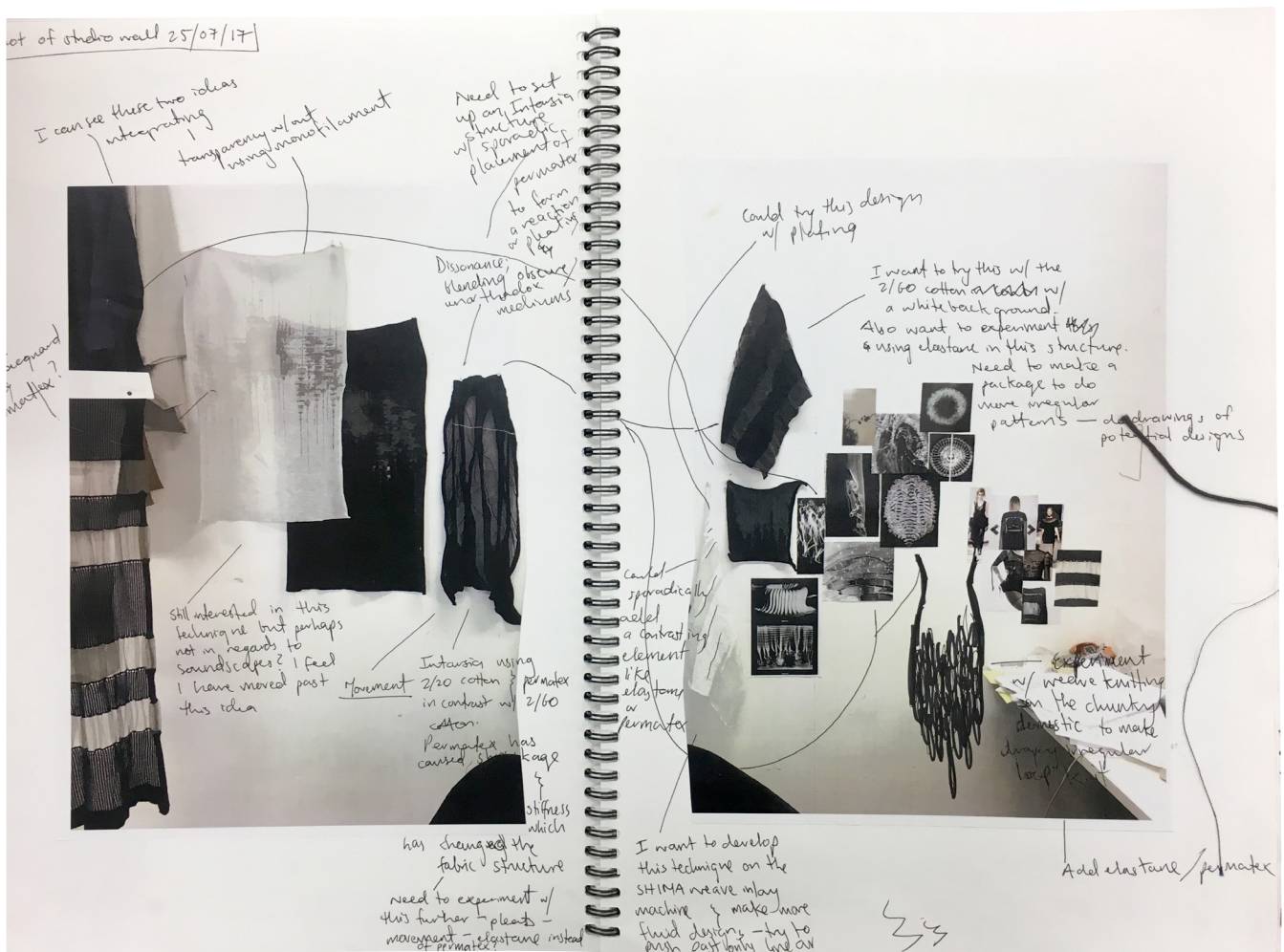


Figure 49. Snapshot of studio wall as shown in workbook dated 25/07/17 shows developments and refinement (Daley, M. 2017)

swatch development stage as a method of freehand design when using the Shima Seiki design software, as well as a mode of initial garment concept sketching.

