“Re-fashioning a Sustainable Classic.”

An exploration into blending through pattern and structure as a method to improve the use of broad wool fibres in commercial fashion fabrics.

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PhD

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A thesis submitted in partial fulfilment of the requirements of the University of Northumbria at Newcastle for the degree of Doctor of Philosophy

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Abstract

The doctoral research study is a practice-based exploration of weft-knitted textile methods in order to promote further use of British broad wool fibres in commercial fashion fabrics. British wool is an appropriate fibre to explore because of its links to localism and the abundance and variety of sheep breeds within the British Isles. British broad wools are often neglected for other fibre types, such as acrylic or nylon blends, due to their perceived ‘rough’, ‘coarse’ and ‘prickly’ handle; these fibres are not seen as favourable in the fashion market. Seven breed-specific broad wools under-utilised in everyday fashion fabrics were investigated. The knitted textile method explored is ‘blending through pattern’, which refers to utilising weft-knitted pattern structures to combine two, three or more yarn types together; thus, each yarn type is knitted through a single feeder. The blending occurs in the same way that different colours are combined through pattern on the knitting machine. Successfully blended fabrics exchange yarn types regularly in order to improve the overall tactility of each fibre type when they are combined in fabric form. Numerous yarn combinations were tested in five pattern types and structures on the knitting machine, resulting in a substantial collection of over 400 knitted fabrics, many of which are considered ‘soft-handling’ and suitable to be worn next to the skin. The fabrics were collated into a swatch library intended to be a guide to encourage knitwear professionals to utilise broad wools within their designs.

Overall, the research drew several conclusions; firstly, it is possible to create soft-handling fabrics from British wool blends, especially if one of the yarn types is Blue-faced Leicester. Secondly, ‘blending through pattern’ is an appropriate method of combining fibre types. Finally, one success of the project was that every participant in the study could envisage themselves wearing at least one of the fabrics presented to them next to their skin.

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Abbreviations

A number of abbreviations are used throughout the study. These refer to some of the breed-specific yarns that have been knitted with.

BFL: Blue-faced Leicester sheep

KR: Kent Romney sheep

WFW: White-faced Woodland sheep

DH: Dorset Horn Sheep

Glossary

Explanations of a number of technical terms used throughout the thesis. These have been taken from the following knitwear publications: (Black, 2002) (Robson & Ekarius, 2011) (Spencer, 2001) (Sissons, 2010) (Udale, 2008). Further explanation of technical terms can be found throughout Chapter 2.1.

Aran: A very textured style of knitting that takes its name from the Aran islands in Scotland. It also refers to the weight of yarn, usually around 2/8 in count. (See below.)

Course: A horizontal row of knitted loops

Fabric quality refers to the number of wales or courses per inch or centimetre. Generally, the higher the figure for a given linear measurement of wales, the finer the machine gauge and the smaller the stitch length.

Fair-Isle: A traditional technique originating from the Fair Isle that typically employs two colours within each row, but many more colours can be used over a garment. Today, the terms Fair-Isle and Float jacquard are often intermixed in both hand and machine knitting to describe any patterns knitted in two colours within the same single-bed stitch structure, producing a clear stitch definition on the front and floats on the reverse side of the fabric.

Fully Fashioned: The shaping of a knitwear garment so that each edge is a selvedge and will not unravel.

Gauge: This is a system of measuring the linear spacing of a number of needles in one inch of the needle bed. The larger the number of needles in one inch, the finer the gauge of the machine and the finer the fabric.

- **Coarse Gauge:** This refers to fabrics created on a knitting machine with a small number of needles per inch. For example, 2.5 or 3-gauge machines are usually referred to as coarse.
- **Standard Gauge**: Also known as medium gauge, it refers to machines with between 5 and 7 needles per inch.
- **Fine gauge:** This refers to fabrics created on a knitting machine with a large number of needles per inch. For example, either 10, 12 or 14 needles per inch are common for commercial ‘fine gauge’ knitwear.

Jacquard (General): Originally, it refers to a woven fabric but also applies to weft-knitted fabrics where two or more coloured yarns each knit a selection of needles to create a pre-determined colour pattern.

Ply: The number of single threads twisted together to form the thickness of the yarn. See page 40 for further details.

Staple: Refers to the length of individual fibres.

Wale: A column of knitted stitches

Yarn Count: This indicates the linear density (yarn diameter or fineness to which a yarn has been spun. There are a number of different count systems, of which two are referred to during the thesis. The continental Metric system **(Nm)**: This refers to the number of 1000 metre hanks that weigh 1000g (1kg). The count is expressed in the following way: 2/28Nm, for example. The second system is Tex **(Tt),** which is the weight in grams of 1000 meters.

Acknowledgements

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Thank you to Northumbria University for all the academic resources, without which the project would not have been possible.

I want to thank the participants who gave their time to participate in the study; their responses shaped its outcome, and so much new knowledge was acquired during the interview process.

Most of all, I want to thank my family, particularly my husband, for his unswerving belief in my ability to complete the project and his patience, support, and love throughout this journey.

Declaration

I declare that the work in this thesis has not been submitted for any other award and is all my work. I also confirm that this work fully acknowledges opinions, ideas, and contributions from the work of others.

Any ethical clearance for the research presented in this thesis has been approved. Approval has been sought and granted by the Faculty Ethics Committee on 18.03.2021.

I declare that the word count of this thesis is 45,860 words.

Name: Julia Mary Wilmott

Signature:

Date: 30.11.2022

1 Introduction

Figure 1:1 Detail of sample 353: A 1x1 stripe structure with ladder and pointelle manipulation.

1.1 Rationale

Craft and sustainability are intertwined through the knowledge, skills, and social responsibility that those working with materials possess. Knitting is suited to this way of working because knitting explores the whole design problem and results in completed artefacts created from raw materials. In this way, the doctoral research study intends to examine one specific raw material, British wool, through the medium of knitted textile design. Knitting combines craft, creativity and technology and has the potential to create sustainably sound artefacts if suitable methods are considered throughout the design process. Thus, the materials chosen to create each artefact should be a valuable design decision before the making process begins.

It could be questioned why this research study focuses on the use of virgin fibres, considering the contemporary global environmental crisis and the overproduction worldwide within the fashion industry. The reason to use British wool is that it already exists, and it is renewable because sheep grow a new fleece every year (IWTO, 2022). The UK, in particular, has the world's most diverse population of sheep breeds, with over 60 different breeds recorded by British Wool (2010).[1] Overall, sheep within the UK are not intensively farmed; different flocks live throughout the country and co-exist within the ecology of the landscape. Sheep breeds have grown, evolved, and diversified with the landscape. Breed-specific farming necessitates different farming methods (Ryder, 2007) that rely on purposeful production, specialist local farming skills and knowledge distinct to the local environment. This is known as a model of 'sustainable, regenerative agriculture' where the sheep co-exist within the natural ecosystems of the British Isles (Why Wool Matters, 2022; Textile Exchange, 2022). Utilising specific breeds within different farming environments enables sheep farming to productively utilise land unsuitable for other livestock, agriculture, or housing (Z Fletcher, 2018).

A sheep's fleece has many different end uses. Sheep such as Blue-faced Leicester are known for their wool, while other sheep have a very 'coarse' fleece, or the sheep's primary function is meat or dairy, meaning their fleece is a secondary product (Appendix 1). These sheep produce a fleece yearly, but the fleeces are either disposed of or utilised for lower-value products. In recent years, prices for British fleece have declined as the global wool market closed in 2020 due to the pandemic. Vast volumes of wool were left unsold, pushing down prices and leading farmers to dispose of or compost their fleece (Mahy, 2020). While sheep have many benefits, they are still an animal with a substantial environmental footprint, thus, for sheep to be a viable part of the ecosystem in the future,

[1] The British wool marketing board was set up in 1950 to oversee the sale of fleece in the UK and ensure the seller is getting a fair price for the sheep. The British wool marketing board regulates the quality of the wool of all its providers and sets the price according to the type of wool/ fleece it is. The BWMB is now known as British Wool.

the use and management of every aspect of the sheep must be maintained and improved. Chapter 2.2 will explore sheep's benefits and environmental impact, but research into the use of sheep's wool is important to ascertain whether new textiles methods can enhance the use of these material resources so they can be utilised efficiently.

Since the beginning of this project, there has been a shift in perception by those in the industry and academia; at the beginning of the project, many textile researchers questioned why wool research was appropriate. Now, new projects have been set up within textile circles, for example, by researchers at the Centre for Circular Design (CCD) and Shemakes to combat what is now being described as a 'design crime' for allowing so much of a single raw material to end up as landfill rather than be utilised for textiles (shemakes, 2022; UAL, 2022).

There is also a shift in values as design thinkers acknowledge that for fashion to be viable in the future, it must connect with the communities in which the artefacts are made and become more localised and specialised (Williams, 2018). Value must be attributed to producing local goods and materials, especially those tied to local identities and histories. Localism favours nearby resources, place-specific knowledge, and community self-reliance. It expresses practices shaped by tradition or nostalgia (Stannard, 2020; Schindler & Holbrook, 2003). It uses materials and social assets available in an area (Fletcher & Tham, 2019) to shape and create a more resilient local economy (Walker, 2007). 'Localism' is not a new concept but one that the British fashion industry has moved away from over the last century. However, it could be a significant way to improve fashion's relationship with the environment and make fashion viable for the future. An American study by Stannard (2020) into farmers who diversified their products, predominantly to become fibre farmers, producing wool to sell in the craft market, discovered that although those working on the farms in general earned small salaries, they loved the way of life and were committed to farming. The products these farmers created from the fibres they produced engaged local communities, and money earned from selling the products went back into caring for the animals, the farm, and the environment alike. Thus, a regenerative local model produced benefits for the local ecosystems.

British wool meets these criteria in that it is bred within communities and different flocks, and thus, fleeces have different attributes, which, in the past, communities have worked with. Shetland fair-isle knitting exemplifies this (Pearson, 2015, pp. 172-218). Examining how communities utilised British-wool in the past is critical to regenerating British farming and the British textile and fashion sector (Z Fletcher, 2018). It is important to remember that different industries are interlinked rather than separate entities; thus, industries should work together for their and the environment's future.

British wool has a rich history, which is illustrated by time. These timelines reveal that the woollen industry was once an integral part of the British economy, but in recent times, wool has fallen out of favour due to changing fashion trends and the prevalence of synthetic materials (Black, 2012, pp. 77, 80). The timelines pinpoint the many highs and lows of British wool's history and infer that, from a historical perspective, there is no reason why wool cannot be prevalent again, mainly because British wool is still a diverse and readily available raw material. The UK contains 3% of the world's sheep, around 32,000,000 (IWTO, 2022). As Anni Albers contemplates in her writings in Design, "The things that have lasted and the things that will last are never subject to quick fashion" (Albers, 2000).

The UK may still have sheep, but much of the industry required to process wool fibres have disappeared (Beatty & Fothergill, 2016; Pirie, M, 2022). Few spinners, dyers, and wool producers creating yarns for the craft or luxury markets remain. Laxton's is one company that specialises in spinning and producing worsted spun wool and has developed their own range of traceable British wool (Laxtons, 2021). Other companies still actively producing wool include West Yorkshire Spinners, Shepley Yarns, and Fernley Spinning Mills, who work with the support of British Wool (2022) and World of Wool, where the yarns for this project were sourced (World of Wool, 2019).

The doctoral research focused explicitly on British wool because despite its many material and immaterial advantages, British wool fibres, particularly those derived from hill or mountain sheep, are repeatedly considered undesirable for apparel. The handle of fabrics created from these fibres are perceived as 'too coarse' and consequently 'off-putting' for consumers looking for a 'soft' or 'comfortable' garment (Sneddon, et al., 2012; Sneddon, et al., 2012). The literature further explores some of these perceptions to understand better why this is. The practice intended to improve the handle of seven British wools through knitted textile methods, explicitly using pattern to blend the yarns together on the knitting machine. The tactility of these fabrics has been interpreted through several phenomenological qualitative investigations, and the outcomes demonstrate British wool's potential for use in fashion fabrics when utilised in conjunction with knitted textiles.

Figure 1:2 The timelines on the following pages visualise wool and knitting's diverse history within the UK over time.

A History of British Wool

An illustration of trends and technological advances in the Woollen Industry through time.

Developments in raw materials through history: Focus on wool and comparable synthetics

3000BC 1st records of domestic sheep began to appear.

6 -7BC: Wool arrived in Britain with the Celtic tribes.

The Badger faced Welsh Mountain sheep can be dated back to the 1st Century AD.

The Norfolk horn was bred and developed during the middle ages.

Shetland Isle Sheep developed to produce fine white wool

Between the 12th and 16th Centuries, the key reason for sheep farming was wool production.

The Black Death in Europe, meant farmers were faced with a severe shortage of labourers. They turned to raising sheep, thus the population increased.

12th Century Henry I built up the wool trade at the mouth of the Tweed.Much of the raw wool was shipped to Flanders.

Black-face sheep established in the UK 13th Century

1197: Ryeland sheep developed by monks in Hereford.

In the 12th century the wool trade moved out of the UK, to Flanders. Raw wool was shipped before being made into cloth and exported.

During the 14th Century the first records of Cheviot hill sheep were recorded.

Romney sheep were introduced to South East England.

Cotswold sheep were established and developed.

Wool merchants given protection between 1327 and 1377

1331: Edward III invited Flemish weavers to Britain. Thus the British wool trade developed.

1350: The Lord Chancellor decreed to sit on a wool sack... It was so important to the economy.

By 1660 two thirds of England's foreign trade based on woollen textile exports.

1700's : The half-bred Scotch sheep bred and established in the UK.

The Blue-faced Leicester was established in the 18th century and evolved in the Tyne and Wear valleys.

Between the 18th and 19th Century hill sheep were introduced to different areas of the country. Breeds included: Lonk Hill, Radnor, North Country Cheviot, Exmoor Horn and Kerry Hill.

During this period Longwool sheep breeds developed and introduced throughout the UK. Breeds include: Devon and Cornwall Longwool, Grey faced Dartmoor, Leicester Longwool, Lincoln Longwool, Teeswater and Wensleydale sheep.

Between 1805 and 1820 wool consumption grew 35%

1800's South-down sheep improved through breeding and spread through South East England.

Llanwenog and Lleyn sheep introduced in Wales

Shropshire sheep, Dorset Down and Devon Closewool breeds introduced to the UK through cross breeding

Boarder Leicester sheep are Bred and developed Across the UK

1810's Suffolk sheep recognised as a pure bred for the 1st time.

1830's Oxford Down created through cross breeding

1835: London wool exchange established

BC | 1AD | 1000 | 1400 | 1500 | 1600 | 1700 | 1720 | 1740 | 1760 | 1780 | 1800 | 1820 | Time 1840

Technological advances in the Knitwear & Woollen Industry

A large number of spindles dating back to 2000BC found. This is the first evidence of spinning by man.

54BC: The Wool trade established under Caesar. The spinning of Yarn and making of cloth began. The Romans built a weaving factory in Winchester

Ovid talks of hand carding wool, the technique similar to what is used today. (Hand carding used until the middle of the 18th C.)

During the 4th and 5th Century the Saxon's put an end to the woollen trade, scattering flocks and destroying factories.

1066: William the Conqueror brought fresh supplies of sheep to England from Europe

1080: The Weavers guild established.

1188: The London Guild of Dyers established.

The town of Worsted was established in Norwich in 1200.

1200: Parliament issues rules for wool dyeing by the request of King John.

The spinning wheel was developed during the 14th century. It was known as the Great wheel or one thread wheel.

1472: Dyers Company of London chartered by Edward IV

1555: William Lee developed the 1st stocking knitting frame

1612: James Lee returns to London (from France) with seven knitters and 8 hand-frame knitting machines to establish the hand-frame knitting industry in the UK.

1655: The quality of London frame stocking recognised internationally. More exported than sold in the UK, at this time.

By 1655, the framework knitting industry could be located in three locations within the UK: London (for fine silk products), the Midlands (for worsted wool products) and the North of England/ the Sottish boarders (for coarse wool products).

1663: A charter obtained from Charles II to register all framework knitters. A seven year apprenticeship was required to work in the industry.

1733: The fly shuttle is introduced by Jonathan Kay.

1758: Jedediah Strutt developed the first V bed knitting machine.

1770: Richard Arkwright improved and patented the Industrial carding machine.

1779: Samuel Crompton invents and patents the spinning mule. The spinning mule can draw out fibres, twist them into yarn and wind many threads simultaneously.

James Hargreaves patents the Spinning Jenny.

1769: Richard Arkwright patented the water frame. A spinning frame, which ran on water power.

1785 -1786: The warp knitting process developed by Josiah Crane

1785: Dr Cartwright develops the first power loom.

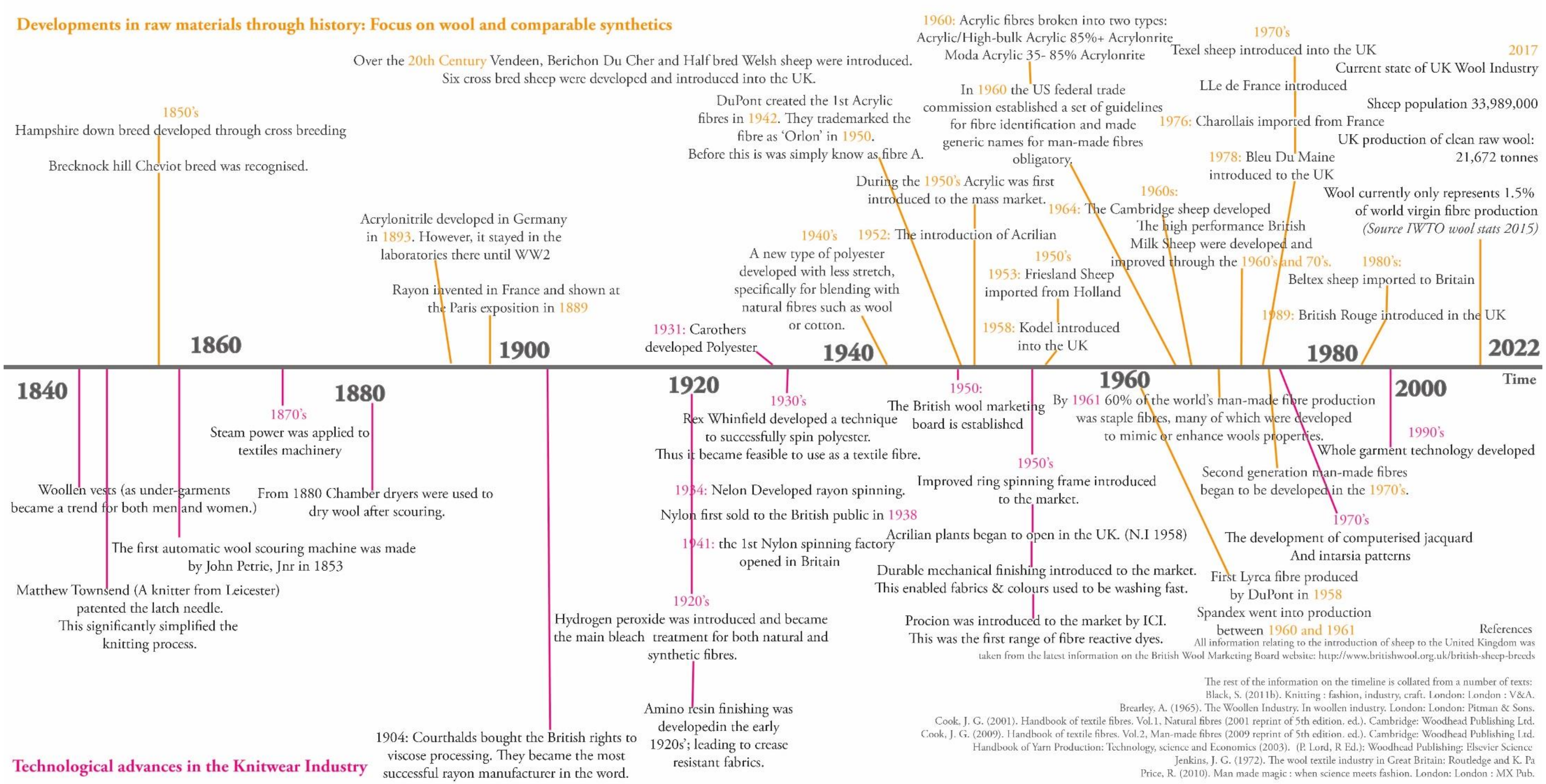
Powered Circular knitting developed by Marc Brunel, from the original circular frame, in 1816.

During the late 18th century chlorine based materials began being used to bleach wool cotton and linen.

1790's: Dr Cartwright undertook his pioneering research into wool combing.

Dr Jaeger revived the five toe sock manufacture. These were knitted socks manufactured in wool.

During the 1700 and 1800's a very successful Recycling business was created in Batley, West Yorkshire.


Developments in raw materials through history: Focus on wool and comparable synthetics
1850's
Hampshire down breed developed through cross breeding
Brecknock hill Cheviot breed was recognised.
Acrylonitrile developed in Germany in 1893. However, it stayed in the laboratories there until WW2
Rayon invented in France and shown at the Paris exposition in 1889
Over the 20th Century Vendeen, Berichon Du Cher and Half bred Welsh sheep were introduced. Six cross bred sheep were developed and introduced into the UK.
DuPont created the 1st Acrylic fibres in 1942. They trademarked the fibre as 'Orlon' in 1950. Before this is was simply know as fibre A.
1931: Carothers developed Polyester
1940's
A new type of polyester developed with less stretch, specifically for blending with natural fibres such as wool or cotton.
1952: The introduction of Acrilian
During the 1950's Acrylic was first introduced to the mass market.
1960: Acrylic fibres broken into two types:
Acrylic/High-bulk Acrylic 85%+ Acrylonrite
Moda Acrylic 35- 85% Acrylonrite
In 1960 the US federal trade commission established a set of guidelines for fibre identification and made generic names for man-made fibres obligatory.
1950's
1953: Friesland Sheep imported from Holland
1958: Kodel introduced into the UK
1964: The Cambridge sheep developed
1960s:
The high performance British Milk Sheep were developed and improved through the 1960's and 70's.
1970's
Texel sheep introduced into the UK
LLe de France introduced
1976: Charollais imported from France
1978: Bleu Du Maine introduced to the UK
1980's:
Beltex sheep imported to Britain
1989: British Rouge introduced in the UK
2017
Current state of UK Wool Industry
Sheep population 33,989,000
UK production of clean raw wool: 21,672 tonnes
Wool currently only represents 1.5% of world virgin fibre production
(Source IWTO wool stats 2015)
1840
1860
1880
1900
1920
1940
1960
1980
2000
2022
Time
Woollen vests (as under-garments became a trend for both men and women.)
Matthew Townsend (A knitter from Leicester) patented the latch needle. This significantly simplified the knitting process.
The first automatic wool scouring machine was made by John Petrie, Jnr in 1853
1870's
Steam power was applied to textiles machinery
From 1880 Chamber dryers were used to dry wool after scouring.
1904: Courthalds bought the British rights to viscose processing. They became the most successful rayon manufacturer in the word.
1930's
Rex Whinfield developed a technique to successfully spin polyester.
Thus it became feasible to use as a textile fibre.
1934: Nelon Developed rayon spinning.
Nylon first sold to the British public in 1938
1941: the 1st Nylon spinning factory opened in Britain
1920's
Hydrogen peroxide was introduced and became the main bleach treatment for both natural and synthetic fibres.
Amino resin finishing was developedin the early 1920s'; leading to crease resistant fabrics.
1950:
The British wool marketing board is established
1950's
Improved ring spinning frame introduced to the market.
Acrilian plants began to open in the UK. (N.I 1958)
Durable mechanical finishing introduced to the market.
This enabled fabrics & colours used to be washing fast.
Procion was introduced to the market by ICI.
This was the first range of fibre reactive dyes.
By 1961 60% of the world's man-made fibre production was staple fibres, many of which were developed to mimic or enhance wools properties.
Second generation man-made fibres began to be developed in the 1970's.
First Lyrca fibre produced by DuPont in 1958
Spandex went into production between 1960 and 1961
1970's
The development of computerised jacquard And intarsia patterns
1990's
Whole garment technology developed
Technological advances in the Knitwear Industry
References
All information relating to the introduction of sheep to the United Kingdom was taken from the latest information on the British Wool Marketing Board website: http://www.britishwool.org.uk/british-sheep-breeds
The rest of the information on the timeline is collated from a number of texts:
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Cook, J. G. (2009). Handbook of textile fibres. Vol.2, Man-made fibres (2009 reprint of 5th edition. ed.). Cambridge: Woodhead Publishing Ltd.
Handbook of Yarn Production: Technology, science and Economics (2003). (P. Lord, R Ed.): Woodhead Publishing: Elsevier Science
Jenkins, J. G. (1972). The wool textile industry in Great Britain: Routledge and K. Pa
Price, R. (2010). Man made magic : when science meets fashion. London: London : MX Pub.

1.2 Background to the Study

The research evolved from the researcher’s own background in fashion and textile design. After studying knitted textiles at university, she spent a decade working as a knitwear designer in the fashion industry, predominantly working with fast fashion companies that produced garments in China, Bangladesh, and the UK. In particular, the company specialised in producing close-to-season knitted products within UK knitwear factories. These companies often worked with up-to-date whole garment technology, but to produce garments at very keen prices, the retailers demanded compromises were made in many areas. One area was the materials utilised to create the garments. 2/28Nm high bulk acrylics were regularly imported from Turkey and China. This yarn is fine and must be plied up to between five and six ends to create the count necessary for a standard gauge garment. However, it was common for the retailer to ask for ends to be removed to reduce costs. Many retailers and knitwear companies use this acrylic yarn, a fibre with limited sustainable benefits. Acrylic is a manufactured fibre developed during World War two. The fibre forming substance is a long chain of synthetic polymers consisting of at least 85% acrylonitrile. The fibre is petroleum-based and is thought to be up to 30 percent more energy intensive in production than polyester and uses more water (Fletcher, 2014, p. 18; Cook, 1984, pp. 393,399). Once created, this fibre is very strong, so it does not breakdown or biodegrade easily. It is often found as part of a blend, making the fibre types harder to separate.

Thus, the researcher began to think about ways to improve the yarns used in local production for the British high street and everyday fashion. The concept of the doctoral research evolved as the researcher discovered that British wool is often being destroyed rather than utilised due to a lack of demand (Mahy, 2020). These practices are happening in close proximity to the same knitwear factories producing these close-to-season garments. The researcher began to consider whether it would be possible to utilise some of this wool for garment production rather than continuously importing a similar acrylic alternative.

1.3 Research Approach

One problem associated with utilising British wool is its perceived ‘coarse and itchy’ handle. The researcher’s own experience as a knitwear designer was that she could design and sample a garment in a range of different materials, but if the company fit model, usually a young (18ish-year-old) woman thought that the garment felt ‘itchy’ when they were wearing it during the fitting process, the garment would not proceed into production, or the yarns would be changed back to an acrylic blend. Thus, for British wool to be an attractive option to young consumers, the researcher believed the tactility of these fibres must be considered and, if possible improved for commercial use.

To better understand the tactility of these fibres, a generative, practice-based approach was taken to the research project. This approach intended to produce a collection of experimental knitted artefacts through the process of ‘thinking through making’ (Ingold, 2013). It was anticipated that the creation of this collection would explore the possibilities that a number of breed-specific broad wool fibres offer for commercial use when they are combined. Specifically, the project examined whether weft knitted textile design could improve the handle of these fibres when they were combined in different patterns and structures. This approach has been referred to as ‘blending through pattern’ throughout the thesis.

Blending through Pattern was determined as the method for the project, rather than blending fibres through spinning, because it utilised the researchers own skills and knowledge as a knitwear practitioner and because it offers flexibility and creativity because fibres are combined when the material is created rather than during the processing stages, Therefore, multiple yarn types can be added or removed in a single sample or over a series of samples, allowing for an enhanced comparison of handle combinations across different pattern structures. It also allows more people to ‘blend’ a yarn as any maker can do it. The method arose from experimentation during the early stages of the research project. The project set out to spin a new yarn blend, but as the spinning facilities available to the researcher were limited, she began exploring blending through knitting on the knitting machine. While doing this, she discovered the possibility of using pattern to combine different yarn types, thus, she began to explore this approach more methodically.

Tactile language has been investigated in order to understand whether it is an appropriate method of describing textiles and whether this language can be utilised to disseminate the tactility of the fabrics created to a broader audience.

The fabric collection was created in ecru to encourage those viewing the fabric collection to consider its tactility before its aesthetics. The thesis will go on to demonstrate that it is challenging to do this.

1.4 Aims and Objectives

1.4.1 Research Aims

The doctoral research aims to encourage knitwear practitioners to use British sheep's wool within their creative design process. This will occur through practice-based research and experimentation in knitted textile design. The research study aims:

1. To inform knitwear designers of the most desirable wool blends, patterns and pattern structure combinations created from the yarns selected for the project.
2. To enable textile design practitioners to make informed decisions regarding their yarn choices before designing and developing appropriate feeling sustainable garments.
3. To develop a method of combining yarns effectively so fibre types can be further utilised for commercial fashion.
4. To explore the language utilised to describe wool and softness.

1.4.2 Research Objectives

1. Develop a comprehensive library of knitted swatches in a variety of different wool blends, patterns, and structures demonstrating each wool type's properties and potential.

2. Through the creation of the swatch library, develop a body of knowledge which communicates and informs creative design decisions for knitwear practitioners

3. To understand consumer perceptions around 'softness' and appropriate language used to describe such qualities, conduct a series of semi-structured interviews with young fashion consumers

1.5 Contribution to Knowledge

1.5.1 Utilising Blending Through Pattern as a Method for Improving a Fibre's Tactility.

The project has been approached as a design project aimed at textile designers; thus, it differs from many research projects assessing material tactility. It intends to combine technical knitwear, design sensibilities and problem-solving to create a collection of fabrics. The proposed swatch library differs from a typical swatch pack, handed out to designers to promote the yarns, trends and patterns of a single company or spinning mill.

These swatches hold no commercial bias and intend to become a comprehensive collection of knitted swatches in multiple yarn types and combinations, demonstrating a new method for combining yarn types in order to improve tactility. Blending fibres is a term most commonly associated with the fibre processing stage rather than a process that occurs after the fibres have been manufactured. During this project, the term blending refers to the approach of using weft-knitted textiles as a method for combining two, three or more yarn types together through pattern and structure on the knitting machine to improve each of the fibres tactility. Although this study focuses on wool, it is anticipated that if it is revealed that using pattern to blend fibre types is successful, these methods could be replicated for other fibre types or fibre combinations in order to improve the overall handle of many different materials. Improving the tactility of existing fibres is significant, as it increases the value of these fibres, which may be underutilised, overlooked, or even destroyed, while newer, softer, or more comfortable materials are produced, some of which have few sustainable credentials.

1.5.2 A Guide for Knitwear Practitioners

The swatch library intends to be utilised as a guide to enable knitwear designers and practitioners to better understand British sheep's wool as an affordable, sustainable yarn that can be used for fashion fabrics. It aims to provide valuable information which when edited and presented to its audience, should guide designers into making informed decisions regarding their material choices before they design garments through showcasing a series of 'soft' handling' woollen artefacts knitted in a variety of yarn combinations and pattern structures.

The swatch library, in its complete state, means to be broad, as it explores as many pattern variations as possible to discover the best yarn combinations and pattern types. For this information to be useful to knitwear designers, the collection will require editing and additional information to be displayed with each swatch. A different iteration of fabrics would need to be shown to each viewer. This way, the collection becomes useful to those working in commercial industry who are often time-poor and would benefit from being presented with an edited selection of yarn combinations. The outcomes of the study can be shared with the broader knitwear community and thus could inform the strategic direction of the wool industry. Knitwear practitioners can then understand and use the knitting methods undertaken in the research within their own work in the future.

1.5.3 Disseminate Knowledge

The thesis articulates the knowledge accumulated through practice-based research regarding which methods for blending are most and least effective. The thesis proposes to interpret the tactility of the sample collection through its use of language, which will develop and evolve as the practice progresses.

1.6 The Thesis

The thesis will go on to discover the possibilities seven of British wools. Chapter 2 will explore the literature intended to give context to the study. It explores four separate areas that intertwine as the practice evolves. The chapter begins by providing a concise overview of some general technical terminology and processes associated with fibres and knitting to give context to the knitting methods analysed in the later chapters. Chapter 2.2 examines wool as fibre and why British wools are appropriate to work with. Those yarns chosen for the practice will be analysed in further detail in Chapter 4. There is a shift in focus during Chapter 2.3, which concentrates on tactility, sensory perceptions, and language to understand why wool is often overlooked as fibre for fashion fabrics and substantiates why the methodological approaches utilised throughout the study are appropriate. Chapter 2.4 returns to knitting to demonstrate why the craft of knitting is suitable for future fashion fabrics.

Chapter 3 unpacks the study's methodological approach and explains how research through design can combine with the phenomenology of language through practice. The methods are then recorded. The methods and practice undertaken are detailed, analysed, and interpreted throughout Chapters 5, 6 and 7. A series of interviews were undertaken during the practice; the findings and how these outcomes affect the study have been recorded in Chapter 6. Chapters 7 and 8 detail the outcomes through a series of conclusions. Throughout the thesis, imagery of the fabrics created is visually represented.

Figure 1:3 Close-up detail of a two-yarn, 4x4x2 hand-manipulated tuck pattern structure.

2 Literature Review

Figure 2:1 Close-up of sample 374; a 4x1 rib-look float jacquard with ladder structure.

2.1 Technical Overview

The section provides a concise overview of some general technical terminology and processes associated with fibres and knitting to give context to the knitting methods analysed in the later chapters.

2.1.1 Yarn

There are many fibre types, but the thesis will focus on wool fibres, a textile fibre found on a sheep's fleece, therefore, wool is an animal fibre. The fibre is an external, multicellular structure made up primarily of a protein known as keratin. It grows from the skin, and its primary function is to protect the sheep from the elements and predators. (Robson & Ekarius, 2011, p. 1). Wool fibres are known as staple fibres. A staple fibre is a unit of matter characterised by flexibility and fineness; fibres have a small cross-sectional area and a length which significantly exceeds the width. For wool, this is between 2000:1 and 5000. Wool staple fibres vary in length from between 50 - 200 mm (Wynne, 1997; Spencer, 2001, p. 1).

Wool staple fibres are turned into yarn through the process of spinning. They are either worsted or woollen spun:

- **Woollen spun fibres**[2] are not combed; they contain a mix of long and short staple fibres, which often vary in length and diameter (Woolmark.com, 2023). Woollen fibres can combine various grades of wool, non-virgin wool fibres and other fibre types. The fibres are blended together after the scouring and cleaning process (Mahar, et al., 2013). Overall, there are fewer processes to create a woollen spun fibre than a worsted spun fibre. Woollen spun fibres tend to be of a chunkier count and are loosely twisted during spinning. Woollen spun fibres are most commonly used to create knitting yarns for knitwear. A fabric made of woollen spun fibres is usually wet-finished to remove any grease or impurities still in the fibre.
- **Worsted spun fibres** are generally finer, smoother, and firmer and created utilising the longest wool fibres. The fibres are dried and scoured before carding. The fibre mass is opened, teased, and cleaned; the fibres are aligned so they lie together in the direction of the yarn. Worsted yarns are flatter, lighter and smoother and are used to create tailoring fabrics, twills and delicate woven materials (Cook, 2001, pp. 94-95; Taylor, 2004, p. 342; Brearley, 1965; Brearley, 1964; Woolmark.com, 2023).

[2] Woollen spun, refers to a method of spinning staple fibres, whereas mention of woollen fibres throughout the thesis is referring to a type of fibre made of wool.

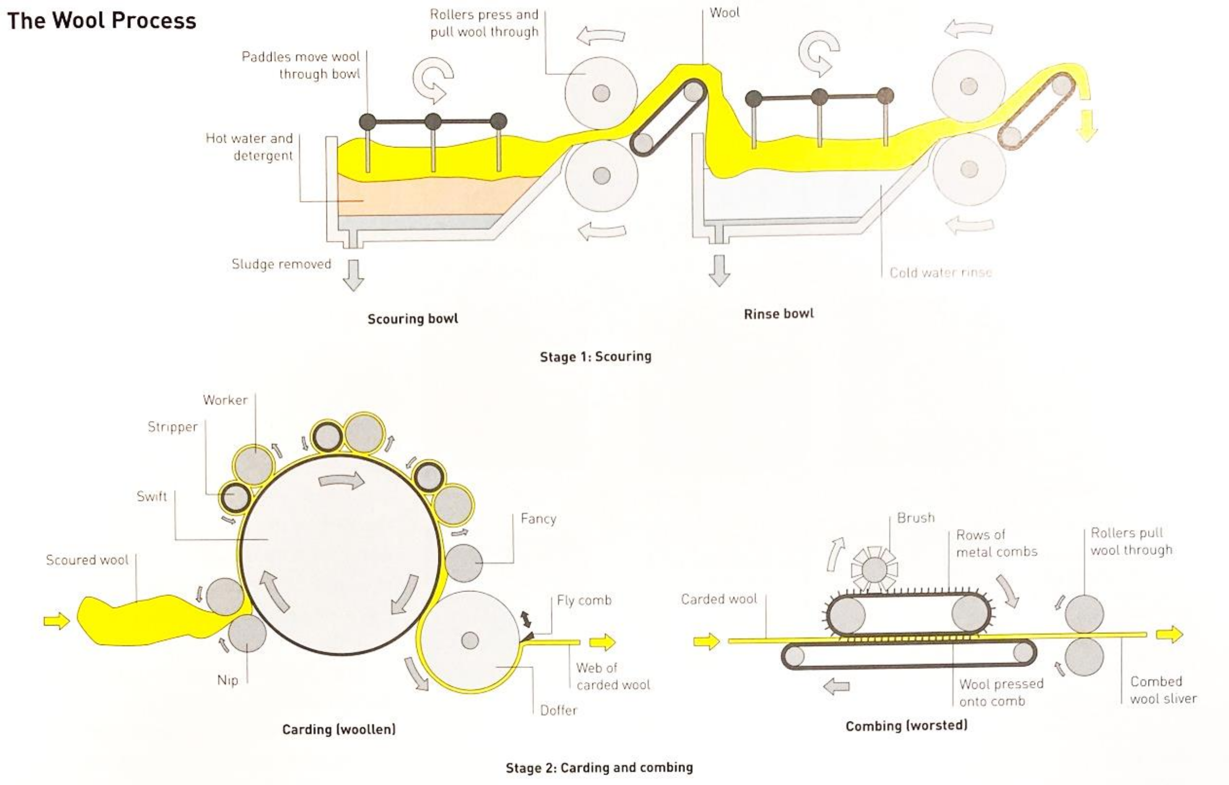


Figure 2:2: Wool Processing. Images taken from Manufacturing Processes for Textile and Fashion Design Professionals (Thompson, 2014, p. 23)

This research project focuses on woollen spun fibres. There are two main types of spinning machines for spinning woollen fibres together: ring spinning and rotary spinning; ring spinning accounts for around 85% of the staple wool market, but rotary spinning is preferred for coarser ‘Broad wool’ types, which is the focus of the practice (Brearley, 1965, pp. 84-85; Wynne, 1997).

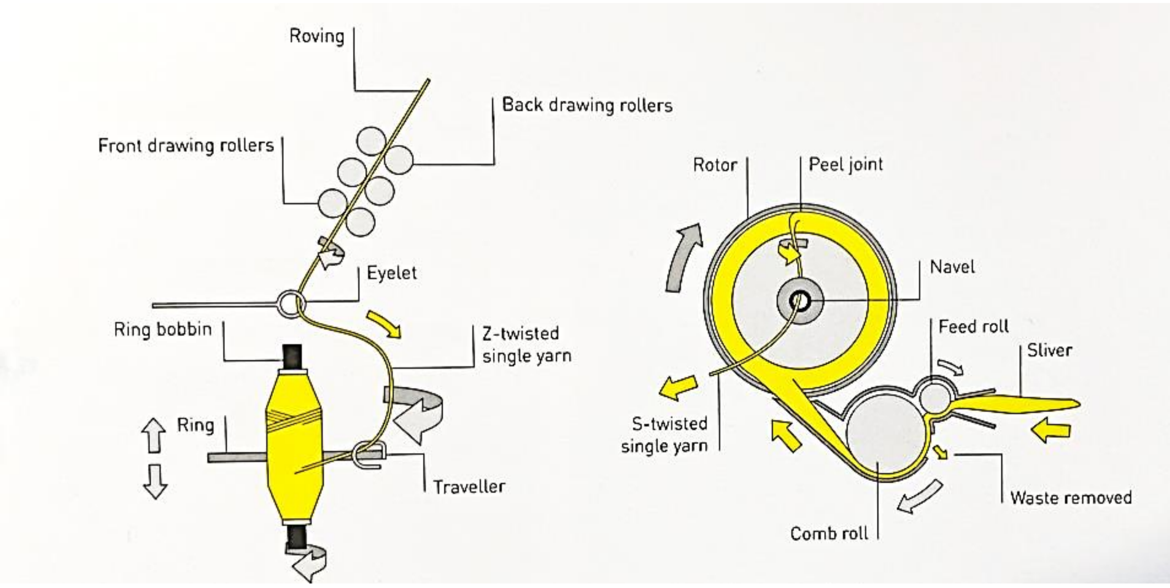


Figure 2:3 The left hand image demonstrates how yarn is spun using the ring-spinning process. The right-hand image demonstrates how yarn is spun using rotary spinning (otherwise known as open-end spinning). Images taken from Manufacturing Processes for Textile and Fashion Design Professionals (Thompson, 2014, p. 57).

During the spinning process, fibres can be twisted in two directions: clockwise, twisting from left to right is known as a Z twist, whilst spinning in an anti-clockwise direction creates an S twist (Brearley, 1965, p. 83). The S twist is more common in woollen spun fibres for knitwear (Diamond, 2019). Twist draws the fibres together and affects the strength and elasticity of the yarn. Long fibres require less twist to hold them together, and thicker yarns require less twist than finer ones. Once the fibre transforms into a yarn through twist (spinning), it lies in a helical path and is subject to both bending (flexing) and twisting (torsion) when in use. The handle and drape of fabrics depend on the bending of the yarn (Wynne, 1997). If a small amount of twist is imposed, the thread is soft and full handling; if a significant amount of twist is inserted, the yarn becomes very compact. In general, worsted spun weaving yarns are spun much tighter than woollen spun knitting yarns (Brearley, 1965, p. 82; Cook, 2001, p. 96).

Fibres are spun to produce a single thread (ply of yarn). To thicken the yarn, two or more single threads are twisted together. This is known as plied yarn. Two single threads twisted together are known as two-ply yarn, and four create a four-ply yarn, etc. Depending on the single thread count, a yarn with four threads can be the same thickness as 2ply yarn (Miller, 1992). The yarn's thickness is also known as the grist of the yarn, the thickness is calculated from how much fibre a yarn contains and how tightly the yarn has been spun. The yarn count indicates the fineness (diameter) of the yarn. Many count systems exist, but the New Metric system (Nm) is the most common. This refers to the number of 1000 metre hanks that weigh 1000g (1kg) (Spencer, 2001, p. 5). The higher the second number is, the finer the yarn (Diamond, 2019, p. 119). The fibre's rigidity refers to its resistance to twisting, defined as the turning force required to put a unit twist between the ends of the fibre and its unit length (Wynne, 1997).

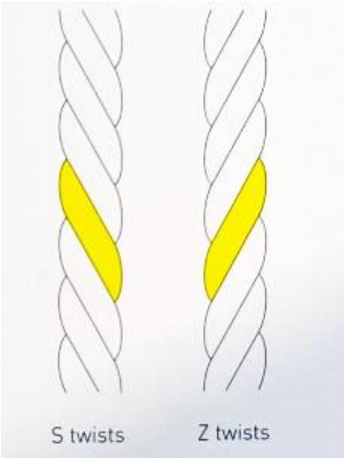
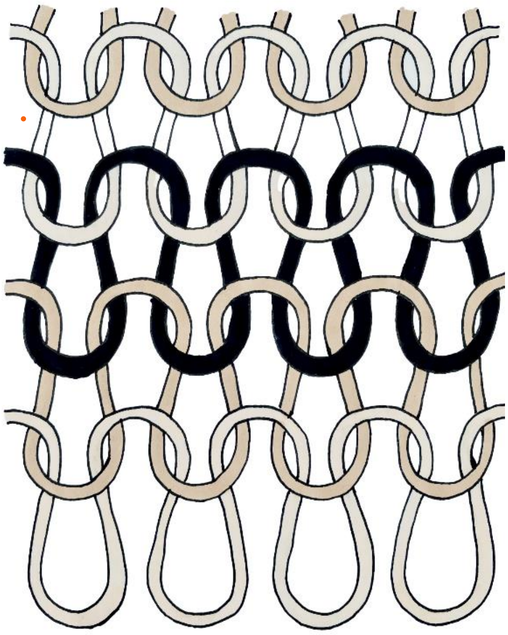


Figure 2:4 The difference between S-twisted and Z-twisted fibres. The image was taken from Manufacturing Processes for Textile and Fashion Design Professionals (Thompson, 2014, p. 57).

2.1.2 Knitting and Structure

Textile structure describes the spatial relationship between segments or pieces of fibre or yarns (Ngo, et al., 2021). There are three types of textile structures known as interweaving, intertwining, and interlooping (Emery, 2009; Spencer, 2001). Interweaving describes woven fabrics, Intertwining describes materials made of knotting and braiding techniques to create a textile surface, and interlooping consists of fabrics formed by a series of loops, i.e., knitted fabrics.

Knitting combines creativity and technical knowledge; understanding the technical advantages and constraints of the knitting machine is necessary to design creatively (Twigger Holroyd & Hill, 2019, p. 10). Knitting is a repetitive process, knitting is iterative, and knitting follows a set course along a line (Von Busch, 2013). There are two types of knitted structures: weft-knitted structures and warp-knitted structures. This thesis focuses on weft-knitted structures, the process of creating fabric through a series of interlooping loops from a single continuous strand of yarn. Each new course of loops is drawn through the previous course of loops in the fabric. The horizontal series of loops becomes a row, known as a course. Each course links with the course below and above to form a line of vertical loops, known as a wale and are perpendicular to the courses. The fabric will unravel if one stitch is cut. Courses and wales are measured in units per centimetre (Taylor, 2004, p. 97; Wynne, 1997, p. 137).



A

B

Figure 2:5 Image A demonstrates four courses of knitted loops interlinking to form the reverse of a plain knit fabric, as seen in image B.

A needle loop is an upright noose formed in the hook of a single needle on the knitting machine. The loop interlocks with the loop formed on the previous needle. The yarn passes from the foot of one loop into the foot and leg of the next loop. A knitted stitch is formed when three or more intertwined loops link together. Stitch length refers to the length of the total needle loop. Generally, the larger the stitch length, the more extensible and lighter the fabric and the poorer the cover, opacity, and bursting strength. Stitch density is the number of loops in a measured area of fabric, e.g., within 3cm squared. It is calculated by counting the number of courses in 3cm and the number of wales in 3cm, then multiplying the number of courses by the number of wales. This calculation is used to determine the quality of the fabric in a knitted, relaxed state (Spencer, 2001, p. 17).

Several factors influence the size of a needle loop. The first is the machine tension setting selected, as every machine offers some variation between tensions, i.e., how large or small the stitch length is. The tension of a knitted fabric refers to a specific number of courses or wales which can be counted in a given area (Black, 1987). Another is the amount of takedown weight added to the fabric, as the yarn is knitting. The loops can distort easily under tension. More take down weight, stretches the stitches, creating longer loops. Some knit structures require more weight than others. Once the fabric is off the machine, it needs time to return to shape once the take-down weight is removed.

There are four primary weft knitted structures: plain or knit structure, rib, interlock, and purl structure. This PhD will focus on patterns produced within a plain structure. Plain knitting, otherwise known as single jersey, single-bed, single-faced or stockinette structures, are produced by weft knitting, every stitch loop is configured the same way. Single-faced fabrics are the equivalent of single-bed fabrics, i.e., they are knitted on one needle bed. The front (or face of the knit) loops are all arranged in columns of V's. On the back of the knit (known as the purl side or the reverse), the loops form interconnecting semi-circles (Hurley, 2019, p. 147), see Figure 2.5. Several types of knitting machines produce single-faced fabrics, including industrial hand flats and domestic knitting machines. The study will utilise a Brother KH-836 domestic knitting machine, as this machine enables the efficiency of machine knitting combined with the flexibility of the hand process. The machine allows for creativity and spontaneity when working with hand-manipulated patterns. The yarns which perform best on this knitting machine range from 2/6Nm to 2/15Nm count yarns (Uppingham Yarns, 2013). Other knitted structures include double-faced, equivalent to double bed knitting and using two needle beds. Rib structure is an example of this type of weft knit.

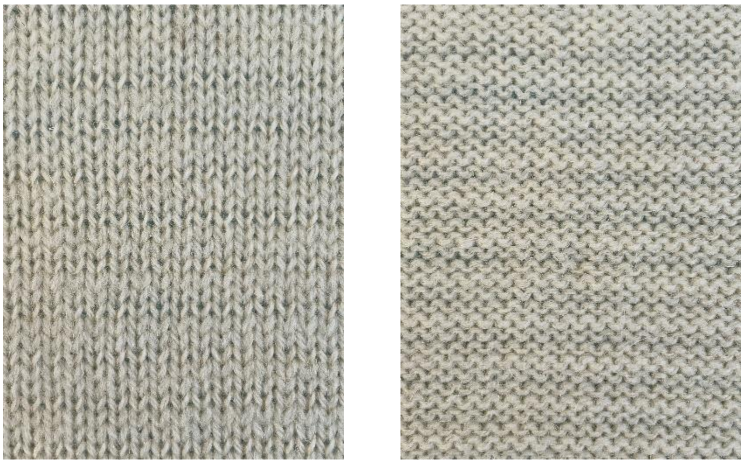


Figure 2:6 The technical face (front) and the technical back (reverse) of a single-faced weft-knitted fabric.

There are many advantages of single-faced fabrics. They are particularly appropriate for commercial fabrics as they are more economical to produce in terms of yarn usage compared to double-bed fabrics. The fabric's characteristics may also be preferable as the material is relatively light and less prone to stretching than rib fabrics, and the structure is more straightforward to knit to shape (Hurley, 2019, pp. 149-150).

Textures created in weft-knitted fabrics are diverse and varied. Still, the majority are constructed from a combination of three knitted formations: plain knit, miss, or float patterns and tuck patterns. Tuck and float stitch patterns are produced using a held loop or loops. This is clearer on the reverse side of the fabric (Hurley, 2019, p. 147; Spencer, 2001).

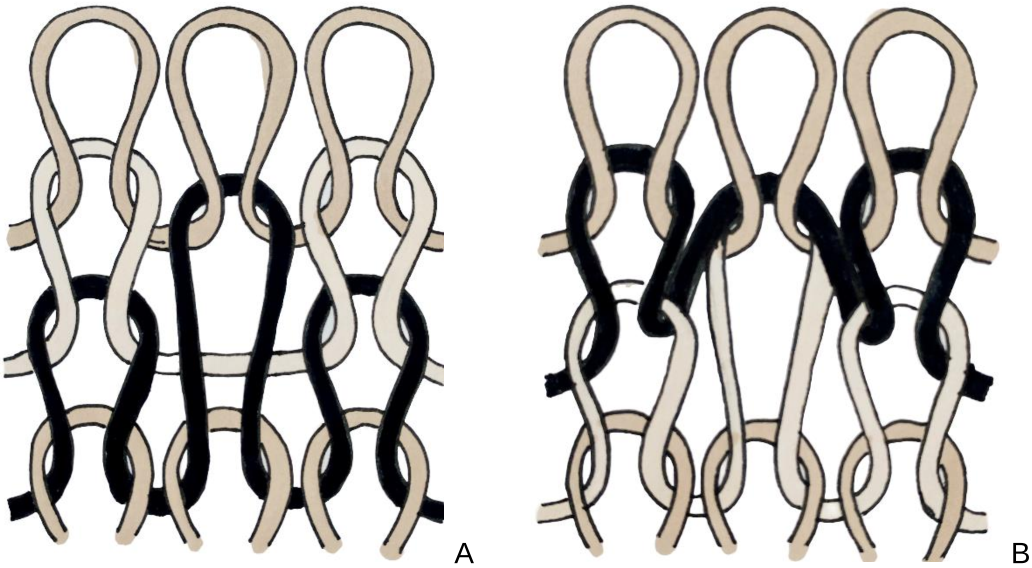


Figure 2:7 Image A) A float or miss stitch pattern. Image B) A tuck stitch pattern

A missed or float pattern is formed when the yarn misses a needle. (Figure 2.4 A)Thus, the needle still holds the previous loop and, instead of forming a knitted loop, creates a float on the reverse of the fabric. Float pattern fabrics tend to be narrower than plain knit structures without floats because the wales are drawn closer together by the floats; this reduces width-wise elasticity but improves fabric stability. These fabrics produce clear pattern definitions. A tuck is formed when the loop is picked up by the needle and held alongside the loop of the previous course. The loops are not intertwined (Spencer, 2001), and no loop is formed on the selected needles in this course. (Figure 2.4 B)

To finish a piece of knit and to stop it from unravelling, the knit needs to be finished with a neat edge; this process is known as binding off (Udale, 2008, p. 72).

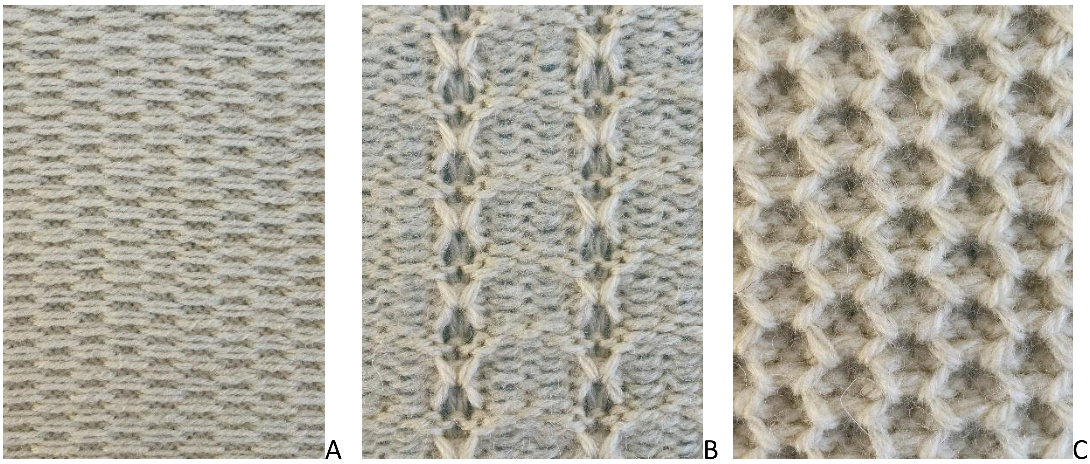


Figure 2:8 Image A demonstrates the reverse of float patterned fabric. The floats are drawing the wales together. Image B, the reverse of a hand-manipulated tuck pattern, demonstrates the loop being picked up. Image C, the reverse of a tuck jacquard, demonstrates many picked-up tucks.

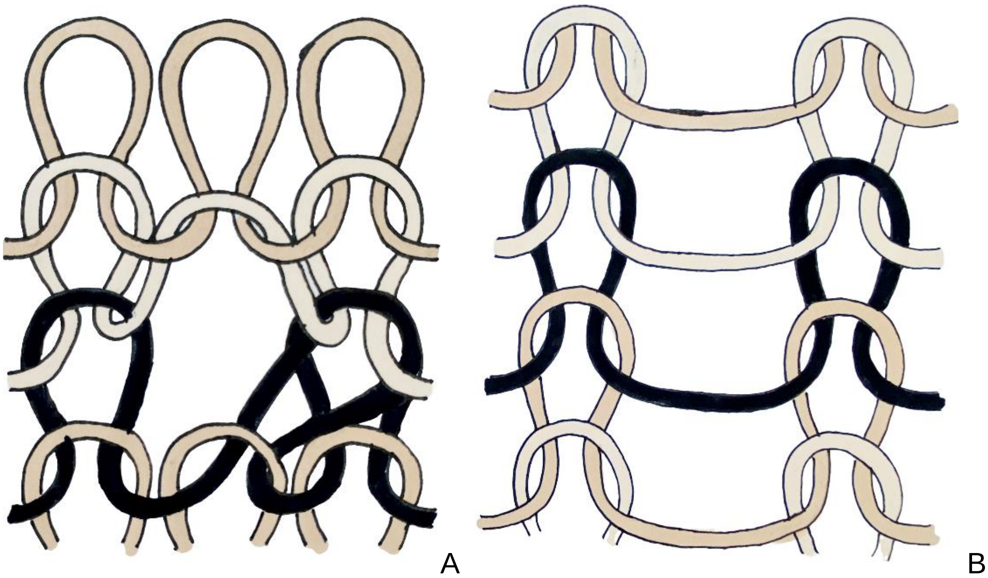


Figure 2:9 Two other stitch formations used within the practice. Image A visualises a pointelle transfer stitch. Image B demonstrates a ladder stitch.

2.1.3 Blending

Blending wool yarns most commonly refers to a process undertaken before the yarn is spun in raw fibre form. The most common reason for blending is to combine the properties of different fibres to create a new fibre. Other reasons for blending fibres include:

- To achieve a particular end use or properties unattainable from a single-fibre
- To improve processability and spinning performance
- To produce aesthetic effects
- To improve the texture or handle of a fibre
- For economic benefits (Wynne, 1997, p. 5)

Blending can occur at various stages of yarn processing using multiple techniques, from fibre production to fabric formation. For example, fibres can be blended together during yarn production, during the twisting process; this is known as folding the yarns or during knitting by combining two or more yarns together within the feeders on the machines (Wynne, 1997, p. 75).

The type of blending that will occur during this practice is none of the above. During the thesis, the term blending refers to the method of utilising weft-knitted pattern structures to blend two, three or more yarn types together; thus, each yarn type will be knitted through a single feeder. The blending occurs in the same way in which different colours are combined through pattern on the machine. The practitioner will change the yarn types manually to create the blended fabric. The patterns and pattern formations utilised to blend the yarns will be discussed in Chapter 3.5.1.3

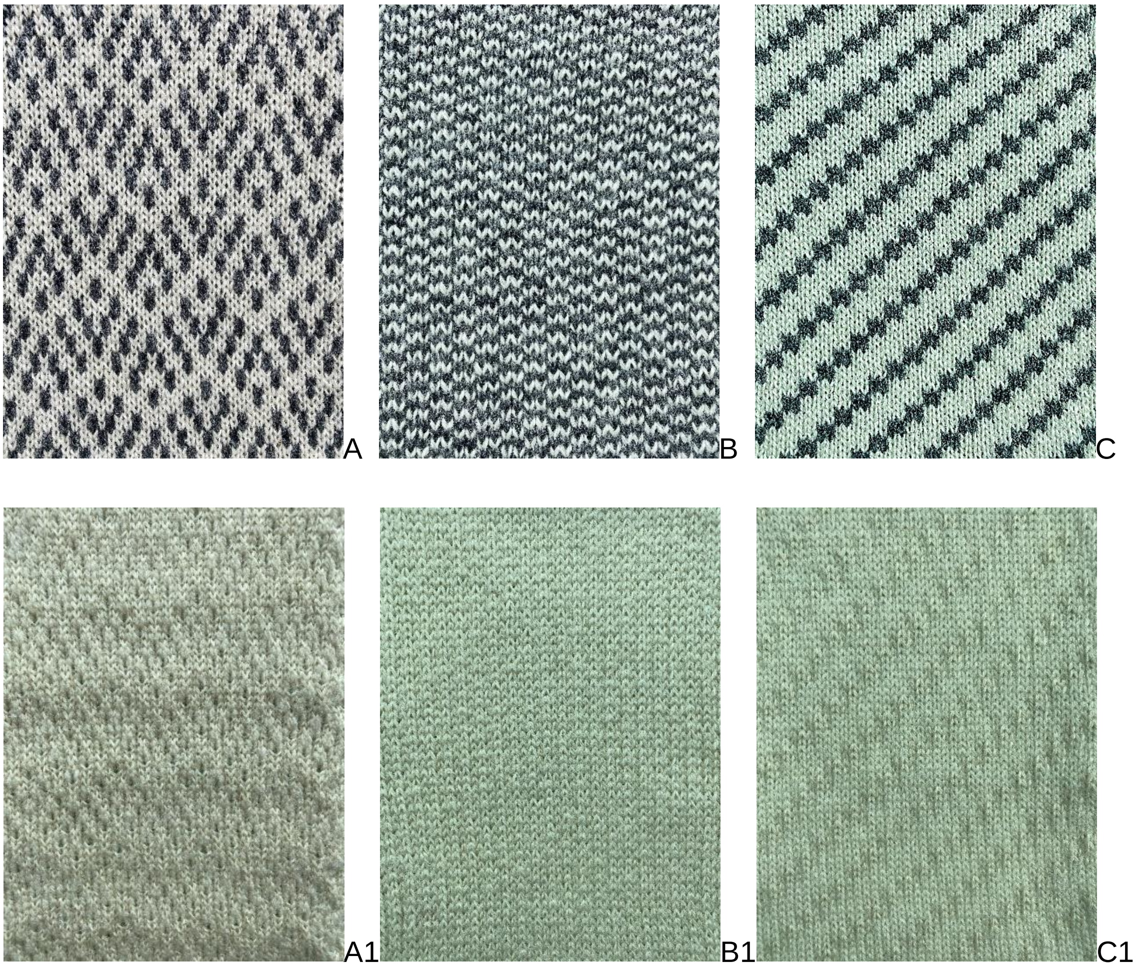


Figure 2:10 Examples of two different yarn types blended together by three single-faced float jacquard pattern. Patterns A, B, and C are in colour and patterns A1, B1 and C1 are the same structures in ecru blends. The images highlight the blending approach. Colour is eliminated, but structure is maintained.