As the project progresses visual notetaking takes form as a process to document

aesthetic qualities with conceptual developments. This takes form through storyboards which connect said imagery with developing textile swatches. This also allows for colour and textural thoughts to be documented. Also through the knitted

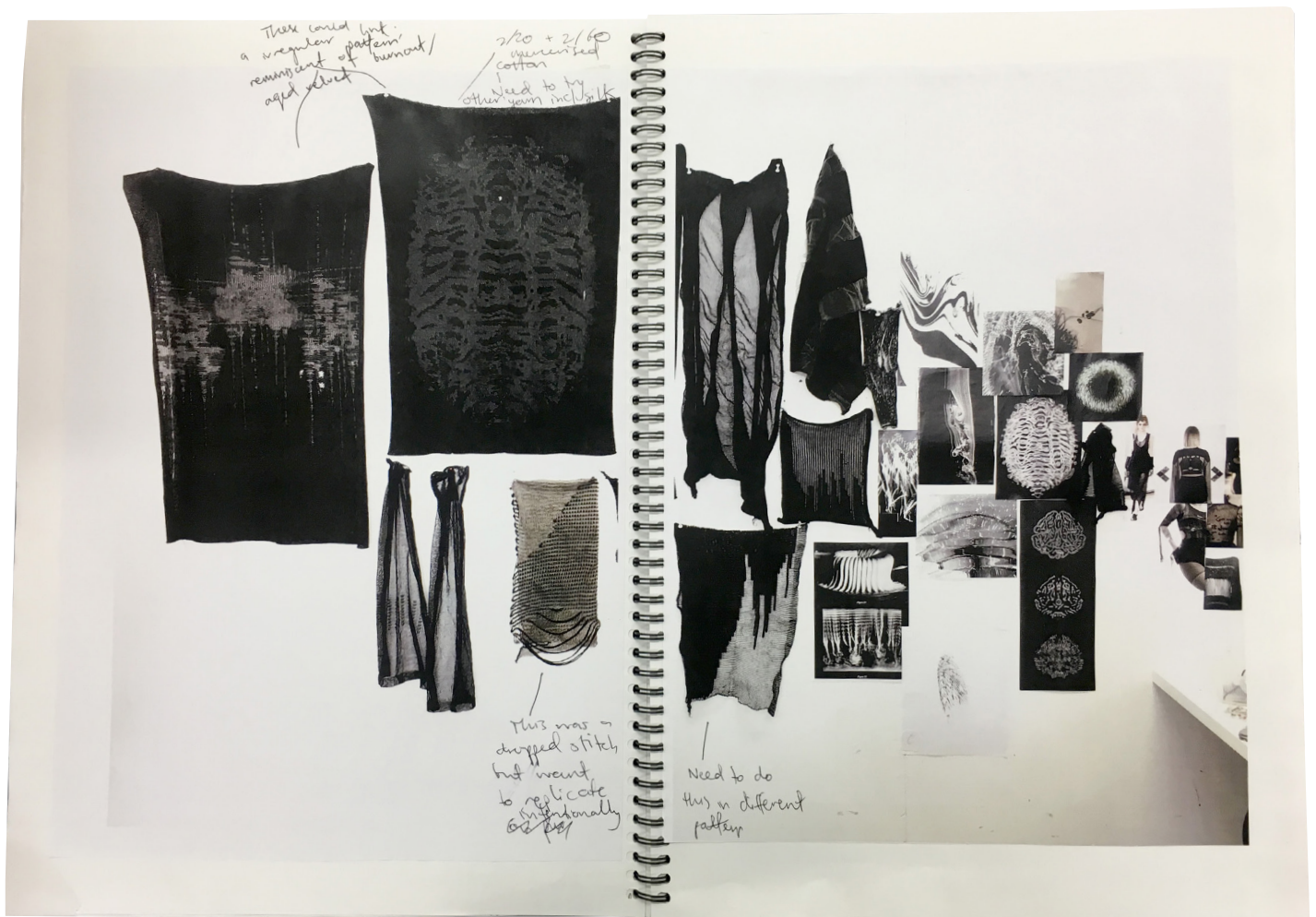


Figure 40. Snapshot of studio wall as shown in workbook, shows gradual progression of developing textiles (Daley, M. 2017)

swatch production phases, technical aspects of the process are constantly being noted to allow for quick reference to specifications such as yarn fiber and

weight, machine gauge, stitch structure and tension. This step is vital in analysing textile properties and contributing to an iterative design process.



Figure 41. Visual mindmap of developing textiles shows connections as well as thoughts for previous and future yarn choices (Daley, M. 2017)

ANALOGUE TO DIGITAL SWATCH DEVELOPMENT

A focus of this research project is the potential of translating craft ideals to a digitally knitted format, whether this be through direct handicraft techniques, aesthetics or translating the essence of the human hand physically or metaphysically. In preposition to this, I created garments using an inlay technique on the domestic hand-flat machines. This technique permitted the use of much heavier yarns in conjunction with a fine knitted structure, which allowed for contrasts of sheer delicacy with opaque textured rigidity. This mixed quality starts to question the inherent characteristics of the textile, with knit and woven areas being used in the same construct.

This way of knitting, while faster than hand knitting, is still rather time consuming. However, this does allow for careful analysis and thought out movement; giving opportunities to carefully manipulate one stitch at a time, and therefore have control over the outcome of the piece. This is beneficial in creating artistically driven pieces, although sporadic pattern formation is not easily achieved with this process. The distinctive spontaneity achieved

through a quick hand sketch without too much conscious thought can translate a raw and organic quality that can not be gained through analytical thinking and over analysis. The Shima Seiki SRY Inlay machine has the capability of performing a similar inlay technique to what I produced on the domestic hand-flat knitting machines. Therefore, I wanted to explore the machines capabilities further by examining whether this technique could be translated to this digital knit medium, and if it would be beneficial for design efficiency and innovative developments (fig. 44).

On comparison of the domestic and digital samples, they appear almost identical. However, upon closer inspection the irregularity in stitch quality is more apparent in the domestic sample. Even though this requires the use of a 'tool' or machine, the motion of creating these pieces remains hand influenced. Much like the gesture of hand knitting; while the use of tools is still required (knitting needles), the hand is in direct control of what they do, what speed and fluidity they move in. This is the same with the domestic machine; the motion of moving the carriage back



Figure 43. Original t-shirt made using a domestic hand flat knitting machine. (Daley, M. 2016)



Figure 44.. Initial samples developed on SRY inlay machine. (Daley, M. 2017)

and forth with the hand is not always systematic. The developing fabric moves, needles can jolt upwards if not weighed down correctly, or if weights are not dispersed correctly variations in stitch tension can occur.

Another approach to translating a craft aesthetic was the desire to replicate an embroidered aesthetic through the

knit structure. The ripple or knop type effect shown in these textiles, displays texture, depth and contrast through subtle layering within the knit structure by creating small raises in the fabric with a tuck stitch technique. Variations in opacity are achieved, which forms a monotonal contrast likened to the effect of an embroidered sheer fabric.



Figure 45. 'Digital knit embroidery' samples (Daley, M. 2017)

MATERIAL DEVELOPMENT ANALYSIS

After initial swatch sampling, selected fabrics are chosen to develop further. This involves experimentations with varied yarn combinations as well as adaptations to pattern design and structure as shown in figure 46. The initial development of this inlay technique uses a rigid mesh yarn. Once infilled with the metal base yarn it looks quite dense and plastic. This mesh yarn did not run through the machine very well, resulting in dropped stitches causing a laddered effect to one side

giving an asymmetric effect to the rectangular swatch. This inspired further exploration into this 'mistake' to see how an intentional laddering with structural integrity would look. This failure displays the ability of creating design opportunities through serendipity and a knowledge shift through unknown and haptic mistakes. Going forward a freehand motion of design was adopted with the Shima Seiki design system as shown in figure 47. This reflects back on translating human essence to the digital