2.2 Wool

Figure 2:11 A pencil study of a Blue-Face Leicester sheep (BFL).

2.2.1 Wool's Properties

Wool is a keratin-based animal fibre obtained from the soft, crimpy hairs that form a sheep's coat, known as fleece (Taylor, 2004, p. 30). Overlapping scales characterise the surface of the wool; the scale pattern depends on the variety and fineness of the wool (Taylor, 2004, p. 44). Wool accounts for 1.1% of the global fibre market (ITWO, 2020). Global wool fibre production was around one million tonnes in 2020, the lowest in fifty years, with wool production for apparel most affected. Broad wool used in interior textiles remained steady (IWTO, 2021). Wool is not the most commonly utilised material in the textile industry but is still vital to many international economies, which is why it should still be considered for use in the future within a portfolio of fibres (Fletcher, 2014, pp. 43-44).

Crimp is commonly used when describing wool fibres; crimp refers to the natural kinks, waves, and bends within each fibre. Crimp is part of the growth process and enables the fibre to hold together when twisted into a yarn (Robson & Ekarius, 2011, p. 24; Cook, 2001, p. 102). The waviness of the fibres enables wool to have an unusual amount of elasticity. Elasticity refers to the amount an individual fibre can stretch without breaking and return to its original length (Wynne, 1997). Wool has a high extension break of 25-35%, combined with a high elastic recovery (99% at 2% and 63% at 20% extension) achieved from its crimpy fibres, giving wool unique resilient properties (Cook, 2001, p. 104).

2.2.2 Types of Wool

Several factors influence the characteristics and properties of the sheep's fleece and the wool it produces; these include the sheep's diet, environment, age, and season of shearing (Allafi, 2022; Fogg, 2010). Wool's quality can also be determined by the part of the body from which the wool fibres originate. Areas such as the shoulder or back generally produce better quality fibres than the fibre from smaller surface areas, such as the tail or the legs of the sheep (Gale, 1971).

It is estimated that there are 1400 breeds of sheep across the world (Robson & Ekarius, 2011, p. 4), the wool that comes from these sheep can be divided into three main types:

- **Fine Wools (Merino or Botany Wool)**
  This is considered the highest grade of wool; the sheep are bred for their wool (Miller, 1992, p. 27). Merino wool is the best-known type of fine wool. Merino fibres have staples of between five and 12.5cm and fibre diameter between 11.5 and 25 microns, with most ranging between 20 -22 microns (Robson & Ekarius, 2011, p. 140). Merino sheep have large quantities of dense, fine wool with regular crimp patterns around 72 wool follicles per square mm (Robson & Ekarius, 2011, p. 135). Merino is the dominant yarn in the wool market; its market share is almost 40% of all wool produced worldwide: around 384,336 tonnes (IWTO, 2022). The wool is usually worsted spun, which means the fibres are fine and smooth. These sheep are not suited to the UK because they rely on warmer environments. Although these sheep originated in Spain, today, the majority of these sheep are located in Australia and New Zealand (Textile Exchange, 2022; Woolmark, 2022).

- **Medium (Crossbred Wools)**
  This covers an extensive range of sheep breeds worldwide, from stronger merino wools to British wools crossed with merinos or fine-grade British wools such as BFL or Southdown sheep. These cross-bred sheep have been developed for wool and meat (Miller, 1992, p. 28). In the UK, medium sheep such as the BFL have a diameter of between 24-28 microns, but this can vary widely between breeds. The

Southdown has a fibre diameter of 27-31 microns (Robson & Ekarius, 2011, p. 70). Staple lengths vary between 6 -15cm (Taylor, 2004, p. 30).

- **Broad Wools (Carpet Wools**)
  Many British sheep fall into this category; the staples of broad wools are more protracted, measuring between 15 - 40 cm in length (Taylor, 2004, p. 30). The yarn is strong and resilient but often lacks the softness required for knitwear. Broad wools are utilised for products such as carpets because of the wool's strength and durability (Woolmark, 2022). These fibres are more likely to contain kemp hairs: coarse, hollow fibres which are brittle and scratchy. They have less elasticity and do not take dye easily (Robson & Ekarius, 2011, p. 25).

Although the UK only has a handful of Merino sheep, it has one of the world's most diverse populations of sheep breeds, with over 60 different breeds recorded. This diversity allows for British wools to have many end uses; these can be viewed in Appendix 1.

Medium	Beltex	prodominently carpets	Soft/ Medium	White/ Creamy	5-12cm	31-34
	Bleu du Maine	In blends for clothing	Medium/ Soft	White/ Creamy	7-13cm	32-34.5
	Border Milksheep	Blended into kniting yarns which require natrual elasticity	Medium/ Soft	White	10-15cm	32.5-35
	British Milksheep	in Knitting Yarn blends	Medium/ Soft	White/ Creamy	8-14cm	32 - 34.5
	Cambridge	Blended for apparel and Hand knitting yarns	Soft/ Medium	White/ Creamy	6-12cm	32-33.5cm
	Devon Closewool	Carpet blends	Crisp/ Soft	White	10 -15cm	34-35
	Friesland	knitwear & cloth blends	Medium/ Soft	White/ Creamy	10 -15cm	33-34.5
	Halfbred -Scotch	Carpets, knitwear, tweed cloths	Medium	White/ Creamy	8-15cm	32.5 - 35
	Halfbred -Welsh	Carpet blends	Medium	White/ Creamy	8-14cm	32.5 - 35
	Llanwennog	Blends for hand-knitting, knitwear and Tweed cloth	Soft/ Medium	Creamy/ White	6-10cm	31.5-34
	Lleyn	Carpet blends	Soft/ Crisp	White	6-12cm	31-34
	Romney (Kent Romney)	Knitwear, blankets, Carpets	Soft/ Sheen	White/ Creamy	10-17cm	31.5-34
	Texel	Knitwear and Woven cloth prodominently carpets	Soft/ Medium	Creamy/ White	7-14cm	31 - 34.5
Cross	Masham	Blended with other lustrous wools for specialist yarns. Carpets	Soft/ Demi -Lustre	White/ Creamy	12 - 25cm	33.5-35
	Mule - North of England	Carpets	Medium/ soft	White/ Creamy	10 -20cm	30-32.5
	Mule - Scotch	Carpets	Medium	White/ Creamy	10-22cm	30.5 -33
	Mule - Welsh	Carpets	Soft/ Medium	White/ Creamy	10-18cm	29-32
	Scottish Greyface	Carpets	Medium	White/ Creamy	12-24cm	31-33
Lustre	**Blue-faced Leicester**	Knitwear, hand-knitting & fine woven cloths	Lustrous & Silky	Creamy/ White	8-15cm	26-26.5
	Cotswold	Carpet blends, Soft furnishings, Craft kniting	Smooth & Lustrou	Creamy/ White	15-25cm	35-38
	Devon & Cornwall longw	Carpets	Medium/ Demi- Lu	Creamy/ White	20-25cm	40-42
	Greyface Dartmoor	Carpets	Medium/ Demi- Lu	Creamy/ White	15-20cm	40-42
	Leicester Longwool	Hand Spinners	Smooth & Lustrou	Creamy/ White	20-25cm	35-38
	Lincoln Longwool	Carpets	Lustrous	Creamy/ White	15-30cm	35-38
	Teeswater	blended for knitting wools	Silky and Lustrous	White/ Creamy	15-30cm	32.5-34
	Wensleydale	Hand knitting and Upholstery yarns	Silky and Lustrous	White/ Creamy	15-30cm	32.5-34
	Whiteface Dartmoor	Carpets	medium/ lustre	Creamy/ White	15-20cm	38-42

Table 2-1: A small section of Appendix 1

UK sheep breeds can be further divided into six smaller subgroups of fibre types:

- Fine wool
- Lustre wool

- Medium wool [3]
- Crossbreeds
- Hill Sheep
- Mountain Sheep

The fine wool breeds and many of the Lustre yarns are considered soft enough to be medium wools; the medium, crossbreeds, hill and mountain sheep are all considered broad wools. Knitting wools spanning both these categories are generally woollen spun yarns, which are the fibres this research project will focus on. The analysis and selection of each breed-specific fibre are detailed in Chapter 4.

2.2.3 The Benefits of Using Wool

Benefits of wool fibres	Drawbacks associated with wool
Versatile Warm Resilient Hard wearing Insulating (used as housing insulation) Flame resistant (good for interiors and clothing) Breathable Anti- Allergen (good for bedding and babies) Easy care: washed by hand or at a low temperature Easy Care: no tumble drying or ironing required Long lasting: (good LCA credentials) Biodegradable and compostable Renewable Recyclable Low energy usage Many immaterial qualities Ties with Localism Traceability	Sheep farming's environmental impact Mulesing Energy used to clean fleece of grease & impurities Local production costs/ general costs Often requires dry cleaning Attracts moths Peoples perceptions of wool People knowledge of wool as a material The tactility of local coarse wools means they are not always appropriate for fashion fabrics

Table 2-2: The benefits and drawbacks associated with wool fibres.

Wool has many properties suited for apparel (Das, et al., 2017). Wool is naturally designed for warmth because thousands of tiny air pockets are trapped between the crimpy fibres to keep the sheep warm even in cold climates (Miller, 1992, p. 28). Therefore, wool is an ideal fibre for warmth and insulation; throughout history, wool has been used to keep people warm; in the far north of Scotland, Shetland wool is used to create beautiful fair-isle jumpers or up and down the coast of the British Isles, fishing

[3] Note: This is a different category from the Medium (Crossbred Wools) category above. This is a rating of wool type, which refers to British wools only, used by British Wool when categorising the handle of UK sheep fleece.

communities wear the thick, warm, and resilient fisherman's ganseys in a variety of patterns (Pearson, 2015). Wool fibres react to changes in temperature and thus are breathable, keeping the wearer cool if it is hot; they are also a good choice when exercising because the hairs protruding from each fibre are naturally moisture-wicking (The Woolmark Company, 2022). Wool absorbs moisture slowly, reducing the amount of sweat next to the skin. The odour is naturally locked into the wool, meaning fewer body odours are emitted when exercising (Wingate, 1984). As wool absorbs moisture slowly, liquids can be sponged off the fabric if the garment is washed.

Wool is washed at a lower temperature than fabrics such as cotton. Otherwise, the wool may shrink; it is also advised not to tumble dry wool products; wool products are usually lined dried. Woollen knitwear does not need ironing, partly due to the fabric's natural stretch, but ironing also flattens the fibre loops. These factors reduce wool's environmental impact across its lifecycle (Laitala, et al., 2018). Additionally, when washed, wool does not produce micro fibres, which many synthetic fibres, such as acrylic, do. The hairs washed away, albeit still pollutants, will biodegrade naturally in the water system over time.

2.2.4 Wool's Environmental Impact

A significant drawback associated with wool is sheep farming's environmental impact. Thus, it is essential to understand this before considering utilising wool during the study. Overall, the energy used to produce wool is low compared to its synthetic counterparts, such as acrylic, which relies on non-renewable fossil fuels for production. Typically, wool production requires almost three times less energy than polyester and four to five times less energy than nylon or acrylic because woollen fibres go through fewer processes to transform the fleece into yarn (Fletcher, 2014, p. 15).

Although the energy used to produce wool is less than that used to produce acrylic or polyester, there is plenty of room for improvement when processing the fibres. A significant amount of water and chemicals are used to clean the fleece of impurities before the carding and spinning processes begin. Raw wool contains many impurities; wool is both dirty and greasy and is the only fibre to require wet cleaning before spinning (Fletcher, 2014, p. 15). The fleece weight is reduced significantly during this cleaning stage as grease is removed, which explains why British Wool sells wool in its greasy and non-greasy states.

Another environmental drawback associated with sheep are the methane emissions they produce. Researching at the University of Leeds, Dr Henry Greathead has found that reducing the amount of protein in an animal feed is one way to reduce each sheep's methane emissions. Thus, by making each sheep more efficient in processing their food, overall methane emissions from livestock decrease (Why Wool Matters, 2022).[4]

On the other hand, a benefit of wool is the speed at which it biodegrades; in ideal conditions, wool can fully degrade in around six months (Swan, 2022). While degrading wool releases sulphur, nitrogen, phosphorous and potassium, which are absorbed into the soil; thus, the wool fibres become a natural fertiliser (Zheljazkov, 2005).

The complexities of the environment, farming and textile outputs are intertwined, and every fibre type has its own ecological footprint (Cline, 2012). There are undoubtedly several environmental barriers to using wool; thus, if wool and sheep are still relevant in the future, they must be in conjunction with the environment and local communities.

Michael Ryder, a sheep expert, writing from a biologist's viewpoint, analyses the relationship sheep have had with humans and the environment over time. He and others agree that sheep are valuable livestock because they produce wool for clothing and mutton for food (Harte, 1973, p. 326). Ryder considered how sheep became domesticated and how sheep, particularly their wool, have changed and evolved. He demonstrates that one reason for domesticating sheep was for the wool and the manufacture of textiles. He believes the importance of wool as a product for clothing, bedding and shelter is still relevant. Sheep are more suitable than cattle for the future as their environmental impact is lower. They can be bred in more diverse locations, utilising a regenerative approach. They have the added benefit of providing wool (Ryder, 2007, p. 782). He questions whether a fibre that man has relied on for so many millennia is obsolete in the 21st century (Ryder, 2007).

Figure 2:12: Blue-faced Leicester sheep in a UK field: Image from (Hunt, 2014)

[4]Relevant section begins at 10mins 46 into video.

2.3 Tactility and Sensory Narratives

This section of the thesis explores softness and how it impacts the tactility of a fibre.

2.3.1 Consumer Perceptions and the Handle of Wool Fibres

"What is a textile? Textiles are warm; they are soft to touch; they are completely flexible and thus take up any desired shape without resistance; and they are usually hard-wearing" (Cook, 2001, p. pg.xv).

Fibres as a single thread are usually described technically so the observer can understand their properties, such as flexibility, fineness, and length-to-width ratio (Spencer, 2001, p. 1). However, once a fibre evolves into a piece of fabric through either knitting or weaving, the fibre take on a new form as a piece of textiles. Textiles evoke many responses; they can be highly emotional for both the maker and the owner, particularly once in the form of a garment. Thus, textiles often evoke descriptive language and emotional responses from those interacting with them (Dolan & Holloway, 2016). For example, today, if a person is considering buying a garment, they rarely assess the quality solely on its functional attributes, such as durability (Ahirwar & Behera, 2022), but instead evaluate the aesthetics and tactility of the garment through sensory and emotional responses. These will vary from person to person, many of whom will not be aware that they are making such assessments (De Klerk & Lubbe, 2008).

Research suggests that consumers of everyday fashion garments would prefer a woollen fabric that is soft and comfortable and that consumers often do not choose woollen clothes because they are perceived as itchy, prickly, or uncomfortable. Softness, comfort, and aesthetics are all significant factors in a consumer's purchasing decisions (Sneddon, et al., 2012; Park & Stoel, 2005; Mikucioniene, et al., 2017). The Australian Wool Innovation (AWI) (2023) has funded extensive research on the perception of wool's tactility. The research group headed by Dr Bruce McGregor, a Senior Researcher at Deakin University, discovered that over 50% of consumers saw the prickle or itch sensation associated with wool as its biggest drawback. The team have found that wool's so-called prickly feeling is caused by "mechanical stimulation of pain receptor nerve endings caused by protruding fibre ends applying a force to the skin" (McGregor, et al., 2015; Naebe, et al., 2018; McGregor, et al., 2015; Mcgregor & Naebe, 2013). To objectively assess the number of prickles, the research group developed the Wool Comfort Meter (WCM) and the Wool Handle Meter (WHM). "The WCM works by using a recording head to scan across the surface of a wool fabric specimen and registering the signals triggered by fibres protruding from the fabric surface that exceed a threshold in bending stiffness. The higher the WCM value, the higher the prickle rating" (Wang, 2013; Naebe, et al., 2018).

"The WHM utilises a ring test whereby a circular fabric sample is pushed through a circular orifice, and simultaneously the push-out force corresponding force-displacement curve is recorded" (Sun, et al., 2018). Both are objective meters for measuring wool comfort and were put into practice during different wearer trials used to assess how the wearer responds to several different knitted garments. The trials discovered that wool does not make the skin itch, instead, it feels prickly to touch. The garments assessed were bought from mainstream department stores, consisted of casual, active, and underwear, and were predominantly fine-gauge knits, all with a wool content of over 85%. In further trials, the Australian research group discovered that much could be achieved in the processing and finishing stages to improve the hand-feel of fine gauge knitted jersey garments. However, these processes are not usually applied to chunky woollen knitwear, and many processes are only temporary (McGregor, et al., 2015). Some experiments have occurred in 'coarse wools', but these were not successful as the surface of the wool was damaged, and many chemical treatments were utilised (Motaghi, et al., 2014). Further research demonstrates that there are links between mean fibre diameter and softness, which is why Merino wools are considered softer (Yu, et al., 2022). Thus, further research is required on garments created in coarse wools.

One finishing technique that can temporarily improve the handle of wool is steam and steaming the fabric. This is because increasing the water content of wool fibres reduces the rigidity of the fibres because the wool swells radially as it absorbs water. If more water is regained, it is easier for the fabric to bend and twist (Naebe, et al., 2013). As the wool dries, it will eventually lose this water through the air.

Apart from steam, none of these processes are applied to improve the comfort of chunky knitwear. Thus, the researcher intends to discover whether structural changes rather than processing techniques can improve the handle of the fabrics. Instead of adding further processes or finishes, which in turn add additional environmental impacts to each garment, the researcher proposes to improve the fabric handle through the making process. Understanding the outcomes of trials undertaken in Australia are relevant to the project as the research was conducted to raise the profile of wool as a wearable fibre and would lead the consumer to ask more questions about the materials they purchase. The trials concluded that the vast majority of garments would produce a prickle sensation if worn next to skin and that rib garments had a higher WCM value than single-faced fabrics (Naebe, et al., 2018).

The literature above observes the significance consumers give to perceived softness and comfort when considering purchasing a garment and that many consumers associate wool as the opposite of soft; it is perceived as rough and uncomfortable. Hence, extensive research was undertaken by the Australian research group to understand wool's handle. Hebrok et al. (2016) agreed that consumers' perception of wool is often negative, but they and Sneddon, et al. (2012) believe that attributes connected to use, performance, value, physical appearance, style and past experience also influence customer experience of wool garments (Hebrok & Klepp, 2014). Thus, Hebrok et al. (2016) explored the average person's 'knowledge' of wool. The study revealed that the participants understood wool to be 'traditional' rather than 'trendy, described wool as itchy and expressed a low tolerance to wearing wool close to the skin. The general perception of wool was that it was uncomfortable and inappropriate for next-to-skin wear.

The research by Hebrok et al. (2016) also revealed that consumers often have many preconceived ideas about fabrics they like and dislike; these associations could include memories of previous garments they have worn, comments from family and friends and past experiences of garments, whether positive or negative or through nostalgia. These are all subjective, emotional responses or perceptions of a fabric. For example, the person may have previously worn garments made of wool and experienced a prickly sensation. Therefore, they consider that all wool garments will evoke the same uncomfortable sensation. In contrast, someone with positive memories of the same garment, may not associate wool garments with prickliness or discomfort, so they are more open to wearing such a garment (Doyle, et al., 2014). Thus, it can be ascertained that sense is influenced by more than physical properties; people's perceptions influence sense, which explains why wool feels different to different people in particular situations. The same wool garment has the potential to conjure negative connotations with one person while being worn regularly by another. Hebrok & Klepp (2014) concluded that the use, attitudes, and perceptions of woollen garments differed between the British and Norwegian informants.

The reason why fibres such as wool are perceived as itchy is explained by David Katz and Merleau-Ponty, two seminal philosophers in the fields of sense, touch, language, and perception; they believe that when a surface is touched or handled, a tactile memory is created. Consequently, the person develops a sense of what that surface feels like and will expect that sense when handling that material in the future. Touch can be considered objective (touching a sharp object) and subjective (describing a fabric as itchy). Usually, touch is orientated to the objective, but in the case of pain, or in this case, prickliness or itchiness, the subjective sense predominates. Thus, this preconceived sense is triggered when the person comes into contact with the material again (Moran, 2015, p. 228).

Another reason wool can be perceived negatively is the lack of knowledge consumers possess of wool as a raw material and where the fibre originated. Research demonstrates that living far from farmland and wool production indicates people have lost many associations they may have previously associated with wool fabrics (Hebrok, et al., 2016; Sneddon, et al., 2012). Hebrok et al. (2016) discovered that although the British respondents were aware that sheep were bred in the United Kingdom, none of the respondents could name an indigenous sheep breed, nor did they believe their clothing contained British-wool or was made in the UK. This research validates the rationale of this doctoral study because it demonstrates that further research and awareness of where materials originate from is necessary if consumers are to invest in locally produced products and engage within their communities.

Overall, the literature observes that consumers do not assess fabrics technically when choosing a material; instead, a complex collection of emotive and sensory responses are employed. Therefore, the fabrics created during the project should not only be assessed for their technical and physical attributes, but the sensory reactions to the materials should be considered. For this reason, the literature considers the language utilised to describe touch. The language uncovered, along with ‘the sense of hand’, is used to phenomenologically investigate the tactile properties of the fabrics created. An edited collection of fabrics was presented to an outside audience for review to understand how these participants responded to the fabrics through touch. Language is one method of determining this response. The research seeks to ascertain whether softness can be assessed through touch alone.

2.3.2 Softness Created by Knitted Structures

The softness of a piece of fabric is directly affected by the fabric’s properties, including the characteristics of the yarn which has created the fabric and its structural and surface properties (Kilic & Okur, 2019). Several research studies have been undertaken with knitted cotton structures to determine the relationship between hand, structure, and density. In both chunky cotton 2/20Nm’s knitwear and very fine circular cotton knitwear (between 20-25 Tex), the denser surfaces have a smoother surface, but the fabrics are very rigid and not necessarily softer. As wale density increases, fabrics lose suppleness and elasticity (Jeguirim, et al., 2010), but the fabric’s resilience increases (Iftikhar, et al., 2021). It was discovered that single-faced fabrics have less elasticity than double-faced fabrics, and open structures are less resilient because they move more. The studies demonstrated that softness decreased when the cover factor increased, but smoothness increased with the cover factor.[5]

Research into chunky cotton knitwear revealed that the ‘tuck and miss stitches, such as tuck and half-cardigan, were the softest. The half cardigan ‘was the fullest and softest and the sample with the loosest density’ (Choi & Ashdown, 2000). The examples above demonstrate that denser knits are smoother, i.e., a fine plain knit is smoother than a chunky gauge tuck pattern, but even though the fabric is smoother, that does not always necessitate that the fabric has a softer handle. The above research all focused on investigating cotton fibres, which are less hairy than the wool fibres proposed during this practice and, therefore, will naturally create a smoother fabric when knitted. However, these results are positive as they demonstrate that pattern has the ability to create soft fabrics, and just because a fabric looks smooth, it does not necessitate it to be soft.

Research undertaken by Wiskott, et al. (2018) in a number of different pattern structures in a 50% new wool merino/ 50% polyacrylic worsted blend yarn, discovered similar findings. Wiskott, et al. (2018) examined many different knitted pattern structures to discover if the handle is influenced by pattern type and found that pattern type could significantly affect the fabric’s handle. The pattern structures which created volume or were dominated by knit stitches were more popular when assessed by the participants evaluating the softness of each of the fabrics. Hence, the research team assessed these patterns as the softest. Again, it was the double-faced cardigan rib structures which were considered the softest. The least popular patterns were the purl-knitted structures. Wiskott et al. (2018) ascertained that thickness, warmth, and weight were all considered in every popular fabric (These are the fabrics that were ranked highly by the participants.)

Tuck stitches are known to create bulky fabrics with lots of stretch, so in theory, these fabrics should be softer than a single-faced stripe fabric. The practice intends to determine whether tucks created in wool fibres are the softest handling pattern structures or whether different pattern structures create softer handling fabrics. Wiskott, et al. (2018) noticed that lightweight fabrics with long floats were well received because the floats allowed the fabrics to relax, creating a soft, smooth surface. Fabrics with floats will be another pattern type experimented with during the study.

Even in cotton fibres, Jeguirim, et al. (2010) discovered that fabric hairiness and softness decrease with increasing density because the loops are less spaced and more compressed. Kilic & Okur (2019) noticed that hairiness affects 85% of fabric-to-fabric and fabric-to-skin assessments, which is an influential factor in fabric handle and sensorial

[5] Cover factor refers to the density of stitches within a given measurement. For example, one inch. The more stitches the higher the cover factor.

comfort properties. Xue, et al. (2017) also recorded surface ‘fuzziness’ influences surface handle. The wool fibres used during the project will be much hairier and fuzzier than the cotton fibres employed in the research above. Thus, it will be interesting to discover whether the practice uncovers the same outcomes. Staple crimp and loose twist contribute to wool’s hairiness, but theoretically, they also reduce stiffness (Liu, et al., 2004). Overall, the research studies suggest that pointelle knitting and fabrics which are not dense should, in theory, be softer than those fabrics with a high pattern and stitch density.

2.3.3 Fabric Handle or Aesthetics

This research intends to consider the tactile properties of the fabric, but often the consumer looking to purchase a garment does not only consider tactility. Instead, the quality of a garment may be judged by its aesthetic appeal first, then its handle, comfort, and many other properties (Jevsnik, et al., 2014). It is a challenging concept for a designer to create an artefact without considering the aesthetics of the design, as aesthetics is usually fundamental to the final design solution. Archer (1968) recognised this problem in his research into design methods. Archer agreed that a product’s aesthetic is essential to a design project. However, objectively assessing an artefact's aesthetics is difficult because perception is subjective (Boyd Davis & Gristwood, 2016).

Sibley (1959) acknowledges that some degree of aesthetic sensitivity is required, and it would be difficult to undertake this project without considering aesthetics, as the knitted pattern structures need to be designed and created. Thus, the fabric's aesthetics will be considered throughout the project. This is particularly significant as the intended end use of these fabrics is garments. Philosophers such as Katz, Merleau-Ponty and Valery believe that the senses are intertwined; hence when the observer perceives an object, they use both senses. Valery determines that tactility is the primary way for the body to affect the mind (Rosenberg, 2020; Valery, 1973, pp. 718-719). When one touches an object, their understanding and image of it grows. Thus, aesthetics is, to a certain extent, intertwined with tactility. However, in this project, the researcher intends to consider the tactility of the sample first and the aesthetics second. Fabrics will be regarded first in terms of softness; then, the researcher will use their professional judgement to refine the patterns, so they are applicable for commercial use. This is because if a fabric does not look appealing, it is unlikely that a consumer will consider buying it.

2.3.4 Sensory Language: The sense of ‘Hand.’

‘Handle is a comprehensive term representing the physical, psychological and social response to the touch of a fabric’ (Yim & Kan, 2018, p. 467). ‘Fabric hand’ refers to the sense of touch and responses which arise when fabrics are touched, squeezed, rubbed, or handled (Jevsnik, et al., 2014). Fabric ‘hand’ is the subjective perception one acquires by feeling fabric to interpret its properties, and fabric handle reflects an individual’s perception (Husserl, 1997, p. 47). Touch and movement combine to create a physiological sensation, a subjective evaluation of a fabric (Sun, et al., 2019). Therefore, fabric handle is an interaction between objective and subjective consciousness.

When the fabric is handled “the sensations produced involve two vital psychological extents these are knowns as qualitative and quantitative perceptions. The qualitative is related to the sensation or particular sensory quality perceived, like softness, smoothness, etc. And the quantitative is related to the intensity of the perceived sensation like very soft, very rough, etc.” (Ahirwar & Behera, 2022). Both factors play a valuable role in subjectively assessing a fabric through the sense of touch, but the qualitative perceptions are usually perceived as the most important sensations (Iftikhar, et al., 2021).

There are many different systems for conducting subjective and objective fabric handle evaluations. The most well-known objective system for evaluating fabric handle is the KES-F system which Kawabata developed in the 1970s. It tests six mechanical characteristics, including tensile strength, shear, bending, compression, surface properties and construction (Jimba, et al., 2020; Carrera-Gallissa, et al., 2016; Sztandera, et al., 2013). The other well-known system is the Fabric Assurance by Simple Testing (FAST) system designed by the Commonwealth Scientific and Industrial Research Organisation. This tests four basic mechanical properties and the dimensional stability of fabrics to predict fabric formability (Sun, et al., 2019). However, these systems are not always applicable to every fibre type and are typically used to assess woven fabrics as there are a number of problems when applying these two systems directly to knitted fabrics in addition to high costs (Wang, et al., 2013). Thus, many other methods have been developed and researched, such as the ‘Wool Comfort Meter’ as previously discussed, created by Naebe & McGregor (2013), designed to objectively test the comfort of woollen materials.

Throughout the literature review, the researcher has referenced many of these systems and the terminology and processes used to assess knitted fabric structures. However, she has assimilated these texts from a designer’s viewpoint, who finds them inaccessible even with a technical knowledge of knitwear. The texts are scientific and evaluate materials based solely on their physical and technical properties. Thus, the researcher began to consider different methods of assessing and interpreting the tactile data of each fabric and methods of disseminating the information so that those who make and/ or purchase commercial knitwear could more easily understand and relate to the outcomes. She believes a gap exists between fashion and textile designers and scientific materials research. Thus, rather than assess the samples objectively based on their physical attributes, such as their mean fibre diameter or there bending and stability properties, she considered a number of the other subjective and emotional perceptions of fabrics considered in Chapter 2.3.1. She believed the sense of hand discussed in Chapter 2.3.4 was one way to assess fabric tactility, but to do this, it was necessary to establish how to communicate what she and others were feeling when they touch and perceived the fabrics. Even Kawabata acknowledged that “textiles as clothing material must fit the human body and the human senses” (Kawabata & Niwa, 1991).

One hundred years ago, Henry Binns, a researcher at the Textile Institute, acknowledged the importance of the sensory properties of wool and that buyers who were not technically trained bought styles based on style, colour, design, and handle. He noted that when buyers chose wool fabrics, they used touch to interpret the fabric’s quality and utilised words such as pliable, supple, soft, kind, lofty, or firm to describe the fabrics properties that they were looking for (Binns, 1926). Thus, the focus of assessing the fabrics created during the doctoral research process will be a mix of the ‘sense of hand’ and a phenomenological evaluation of the language utilised to describe the knitted fabrics.

The researcher believed it was possible to utilise language as one of the components of understanding the fabric’s tactility, but before making and reflecting on the samples, she needed to ascertain what the most appropriate ‘meaningful’ language was in order to interpret the samples accurately. The doctoral research aimed to improve the ‘handle’ of seven British-wool yarns through knitted textile methods. Thus, throughout the research project, it has referred to words such as ‘handle’ or ‘softness,’ but are these words the most appropriate when discussing fabric tactility? Do such words evoke an authentic response from those who are not textile specialists experiencing the fabrics? The interview process was used to establish this.

2.3.5 Language Analysis

The researcher began by exploring a broad selection of journal articles which discussed and articulated knitted fabrics and, where possible, woollen knitted fabrics' sensory properties. The journals were selected because they were relevant to the study, either in describing wool's properties or in describing how fabrics are objectively assessed. The majority of these articles have been referenced throughout the study. The journals were re-read and evaluated to determine how those from a design background would respond to the language within them and whether it was accessible. The researcher's starting point was *"A review of fabric tactile properties and their subjective assessment for next-to-skin knitted fabrics"* (Mahar, et al., 2013). This research paper is particularly relevant to the study as the research utilised language to assess different woollen fabric types. Xue, et al. (2017) call this type of language sensory descriptors.

Mahar, et al. (2013) compiled a list of sensory descriptors by both textiles experts and the participants experiencing the fabrics and recorded the variety and frequency of the terms. The extensive list of language collated from this article inspired the sensory descriptors used to portray the sensorial properties of the fabrics created throughout this thesis. The research outcome was a list of seven pairs of relative adjectives that different companies could use to describe fabrics, and a grade of hard/ softness exists within each descriptor.

- Rough/ Smooth
- Hairy/ Clean
- Hard/ Soft
- Warm–Cool
- Heavy/ Light
- Tight/ Loose
- Dry/ Greasy

The article concludes how difficult it is to objectively review fabrics, as sensory properties are always interpreted by an individual's perceptions.

In total, twelve journal articles were reviewed and analysed specifically for the language and narratives within them. Information interpreting methods of assessing woollen fabrics for softness were examined first. Then the researcher re-read each article and recorded every sensory and descriptive word. This information can be found in full in Appendix 3.

Many articles that use language to describe fabric properties have referred to the language used within the KESF and FAST systems, This technical language, such as compressibility, bending properties, tensile properties, stability, fabric shear and surface friction, was not recorded, as the researcher believed this language is too technical and not accessible. Instead, the researcher searched for language which describes the fabric subjectively and reveals the emotional response of those handling the fabric. This language is to understand emotive responses to the fabrics. A comprehensive directory of adjectives appropriate for describing wool fabrics was collated.

The two most common words written within the twelve articles were soft/ softness and thick/ thickness. Both words were included in nine of the articles. Other common words included: rough/ roughness, smooth/ smoothness, stiffness, warm, and lightweight. Through reading the papers, the researcher concluded that these words are universally accepted within academia as sensory descriptors of fabric properties but are also assessable to a broader population. The word handle appears in half of the articles because several refer to methods and fabric properties rather than fabric tactility.

Appendix 3 contains the complete list of words gathered from each journal article and the frequency of each term. The language collated has been used to fabricate the narrative throughout the thesis. They were also provided to the interviewees as a word bubble. This offered an opportunity to compare the fabric descriptors with the participant’s language.

The words in the word bubble were separated into positive and negative groups in order to encourage the interviewees to read, digest and choose words when describing the samples during the interview process, which was only a set period of time, in which they may have felt pressured to answer quickly. It was felt that one long list of words was too dense, and difficult to locate the right word. Thus, positive, and negative were used as umbrellas to separate word groups and also so it was possible to gauge an overall sense of the sample. I.e., whether the overall perception of the sample was positive or negative. In hindsight, some of the words deemed negatively could be used positively and vice versa. (This is discussed in the conclusions in chapter 7.4.) However, this bubble was developed relatively early within the practice, (at the end of Phase 2, when the samples knitted were being analysed) and this is the form in which it was presented to the interviewees. Chapter 6.3 goes onto explain how much easier the interviewees found describing the samples once the word bubble was presented to them, so the format was successful.

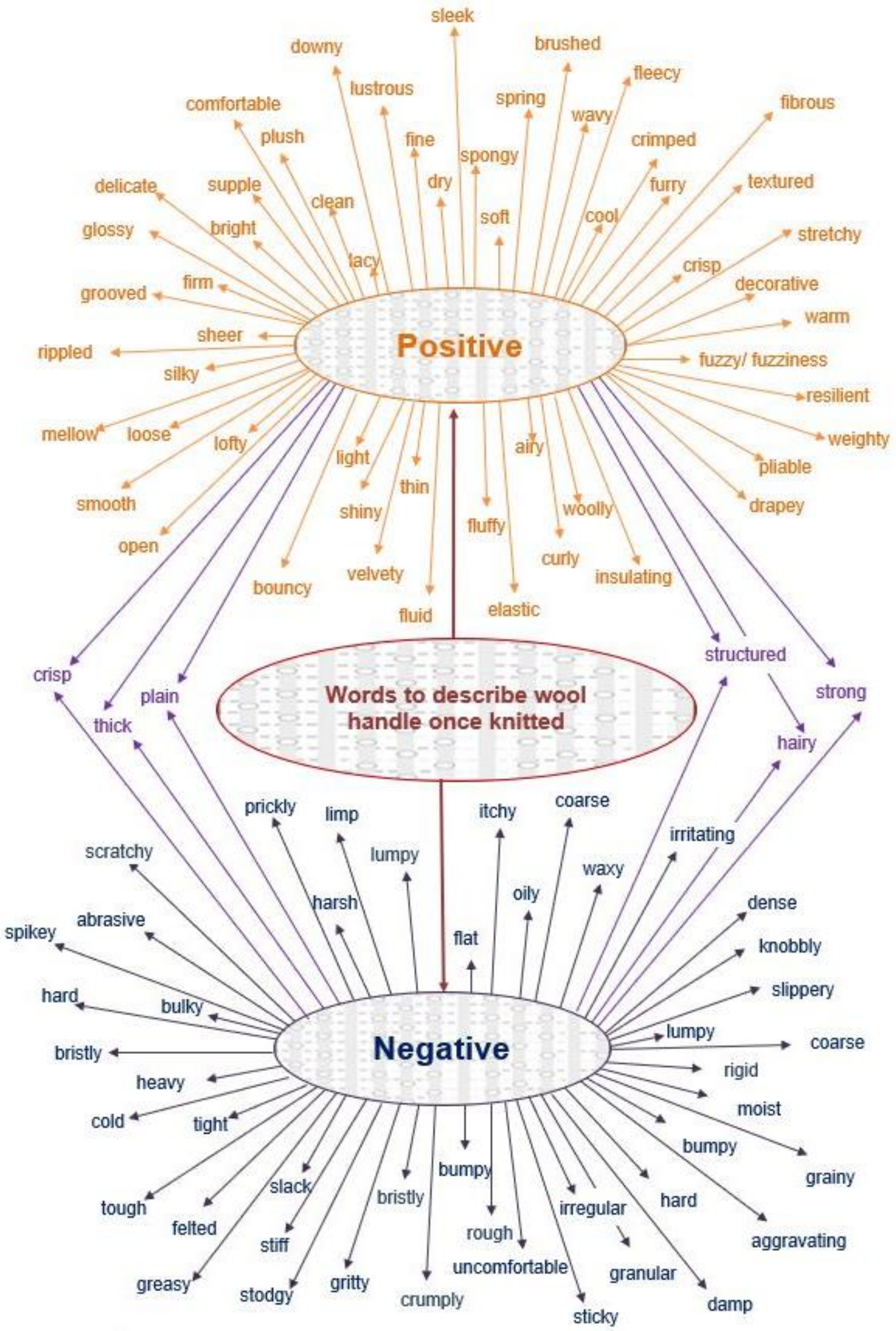


Figure 2:13: The fabric descriptors collated from the journal article review. This is the word bubble provided to the interview participants.

2.4 Knitting, Craft and Sustainability

Knitted fabrics have many end uses, but the most common is garments. Knitted fabrics lend themselves to clothing because they are naturally very extensible, conform easily to the shape of the figure and drape gently. This allows the garment to move with the wearer when worn (Taylor, 2004, p. 100). Knitted fabrics have different properties to woven fabrics, meaning that knitted fabrics often have different end uses than woven fabrics, such as next-to-skin wear (Mahar, et al., 2013). Knit's natural ability to stretch and move with the person wearing it enables the garment to suit a broader range of people. Garment fit and suitability are essential to ensure the garment is worn repeatedly and for an extended period.

Due to knitted fabrics' association with garments, throughout history, the patterns which form the fabric have been manipulated by the knitter to create different decorative surface patterns and textures. The number and type of different patterns are vast. Some patterns are better suited to hand knitting and others to machine knitting. Again, some machines are more appropriate for specific patterns than others (Pearson, 2015)**.**

2.4.1 The Advantages of Knitted Garments for Sustainability

The consumer has been led to believe that garments have a finite lifetime and should be replaced every season (Lynch & Strauss, 2007, p. 134; Pesendorfer, 1995). In reality, there is no need for this; knitwear lends itself to slow fashion rather than being trend-driven; knitwear design is an area for outstanding creativity and garments made from single or double-faced knitted structures will always have their place in fashion (Fogg, 2010, p. 200). However, a beautifully crafted fair-isle sweater in a Shetland wool blend is timeless and will transcend the cycles of seasonal trends (Pearson, 2015, p. 180). Likewise, a traditional wool or cashmere Pringle twinset may not be trend driven but is timeless and should last a lifetime (Barty-King, 2006, pp. 101-114). Traditional knitted shapes have not changed vastly over the last 100 years. Much of the creativity in a knitted sweater is derived from the patterns and colours explored within the knitted structure. In countries like the UK, where winters are cold, knitwear is worn daily for warmth. Thus, to make a knitted garment that will last and can be worn season after season, every aspect of the garment needs investing. 'This is because even a 'sustainably produced' garment becomes unsustainable if the garments are only worn a few times and discarded quickly (Jung & Jin, 2014; LeBlanc, 2012)

To produce a knitted garment that will be long-lasting, the garment ought to be made in fibres which are well-spun and durable. The garment's fit, make, and finish is fundamental to ensuring the garment wears well. Thus, investing in suitable fibres is one crucial element to ensure the garment’s longevity. Whether a garment is produced as part of a production line or as a one-off, hand-crafted piece, it is critical to prolong the product’s life and maximise its wearability. A longer product lifespan reduces the consumption of natural resources and energy. In theory, a well-produced garment should encourage people to buy less in quantity (Jung & Jin, 2014). As well as the garment’s physical attributes, the garment’s design and fabric are also vital, as Johansson (2010) argues that well-designed products are long-lasting in terms of style.

When knitted products have reached the end of their life, they have a further advantage; theoretically, they are much more suited to design for disassembly. This is where a product is designed to disassemble at the end of its life so the materials can be re-used (Forst, 2020). Forst suggests that fashion designers should only be designing garments that consider the end of the garment’s life, and a garment must be designed to be circular. Thus, the designer should always question what will happen to the garment at the end of its natural life. Therefore, the ability to reuse the materials is a key consideration.

Textile recycling is not new; wool, for example, has been recycled for at least 200 years. The waste products are known as shoddy or mungo. Wool already has an established recycling route through mechanical shredding. The process takes knitwear fibres of sufficient length; they are carded and re-spun into yarns of pure wool or wool blends. These yarns are converted into knitwear, providing a cost-effective wool fibre supply (IWTO, 2022). Nonetheless, the same wool fibres cannot be recycled indefinitely, and virgin fibres are often combined with recycled fibres to ensure the ongoing quality of fibre (Wang, 2006) .

In the past, there were fewer raw material types used within the textiles sector, which meant there was little need to design textiles or fabric that would recycle or disassemble. The variety of yarns is continuously growing and evolving (Affinito, et al., 2017), when synthetic fibres were introduced into the market in the early twentieth-century, recycling textiles became more complex fibres became more robust, making it more difficult to shred individual fibres. Additionally, the number of distinct types of fibres blended within a single garment has grown, making the sorting process difficult. It is far harder to break down these new blends of mixed fibres found in the marketplace today (Wang, 2006, p. 9).

Although design for disassembly is a relatively new concept in textile design, it is a process which occurs implicitly for hand-knitters. If the knitter makes a mistake, they will unravel the yarn and begin again. This process is known as frogging (Stearns, 2023). Likewise, one reason so few historical knitted garments exist is that if a garment was no longer suitable, it was common to unwind it and re-use the yarn. This process was particularly encouraged in the 1940s during World War Two when 'make do and mend' became patriotic (The Ministry of Information, 2007). Twigger Holroyd (2017) agrees that the practice of reworking knitted items would have been an integral element of knitting activity in the past, but such approaches have fallen out of favour in recent decades. Frogging only goes as far as taking the garment apart, which is a relatively basic method of disassembly, and blended fibres are not separated. Generally, it is more difficult to disassemble commercially made garments than hand-knitted ones.

Overall, a knitted garment is created with fewer processes than a woven one, as the fibre is transformed into a piece of the garment if it is fully fashioned. Theoretically, this should use less energy. Fully Fashioning is the process of shaping individual garment pieces while knitting either on a machine or by hand; each edge is a selvedge, and each piece fits together to create the garment, with no waste (Black, 2002, p. 189). Fully fashioning is a form of zero-waste pattern design. Knitted garments are usually linked together using the same yarn that the garment was knitted in, meaning no contaminating fibres are hidden within the garment. This adds to the ease of disassembly at the end of the garment's life.

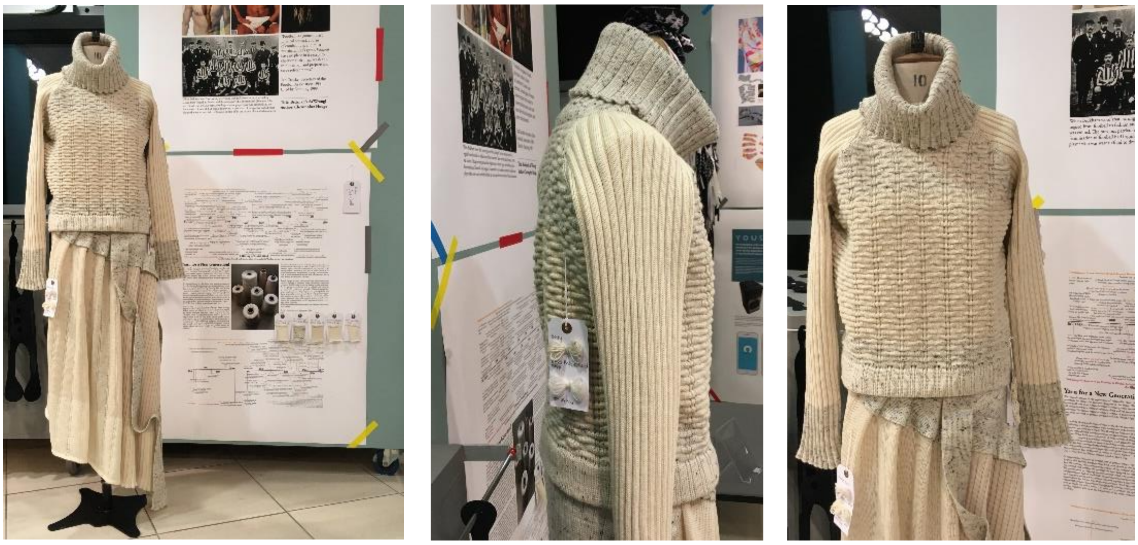


Figure 2:14: Examples of the researchers own fully-fashioned 100% British wool garments created on a mixture of domestic and industrial hand-flat machinery.

Home knitting by hand or machine is the most common form of local production; these garments are ethically produced, considered slow-fashion garments (Jung & Jin, 2014), and are usually fully fashioned-fashioned with little waste. However, commercial knitwear is not traditionally associated with local production, even though many garments produced for the mass market are made by home workers (Klepp, et al., 2022), particularly chunky gauge knitwear and crocheted garments.

Alternatively, Seamless knitting utilises whole garment machinery to knit a garment down as a single piece. The artefact emerges from the machine complete; only the ends need sewing in. This technology is zero waste, and labour costs are low. Consequently, the machinery offers the potential to create ethically made sustainable garments (Shima Seki MFG, 2022). Today Knitwear is a subject of great creativity and is also an area of the fashion and textiles industry which combines craft knitting and technological advancements suited to the challenges the fashion and textiles industry faces through the use of computerised and whole garment technologies (Fogg, 2010, p. 202). Issey Miyake's A-POC concept developed during the 1990s is an example of how creative idea is developed; firstly, through craft and prototyping, then through technology (Black, 2012, p. 185; Fogg, 2010). It can be argued that creative knitting has influenced the development of knitting technology (Matkovic, 2010). For example, many designers utilise domestic knitting machinery to explore their designs before digitising ideas as textile design students use these machines in university and take this knowledge learnt to their graduate positions.

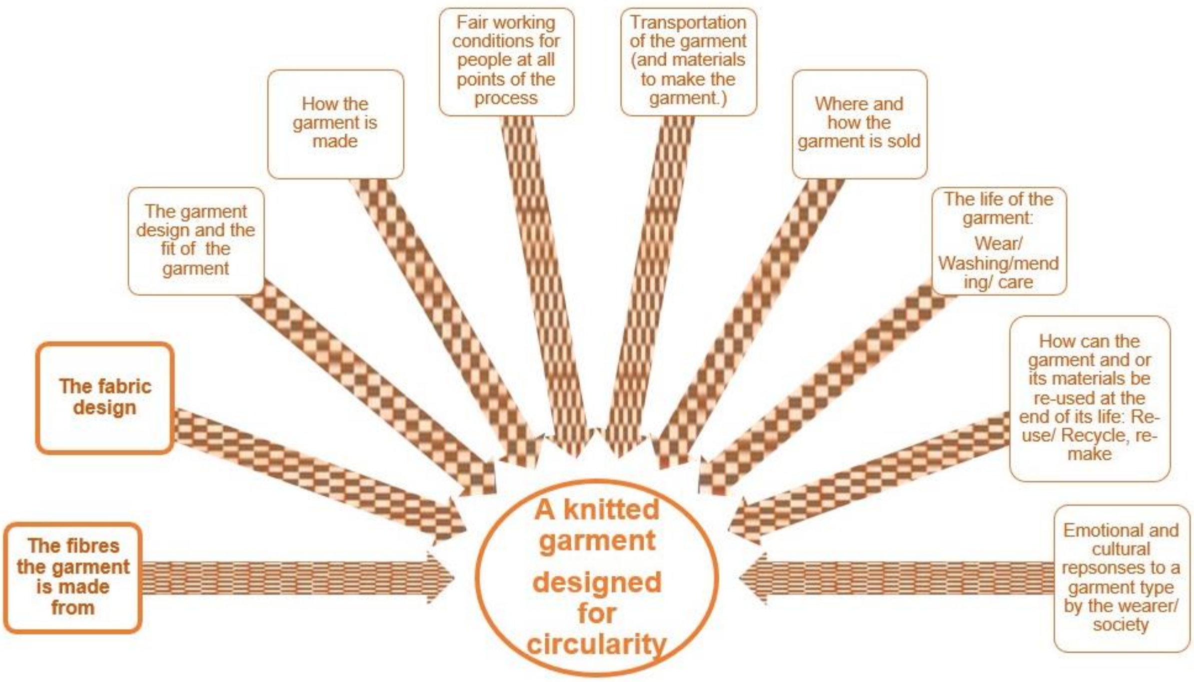


Figure 2:15:The factors which ought to be considered before designing and producing a sustainably knitted garment. The research project will focus on the first two factors: the fibres and the fabric design. However, for a garment to be 100% sustainable, every aspect must be considered at the design stage.

2.4.2 Craft and Design

Instead of viewing garments as pieces of ‘inert’ manufactured objects made of individual parts, Dilys Williams argues that the fashion system should be seen as a network of related elements that have a systematic impact as they work together. Social, economic, environmental, and cultural actions and materials are intertwined and ought to work together (Williams, 2018). Thus knitting, knitted garments, and the materials that make the garments are not stand-alone elements but cogs that fuse together to create wearable artefacts. This is where the importance of craft and design unite. Designers should not divorce craft from design because crafting an object requires decisions regarding structure and appearance (Dormer, 1997, p. 12). The garment should be embraced both for the craft of its manufacture and the traditions, practices and heritage of the artefact and the materials the garment descended from. Craft as a medium can take several forms: an art form (Lindsay, 2015), traditional practice, or as functional design. By combining these practices with design, fashion sustainability can be promoted in the future (Vaananen, et al., 2017).

Historically knitting was a local occupation. The techniques and methods of creating knitted patterns were passed down from generation to generation in the communities they were part of. With Industrialisation in the second half of the eighteen century came the rise of the middle class, and modern wool and textile suppliers began to develop as we know them today, who by the 1850s began to disseminate knitted patterns more widely. By the early 1900s’ knitting patterns became cheaper and more accessible, thus some of the knowledge associated with community knitting, passed down through word of mouth, was lost (Black, 2012, pp. 124-125; Pearson, 2015, p. 6; Rutt, 1987). Therefore, localism can be encouraged if the industry works with communities and learns, understands, records, and utilises their skills and knowledge in order to produce sustainable garments (Fletcher, 2018; Fletcher, 2016). Knitting is a hybrid craft; knitting skills embrace both craft and industry and have, over time, developed through hand skills, mechanical operation, and, more recently, electronic, and digital technologies (Steed, 2016, p. 147).

Craft has the opportunity to be a mediator for design; Craft can combine the conventional boundaries of tradition, and design with a wide range of materials, media, and technologies, offering opportunities to produce objects which are innovative and sustainably sound (Vaananen, et al., 2017). Craft and sustainability are intertwined through the knowledge, skills, and social responsibility that those working with materials possess. Knitting is suited to this way of working because knitting explores the whole design problem, from the raw material to knowledge of traditional and contemporary techniques and results in completed artefacts (Affinito, et al., 2017).

This way of working is how the craft knitter goes about their work, but Knitwear designers working for large corporations are often disassociated from the artefact, the material, and the environment it has evolved from. The researcher's own experience as a knitwear designer was to sit at a computer and draw up patterns, and garment ideas, which were then sent away to be made at a factory. This way of working obstructs the designer from working with materials and experiencing their properties. Gwilt & Rissanen (2011, p. 17) noticed that many designers do not question the production processes involved in developing a fabric or recognise the negative environmental and social impacts associated with different fabric types. Instead, often the designer is significantly removed from the materials they work with. They believe this approach is understandable, as the time available for research into sustainable fibres, materials, and processes is minimal in companies turning clothing around quickly. Indeed, this resonates with the researcher's experience working as a designer for the mass market. Fabric decisions were often beyond their control, instead dictated by either the buyer's requests or cost restraints.

For knitwear designers from all areas of the design spectrum to truly create thoughtful clothes that work at one with the environment, designers must understand the properties of the material they are working with and the processes that the maker undertakes to create clothing. Industry and innovative technologies must unite with craft makers to create beautiful products for the future. Li Edelkoort, a leading trend forecaster, articulated that the current fashion systems are outdated. She considers one of the most significant issues is a designer's lack of knowledge of materials (Edelkoort, 2017). Fletcher (2016, p. 139) agrees, stating, 'even amidst material excess, we do not value materials enough and cannot tell one fibre from another, though handle'. Edelkoort believes garments should be viewed as beautiful individual products rather than a collection of garments. Thus, the fibre composition of the garment will become increasingly important. She advocates for further research and development into textiles and encourages more companies to follow the lead of companies such as Nike and Adidas, who invest heavily in materials research and development (Nike, Inc, 2022; NIke, Inc, 2012). She considers that textiles can lead the changes in fashion and manufacturing in the future.

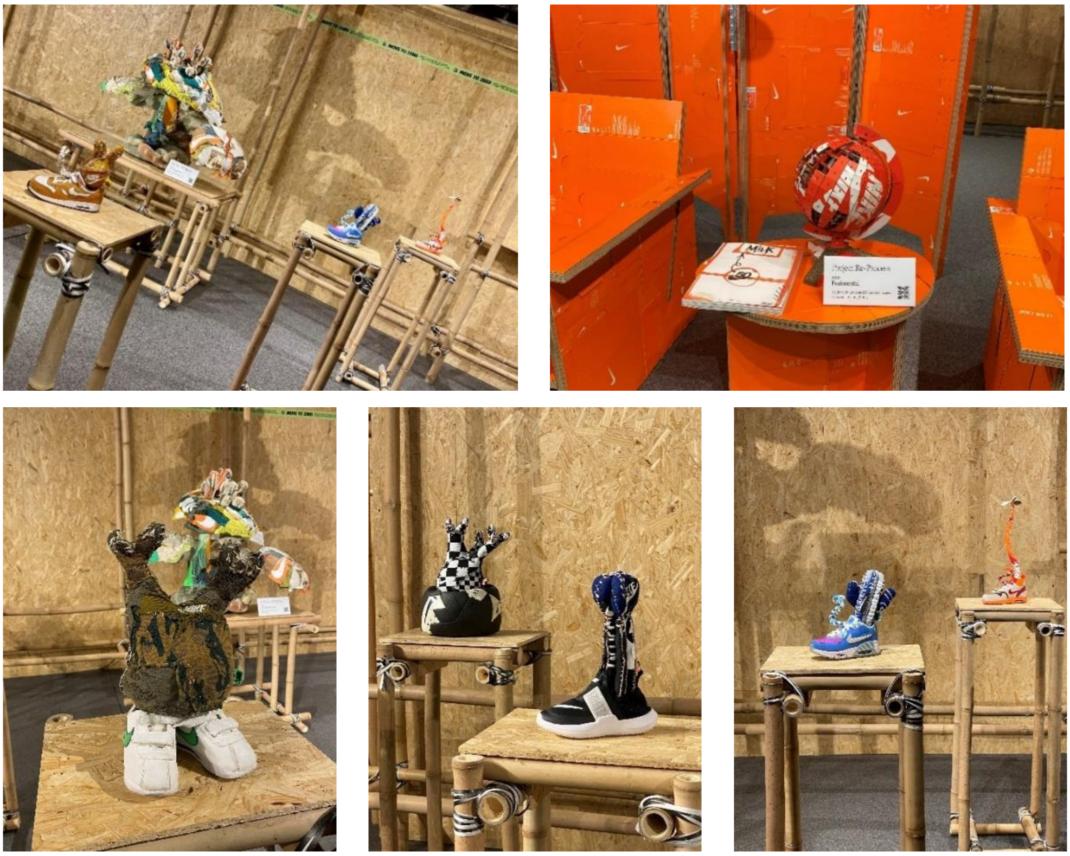


Figure 2:16: Images from the 'Nike at 50. A Genealogy of Progress', taken on the 10th of June 2022 at K11 Musea in Hong Kong, documenting approaches Nike are exploring utilising leftover materials collected from the production process.

The choice and understanding of materials fashion and textiles designers choose ought to be the starting point in every design journey, as the choice of material impacts every part of the final artefact. The designer must understand the material's unique qualities and constraints compared to other materials if the designer is to create a garment which can be considered sustainable (Karana, et al., 2015). Successful designers will experiment and become experts with the materials they believe can improve their designs for the future. Experimentation with different fibres and materials can improve material choices for circularity, which is why research into different material types is crucial. Designers should consider the material's function before beginning a design. Is the material required for its aesthetic qualities, handle, texture, colour, pattern, or surface interest (Udale, 2008, p. 10)? Those materials which improve or complement a garment should be utilised.

Today, a challenge for textile designers is persuading the consumer to engage with the materials they are wearing and to help them understand that there is a relationship between materials, the wearer, the object, the maker, and the environment. It is anticipated that this should help the consumer recapture clothes as valuable objects (Hebrok & Klepp, 2014; Howes, 2003). Hence the knitwear designer's focus should be understanding the properties of knitted fibres to create beautiful one-off artefacts made to last. Thus, the fibre the product is made from is an essential first consideration, as the fabric and garment design should evolve from the fibre's natural properties. The designer is working with the materials to benefit the outcome.

Designers have a unique privilege to change and improve the fashion and textiles sector through their decision-making by ensuring that as many elements of the artefact they design are sustainable. The designer can reduce textile waste and create products incorporating circular design thinking at the beginning of the fabric or garments life. The textile designer should design ethically and environmentally responsible fabrics. Fabrics should be designed so they are low waste, designed for longevity and recyclability, and, if possible, designed for disassembly. Designing in wool offers another advantage: it helps strengthen and diversify the economy, utilising local products (Walker, 2007). Designing in this way should be considered exciting and rewarding. Knowing the products designed with the environment's future in mind can only be good as it allows for personal satisfaction achieved from the act of making and improves the environmental impact on the planet during the process (Haffenden, 2018, p. 12).

2.5 Intertwining Knitting, Wool, Craft, and Tactility

The literature has explored four separate components that inform the practice. The literature reveals the importance that craft and design play in creating artefacts for the future and that knitting is an appropriate method of exploration because of its position as a hybrid craft. Knitting has been intertwined with material culture throughout history and is seen as 'increasingly important both for the understanding of old and new materials in the creation of fashion and for ideating new strategies to employ a wealth of knowledge already existing in the field' (Fiorani, 2016, p. 39).

Knitting will be used in this project as the method of gaining new knowledge about the potential of one material, British wool. By exploring knitted structures, an understanding of the materials will grow and evolve. Affinito; et al. (2017) believe that knitting new ideas in small samples of stitches is fundamental to understanding a single yarn type and is, therefore, the most appropriate developmental research method. A more sustainable fabric can be created through a better understanding of how to use British wool fabrics in fashion, one with ties to place, one that has been created within an appropriate ecology and grown with it. Fletcher refers to this as 'true materialism', a society where materials and the world they rely on are cherished (Fletcher, 2016).

For these fabrics to be cherished, the fibre needs to be better understood by the person engaging with it; they need to understand and relate to it its tactile properties. Thus, the tactile properties of the fabrics created will be interpreted using the ‘sense of hand’ to understand better both its properties and the emotional response the fabric evokes when a person interacts with it (Moran, 2015).

3 Methodology and Research Design

Figure 3:1 Detail of sample 291.

3.1 Introduction

The doctoral research study is practice-based, conducting research through creative textiles design on the knitting machine. New knowledge is generated by utilising iterative hands-on experimentation to blend seven breed-specific British wool types in a variety of knitted patterns and structures. This type of practice-based research is known as 'Research through Design'. Research through design includes materials research, developmental work, and action research (Frayling, 1993, p. 5). The doctoral research endeavours to be all three of these; the materials are the focus of the practice; it is how the materials behave when combined, which will create new knowledge. Igoe (2021, p. 43) refers to this as 'Textilic Practice', where the materials have the capacity to affect change. The research study is developmental as the practice intends to create a collection of fabrics to inform other design practitioners of the possibilities of working with a specific material (British wool). Therefore, the project is not presenting a complete, definitive solution; instead, the research proposes a number of different ideas created to inspire knitwear designers to challenge their material choices. However, the collection of fabrics has been produced in response to a 'perceived design problem' and proposes possible solutions through the different knitting methods, therefore it is action research (Gray & Malins, 2004, p. 75). Hornbuckle (2021) suggests that material samples are an appropriate solution to a perceived design problem because they mobilise different forms of knowledge and make this knowledge accessible to a broad range of people.

3.2 The Methodological Approach: Thinking Through Making

Having established that the research is known as research through design, the next step was selecting the right methodological approach to the project. Cross (2006) considers that when designers undertake a research project, they tend to produce the solution rather than systematically analyse the problem, which is regarded as a more 'scientific' way of working. Thus, design methods should not be directly compared to scientific methods (Cross, 2011; Ingold, 2013). Cross argues that 'experienced designers know that it is possible to gather information about a design problem forever, but they must move on to generating solution proposals' (Cross, 2011, p. 121). Dorst agrees that designing is not vague and must be vigorous in its approach when delivering solutions (Dorst, 2015, p. 43). This was a valuable consideration as it is possible that the sampling undertaken during the practice could continue indefinitely. Thus, the researcher must then it is time to stop making and reflect on what has been created.

The doctoral study is generative because it intends to produce a series of knitted artefacts but is also iterative. The iterative nature of the project lies in the sampling, resampling, and changing of the designs through the process of reflection, then design, reflection, and re-design. The inspiration for this approach was anthropologist Tim Ingold who suggests that theory and idea generation lead to making and that thinking through making is a series of improvisations. The improvisation when making is creativity, and that creativity is innovation (Ingold, 2013; Ingold, 2010). Thus, the experiments the researcher chose to pursue when knitting became the methods, which is the innovation.

Ingold (2013, p. 6) demonstrates that both a theorist and maker can create new knowledge, although the methods undertaken are different "It is not that the former only thinks and the latter only makes, but that one makes through thinking, and the other thinks through making". Thus, the designer, maker and craft person encourages new knowledge to form from their practice which, in this case, is knitted textiles. Scrivener (2000) agrees that makers create knowledge through the artefacts they produce, which is why they have chosen to undertake the research. They conclude that craft can innovate, and the research evolves and has the potential to establish new commercial protocols. Congdon (2020) agrees that this was possible through her doctoral practice, where 'the ideas embedded with many of the artefacts made during the PhD are central with much of the knowledge generated through making them'.

The concept of knowledge growing through making is pivotal to the project. Assigning periods of time dedicated to experimenting, making, and creating ideas cultivates new knowledge inherently. Experimentation between the yarn type and each pattern type generates knowledge of each material's capabilities and limitations. Through iterative sampling, patterns evolve, develop, and iterations are repeated until the ideal combination of fibre and pattern is discovered. Consequently, as the project progressed, it was easier to determine which blends achieved the optimum outcome in each pattern type. Ingold (2013, p. 21) rationalises through working in this way, the maker corresponds with the materials they are using rather than forcing the material to create an artefact. The maker desires to discover what the material is capable of.

This way of corresponding and connecting with the materials is responsive. Throughout the practice, the researcher responded to the yarn's reaction to each different pattern experiment. Albers (2000, p. 20) believes that if the craftsman listens to the material, the material will tell the maker what to do. In this way, the selected yarns prescribe the pattern choices and working methods throughout the doctoral study. How the researcher interprets them determines the outcome of the study.

Ingold recognises the importance of the relationship between the maker, the material, and the artefact and identifies the importance of the material's environment to the making process. He uses the example of stone, explaining how the same stone looks different and has different properties depending on its environment. This demonstrates that the properties of the materials are of great importance to the maker (Ingold, 2013, pp. 40-41; Ingold, 2013). Through immersion within the material's properties within the material environment, the practitioner's ability to work with the material flourishes. Roxburgh (2021, p. 181) expands that it is not only the material's properties that change depending on the environment but also how the maker perceives the materials they are interacting with. Thus, the researcher's relationship to the yarns will be significant to the practice. Consequently, thinking through making as a methodology can be linked to localism and how 'commercial textiles' may be created in the future. It is imperative that makers understand the qualities and the environments of the materials they work with (Fletcher, 2022) and that any artefact created should be more than serving a functional purpose; they should be meaningful and durable so they last. By utilising local materials that respond to their environment, the maker has the opportunity to create a more purposeful artefact, which should hold its value for longer (Walker, 2010).

3.3 Tacit Knowledge

The importance of tacit knowledge to the research project must not be underestimated. Tacit knowledge was formalised by Polanyi, who divulges, "We know more than we can tell" (Polanyi, 1983). Polanyi asserts that the practitioner develops, grows, and absorbs knowledge through their own experiences and interactions when creating and, thus, becomes an expert in their practice. This knowledge is sometimes difficult to formalise and communicate because the knowledge is connected to each individual's knowledge and skills. Thus, explicit knowledge written formally is only part of a larger body of knowledge that the individual may not realise they need to divulge or explain (Suib, et al., 2020). Knowledge develops through immersing oneself in a particular area and honing and practising skills repeatedly. Ingold (2013) agrees; he observed that practitioners often miss out on more technical processes when describing their practice because they do not realise these details are new knowledge because the processes are intuitive. He identifies this as the difference between personal and articulate or explicit knowledge. Dormer (1997) believes that textiles practice, in particular, relies on tacit knowledge to facilitate the combinations of different patterns, fibres, and materials. This ability is intuitive to the textile designer, but how they came to such conclusions is often difficult to record.

This doctoral study will lean on the researcher's tacit knowledge of machine knitting and knitwear design. Writing down every knitting process undertaken during the project will require a tremendous amount of dialogue and is not necessarily beneficial to the overall flow of the thesis. Thus, a summary is considered enough. Knowledge, including how to construct a knitted fabric, how to utilise the machine, how much take-down weight is appropriate and how to fix any holes or problems that arise during the making process, is the knowledge that the designer already possesses when embarking on the project.

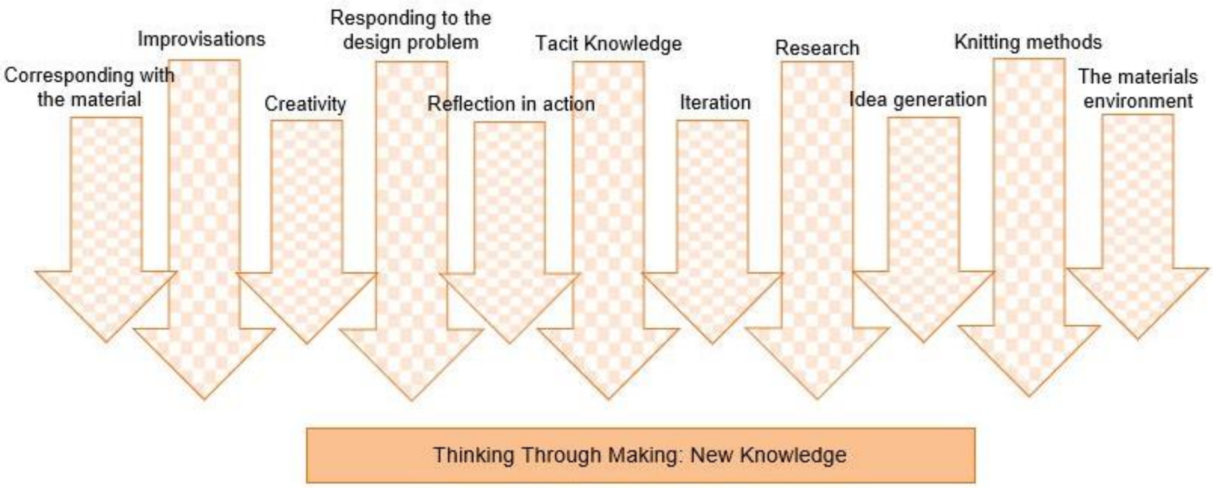


Figure 3:2 Thinking through Making in Practice.

3.4 Evaluation of the Practice

If the practice evolved iteratively through making, with new knowledge growing through the practitioner's tacit knowledge, the outcomes, (in this case, a collection of fabrics) ought to be analysed retrospectively during phases of reflection and evaluation (Forst, 2020). It is how the researcher reflects, analyses understands, visualises, and communicates the knowledge which shaped the outcomes of the research study. The reflection process began fairly iteratively, but as the researcher read and analysed similar practice-based design methodologies from researchers working within textiles, which have been published since this practice began, they discovered their way of working was unintentionally following a similar framework. Both Forst (2020) and Hall (2021), doctoral researchers at UAL (2022), fused a variety of design approaches into what they describe as a "Bricolage of Methods'. They follow a four-step process throughout each of their methods, which were actioned during various project stages. Goldsworthy (2012), who developed a similar framework, inspired their approach. This way of working effectively organises different complex data collation approaches and fuses them together cohesively. It was through understanding these recent doctoral studies that the research approach to the doctoral practice was solidified. This practice was also undertaken in four phases, although the approach taken was different, and more linear. The knowledge grown from the practice was analysed and interpreted using two methods: Reflection in action and retrospective reflection. The retrospective reflection was phenomenological in its approach to collecting, analysing, and interpreting the tactile data.

'Reflection in action' transpired throughout the practice (Schon, 2016). During the research study, there were also fixed intervals where making will cease. The fabrics were compared and refined to ascertain the most effective versions to develop further. Scrivener (2000) believes reflection should be central to creative production and that reflection in action is part of tacit knowledge and demonstrates that the practitioner is competent in their practice. Schon (2016) explains that if the practitioner treats their case as unique, they will attempt to reflect upon what is in front of them, consider problems and produce unique solutions. Scrivener (2000) explains that reflection in action has a characteristic structure: the practitioner finds the problem cannot be solved, so it is reframed, and this becomes the basis for new experimentation to discover the consequences that emerge from it. New discoveries call for further reflection, and these stages are repeated throughout the practice. The practice will be evaluated retrospectively within a framework to interpret how the reflection in action transpired.

The retrospective reflection utilised two methodological approaches a phenomenological critique of the collection and the visualisation of the outcomes using a graphical representation of the data and imagery to interpret the artefacts created.

3.5 Phenomenology as a Method of Data Collection

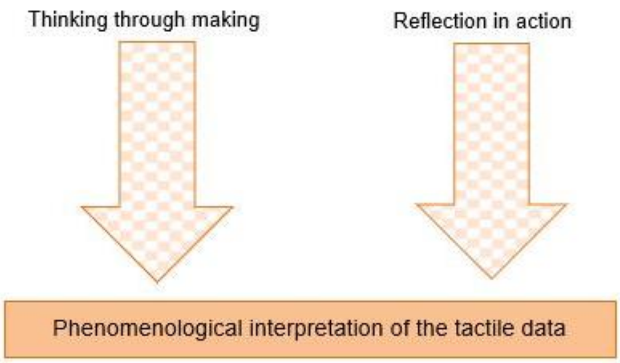


Figure 3:3 Data collection and analysis.

Phenomenology is interested in the phenomena that appear in one's consciousness as one engages with the world around them. It is interested in people's experiences with the world through the objects they encounter (Husserl, 1989). Phenomenology is also a method of investigation (Henry, 1999). Phenomenology examines subjective experiences and tries to understand how people engage or perceive these experiences through the senses and language. Husserl and Merleau-Ponty were two philosophers that developed the philosophies associated with the psychological explorations of perception, vision, and touch (Moran, 2015, pp. 216-217). Merleau-Ponty describes three distinct experiences which occur through touch: a touching of the sleek and the rough, a touching of things and a veritable touching of the touch" (Murray & Holmes, 2013; Merleau-Ponty, 1968, pp. 133-134). During Husserl's 'Ding and Raum' lectures, Husserl discusses tactile properties, including the feelings of smoothness and roughness and explains that through touching the object, the person gains a sense of the smoothness; this sense is an individual subjective sense of perception (Husserl, 1997, p. 47). These experiences of touch are combined with the sensation of bodily self-movement, which Husserl explains, 'The object experienced is assembled out of our experiences: colour, shape, texture etc. (i.e. its properties) and bodily movements such as the hand, head, neck, or eyes moving (Moran, 2015, pp. 216-217; Husserl, 1997, p. 298). There can be no sensory experience without bodily movement, and tactile qualities such as roughness and smoothness disappear if movement is eliminated (Moran, 2015, p. 228). Merleau-Ponty explains that "smoothness is not a collection of similar pressures but how a surface utilises the time occupied by our tactile exploration or modulates the movement of the hand". Movement and time are objective conditions of knowing touch and a phenomenal component of tactile data (Merleau-Ponty, 2005, pp. 315, 364).

Through these tactile interactions with the fabric, the researcher phenomenologically investigated each of the samples created through their own perception of the tactility of the material. (This is described in Chapter 2.3.4 as 'the sense of hand'). The researcher assessed the sample's softness by handling each fabric separately and recording their sensory assessment of its handle (Kawabata & Niwa, 1991).

As discussed in Chapter 2.3.5, the fabric's tactility was investigated using another method, language. In particular, the sensory descriptors are used to communicate a sense of each sample. Merleau-Ponty believed that thinking could occur through the spoken word, in and through an embodied language (Murray & Holmes, 2013). If Phenomenology is a method of investigation, then the phenomenology of language consists of applying this method to a specific problem (Henry, 1999). Murray & Holmes (2013) suggest interpretive strategies can be drawn from how ideas are communicated in dialogue. These can be built from the significance of gestures, lacune, hesitation, word choice and figures of speech.

"The word, far from being the mere sign of objects and meanings, inhabits things and is the vehicle of meaning. Thus speech, in the speaker, does not translate readymade thought but accomplishes it" (Merleau-Ponty, 2005).

John Austin, a British philosopher of language, agreed with Merleau-Ponty's theory that linguistic forms are meaningful; however, not by themselves but when applied to real situations, he asserts that words take on 'operative meanings' (Leeten, 2022). Therefore, the researcher recorded the language they judged best portrayed each of the fabric's tactility and utilised this language to interpret the handle of each of the samples created. The words became 'meaningful' through their assessment of the fabrics.

Merleau-Ponty (1942, p. 11) suggests that when the hand grasps something, the object's property and the subject's intention are blended together to create a new whole. This refers to the relations between body and mind, between the perceived world and the perceiving subject, and between language and speaker (Okamoto-MacPhail, 2018). This new perception experienced by the subject is expressed and evaluated through the language spoken. Okamoto-MacPhail (2018) suggests that Merleau-Ponty is alluding to the fact that language is the sixth sense, which only applies to humans and is a form of memory. Overall, Merleau-Ponty identifies that the body is a whole, and the whole system of sensory experiences gives us our sense of objects in the world (Moran, 2015, p. 229). Thus, the objects we perceive are not stable but dependent on our multi-sensory perception (Roxburgh, 2021, p. 181). It is through the combination of one's sensory experiences and the language utilised to describe it that one's perception of an object is formed.

Since the researchers' assessment of the tactile qualities of the fabric produced could be subjective, a period of external retrospective reflection occurred during the study. Six participants were invited to view, handle, and respond to an edited collection of fabrics and to understand the participant's perceptions of the fabrics through their sensory experience of 'the sense of hand' and language. This engagement transpired through a series of questions. By inviting the participants to engage with the samples through touch and sight, the participants were expected to empathise with the materials and give individual accounts of their experience of the samples in language accessible to them. While the researcher was primarily looking to understand each participant's perceptions of the handle of the fabric, she was interested in ascertaining whether the handle could be assessed without the other senses or whether, as Merleau-Ponty claimed, the senses work as a whole. How each participant describes the handle of each fabric will be recorded; firstly, to understand how soft they perceive the handle to be, and secondly, to understand how they perceive the fabric as a textile. The researcher also used this time of reflection to ascertain whether those viewing the samples have any preconceptions of the fabrics based on previous sensory experiences or preconceived ideas of wool fabrics.

A visual approach was adopted in order to interpret the tactile data collected through these phenomenological investigations. This is because the research is aimed at designers, who are inherently visual people. This visualisation occurred in several forms: Firstly, through photographic images of the fabric created. Secondly, the reflection process was visualised through a series of graphs, charts, and word clouds. Colour was used throughout the visualisation process since Manovich (2011) observed that artists and designers pay more attention to visual properties, such as colour, which are usually considered visual properties.

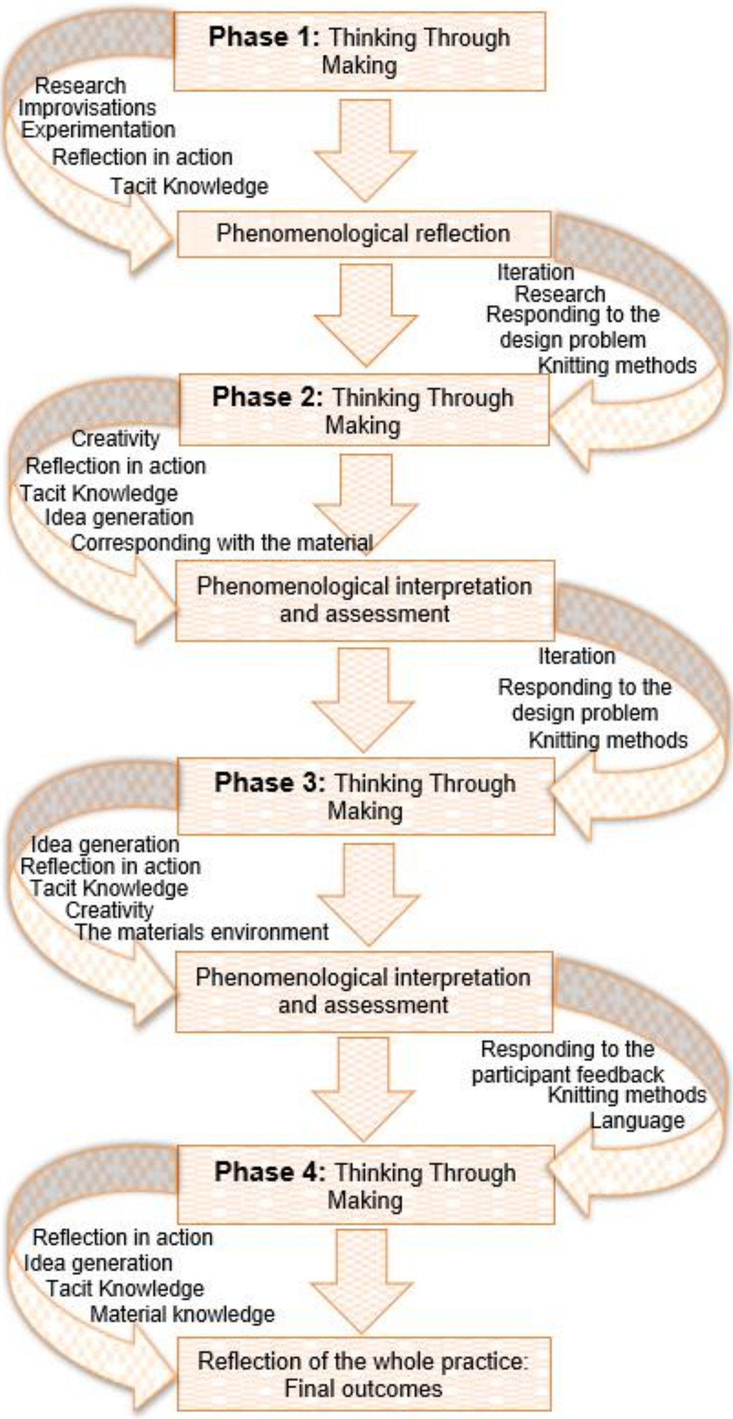


Figure 3:4 The methodological approach to the research study.

3.6 Research Methods and Design

This section will establish how practical methods and a structured framework built on the theoretical, methodical foundation were formulated. Chapter 3.6 explains the different components which fuse together to enable thinking through making to materialise. Chapter 3.7 explain the methods used to interpret the tactile data acquired during the practice.

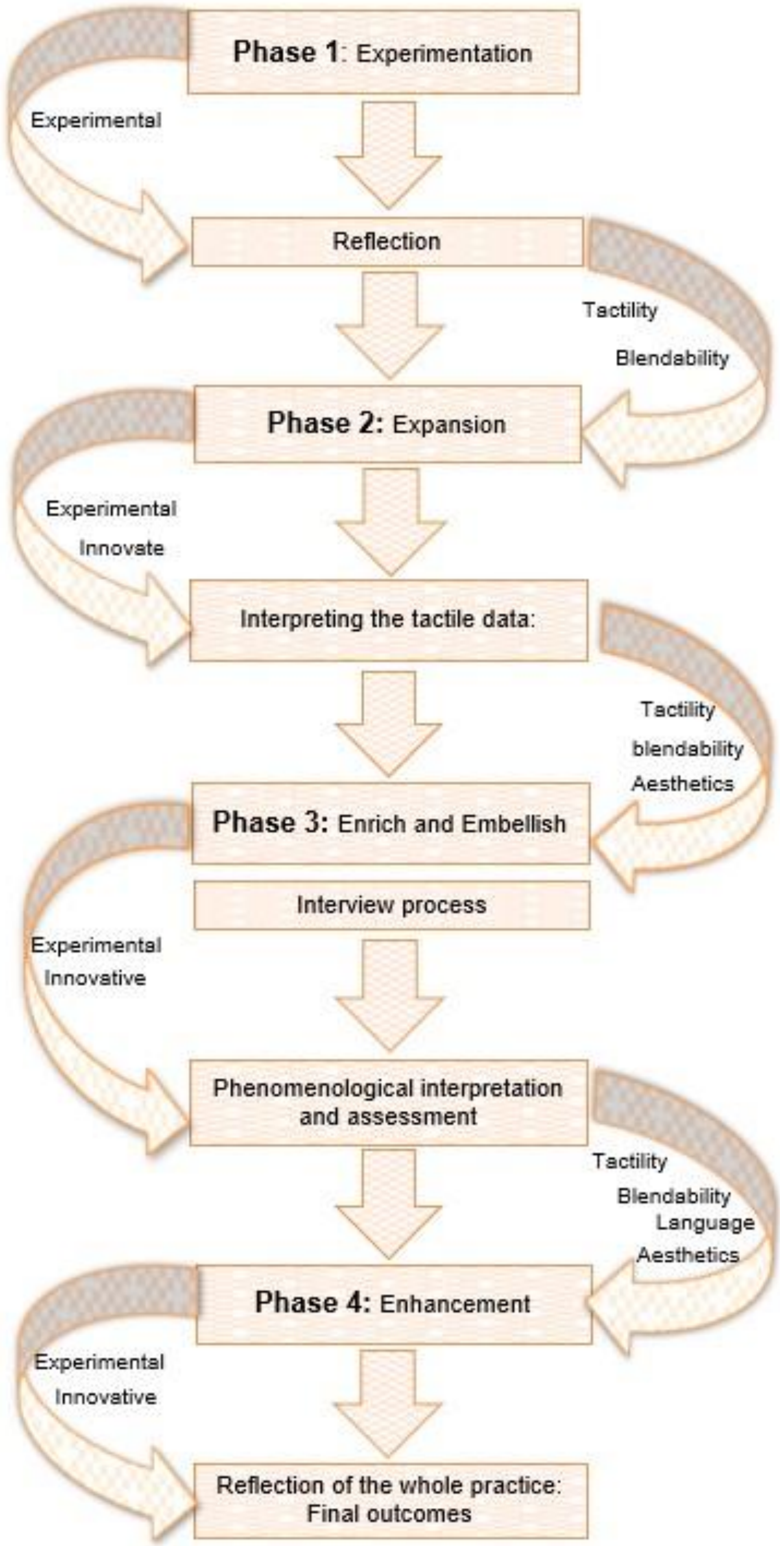


Figure 3:5 A translation of the methodological approach recorded in Figure 3:4 into the practical research design. The practice took place in four phases over an extended time frame. Four distinct periods of making (the practice) were followed by four periods of reflection, analysis, and interpretation.

Each component below was considered before the research began to ensure the practice ran effectively and ensured control and consistency throughout the practice and data collection.

3.6.1 The Knitting Machinery

Every fabric has been constructed on a Brother KH-836 domestic knitting machine. This allows the efficiency of machine knitting combined with the flexibility of the hand process. A domestic machine was preferred to hand knitting as machine knitting offers speed, constant tension, and even knitting (Haffenden, 2018, p. 15). The needles are visible, which enabled design development to take place iteratively in 3D. The practitioner can create, amend, and adjust patterns as they knit. It is easy to correct mistakes on this machine.

The consistency of the domestic machine was a significant control factor that enabled the practitioner to concentrate on pattern exploration and developing creative methods to combine yarn types. Although all sampling took place on one Brother machine, the research project did not require a particular model of machine, as the patterns are generic and could be produced and translated onto various machinery (Guagliumi, 2008, p. intro). This is important if the patterns are recreated in the commercial market. During the practice, the same machine is utilised for consistency purposes. It was the creativity of the ideas and 3D design development which determined the outcomes of the project.

3.6.2 The Yarn

The yarn selection: including why and how specific yarns were chosen determined the practice, so the process is discussed in detail in Chapter 4. The yarns were selected to suit the requirements of the knitting machine. This way of working enabled responsive designing, where the practitioner responds to the yarn’s requirements.

Yarn testing and brainstorming took place in 3D on the knitting machine. The initial testing and idea generation led to pattern selection and the creation of initial samples and design developments.

3.6.3 Pattern Types

The creativity of the practice was determined through the use of appropriate patterns. Thus, the practice began by investigating suitable pattern types to experiment with. A requirement was that the patterns work within the restraints of the machine. Patterns created from single-faced fabrics through either manual needle transfer or the machine's punch-card function were deemed the most suitable for domestic machinery (Guagliumi, 2014, p. 6). An infinite number of pattern types could be explored, but to ensure each pattern type could be explored in depth, five pattern types were chosen; thus, decisions were made early in the research about the types of pattern to explore. Further research may lead to different patterns being studied in the future. (See Chapter 8.6.) In order to determine the types of patterns, it was important to establish what the research project expected to achieve. The intended end use of the fabrics is commercial fashion garments, particularly ladies' sweaters and cardigans; thus, many intricate, beautiful textile patterns may look impressive but may not be the most suitable. Instead, simple techniques which had the potential to be manipulated were investigated. The benefits of single-faced fabrics for commercial use are highlighted In Chapter 2.1.

Typical patterns for commercial knitwear include rib, cables, stripe, or jacquard or tuck patterns. These patterns are often regarded as a vehicle for colour and pattern and offer movement and comfort to the wearer. Due to the constraints of the machine and the decision to focus on single-faced fabrics, traditional ribbing was not experimented with. (See Chapter 8.5.4 for further details). Cables are also best produced within a rib structure; thus, they, too, were deemed unsuitable for this project. Thus, if ribbing and cabling patterns commonly associated with woollen knitwear were not appropriate to the project, the researcher needed to ascertain those which were. Thus, five pattern types were selected for experimentation and further development during the project. Four of the five pattern types are patterns that can often be found on commercial knitwear on the UK high street. The fifth pattern type Inlay is more experimental, but its links with weaving offer opportunities for experimentation and commerciality.

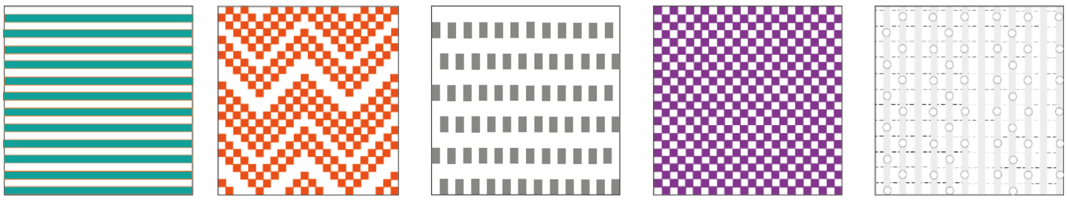


Figure 3:6 The pattern types: Stripe, Float jacquard, Hand-Manipulated Tuck, Tuck jacquard, and Inlay.

3.6.3.1 Stripes

These are one of the simplest and often the most effective knitting methods for fashion fabrics. Stripes offer an easy and effective way to combine colours and textures into a knit structure (Hurley, 2019, p. 153). It was anticipated that by striping yarns next to each other, the overall handle of the fabric would be improved as the textures of the different fibres would be experienced through handling the fabric. Thus, the practice began by experimenting with combining yarns in stripes of varying depths of courses. No colour was used in case it influenced the perceptions of those sensing the fabrics. Typically, stripes are associated with colour; fashion retailers often utilise stripes within their core ranges to update and refresh their collections. This is known as 'Purposeful Obsolescence', where retailers purposefully change and refresh fashion products for profit. (Lynch & Strauss, 2007; Sproles, 1981) However, stripes also have the potential to form the base of other knitted pattern structures, which is why they are appropriate to the practice.

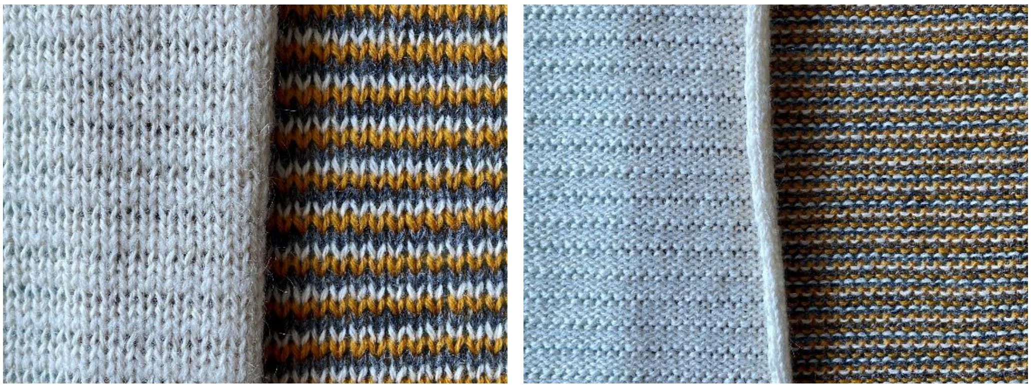
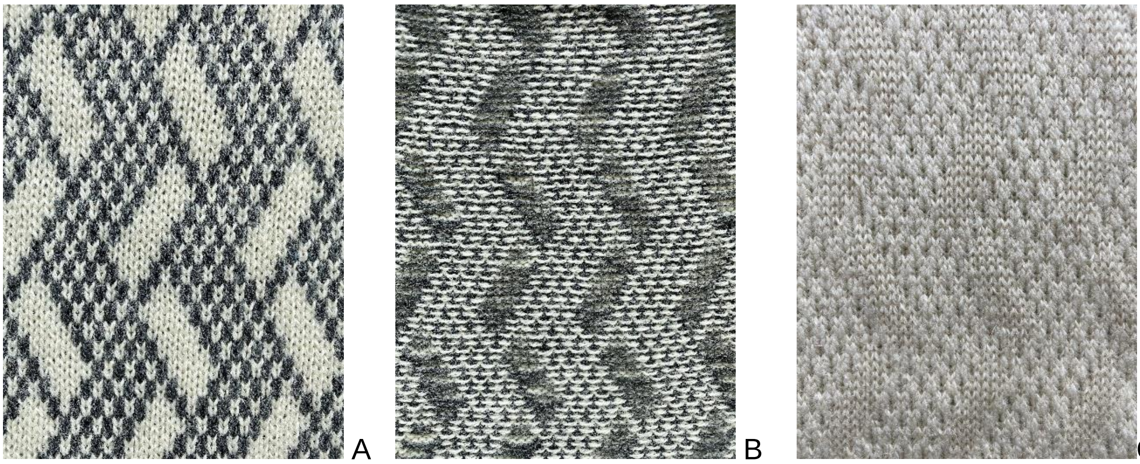


Figure 3:7 The face and reverse of a 1x1 (single course) knitted stripe structure knitted in three yarn types.

3.6.3.2 Float Jacquard

The patterning functions on the domestic knitting machine create float jacquard, tuck, weaving and slip pattern patterns. A float jacquard (or fair-isle structure) is a method of knitting two or more yarns in one course (Brown, 2013, p. 89). The structure is created by selecting a repeating pattern of needles to knit the first yarn; the second yarn, usually of a different colour, is missed, and a horizontal float appears on the reverse of the fabric. The loops of two courses are combined to produce one complete course of face pattern loops. (Hurley, 2019, p. 153; Spencer, 2001, p. 92). Float jacquards are an effective method of producing colourful areas of flat patterns in repetitive sequences (Lee, 1990, p. 20). While float-jacquard are associated with woollen knitwear in the form of fair-isle knitting, they have been used during this project for their structure and ability to blend two or more yarn types in different pattern formations. Float jacquard was preferred as a technique to combine two yarns on a course over techniques such as plating because of jacquard's ability to interchange yarn types from the front to the back of the knit many times over a course. Plating, which could be considered appropriate for the project, does not blend the yarns as effectively as float jacquards and it also provides a blank canvas for further fabric manipulation, as the patterns created look like flat plain knit when knitted in ecru. Float jacquards can be manipulated by inserting stripes of plain knitting, adding stripes of texture, or using openwork to create pointelle or ladders (Allen, 1989). The reverse of a float jacquard structure is covered in floats, the length of which is determined by the pattern.



A B C

Figure 3:8 Examples of a two-colour or two yarn type float jacquard, A) is the face, B) is the reverse and C) is the face in two types of ecru yarns.

3.6.3.3 Hand-manipulated Tuck

Hand-manipulated tuck is 3D, versatile and produces a bulky stretchy fabric that can create sculptural outcomes (Udale, 2008, p. 80). It can be generated manually or using the patterning functions on the knitting machine. Tucked patterns create fabrics with interest at both the back and the front (Allen, 1989, pp. 8-9). Tucks were chosen because they generate a double-sided fabric structure which may be one method of minimising the amount of ‘prickle’ next to the skin and, in turn, improving the tactility of the fabric. Therefore, two methods of tuck formations were explored, manually creating patterns by hand, and using the tuck patterning function on the knitting machine.

Many tuck patterns are recognisable to the general population and are commonly seen on everyday knitwear in high street stores. Therefore, if tuck patterns are already associated with commercial garments, experimentation was required to generate innovative versions of the pattern which blend different yarn types effectively.

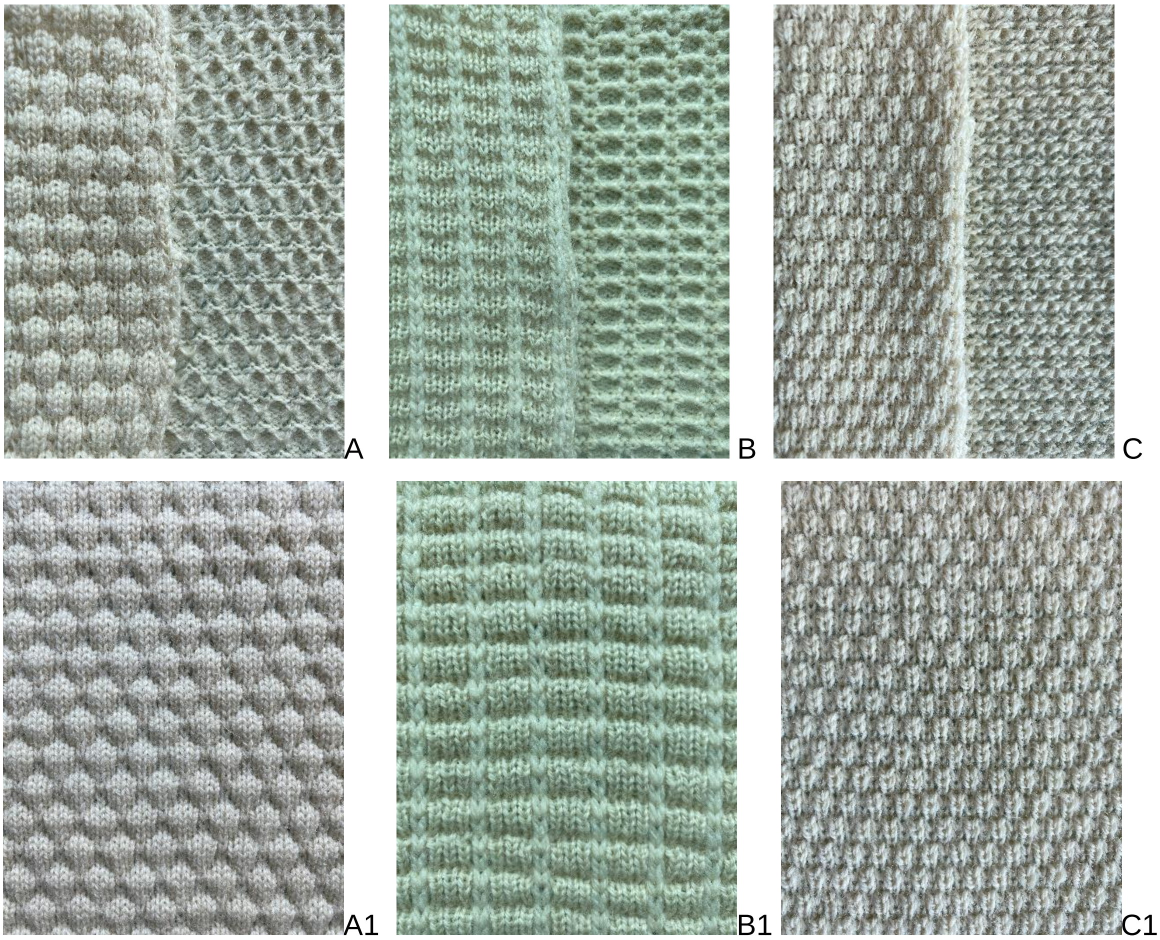


Figure 3:9 Image A/A1) A traditional shell stitch tucked structure. Image B/B1) a 4x4x2 two yarn type knit structure. Image C/C1) a mini 1x2x2 tucked structure in two yarn types.

3.6.3.4 Tuck Jacquard

Tuck jacquard is another structure created using the patterning functions on the knitting machine. Unlike float jacquard, tuck jacquard knits one yarn type at a time while holding selected stitches, while the other needles knit normally (Allen, 1989, pp. 8-9) in order to create tucks rather than create a float pattern. This pattern type is very similar to hand-manipulated tucks in that the same tuck structures can be produced. This pattern type was chosen for experimentation within the study as it allowed the same float jacquard pattern card to be used and recreated in a tuck formation.

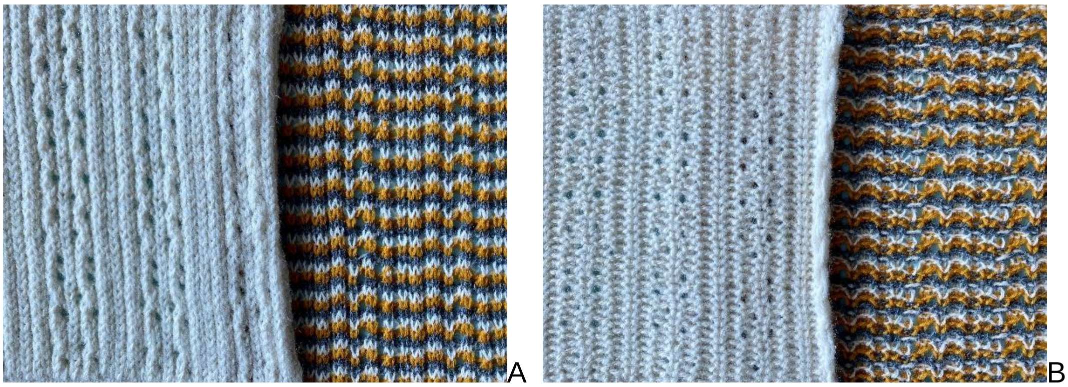


Figure 3:10 The face and reverse view of a 2x1 three colour tuck jacquard structure which has been further manipulated with ladders and pointelle.

3.6.3.5 Inlay

The final pattern type investigated is a weaving technique known as inlaying. Inlaying is the process of incorporating non-knitted threads into the reverse side of a base structure of knitted yarns (Allen, 1989, p. 140). Inlaying can modify the properties of a knitted structure, such as its stability, stretch, handle, weight, surface interest and aesthetics (Spencer, 2001, p. 54). This is because the yarn is trapped horizontally within the knitted structure. Inlaying enables fibres of heavier counts to be blended into the fabrics by inlaying the fibres on top of the needles or weaving in and out of the needles. The investigation began by exploring different patterning options to determine which types of weaving techniques were the most appropriate for the project.

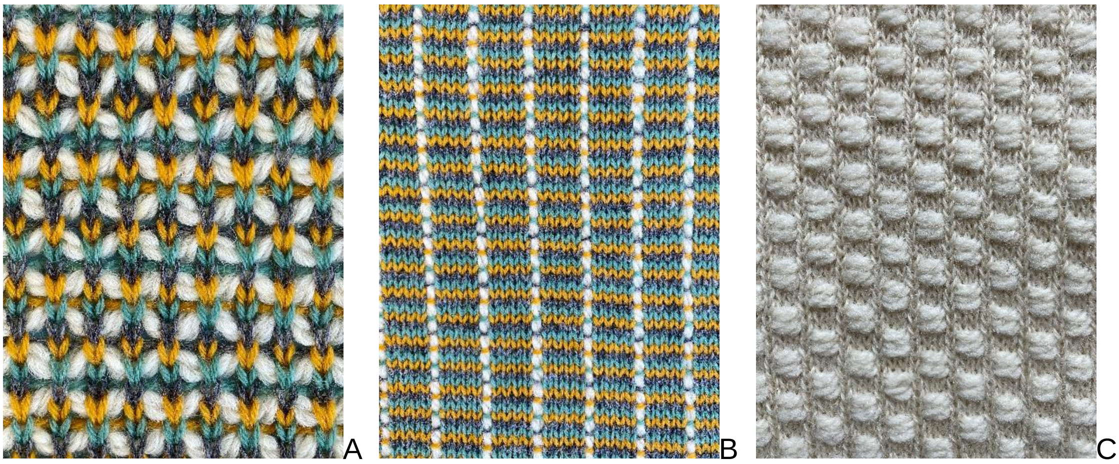


Figure 3:11 Three types of Inlay fabric: A) Inlaying over and under the needles. B) Vertical Inlay; this is created by weaving yarn in and out of ladders (or missed stitches) within the fabric. C) Inlaying in front of and behind the needles, though manually lifting the stitches from the needles.

The techniques in figure 3:11 were chosen because they all presented the possibility of creating stretch and movement within a single-faced knit structure which theoretically ought to create a softer handle (Iftikhar, et al., 2021).

3.6.4 Hand manipulation

The practice has investigated applying different hand-manipulation techniques to each of the five pattern types above in order to alter the fabric’s construction. Hand-manipulated stitches offer variety, flexibility, and adaptability when making and can be used in conjunction with many knitted structures across any machine to manipulate well-known patterns into new designs (Walker, 1968, p. 3; Spencer, 2001, p. 57). Lace or eyelets, also known as openwork or pointelle, are constructed by introducing empty needles by transferring one loop onto an adjacent loop (Spencer, 2001, p. 171) See figure 2.7 A. The needle is left in action, and the carriage is taken across; this creates the hole. Any number of holes can be created on a single course and over a piece of fabric, enabling creative patterning to transpire. Ladders produce similar effects; they are created in the same way, except the needles are left out of action, so the hole becomes permanent, and a missed stitch appears on each course of the fabric (Spencer, 2001, p. 61). See figure 2.7 B.

It was anticipated that these structures would manipulate the knit structures to further blend the yarns together and open up the structure, reducing the density of the fabric, which should, theoretically improve its overall tactility by creating a lighter, airy fabric, with the potential to feel softer next to the skin.

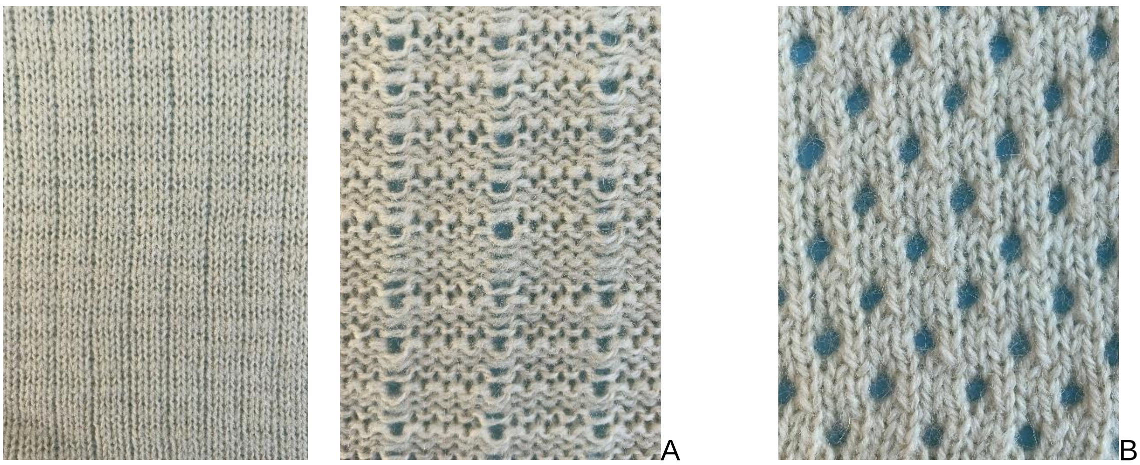


Figure 3:12 Examples of hand-manipulation. A) The face and reverse of a single-faced fabric with a single ladder running through it. B) A single lace-hole transfer, repeated to create a pointelle pattern.

3.6.5 Colour

Knitwear is often associated with colour, and techniques such as stripes or float jacquard are usually intended to add interest to a design by mixing colours together (Brown, 2013, p. 82). This sample collection is different as it aimed to concentrate on the tactility of the fabrics. Thus, the decision was made to develop the entire sample collection in ecru before the project began. Every yarn utilised has been sourced in its natural unbleached colour. Unbleached yarns were sourced because dyeing and finishing processes can affect the yarn handle (Jevsnik, et al., 2014), thus working with different coloured dyes could result in a single yarn type handling differently (Jeguirim, et al., 2010).

Colour is subjective, and everyone perceives colour differently (Brown, 2013, p. 82). Humans utilise their whole sensory being to perceive objects, and colour adds richness and understanding to complex visual information (Hanson, 2012, p. 1.1). By working in ecru, the researcher was persuaded to interpret the fabric utilising the sense of touch first before being drawn to the fabrics aesthetics.

Figure 3:13 The same pattern types in ecru and colour demonstrate the influence colour has when perceiving a fabric. A/A1) Ecru and colour 1x1 inlay structures. B/B1 4x1 rib-look float jacquard structures in ecru and colour. C/C1) A horizontal zig-zag float jacquard structure in ecru and colour.

3.6.6 Design Development

Overall, design development took place in 3D through knitted experimentation. Before knitting, pattern designs were brainstormed in 2D and drawn out on squared paper so the designs could be easily translated onto the machine. A digital version was created in Adobe Illustrator when the designs were finalised.

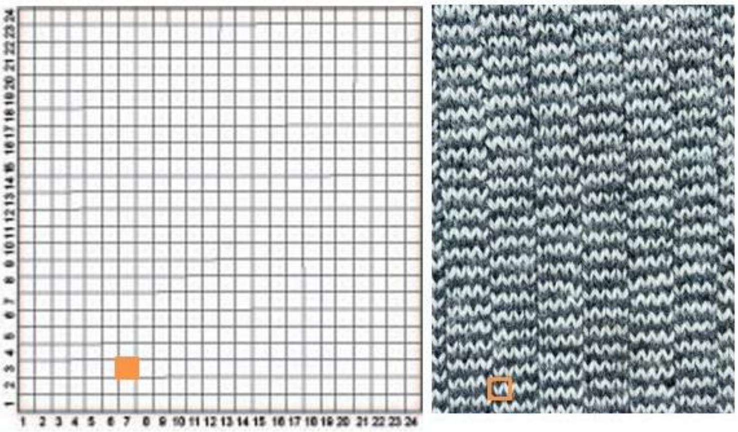


Figure 3:14 Each square on the squared paper represents one knitted loop. As visualised by the orange square above.

The digital drawings illustrating the design ideas later in the thesis were developed in the same way. Every drawing is a 24 x 24 square representing 24 x 24 stitch loops. This is often referred to as a 24-stitch repeat. The reason why each illustration is 24x24 is that this is the width of a float-jacquard repeat on the Brother KH-836 knitting machine. As seen by the images in figure 3:15 below, the actual repeat of the 4x1 float jacquard is actually much smaller; in fact, only 8x2 stitch loops.

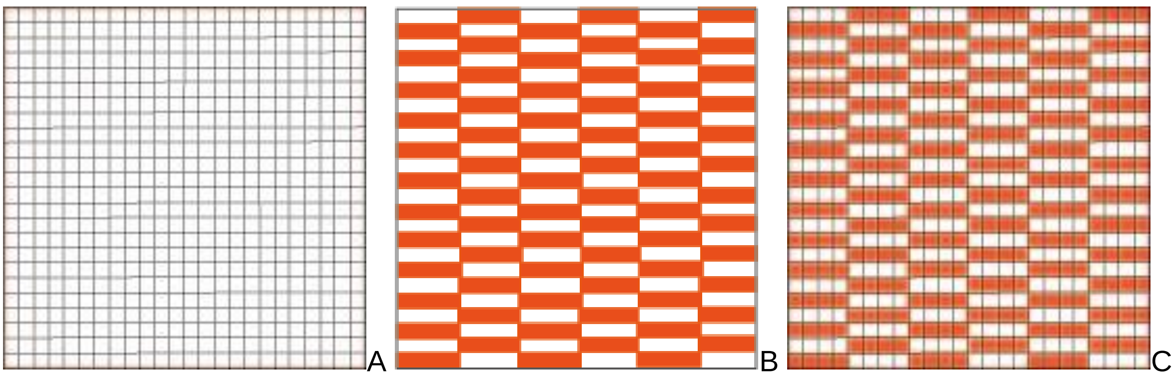


Figure 3:15 A) A blank 24 x 24 square repeat. B) A 4x1 rib-look float jacquard illustration. C) A 4x1 rib-look float jacquard illustration with squares.

The designs use recognisable colours and shapes to visually represent each pattern variation within each pattern group. A different colour represents each pattern group:

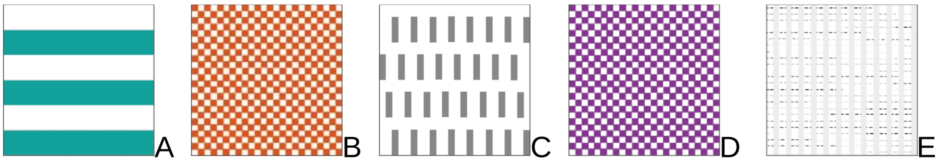


Figure 3:16 A) green = stripes, B) orange = float jacquard, C) grey= hand-manipulated tuck, D) purple = tuck-jacquard, E) white/ pencil =inlay.

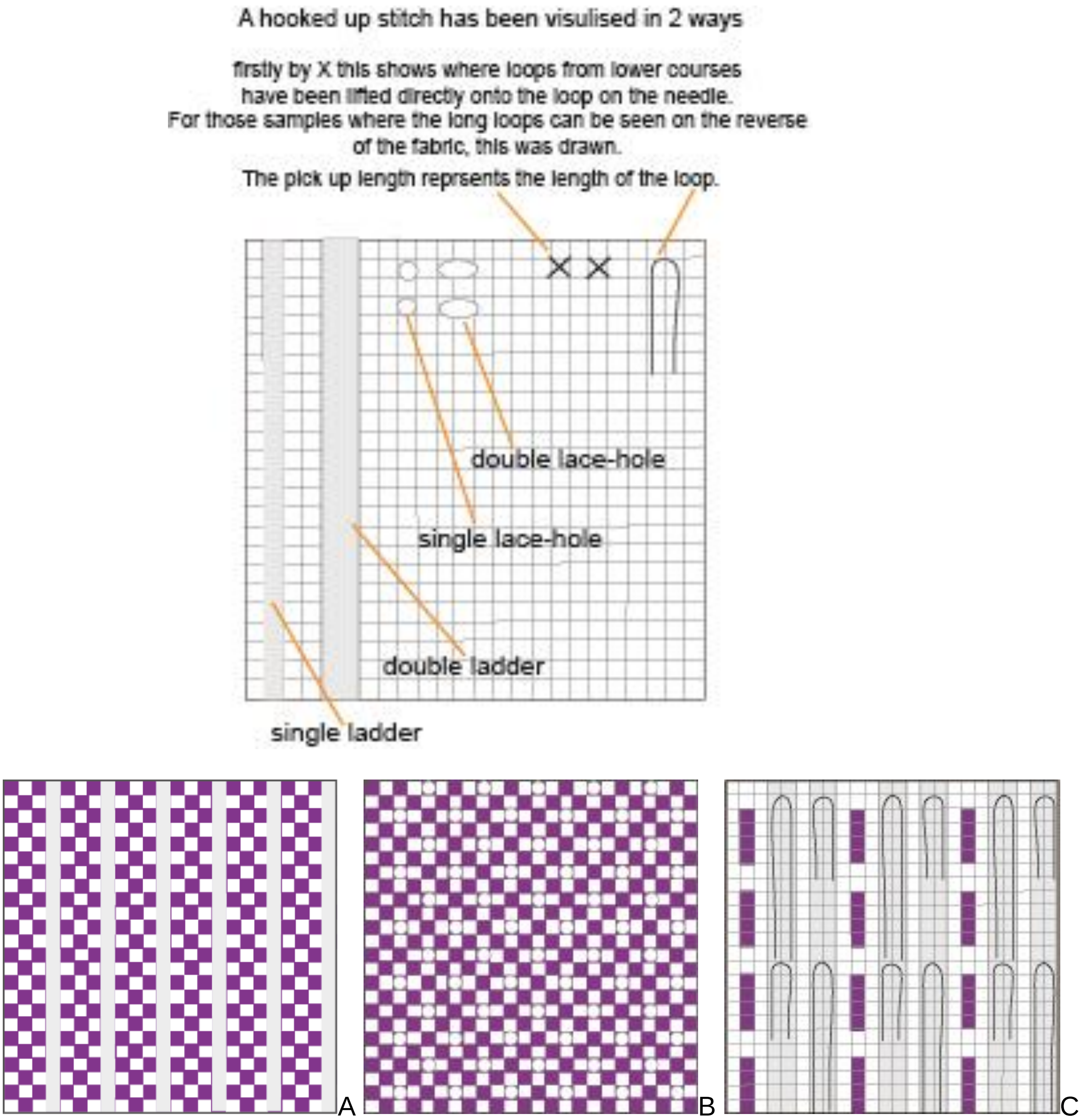


Figure 3:17 A key interpreting what the shapes on each drawing represents: A) single ladders, B) lace-holes, C) elongated hook-up. The squares have been overlaid to demonstrate the length of each hook-up loop. The purple shows how many wales the tucks were held for.

When the initial designs were finalised, the sample was recreated on the knitting machine to grasp whether the 2D design translated into 3D. This is because knitted stitches do not knit squarely; proportionally, plain knitted loops are wider than their length. In addition, the knitter works with the reverse of the sample facing them rather than the front. The finished pattern is hidden until the fabric is finished on a single-bed domestic knitting machine.

When developing and testing a pattern in 3D, the knitter instinctively observes how effective the pattern is and makes adjustments while creating each sample. (Reflection in action.) Once the sample was taken from the machine, further observations were made to each sample concerning whether the pattern was effective and whether it was appropriate for the project. The pattern may be amended, improved, and reworked accordingly. This process may occur several times before the pattern is presented in its final form. Patterns were adapted throughout the project to enable a single pattern structure to knit in various yarn combinations.

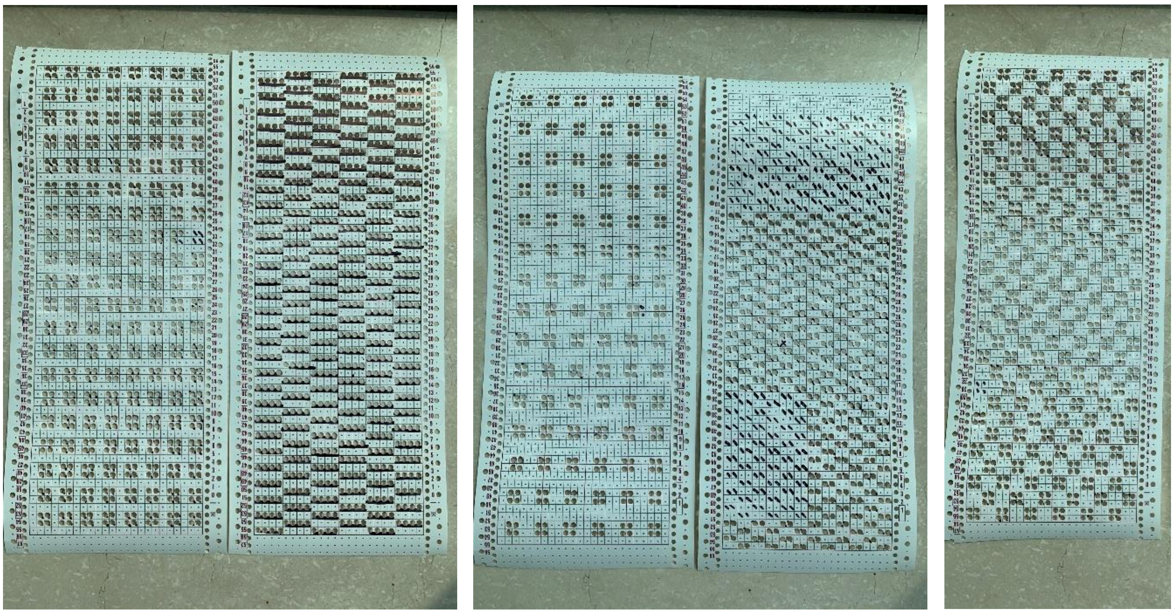


Figure 3:18 Examples of the punch-card patterns originally developed to create the float-jacquard and tuck-jacquard patterns. The punch-card paper is 24 stitches wide, each square represents one stitch. Further cards were developed to create the zigzag patterns.

3.7 Evaluating the Sample Collection

The practice took place in four phases, see figure 3.5. Analysis and reflection of the fabrics produced transpired at the end of each phase. The first phase allowed experimentation with each yarn and pattern type; thus, the interpretation was reflective and sensory.

Those patterns that effectively combined two yarn types were further developed in 3D and sampled in several different yarn combinations during phase 2. At the end of this phase, samples were analysed, and the tactile data was recorded. The criteria utilised to determine how effective each sample included:

- Does the fabric knit down with no imperfections? Is the overall fabric quality good?
- Do the yarns utilised in the sample combine together evenly and regularly?
- Is the sample soft to the touch when handled?
- Is the handle good enough to be worn next to the skin?
- Can the sample be considered innovative? *
- Does the fabric look finished or aesthetically pleasing?

*Innovation means the use of a new idea or method (Cambridge University Press, 2022). Thus, when a sample is perceived as innovative, it signifies that it has been created utilising a new method. I.e., an original pattern designed by the practitioner in a combination of yarns that have combined effectively. More often, samples are referred to as experimental, indicating the fabric is trying to be an original pattern; however, it is not new enough, it is not aesthetically pleasing, or it has not blended the yarns cohesively.

If a sample does not meet the criteria above, the researcher considered whether the sample had the potential to become innovative if it was changed in some way, for example:

- Should the sample be knitted again in a different yarn combination?
- Should the pattern be revised to improve the blendability?
- Does the pattern need a complete redesign?

This recording and analysing of the tactile data was repeated at the end of phases 3 and 4 of the practice.

Throughout the assessment process, three factors were continually evaluated. Firstly, the tactility of the fabric. i.e., how soft the fabric is. Secondly, how effectively the yarn types combine together, and thirdly, whether the researcher deems the patterns created suitable for commercial garments, i.e., the aesthetics or look of the fabric.

- Tactility = softness

- Blendability
- Aesthetics = commercial suitability.

3.7.1 Fabric Softness

This is the most influential factor because the project aims to improve the perceived handle of different British wool yarns through pattern and structure. The researcher assessed the softness of each fabric subjectively through the method of touch or ‘fabric hand’. The fabric is touched and bent by finger and stretched lightly by hand. (Kawabata & Niwa, 1991). To determine how coarse or soft each sample is, the quantitative method of assessing the intensity of the handle is utilised, i.e., whether the sample is very soft, soft, or acceptable (Ahirwar & Behera, 2022). See Chapter 2.3.3 for definition. The softness ratings were recorded in the sample matrix; see Chapter 3.7.3.2.