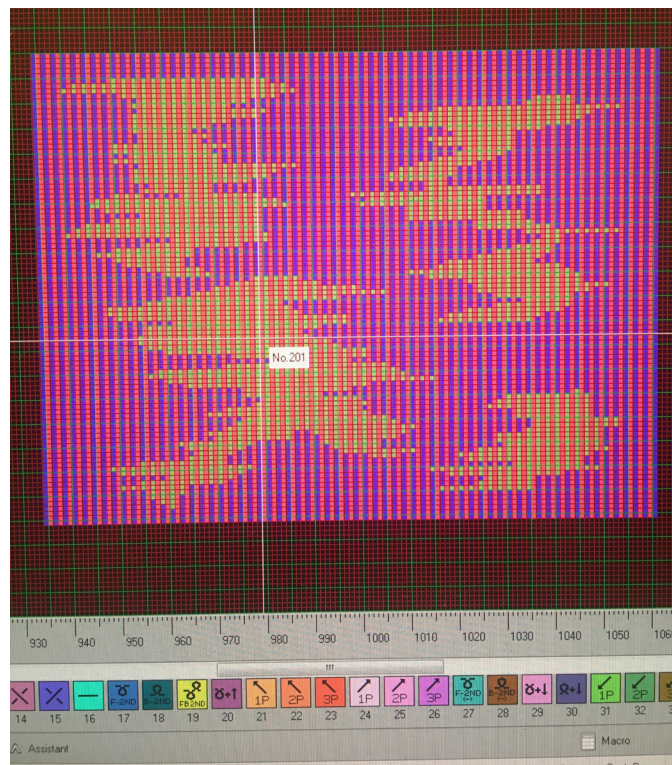


Figure 47. Snapshot of 'ripple' float free hand drawn pattern in knit design software (Daley, M. 2017)



Figure 46. (Clockwise from top left) Mesh inlay experimentation then gradual developments leading to the freehand approach of using the design system (Daley, M. 2017)

medium. Aesthetic observations show the underlying structure is more visible with the disappearing and reappearing of contrasting layers, formed by the irregularity of floating yarns falling and overlapping each other. This also links back to conceptual themes of this project exploring dissolution and regeneration through reductive knitting processes.

These diverging variables can challenge the material nature of the fabrication. This is explored in figure 48, which shows pieces that are developed from the same pattern, however the use of contrasting fibers and techniques such

as jacquard, then tubular jacquard, completely change the aesthetic and physical properties of the textile, showing the inherent force of the knit.

Parallel to this I developed pieces using an intarsia tubular overlay knitting technique. While not the same in structure, they do show some similarities in aesthetic. Inversion of yarn creates a new aesthetic as well as structural illusion. Layers submerge and ascend one another, challenging perception of surface and gives a sense of movement to an otherwise static object.



Figure 48. Swatches which have used same pattern but with different structures (Daley, M. 2017)



Figure 49. Monofilament overlay technique shows same structure but yarn is inverted (Daley, M. 2017)



Top to bottom:

Figure 50. Two dimensional visualisation of three dimensional construct using collage technique (Daley, M. 2017)

Figure 51. Draping two dimensional fabric over three dimensional body for visual research (Daley, M. 2018)

2D TO 3D IDEATION

This phase of development involved an ideation process by visualising a selection of textiles as three dimensional constructs through flat drawings and collages. This also moved the flat two dimensional swatches into visual three dimensional aspects via pinning swatches on the mannequin and draping swatches over the body.

Silhouettes reflect on the projects inspiration from Japanese aesthetic principles of simplicity and modesty, including that of the Kimono which considers space, balance and the relationship of the underlying body (English, 2011).

Placement and scale of design is explored here. Also this ideation step influences further textile developments as new insights are gained by viewing the textile through these different views from flat two-dimensional to the structural depth of the three-dimensional.



Figure 52. Comparison of flat knitted textile swatch with garment collage ideation and draping same fabric over mannequin (Daley, M. 2018)



Figure 53. Flat garment concept sketch compared to swatch developments flat (bottom) and pinned to body (top). (Daley, M. 2018)

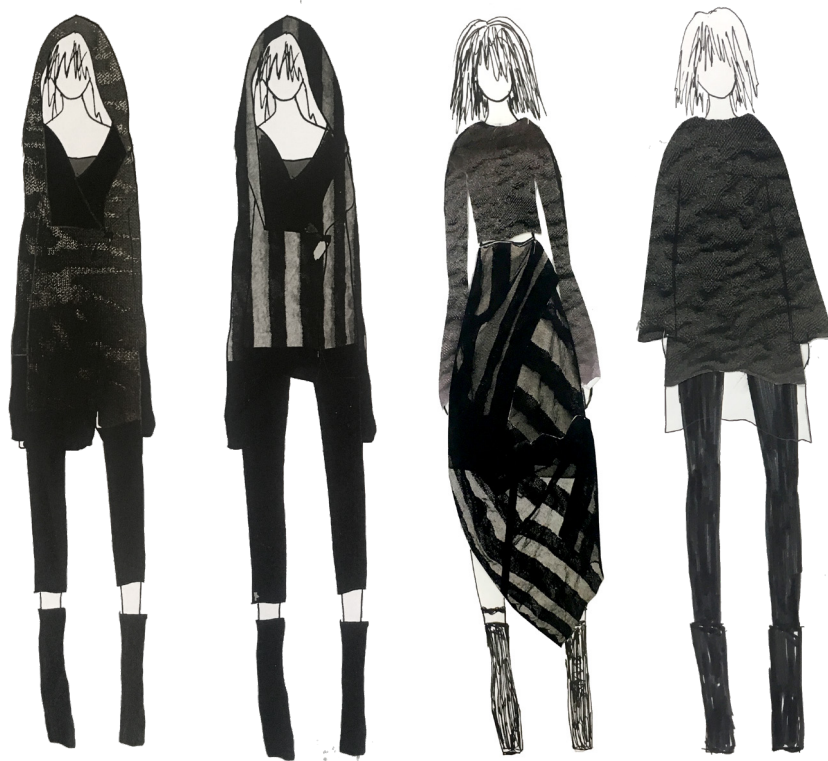


Figure 54. Top: Flat garment concept collages utilizing imagery of fabric swatches (Daley, M. 2017)

Figure 55. Left: Fabric swatch pinned to mannequin (Daley, M. 2017)

Figure 56. Right: Fabric swatch draped over the body (Daley, M. 2018)

ITERATIVE DESIGN PROCESS

An iterative design process means continual reflection and analysis for further developments. Failures are also considered and reflected upon throughout this as a mode of reflection and refinement. Kawakubo uses impulsive processes within her work. *"I could say that my work is about looking for accidents. Accidents are quite important for me. Something is new because it is an accident"* (Kawakubo in Japanese Fashion Designers, 2011). This also highlights a way of thinking within this practice, because throughout there are definite goals in place, however

there is an understanding that the further this project advances through the making, other previously unconsidered goals and/or issues may arise by viewing the textile through a three dimensional ideation process, also resulting in new insights. This contributes to an iterative process, whereby further investigation is made based on those findings. This is shown in figure 59 with the 'morph' knit swatch. I wanted to achieve a sense of movement with this laddered structure, as shown in figure 53 with a drawing which resembles a generative sort of design. Further understanding



Figure 57. Velvet inlay trial and error (Daley, M. 2018)



Figure 58. Monofilament inlay (Daley, M. 2017)

is gained when a textile is draped over the mannequin to expand on the understanding of how it will translate to the human form. While aesthetically this textile is pleasing in how the yarn floats drape, there is too much symmetry in this design, so after photographing it further development ideas are drawn from it into the distorting aesthetic pattern as shown in figure 61.

Further inlay developments are also a result of this process as seen in figure 58. The aim was to create a chain like loop reminiscent of the visualisation figure 50. This inspired further experiments on the inlay knitting

machine. While it does not resemble the structure that was imagined, something new had been created as a result of this process; the thread appears to be floating with the use of a transparent structural yarn. The desire to experiment further with unique materials was also a result from the swatch in figure 51. On analysis the upscaled version of the mesh inlay fabric, is reminiscent of the stark density of black velvet. Therefore, this led to an experimentation with velvet ribbon in the inlay machine (see figure 57). Drop stitches occurred due to an issue with tension, however this inspires further ideas for other textile developments.



Figure 59. 'Morph' inlay swatches (Daley, M. 2018)



Figure 60. Top: Morph inlay large sample draped over mannequin (Daley, M. 2018)

Figure 61. Bottom left: Morph inlay photo with drawn on ideation for further development (Daley, M. 2018)

Figure 62. Bottom right: Textile swatch development based on figure 62 (Daley, M. 2018)

2D SWATCH TO KNITTED GARMENT TRANSLATION (ISSUES AND RESOLUTIONS)

The ripple inlay fabric is developed into a dress in response to concept drawings in section 2.2.5. The pattern shape resembles a triangle to achieve a dropped shoulder/cap sleeve effect.

However, the metal yarn used as the main composite shows how fiber content can affect the shape and overall design outcome with the shoulders extending out and looking quite stiff.



Figure 63. Ripple inlay dress initial developments. Top shows cotton structure, bottom shows metal yarn structure (Daley, M. 2018)

Therefore iterations were made to the design and the choice to trial this fabric as a t-shirt instead was made. This fits more with a woven structure, which the knit properties have a much closer resemblance to.