3.7.2 Blending and Aesthetic Judgement

The second assessment was how effectively the yarn types blended together. This assessment was made utilising both touch and sight and is more intuitive. The researcher visualised how the yarns combine while creating the samples; thus, if blendability could be improved during the making process, she endeavoured to do so. This is an example of thinking through making and tacit knowledge utilised throughout the practice.

A further aesthetic assessment occurred when the tactile data was recorded to assess whether the sample was innovative and would be appropriate as a fabric for apparel. The tactile information was recorded in the sample matrix. The sample matrix can be seen in full in Appendix 6.

3.7.3 Analysing and Visualising the Data Using a Sampling Matrix:

The sample matrix was created to record the tactile data. It is a vast spreadsheet containing every detail gleaned from each ecru sample created. The intention was that compiling the tactile data together would allow each sample's data to be compared and analysed effectively using several different methods (Xue, et al., 2017). The sample matrix enabled the visualisation of the tactile data because charts and tables were developed directly from it. The information held within the matrix can be broken down into several groups.

3.7.3.1 The Sample Makeup:

This information is straightforward but essential if the samples are to be recreated; it is only possible with the information which details how each sample was made. This information is also held on the label of each sample and in the researcher's knitting journal.

- The yarns each sample is made from.
- The number of ends in each sample
- The sample tension, the number of courses and wales that make up each sample.
- The samples pattern type and its variation
- The sample number.

Including this information facilitates greater knowledge of the fabric. For example, if two samples are both considered soft, data may be required to understand why they both feel similar. Have both samples been knitted in the same tension? Do both samples contain the same number of ends of yarn etc.?

	Yarn Types: Creating the Yarn mix										Sample make up						
N	KR	BFL 1	BFL 2	WFW	DH	Tees	Sdown	Texel	Jacob	N	of (	Tensio	course	wales	Pattern	No	Pattern Description
272			1			1				BFL 2 Tees	2 ends (	8.2	60	91	Tuck Jacquard	4	2x1 tuck stitch punchcard w ladder pointell
273	1		1		1					KR BFL 2 DH	3 ends (	8.2	66	101	Tuck Jacquard	4	2x1 tuck stitch punchcard w double ladder
274	1	1			1					KR BFL 1 DH	3 ends (	8.2	66	101	Tuck Jacquard	4	2x1 tuck stitch punchcard with ladder
231	1		1							KR BFL 2	2 ends	9	61	101	Tuck Jacquard	4	2x1 tuck stitch punchcard with ladder
56		1				1				BFL 1 Tees	2 ends	8 & 8.2	60	115	Tuck	3	4x2x2 Tuck stitch with pointelle
264	1		1	1						KR BFL 2 WFW	3 ends (	8.2	61	101	Tuck Jacquard	4	2x1 tuck stitch punchcard w double ladder
328	1		1							KR BFL 2	2 ends (	9	66	71	float Jacquard	4	2x1 rib look with ladder pointelle
158			1			1				BFL 2 Tees	2 ends	9	66	79	float Jacquard	4	2x1 rib look jacqd with ladder/ pointelle
363	1	1		1						KR BFL 1 WFW	3 ends (	9	60	64	Stripe	1	lace and ladder knit
276			1	1	1					BFL 2 WFW DH	3 ends (	8.2	66	101	Tuck Jacquard	4	2x1 tuck stitch punchcard with ladder
283	1		1							KR BFL 2	2 ends (	9	60	103	Tuck	3	Double ladder tuck stitch

Figure 3:19 A screenshot from the sample matrix of the sample makeup information.

3.7.3.2 The Samples Tactility:

Five categories were chosen to assess each sample.

- Softness
- Touch next to skin.
- Texture
- Stretch
- Weight

For each category, a rating has been given between 1 to 5.

For example: Softness: 1 = coarse, 2 = acceptable, 3 = acceptable to good, 4 = soft-good, 5 = very-soft. (These numbers are the quantitative measures of how soft each sample is, this allows one to understand the perceived softness of each sample.)

		Yarn handle rankings: 1 - 5				
Sample N		Softness	Texture	Stretch	ouch next to s	Weight
272	p	5. soft - Very soft	4. very textural	5. Very Stretchy	4. soft	3. Medium
273	la	5. soft - Very soft	4. very textural	4. A good amount	4. soft	3. Medium
274	er	5. soft - Very soft	4. very textural	4. A good amount	4. soft	3. Medium
231	er	5. soft - Very soft	3. Textured	5. Very Stretchy	4. soft	3. Medium
56		5. soft - Very soft	3. Textured	4. A good amount	4. soft	3. Medium
264	la	5. soft - Very soft	3. Textured	4. A good amount	4. soft	3. Medium
328		5. soft - Very soft	3. Textured	4. A good amount	4. soft	3. Medium
158	lle	5. soft - Very soft	3. Textured	4. A good amount	4. soft	3. Medium
363		5. soft - Very soft	3. Textured	5. Very Stretchy	3. Acceptable	4. light
276	er	4. soft - good	4. very textural	5. Very Stretchy	4. soft	3. Medium
283		4. soft - good	3. Textured	4. A good amount	4. soft	4. light
410		4. soft - good	3. Textured	4. A good amount	4. soft	4. light

Figure 3:20 A screenshot from the sample matrix of the ratings used to assess each sample.

The grading system was based on the tactility charts utilised by Mahar, et al., (2013) whose charts used a rating system from 1 - 11. The survey compares many fibre types, requiring an extensive grading system. This was not needed for this project as the fibres were selected to be as similar as possible; thus, the comparisons are within a single fibre type and count. Five points were chosen to determine the quantitative intensity of each category. The words chosen to describe each sample came from the outcomes of the journal assessment and the acknowledgement of the popularity of these terms. (See Appendix 3)

At the end of the project, the five categories were employed to rank the samples in order of overall perceived softness. A downside of only rating the samples between 1 and 5 was that there needed to be more differentiation between the samples. Thus, the weighted rating system was developed. This system prioritises the two most influential categories, perceived softness through the handle and perceived softness next to the skin. Stretch, weight, and texture are other factors which influence a fabric's overall tactility; hence they were recorded in case any correlations could be seen when the results were collated. These factors were included in the weighting.

Stretch was included due to the findings in the literature. Theoretically, stretchiness should correlate to softness. I.e., the stretchier fisherman's ribs were found to be the softest in the research by Choi & Ashdown (2000). Weight relates to the commerciality of the fabric; again, theoretically, for the case of this research study, it has been assumed that a lighter fabric is preferable. The outcomes of the interviews supported this assumption. At the beginning of the project, it was assumed that texture would improve the tactility of the fabrics by adding stretch, open areas, and interest and enabling less of the coarser fabrics to be next-to-skin; hence those samples with more texture ranked higher than those without. The conclusions and the interviews divulge this was not always the case, which shows that the inclusion of texture has not overtly affected the results.

The percentages distinguish how valuable each component is to the overall tactility of each sample (Martin, 2019, p. 252).

- 42.5% Softness
- 42.5% Touch next to skin
- 5% Texture
- 5% stretch
- 5% weight

Sample N	Rough ranking (Softest sample to coarses Overall Score (42.5% Softness, 42.5% Touch, 5% Texture, 5% Stretch, 5% Weight	Overall Rank
272	4.425	1
273	4.375	2
274	4.375	2
231	4.375	4
56	4.325	5
264	4.325	5
328	4.325	5
158	4.325	5
363	4	9
276	4	10
283	3.95	11
410	3.95	11

Figure 3:21: A screenshot taken from the sample matrix of the overall sample ratings.

3.7.3.3 Qualitative Information Concerning the Sample.

Sample N	Is this sample innovative?	Stitch assessment	3 descriptive words to describe the sample and its handle 1st word	2nd word	3rd word
272	6. Yes	fancy	airy	hairy	cosy
273	3. No. Experimental	Simple	spongy	fuzzy	light
274	2. No. Simple/ commercial	commercial	spongy	light	drapey
231	2. No. Simple/ commercial	Simple	spongy	soft	silky
56	4. Potential with further manipulatio	fancy	hairy	fluffy	silky
264	3. No. Experimental	Simple	spongy	fluffy	stretchy
328	6. Yes	fancy	silky	smooth	pliable
158	6. Yes	Innovative	hairy	velvety	silky
363	6. Yes	fancy	light	drapey	delicate
276	6. Yes	fancy	stretchy	spongy	lofty
283	6. Yes	fancy	flat	light	drapey
410	6. Yes	fancy	fuzzy	holey	light

Figure 3:22: A screenshot taken from the sample matrix of the qualitative tactile data recorded from each sample

An Overview of the Pattern

This single-word description evaluates the overall aesthetic of the fabric; the words are simple[6], fancy[7], commercial[8] and innovative.

Three Descriptive Words:

The sensory descriptors were selected from the word bubbles generated from the outcomes of the journal article review (Appendix 3) to describe the researcher's response to each sample. By collating the language within the matrix, it is possible to identify the number of times each word was used to describe a sample. Charts were created from the matrix to represent this data and reveal the most common descriptors. Word clouds were utilised to interpret these charts and understand the 'meaningful' language collected. They were considered an appropriate method of data interpretation as they are straightforward and visually appealing methods of engaging the viewer with the collated language (Martin, 2019, p. 256). The clouds utilise effectiveness and perception, i.e., the properties with the most significant effect on those experiencing them. These were font size, weight, and colour (Heimerl, et al., 2014).

The clouds were created in a Python library (Mullar, 2022). The size of each word represents its frequency in the total universe. Colours were selected for easier visualisation of the terms. The word clouds represent the researcher's sensory response to each sample and have been collated and visualised by individual yarn types and in each pattern group. Word clouds were also used to disseminate the phenomenological data collected from the interview participants.

[6] Barbara Walker's treasury of knitting patterns first chapter is called 'Simple Knit-Purl Combinations. This refers to a pattern which knit professional deems as basic, core or structural. (Walker, 1968, pp. 9-37)

[7] Fancy is commonly used terminology by knitters to describe a decorative pattern. The same book has an entire chapter devoted to 'Fancy Texture Patterns', a term which describes many of the more decorative patterns developed by the researcher. (Walker, 1968, pp. 128-146)

[8] These are patterns which are commonly found on commercial garments in mass-market stores. These patterns include ribbing, cables, or basic tuck combinations.

Figure 3:23: A word cloud disseminating every sensory descriptor recorded in the sample matrix.

3.8 Interview Rationale

The project intended to understand consumer perceptions around 'softness'. Therefore, it was essential to ascertain the consumer's perceptions of British wool and discover whether it is a fabric they would consider wearing. To do this, the researcher undertook a series of six individual interviews, during which they enquired about the participant's perceptions and associations with wool. The participants' sensory descriptors were documented and compared to the descriptive language collated in figure 2.13, which has been utilised throughout the research study. This descriptive language visualised the participant's sensory response to each fabric and has been collated in a number of word clouds.

The interviews revealed whether the participants agreed with the findings of the research undertaken. If the participant's responses did not agree with the findings of the practice, there was time to reflect further, review the sample collection, and re-visit some of the blends and patterns before creating the final swatch library. The interviews set out to divulge which samples the interviewees thought were the softest and roughest to handle and to discover whether they would consider wearing any of the fabrics created. If so, this could indicate that the fabric blends were effective.

3.8.1 The Interview Process

Six individual interviews took place online after Phase 3 of the practice. Individual online interviews were selected as the method of data capture because interviews allowed an external audience to respond to the practice directly (Denscombe, 2014, p. 184). The questions were designed to encourage the participants to describe their perceptions and responses to the samples. The interviewer looked to interpret how they sensed the samples and whether the reaction was emotive, positive, or negative. Individual interviews enabled everyone to participate equally in an environment they felt comfortable in. Individual interviews prevent one or more people from dominating the conversation, while others may not respond or agree with others. By conducting the interviews individually, participants could respond in their own time, expressing their sensed experience without influence from louder voices within a group. It also ensured that everyone responded with the language they typically use in everyday conversations rather than mimicking others.

A challenge associated with undertaking individual online interviews rather than hosting an in-person focus group was that it was not possible to exhibit the samples as a collection. Instead, each participant required their own set of samples to analyse. Thus, the researcher edited and selected a small range of fourteen samples to re-knit. The samples were selected using the tactile data compiled in the sampling matrix, which determined the best sample combination to represent the range of yarns, patterns and handles in the collection. The process undertaken to select the sampling is detailed at the beginning of Chapter 6.

Individual sample packs were created and distributed to each participant for assessment. (This way, multiple people did not handle samples.) Multiples of each sample were made one at a time, so they were all almost identical. The sample collections, interview questions, and consent forms were individually packaged before being sent for review.

The outcomes of the interviews were analysed before being visualised into a series of charts and word clouds which interpret both the common language and the whether the participants agreed with the researcher's findings regarding each sample's tactility. The outcomes influenced the types of samples created during Phase 4 of the practice and the final curation of the sample collection.

3.8.2 The Interview Structure

The interview questions were semi-structured; they asked the same questions to each participant, but there was time for the participant to talk freely within each question. The focus was inviting the candidates to rate the fabrics in order of softness and use descriptive ‘meaningful’ language to describe the samples.

Each interview lasted between forty minutes and one hour. The questions were divided into three clear sections intended to make the process less daunting. The first section introduced the subject of wool to each participant; it allowed for a discussion regarding wool fibres, the participant’s experience of wool, and their understanding of fabric softness.

The second section of the interview focused on the sample collection. The samples and interview questions were provided in advance of each interview; this enabled the participants to examine the samples and determine how they might respond to the questions in advance of the interviews, which allowed more time for discussion, including determining why the participants responded to each of the fabrics in the way they did.

The third section questioned handle versus aesthetics. This was to discover how aesthetics influenced each participant’s decision-making when rating, describing, and responding to the fabrics.

Number	Questions
	Section 1: What is wool?
1	What are your opinions of wool? (Do you have any preconceived thoughts regarding the fibre?)
2	Is wool a fabric which you would choose to wear? (Y/N) and what are your reasons for this?
3	How would you describe softness?
4	In your experience what is soft?
5	Do you have any insights into describing roughness or hardness?
	Section 2: The sample collection
6	Can you try to rank the samples in front of you from 1 -14 in order of softness. (1 being the softest and 14 being the roughest/ hardest.)
7	Talk me through your decision making process when ranking the sampling? (What are your reasons for ranking the samples in this way?)
8	Are there any samples which stand out to you? If so why is this? (Which are your favourites and why?)
9	Can you choose a maximum of three descriptive words to describe each of the samples in front of you?
10	Looking at the list of words on the screen, are there any further words you would choose to describe each of the samples?
11	Would you wear a garment made any of these fabrics next to your skin? Y/N. Again what are your reasons for wearing/ not wanting to wear these fabrics?
	Section 3: Handle versus Aesthetics
12	Do you think the look of the samples influenced your decision making, when ranking the samples from hard to soft? Why is this?
13	Do you think the look of the samples influenced your decision making when choosing a favourite sample? Why is this?
14	When considering buying a garment, what is more important to you: the look of the garment or the materials the garments are made from? What are your reasons for your choices?
15	Do you find it's harder or easier to review the samples, when there is no diversity or range in colour in front of you?

Table 3-1 The interview questions.

3.8.3 The Participants

The project's rationale explains that the fabrics created during the doctoral study will be aimed at the UK's everyday garment market. These shops predominantly target younger shoppers, so it is imperative that those undertaking the interviews were young but not necessarily people who would typically choose to buy woollen garments. Thus, the age group selected to participate in the study were students between 18 and 25. The intention was to advertise the sessions within the university openly. However, due to the on-campus study being prohibited, a targeted sampling method was chosen to select between six and eight students to participate in the research project.

3.9 Photography and Digital Swatch Library

Every sample has been documented in a series of photographs showing the sample's front, back and details. Many of these photos can be seen throughout the thesis. The photographs are also collated in the form of a digital swatch library. The link is below:

https://juliamarywilmott.wixsite.com/newyarnblends

3.10 Possible Variables of the Study

A number of variables were taken into account before the practice began.

- **Each yarn's spinning parameters:**
  This is likely the most significant variable within the study, as no two cones purchased within the same yarn type are the same. How tightly the yarn has been spun will affect the knitting properties and how well the yarn stands up to washing, wear and handling. The researcher cannot influence this variable but should record any yarns that are very loosely spun or ends which are unravelling when knitting.
- **Maintaining a consistent standard of sampling and finishing**
  This is possible if the research methods are followed. Every sample was knitted as if it was a final sample to achieve consistent fabric quality.
- **Maintaining a consistent sampling size**
  Samples have been knitted to the exact physical dimensions rather than knitting to a defined number of courses and wales; this is to allow for different properties between pattern types. Therefore, some fabrics are almost double the number of wales to other samples.

3.11 Ethical Recommendations

Ethical approval has been granted for the doctoral practice.

Most of the study did not require ethical scrutiny because the practice was undertaken in either the researcher's own workshop or using university facilities which have already been risk assessed. No one else undertook the knitting practice; thus, no participants handled any machinery.

The interviewees signed an informed consent form before beginning the interview. The discussions started with the researcher explaining the purpose of the sessions, how the sessions will influence the study and how the information collected during the sessions would be utilised. None of the candidate's personal information has been divulged.

4 Yarn

Figure 4:1 Detail of sample 272. A 2x1 tuck-jacquard structure with ladders and pointelle.

4.1 Exploring Sheep Breeds

The United Kingdom has an extensive and diverse sheep population (British Wool, 2022). This chapter evaluates several available breeds to determine why the fibres were appropriate for the project. The evaluation transpired before the practice began because the yarns were required for knitting. To choose the most appropriate yarns, several variables were considered.

- The location the sheep originates from.
- The cost of the raw fleece at the market.
- The availability of fleece in the market.
- The availability of the yarn once spun as an unbleached fibre in cone form.
- The count of the yarns available.

There are already various 100% British-wool coned yarns on the market that fashion brands could utilise. These yarns contain wool from British sheep, but the breeds, quality, blend or whether the wool is recycled is not determined. This research focuses on the tactility of breed-specific fibres and how they interact and behave when they combine through pattern. The study anticipates that utilising breed-specific yarns will increase consumer understanding and knowledge of British wool fibres as a material which is comfortable to wear.

Many single-breed fibres are available in balls or hanks for craft use. However, it is more difficult to source single-breed woollen fibres on a cone which is how most knitwear professionals require the yarn. The yarns were narrowed down organically based on breeds available in the market, on a cone and in a count fine enough to knit on a Brother domestic knitting machine. The counts which are most appropriate range from 2/6Nm to 2/15Nm. These yarns are also referred to as DK, 3ply or 4ply yarns.

The researcher was looking for a fibre already being spun into yarn to evaluate its potential for use in the commercial market. The yarn should not be too expensive as this would be a perceived barrier to many buyers, but because fleece prices have fallen, this factor became less of a concern. Figures 4:2 - 4:5 visualise the mapping process undertaken to discover those breeds most appropriate for the study. The breeds were sorted by location because if breeds are considered too rare, it may be difficult to meet production demands. As the researcher began the project in the Northeast, it initially intended to focus on yarns from this area, but these yarns were difficult to source, so the sourcing area was increased to include breeds available throughout the UK. Different colours have been used to visualise the four stages of the sorting process.

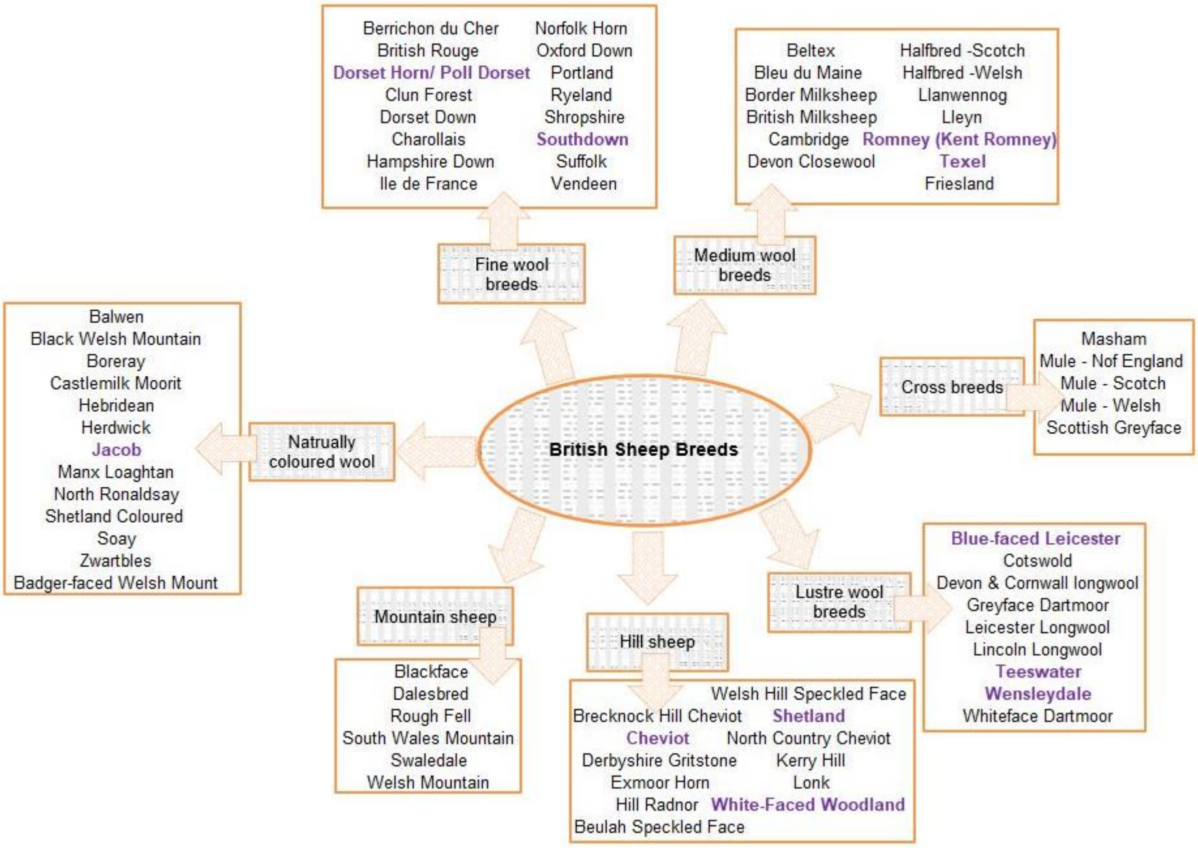


Figure 4:2 Stage 1, mapping sheep in order to determine the most appropriate yarn types for the study. This diagram breakdowns every British sheep breed by type (British Wool, 2010).

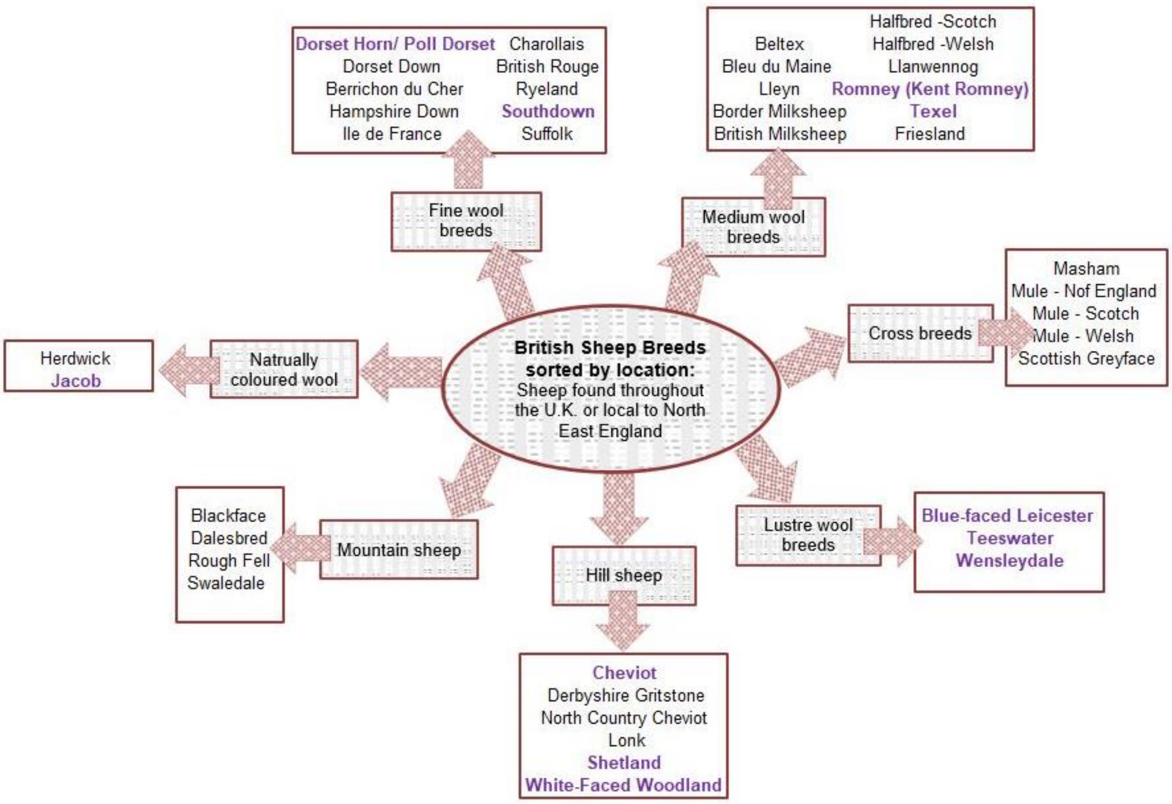


Figure 4:3 Stage 2, sorting sheep type by location. Sheep available throughout the UK or Northeast of England were considered appropriate for the study.

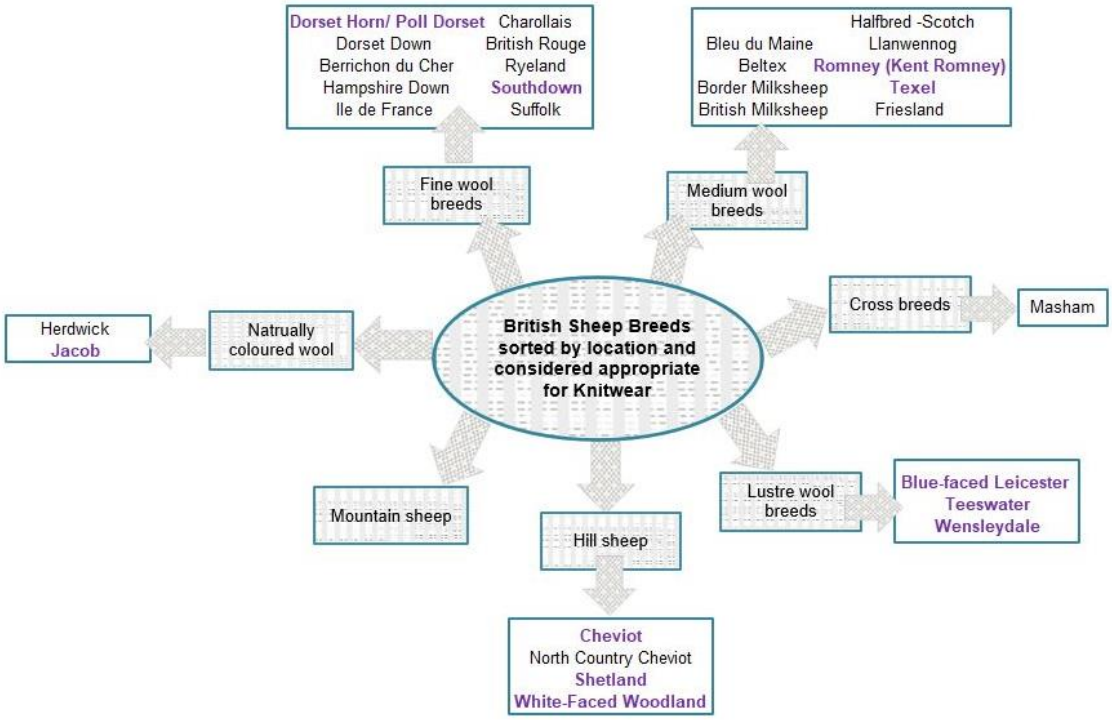


Figure 4:4 Stage 3, sorting sheep from an appropriate location whose fleece is suitable for knitting yarns. This information was sourced from Appendix 5 and (British Wool, 2010).

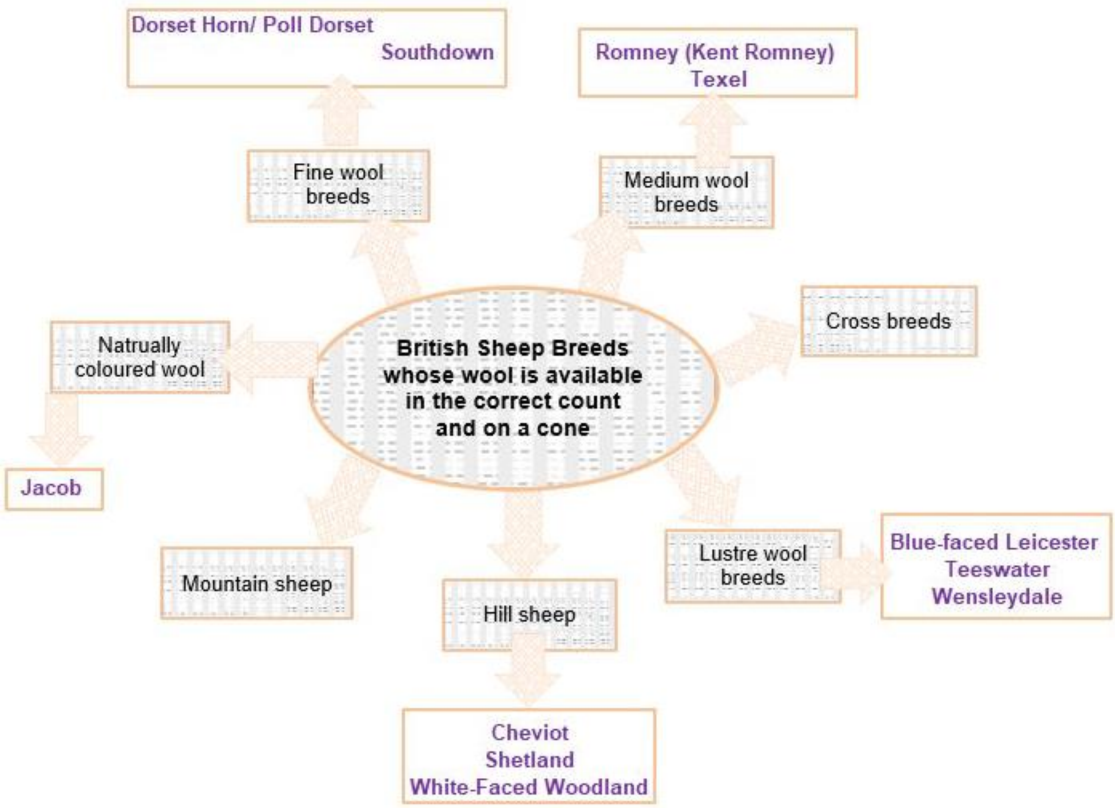


Figure 4:5 Stage 4, sorting sheep from an appropriate location, whose fleece is suitable for knitting, which was available to buy on a cone in the right count in 2019, when the materials for the project were sourced.

After considering each factor, ten different types of yarn were sourced and experimented with.

The yarns were:

- KR
- BFL
- Southdown
- Texel
- Teeswater
- WFW
- Cheviot
- Shetland
- Jacob
- Wensleydale

All of these yarns are highlighted in purple in Figures 4.2 - 4.5.

These yarns were knitted and tested in several patterns to determine their properties. Ten types of yarn were considered too broad to work with during the project as it would be difficult to explore every yarn combination thoroughly. The findings of each yarn's properties were considered, but the following yarns were not investigated further.

4.1.1 Cheviot

This yarn sourced is very bulky and too chunky for the machine (around 2/2Nm). It was impossible to source an unbleached yarn on a cone in a suitable yarn count. Originally the researcher intended to untwist the yarn and use one of the plies to sample with, as the yarn is twisted very loosely. Unfortunately, this process affected the quality of the test fabric. This is because the single-plied yarn tends to spiral, especially if they have been pre-twisted. Two chunky yarns were sourced, but the Texel fibre was considered more appropriate because it was cheaper and theoretically softer. The Texel fibre was utilised for weaving and inlaying rather than knitting directly; thus, two chunky yarns were considered unnecessary.

Figure 4:6 Cheviot Yarn in a chunky count, twisted and untwisted.

4.1.2 Wensleydale

This yarn was the right weight and a good handle, but its properties are almost identical to the Teeswater. Teeswater is a more widely available fibre, and the price was lower per kg when the decisions were made.

4.1.3 Jacob

This yarn was only available in 2/4Nm. The yarn would knit through the machine on every other needle, but it was hairy and difficult to manipulate. It is the same weight as the Southdown, but its handle is not as soft. The properties of Southdown are more appropriate to the project. Only one 2/4Nm weight yarn was required.

4.1.4 Shetland

Although this yarn was sourced for experimentation and testing, it was decided that it is too well-known, and the project should focus on underutilised and underpromoted breed types.

Therefore, the breeds selected were:

- KR
- BFL
- Southdown
- Texel
- Teeswater
- WFW
- DH**

* One yarn was introduced later: the DH. This was because it became available on a cone in the correct count. It was a yarn that met the initial criteria. As determined by the practice, this was a good decision.

Figure 4:7 Examples of single-breed type British wool yarns on a cone.

Of the yarns selected, five breeds are considered standard, and two are considered vulnerable, the Teeswater and the WFW. Ultimately, it may mean these sheep have less availability, and acquiring more significant quantities of these yarns could be challenging. However, this should not be a problem as the yarn is already available in cone form, and the researcher uses each of the yarns as a blend. It was anticipated that each sheep breed could produce enough wool for small design features within garments if there was a demand for it.

4.2 Attributes of the Yarns Selected

Before knitting, the yarns were assessed theoretically to determine how appropriate they were to the project. Each yarn's fibre diameter was evaluated and rated from softest to hardest. A yarn with a smaller fibre diameter is theoretically softer than a wider fibre.

1. BFL = 26-26.5 microns
2. Southdown = 29-30.5 microns
3. Texel = 31 – 34 microns
4. KR = 31.5 – 34 microns
5. WFW = 32 -33 microns
6. Teeswater = 32.5 – 34 microns
7. DH = 33-34 microns

Using the 2019 prices of fleece per clip (British Wool, 2019), the yarns were rated from cheapest to most expensive. One is the most affordable, and seven is the costliest.

1. Southdown (£0.56/kg)
2. WFW (0.62 – 0.92/kg)
3. Texel (£0.66/kg)
4. DH (0.74/kg)
5. KR (£0.75/kg)
6. BFL (3.40/kg)
7. Teeswater (6.00/kg)

These factors determine that, theoretically, the Southdown yarn has the potential to be the most appropriate yarn for the project and create the softest fabrics when knitted. However, Southdown and Texel fibre could only be sourced in a chunky count. The count of the yarn determined that these fibres could not be knitted in every pattern type; thus, the researcher developed methods to creatively incorporate these yarns into the samples. Theoretically, these factors determine the Teeswater as the least appropriate yarn. However, as this yarn was sourced in the correct count, it was used throughout the practice.

Therefore, the selected yarns were divided into two groups: principle yarns and auxiliary yarns. Principle yarns are the five types of yarn used throughout the practice in every pattern group. (KR, WFW, DH, BFL, Teeswater). The Texel and the Southdown are auxiliary yarns, utilised in some pattern groups when it was possible to combine them.

4.3 The Chosen Breeds

To better understand each of the yarns and their properties, the researcher completed a detailed knitted exploration of the five principle yarns in every pattern type. Eight samples were knitted in five yarns. The patterns were:

1. Single-faced knit.
2. Plain knit with ladders.
3. Plain knit with pointelle.
4. 1x1 birds-eye float-jacquard.
5. 2x1rib-look float jacquard.
6. 1x2x2 hand-manipulated tuck.
7. 2x1 tuck-jacquard.
8. 1x1 inlay samples.

Phots of the samples and a summary of the yarn and each of their properties can be found below. Information regarding each breed was collated from several sources, including British Wool (British Wool, 2010), the Natural fibre company (The Natural Fibre Company, 2017) and The Fleece and Fibre sourcebook (Robson & Ekarius, 2011).

Figure 4:8 The eight patterns were tested in five yarn types. Their properties are documented below.

4.3.1 Kent Romney (KR)

Figure 4:9 Kent Romney Yarn.

Established in the Romney Marsh region of Kent in the thirteenth century, the sheep have been bred and evolved to produce good-quality meat and fleece. The wool ranges in quality from coarse to fine.

- Fleece Weight: 3-5kg
- Microns: 31- 34
- Staple length: 10 -17 cm
- Fleece colour: white/ creamy
- Price per clip (2019): Romney Hog £0.75 [9] (British Wool, 2019)
- Price per clip (2021): Romney Hog/ Ewe £0.42. Lambs £0.64 [10] (British Wool, 2022)

KR has many advantages, including a low price, a high fibre yield per fleece for spinning and a relatively soft handle. The sheep are predominantly located in Southeast England.

This fibre has an acceptable to coarse handle. While it is considered possible for this fibre to be worn next-to-skin is not soft and would benefit from being combined with a softer yarn.

- This fibre is hairy; lots of long loose staples and fuzz protrude from the strand, which has shed when knitting and throughout the washing and steaming process.
- There are also several thicker white coarse fibres (Kemp) which come loose from the fibre during the knitting process. They can be pulled out easily. If these fibres

[9] These were the clip prices when the researcher was purchasing yarn for the project. The researcher began researching yarns in 2017 but bar the Teeswater most prices remained stable between 2017 and 2019. 2017 Prices can be accessed here: (British Wool, 2017)

[10] These prices are taken from the most up to date at the time of submission. Prices have changed over the course of the PHD which means some yarns initially selected for price are more or less valuable than they were.

were not extracted, the end fabric could be pricklier as these white fibres are relatively coarse and sharp.

- The yarn knits well. It is a reasonably thick fibre which knits and can be manipulated more effectively on a loose tension.
- It would benefit from blending with a smoother or tighter spun yarn.
- Its texture is limp, knitted in flat open patterns, such as inlay or ladders. The handle is improved when knitted in patterns with more volume.

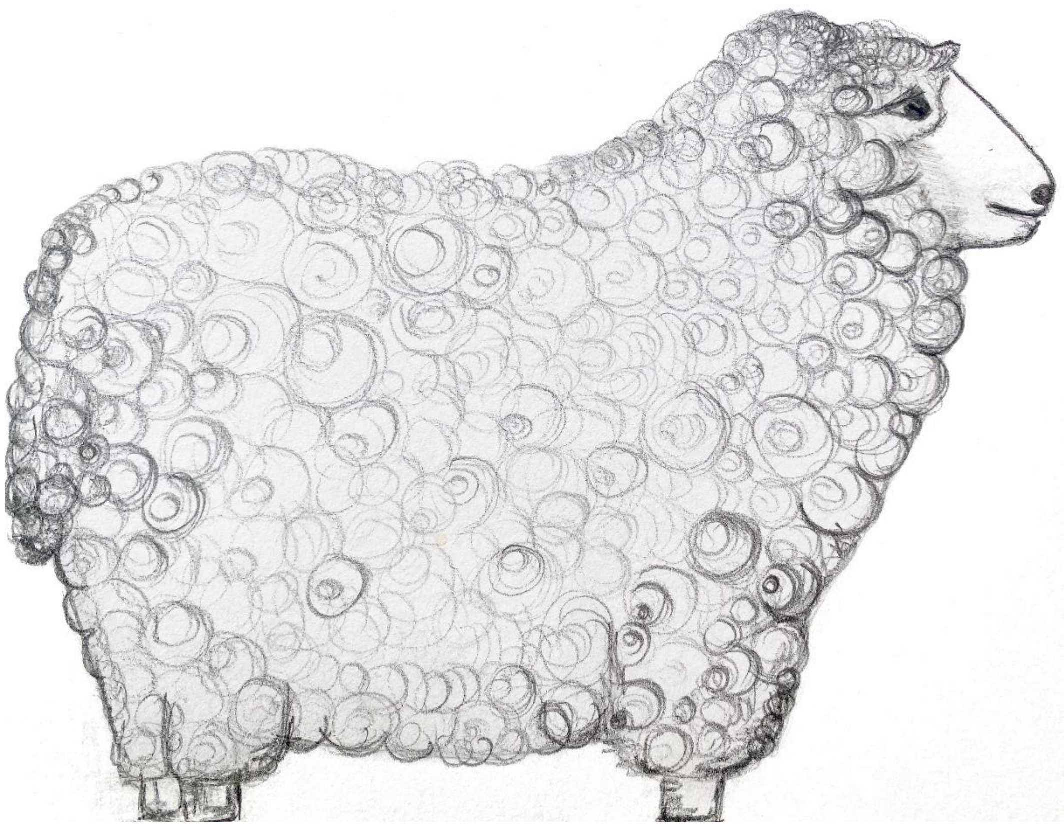


Figure 4:10 Pencil study of a Kent Romney Sheep.

4.3.2 White-faced Woodland sheep (WFW)

Figure 4:11 White-faced Woodland Yarn.

The sheep originate from the south Pennines and are probably related to the Swaledale or Lonk sheep. They are hardy sheep located both in the hills and nearby lowlands. Their wool is most commonly used for carpet production. However, the yarn handle is known to be inconsistent and can also produce one of the softest handled fibres by a hill-bred sheep.

- Fleece weight: 2- 3 kg
- Microns: 32-33
- Staple Length: 10-15 cm
- Fleece colour: White
- Wool grading: Hill
- Price per clip: (2019) £0.62 - £0.92
- Price per clip: (2021) £0.34 - £0.39

The handle of this fibre is the coarsest of the yarn selected and benefits from blending with a softer yarn. On its own, its handle is hard, dense, and flat.

- It is a strong yarn which is well spun and has not shed many staples during the knitting or finishing process. However, there are a lot of fuzzy hairs protruding from the strand itself. The fuzzy ends can be pulled from the strand but do not fall away easily. The fuzziness makes the yarn feel softer.
- This yarn is manipulated more effectively when knitted on a loose tension.
- The yarn is more successful when the pattern is open; thus, the fabric is not too dense. The yarn needs to be blended if the pattern is more sculptural.

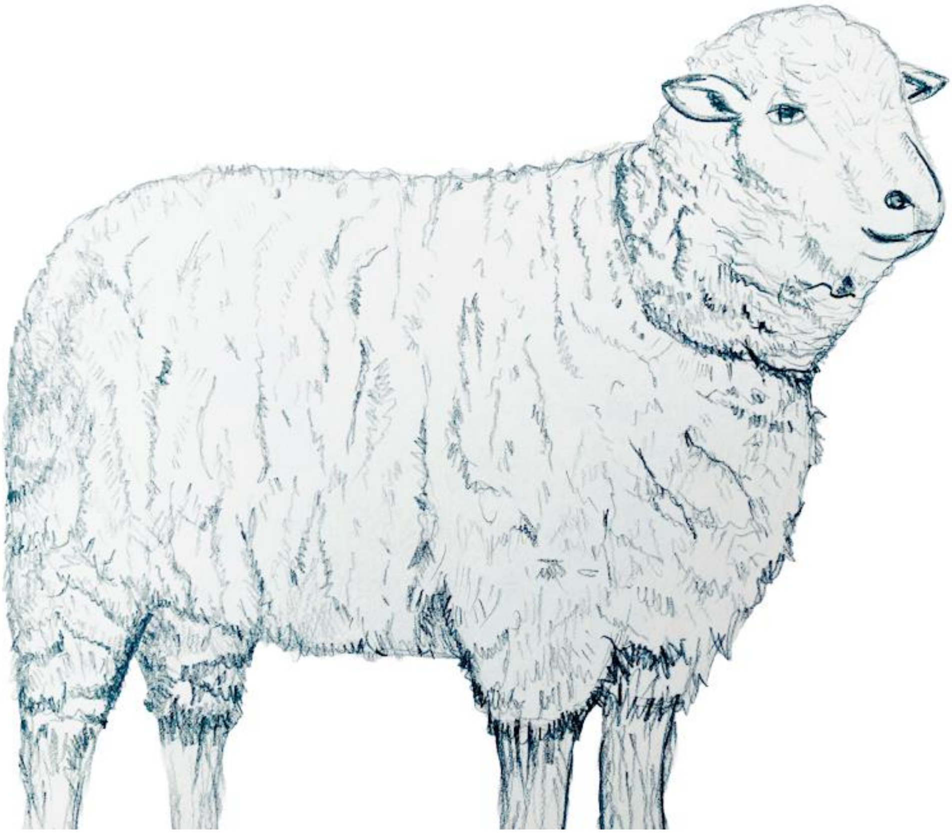


Figure 4:12 Pencil Study of a White-faced Woodland Sheep.

4.3.3 Dorset Horn: (DH)

Figure 4:13 Dorset Horn Yarn.

DH is an ancient British breed, although the first flock was not recorded until 1891. The wool is high quality, white and very dense. Specialist flocks are located throughout the UK.

- Fleece weight: 2.5 - 3kg
- Microns: 33-34

- Staple Length: 8-10 cm
- Fleece colour: White
- Wool grading: Fine
- Price per clip (2019): £0.74
- Price per clip (2021) Ewes/ Hogg's: £0.40 Lambs: £0.38

The yarn has a dry handle and is probably the closest to an acrylic yarn in appearance and handle. It is not hairy and is an extremely easy fibre to knit with.

- The look of the fibre is relatively smooth and dry, with only a small number of long hard staples protruding irregularly from the fibre. These are more visible when the yarn is knitted. There is a small amount of fuzz.
- Minimal fibres and impurities were shed during the washing process. The water is also less discoloured; therefore, less grease and impurities ingrained in the yarn.
- This yarn knits easily; the samples created are of good quality and do not feel 'itchy.' It is spongy and springy and adapts well to sculptural, textured patterns.

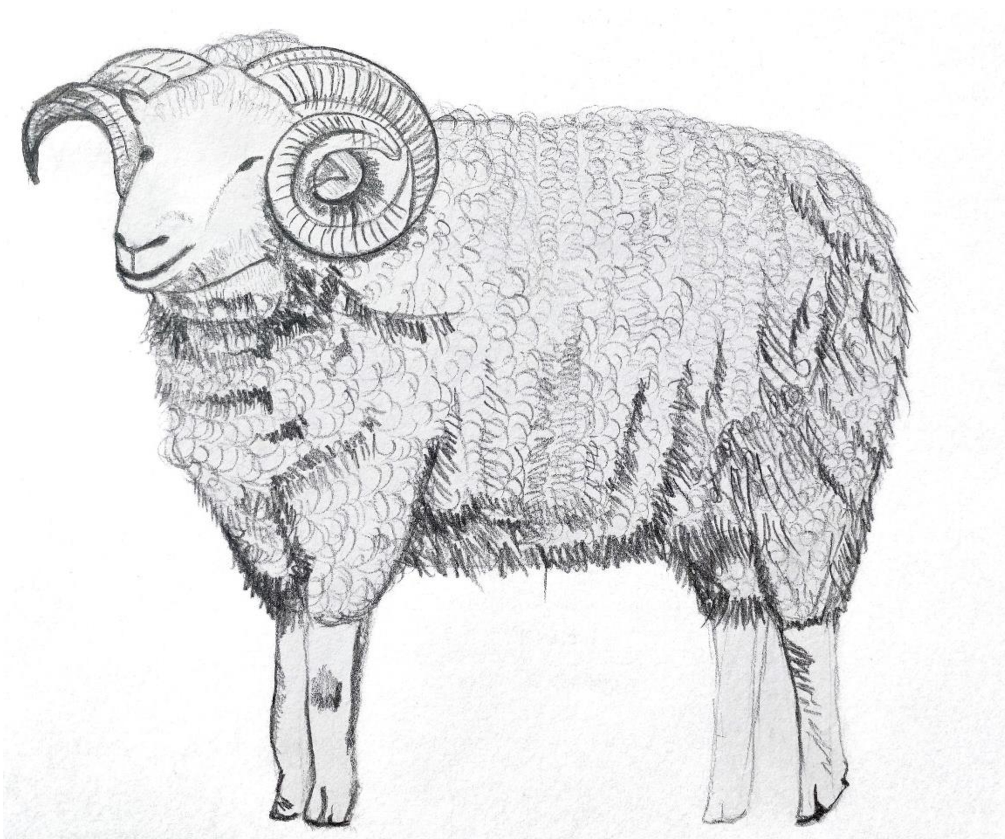


Figure 4:14 Pencil study of a Dorset Horn Sheep.

4.3.4 Blue-Faced Leicester Sheep (BFL)

Figure 4:15 Blue-faced Leicester Yarn.

BFL was established in the eighteenth century and developed in the Northeast around 100 years ago. The fleece is delicate and soft with a semi-lustre feel. The fleece is uniform; most have similar micron counts, fibre lengths and weight. The fibre blends well with other fibres and is readily available in the UK.

- Fleece Weight: 1-2kg
- Microns: 24-26.5
- Staple length: 8-15cm
- Fleece colour: creamy white
- Price per clip (2019) £3.40
- Price per clip (2021) £5.50

Theoretically, the BFL has the most favourable properties, but the fleece price is relatively high compared to other yarns. The fleece has held and increased its value during the project. This is a more expensive yarn, so blending this yarn with cheaper wool should create a more affordable fabric.

Once knitted, it was established that it is the softest yarn and does not require blending with another yarn to improve its handle. It is intended that this yarn will improve the handle of other yarns. Two qualities of this yarn have been used during the practice: a 2/8Nm version and a finer 2/16Nm sock weight. The reason is that only the 2/16 weight was available when the project began. The 2/8Nm version was purchased when it became available. The yarn analysis was undertaken in this version as it has more similarities to the other yarns used throughout the practice.

- The fibre has a natural sheen to it, which gives the impression that it is pretty smooth when it is quite hairy, with many small staples coming away from the yarn.

Many fibres and impurities shed during the washing process; the water was dirty. This could indicate that the yarn is naturally greasier than the other yarn types.

- This yarn is easy to knit with, although the fibre tends to split, so care needs to be taken when transferring loops.
- This yarn handles well in every pattern type. Even the pointelle sample is soft.

Figure 4:16 The two counts of BFL side by side. BFL 1 (2/8Nm) on the left and BFL 2 (2/16Nm) on the right.

4.3.5 Teeswater Sheep (Teeswater)

Figure 4:17 Teeswater Yarn.

Teeswater sheep were developed in County Durham during the nineteenth century and improved during the 1950s. They are described as having “long, lustrous, shiny wool”. The locks hang individually and do not clump together (Robson & Ekarius, 2011).

- Fleece Weight: 3 – 6 kg
- Microns: 32 – 34
- Staple length: 15 -30 cm
- Fleece colour: White
- Price per clip (2019) £6.00
- Price per clip (2021) £5.00

Since the research began, the price of Teeswater has risen (£2.80kg in 2017 to £6.00kg in 2019). Although the price has dropped again, it is still costly; blending it with a cheaper yarn should improve this. Therefore, the yarn can be considered a specialist fibre. The texture and handle of the yarn are pretty different to other yarns. It is one of the softer yarns, so theoretically could improve the handle of other yarns.

- The yarn is very hairy, with many long staples protruding from the fibre; on top of that, many smaller staples can be seen, making the yarn look hairy and fuzzy.
- The yarn feels hairy and soft, but it is not necessarily soft to touch as the hairs are long and feel quite prickly when knitted, particularly in an open structure.
- It sheds lots of fibres during the washing process.
- It knitted well in every pattern type.

Figure 4:18 Pencil study of a Teeswater Sheep.

4.3.6 Southdown Sheep (Southdown)

Figure 4:19 Southdown Yarn.

These sheep were established as the breed known today in 1893. There are three types of Southdown sheep, but medium-sized sheep are used in commercial agriculture. The wool from the sheep is delicate and soft.

- Fleece weight: 1.5 -2 kg
- Microns: 29 – 30.5
- Staple Length: 4-6 cm
- Fleece colour: Creamy/ White
- Grading: Fine
- Price per clip (2019): £0.56
- Price per clip (2021): £0.35

Overall, the handle of the yarn is good, but the weight of the yarn sourced means it is too heavy to knit in every pattern type,

- This yarn is very white, smooth with few long staples protruding from the fibre. It only has a small amount of fuzz surrounding it.
- The yarn feels soft and spongy.
- It knits well and doesn't shed too much during the washing process.

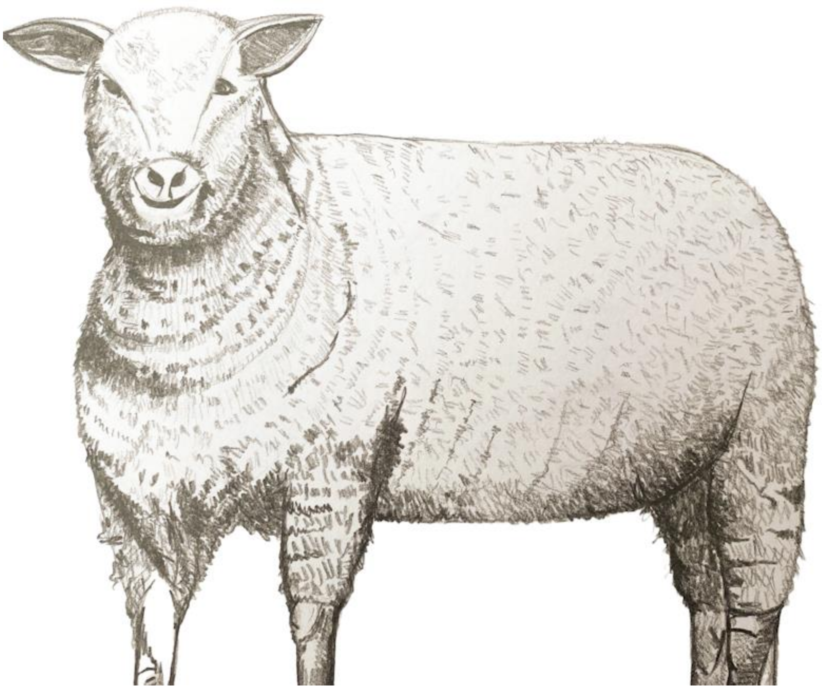


Figure 4:20 Pencil study of a Southdown sheep.

4.3.7 Texel Sheep (Texel)

Figure 4:21 Texel Yarn.

The Texel breed was introduced into the UK from the Netherlands in the 1970s. Texel's have a matte white fleece of medium softness. The breed is primarily known for meat, which is a reason to promote and use this fleece, as the fleece will always be a by-product if the sheep is famous for meat.

- Fleece Weight: 2.75 – 3.5 kg
- Microns: 31 – 34.5
- Staple length: 7-14 cm

- Fleece colour: White
- Price per clip (2019) £0.66
- Price per clip (2021) £0.45

The Texel has commercial properties, and the yarn handle is good, but it is too chunky to be knitted in every pattern type.

- The yarn is very loosely spun; it is 3ply but separates easily when knitting.
- No large stapes protrude from the fibre, but much fuzz is visible.

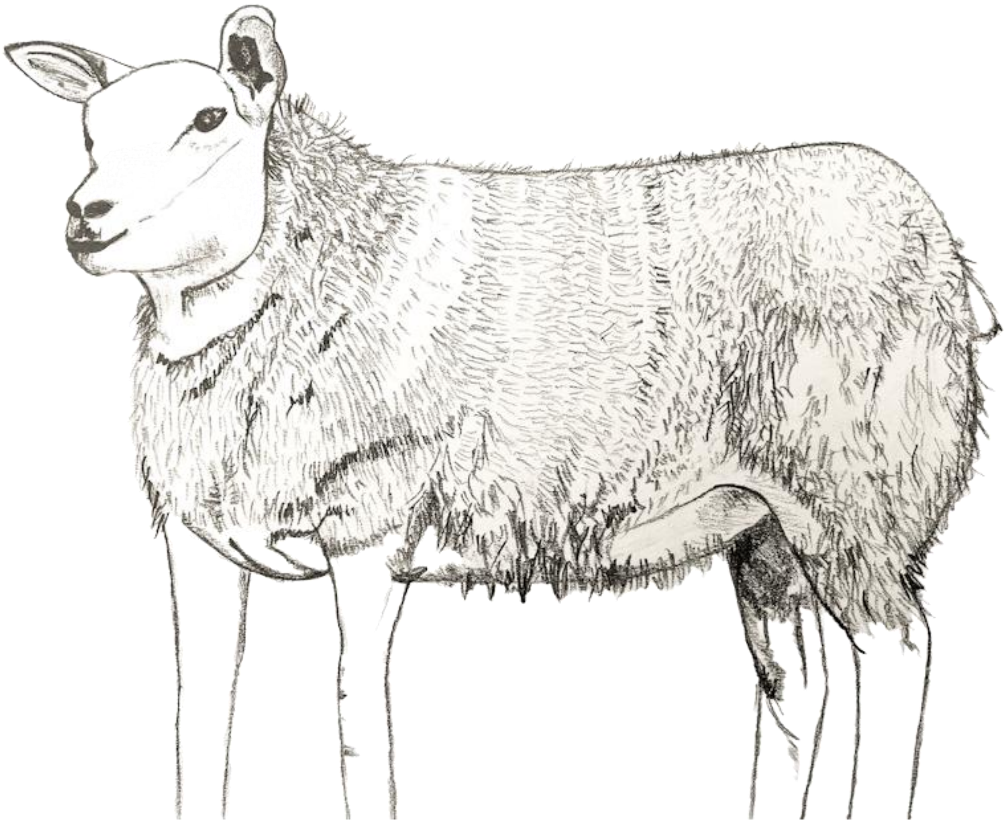


Figure 4:22 A Pencil study of a Texel Sheep.

4.4 Comparison yarns

Along with the 12 blended British wool samples (See chapter 6.2), the researcher also provided each participant with two further fabric swatches during the interview process. These swatches were to help the participants differentiate between the softness and coarseness of each sample and provide them with a consistent comparison of fabrics they should already recognise.

4.4.1 Merino Wool

An unbleached fibre in the exact count and sourced from the same supplier as the British wools were knitted. Merino wool is typically regarded as the softest quality wool. It is likely that the samples created will be less soft than the merino fibre. The reason for providing a Merino swatch to the participants was to discover whether any of the British-wool samples would be considered comparable to the Merino in terms of softness.

Figure 4:23 Merino yarn knitted up and on a cone.

4.4.2 Acrylic

A single-ply 2/28's Nm acrylic fibre was knitted, although three ends of this yarn were required to knit the fabric. This is a quality used by most commercial retailers; thus, the handle of this swatch should be familiar to the interview participants. The researcher intended to determine whether the British-wool fabrics created during the practice were comparable in handle to the acrylic fabric.

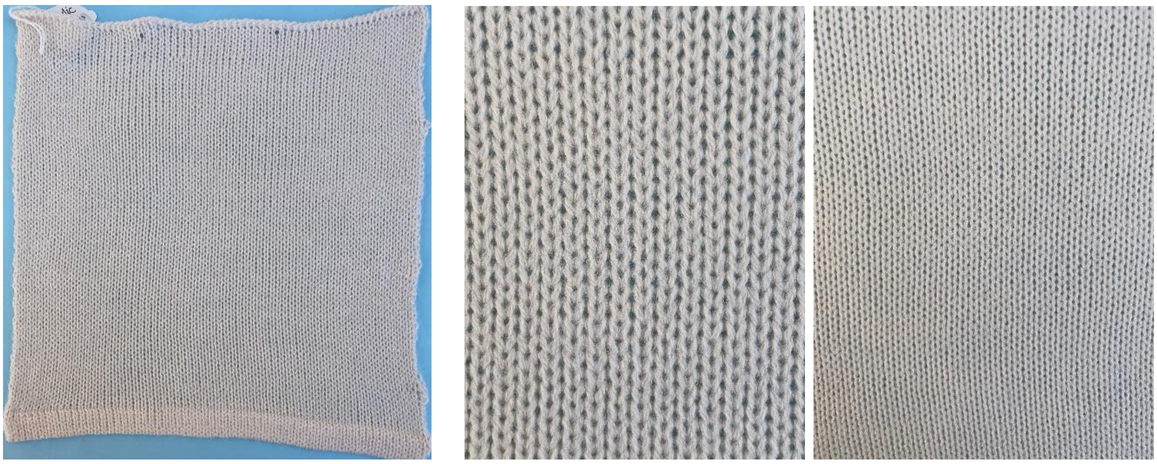


Figure 4:24 Close-up images of the 2/28 Acrylic fibre utilised during the interviews. This fibre is commonly used in knitwear found on the British High-street.

5 Experimentation, Expansion, Evaluation

Figure 5:1 Detail of sample 20, a 1x1 inlay structure.

5.1 The Making Processes

The iterative making and production of the sample collection evolved over three years. The extended timeframe allowed for many iterations of each sample to be produced and for extended periods of reflection (Scrivener, 2000). Chapters 5, 6 and 7 describe the process during each of the 4 phases.

The below images detail the making process.

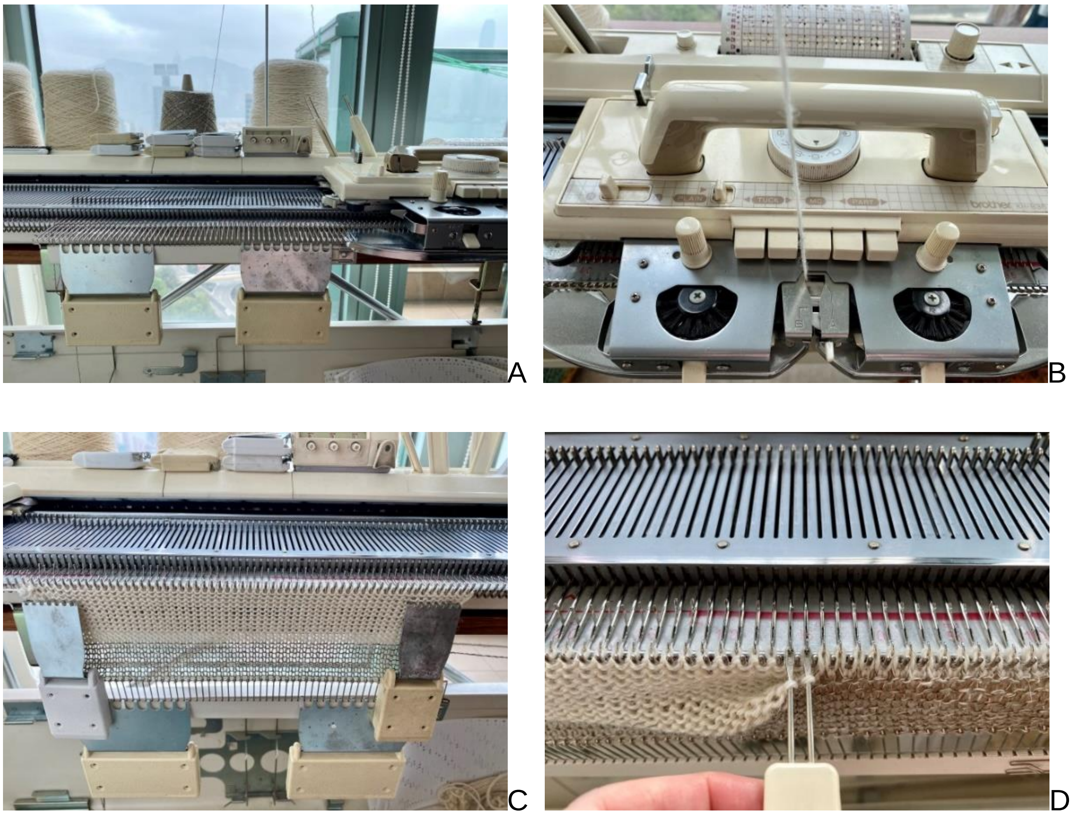


Figure 5:2 Step 1: records how to set up the knitting machine and cast on.

Step 1: Cast on waste yarn and create tubular hem: Most samples have been knitted with a 6-by-6 course tubular hem. This edging creates a secure edge that helps prevent sample laddering or unravelling. It is a balanced reversible, flat structure which can be extended to any depth and is elastic (Spencer, 2001, p. 179).

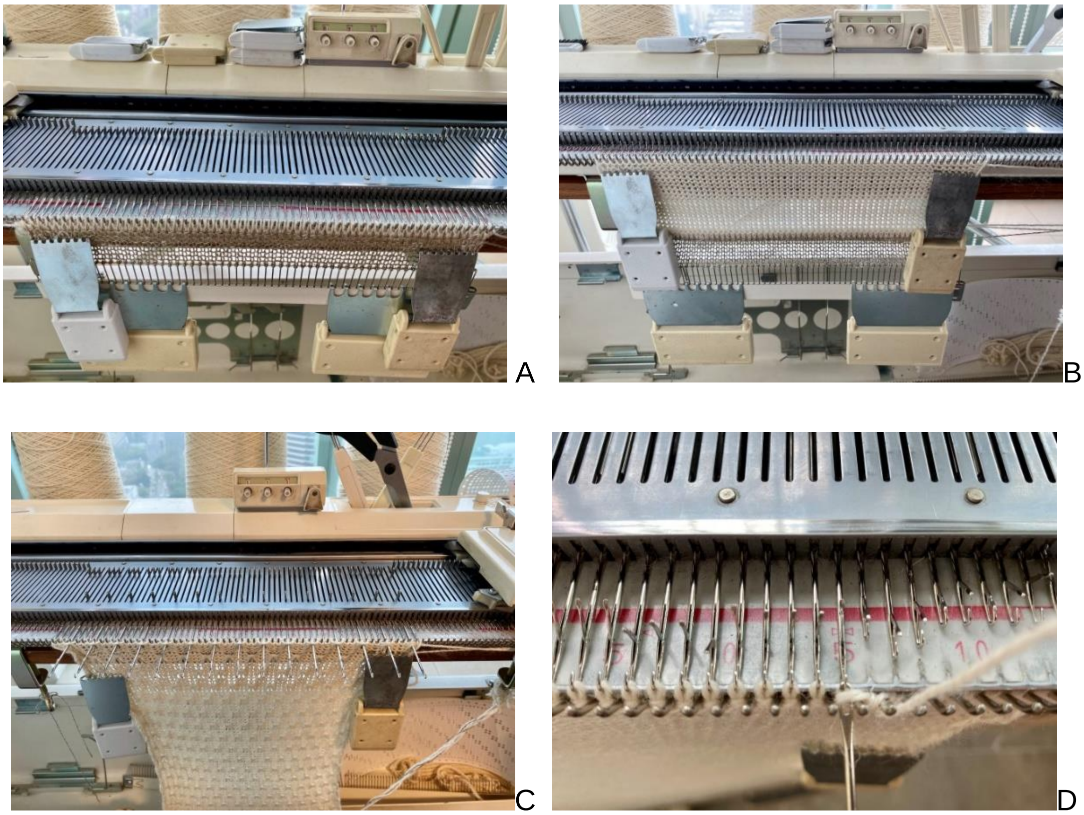


Figure 5:3 Step 2: Knit the body of the sample in the chosen pattern. Bind off the knit and take off the machine.

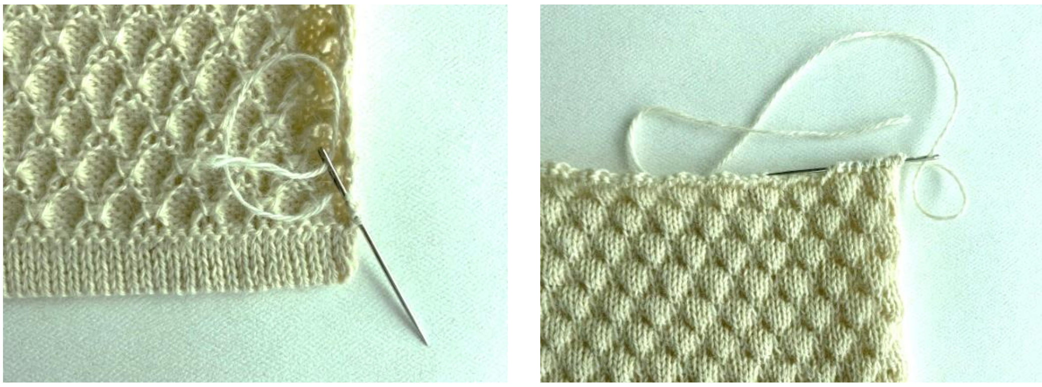


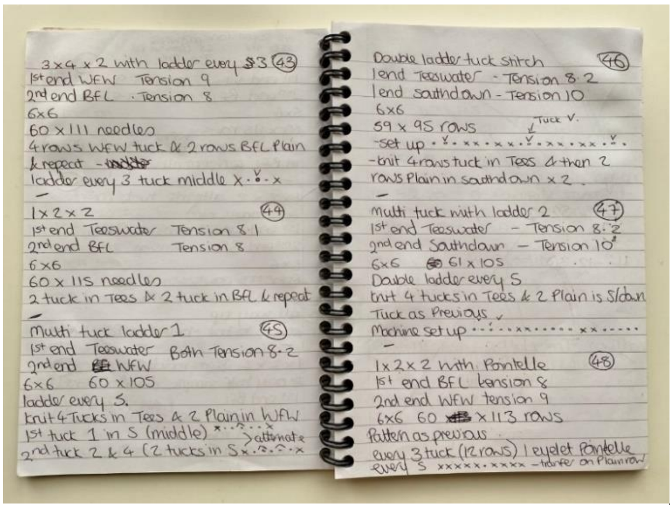
Figure 5:4 Step 3: To finish the sample sew in all loose ends and fix any holes or mistakes.

Figure 5:5 Step 4: The washing and drying process.

Step 4: wash samples: The yarns utilised are ecru and contain several impurities and grease; they are oil spun, so that must be removed. The samples have all been hand washed with soap and tepid water. The water should be cool, or the samples will shrink. The washed samples are then laid out flat on a towel to dry.

Figure 5:6 Step 5: A & B) The blocking process. C) Labelling the samples.

Step 5: Samples were blocked back to their original shape. Single-faced fabrics tend to roll, so each swatch is pinned back into shape and steamed to flatten the sample without damaging it. The iron should not touch the sample to avoid burning or shining the fabric. During the sampling process, information was recorded in the practitioner’s journal. Once the samples were finished, they were individually tagged with all the sample information and given a unique number.

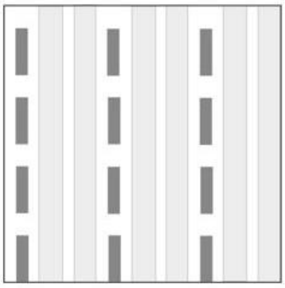


A

B

Double ladder tuck stitch knit

Swatch number: 64



Yarn 1: White-faced Woodland

Yarn 2: Blue-Faced Leicester (3ply)

Gauge: Standard domestic

Tension: 8.2

Number of ends of yarn: 2, 1 of each type above

Number of stitches in swatch: 60

Number of rows in swatch: 103

Hem finish: All needle 6x6 cast on.

Pattern: Needle set up as below: (star = knit, x = ladder, v = tuck)

v v v v (Tuck where V is.)
* ** x x * x x * ** x x * x x* ** x x * x x * ** x x * x x (and keep repeating)

Knit four rows tuck stitch in WFW and two rows plain (no tuck) in BFL all the way up the sample

Reflections on sample v1: *(30.06.2020)*

(E.g. was the swatch easy to knit? What is the hand feel like? Is the stitch and overall swatch as imagined? Any other comments…)

- The addition of the double ladder has opened the structure up a lot, meaning the pattern knitted well and has blended the yarn types fairly successfully.
- Handle: Sample feels light and fairly soft, lots of movement and stretch in the sample. Back of the sample, where the BFL sits, is soft and fluffy. Overall works well.
- Stitch: Stitch front and back looks good once knitted. Good combination as pattern can be seen, due to colour variations in the yarn. (Use for photos). Maybe have pressed a little too flat, had more body when it was first off the machine.
- Overall swatch: Good, A lighter hem, possibly with a ladder would improve the overall handle of the sample further.
- Would I knit this again? **Yes.**

C

Figure 5:7 Images documenting how the sample information was documented during the practice: A) in a journal, B) on a label and C) in a Word document. This is referred to as the sample information sheet.

5.2 Timeline of the Practice

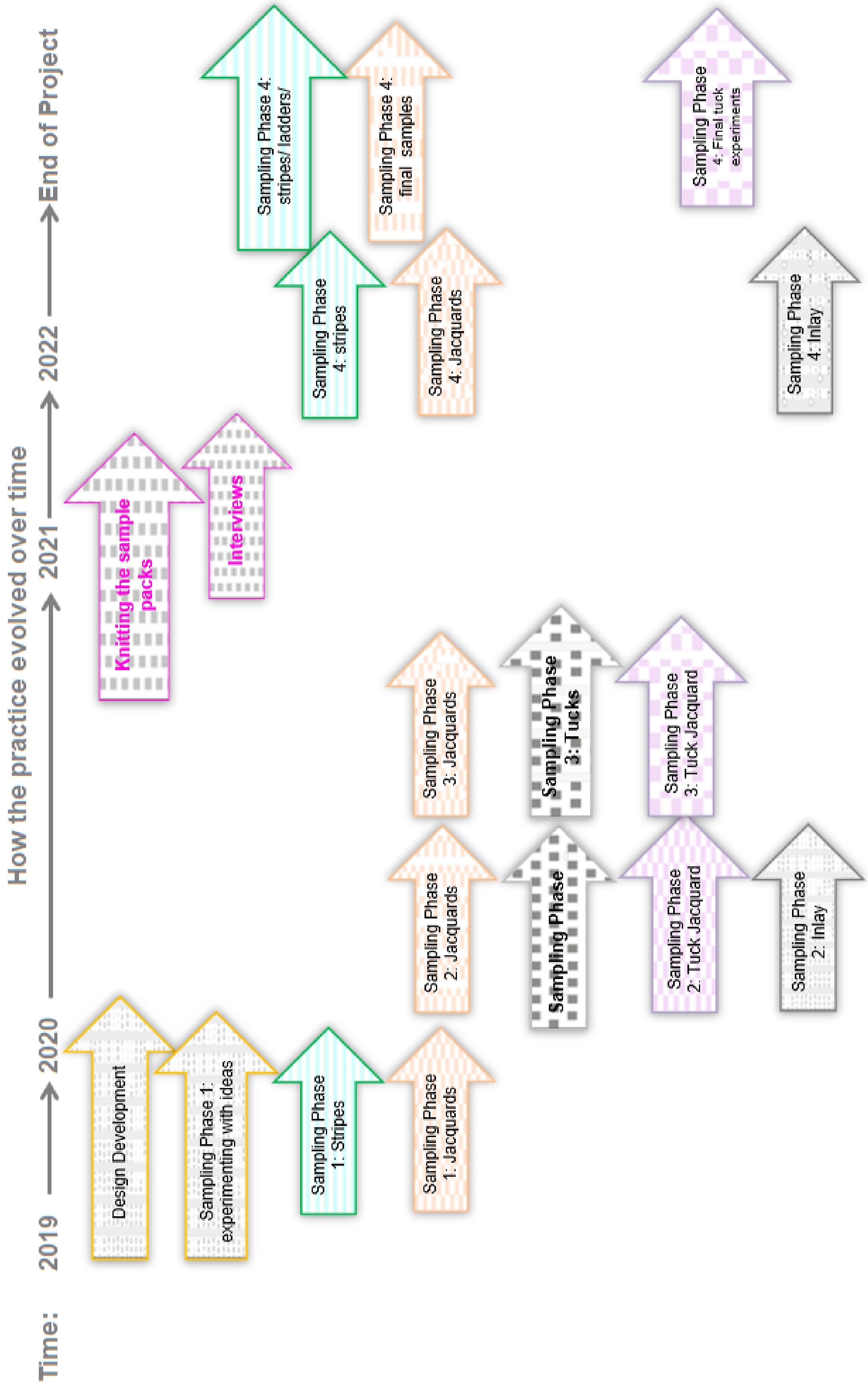


Figure 5:8 The four sampling phases. This diagram illustrates which sample groups were sampled during each phase of the sampling and when each sampling phase occurred

Phase 1 = Experimentation

This began in the third year of the doctoral study and was experimental, exploring ideas, testing pattern designs, and discovering each of the yarn's capabilities. Many of these samples were not developed further. The patterns that combined the yarns effectively or were aesthetically exciting were those developed in phase 2.

Phase 2 = Expansion

This period of sampling lasted four months. During this period, an extensive collection of samples was generated, and each pattern was knitted in different yarn combinations. Phase 2 focused on four pattern types:

1. Float jacquard
2. Hand-manipulated tuck
3. Tuck jacquard
4. Inlay

The process of recording tactile data concerning each sample began. Data was compiled into the sample matrix. The researcher also mapped their thought process when reviewing the second sampling phase and recorded the following steps visually as a map and through a series of individual sample sheets.

Phase 3 = Enrich and Embellish

The third phase began at the end of 2020. It was focused on exploring the blendability of different yarn combinations in those fabrics, which were effective during phases one and 2. For example, where a sample effectively blended two yarn types to create a relatively soft handle, the next step was to increase the number of yarns combined from 2 ends to 3 or 4 ends. The researcher wanted to ascertain whether reducing the proportion of BFL and Teeswater but adding a third, different end of the yarn could create an equally soft sample. This sampling phase successfully generated many soft samples with exciting pattern and blend combinations. The tactile data was collated in the sample matrix.

Phase 4 = Enhancement

This began in early 2022. This phase focused on responding to the interview process's outcomes and developing samples missing from the collection.

5.3 Phase 1: Experimentation

Three pattern types were explored during Phase 1.

5.3.1 Stripe

This phase began knitting stripes to gain an understanding of how the materials corresponded with each other. The stripe formations have been named according to how many courses wide each stripe is in each yarn type. For example, a 4x4 stripe refers to four courses of yarn repeated before the yarn type is changed, and four courses are knitted in the second yarn.

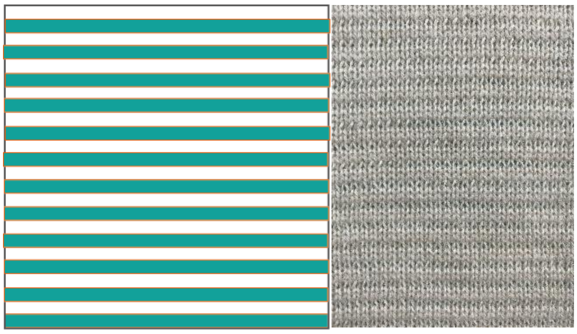


Figure 5:9 1x1 stripe repeat.

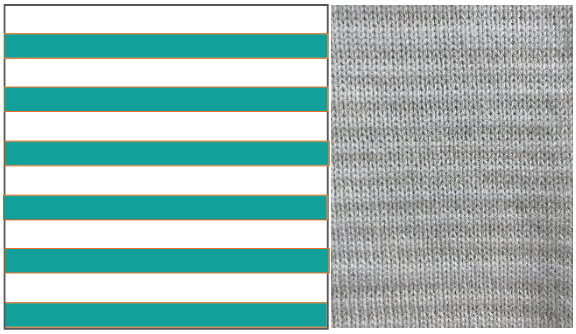


Figure 5:10 2x2 stripe repeat.

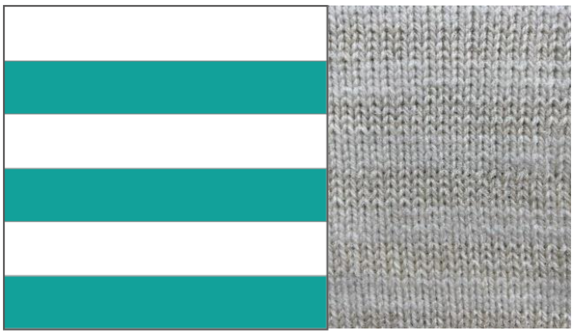


Figure 5:11 4x4 stripe repeat.

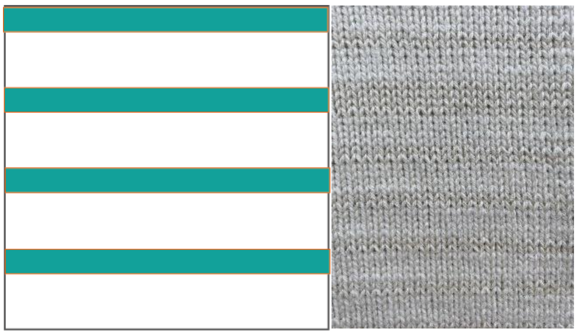


Figure 5:12 4x2 stripe repeat.

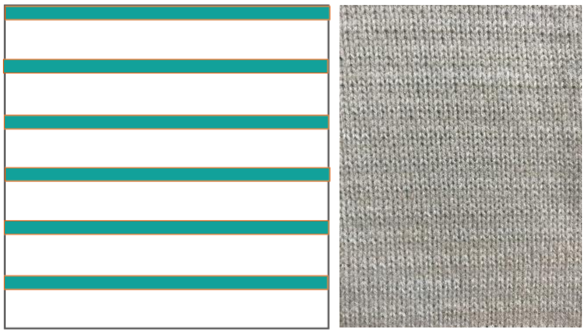


Figure 5:13 3x1 stripe repeat.

Stripes were expected to be well-suited to the research. However, the chunky stripes were not combining different yarn types effectively; the different yarns were sitting next to each other hence the handle of the coarser yarns was not improved. Thus, the researcher saw this as an opportunity to investigate whether the stripes could be enhanced with hand-manipulated techniques. These techniques did not manipulate the fabric enough to improve its handle, even though the knit structure was altered.

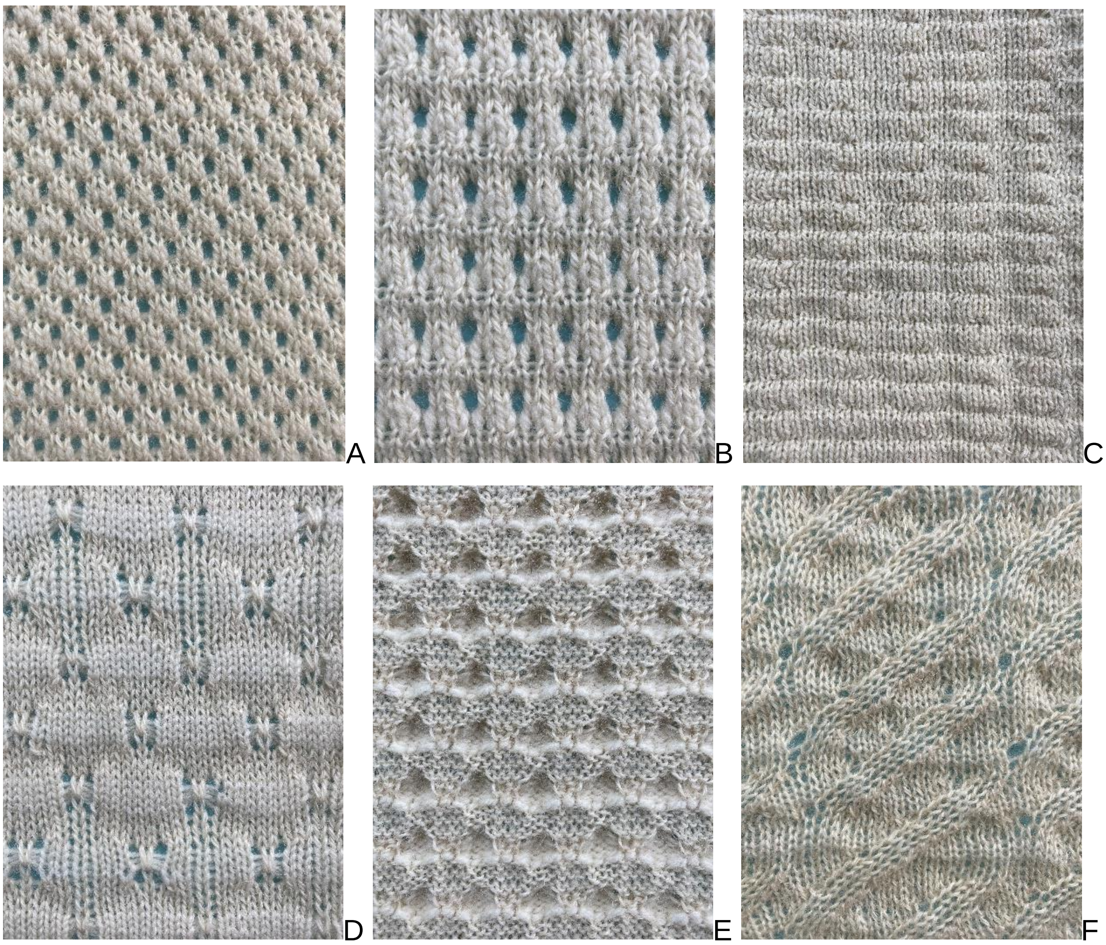


Figure 5:14 Images A – F above depict some initial experimentation with hand-manipulated techniques. All of these techniques were applied to single-face stripe structures. A) Sample 3: 1x1 stripe with pointelle. B) Sample 4:2x2 stripe with pointelle. C) Sample 211: 4x2 stripe with hook up D) Sample 210 4x4 stripe with ladder and tuck E) Sample 5 4x2 stripe with pick up. This image is of the reverse. F) Sample 7: 1x1 stripe with travelling transfer stitch.

5.3.2 Float Jacquard

Experimentation within this pattern group began by developing seven elementary geometric pattern structures utilising small clusters of stitches. The stitch formations are small, enabling the yarn in the front and back feeder interchange many times over every course, thus blending the yarns together. Knitting these fabrics enabled the practitioner to ascertain what different yarn combinations felt like, explore the constraints of each yarn type, and discover the types of patterns which suited each yarn. The initial designs were developed systematically, the designs are experimental rather than innovative. The below images document that each pattern can be seen knitted up. Image A shows the 2D design developed first. B demonstrates the pattern in colour. C and D record the face and the reverse of the fabric knitted in Ecru.

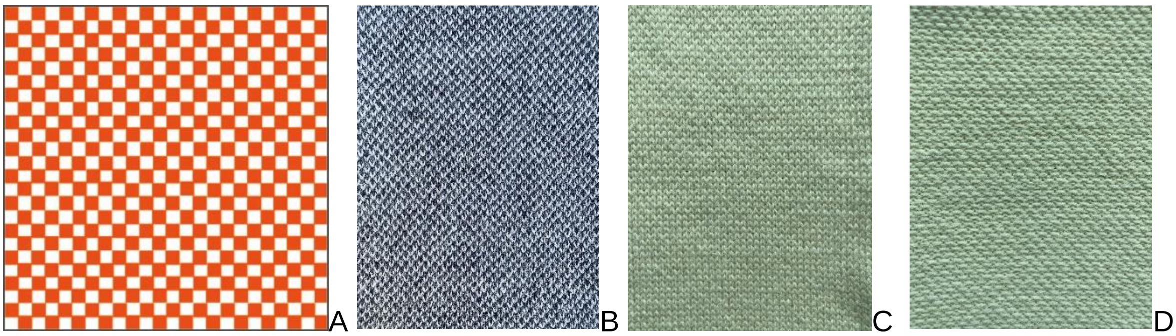


Figure 5:15 1x1 birds-eye check structure.

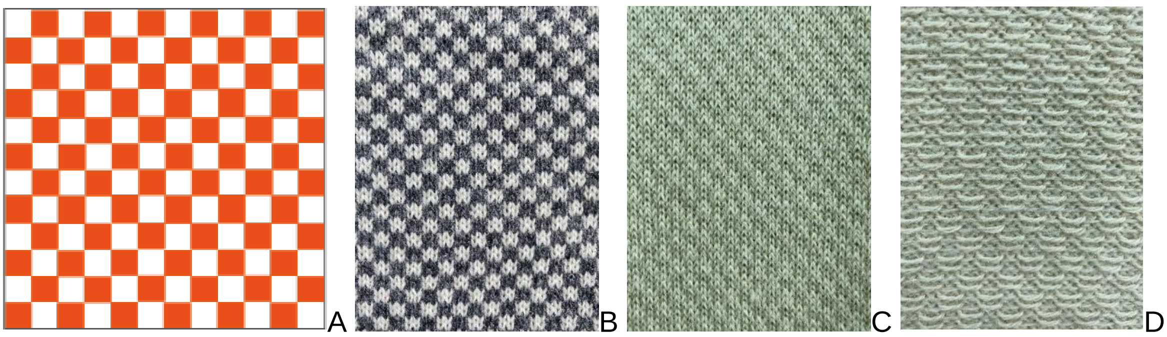


Figure 5:16 2x2 birds-eye check structure.

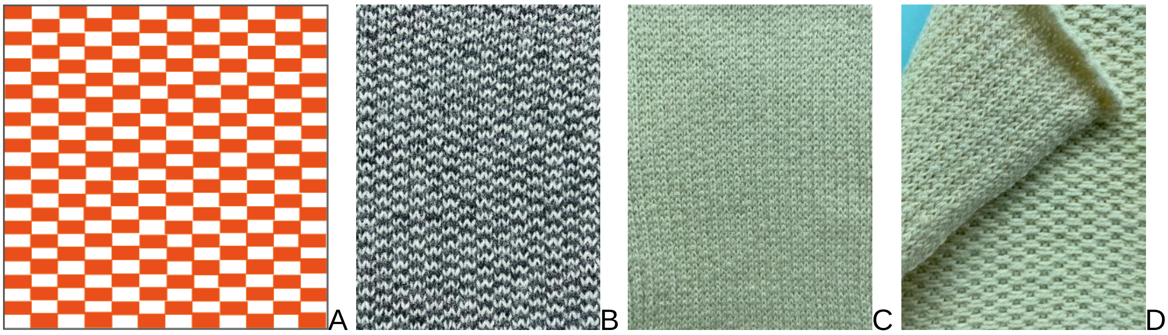


Figure 5:17 2x1 rib-look structure.

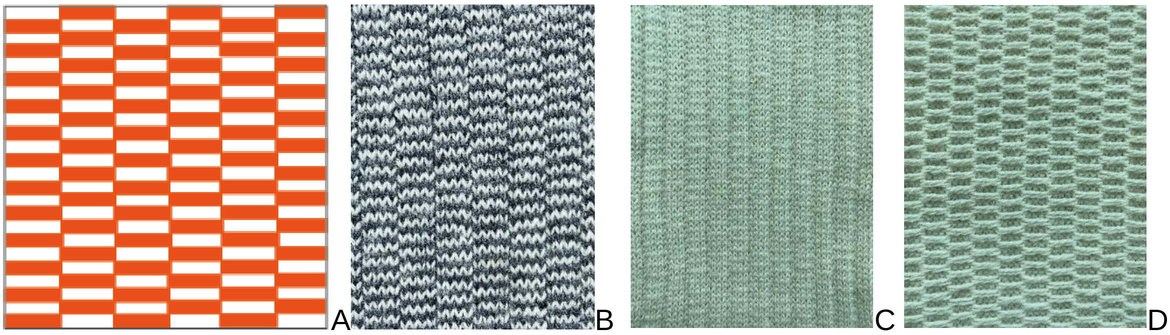


Figure 5:18 4x1 rib-look structure.

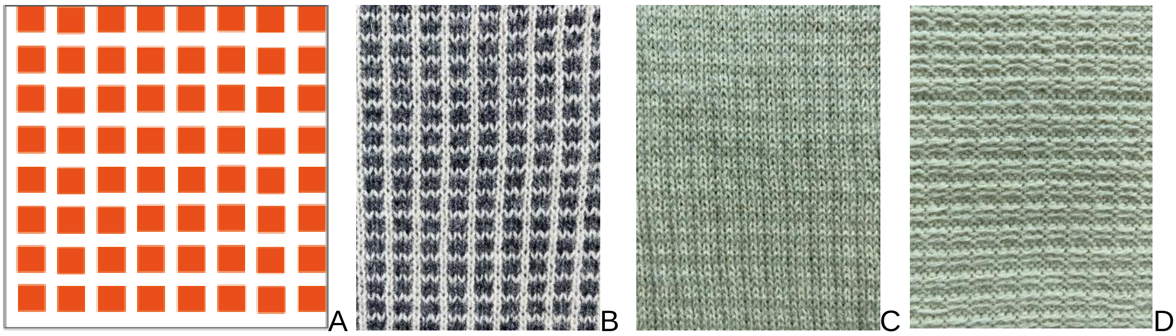


Figure 5:19 Simple square check structure version 1.

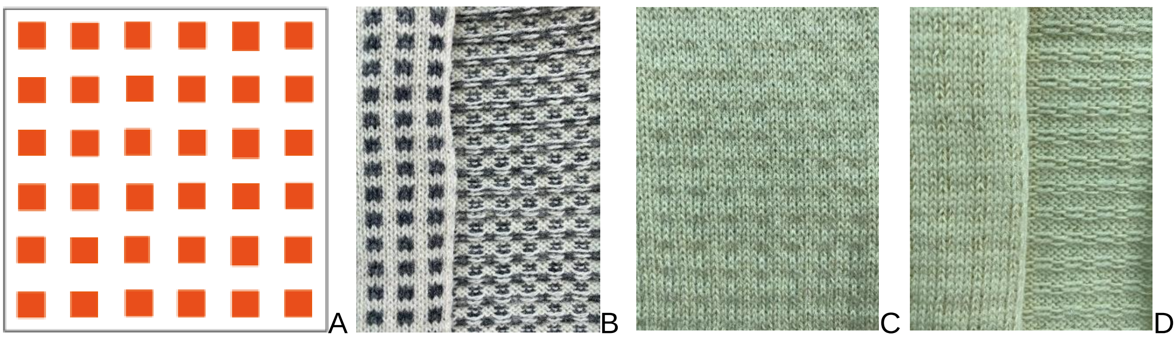


Figure 5:20 Simple square check structure version 2.

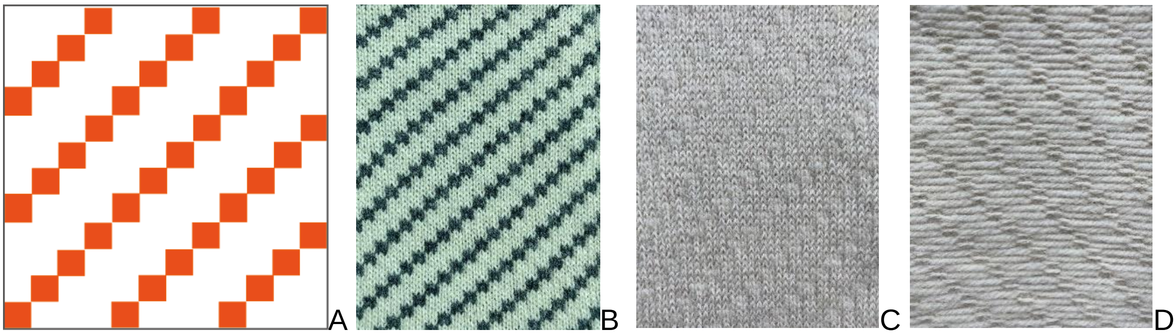


Figure 5:21 Diagonal checked structure.

Five of the patterns blended the yarns cohesively, and two of the patterns were less effective because the spatial frequency between each of the floats on the reverse of the knit was too great ,the yarns needed to combine more regularly. When knitted, the samples look similar to the 2x2 birds-eye check, which effectively combined the yarn; thus, this pattern formation was developed further.

The 2x1 and 4x1 float jacquard patterns have been called rib-look throughout the project because the fabric resembles a rib once knitted. The long floats on the reverse pull together, relaxing the fabric. This has resulted in a fabric which stretches and moves. This movement reduces slightly through the washing and pressing process, but the vertical (rib-look) lines are very prominent, even on those samples that have been stored flat for a long time.

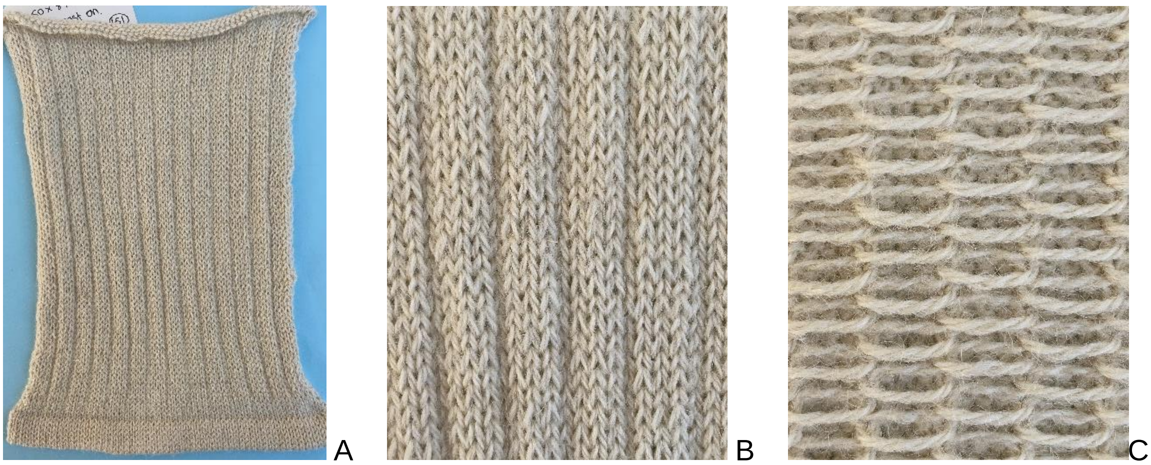


Figure 5:22 Sample 161: A 4x1 rib-look float jacquard knitted in KR/BFL1. This was knitted during phase 1. The rib-look structure can be seen clearly in picture B. Picture C demonstrates the floats on the reverse of the fabric, encouraging the fabric to relax. This fabric has been stored flat for a long time but still has the stretch and bounce of a rib.

5.3.3 Inlay Fabrics

These fabrics evolved iteratively through an experimental process. The method was developed through the creation of the below sample 171. The practitioner attempted to create a blended stripe by introducing a second yarn onto the back of the single-faced structure, using the method of laying the second yarn above and below each of the selected needles. They discovered that this method of inlay did not significantly improve the fabric's handle, but the idea inspired further samples. The outcomes were many exciting structures.

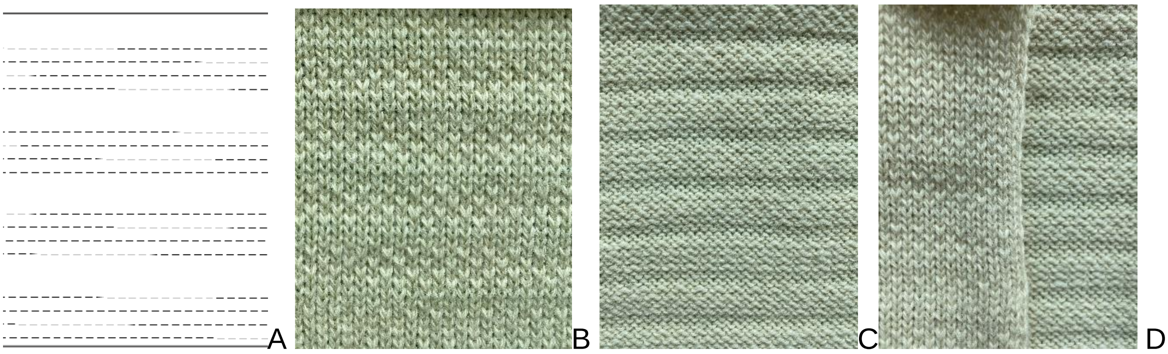


Figure 5:23 The original Inlay weave sample (Sample 171) A shows the 2D design, B, C, and D the face and reverse of the fabric.

Below is a copy of the practitioner's reflection on the sample written when reviewing phase 1. These notes are helpful as they succinctly explain the practitioner's methods and path when navigating the sampling process.

Reflections on sample v1: *(30.06.2020)*

(E.g. was the swatch easy to knit? What is the hand feel like? Is the stitch and overall swatch as imagined? Any other comments…)

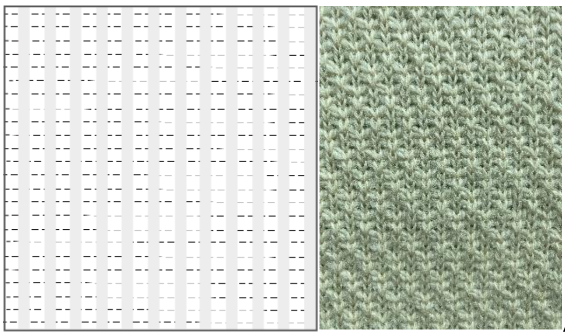
- Like many of the single bed fabrics the overall handle of this sample is not that good. The inlaying has done little to improve the sample.
- However it was this sample that inspired the development of further more successful inlay samples so the idea is good.
- Handle: Quite hard/ rough.
- Stitch: Simple.
- Overall swatch: would be better in a softer yarn mix.
- Would I knit this again? **No.**

Where to go next…

- Redesign/ Rework sample
- Rework stitch pattern
- Rework in a different yarn blend
- Knit the same swatch again in a different yarn blend
- Keep sample for group reflection/ swatch Library
- Could this swatch be knitted into a garment? **Yes/No**

Figure 5:24 Original design notes (dated 30.06.2020).

Four variations of one structure were created, demonstrating that more open compositions allowed the yarn to blend more effectively. The 4x1 inlay did not enable the yarns to combine because blocks of four wales were too wide. The handle was quite rough. In comparison, the handle of the two 1x1 inlay fabrics was relatively soft. Thus, the 1x1 and 2x1 patterns were developed further in phase2.


A

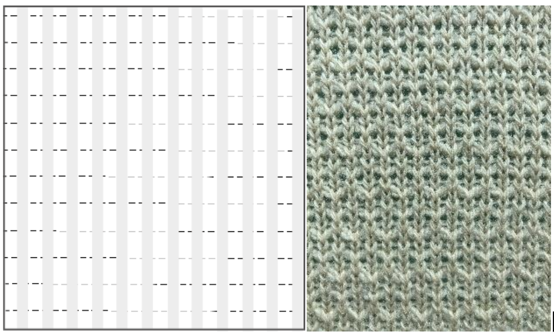

B

Figure 5:25 1x1 inlay structures A) The dotted line shows yarn inlaid every row B) The dotted line shows yarn inlaid every other row.

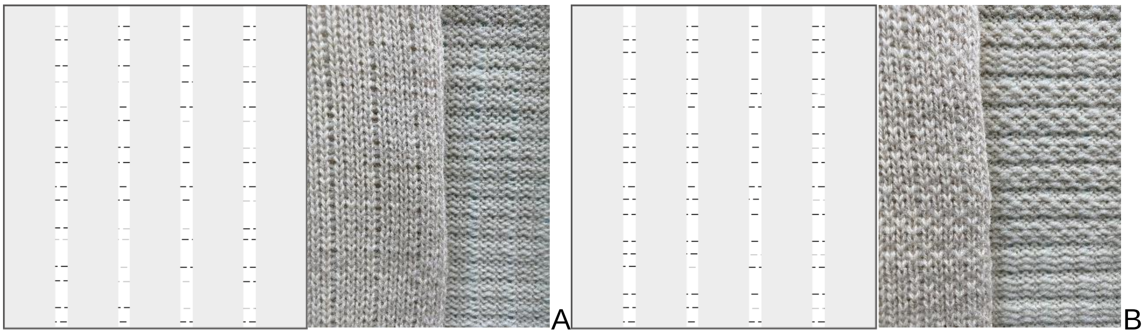


Figure 5:26 Experimental 4x1 Inlay sample A) 2x1 inlaid stripe repeat B) 3x1 stripe repeat

5.3.4 Evaluation of Phase 1: Experimentation

Yarns

Initially, eight yarns were tested and experimented with. As discussed in Chapter 4, at the end of phase 1, it was determined that two yarns, Jacob, and Wensleydale, were not appropriate for the project. These yarns and the samples utilising these yarns were not developed further. However, the practitioner discovered the potential the Teeswater and the BFL had to improve the handle of the coarser yarns. One outcome was for the practitioner to source a second weight of BFL, which enabled further experimentation.

Samples

63 samples were created. Sampling was very experimental, aimed at testing ideas and informing fabric quality. The practitioner utilised their tacit knowledge and experience to decide which fabrics met the aims of the project and had the potential to be developed further and knitted in different combinations of each different yarn type.[11]

Eight combinations of the 2x2 birds-eye check knit were generated. Sample 177 (BFL/Teeswater) was the softest, and once the sample collection was ranked at the end of practice ranked 45th out of 367, which demonstrates it is relatively soft. Sample 184 (Southdown/ Jacob) had the coarsest handle, described as thick, dense, and itchy. In every pattern type, this yarn combination was considered acceptable, and language such as: dense, scratchy, prickly, thick, itchy, rough, ridged, felted and flat were consistently utilised to describe the samples. This is one reason Jacob was not explored further, and the Southdown became an auxiliary yarn.

[11] To avoid confusion, there is a reason why the early samples have high or irregular numbers assigned to them. A numbering system was not used at the beginning of the project, but it became necessary to keep track of the samples and their information. These samples were numbered by sample group when the researcher reflected on the fabrics at the end of phase 2 and the sample matrix was developed.

The 4x4, 4x2, 2x2 and 3x1 stripe patterns were all generated in the same three yarn combinations: KR/ BFL, KR/WFW and Jacob/ Southdown. They provided enough information to determine that these stripe patterns were not combining the yarns effectively. These stripes were not sampled further. The 1x1 stripe was knitted using three yarn combinations; this pattern was repeated during phase 4.

During phase1, the 4x1 and 2x1 rib-look float jacquards were tested less than the 2x2 Birdseye check, but the researcher recognised the potential of these fabrics and began to explore them during phase2. These patterns became the most investigated pattern types of the research project.

5.4 Phase 2: Expansion

Phase 2 was expansive; it aimed to discover how variations of two yarn types combined over a wide variety of different pattern types. Four pattern groups were explored extensively.

5.4.1 Float jacquard

Zigzag Patterns

Phase1 determined that for a float jacquard structure to blend the yarn cohesively, the yarns must regularly exchange on every row, and the float length should be no more than three loops. Many new pattern designs were explored in 2D; eight were selected for development in 3D. The designs are geometric and focus on zigzag patterns with small clusters of stitches creating a linear pattern.

It was becoming more apparent how the yarns behaved together; thus, seven variations of yarn were selected to develop in each pattern type. Chapter 5.3 records the outcomes of this experiment. 54 ecru samples were constructed.

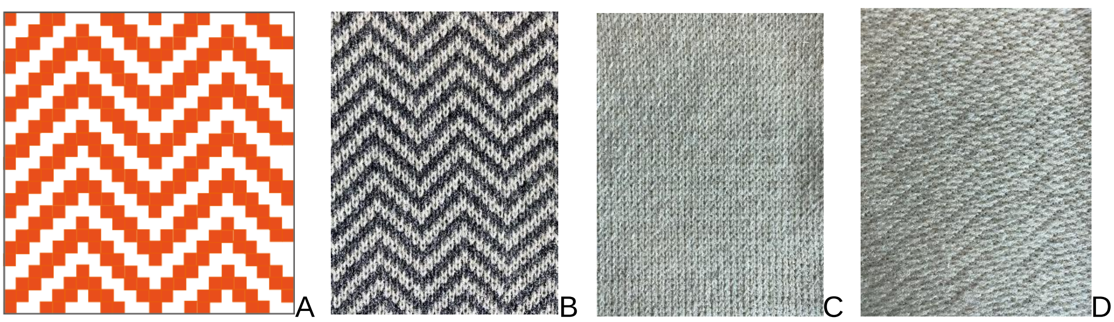


Figure 5:27 Horizontal zigzag 1: A illustration. B in colour. C Face of knit. D reverse of knit.

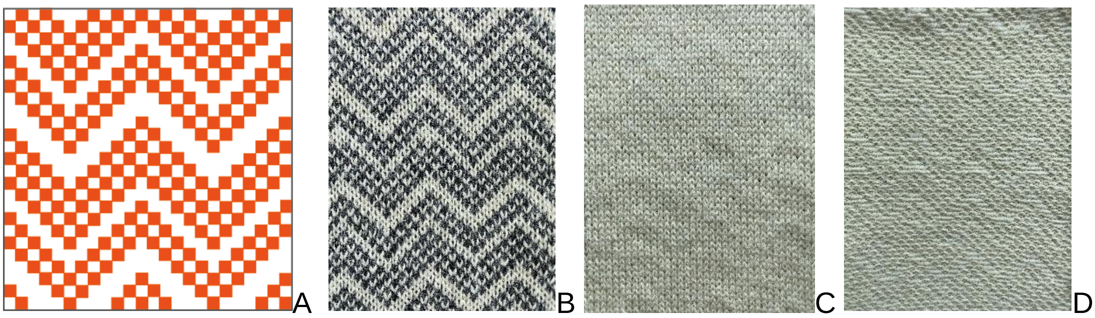


Figure 5:28 Horizontal zigzag2: A illustration. B in colour. C Face of knit. D reverse of knit.

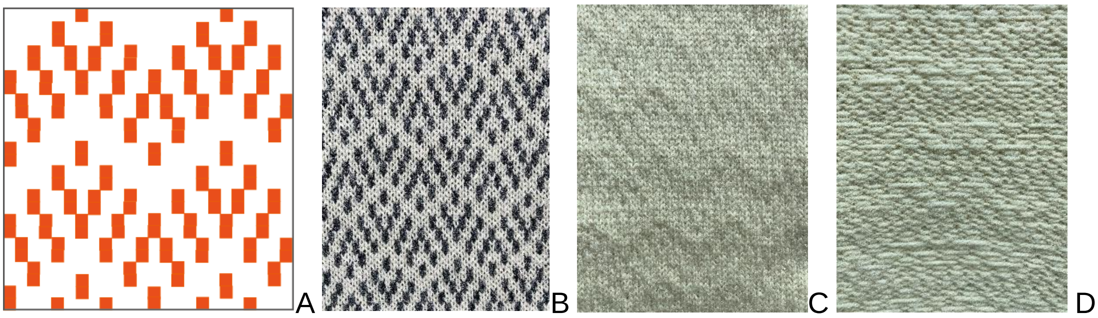


Figure 5:29 Horizontal zigzag3: A illustration. B in colour. C Face of knit. D reverse of knit.

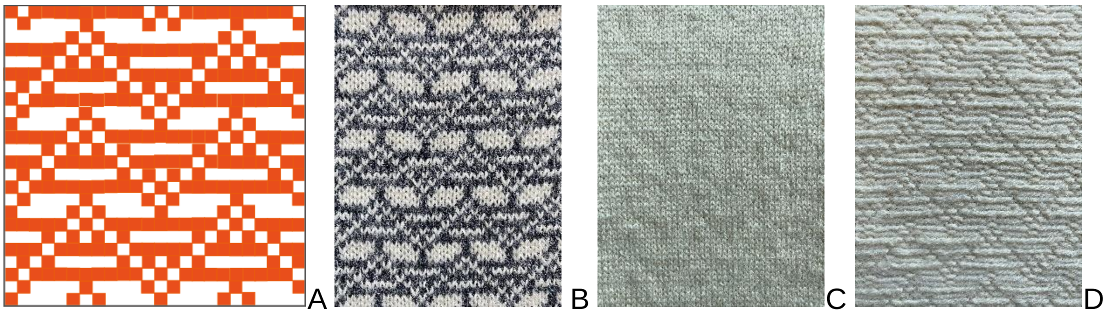


Figure 5:30 Stripe horizontal zigzag: A illustration. B in colour. C Face of knit. D reverse of knit.

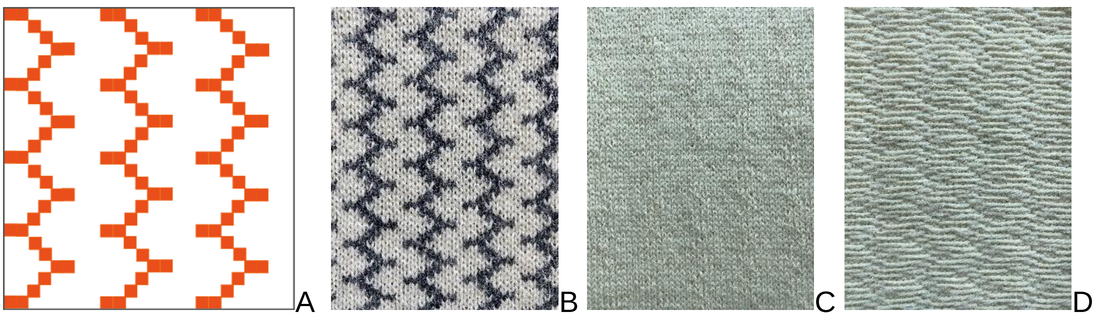


Figure 5:31 Vertical zigzag1: A illustration. B in colour. C Face of knit. D reverse of knit.

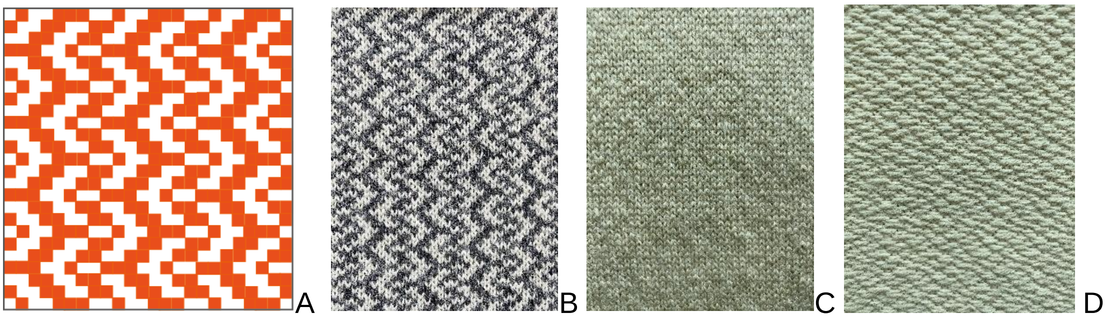


Figure 5:32 Vertical zigzag2: A illustration. B in colour. C Face of knit. D reverse of knit.

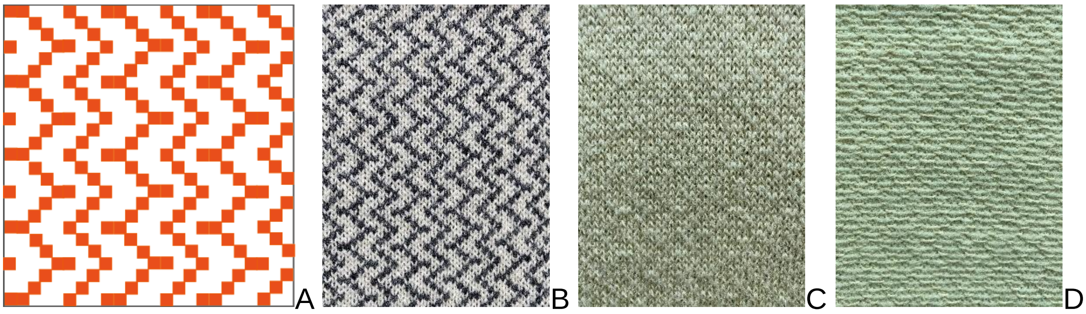


Figure 5:33 Vertical zigzag3: A illustration. B in colour. C Face of knit. D reverse of knit.

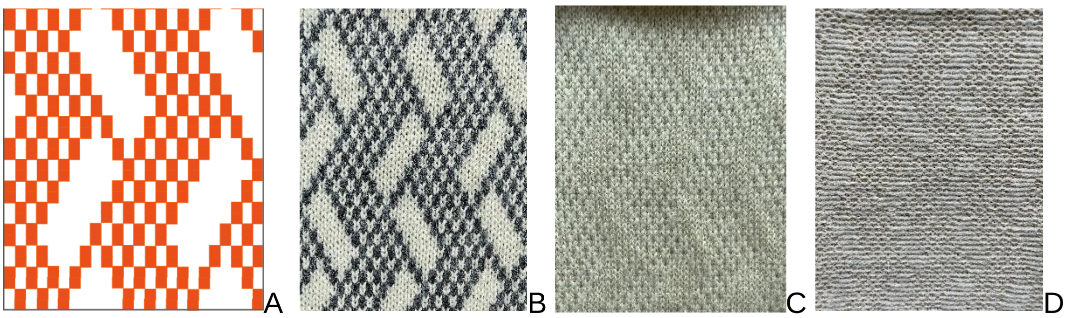


Figure 5:34 Diagonal, vertical zigzag: A illustration. B in colour. C Face of knit. D reverse of knit.

Rib-look pattens

Experimentation concentrated on the 2x1 and 4x1 rib-look patterns. The patterns were manipulated, refined, and evolved to become more innovative and, in some cases, more complicated.

The Patterns below are 2x1 rib-look fabrics; the figure records their pattern variation. [12]

[12] Note: Not every iteration of the 2x1 and 4x1 rib look float jacquard pattern were knitted in colour, unlike the zig zag combinations, which is why only the ecru samples are visualised.

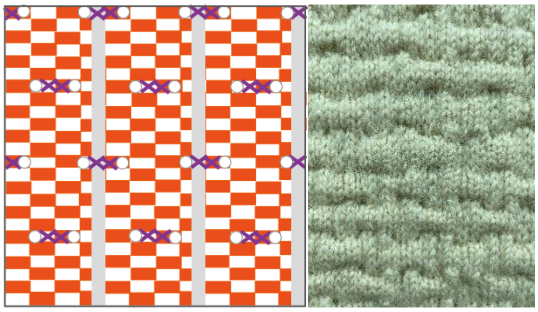


Figure 5:35 Sample 146, ladder & hook up.

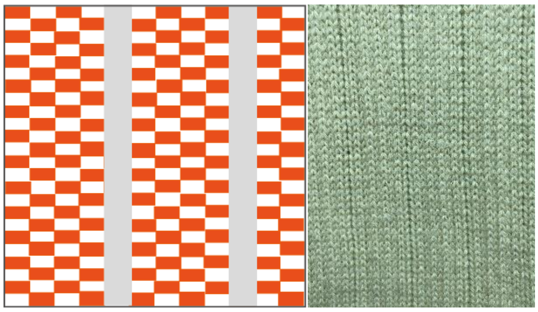


Figure 5:36 Sample 147, ladder.

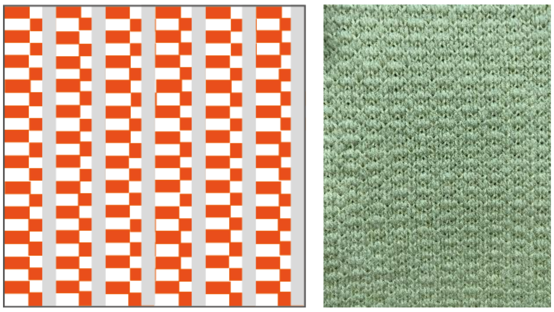


Figure 5:37 Sample 150, ladder.

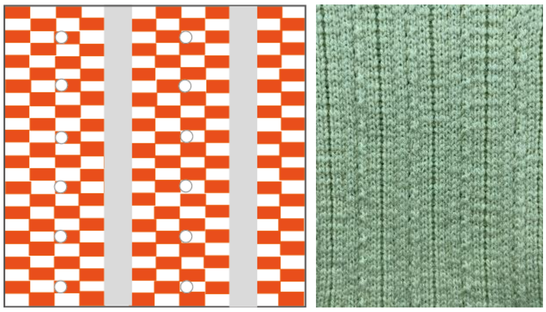


Figure 5:38 Sample 151, ladder & pointelle.

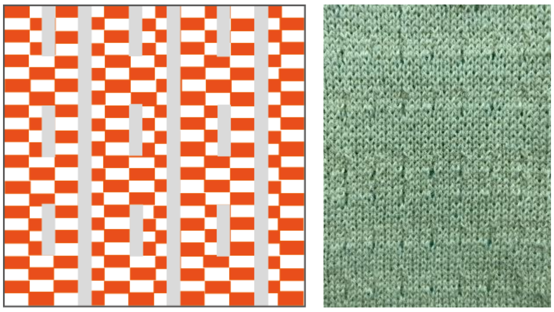


Figure 5:39 Sample 152, ladder.

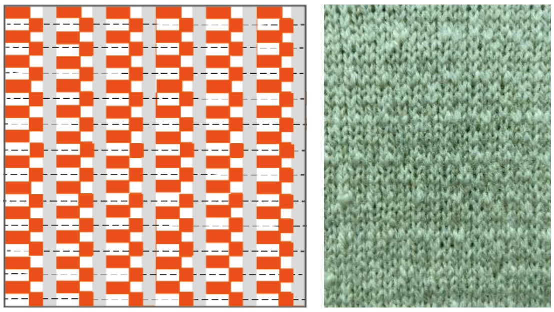


Figure 5:40 Sample 153 & 154, ladder & Inlay.

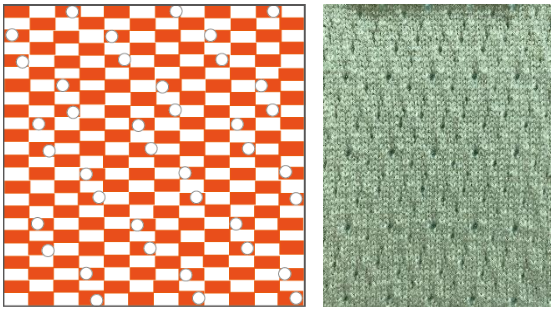


Figure 5:41 Sample 156, pointelle.

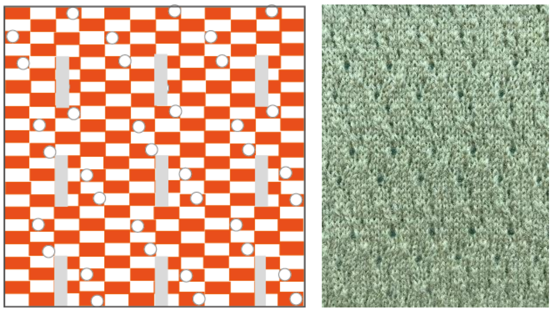


Figure 5:42 Sample 158, ladder & pointelle.

4x1 Rib-look float jacquard samples.