The relationship of the textile to

underlying body becomes apparent here; a two dimensional shape is brought to life with the insertion of the body, as the body's contours dictate the way the fabric drapes, causing some areas to pull taut and others to hang away from the body. This also extends to



Figure 64. Ripple Inlay tshirt pieces pre make up (Daley, M. 2018)

Figure 65. Ripple Inlay tshirt fully fashioned (Daley, M. 2018)

a reflection on the inlay morph design which was also made before taking it through to the more distorted design as mentioned previously in section 2.2.6. This was pinned to the body in figure 66 to see how the detail drapes and metal yarn react. A temporal yarn, once pinned on the body, is constrained and contours to the body shape well. Although there is

a realisation that due to the fabric acting more like a woven, with little stretch, this silhouette may not work as a fully fashioned garment. In response, the use of an elastic inlay yarn resolved this.

Parallel to this, further two dimensional swatch development is undertaken with the inkdrop purl plain design. This was



Figure 66. Morph inlay piece pinned to contour of the body (Daley, M. 2018)

to explore how a change in fiber and machine could affect this design, so this was trialled as a whole garment piece. Because the original swatch was knitted on the 14 gauge SIG machine, the textile had to be re-developed and designed for the 7 gauge whole garment machines capabilities. The silhouette is designed with the fabric in mind, with an attempt

to create a raised 'turtle neck' feature in the hopes of it distorting with the ripple of the purl plain design reflecting a sense of asymmetry in the garment. On first trial the neckband extension is not deep enough, therefore adjustments needed to be made to the pattern to add more exaggeration to the neckline.



Clockwise from top left:

Figure 67. 14 gauge purl plain inkdrop samples in varied yarns ranging from metallic, wool and fine cotton top to bottom (Daley, M. 2017)

Figure 68. First Wholegarment trial using 2/30nm wool yarn (Daley, M. 2018)

Figure 69. Wholegarment piece in design system (Daley, M. 2018)

REFINEMENT

At this point further refinement is made and a set of 'final' garment concepts are realised to inform the next stages of development. Consideration of wearability, yarn handle, accessibility to yarn and tools as well as aesthetic desires are reflected in these visualisations. There

is still the potential for further textile developments as this is the generative/ fluctuating process of this project. This can be seen as shown in figure 72 which was a result of the desire to create the morph design as a more irregular pattern. because the nature of this



Figure 70. Refined garment concept drawings (Daley, M. 2018)

remediation was by free hand drawing on the photograph the same approach was applied when using the design system, drawing a freehand inlay scribble but still guided with intent, purposely making some areas densely woven and others with varied size floats. This idea was developed further, when knitting

this through the use of a metallic yarn, instead of the metal yarn used prior. The metallic aspects of the yarn gives a similar aesthetic although with more iridescent features, changing colour in certain lighting, but is softer and drapes better which aesthetically works well for this piece in response to the concept drawing.



Figure 71. Refined garment concept drawings (Daley, M. 2018)

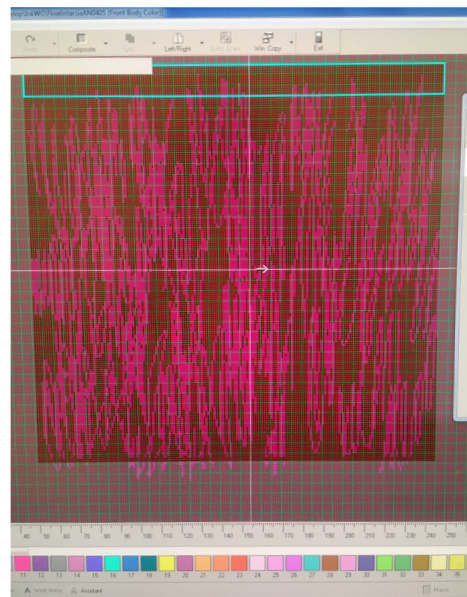


Figure 72. Refined concept drawing (left) with responding textile development (Daley, M. 2018)

2.3 Exhibition of Final Work

My final body of work was displayed as part of the Auckland University of Technology's Master of Design Exhibition at Gallery 1. Decisions I made in displaying my work attributed to aims of expressing the developmental process of garments with their corresponding textiles, as each piece informed the other

while showing the transitional states of three-dimensional exploration of two-dimensional surface. Initial smaller swatches in various colour ways and fiber compositions are next to their larger counterparts which show considerations in fiber, tone and scale - an important stage of this practice-led research.



Figure 73. Final garments hanging at Gallery 1 exhibition; final stage of design process (Daley, M. 2018)

A conceptual store set-up is simulated with hanging garments and textiles which explores the projects aims of analyzing the place for such a design process in local industry and the viability in a commercial context while also encouraging attendees to browse, examine and interact. The transparent nature of garments and textiles is also utilized in relation to the space with light

and shadow that travels through it at different times.

I have also included imagery of a selection of the final garments on mannequins together which further inform the transition to three-dimension in relation to the body. Figure 78 shows the finished garment form from an iterative process as shown in fig. 72 from section 2.2, page 77.



Figure 74. Large textiles; stage 2 of process (Daley, M. 2018)

Figure 75. Smaller swatches of developing textiles; stage 1 of process (Daley, M. 2018)



Figure 76. Relating textiles in final garment forms (Daley, M. 2018)



Figure 77. (Left) Relating textiles in final garment forms (Daley, M. 2018)

Figure 78. (Right) Final garment of iterative process (Daley, M. 2018)

3

CONCLUSION

This project has explored knitted fabrications natural and variable forces as two dimensional and three dimensional constructs, and shown how analysing failures throughout a design process can inform further generative design outcomes. This is shown through an iterative process exchanging between two dimensional swatch, three dimensional ideation in a two dimensional construct, and then through a three dimensional physical realisation as garments. Insights were gained into how these changing states are affected by fiber compositions, stitch structure and scale. The use of failure as a tool for reflection, refinement and further ideation was shown through the design process as seen in the velvet inlay sampling, which inspired the desire to create an intentional ladder structure to the underlying inlay.

Craft based approaches are explored through a digital knit medium to translate touch of the hand to technological processes while uncovering innovatory potentials. This is demonstrated in a number of ways such as translating an analogue inlay technique to the SRY digital knit Inlay machine. This proved to be time efficient and less labour intensive. However, it

does allow an ease in accessibility to these artisanal/crafted techniques. The originality of the handmade artefact could become lost in a sense if there is an ease of replication, and in turn a loss of human essence. However, this is why direct hand drawn designs in the knit design system are beneficial which are singular to the designer and not easily replicated. Furthermore these imperfect nuances created through spontaneous drawing translates the wabi sabi aesthetic and reflects a sense of decay and impermanence in response to the projects conceptual groundings. These are communicated through a small garment sample range which embodies said aesthetic, with the use of diverging textures, draping floats, paired with simplistic silhouettes to allow the detail of the textile to inform the design. This project also has created a larger knitted sample range for future projects, which takes careful consideration of yarn, fiber, handle and wearability while still translating the designers style and values into the knitted swatches.

Extending from this is also an investigation and the consideration of a niche designer processes applicability in the New Zealand industry. Based on a review of the industry and a practical

experience as an acting designer, there seems to be a few approaches that could be taken such as, working as a sole designer utilizing only hand made processes so as to retain control entirely of the production process - meaning no middle man and no pressures to meet minimum order requirements. However acquiring materials such as yarn in minimal quantities can prove problematic within New Zealand. Alternatively to access the digital machinery there is the potential to use the Auckland University of Technologies,

Textile and Design Lab for swatch sampling and production, however this is expensive and finishing techniques such as linking would need to be additionally outsourced. A response to this could be to develop mostly on the wholegarment machine which requires little to no makeup however the tradeoff is the limited capabilities and only a 7 gauge fabric can be produced on this, however in reflecting on some of the findings of this project, these limitations could provide another opportunity for serendipitous innovation.

References

- Barrett, E., & Bolt, B. (2010). *Practice as research: approaches to creative arts enquiry*. London : I.B.Tauris, 2010.
- Chenoune, F., Dusinberre, D., & Martin, R. (1993). *A history of men's fashion* (pp. 229-240). Paris: Flammarion.
- Christies. (2015). "Never Imitate Others: the story of Gutai", 2015. Accessed March 18, 2018. https://www.christies.com/features/Gutai_Group-5053-1.aspx
- Dagognet, F. (1992). *Etienne-Jules Marey: a passion for the trace* (p. 134). New York: Zone Books.
- Deleuze, G., & Guattari, F. (2004). *A Thousand Plateaus* (London. Continuum, 5.
- Dormer, P. (1997a). Craft and the Turing Test for practical thinking. *The culture of craft*, 137-157.
- Eckert, C. (1999). *Managing effective communication in knitwear design. The Design Journal*, 2(3), 29-42.
- Eckert, C., & Stacey, M. (2000). *Sources of inspiration: a language of design. Design studies*, 21(5), 523-538.
- English, B. (2011). *Japanese fashion designers: the work and influence of Issey Miyake, Yohji Yamamoto and Rei Kawakubo*. Berg.
- Evans-Mikellis, S. (2011). *Future forms : a methodological investigation for garment shape innovation in knitwear design : a thesis submitted to Auckland University of Technology in fulfillment of the requirements for the degree of Master of Art and Design, 2011*.
- Fan, J., Yu, W., & Hunter, L. (2004). *Clothing appearance and fit: Science and technology*. Elsevier.