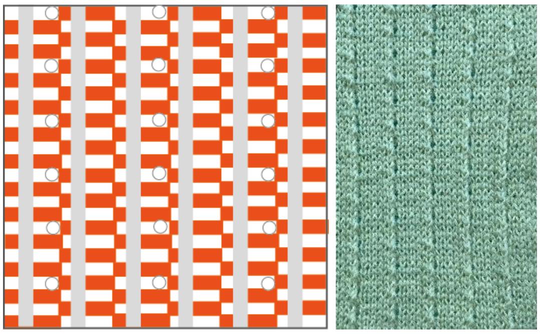


Figure 5:43 Sample 135, ladder & pointelle.

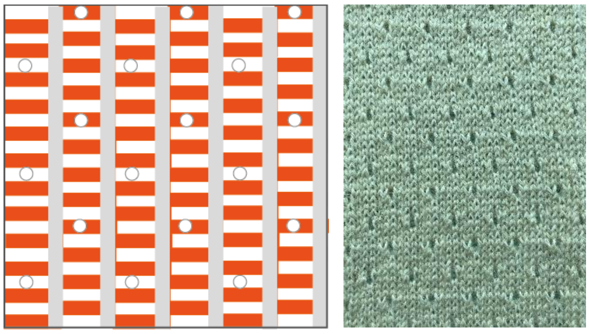


Figure 5:44 Sample 136, ladder & pointelle.

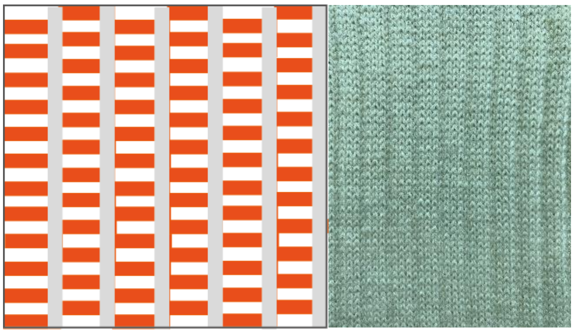


Figure 5:45Sample 138, ladder.

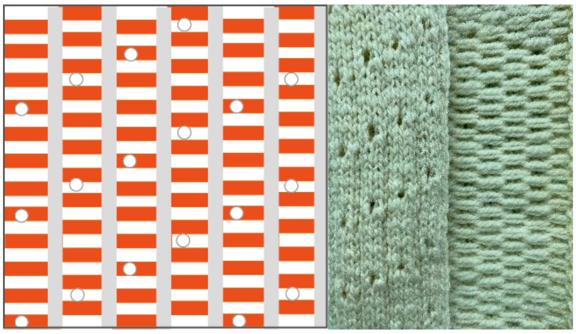


Figure 5:46 Sample 140, ladder & pointelle.

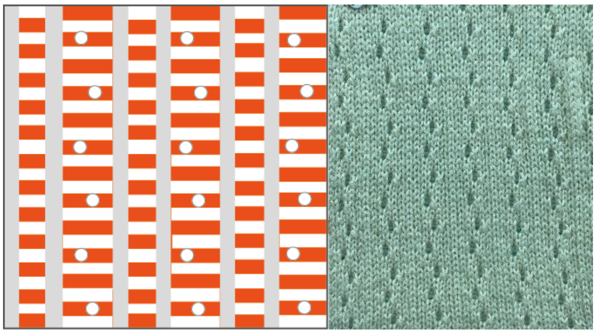


Figure 5:47 Sample 141, ladder & pointelle.

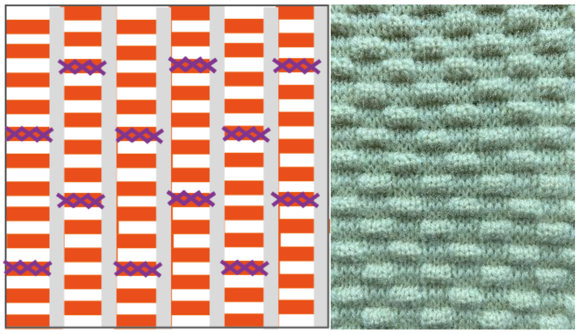


Figure 5:48 Sample 142, ladder & hook up.

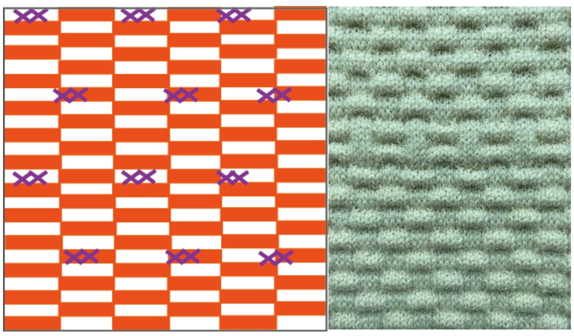


Figure 5:49 Sample 143, hook up.

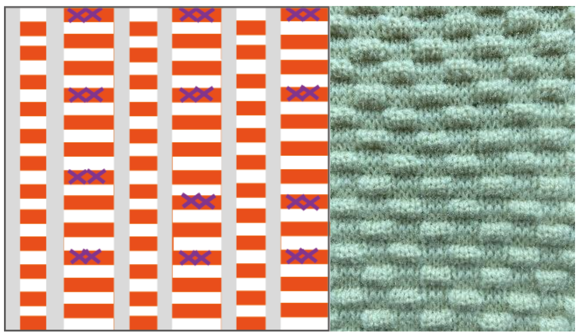
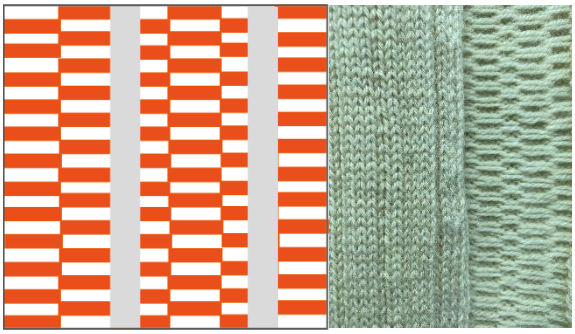


Figure 5:50 Sample 144, ladder & hook up.



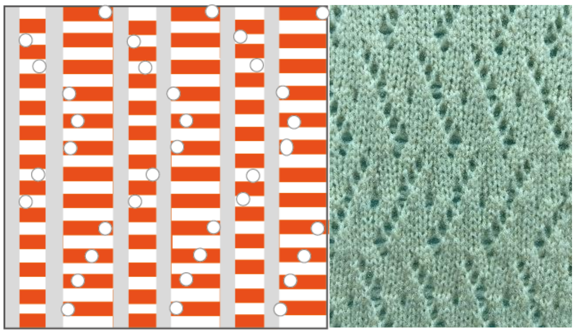


Figure 5:51 Sample 148, ladder.

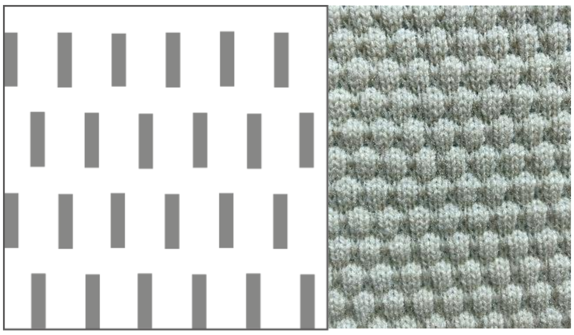
Figure 5:52 Sample 159, ladder & pointelle.

Many of these patterns blended the yarns cohesively and created aesthetically pleasing samples. Sample 158 (Figure 5.42), a pointelle and ladder sample, is considered the softest sample made during this phase 2.

5.4.2 Hand-Manipulated Tuck

These patterns evolved in 3D. The layout of the tucks required experimentation to discover where it was possible to insert ladders or extra tucks within each knit structure. Due to the count and hairiness of the yarns, lots of takedown weight was required to keep more than two courses on each needle, or the yarn tended to fall off or miss a loop when knitting. The researcher anticipated that denser structures would become more open by adding ladders, thus adding more movement and elasticity, and therefore improving the fabric's handle. Many versions were knitted, exploring ladder placements within tuck patterns. Those patterns which knitted well were recreated in different yarn combinations.

The different tuck formations were experimented with in different yarn variations.



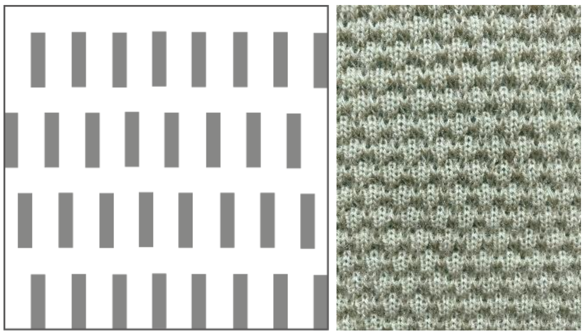


Figure 5:53 Sample 170 3x4x2 formation.

Figure 5:54 Sample 56 4x2x2 formation.

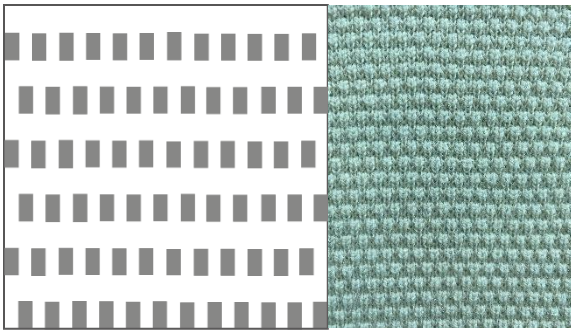


Figure 5:55 Sample 40 1x2x2 formation.

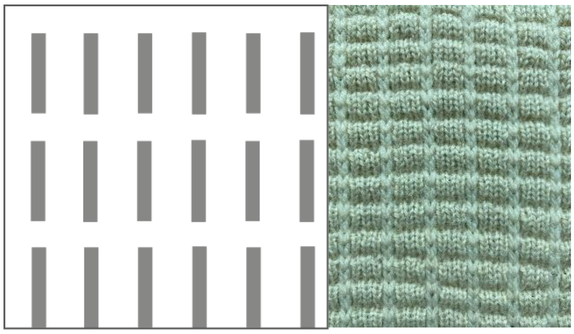


Figure 5:56 Sample 36 6x4x2 formation.

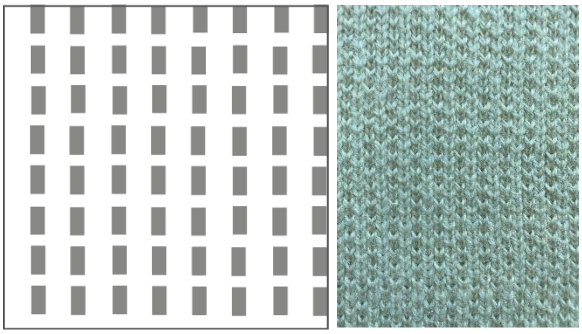


Figure 5:57 Sample 42 1x2x1 formation.

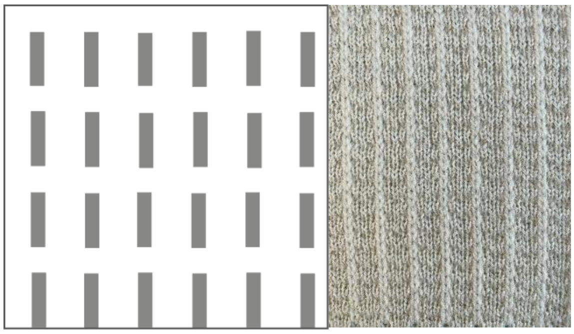


Figure 5:58 Sample 39 4x4x2 formation version 2

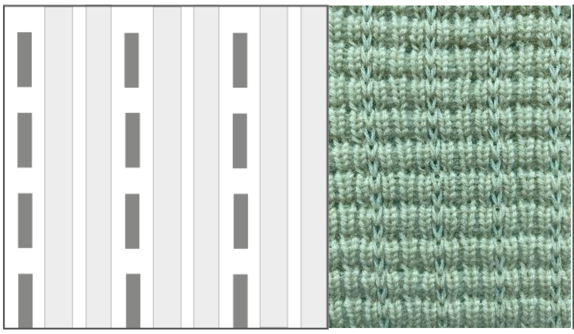


Figure 5:59 Sample 64 double ladder tuck.

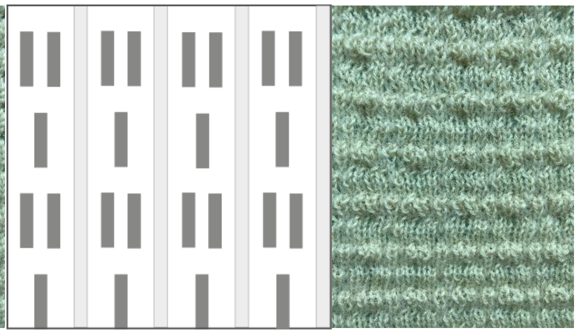


Figure 5:60 Sample 65 multi ladder tuck.

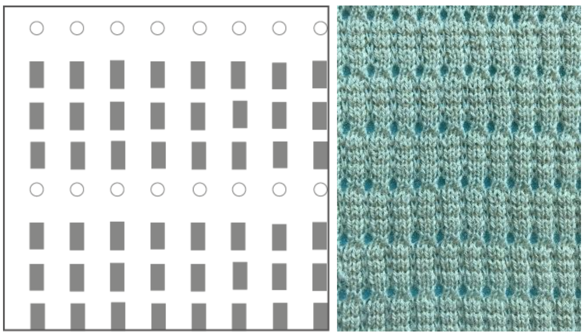


Figure 5:61Sample 194 2x1 with pointelle.

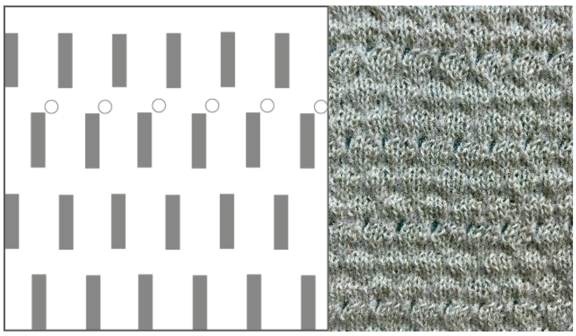


Figure 5:62 Sample 50 3x4x2 with pointelle.

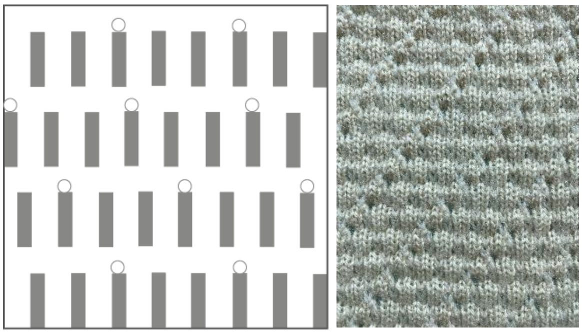


Figure 5:63 Sample 574x2x2 with pointelle.

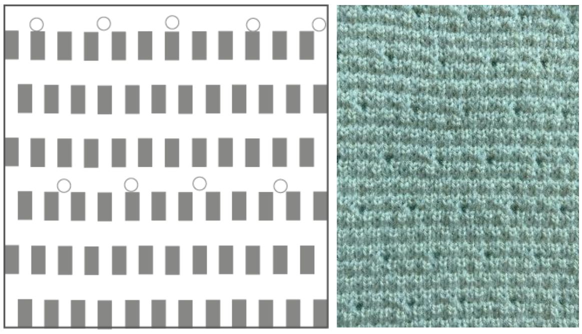


Figure 5:64 Sample 491x2x2 with pointelle.

5.4.3 Tuck Jacquard

The tuck-jacquards are a separate pattern group, but they could be considered a hybrid of float jacquard and hand-manipulated tuck. The patterns are created using the punch-card function on the knitting machine, but instead of selecting the fair-isle setting, the tuck function is selected.

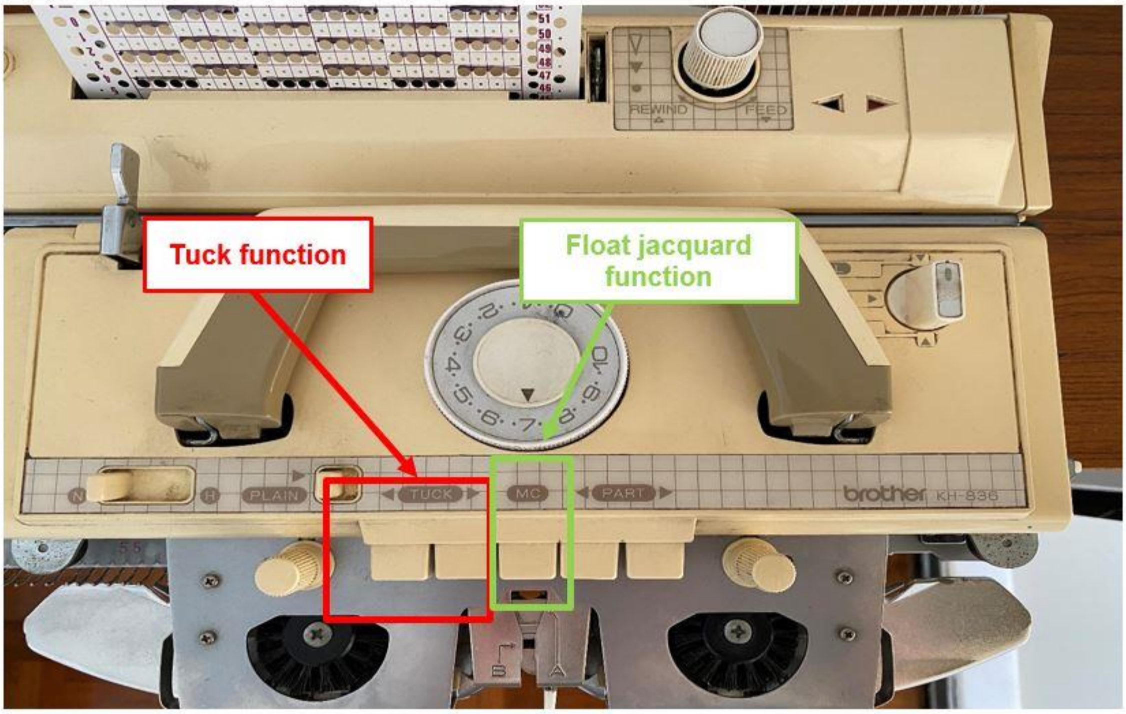


Figure 5:65: The carriage on the knitting machine. Red highlights the tuck function, Green highlights float jacquard function.

The machine tucks the yarn rather than knits the pattern using the second end of the yarn. Only one yarn is knitted at a time. The same punch-cards developed to create the float jacquard patterns were utilised to generate the tuck jacquards. This allowed for direct comparison between the fabrics. The below designs are the same but have been re-coloured, so it is clear they belong to a different pattern group.

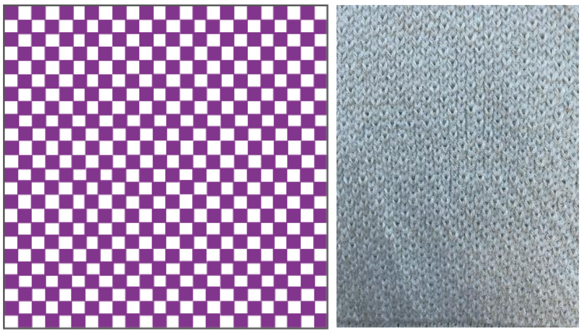


Figure 5:66 1x1 birds-eye tuck jacquard structure.

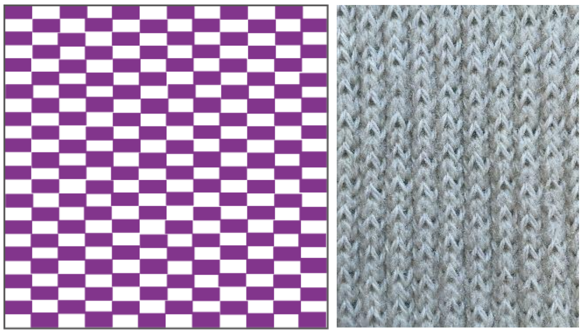


Figure 5:67 2x1 rib-look tuck jacquard structure.

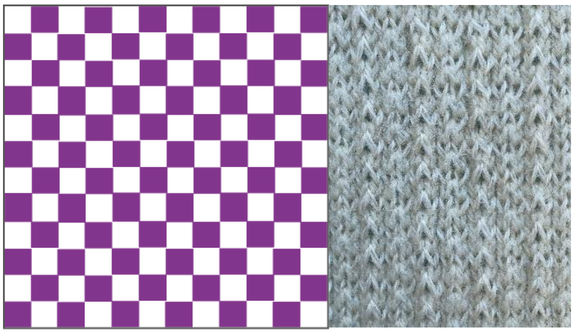


Figure 5:68 2x2 birds-eye check tuck jacquard structure.

5.4.4 Inlay

The inlay fabrics which were effective during phase 1 were recreated, investigating how often the yarn ought to be inlaid into the fabric to create a ‘soft’ handle. The second step was to experiment with different yarn combinations. The third step was manipulating those fabrics, which addressed steps one and two, adding, pointelle, and holding stitches and ladders to the fabric surface. A varied body of samples was generated. Examples of the different structures can be seen below.

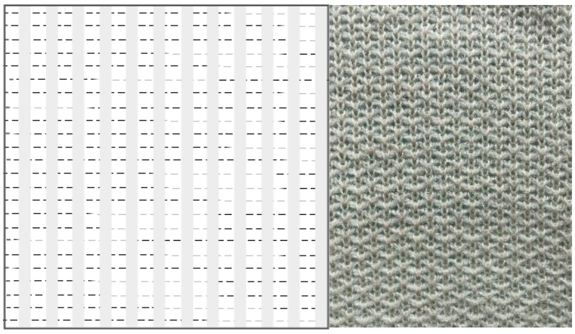


Figure 5:69 1x1 inlay every row.

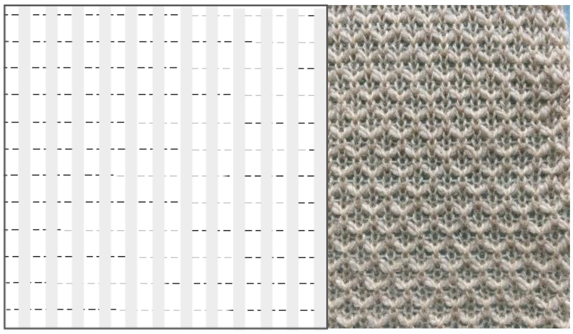


Figure 5:70 1x1 inlay every other row.

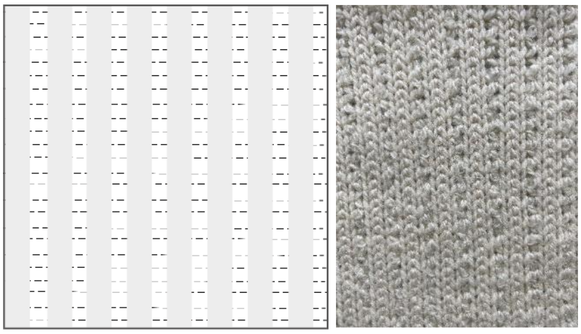


Figure 5:71 2x1 inlay every row.

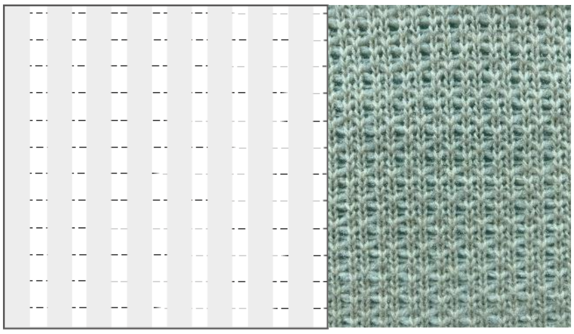


Figure 5:72 2x1 inlay every other row.

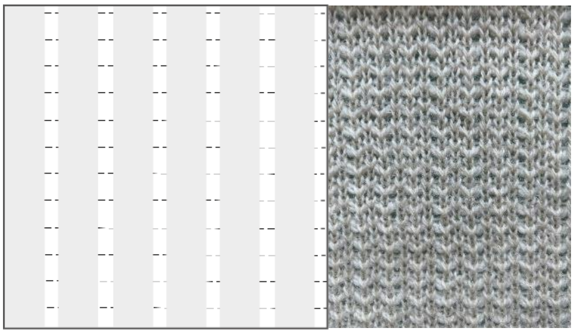


Figure 5:73 3x1 inlay every other row.

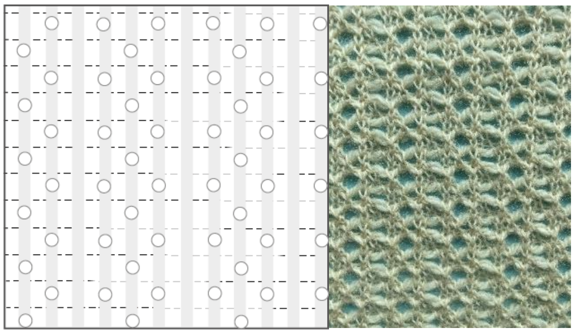


Figure 5:74 1x1 inlay with pointelle.

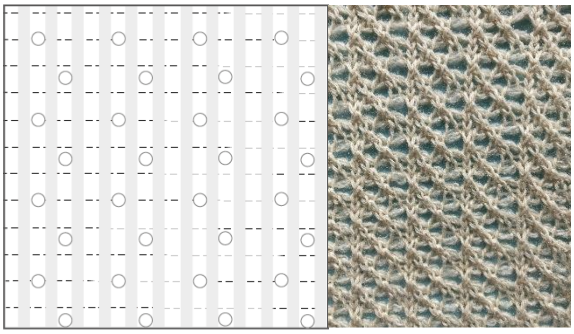


Figure 5:75 1x1 inlay samples with pointelle.

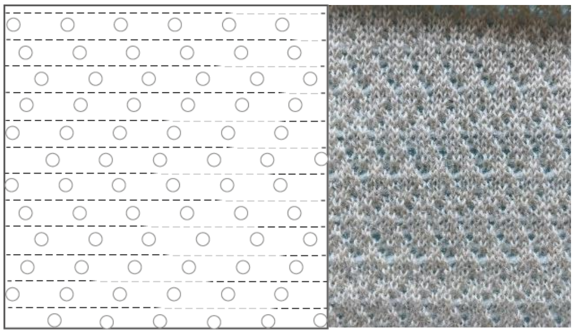


Figure 5:76 Zig zag inlay with pointelle.

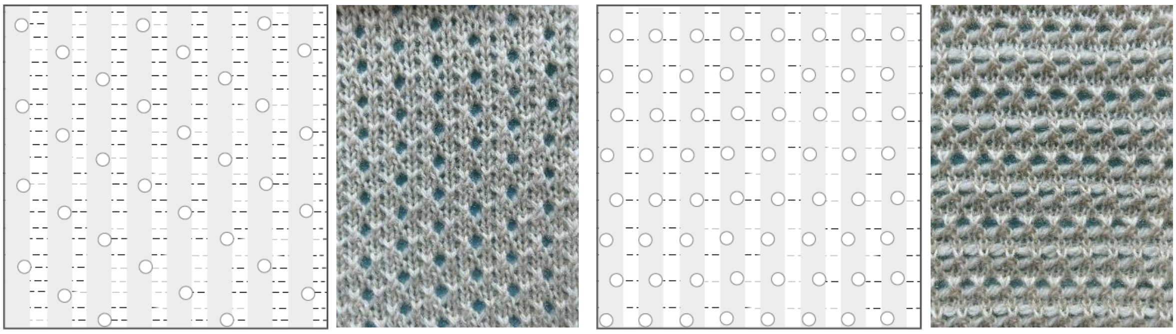


Figure 5:77 Two versions of 2x1 inlay with pointelle.

Figure: 72 reveals that the 3x1 inlay samples are aesthetically more interesting than the 4x1 samples developed during phase 1; however, it was determined that three wales without a ladder were still too many to improve the tactility of the fabrics noticeably. The 1x1 and the 2x1 fabrics have the best balance between handle and aesthetics.

The practitioner discovered that inlaying yarn on every course created softer fabrics if the suitable yarn was utilised. The process was time-consuming and created dense fabrics in the thicker yarn blends with little movement; hence, experimentation with inlaying yarn on every other course occurred to establish the right balance between construction time and tactility.

Different inlay methods were also explored during phase 2. Several techniques were examined, all of which were hand-manipulated. The results included a number of tactile and beautiful fabrics. However, some of the samples created were highly time-consuming, thick, and not commercial. These samples were not developed any further. An area for future experimentation would be to discover whether these samples could be generated more efficiently on computerised knitting machinery. The below fabrics (figures 5:77 - 5.81) were created by lifting the loops away from the needles using a transfer tool and then manually laying the yarn in front of the loops. Consequently, a two-sided fabric was produced, which has been described as in/out inlay.

Figure 5:78 Sample 27, in/out inlay in 3x3 formation.

Figure 5:79 Sample 25 in/out Inlay in a 1x3 formation.

Figure 5:80 Sample 31 yarn wrapped front to back.

Figure 5:81 Sample 32, tartan look inlay with pointelle.

Figure 5:82 Sample 24, 3x3 travelling inlay.

5.4.5 Evaluation of Phase 2: Expansion

	Two yarn combinations																											
Yarn type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Kent Romney	■	■	■	■	■	■	■																					
Blue faced Leicester 1	■							■	■	■	■	■	■															
Blue faced Leicester 2		■						■						■	■	■	■	■										
White-faced Woodland			■						■					■					■	■	■	■						
Dorset Horn				■						■					■				■				■	■	■			
Teeswater					■						■					■				■			■			■	■	
Southdown						■						■					■				■			■		■		■
Texel							■						■					■				■			■		■	■

Table 5-1 The number of different two yarn type combinations.

During phase 2, the sample collection grew to 250 samples and covered an expansive range of pattern types and yarn combinations. During this phase, ideas were tested, developed, and refined.

Yarns:

Phase 2 focused on combining two yarn types and discovering which patterns achieved this cohesively while knitting precise patterns. Table 5-1 visualises the number of two colour yarn combinations; there are 28 variations. Early in the practice, it was decided that creating 28 versions of every pattern variation would limit the variety of patterns experimented with; only nine to ten pattern types would have been generated. Consequently, the project's overall creativity was balanced with evaluating the potential of different yarn combinations throughout the making process.

The zigzag float jacquard patterns exemplify how the yarn combinations experimented with were balanced throughout a pattern group. It was impossible to sample every yarn combination in each of the eight pattern structures visualised in Figures 5-27 – 5-34, but it was possible across this pattern group. The researcher divided the yarn combinations over the eight designs and knitted the samples; results and yarn combinations can be seen below in tables 5-2 to 5-9. A key to the colours used in the tables is as below:

Orange = 1st yarn type (Feeder A)

Purple = 2nd yarn type (Feeder B)

The yarns are colour-coded as below:

KR = Purple (Kent Romney) WFW = Blue (White-faced Woodland)

DH = Black (Dorset Horn) BFL1 / BFL2 = Red (Blue-faced Leicester)

TEES = Green (Teeswater) S/DOWN = Yellow (Southdown)

TEXEL = Pink (Texel)

The column highlighted with green highlights the five softest samples within the pattern group, the exceptionally soft samples. The columns highlighted in red highlight the four samples the researcher considered the coarsest within the zigzag pattern group.

	Vertical zigzag 1					
Sample number	70	71	72	73	74	75
Yarn						
Kent Romney						
Blue faced Leicester 1						
Blue faced Leicester 2						
White-faced Woodland						
Dorset Horn						
Teeswater						
Southdown						
Rank within this pattern type	5	1	1	1	1	6
Ranking within pattern group	32	9	9	9	9	47
Overall sample ranking	310	121	121	121	121	355

Table 5-2 Vertical zigzag 1 yarn combinations table.

	Vertical zigzag 2						
Sample number	76	77	78	79	80	81	131
Yarn							
Kent Romney							
Blue faced Leicester 1							
Blue faced Leicester 2							
White- faced Woodland							
Dorset Horn							
Teeswater							
Southdown							
Rank within this pattern type	4	3	1	5	5	2	7
Ranking within pattern group	23	16	4	32	32	9	43
Overall sample ranking	251	219	51	310	310	121	328

Table 5-3 Vertical zigzag 2 yarn combinations table.

	Vertical zigzag 3						
Sample number	86	87	88	89	90	91	92
Yarn							
Kent Romney							
Blue faced Leicester 1							
Blue faced Leicester 2							
White- faced Woodland							
Dorset Horn							
Teeswater							
Southdown							
Rank within this pattern type	6	3	2	7	4	1	4
Ranking within pattern group	46	23	18	47	32	16	32
Overall sample ranking	334	251	224	355	310	219	310

Table 5-4 Vertical zigzag 3 yarn combinations table.

	Diamond vertical zigzag 4							
Sample number	93	94	95	96	97	98	127	128
Yarn								
Kent Romney								
Blue faced Leicester 1								
Blue faced Leicester 2								
White- faced Woodland								
Dorset Horn								
Teeswater								
Southdown								
Rank within this pattern type	5	6	3	2	3	8	1	6
Ranking within pattern group	23	29	18	6	18	32	1	29
Overall sample ranking	251	293	224	108	224	310	37	293

Table 5-5 Diamond, vertical zigzag 4 yarn combinations table.

	Horizontal zigzag stripe					
Sample number	99	100	101	102	103	104
Yarn						
Kent Romney						
Blue faced Leicester 1						
Blue faced Leicester 2						
White- faced Woodland						
Dorset Horn						
Teeswater						
Southdown						
Rank within this pattern type	3	5	2	1	4	5
Ranking within pattern group	23	47	18	7	29	47
Overall sample ranking	251	355	224	113	293	355

Table 5-6 Horizontal zigzag 1 yarn combinations table.

	Horizontal zigzag 2					
Sample number	109	110	111	112	113	114
Yarn						
Kent Romney						
Blue faced Leicester 1						
Blue faced Leicester 2						
White- faced Woodland						
Dorset Horn						
Teeswater						
Southdown						
Rank within this pattern type	2	4	3	1	5	5
Ranking within pattern group	7	32	18	5	47	47
Overall sample ranking	113	310	224	78	355	355

Table 5-7 Horizontal zigzag 2 yarn combinations table.

	Horizontal zig zag 3					
Sample number	121	122	123	124	125	126
Yarn						
Kent Romney						
Blue faced Leicester 1						
Blue faced Leicester 2						
White- faced Woodland						
Dorset Horn						
Teeswater						
Southdown						
Rank within this pattern type	2	4	1	5	5	3
Ranking within pattern group	9	32	1	43	43	23
Overall sample ranking	121	310	37	328	328	251

Table 5-8 Horizontal zigzag 3 yarn combinations table.

	Horizontal zig zag 4					
Sample number	115	116	117	118	119	120
Yarn						
Kent Romney						
Blue faced Leicester 1						
Blue faced Leicester 2						
White- faced Woodland						
Dorset Horn						
Teeswater						
Southdown						
Rank within this pattern type	1	3	4	6	4	2
Ranking within pattern group	3	23	32	47	32	9
Overall sample ranking	44	251	310	355	310	121

Table 5-9 Horizontal zigzag 4 yarn combinations table.

The eight tables above (Tables 5-2 – 5-9) record the yarn combinations and softness ratings of each of the eight zigzag formations. The rankings recorded at the bottom of the tables are taken from the sample matrix, which rated every sample created during the practice. The final rating is the sample's overall rating within the collection, assigned once every sample was knitted and analysed. The two rankings above have been calculated from the matrix in order to assess how soft each of the samples within the pattern type and pattern group are. Of the five samples highlighted in green, four samples contain the finer, 2/16 Nm BFL yarn blended with a 2/8 Nm yarn. The two softest samples in this pattern group are combined with Southdown, a yarn which has created many fabrics with a dense and coarse handle in other pattern types, as the research will go on to divulge. These fabrics demonstrate that pairing the Aran weight Southdown with a finer yarn in the right pattern structure can create a soft sample, even if the yarns handle is coarse. Thus, it is possible to create samples of a soft handle utilising British wools if the right pattern structure, yarn weight and type are selected. Conversely, when the Southdown has been blended with the WFW or DH (two samples highlighted in red above), the handle feels rough. For this Southdown yarn to be utilised in fabrics for garments, it requires blending with either a finer count or a softer handling yarn or both to improve its tactility. Otherwise, a heavier gauge machine is needed for further testing.

The overall results demonstrate that despite pattern type, the BFL improves the handle of the sample as samples across each pattern type rank higher (i.e., the researcher considers them softer) if this yarn is included. In contrast, the Teeswater, which is regarded as soft theoretically, has not improved the handle of the yarn types it has been blended with.

Sample number	Overall rank	Rank within pattern group	Yarns
123_ 127	37	1	BFL1/SDOWN_ BFL1/SDOWN
115	44	3	BFL1/DH
78	51	4	BFL/KR
112	78	5	BFL1/WFW
96	108	6	TEES/ BFL2
102_109	113	7	WFW/BFL1
71_72_73_74_81_120_121	121	9	DH/BFL2_ BFL2/DH_BFL2/TEES_BFL2/WFW_BFL2/DH_DH/BFL2_BFL2/KR
77_91	219	16	TEES/ BFL2_BFL1/DH
88_95_97_101_111	224	18	TEES/KR_TEES/WFW_KR/TEES_KR/BFL2_BFL2/TEES
76_87_93_99_116_126	251	23	DH/TEES_WFW/BFL2_DH/BFL1_BFL2/DH_KR/TEES_WFW/TEES
94_103_128	293	29	DH/TEES_WFW/TEES_WFW/SDWN
70_79_80_90_92_98	310	32	DH/KR_WFW/DH_WFW/TEES_TEES/WFW_WFW/TEES_KR/WFW
110_117_119_122_129	310	32	DH/WFW_KR/WFW_TEES/DH_DH/SDWN_TEES/SDWN
124_125_131	328	43	TEES/KR_WFW/SDWN_DH/SDWN
86	334	46	KR/DH
75_89_100_104_113_114_118	355	47	TEES/DH_WFW/DH_DH/KR_TEES/DH_WFW/DH_KR/DH_TEES/WFW

Table 5-10 Zigzag float jacquard sample summary chart.

Table 5-10 visualises how the samples rank overall and as a group. The yarn types have been written in different colours to visualise the blends and demonstrate the impact different yarns have on the handle of each fabric. This table shows that samples containing BFL are considered softer than those samples containing Teeswater as the softer fibre, or do not contain either yarn type. The table demonstrates the variations in the handle of this pattern type across the collection. It determines that while the pattern's structure incrementally influences the fabrics tactility, the yarn combination is the most significant factor, in determining fabric tactility. It should be noted that none of the zigzag patterns were further manipulated, and the fabrics are not textural, so the whole fabric group is very similar.

Tables 5-11 and 12 records how much of each yarn type has been used during phases 1 and 2 and the number of samples developed in each yarn combination. This information establishes that a balance of yarn types was utilised across the collection and throughout each pattern group. Less DH was used because this yarn was sourced after phase 2 began.

	Yarn used in phase 1 & 2 of the sampling							
	Kent Romney	BFL 1	BFL 2	WFW	Dorset horn	Teeswater	Southdown	Texel
Kent Romney	81	30	10	16	8	12	7	5
BFL 1	30	71	1	21	3	9	16	0
BFL 2	10	1	46	11	15	8	3	0
WFW	16	21	11	81	6	22	9	1
Dorset horn	8	3	15	6	46	9	5	0
Teeswater	12	9	8	22	9	73	7	11
Southdown	7	16	3	9	5	7	49	3
Texel	5	0	0	1	0	11	3	17

Table 5-11 visualising yarn combinations utilised across phases 1 and 2.

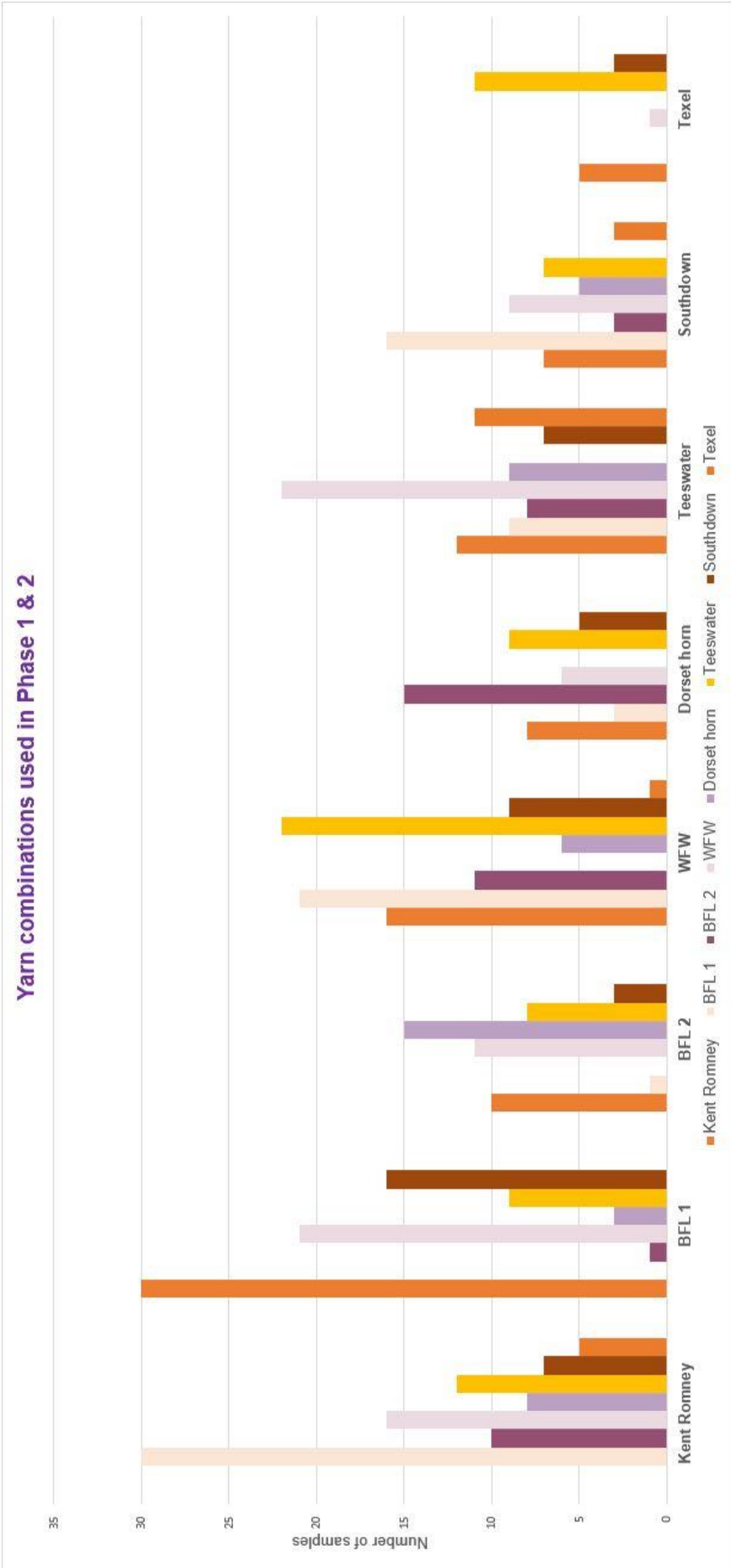


Table 5-12 The information from Table 5-11 recreated as a bar chart.

Samples

Ranking	Sample No	Patern type	Pattern	Yarn combination	
				Yarn A/ Feeder A	Yarn B/ Feeder B
1	56	Hand Tuck	4x2x2	BFL1	TEES
2	158	Float Jacquard	2x1 w ladder/ pointelle	BFL2	TEES
3	230	Tuck Jacquard	2x1	KR	BFL2 / TEES
4	232	Tuck Jacquard	2X2 Check	KR	BFL2
5	12	Inlay	1x1	KR	2 ends BFL1
6	55	Hand Tuck	4x2x2 w pointelle	BFL1	WFW
7	64	Hand Tuck	Double ladder	WFW	BFL2
8	142	Float Jacquard	4x1 rib look w hook up	KR	BFL1
9	147	Float Jacquard	2x1 rib look w ladder	DH	BFL2
10	156	Float Jacquard	2x1 rib look w pointelle	BFL2	WFW
11	123	Float Jacquard	Horizontal zig zag 3	BFL1	S/DOWN
12	127	Float Jacquard	Horizontal zig zag Di	BFL1	S/DOWN
13	132	Float Jacquard	4x1 rib look	DH	BFL2
14	148	Float Jacquard	4x1 rib look w ladder	KR	BFL2
15	115	Float Jacquard	Horizontal zig zag 4	BFL1	DH
16	191	Float Jacquard	1x1 birds-eye	DH	BFL2
17	9	Inlay	2x1	S/DOWN	2 ends BFL1
18	139	Float Jacquard	4x1 rib look	BFL1	S/DOWN
19	78	Float Jacquard	Vertical zig zag 2	BFL2	KR
20	130	Float Jacquard	Diagonal check	DH	BFL2
21	34	Hand Tuck	4x3x2	TEES	BFL1
22	229	Tuck Jacquard	2x1	TEES	WFW
23	35	Hand Tuck	4x3x2	BFL1	S/DOWN
24	36	Hand Tuck	6x3x2	BFL1	S/DOWN
25	37	Hand Tuck	4x3x2	BFL1	WFW
26	44	Hand Tuck	1x2x2	TEES	BFL1
27	51	Hand Tuck	3x4x2 w pointelle	TEES	BFL1
28	65	Hand Tuck	Double ladder	BFL2	KR
29	146	Float Jacquard	2x1 w ladder/ tuck	BFL2	DH
30	13	Inlay	1x1 w pointelle	KR	2 ends BFL1
31	1	Stripe	1x1	TEES	WFW / BFL1
32	112	Float Jacquard	Horizontal zig zag 2	BFL1	WFW
33	136	Float Jacquard	4x1 w ladder/ pointelle	TEES	BFL2
34	155	Float Jacquard	2x1 rib look	KR	TEES
35	192	Float Jacquard	1x1 w pointelle	DH	BFL2
36	193	Float Jacquard	1x1 w pointelle	DH	BFL2
37	238	Tuck Jacquard	1x1	BFL2	DH
38	96	Float Jacquard	Horizontal zig zag Di	TEES	BFL2
39	137	Float Jacquard	4x1 rib look	TEES	BFL2
40	41	Hand Tuck	1x2x2	WFW	BFL1

Table 5-13 Phase 2 top 40 samples: A summary of successful yarn blends and pattern types as rated by softness, taken from the sample matrix.

** These charts will summarise the information collated in the sample matrix going forward. Each chart is colour coded using the same colours utilised in Chapter 4 to represent each yarn type and tables 5-2 – 5-9 seen earlier in the chapter.

Table 5-13 demonstrates that a collection of suitable quality fabrics in various handles and pattern structures were generated during phase 2. Overall, the hand-manipulated and the tuck jacquards created soft samples, but most of the softest fabrics were float jacquard patterns. Two patterns, in particular, were regularly rated as soft. The 4x1 and the 2x1 rib-look samples. These pattern structures are analysed as a collection during Chapter 7, as both structures were sampled during every phase of the practice. However, one 2x1 rib-look structure created the softest sample during phase 2, sample 158. The fabric is considered innovative because the 2x1 rib-look fabric structure has been manipulated with travelling ladders and pointelle, enabling the different yarn types to combine well. The fabric is knitted with the two softest yarns, BFL and Teeswater. Thus, the practitioner tested this pattern during phase 3 of the practice to determine if fabrics created in this pattern structure are still soft when knitted in different yarn combinations.

In the overall sample rating, sample 56 and sample 158 rate highly (fifth softest), and they are the same yarn combination; thus, this was another pattern structure which required further exploration in phase 3. The hand-manipulated tucks as a pattern group achieved many of the objectives set out at the beginning of the research; they are textural, they have volume, they have plenty of stretch and elasticity, and are not dense. However, the researcher did not feel that sample 56 or the hand-manipulated tucks as a pattern group were as aesthetically appealing as the 2x1 rib-look float jacquards. Overall, the final collection of tuck patterns resembles commonly utilised patterns seen in high-street knitwear. For these patterns to innovative, the practitioner ought to redesign the structures, so they are as aesthetically interesting as they are to touch. Further testing was required during phase 3 to refine and improve these fabrics.

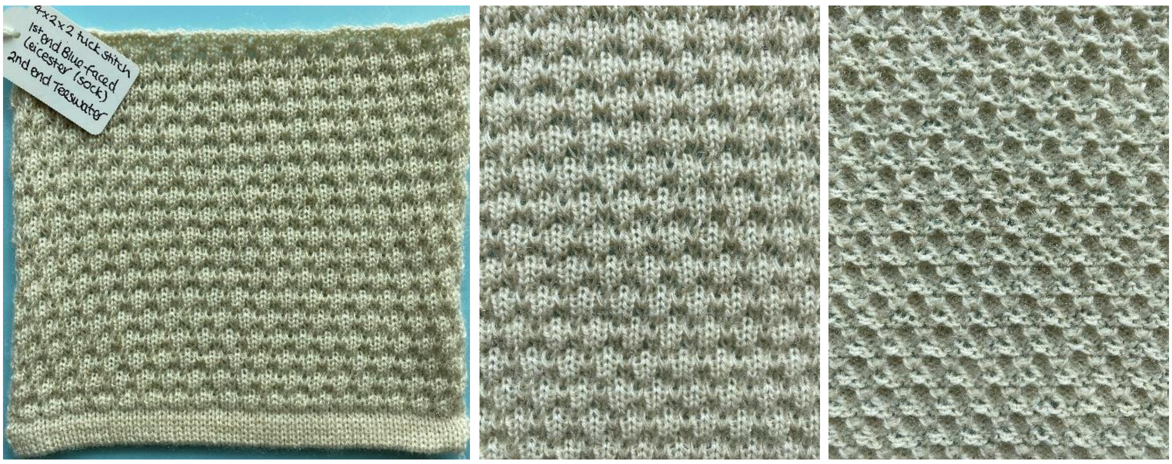


Figure 5:83 Sample 56 4x2x2 hand-manipulated tuck fabric structure.

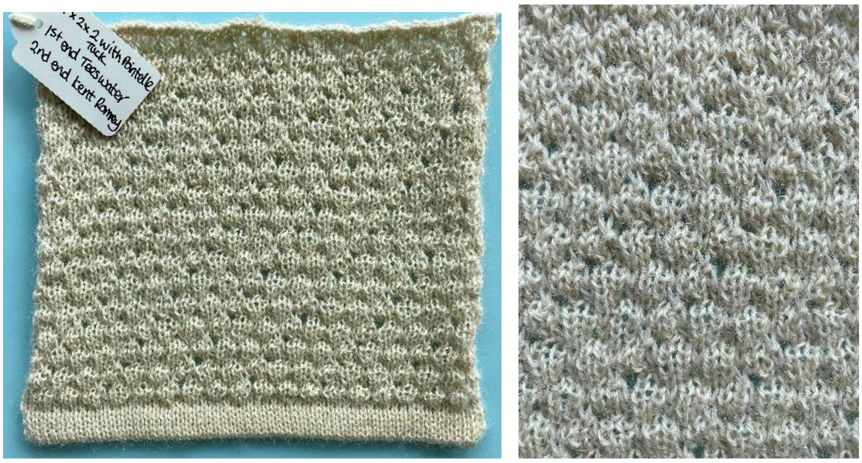


Figure 5:84 Sample 57 is the same 4x2x2 structure as sample 56, but adding pointelle throughout the pattern, this improved the blendability incrementally.

Figure 5:85 Sample 56 and 57 side by side for comparison.

6 Enrich, Embellish, Engage

Figure 6:1 Detail of sample 314, a 2x2 birds-eye check float jacquard with pointelle.

6.1 Phase 3: Enrich and Embellish

Phase 3 saw the emphasis of the practice shift to the number, variations, and methods utilised to blend different yarn types together. Many of the more complicated patterns needed to be explored further. This concentrated period of focused sampling created several very soft fabrics.

6.1.1 Float Jacquard

After analysing the data collected in phase 2, the practitioner focused on developing five structures in yarn combinations and structural formations: The patterns were the 2x1 rib-look, sample 158, 4x1 rib-look, 2x2 birds eye check and the diamond check.

Sample 158

(Refer to figures 5:42, 6:2 and 6:27 for images)

At the end of phase 2, sample 158 was rated as the softest jacquard sample created to date. Sample 158 is a 2x1 rib-look float jacquard structure, but this structure has been singled out because a period of practice was dedicated to manipulating this fabric, in particular, using different combinations of yarn types and structural formations. In total fourteen versions were created. In every version, the pointelle transfer was identical. Six versions were the same structure as sample 158; only the yarn combinations changed. The ladder formation and the combination of yarn types interchanged in the other eight versions. Table 6.1 demonstrates the outcomes.

Ranking	Sample No	Yarn combination		Pattern variation	Softness/ handle
		Yarn: feeder A	Yarn: feeder B		
1	328	BFL2	KR	extra ladder	Very Soft
2	158	BFL2	TEES		Very Soft
3	253	KR	BFL2	extra ladder	Soft -good
4	256	DH	BFL2	no ladder	Soft -good
5	251	KR	TEES		Soft -good
6	246	BFL2	KR		Soft -good
7	247	BFL2	DH		Soft -good
8	254	KR	BFL2 / TEES	extra ladder	Soft -good
9	248	BFL2	WFW		Acceptable- good
10	249	WFW	BFL2 / TEES		Acceptable- good
11	250	WFW	BFL2 / TEES	no ladder	Acceptable- good
12	252	KR	TEES	extra ladder	Acceptable- good
13	255	DH	BFL2 / TEES		Acceptable- good
14	257	WFW	BFL2	ladder every 4	Acceptable- good
15	258	DH	BFL2 / TEES	ladder every 4	Acceptable- good

Table 6-1 records the new variations of 158 created during phase 3. The rankings have been taken from the overall rankings recorded within the sample matrix. This table has collated and reorganised the information to demonstrate the softness of each sample within this pattern structure.

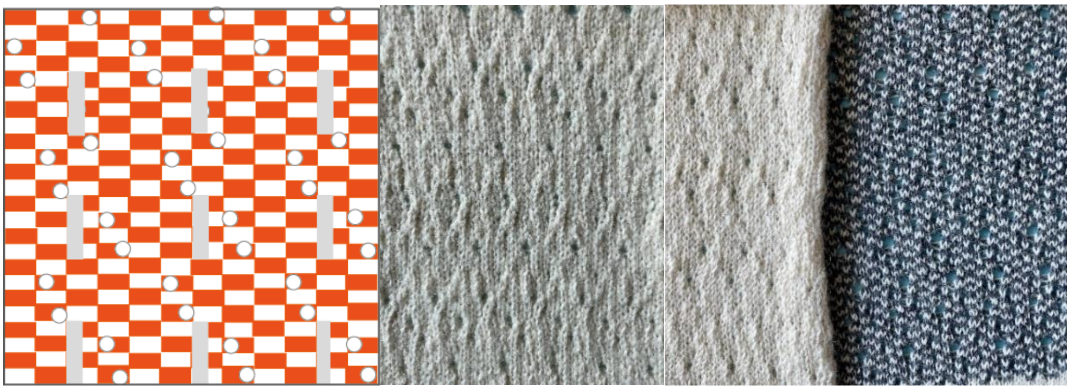


Figure 6:2 Pattern and details depicting samples 158, 246, 247, 248, 249, 251 & 255.

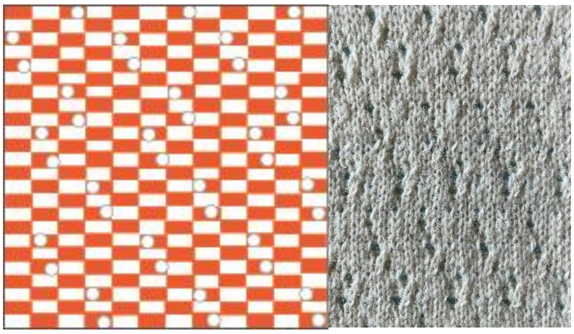


Figure 6:3 samples 250 & 256, no ladder.

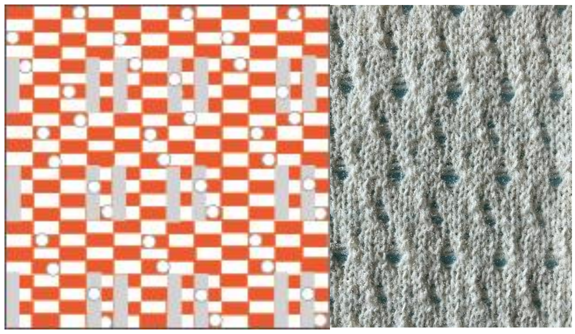


Figure 6:4 samples 253, 253 & 254, extra ladder.

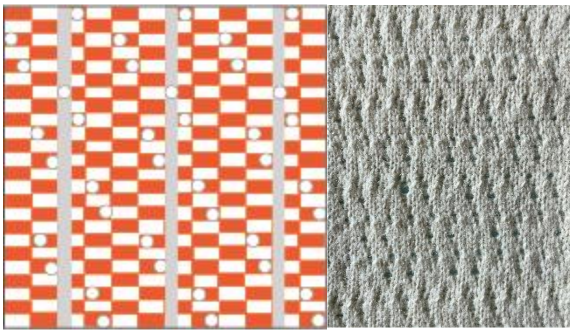


Figure 6:5 samples 257 & 258, ladder every four wales.

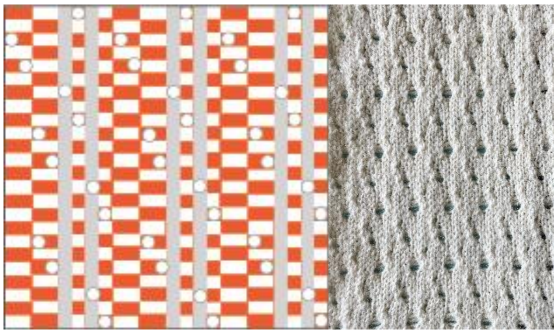


Figure 6:6 sample 328, extra ladder.

Sample 158 is soft for three reasons: the combination of yarn types; BFL/Teeswater (the two softest yarns), the fabric's structure and the fabric's blendability. It was anticipated that changing the yarn combinations in this pattern variation would create some equally soft fabrics. Only one fabric they created is as soft as 158, sample 328. (This sample is analysed in 6.4.2.3) The other samples are soft and visually pleasing but aren't as soft as 158.

In conclusion, the data above reveals that the yarn combination has more effect on the overall tactility of each sample than the incremental changes within a pattern's structure. Each yarn type has been highlighted in a different colour to visualise this. For example, BFL2/ DH and/or KR are usually softer than the combinations with Teeswater and/ or WFW blended together.

Blendability: Experimentation within Float Jacquard Structures

In all five pattern structures experimented with during phase 3, plain versions of each pattern type were tested in three or four types of yarn: usually, combining one end of each type. The reason for this was to ascertain whether the yarn handle could be improved if more types of wool were combined and determine whether those samples which had been knitted with BFL running through them in a two yarn combination would still be as soft if the proportion of BFL was reduced when a third yarn type was introduced. I.e., if a float jacquard combination of KR/BFL2 was considered soft, would it still be regarded as soft if the blend was changed to a KR/DH/BFL2 combination? One yarn remained in feeder A, and the yarn in feeder B interchanged every two rows. Table 6-1 records five versions of these combinations created with the same pattern formation as sample 158. In addition, six plain 2x1 rib-look versions were created, six plain 4x1 rib-look versions, seven versions of the 2x2 check knit and five versions of diamond knit float jacquard.


A


B

Figure 6:7 Sample 309, a 2x1 rib-look structure knitted in three types of yarn, in ecru (image A) and colour (image B).

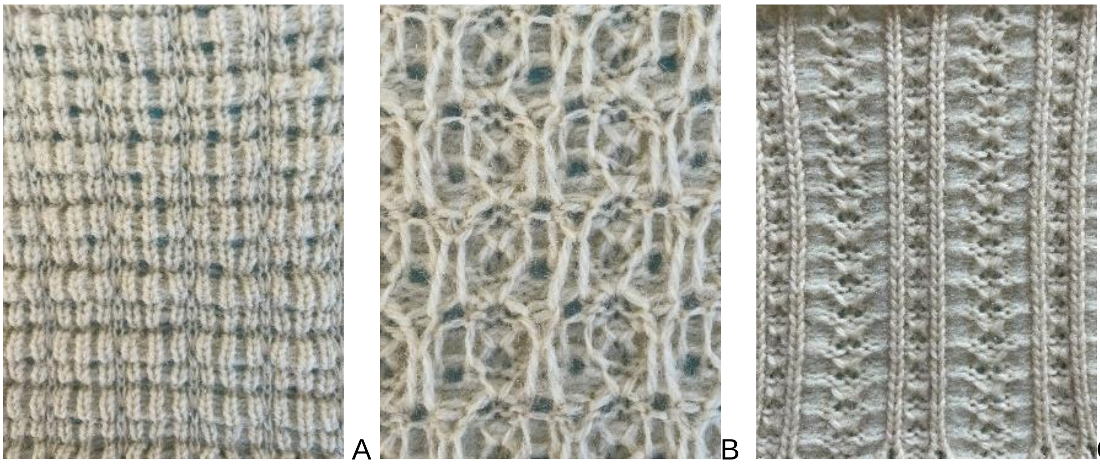
Figure 6:8 colour version of 2x2 birds-eye check to demonstrate variations in pattern structure.

Overall, the results reveal that changing the yarn did not create significantly coarser samples; however, the samples created using three yarn types were not noticeably softer than if they had been knitted in two yarn types, one of which was BFL. Again, this confirms that yarn type has the most significant impact on an individual fabric's tactility, but as will be discussed in depth in Chapter 7.5, the pattern structure and blendability also have the ability to influence the overall tactility of fabric if the correct structure is utilised.

6.1.2 Hand-Manipulated Tuck

During phase 3, three structures were tested in various combinations of yarn types: the double ladder tuck structure, the 1x2x2 structure (see figure 5:55) and the 4x4x2 structure (see figure 5:58).

Within the double ladder tuck pattern, eleven new samples were created; seven of which were as the original pattern in new two and three yarn combinations, and four were in new yarn and pattern combinations. Two versions of this pattern were created by manipulating the sample with hooked-up stitches.



A B C

Figure 6:9 Images A and B demonstrate the face and reverse of samples 291, 306 & 364; the double tuck pattern with a hand-manipulated hook-up pattern which creates an interesting texture on the reverse of the fabric. Image C is of sample 290 a is a double ladder tuck with a hand-manipulated reformed technique. The ladders have been picked up using a crochet hook to create a wale of plain knit on the reverse of the fabric. The fabrics are aesthetically pleasing. However, this technique did not make the fabric softer; instead removed the stretch and elasicity from the fabric.

Eight new versions of the 4x4x2 pattern were created, five of which were as the original sample in three yarn types, and three samples were new experiments with a pointelle structure. Six versions of structure 1x2x2 were developed, three of which were as the original, two with ladders and one with pointelle.

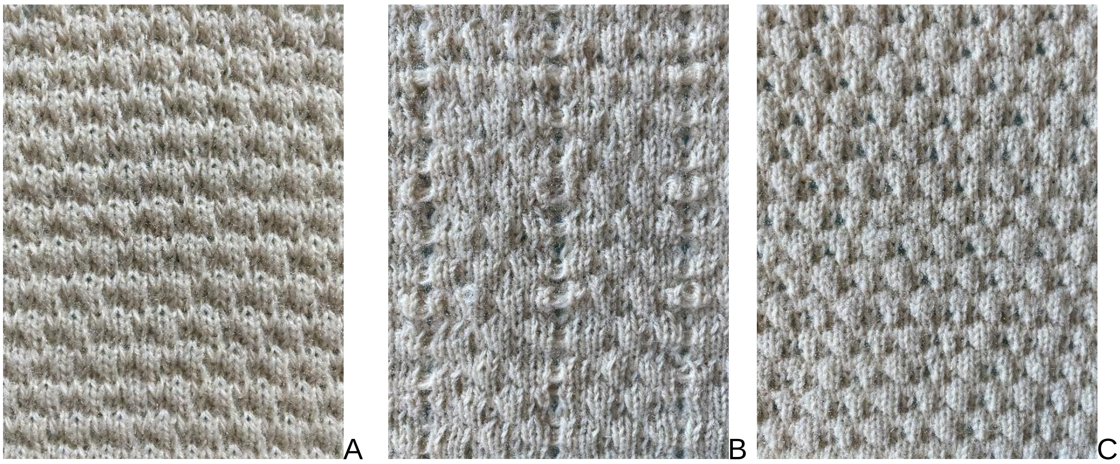


Figure 6:10 A) Sample 300, a 4x4x2 tuck in WFW/BF1/ Tees B) Sample 303, a 4x4x2 with ladder pick up in DH/Tees/ BFL2 C) Sample 305, a 4x4x2 with pointelle in KR/DH/BFL2

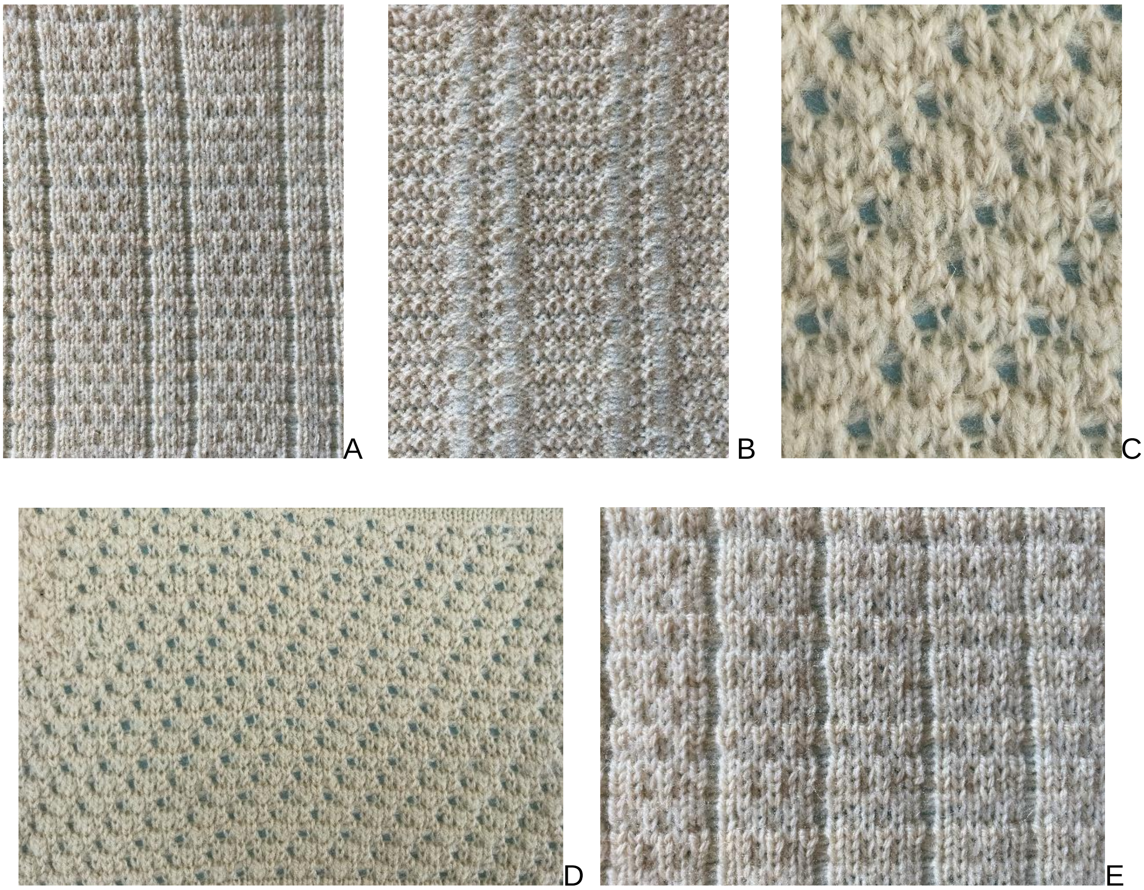


Figure 6:11 Examples of the new structures developed within the 1x2x2 tuck formation.

A & B) show sample 297 in a DH/ WFW/ BFL2 mix C & D) record sample 298 in a WFW/ BF1/ BFL2 mix. Sample E details sample 299 in a KR/ Dh/ BFL2 mix

Table 6-2 records that the double ladder structures are the softest hand-manipulated tuck samples created during phase 3. The other stand-out sample is sample 298, a 1x2x2; this sample is the only sample in the collection knitted with both counts of BFL; thus, what is surprising is that this sample it is not rated higher (i.e., softer). All the fabrics rated ‘soft’ combine three yarns in open structures to create soft and stretchy samples. All of the ‘soft handling' tuck samples have at least one end of BFL blended through them. The samples are good examples of fabrics answering the project's aims; they have a soft handle, blend the yarn cohesively, creative hand manipulation and are aesthetically pleasing. The samples are not innovative in that they look new; however, all the patterns are appropriate for commercial knitwear.

Ranking	Overall rating	Sample No	Yarn combination			Pattern Type	Pattern variation	Softness/ handle
			Yarn A	Yarn B	Yarn C			
1	11	283	BFL2	KR		Double ladder		Soft -good
2	13	291	KR	BFL1	TEES	Double ladder	hooked up	Soft -good
3	13	364				Double ladder	hooked up	Soft -good
4	21	298	WFW	BFL2	BFL1	1x2x2	pointelle	Soft -good
5	21	306	KR	DH	BFL2	Double ladder	hooked up	Soft -good
6	62	284	BFL2	TEES		Double ladder		Soft -good
7	62	285	BFL2	TEES	KR	Double ladder		Soft -good
8	62	305	KR	DH	BFL2	4x4x2	pointelle	Soft -good
9	147	287	DH	TEES		Double ladder		Soft -good
10	152	286	DH	BFL2		Double ladder		Acceptable- good
11	152	288	DH	BFL2	WFW	Double ladder		Acceptable- good
12	152	292	BFL1	TEES	WFW	3x4x2		Acceptable- good
13	152	293	BFL2	TEES	DH	3x4x2		Acceptable- good
14	152	294	DH	BFL2		1x2x2		Acceptable- good
15	152	295	DH	BFL2	TEES	1x2x2		Acceptable- good
16	152	296	BFL1	TEES	WFW	1x2x2		Acceptable- good
17	152	297	DH	WFW	BFL2	1x2x2	ladder	Acceptable- good
18	152	299	KR	DH	BFL2	1x2x2	ladder	Acceptable- good
19	152	300	WFW	TEES	BFL1	4x2x2		Acceptable- good
20	152	301	KR	BFL1	TEES	4x2x2		Acceptable- good
21	152	302	DH	BFL1	TEES	4x2x2		Acceptable- good
22	152	303	DH	TEES	BFL2	4x2x2	hooked up	Acceptable- good
23	152	304	WFW	TEES	BFL2	4x2x2	hooked up	Acceptable- good
24	192	289	WFW	BFL2		Double ladder	reformed stitch	Acceptable- good
25	224	290	WFW	BFL2	KR	Double ladder	reformed stitch	Acceptable- good
26	345	331	KR	S/dwn		3x4x2	ladder	Acceptable
27	349	327	BFL1	S/dwn		4x4x2	pointelle	Acceptable

Table 6-2 Phase 3 hand-manipulated tuck sample analysis.

6.1.3 Tuck Jacquard

These patterns were explored in depth during phase 3 because the outcomes of phase 2 identified that most of the tuck-jacquards were both soft to touch and soft next to the skin. These samples were some of the softest samples created during phase 2. During phase 3, twelve new tuck jacquard fabrics were created in a series of two and three yarn type combinations. The fabric designs which were developed are below:

Figure 6:12 Sample 273 is a 2x1 rib look tuck jacquard structure with a double ladder. The images show the front and back of the knit. Sample 264 was knitted in the same structure.

Figure 6:13 Sample 272 is a 2x1 rib look tuck jacquard structue with laddera & pointelle. This is the softest sample within the collection. The images show the front, back and a close-up of sample 272. (Image 6:15 is a bigger version of this sample). Samples 263 & 271 were knitted in the same structure.

Figure 6:14 Sample 275 2x1 rib look tuck jacquard structure with a single ladder every six wales. The images show the front, back and a close-up of the knit. Sample 274 was knitted in the same structure.

This focused sampling created three of the softest samples within the entire collection and five of the top ten samples overall, so the pattern structures and yarn types combined successfully. Table 6-3 records every tuck-jacquard sampled during Phases 2 and 3. It demonstrates that it is the 2x1 (rib-look) pattern structure that is creating the softest samples; this is the same pattern structure as the 2x1 rib-like float jacquard and uses the same punch-card. This structure, in particular, has been very successful throughout the project. Although these samples feel good and feel soft next-to-skin as well, at the time, the researcher did not consider them particularly innovative, as the structures created look so similar to a cardigan and half cardigan patterns, which are a traditional type of ribbing utilised in fisherman's ganseys.

However, on reflection, the researcher ascertains that this is the innovation; a collection of single-bed fabrics have been created, which gives the impression of a double-bed fabric both in handle and aesthetically but, theoretically, should be lighter, be less dense and use less yarn. These samples have succeeded in combining innovation, creativity, and commerciality. These samples can be considered aesthetically more innovative than the hand-manipulated tucks created during Chapter 6.1.2. This is because the samples have succeeded in combining the structural elements of jacquard, tuck and miss stitches and lace transfer to create new pattern structures which are very soft and sculptural, have lots of volume and are appropriate for next-to-skin wear because the fabrics naturally sit away from the skin, as the structure creates many bumps and air pockets.

Ranking	Overall rating	Sample No	Yarn combination			Pattern Type	Pattern variation	Softness/ handle
			Yarn A	Yarn B	Yarn C			
1	1	272	BFL2	TEES		2x1 rib look	ladder pointelle	Very Soft
2	2	273	BFL2	KR	DH	2x1 rib look	double ladder	Very Soft
3	2	274	BFL1	KR		2x1 rib look	ladder	Very Soft
4	4	231	KR	BFL2		2x1 rib look	ladder	Very Soft
5	5	264	BFL2	WFW	KR	2x1 rib look	double ladder	Very Soft
6	10	276	BFL2	WFW	DH	2x1 rib look	ladder	Soft -good
7	13	230	KR	TEES	BFL2	2x1 rib look		Soft -good
8	13	232	KR	TEES	BFL2	2x1 rib look		Soft -good
9	13	263	WFW	BFL2		2x1 rib look	ladder pointelle	Soft -good
10	13	271	KR	BFL1		2x1 rib look	ladder pointelle	Very Soft
11	21	259	DH	BFL2		2x1 rib look	ladder	Soft -good
12	21	261	WFW	BFL2		2x1 rib look	ladder	Soft -good
13	21	262	WFW	BFL2	TEES	2x1 rib look	ladder	Soft -good
14	56	229	TEES	WFW		2x1 rib look		Acceptable- good
15	56	275	BFL2	KR	DH	2x1 rib look	ladder	Acceptable- good
16	77	260	BFL2	TEES		2x1 rib look	ladder	Soft -good
17	79	238	TEES	DH		1x1 birdseye	1x1 tuck	Soft -good
18	133	233	TEES	WFW		2x2 birdeye		Acceptable- good
19	133	235	TEES	DH		2x2 birdeye		Acceptable- good
20	133	236	TEES	KR		2x2 birdeye		Acceptable- good
21	133	239	TEES	DH		1x1 birdseye	ladder	Acceptable- good
22	148	234	BFL2	WFW	KR	2x2 birdeye		Acceptable- good
23	192	237	TEES	KR	KR	1x1 birdseye		Acceptable- good

Table 6-3 Phase 3 Tuck Jacquard analysis. This table shows all of the samples within the tuck jacquard group, the yarns they have been knitted in, the pattern structure and type. The samples are sequenced in order of softness.

Figure 6:15 A larger close-up image of sample 272, a 2x1 rib look tuck jacquard structure manipulated with ladders and pointelle.

6.2 The Interviews: Selecting and Creating Samples for the Interview Process

The doctoral research aims to enable consumers to understand the value of British wool as an affordable, sustainable yarn to utilise within fashion products. Hence a series of individual interviews were conducted after phase 3 of the practice to determine this information. The process began by creating six sample packs of fourteen samples.

The samples were selected utilising the tactile data collected. The edited collection needed to represent a balance of samples across each yarn type, each pattern group, and each softness rating. To ensure each was equally represented, the researcher analysed each softness group and selected several samples from each rating. They laid out each sample and sorted them into categories, firstly by pattern and then again by yarn type; this allowed them to narrow the collection down to twelve fabrics representing the entire collection's character. The samples were then sorted from softest to coarsest.

sample number	Sample type	Sample name	Yarn mix	Softness
325	control sample -jacquard	4x1 rib look with ladder	100% Merino wool	soft - very soft
326	control sample -jacquard	2x1 rib look	100% Acrylic	soft - very soft
158	Jacquard	2x1 rib look w ladder & Pointelle	BFL2 / Teeswater	soft - very soft
328	comparison -jacquard	2x1 rib look w ladder & Pointelle	Kent Romney / BFL 2	soft - very soft
309	comparison -jacquard	2x1 rib look	Kent Romney / Dorset Horn / BFL 2	soft -good
291	tuck stitch	Double ladder tuck with hook up	Kent Romney /Teeswater/ BFL1	soft -good
276	tuck jacquard	2x1 tuck punch card w ladder Poi	BFL 2/ WFW/ Dorset Horn	soft -good
1	Stripe	1x1 Stripe	Teeswater/ WFW/ BFL 1	soft -good
21	Inlay sample	1x1 Inlay sample with pointelle	Teeswater/ Texel	Acceptable to good
108	Jacquard	Diagonal check jacquard with poi	WFW/ Teeswater	Acceptable to good
299	tuck stitch	1x2x2 tuck stitch with ladder	Kent Romney/ Dorset Horn/ BFL	Acceptable to good
58	Inlay sample	1x1 Inlay sample	Kent Romney / Texel	Acceptable
180	Jacquard	2x2 check Knit - punch card	WFW / Kent Romney	Acceptable
39	tuck stitch	3x4x2 tuck Stitch	WFW/ Southdown	Acceptable

Table 6-4 screenshot of the selected samples.

Within the twelve samples, two are rated very soft. This is because fewer 'very soft' samples are within the collection. Four samples were 'soft,' three samples were of 'acceptable to good' (of average) handle, and three were considered 'acceptable.' There is a fifth rating of 'coarse', but no coarse samples were selected to show to the participants as only one sample within the collection was rated coarse.

Of the twelve samples, five are float jacquards, three hand-manipulated tuck samples, two inlay samples, one tuck jacquard and one stripe. This ratio represents the overall balance of pattern types within the collection.

The yarns were more challenging to balance because some samples contained two ends of yarn, and others had four.

Kent Romney	5
WFW	6
Dorset Horn	3
BFL 1	2
BFL 2	4
Teeswater	5
Texel	2
Southdown	1

Table 6-5 The breakdown of yarns within the edited sample collection.

This breakdown is representative of the collection. KR and WFW have been utilised consistently throughout the sampling as they are the two yarns that benefit most from the blending process.

Figure 6:16 The tweleve samples selected for interview. The first image is of the samples which were replicated and sent to each of the participants. The second image is of the sample collection knitted in colour to demonstrate the pattern variations and the number of ends of yarns utilised within each sample.

6.3 Timeline of the Interviews

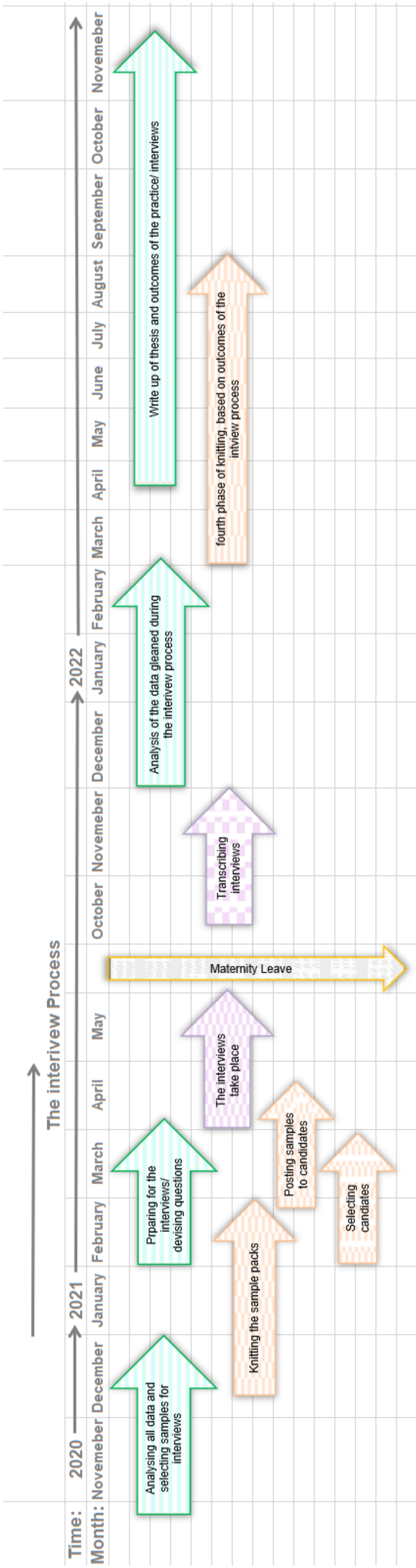


Figure 6:17 The timeline of the interview process.

In total, six participants agreed to take part in the interview process. On Microsoft Teams, the interviews took place over two weeks, between 28th April and 6th May 2021. Discussions began with a concise summary of the research project. An information sheet was provided with the sample packs. Still, the researcher elaborated on this, discussing the project's background, especially to explain why wool is a critical area for future design research. The interviews were semi-structured; the interviewer led the conversations and prompted the interviewees if needed. However, each participant was given time to handle the fabrics and consider their responses. The interviews were recorded and transcribed in Appendix 5.

The researcher noted that all the participants understood the language utilised within the study, demonstrating that the language used throughout the doctoral study to describe fabric tactility is appropriate. The participants found the word bubble extremely helpful as they struggled to think of different descriptive words to describe each sample.

6.4 Evaluation of the Interview Process

This section interprets and analyses the data collated during the interview process.

6.4.1 Softness

1	What are your opinions of wool? (Do you have any preconceived thoughts regarding the fibre?)
2	Is wool a fabric which you would choose to wear? (Y/N) and what are your reasons for this?
3	How would you describe softness?
4	In your experience what is soft?
5	Do you have any insights into describing roughness or hardness?

Table 6-6 Questions one to five.

The discussions with each participant began by discovering their perceptions of wool and whether they would consider wearing wool next to the skin.

The two most popular responses to question one (by four of the six participants) were that wool is Itchy and wool is warm. These findings echo the consumer responses discussed in the literature (Hebrok & Klepp, 2014; Sneddon, et al., 2012). Overall, half of the participants stated that they 'love the look' of wool, but as the speech bubbles below demonstrate, there were many other descriptions, some of which evoke negative connotations. Phrases such as heavy, difficult to care for and expensive were mentioned.

Figure 6:18 The participant's perceptions of wool; their responses to question one.

There was a more mixed response when the participants were asked whether they would consider wearing wool next to their skin; although all the participants stated they would be happy wearing wool with a layer underneath, only two participants said they would be happy to wear wool next to their skin.

The answers to these questions reiterate what was discussed in the literature regarding consumer perceptions; only two participants could envisage wearing wool next to the skin and that preconceptions and memories are part of how they understand the tactility of wool. The highlighted quote (in red) visualises this. The participant acknowledged they did not purchase wool garments because of their negative memories of wearing woollen clothes as a child.

The questions then uncovered the participant's perceptions of what is soft and what is rough. These questions were asked so the researcher to understand better how the participants perceive soft and rough and whether they are the correct terminology when describing fabric tactility.

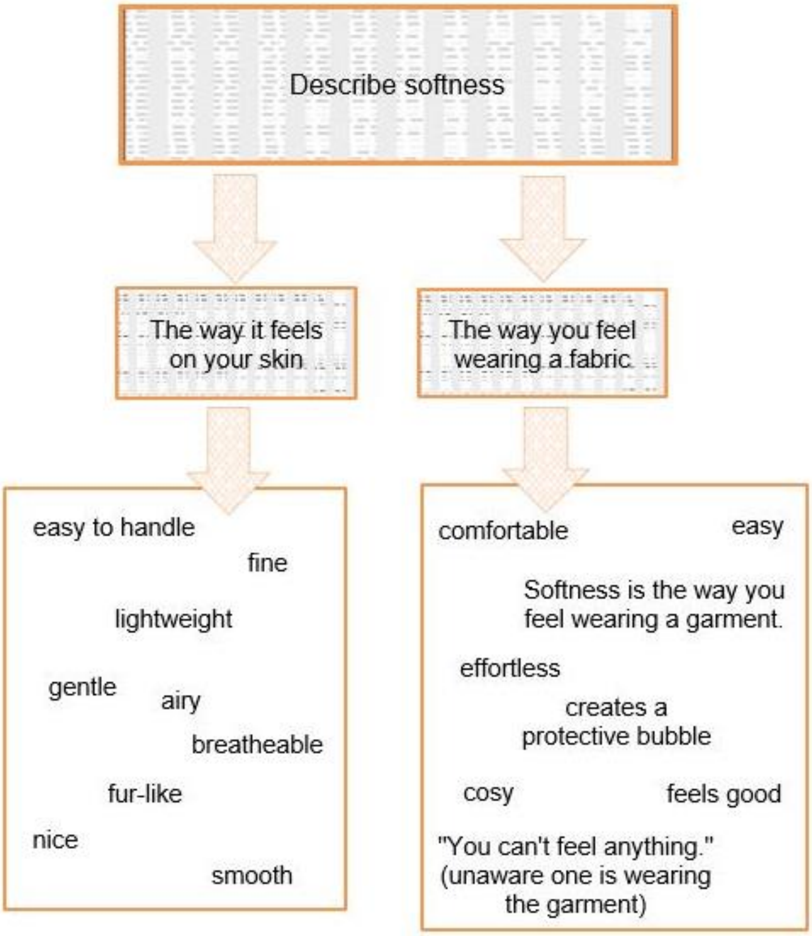


Figure 6:19 The participant's responses when asked to describe softness, (question three).

Soft v's Rough descriptions	
Soft	Rough
jersey:	stiff garments: little movement
pjamas, lounge-wear	wet jeans
duvets, pillows, bedding	hard/ uneven textures
cotton wool	man-made wool garments
cashmere	sand
fur	tweeds/ linens
animals	raw fibres
feathers	weaving
fluffy textures	angular objects
leaves on a plant	sieve
smooth surfaces	sponges/ things that bristle
bubbles	interior fabrics

Table 6-7 Softness descriptions: The participant's answers to questions four and five.

The answers given by the participants when asked to describe softness were all surprisingly similar. Comfort, along with how ‘something’ feels on the skin, was the most used term. The word softness evokes the feeling of comfort and craving something to feel good next to the skin; this was echoed when the participants were asked to describe what they associated as soft, and as Table 6-7 records, the answers revolved around objects or experiences the participants deem as comforting or comfortable, i.e., wearing pyjamas or feathers or animals. Again, the responses back up the literature and demonstrate the importance consumers give to comfort when considering purchasing a fabric (Sneddon, et al., 2012; Sneddon, et al., 2012). The number of natural materials listed as rough in response to the question of what one associates with being rough surprised the researcher. Wool was mentioned, along with tweeds and linens. Perhaps wool and other natural fibres are considered rough because of their associations with itch and prickliness over time. These answers determine that soft and rough are appropriate terminology when describing fabric handle. Every participant understood the language used and its associations.

6.4.2 The Sample Collection

6	Can you try to rank the samples in front of you from 1 -14 in order of softness. (1 being the softest and 14 being the roughest/ hardest.)
7	Talk me through your decision making process when ranking the sampling? (What are your reasons for ranking the samples in this way?)
8	Are there any samples which stand out to you? If so why is this? (Which are your favourites and why?)
9	Can you choose a maximum of three descriptive words to describe each of the samples in front of you?
10	Looking at the list of words on the screen, are there any further words you would choose to describe each of the samples?
11	Would you wear a garment made any of these fabrics next to your skin? Y/N. Again what are your reasons for wearing/ not wanting to wear these fabrics?

Table 6-8 Questions six to eleven.

The questions listed above in Table 6-8 were the focus of each interview. The questions were designed to encourage the participants to respond to the samples and explore the language used to describe them. The responses influenced phase 4 of the practice.

The discussion began by inviting each participant to rank the samples from softest to roughest. (1 is the softest, and 14 is the roughest). The participants did this while the interview took place. Still, in most cases, the participants had already reviewed the samples prior to the interviews and made some decisions regarding which samples they preferred.

Once they had determined the sample order, the participants were asked to describe each sample. Overall, they found this challenging, with most participants needing help thinking of different descriptive language for every sample. The word bubble was then provided, and the participants were invited to describe the samples again, using the words contained within it. They found this process much more straightforward. Finally, they were asked to divulge further thoughts regarding each fabric, including which fabrics they liked/ disliked, why, and whether they would consider wearing any of the presented fabrics next to their skin.

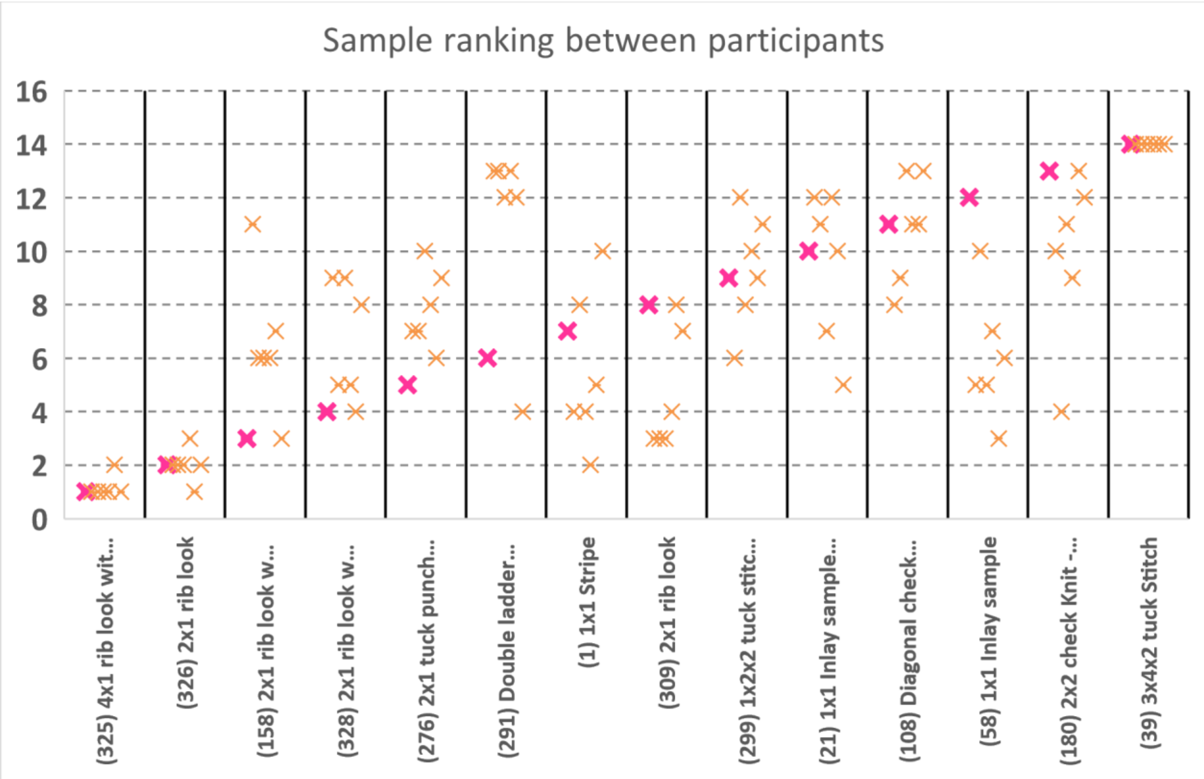


Table 6-9 Softness ranking comparison chart between the researcher and participants. The pink x signifies the researchers ranking between 1 & 14, and the orange x's are the participant's rankings.

Table 6-9 has collated how each participant rated the samples from softest to hardest and compared the results to the researcher's ratings at the end of phase 3. It records that while the participants and the researcher agree with the tactility of some of the samples, such as 325, 326 and 39, several discrepancies are revealed as the participants did not agree with all of the researcher's findings. This is analysed sample-by-sample below from 6.4.2.1

The participants agreed that sample 325, the merino wool sample, is the softest, describing it as '*soft and light'* and '*really beautiful*.' 67% of participants rated the acrylic sample (326) as the second softest. While the participants agreed with the researcher regarding these samples, the researcher anticipated that the participants would determine that several British-wool blend samples were as soft as or softer than the acrylic, but this was not the case. Through the questioning, the researcher discovered that although overall, the acrylic was rated as soft, not all the participants actually liked the handle of the fabric or said they would be prepared to wear a garment made of the fabric. While discussing the samples, the researcher proposes that the participant's opinions of the acrylic fabric may have been influenced once they were informed of the fabrics composition, thus once they knew it was acrylic, they felt they 'should not like' the sample as this is the fabric the research was trying to imitate and improve. These findings reveal that softness and consumer preference are separate considerations.

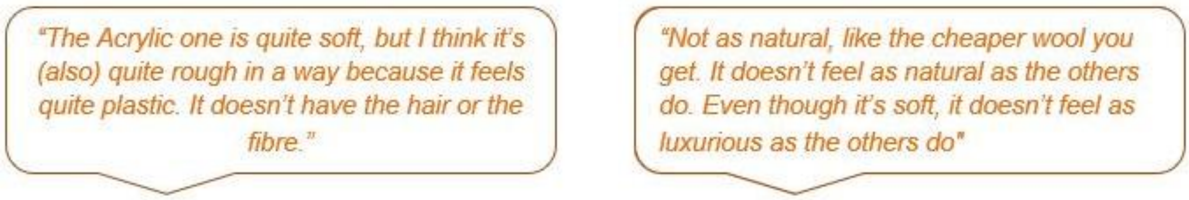


Figure 6:20 Participant comments regarding sample 326, the acrylic control sample.

Table 6-9 reveals that the most significant discrepancies were between sample 291, which the majority of participants determined to be coarser than the researcher, and samples 58 and 180, which the participants evaluated to be softer, which may demonstrate that these samples have the potential to be wearable fabrics. However, the table also indicates that the participants had a more mixed response to the samples the practitioner developed from the original knit, either with hand-manipulation or different yarn combinations. The participants responded first and foremost to the overall texture of the fabric and then considered its softness. Overall, the researchers concluded that the participants found too much texture off-putting, which negatively impacted their response to the tactility of the fabric.

Figure 6:21 Sample 325-word cloud, decribing the merino sample.

The word cloud above visualises the participant's sensory descriptors of sample 325, the merino wool sample. The language is very positive; it will become apparent that the language to describe the British wool samples is not as affirmative. The language in this word cloud is noticeably different from that of the following word clouds. This cloud depicts the softness of the merino wool in comparison to the British-wool blended samples.

6.4.2.1 Sample 309: 2x1 Rib-Look Float Jacquard

Figure 6:22 Details of sample 309, a 2x1 rib-look float jacquard structure. The images show the front and reverse of the swatch in ecru and colour to visualise how the yarns have combined.

Three participants agreed that sample 309, a swatch knitted in the same pattern as the control samples were the softest British wool fabric. None of the participants considered the sample to be softer than the control samples. Four participants stated they would wear this fabric next to their skin. One participant said that they would not wear it. However, the reason was that the sample was too fancy, and they would have preferred a plainer fabric rather than the tactility of the fabric. Overall, the aesthetics of the fabric influenced its popularity. The participants who liked the sample rated it highly because it was a fabric they could imagine wearing, demonstrating that consumer preference considers many factors, as well as comfort and durability.

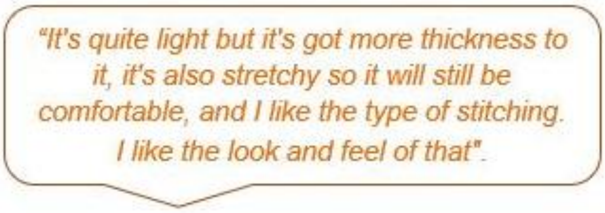


Figure 6:23 A participant's response to sample 309.

This feedback suggests that simple patterns blended in three different yarns can be as soft as or softer than fancy patterns knitted in the same or fewer types of yarn. These 'simple' fabrics are just as effective at blending the yarns, creating an effective outcome that the participants considered wearable.

Figure 6:24 Sample 309 word cloud collates each of the participant's sensory descriptors. Overall, the language can be considered positive; describing a thick, spongy comforting fabric.

6.4.2.2 Sample 39: 3x4x2 Hand-Manipulated Tuck

Figure 6:25 Details of sample 39, 3x4x2 hand-manipulated tuck structure. The images show the front and reverse of the swatch in ecru and colour to visualise how the yarns have combined.

An area where both the participants and researcher agree is that the handle of sample 39 is the coarsest of the samples. The handle of the sample is very dense and hard. This is due not only to the mix of fibres but the count of the fibres in which it is knitted. The Southdown is a heavier count (2/4Nm), which is too bulky for the machine. This demonstrates that many factors influence fabric softness, including tension and using appropriate yarns for the machine gauge. Surprisingly, however, although every participant rated this sample as the coarsest, one participant stated that it was their favourite, saying the pattern was 'beautiful.' two participants articulated that they 'loved the look' of the sample despite ranking it as the coarsest and stated that they could imagine the fabric utilised for outwear. Thus, aesthetics are crucial in drawing consumers to a textile or garment; the participants valued aesthetics over handle when viewing the fabric, but, ultimately, the tactility of the fabric influenced how they rated the sample; this is communicated through the language in the word cloud below.

Figure 6:26 Sample 39 word cloud highlighting the negative emotions fabric 39 evoked.

Overall, the language has negative connotations, which is understandable, considering this is the coarsest fabric within the edited collection. This word cloud demonstrates that the participants were considering tactility when handling the sample because none of the frequently used terms articulates the participant's positive response to the aesthetics of the samples.

6.4.2.3 Samples 158 and 328: 2x1 Rib-Look Float Jacquard Structures with Ladder and Pointelle Manipulation.

Figure 6:27 Details of samples 158 and 328. The images show the front and reverse of the fabrics in ecru and colour to visualise how the yarns have been combined.

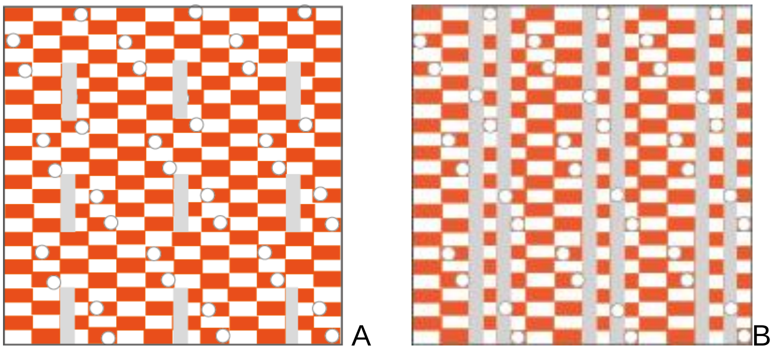


Figure 6:28 Illustrates the pattern variation between A, sample 158 and Image B, sample 328.

Sample 328 is a reworked version of sample 158, the softest float jacquard structure developed during Phase 2. It is produced in a different blend of British wool yarns and a slightly different pattern formation. (An extra ladder every other four wales, the pointelle pattern is the same). These were the two samples presented to the participants, which the researcher considered the softest (Very soft). However, only one of the six participants agreed. One participant considered sample 158 relatively rough because they felt it was too hairy, too itchy, and too textured. The data reveals that four participants found sample 328 to be softer than 158.

The findings demonstrate that the participants found the hairs from the Teeswater fibre to be coarse and itchy. Although theoretically, the Teeswater fibre is a better-quality, more expensive fibre, which can feel very soft and lustrous if mixed with a fibre such as the BFL. The participants tend to prefer the handle of the BFL blended with the KR or another less hairy yarn in these combined pointelle and jacquard fabrics. This indicates that surface fibre is perceived as a negative property when handling the fabric. The KR is both cheaper and more widely available than the Teeswater; thus, a KR/BFL blend is commercially preferable to a Teeswater/ BFL blend if the handle is considered soft enough. There is aesthetically very little difference between the two samples; the yarns are combined similarly.

Although the samples are comparable, the difference the second yarn type has made to the perceived handle is represented in the two-word clouds below, figures 6:29 & 6:30. Sample 328 is technically more textured and more open in structure than 158, but the fibre type has changed the surface appearance and the handle of the fabrics. The openwork structure in 328 has successfully affected the fabric handle, whereas the properties of the Teeswater have negatively impacted how sample 158 is perceived compared with 328. Comparing these samples demonstrate that the fibre blend and the pattern type affect the fabric's surface and tactility.

Figure 6:29 Sample 158 word cloud.

Figure 6:30 Sample 328-word cloud.

6.4.2.4 Samples 58 and 21: 1x1 Inlay Samples.

Figure 6:31 Details of sample 58 (1x1 inlay) and sample 21 (1x1 Inlay with pointelle). The images show the front and reverse of the swatch in ecru and colour to visualise how the yarns have combined together.

Sample 58’s popularity was a revelation. Overall, the participants responded positively to the sample. In fact, it was one of the participant’s favourite British wool sample, ranking it as the third softest overall. The participants were drawn to the fabric’s lightness and liked that it wasn’t what they considered a typically chunky woollen fabric. In response to this feedback, the researcher explored sampling with several different yarn combinations, previously unexplored in this pattern, during phase 4. This sample was preferred to sample 21, which is also an inlay sample.

Overall, sample 21 was less popular because the participants perceived the holes as ‘too big. Some stated they did not associate chunky knitwear with open ‘lacy’ fabrics. Sample 21 is knitted in Teeswater, which strengthens the argument that it is the yarns properties which the participants were not fond of. The openwork structure enabled the hairs of the

Teeswater to raise to the fabric's surface, making the sample feel 'pricklier.' Although this structure has the ability to affect fabric handle positively, in this instance the yarn types employed have negatively impacted the fabric's tactility.

No 58: 1x1 Inlay sample Kent Romney/ Texel		No 21: 1x1 Inlay sample with pointelle Teeswater/ Texel	
Positive	Negative	Positive	Negative
open airy sheer light loose breathable nice pattern crisp textured grooved rippled soft plush springy mellow flexible intricate see-though	scratchy knobbly firm limp	open airy/ very airy sheer light loose/ looser/ very loose breathable lacy holey fuzzy brushed	irritating bulky itchy coarse not wear-able not sturdy feel fibres hairy dry rough/ rougher scratchy knobbly gritty

Table 6-10 Sample 58 and 21 sensory descriptors comparison.

Again, the participant's language reveals the differences between the two samples. These have been visualised in two different ways. The table above divides the words into terms with positive and negative connotations. The word clouds communicate which sample the participant preferred by the frequency of the terms chosen to describe the samples.

Figure 6:32 Sample 21-word cloud.

Figure 6:33 Sample 58-word cloud.

6.4.2.5 Sample 276: 2x1 Tuck Jacquard with Ladders and Pointelle.

Figure 6:34 Details of sample 276. The images show the front and reverse of the fabrics in ecru and colour to visualise how the yarns have combined.

The participants agreed with the researcher's findings that sample 276 is soft. However, there was nothing mentioned explicitly regarding this sample; their feelings towards the fabric were neutral. The language used to describe the sample varies, revealing that some participants were more drawn to the fabric than others.

However, the samples within this pattern group (tuck jacquard) are the most consistently soft fabrics throughout the entire practice, with five samples ranking in the top 10 softest samples of the entire sample collection. (This information was collated by the researcher at the end of the practice.) These mimic the findings of Choi & Ashdown, (2000) who found the half-cardigan stitches to be the smoothest and softest. This structure of the tuck jacquard fabric mimics a double-bed half-cardigan pattern to a certain extent. The lack of feedback for this sample, combined with the fact the practitioner has already created several of what they judge to be exceptionally soft samples, which answer the aims of the research study, meant the researcher did not further sample in this pattern type during phase 4 of the practice.

The researcher speculates that the participants were not drawn to this sample as the pattern is relatively commercial; the fabric structure is what one would expect chunky knitwear to be made in, again the innovation within the tuck jacquard structure is that a single-bed fabric can still be as soft and spongy as a double-bed fabric if the right yarn types and pattern structure are combined.

Figure 6:35 276 word cloud.

6.4.2.6 Sample 108: Diagonal Check Float Jacquard with Pointelle.

Figure 6:36 Details of sample 108. The images show the front and reverse of the fabric in ecru and colour to visualise how the yarns have combined.

The participants agreed that sample 108 has an acceptable to good (of average) handle. Again, there were few specific good or bad comments regarding the sample. This sample is float jacquard which has been further manipulated with pointelle. The pointelle has done little to improve the yarns' blendability or the fabrics' handle. The pointelle has made the fabric aesthetically more attractive.

Figure 6:37 108-word cloud.

6.4.2.7 Sample 1: 1x1 Stripe

Figure 6:38 Details of sample 1. The images show the front and reverse of the fabric in ecru and colour to visualise how the yarns have been blended together.

Sample 1 was rated highly by most participants, who agreed that the fabric was soft to the touch, would be soft next to the skin, and they would consider wearing it in garment form. This is the simplest fabric of those knitted for the edited collection; the yarn type changes on every course, which in this case, has effectively blended the yarns creating an even blend and a soft handle. The participants were drawn to the light, simple fabrics they envisaged, easy to wear. The researcher only knitted a handful of samples in this pattern group because the other stripe combinations were ineffective. Thus, the researcher used phase 4 to develop new versions of the 1x1 stripe in different yarn combinations.

Although the participants responded positively to the sample, the word cloud below demonstrates that the language describing this sample is more mixed and that there is room to improve the tactility of the fabric further, even if it was aesthetically attractive.

Figure 6:39 Sample 1 word cloud.

6.4.2.8 Sample 291 Double Ladder Hand-Manipulated Tuck with Hook-up

Figure 6:40 Details of sample 291. The images show the front and reverse of the fabric in ecru and colour to visualise how the yarns have been blended together.

The participants agreed that the handle of this sample was ‘rigid’, ‘aggravating’ and lumpy. It was not popular, with all participants agreeing that they would not wear this fabric next to their skin. This assessment conflicts with the researcher’s interpretation of the sample, which judged the sample to be soft to the touch, attractive aesthetically, blending the yarns well and thus an innovative sample meeting the aims of the research project.

The fabric combines three yarns, KR/ BFL1/ Teeswater. The researcher rated the sample as the fourth softest, and one participant agreed, but every other participant rated the sample as 10th or 11th. Overall, it appears the participants had an aversion to the texture of the sample. One participant went as far as to describe it as a macramé bag, stating that it is ‘too rough, too much texture, and the pattern is too see-through.’ Here the participants are evaluating the fabric structure before the yarn type, but the yarn has affected the overall handle because of the way it has reacted to the knitted structure. The open structure has allowed the hairs of the yarn to protrude rather than be intertwined in the knit structure, which would be the case if it was a densely knitted structure.

The researcher found this conflicting feedback helpful. As a textile designer, they were associating the more innovative fabrics, in terms of pattern, as the most successful. However, this is only sometimes how the consumer would view them; this is why they used phase4 of the practice to focus on blendability rather than pattern techniques.

This one I didn’t really like, it’s just too textured and I think it would be quite scratchy and uncomfortable on the skin as well. I think it’s quite uneven, that’s what I don’t like about it.

Figure 6:41 A participant's response to sample 291.

The feedback reiterates the subjective nature of textile design and demonstrates how many different responses a single piece of fabric evokes. This fabric, in particular, articulated several different emotional reactions as the two figures visualising the language utilised to describe the sample demonstrate. Many negative words have been used, but some very favourable terms. What is striking about word cloud 291 is that the words utilised are very different from those which are usually the most popular words to describe a sample. This fabric has evoked the most emotional response of those provided to the interview candidates.

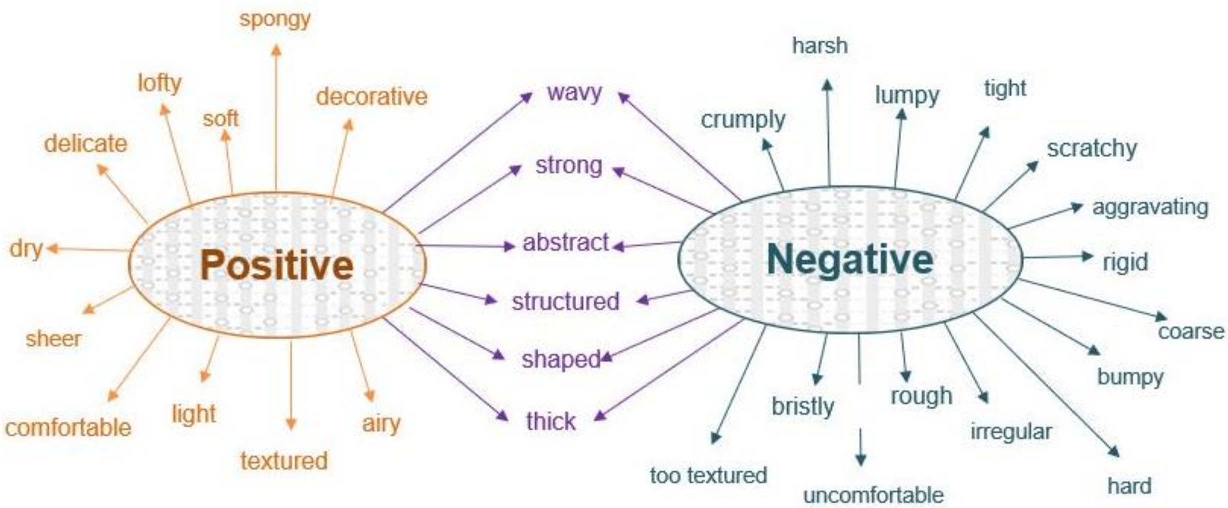


Figure 6:42 Positive, negative, and neutral words used to describe sample 291.

Figure 6:43 Sample 291 word cloud, another method of interpetting the language used to describe sample 291.

6.4.2.9 Sample 299 1x2x2 Tuck Pattern with Ladder

Figure 6:44 Details of sample 299. The images show the front and reverse of the fabric in ecru and colour to visualise the yarns that have been combined.

The researcher and the participants agreed that the handle of sample 299 was acceptable. It is an average fabric. Descriptions of the sample included that 'it's light-weight, quite soft, but it's still got a little bit of scratchiness to it.' This is a relatively accurate summary of a fabric made from British wool. Unlike the previous sample, this fabric has evoked very little emotional response; the language utilised to describe the fabric is mixed but, on the whole consistent with the language the participants used throughout the interview process.

The findings demonstrate that this hand-manipulated tuck pattern with small clusters of tucks has enough interest to make it 'new'. It is a reasonably commercial fabric that would work when knitted into garments.

Figure 6:45 Sample 299-word cloud.

6.4.2.10 Sample 180: Diagonal Check Jacquard with Pointelle

Figure 6:46 Details of sample 180. The images show the front and reverse of the fabric in ecru and colour to visualise how the yarns have been blended together.

Sample 180 is knitted in WFW and KR, the two roughest British wool yarns utilised during the doctoral study. The researcher evaluated that this fabric has a good handle but is too coarse to wear next to the skin. The participants agreed, repeatedly ranking the sample as one of the hardest. None of the participants had any specific comments regarding this sample. This may reveal that neither the yarn combination nor the pattern is overly exciting, and the fabric failed to make an impression on the participants. The words utilised to describe the fabric include tight, bristly, firm, stiff and itchy. These words demonstrate the participant's response to the sample.

Since knitting this sample, many softer, more exciting versions of this fabric have been created. This was one of the very first samples knitted during phase 1. Thus, the practitioner has spent time reflecting on and improving the sample and the yarn combination. During phase 1, it was revealed that samples created in this yarn combination created a rough handle which often felt coarser than if the sample was knitted in KR alone. Thus, as the practice progressed, finding methods of improving the handle of this yarn combination, either by utilising different pattern structures or by adding another yarn type, was significant to improve the handle and blendability of the fabric.

Figure 6:47 Sample 180-word cloud.

6.5 The Language Chosen by the Participants

The interviews provided an opportunity to discover whether the participants would employ the same language to describe the fabrics as the language encountered in the literature utilised by fashion and textile professionals and academics. This is why the participants were invited to describe the sampling twice. The word clouds below record that the sensory descriptors used by the participants have many similarities to that used during the thesis, which ascertained that the language utilised is appropriate, understandable, and accessible. The most significant difference was the diversity of the language employed. The selection of language used by each participant first time they were asked to describe each sample was narrow, with only a slight variation in descriptions between samples. The word bubble allowed the participants to be more inventive with their descriptions. The second time the variety of language is more comprehensive, enabling the participants to visualise how they sensed the samples lucidly. The word clouds demonstrate that when the participants were asked to describe the fabrics in their own language, words such as ‘scratchy’ or ‘rough’ and even itchy were more common than when they had a body of adjectives to choose from; thus, the researcher wonders whether some of wools preconceptions come from common language associations.

More importantly, the word clouds demonstrate that the most commonly utilised language is positive rather than negative. Soft, light, thick airy and warm were used first, and terms such as loose, springy, textured, open and hairy were utilised the second time. These words create a sense of comfort and give the impression that the samples have some surface texture. None of these words conveys the sense that the fabric is prickly or feels rough next to the skin. An extensive range of language was utilised, summarised in the two word clouds below, which is why the language was broken down by sample type for analysis.

Figure 6:48 The participant's language chosen to describe the fabrics.

Figure 6:49 The participants' language to describe the fabrics when using the word bubble for guidance.

6.6 Texture and Aesthetics

	Section 3: Handle versus Aesthetics
12	Do you think the look of the samples influenced your decision making, when ranking the samples from hard to soft? Why is this?
13	Do you think the look of the samples influenced your decision making when choosing a favourite sample? Why is this?
14	When considering buying a garment, what is more important to you: the look of the garment or the materials the garments are made from? What are your reasons for your choices?
15	Do you find it's harder or easier to review the samples, when there is no diversity or range in colour in front of you?

Table 6-11 Questions 12- 15.

Section three of the interviews was an opportunity to discover whether the participants sensed the aesthetics of the fabrics influenced their decision-making when analysing the samples. The consensus was that they tried not to be influenced by aesthetics, but most participants suspected they were and found it challenging to separate tactility and aesthetics. This is emphasised as aesthetics were discussed many times during the second section of the interviews. Many participants observed that the different surface textures did influence their decision-making process and asserted that texture did affect the fabric handle. Overall, the participants concluded that the more patterned and textured samples were rougher than those knitted in more subtle structures, which they determined were softer.

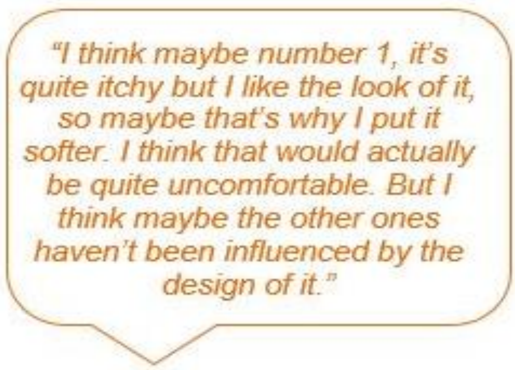


Figure 6:50 Participant response to question twelve.

The researcher believes the participants tried their best to analyse the samples through touch first. The interviewer witnessed each participant feeling the samples, rubbing their hands over them, and putting them on their arm before making their decisions. However, as many participants alluded to in the quotes above and below, several other factors influenced their choices. One was preconceptions of what a piece of fabric should feel like, and another was the aesthetics of the sample.

The researcher expected that any preconceptions about knitted fabrics could have been diminished by making the participants examine and assess the fabrics twice. However, she is still determining if this happened in practice as the participants asserted that the factors mentioned have as much influence over their decision-making process as touch.

Figure 6:51 Participants' responses to question thirteen.

The interviews determined that several distinct factors influenced the decision-making process: the handle, the fabric structure, preconceptions, and the aesthetics of each fabric, and it is challenging to distinguish each of these factors when engaging with a fabric. The participants agreed that it was more straightforward to examine the samples in ecru as it accentuated the textures and helped them focus on the tactility of the fabric. As it would have been difficult for the participants to assess how well the yarns blended together, the researcher did not ask them to evaluate this. Instead, the researcher used the outcomes of the interviews to ascertain whether the yarns were perceived to be well blended for the answers and sample rankings.

6.7 Key Findings

The interviews were a positive experience; every participant responded warmly and enthusiastically to the sampling and was happy to discuss their thoughts regarding the materials in front of them. The overall results only partially agreed with the researcher's critique of the sample collection. Thus, Phase 4 was an opportunity to respond to the feedback by developing those samples the participants deemed the softest and most wearable.

Overall, the more textured and patterned samples were less well-received than those with less texture. The researcher believes some participants struggled associating the combination of the open textures and the heavier wool fibres with wearable knitted fabrics. Through viewing and handling the yarns, the participants concluded that the smoother, lighter swatches were more wearable, even if they ascertained that the swatch was itchy. This response demonstrated that the fabric structure was more valuable to the participants than the yarn. It reveals that sample collection can be considered 'new' as it has challenged the participant's perceptions of what a knitted fabric 'should' resemble and highlights the challenge of determining tactility without including aesthetics.

Sample 39 is a great example of this; although the participants unanimously agreed the sample felt coarse, the participants were very optimistic about the look of the sample, and a number could see themselves wearing it. The responses of the interview process led the researcher to conclude that they could not dismiss the aesthetics of the sample, as this often played a crucial role in how the participants perceived and responded to each fabric. For fabrics to be genuinely considered successful, aesthetics must be considered. Through this feedback, the researcher developed a three stage assessment of the final sample collection.

1) The tactility of the sample: i.e., how soft the sample is.
2) The blendability of the sample: i.e., have the fibres combined well together?
3) The aesthetics of the sample: Firstly, does the sample look wearable? And if so a further assessment to understand whether the fabric new... i.e.? Is it the pattern the researchers design, (it is innovative or experimental) or is it a fabric which has been seen in commercial knitwear before? (It is commercial or simple.)

Blendability and aesthetics are holistic assessments that the researcher has made through their professional judgement. This time of feedback and reflection helped shape this process and the final collection edit.

It was observed that a number of the very textured samples which received negative comments all contained Teeswater. The researcher believes that it may be the yarn the participants were adverse to rather than the pattern structure itself, as many comments concerning these samples were that they were too hairy or too itchy. However, it could be a combination of both factors, as the quote below alludes too.

> *291 – It feels like a macramé bag, a little too rough and the stitch is too see-through. Too much texture and the knit are too see through 21 – Similar to above – I don't like the large spacing in the knit. I wear knitwear it's for comfort and coverage so I'm not that keen on the large spacing and yeah, it's a little bit rougher.*

Figure 6:52 A participant's description of samples 291 & 21.

> *"Yes, definitely I would, some of them are definitely soft enough to be worn next to the skin and are stretchy, airy, breathable, but yeah probably the lighter ones but even the last one, even though I've marked it the least soft, I would probably wear it just because I like the look of it. I think give or take you often will choose something a bit less comfortable for the aesthetic."*

Figure 6:53 A Participant discussing whether they would wear any of the fabrics next to their skin.

Theoretically, using objective properties, the Teeswater yarn is the second softest fibre and the most expensive wool. However, it is a specialist yarn with many more loose and long staples that protrude from the fibre, consequently making the fabrics very hairy to handle. It has what could be described as a mohair-like handle. The mixture of an unusual open structure and a very hairy yarn may not have appealed to those not used to handling woollen fabrics, and thus may not be the best yarn to introduce to the mainstream, commercial market.

In response, the researcher used less of the Teeswater yarn during phase 4 and focused on recreating the effective samples in alternative yarn blends. It was beneficial to experiment with this yarn during the project, but the outcomes of the interview process confirmed that this is a yarn which can be uncomfortable next to the skin. A significant positive that can be taken from the interview process is that the participants seemed to prefer the handle of the theoretically coarser yarns, the KR and DH. These yarns are cheaper and more widely available, and so are more commercial options.

There was an exception to these conclusions. Sample 1 has both Teeswater and WFW (the coarsest yarn) blended through it, but the participants gave it positive feedback; it was rated the second softest sample of the British wool sample. This sample is considerably lighter than many other samples they viewed. Therefore, it could be concluded that if these fibres are blended regularly and knitted finely enough, every yarn used in the project can be workable in commercial garments. This structure nor this pattern group was not experimented with during phases 2 and 3, because the broad stripes, experimented with during phase 1 did not combine the yarns effectively. Thus, in response to the feedback received during the interviews, the researcher tested this pattern structure extensively in different yarn blends and pattern combinations during phase 4 to discover if the 1x1 course stripe was effective at combining yarn types. A number of hand-manipulated versions were also explored. The researcher anticipates that the new samples created in response to the participant feedback generated samples which are softer and more comfortable to wear next to the skin.

The interview process facilitated addressing the overall aims of the practice. The interviews provided an opportunity to explore the language used by those responding to the sampling. It was discovered that the language utilised in the project is appropriate, accessible, and understandable. It also provided the opportunity to ascertain how the samples are being assessed and critiqued and whether the yarn blends and the fabrics created are appropriate as commercial fashion fabrics. Overall, most fabrics were received positively. Every participant concluded they liked and could see themselves wearing at least one of the fabrics next to their skin, which is also a success of the project, as it has succeeded in creating several fabrics which are soft enough for wear in combinations of underutilised British wool fibres.

7 Enhance and Establish

Figure 7:1 Detail of sample 298: A 1x2x2 hand-manipulated tuck structure with pointelle.