- Fast, M. (2013). "About Mark". Accessed March 23, 2018. <http://www.markfast.net/about.html>
- Gabriel, N. (2015). Construction knitting: an exegesis submitted to Auckland University of Technology in partial fulfilment of the requirements for the degree of Master of Art and Design (MA&D), 2015.
- Garner, S., & McDonagh-Philp, D. (2001). *Problem interpretation and resolution via visual stimuli: the use of 'mood boards' in design education*. *International Journal of Art & Design Education*, 20(1), 57-64.
- Ingold, T. (2007). *Lines : a brief history*. London ; New York : Routledge, 2007.
- Ingold, T. (2010). *Bringing things back to life: Creative entanglements in a world of materials*.
- Jenny, H. (2001). *Cymatics: a study of wave phenomena and vibration*. MACROmedia.
- Keene, D. (1981). *Appreciations of Japanese culture*. Kodansha America.
- Koren, L. (2008). *Wabi-sabi for artists, designers, poets & philosophers*. Imperfect Publishing.
- Mäkelä, M. (2007). *Knowing through making: The role of the artefact in practice-led research*. *Knowledge, Technology & Policy*, 20(3), 157-163.
- Ezio, M. (2015). *Design, When Everybody Designs: An Introduction to Design for Social Innovation*. The MIT Press, 2015
- McCullough, M. (1998). *Abstracting Craft: The Practiced Digital Hand*. MIT Press
- McKinney, E., Stanley, A. E., Plummer, B., Thompson, K., & Rorah, W. (2016). *Tacit magic: understanding the principles behind Nakamichi's creative pattern cutting*. *International Journal of Fashion Design, Technology and Education*, 9(2), 130-141.
- Nomd. (2016). "About Nom*d". Accessed March 23, 2018. <https://www.nomdstore.com/nz/about>
- Oakley, P. (2015). *Digital Crafting: Defining the Field in 2015*. *Making Futures*, 4(1), 1-5.

- Olkhova, Valeriya. "About Voft." 2018. Accessed February 5, 2018. <https://www.voft.eu/about-voft>
- Paterson, M. (2007). *The Senses of Touch: Haptics, Affects and Technologies*. Berg Publishers, 2007
- Penata, Maria. "Binding Softness." 2016. Accessed March 28, 2017. <http://www.interactivearchitecture.org/binding-softness.html>
- Polanyi, M. (1958). *Personal Knowledge Towards a Post-Critical Philosophy*. Routledge & Keegan Paul Ltd, 1962
- Prytherch, D., & Jerrard, R. (2003, July). *Haptics, the Secret Senses; the covert nature of the haptic senses in creative tacit skills*. In Proceedings of the Eurohaptics 2003 Conference, Dublin, Ireland.
- Smith, A. E. (2013). *Seamless knitwear: Singularities in design* (Doctoral dissertation, Auckland University of Technology).
- Stephen, C. (2016). *Digital dynamics : an interactive design process for generating knitted textiles : an exegesis submitted to Auckland University of Technology in partial fulfilment of the requirements for the degree of Master of Creative Technology (MCT), 2016*.
- Tung, F. -W. (2012). *Weaving with rush: Exploring craft-design collaborations in revitalizing a local craft*. International Journal of Design, 6(3), 71-84.
- Taylor, J., & Townsend, K. (2014). *Reprogramming the hand: Bridging the craft skills gap in 3D/digital fashion knitwear design*. Craft Research, 5(2), 155-174.
- Udale, J. (2014). *Fashion knitwear*. London, [England] : Laurence King Publishers, 2014.
- Vervoordt, A., & Paul, M. (2010). *Inspiration Wabi*. Jacoby & Stuart.
- Yang, S. (2010). A creative journey: Developing an integrated high fashion knitwear development process using computerized seamless v-bed knitting systems. Perth, Australia: Curtin University.