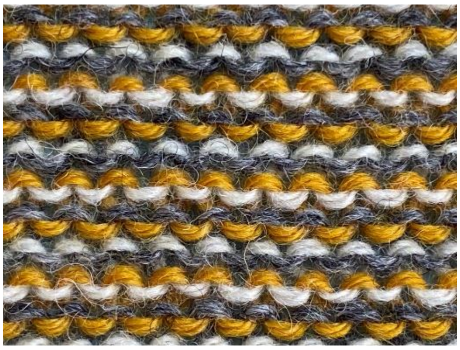
7.1 Phase 4: Enhancement

Phase 4 began once the interviews were completed and analysed. The focus of the project shifted during this phase in response to the outcomes of the interviews. Rather than trying to create ‘innovative’ fabrics with a soft handle, Phase four explored blending different yarn types in various combinations utilising what could be considered more elementary or commercial pattern structures, (those which were popular with the interviewees). Every structure was developed in 3D directly on to the knitting machine; thus, design drawings weren’t created. Instead, colour versions of the samples were knitted to visualise the different blending techniques experimented with.

7.1.1 Stripes, Inlay, Ladders, Pointelle

In response to the positive feedback sample 1 received during the interviews many new versions were generated. Sample 1 utilises three yarn types (Teeswater/ BFL1/ WFW) and changes yarn type on every course; thus, rather than the yarns sitting next to each other as they do in the broader stripe combinations, the yarns blend as the loops of the one yarn type interloop through the loops of another yarn type on every course.


A


B


C

Figure 7:2 A) the face of a three-colour 1x1 stripe structure, demonstrating how the loops interloop and combine the fibres together over a number of courses and wales. B and C) demonstrates the reverse (the back) of the knitted structure.

In total, 34 1x1 stripe combinations were created, four of which were knitted in the same structure but with different yarn combinations. Seven samples were knitted in the same structure, adding a ladder, and vertically inlaying another end of yarn through the fabric. Four samples were knitted in the same structure with ladders through the sample. Nine 1x1 inlay samples changed the yarn type on every course; thus, combining the ladder stripe and inlay structures together. Ten samples were created combining the 1x1 stripe with pointelle and ladder structures. This was to discover whether manipulation would further blend the yarns.

The images below demonstrate every different pattern structure which was created.

Figure 7:3 A 1x1 course stripe structure as sample 1.

Figure 7:4 A 1x1 course stripe strucutre with a single ladder repeat throughout.

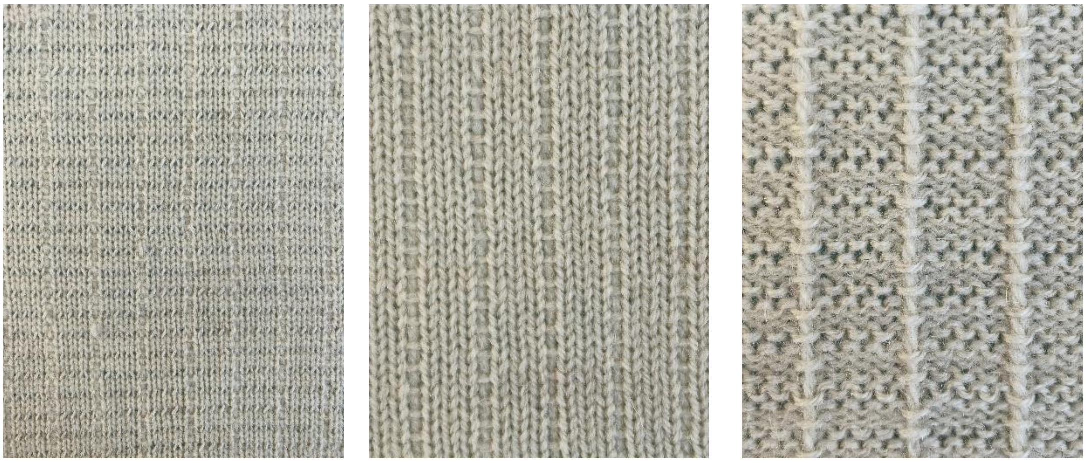


Figure 7:5 A 1x1 stripe structure with ladder and vertical inlay manipulation.

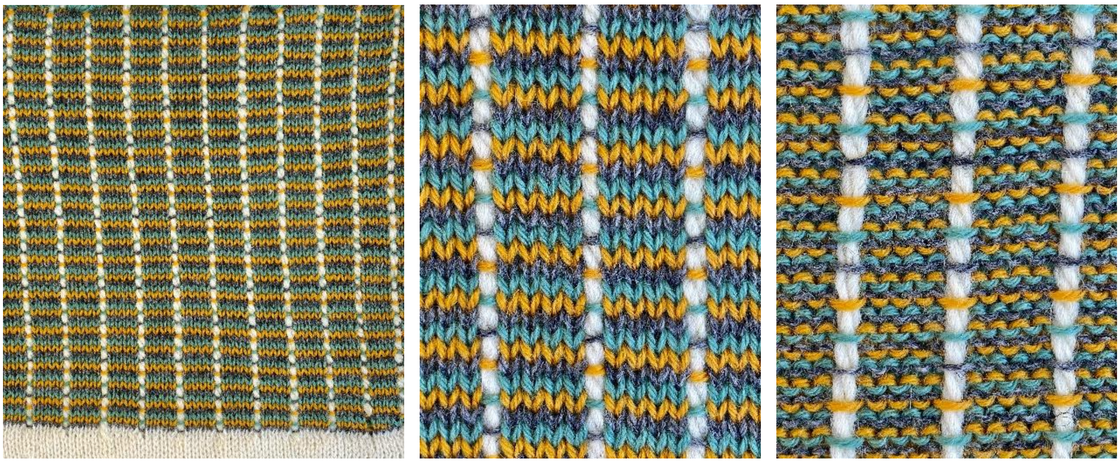
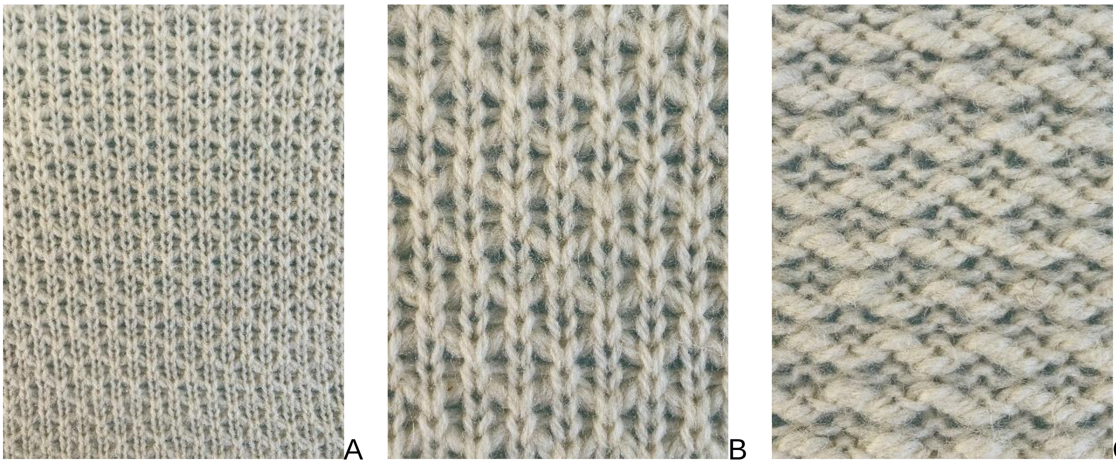


Figure 7:6 A 1x1 stripe with ladder and vertical inlay structure in ecru and colour to visualise the yarn changing every row.



A B C

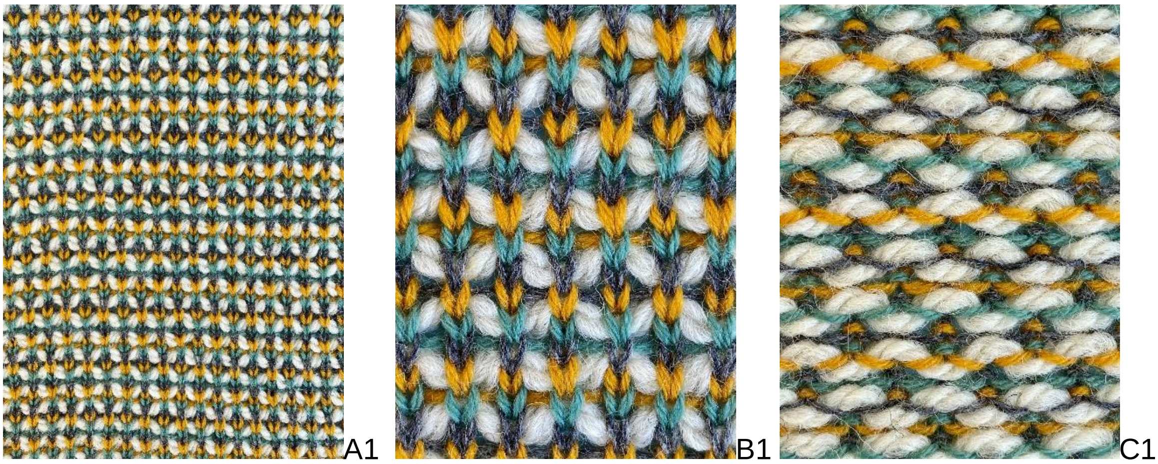


Figure 7:7 Six images of Sample 406, A 1x1 inlay structure, visualising the yarn changing on every course.

Figure 7:8 Sample 353, A 3x1 ladder structure, manipulated with racked look pick up technique.[13]

[13] Racked look refers to the process of racking the bed on double-bed machinery to create a vertical zigzag effect.

Figure 7:9 Sample 354, A 3x1 ladder structure manipulated with racked look pick up technique.

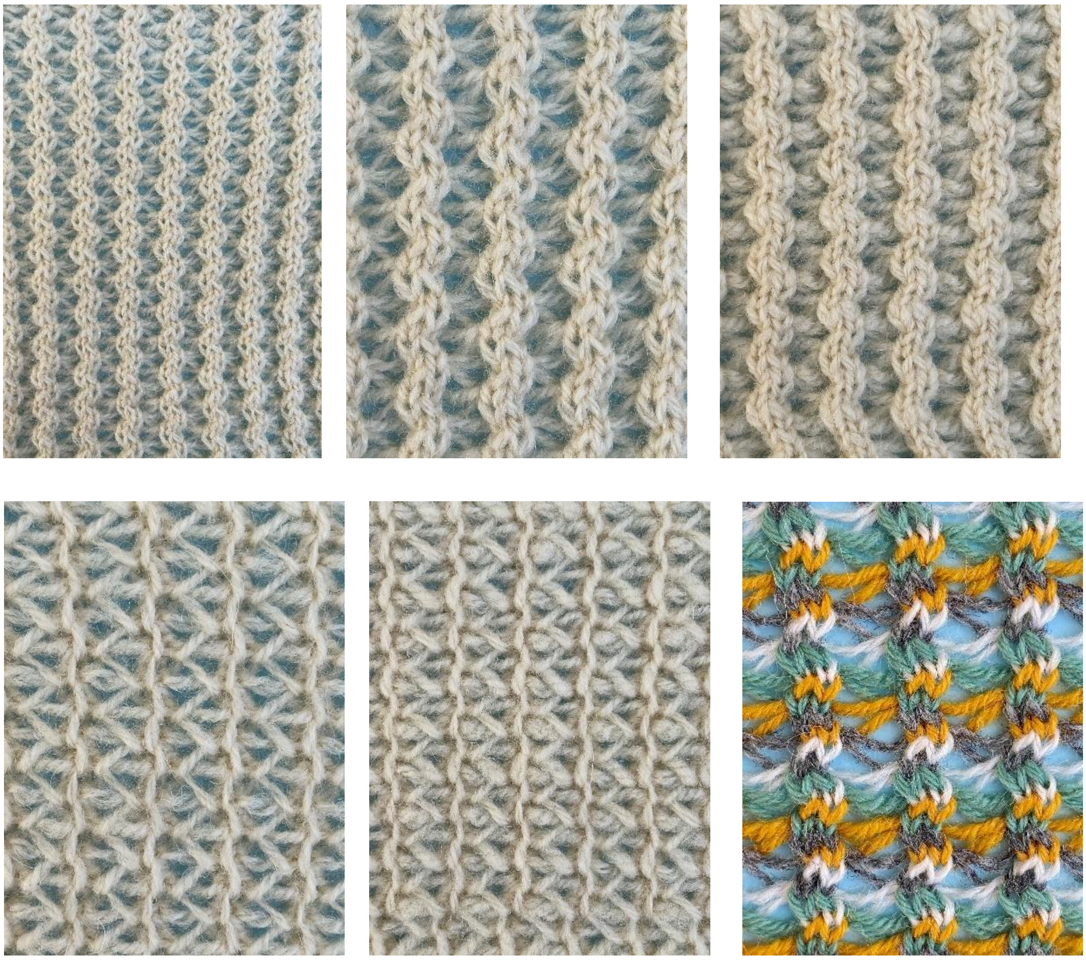


Figure 7:10 Samples 357 and 359 are 2x3 ladder structures manipulated with racked look pick up techniques. (The ladder is picked up using a transfer tool and hooked onto the adjacent needle loops.) The samples demonstrate the differences the different yarn types make to the structure of the fabric. The final image documents how the yarns combine together.

Figure 7:11 Sample 358, a 3x3 ladder strucutre manipulated with a racked look pick-up technique.

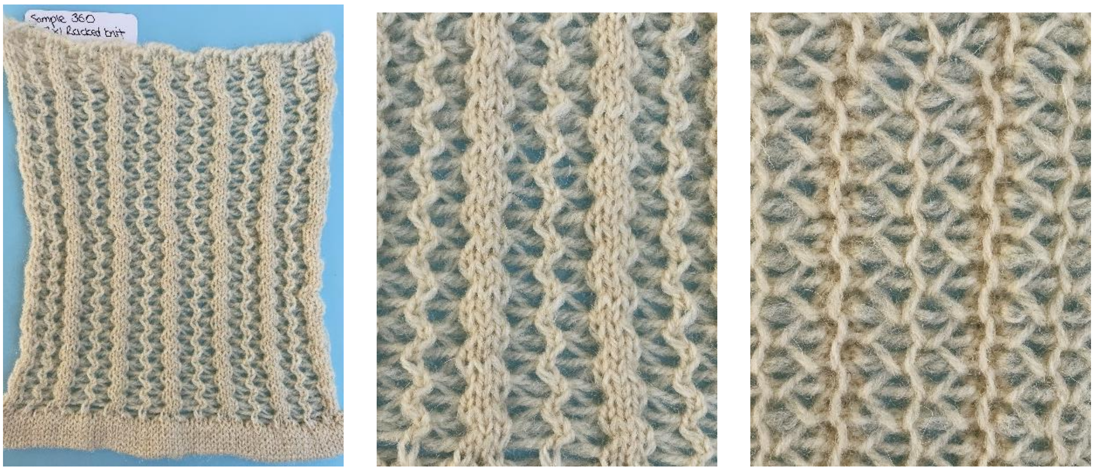


Figure 7:12 Sample 360 3x3x1 ladder structure manipulated with a racked look pick-up stitch.

Figure 7:13 Sample 361 a 2x1 pointelle striped structure. (Two needles in action, one out, pointelle transfers on every row.)

Figure 7:14 Sample 363 a 2x1 pointelle and ladder striped structure.

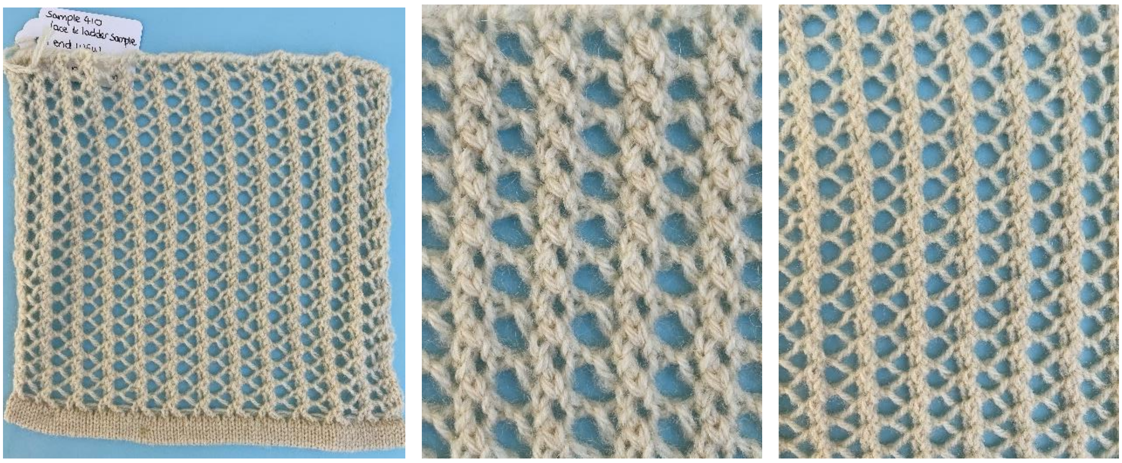


Figure 7:15 Samples 362 and 410 Pointelle and double ladders within a 1x1 course stripe structure.

Table 7-1 visualises the yarn combinations in which the above samples were knitted and how soft they are. The table includes sample 1, the original sample, as a comparison. Overall, the pointelle and ladder fabrics successfully combined the yarn consistently, they look aesthetically pleasing, and the handle overall is good. The samples are light and airy, and while they are textured, the researcher determines the texture is small enough to be considered wearable or commerical by those viewing the sample collection.

Ranking	Sample No	Patern type	Pattern	Yarn combination			
				Yarn A	Yarn B	Yarn C	Yarn D
1	363	Pointelle & ladder stripe	2x1 pointelle w ladder	KR	BFL1	WFW	BFL1
2	410	Pointelle & ladder stripe	Pointelle w double ladder	WFW	BFL2	DH	
3	362	Pointelle & ladder stripe	Pointelle w double ladder	KR	BFL2	DH	BFL2
4	353	Pointelle & ladder stripe	3x1 ladder rack look pick up	DH	WFW	BFL1	
5	404	Stripe/ inlay mix	1x1 inay	DH	WFW	BFL2	
6	357	Pointelle & ladder stripe	2x3 ladder rack look pick up	DH	KR	BFL2	KR
7	361	Pointelle & ladder stripe	2x1 pointelle	DH	KR	BFL1	
8	1	1x1 stripe	Orignal sample	TEES	BFL1	WFW	
9	338	1x1 stripe	as original	WFW	BFL1	DH	
10	394	1x1 stripe and ladder	ladder w 3 wales	WFW	BFL1	DH	
11	395	1x1 stripe and ladder	ladder w 3 wales	TEES	BFL1	WFW	
12	401	1x1 stripe and ladder	double ladder w 4 wales	WFW	BFL1	DH	
13	402	1x1 stripe and ladder	double ladder w 4 wales	TEES	BFL1	WFW	
14	406	Stripe/ inlay mix	1x1 inay	DH	KR	WFW	TEXEL
15	358	Pointelle & ladder stripe	3x3 ladder rack look pick up	WFW	KR	DH	
16	359	Pointelle & ladder stripe	3x2 ladder rack look pick up	DH x2	BFL2	S/DOWN	
17	360	Pointelle & ladder stripe	3x3x1 ladder rack look pick up	WFW	KR	DH	
18	337	1x1 stripe	as original	KR	DH	BFL2	
19	339	1x1 stripe	as original	DH	WFW	KR	
20	341	1x1 stripe	as original	KR	DH	WFW	BFL2
21	390	1x1 stripe and ladder	vertical inlay	DH	KR	TEES	S/DOWN
22	392	1x1 stripe and ladder	vertical inlay	KR	TEXEL		
23	405	Stripe/ inlay mix	1x1 inay	KR	WFW	DH	BFL2
24	407	Stripe/ inlay mix	1x1 inay	DH	KR	BFL1	S/DOWN
25	355	Stripe/ inlay mix	1x1 inay	DH	S/DOWN	WFW	
26	356	Stripe/ inlay mix	1x1 inay	DH	KR	BFL2	KR
27	403	Stripe/ inlay mix	1x1 inay	DH	KR	TEXEL	
28	408	Stripe/ inlay mix	1x1 inay	DH	WFW	TEXEL	BFL2
29	354	Pointelle & ladder stripe	3x1 ladder rack look pick up	KR	DH	S/DOWN	
30	387	1x1 stripe and ladder	vertical inlay	TEES	BFL1	WFW	TEXEL
31	393	1x1 stripe and ladder	vertical inlay	DH	S/DOWN		
32	388	1x1 stripe and ladder	vertical inlay	TEES	BFL1	WFW	S/DOWN
33	389	1x1 stripe and ladder	vertical inlay	TEES	DH	WFW	TEXEL
34	391	1x1 stripe and ladder	vertical inlay	TEES	TEXEL		
35	409	Stripe/ inlay mix	1x1 inay	DH	KR	TEES	TEXEL

Table 7-1: 1x1 stripe structure analysis. All ratings were taken from the sample matrix and ordered in the sequence of softness.

These samples were created as a response to a culmination of the knowledge grown from the first three phases and the interview process. They are made with an improved understanding of which yarn types combine effectively, how many types of wool are required to improve the samples handle and how often the yarn types ought to exchange. The interview process helped determine what is considered aesthetically pleasing.

Table 7-1 records that a wider variety of yarn combinations were experimented with and that the handle of the samples produced was adequate. During Phase 4, the proportion of BFL and Teeswater utilised was reduced in response to the interview feedback. The table also demonstrates that the samples with Teeswater blended through were rougher than those that did not include this. However, it should be noted that many of these samples are the vertical inlay, the least successful pattern type. Samples in the top half of the table were all rated as soft. The yarn experimentation was successful to a certain extent.

Table 7-1 highlights that those fabrics not considered soft were either the 1x1 inlay or the vertical inlay samples. Weaving an end of yarn vertically through the fabric has not noticeably improved tactility. These fabrics are more rigid than the 1x1 stripe samples where the yarn has not been vertically inlaid. The vertical inlay was woven in by hand once the fabric was finished; this method of inlay drew the loops together, creating an aesthetically pleasing but dense fabric. The 1x1 inlay fabrics are similar in the handle to those made previously. The Inlay samples have been rated separately as a pattern group in the table below.

Ranking	Sample No	Yarn combination				Pattern variation	Softness/ handle
		Yarn A	Yarn B	Yarn C	Yarn D		
1	12	KR		BFL1 x 2		1x1 w pointelle	Soft -good
2	404	DH	WFW	BFL2		1x1	Soft -good
3	244	S/DOWN		BFL2		1x1 (ER)	Soft -good
4	245	S/DOWN		BFL2		1x1	Soft -good
5	9	S/DOWN		BFL1 x 2		2x1 (ER)	Soft -good
6	13	KR		BFL1 x 2		1x1 w pointelle	Soft -good
7	406	DH	KR	WFW	TEXEL	1x1	Soft -good
8	6	TEES		TEXEL		2x1 (ER)	Soft -good
9	15	KR		BFL1 x 2		2x1 w pointelle	Soft -good
10	17	KR		BFL1 x 2		3x1 w pointelle	Soft -good
11	21	TEES		TEXEL		1x1 w pointelle	Soft -good
12	20	TEES		TEXEL		1x1	Soft -good
13	11	KR		BFL1 x 2		1x1	Acceptable- good
14	29	WFW		TEES x 2		1x1	Acceptable- good
15	60	KR		TEXEL	S/DOWN	1x1	Acceptable- good
16	62	WFW		S/DOWN		1x1	Acceptable- good
17	405	KR	WFW	DH	BFL2	1x1	Acceptable- good
18	407	DH	KR	BFL1	S/DOWN	1x1	Acceptable- good
19	8	TEES		S/DOWN		3x1 w pointelle	Acceptable- good
20	19	KR		TEXEL		2x1 w pointelle	Acceptable- good
21	23	TEES		TEXEL		2x1 w pointelle	Acceptable- good
22	14	KR		BFL1 x 2		2x1	Acceptable- good
23	355	DH		S/DOWN	WFW	1x1	Acceptable- good
24	356	DH	KR	BFL2	KR	1x1	Acceptable- good
25	10	S/DOWN		WFW		2x1	Acceptable- good
26	27	TEES		TEXEL		3x1	Acceptable- good
27	28	TEES		TEXEL		3x1 w pointelle	Acceptable- good
28	63	WFW		BFL1	BFL2	2x1 w pointelle	Acceptable- good
29	241	S/DOWN		BFL1	WFW	2x1 (ER)	Acceptable- good
30	242	S/DOWN		BFL1		2x1	Acceptable- good
31	243	S/DOWN		BFL1	WFW	2x1	Acceptable- good
32	403	DH	KR	TEXEL		1x1	Acceptable- good
33	408	DH	WFW	TEXEL	BFL2	1x1	Acceptable- good
34	25	TEES		TEXEL		in/out check	Acceptable- good
35	31	WFW		JACOB	TEES	in/ out tartan	Acceptable- good
36	32	KR		S/DOWN	BFL1	in/ out tartan	Acceptable- good
37	61	WFW		TEXEL		1x1	Acceptable- good
38	175	WFW		BFL1	TEES	1x1 (ER)	Acceptable- good
39	227	KR		S/DOWN		2x2	Acceptable
40	212	TEES		BFL1	S/DOWN	1x1 (ER)	Acceptable
41	16	KR		BFL1 x 2		3x1	Acceptable
42	22	TEES		TEXEL		2x1 w pointelle	Acceptable
43	58	KR		TEXEL		1x1	Acceptable- good
44	409	DH	KR	TEES	TEXEL	1x1	Acceptable- good
45	18	KR		TEXEL		2x1	Acceptable
46	24	TEES		TEXEL		in / out zig zag	Acceptable- good
47	26	TEES		TEXEL		in/out check	Acceptable- good
48	33	TEES		TEXEL	S/DOWN	in/ out tartan	Acceptable- good
49	228	KR		S/DOWN		4x1	Acceptable
50	30	WFW		JACOB		in/ out tartan	Acceptable
51	226	KR		WFW		4x1	Acceptable
52	59	KR		TEXEL	S/DOWN	1x1 (ER)	Acceptable
53	171	KR		WFW		Inlay weave 1	Acceptable

Table 7-2: Inlay sample analysis of all of the Inlay variations created during the research study.

The Inlay pattern group was the most experimental group explored during the research practice. The results above demonstrate this, as it is unclear which yarn blends and pattern variations are the most effective. Table 7-2 records a more significant variation in the handle of these samples than the stripe group examined before, due in part to the number of techniques, yarn combinations, and the variation of pattern structures experimented with before it was understood which structures had the ability to produce a soft handling sample. No Inlay samples were made during phase 3 because the samples were not considered soft during the reflection process, that took place at the end of phase 2. The interview process encouraged the researcher to reevaluate the pattern group because the interviewees responded positively to sample 58. Using the single-course stripe technique, the researcher investigated knitting the 1x1 inlay structure using three yarn types. Again the results are mixed; only two of the nine samples are considered soft. The others are all acceptable to good. This pattern group has created several visually attractive fabrics, but other pattern types have been more successful in creating soft-handling fabrics; this may be because the fabrics do not have enough volume, or it could be because the yarn type which has been inlaid at the back of the fabric.

7.1.2 4x1 and 2x1 Rib-Look Float Jacquard Structures.

4x1 rib-look float jacquard structures.

During the interviews, it was unanimously concluded that the two control samples (325 and 326) were the softest. 325 is a 4x1 rib-look structure with a ladder running through it. 326 was a 2x1 rib-look structure. Overall, the interviewee’s favourite British wool sample was 309, a 2x1 rib-look structure in a blend of three yarn types. The response to all three of these samples was how smooth the fabric felt and that it would make a lovely garment. This echoed the findings of Wiskott, et al., (2018) regarding their evaluation of samples with long floats. The participants in their study also concluded that the fabrics viewed were soft and smooth. Thus, the researcher decided to develop the 4x1 float jacquard fabrics; further, this time, exploring different ladder combinations and formations in different yarn types. The primary reason was to ascertain whether it was possible to recreate a swatch resembling the softness of 325 (the merino wool sample). The process and structures was then repeated with the 2x1 float jacquards. Throughout the exploration into float jacquard structures, the researcher endeavoured to ensure the floats were not too long, so that the fabric's durability, (i.e., the floats catching or pulling), would not be an issue. Thus, the patterns visualised throughout the thesis are designed with this in mind, hence using patterns with small clusters of repeating stitches. Discovering that regular floats actually create a smoother, fuller rib-like surface was initially a surprise and a positive design outcome. Every sample type created is recorded in a series of photographs below:

Figure 7:16 Sample 369, a 4x1 rib-look float jacquard with single ladder structure.

Figure 7:17 Sample 370, a 4x1 rib-look float jacquard with a double ladder structure.

Figure 7:18 Samples 366 & 368, 4x1 rib-look float jacquard's with a triple ladder structure.

Ranking	Sample No	Yarn combination		Pattern variation	Softness/ handle
		Yarn: feeder A	Yarn: feeder B		
1	142	KR	BFL1	ladder pick up	Soft -good
2	132	DH	BFL2		Soft -good
3	148	KR	BFL2	ladder	Soft -good
4	370	KR/DH/BFL2/KR	KR/DH/BFL2/KR	double ladder	Soft -good
5	162	BFL1	KR		Soft -good
6	139	BFL1	S/DOWN		Soft -good
7	374	WFW	BFL1 / DH	ladder	Soft -good
8	266	BFL2	KR / TEES		Soft -good
9	267	BFL2	DH / TEES		Soft -good
10	349	KR	DH / WFW	double ladder	Soft -good
11	371	WFW	TEES	double double ladder	Soft -good
12	373	DH	BFL2 / DH	ladder	Soft -good
13	137	TEES	BFL2		Soft -good
14	161	KR	BFL1		Soft -good
15	366	DH/KR/ BFL2/DH	DH/KR/ BFL2/DH	tripple ladder	Soft -good
16	159	DH	WFW	ladder & pointelle	Acceptable- good
17	144	DH	BFL2	ladder pick up	Acceptable- good
18	268	BFL2	TEES / WFW		Acceptable- good
19	269	BFL2	KR / DH		Acceptable- good
20	270	BFL2	DH/ WFW		Acceptable- good
21	135	WFW	TEES	ladder & pointelle	Acceptable- good
22	141	WFW	KR	ladder	Acceptable- good
23	265	KR	BFL2 / WFW		Acceptable- good
24	352	WFW	DH	tripple ladder	Acceptable- good
25	365	KR	DH	tripple ladder	Acceptable- good
26	134	KR	DH		Acceptable- good
27	368	DH	KR / WFW	tripple ladder	Acceptable- good
28	138	KR	DH	ladder	Acceptable- good
29	143	DH	KR	pick up stitch	Acceptable
30	369	DH	BFL1 / WFW	ladder	Acceptable- good
31	140	DH	S/DOWN	ladder & pointelle	Acceptable
32	133	DH	S/DOWN		Acceptable
33	163	JACOB	S/DOWN		Acceptable
34	160	WFW	KR		Acceptable

Table 7-3: 4x1 rib-look float jacquard sample analysis of every pattern variation created during the research practice, sequenced in order of softness.

Both ladder placement and different yarn combinations were explored; as previously discussed, the researcher attempted to reduce the proportion of BFL and Teeswater within the samples while retaining its handle; therefore, the results are mixed as Table 7-3 records. The softest double ladder sample is 370, a fabric knitted with four yarns; the yarn changes every row. It feels warm, good quality, thick, spongy, and bouncy. Overall, it is very effective; it's not as soft as the Merino, but it offers an alternative in a mix of readily available British wool yarn types that are affordable. The 4x1 rib-look samples created in phase 4 are successful. The majority are rated as soft-good, including both 349 and 371, neither of which contain any BFL. Adding ladders to these structures has distorted the shape of the fabric, and the floats have relaxed further; thus, the fabric is longer and thinner, which is aesthetically suitable, but this would need to be taken into account if these fabrics were developed into garments.

Figure 7:19 Samples 349 & 371, 4x1 float jacquard structure's with ladders distorting and lengthening the fabric structure.

2x1 Rib-Look Float Jacquards

The outcomes of the 2x1rib-look sampling were similar to the 4x1 outcomes resulting in a body of soft samples generated in many combinations of yarn types. The researcher completed the 2x1 rib-look collection by creating three structures which transfer and utilise the same pointelle techniques as the successful ladder and pointelle stripe structures made earlier in phase 4. (Sample 353) These samples are soft, have effectively combined the yarns on the face and the reverse of the fabrics, and are aesthetically beautiful. An area of further work is further investigation of these 2x1 rib-look structures. The fabrics are visualised in the photos below:

Figure 7:20 Sample 380 & 382 2x1 rib-look float jacquard structures with ladder and pointelle manipulation. Sample 380 is knitted in three yarn types and sample 382 is knitted in four yarn types.

Figure 7:21 Sample 386, a 2x1 rib-look float jacquard with ladder and pointelle manipulation is knitted in three yarn types. The pointelle transfer is slightly different from samples 380 and 382. Figures 7:52 –7: 55 found in chapter 7. 5, are coloured versions of these knits demonstrating the different blend combinations.

It could be argued the 2x1 rib-look float jacquard has several advantages over the 4x1 rib-look structure. The yarn regularly interchanges as the stitch repeat is smaller, causing the fibres to blend regularly. As a result, the float length on the reverse of the fabric is shorter; thus, it’s less likely to pull, click or catch if worn. On the other hand, the broader wales created by the 4x1 structure permit further pattern manipulation within the fabric, and the broader floats at the back, relax the fabric further, accentuating the rib-look effect. Consequently, the 4x1 rib-look structures are more effective with ladders, as the fabric still holds its rib-look structure, whereas the 2x1 structures flatten out and lengthen further, the float length also increases, which make the structure look like a 4x1 structure. The 4x1 rib-look could be considered more creative and textural, and the 2x1 rib-look could be considered more commercial.

Figure 7:22 Sample 378, a 2x1 rib-look float jacquard with double ladder structure. The structure looks flatter than a 4x1 structure, but the floats on the back look similar. (4x1 structure below for comparison. Figure 7:23, sample 137.)

Figure 7:23 Sample 137 4x1 rib-look float jacquard sample, demonstrating rib-look structure.

Ranking	Sample No	Yarn combination: Yarn: feeder A	Yarn combination: Yarn: feeder B	Pattern variation	Softness/ handle
1	328	BFL2	KR	ladder & pointelle	Very Soft
2	158	BFL2	TEES	ladder & pointelle	Very Soft
3	147	DH	BFL2	ladder	Soft -good
4	156	BFL2	WFW	pointelle	Soft -good
5	253	KR	BFL2	ladder & pointelle	Soft -good
6	256	DH	BFL2	ladder & pointelle	Soft -good
7	251	KR	TEES	ladder & pointelle	Soft -good
8	380	DH	BFL1 / KR	pointelle	Soft -good
9	382	DH/ KR	BFL1 / WFW	pointelle	Soft -good
10	146	BFL2	DH	ladder and tuck	Acceptable- good
11	386	DH	BFL1 / KR	pointelle	Soft -good
12	155	KR	TEES	pointelle	Soft -good
13	246	BFL2	KR	ladder & pointelle	Soft -good
14	247	BFL2	DH	ladder & pointelle	Soft -good
15	254	KR	BFL2 / TEES	ladder & pointelle	Soft -good
16	307	KR	BFL2		Soft -good
17	377	KR	BFL2 / WFW	double ladder	Soft -good
18	186	KR	BFL1		Soft -good
19	312	DH	BFL2 / WFW		Soft -good
20	379	DH	BFL2 / KR	ladder	Soft -good
21	157	BFL2	TEES		Soft -good
22	381	DH	BFL1 / KR	ladder	Soft -good
23	150	BFL1	S/DOWN	ladder	Acceptable- good
24	248	BFL2	WFW	ladder & pointelle	Acceptable- good
25	249	WFW	BFL2 / TEES	ladder & pointelle	Acceptable- good
26	250	WFW	BFL2 / TEES	ladder & pointelle	Acceptable- good
27	252	KR	TEES	ladder & pointelle	Acceptable- good
28	255	DH	BFL2 / TEES	ladder & pointelle	Acceptable- good
29	257	WFW	BFL2	ladder & pointelle	Acceptable- good
30	258	DH	BFL2 / TEES	ladder & pointelle	Acceptable- good
31	308	KR	BFL2 / TEES		Acceptable- good
32	309	KR	BFL2 / DH		Acceptable- good
33	310	DH	BFL2 / WFW		Acceptable- good
34	311	DH	BFL2 / KR		Acceptable- good
35	152	DH	TEES	ladder	Acceptable- good
36	378	KR / WFW/ BFL2/ KR	KR / WFW/ BFL2/ KR		Acceptable- good
37	145	DH	BFL2		Acceptable- good
38	153	DH	WFW	ladder and inlay	Acceptable- good
39	154	KR	WFW	ladder	Acceptable- good
40	240	WFW	KR		Acceptable
41	151	DH	S/DOWN	ladder & pointelle	Acceptable
42	149	BFL1	S/DOWN		Acceptable

Table 7-4 details every 2x1 rib-look sample created during the research practice. They have been sequenced by perceived softness.

Overall, the 4x1 and 2x1 rib-look float jacquard structures created the most samples that met the aims and objectives, which is why iterations of the patterns were generated repeatedly. The fabrics are innovative in that they are all single-faced fabrics, mimicking the properties of double-faced fabrics while utilising less yarn. The long floats, particularly of the 4x1 fabrics, allow the material to relax, creating movement and a smooth, soft surface even in rough yarn mixes. Introducing ladders improved the structures further as floats relaxed further; the fabric was less dense and had more movement. This agrees with the findings of Iftikhar, et al., (2021) and Wiskott, et al., (2018) reviewed in the literature.

7.2 The Outcomes of the Practice

In total, 450 samples were created, of which the data gathered from 367 ecru samples has been recorded and collated within the sample matrix. Every sample has been washed, pressed, labelled, drawn digitally, and photographed. The samples have been collated as both a physical and a digital library. The physical library is edited to display those samples demonstrating the most successful knitted methods utilised to blend the yarns together in successful combinations. The data to substantiate these samples can be found collated in the sample matrix and a series of tables, charts and word clouds which visualise the data complied throughout the study. Coloured samples have been created in numerous pattern structures to enable those viewing the samples to understand how the yarn types have combined.

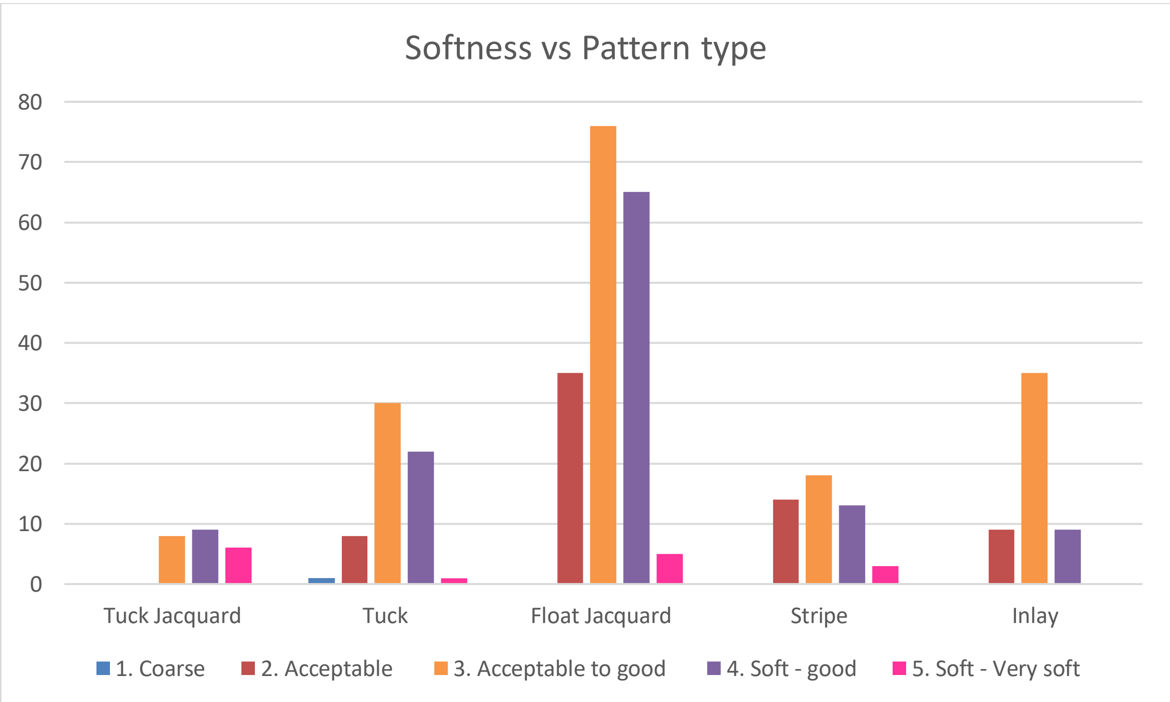


Table 7-5 An overview of how soft each pattern group is represented by the number of samples in each softness group.

Throughout the previous chapters, each phase was recorded and interpreted. The outcomes have been summarised in Tables 7-5 and 7-6. Table 7-5 identifies that more float jacquard samples have been created than any other sample type (181 samples). Still, overall, the tuck jacquard patterns have created a more significant proportion of very soft samples. 26% of the tuck jacquard samples are very soft, compared to just 3% of the float jacquard samples.

The softest samples in the collection can be seen in Table 7-6. As explained in Chapter 3.6, every sample was rated between one and five in five areas to determine its overall handle. The areas were given a percentage value based on their importance.

Ranking	Sample No	Patern type	Pattern	Yarn combination			
				Yarn A	Yarn B	Yarn C	Yarn D
1	272	Tuck Jacquard	2x1 w ladder/ pointelle	BFL2	TEES		
2	273	Tuck Jacquard	2x1 w double ladder	BFL2	KR	DH	
2	274	Tuck Jacquard	2x1 w ladder	BFL1	KR	DH	
4	231	Tuck Jacquard	2x1 w ladder	KR	BFL2		
5	56	Hand Tuck	4x2x2	BFL1	TEES		
5	264	Hand Tuck	2x1 w double ladder	BFL2	KR	WFW	
5	328	Float Jacquard	2x1 w ladder/ pointelle	BFL2	KR		
5	158	Float Jacquard	2x1 w ladder/ pointelle	BFL2	TEES		
9	363	Point / ladder stripe	2x1 pointelle w ladder	KR	BFL1	WFW	BFL1
10	276	Tuck Jacquard	2x1 w ladder	BFL2	WFW	DH	
11	283	Hand Tuck	Double ladder	BFL2	KR		
11	410	Point / ladder stripe	Pointelle w double ladder	WFW	BFL2	DH	
13	230	Tuck Jacquard	2x1	KR	BFL2	TEES	
13	232	Tuck Jacquard	2x2 check	KR	BFL2		
13	263	Tuck Jacquard	2x1 w ladder/ pointelle	WFW	BFL2		
13	271	Tuck Jacquard	2x1 w ladder/ pointelle	KR	BFL1		
13	291	Hand Tuck	Double ladder w hook up	KR	BFL1	TEES	
13	362	Point / ladder stripe	Pointelle w double ladder	KR	BFL2	DH	
13	364	Hand Tuck	Double ladder w hook up	KR	BFL1	DH	
20	12	Inlay	1x1 w pointelle	KR	BFL1 x 2		
21	55	Hand Tuck	4x2x2 w pointelle	BFL1	WFW		
21	64	Hand Tuck	Double ladder	WFW	BFL2		
21	259	Tuck Jacquard	2x1 w ladder	DH	BFL2		
21	261	Tuck Jacquard	2x1 w ladder	WFW	BFL2		
21	262	Tuck Jacquard	2x1 w ladder	WFW	BFL2	TEES	
21	298	Hand Tuck	1x2x2 w pointelle	WFW	BFL1	BFL2	
21	306	Hand Tuck	4x2x2 w pointelle	KR	BFL2	DH	
21	353	Point / ladder stripe	3x1 ladder rack look pick up	DH	WFW	BFL1	
29	404	Inlay	1x1 w pointelle	DH	BFL2	WFW	
30	142	Float Jacquard	4x1 w ladder pick up	KR	BFL1		
30	147	Float Jacquard	2x1 w ladder	DH	BFL2		
30	156	Float Jacquard	2x1 w pointelle	BFL2	WFW		
30	253	Float Jacquard	2x1 w ladder/ pointelle	KR	BFL2		
30	256	Float Jacquard	2x1 w ladder/ pointelle	DH	BFL2		
30	320	Float Jacquard	Diagonal squares w pointelle	BFL2	TEES		
30	251	Float Jacquard	2x1 w ladder/ pointelle	KR	BFL2	TEES	
38	123	Float Jacquard	Horizontal zig zag 3	BFL1	S/DOWN		
38	127	Float Jacquard	Horizontal zig zag 4	BFL1	S/DOWN		
38	132	Float Jacquard	4x1	DH	BFL2		
38	148	Float Jacquard	4x1 w ladder	KR	BFL2		
38	244	Inlay	1x1	S/DOWN	BFL1 x 2 (ER)		
38	245	Inlay	1x1	S/DOWN	BFL1		
38	370	Float Jacquard	4x1 w double ladder	KR	DH	BFL2	KR

Table 7-6 The top 40 softest samples, based on softness. This table was taken directly from the sampling matrix and calculated using the percentages discussed in chapter 3.7.3.2.

Table 7-6 reiterates the findings of the sample analysis in previous chapters. Overall, the tuck jacquards and hand-manipulated tucks are the softest samples. They rank highly because they are soft to touch, stretchy and textured; they score highly in each area, which improves their ratings. The tucks have performed as the researcher anticipated, creating sculptural fabrics with texture which cohesively blended yarn types at the front and the back of the fabric. This may confirm that utilising tuck patterns is one method of minimising the amount of 'prickle' next to the skin and, in turn, improving the handle of the fabric.

The float jacquards with small clusters of stitches, such as the 2x1 and 4x1 rib-look structures and the fine 1x1 course stripes, successfully blended the yarns cohesively. The structures were consistently soft, depending on the yarn types used.

The inlay samples have lots of potential to create soft samples, but further sampling is required to explore every yarn combination in every inlay structure; this is an area for further work. As Table 7-1 reveals, it does not confirm which pattern structure is the softest.

Openwork, i.e., the pointelle and ladder combinations in general, have improved the handle of the fabrics and added aesthetic appeal, but some of the feedback from the interview participants determined that fabrics which are too open, too loose, or too textured lose their appeal and were not considered wearable. Thus, taking this feedback into account, the amount of openwork and texture should be considered if the fabric is to be deemed suitable for commercial fabrics. For this reason, there was a shift in focus in the final phase of the practice, from creating fancy pattern structures which improved the blendability of the yarn to blending different yarn combinations, utilising more yarn types with higher proportions of the coarser broad wool yarn types within more basic structures, which could be considered more commercial.

7.3 Yarn

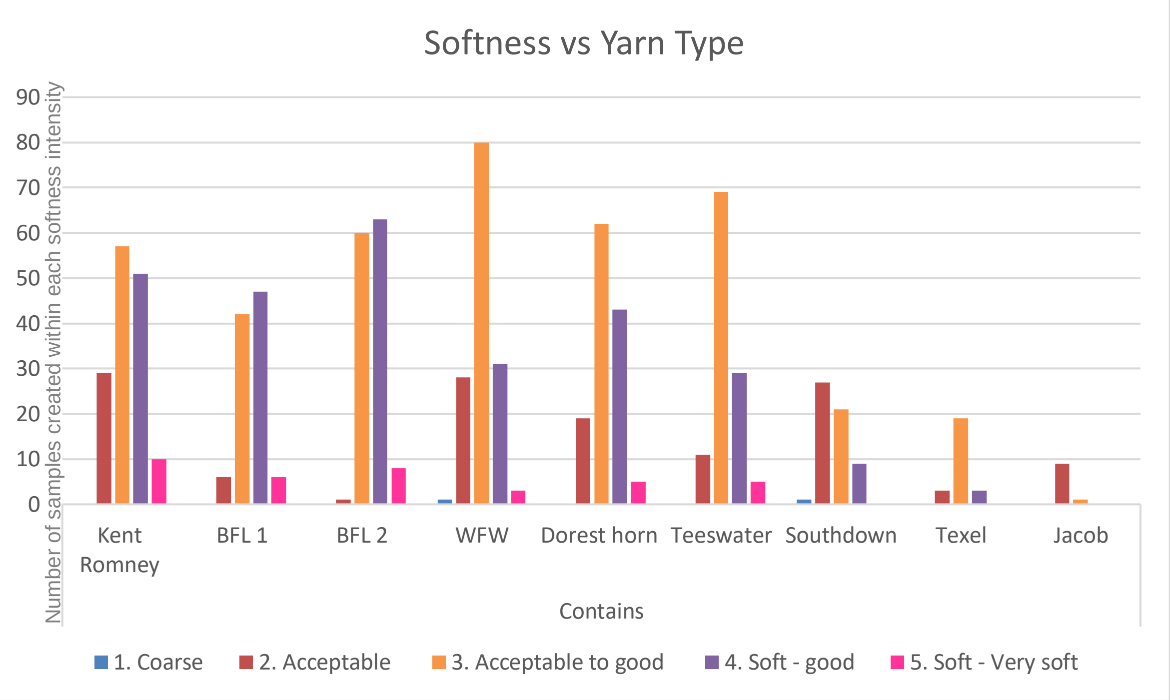


Table 7-7 The number of samples rated from very soft to coarse in each yarn type. This table breaks down each sample by individual yarn type; thus, the same sample is included in the chart multiple times, depending on the number of ends of yarn it contains.

Throughout Chapters 5 and 6, analysis of each pattern group demonstrates that samples with at least one end of BFL running through them are typically rated the softest samples. Tables 7-7, 7-8, and 7-9 confirm this analysis. Table 7-7 records the number of soft and very soft fabrics containing BFL. Proportionally fewer samples containing BFL have been rated as acceptable or acceptable to good (average), thus, revealing that combining an end of BFL within a fabric ought to improve its overall tactility.

Tables 7-8 and 7-9 break down yarn softness by yarn combination. Table 7-8 records each of the 70 yarn combinations experimented with during the practice and visualised this information by demonstrating proportionally how soft each yarn combination is considered. Sample 7-9 summarises the data presented in Table 7-8, focusing on blends experimented with in at least five samples.

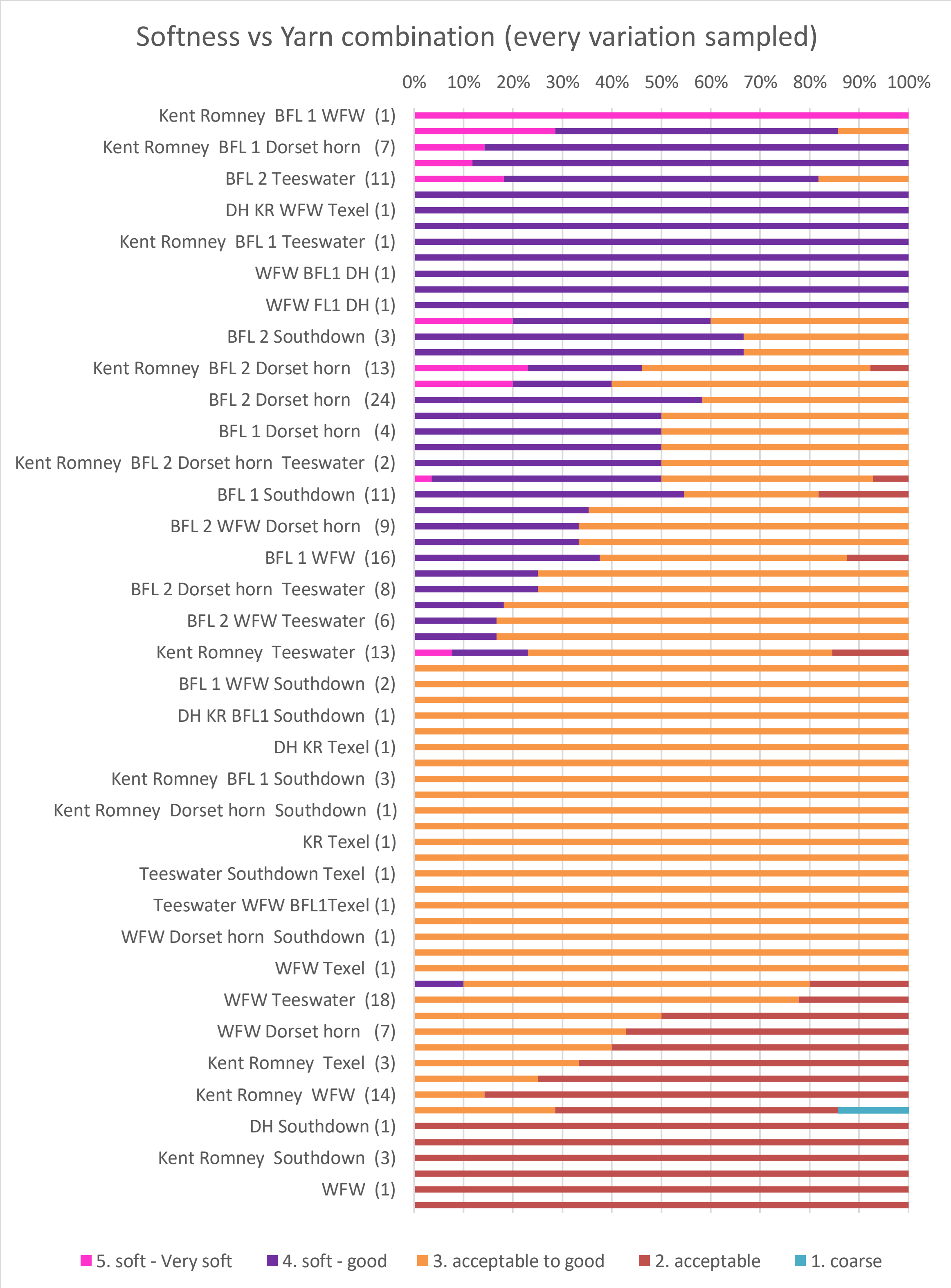


Table 7-8 records every yarn combination created during the practice. Every other yarn combination is written on the axis. Seventy combinations were knitted in total.

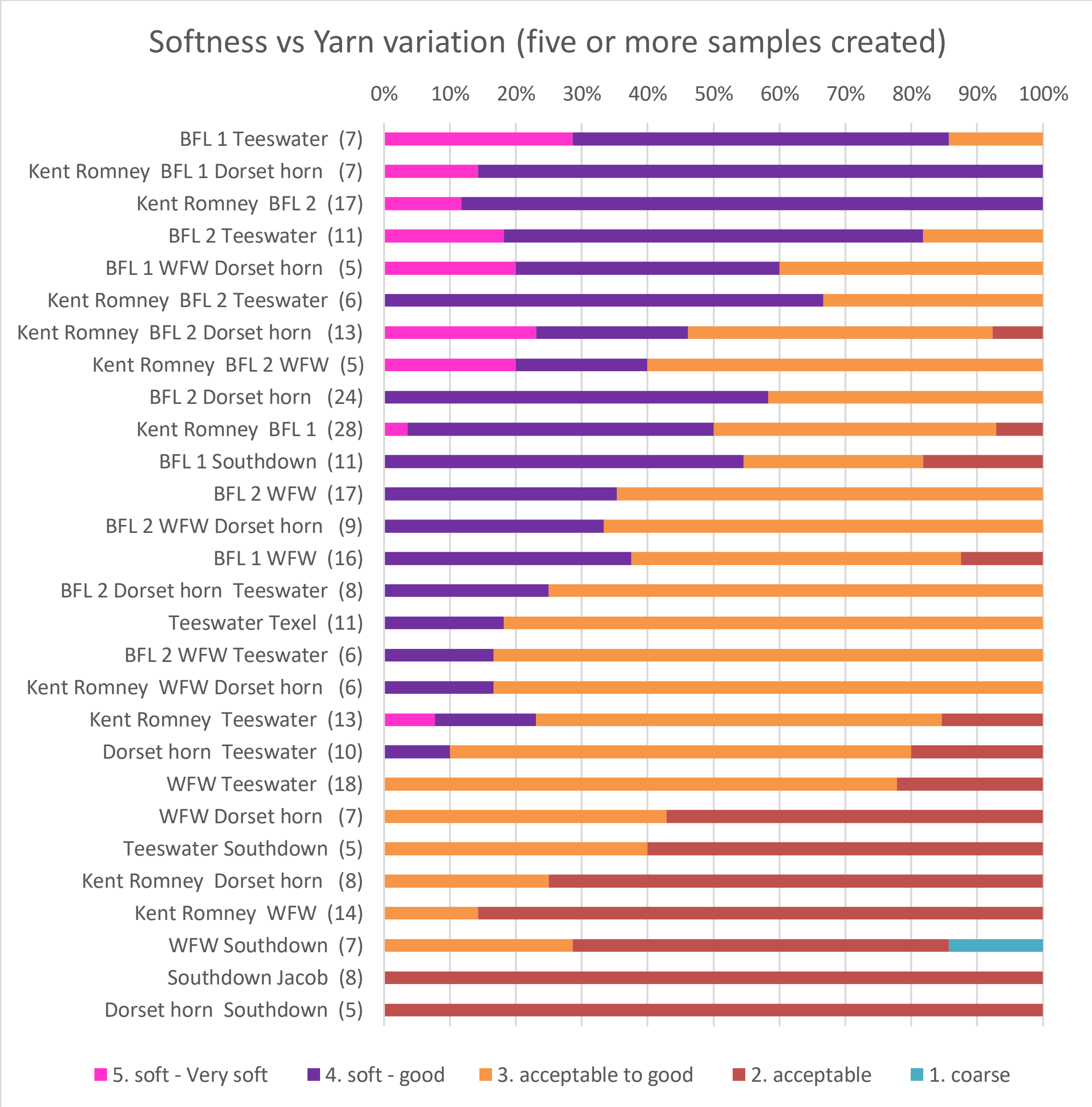


Table 7-9 visualises the number of times a sample in each yarn combination has been knitted and how soft it is; it also demonstrates the average score of each yarn combination; through interpreting this data, it is possible to understand what the softest yarn combinations are.

Table 7-9 reveals that the softest yarn combinations are BFL1/ Teeswater, BFL2/ Teeswater and KR/ BFL2; thus, all the softest blends combine two types of yarn, all containing BFL. Theoretically, the BFL/Teeswater combination ought to be the softest as these are the softest yarns; therefore, the table confirms the yarn analysis undertaken in Chapter 4.2. Thus, the most significant finding is how soft the KR/BFL2 combination is; this yarn combination is considered as soft as the BFL1/ Teeswater mix. The information meets the project’s aims, demonstrating that the handle of medium grade, British broad wool can be improved if blended with a softer yarn type. Although wool produced from Romney fleece is utilised for knitwear, it is not known for having a soft, luxurious, or lustrous handle. This result demonstrates that it is possible for KR wool to have a soft, lustrous handle when combined with a BFL fibre. The KR/ BFL yarn combination has been sampled consistently across all four phases of the practice and in every pattern type; thus, these findings can be considered accurate because this yarn combination has been tested extensively. The researcher anticipates that these fabrics will encourage designers to utilise BFL/ KR yarn blends when designing knitwear in the future.

Table 7-9 demonstrates that even fibres such as the WFW, a hill sheep whose wool varies greatly, but its most common end use is carpets, can be improved if blended with a softer fibre. WFW is rated as 3.4 (Slightly above the average handle) when combined with BFL2 compared with 2.1 (acceptable to coarse) when blended with KR. The sampling phases demonstrated that blending these two yarns together did not improve the handle of either yarns, regardless of pattern type. Thus, the yarn type has the most significant impact on fabric tactility, but if a yarn combination works together, its handle can be improved by the pattern types the yarns are knitted in.

How soft each yarn is can also be determined by the language the researcher has utilised to describe each sample.

7.4 Language Analysis

In addition to visually interpreting the tactile statistical data through a series of charts, the experience the practitioner sensed when handling the fabrics was recorded using the sensory descriptors, which she felt best expressed each sample. These are the same descriptors which formed the word bubble and were given to the interview participants. Three words were selected to describe each sample resulting in a long and varied list of adjectives. The language utilised to represent each sample is relatively similar because the yarns are all the same weight, the same type and have similar properties. Even in the most innovative blends created, it would be improbable to create a fabric which would evoke the sense of a shiny, reflective, or sparkly material.

The descriptors collated into the sample matrix were compiled into a list to determine the frequency of each word, Table 7-10 records the top 20. Fuzzy is the most frequently documented word in the matrix, used to describe just over a quarter of the ecru samples within the collection. This makes sense; the researcher accurately describes and records what they can feel; as Chapter 4 ascertained, the staples of each yarn type have fuzz protruding from them, which will be knitted into the fabric. Fuzzy, utilised on its own, is considered a fairly neutral term; it gives connotations of warmth and comfort but could also be used to describe a pilling fabric. Therefore, fuzzy alone does not visualise the material or its tactility.

Word	Count
fuzzy	104
spongy	91
hairy	84
flat	59
prickly	54
rough	51
thick	50
light	48
dense	43
smooth	41
scratchy	30
drapey	26
silky	26
bumpy	24
woolly	20
insulating	17
fluffy	16
coarse	15
open	14
limp	12

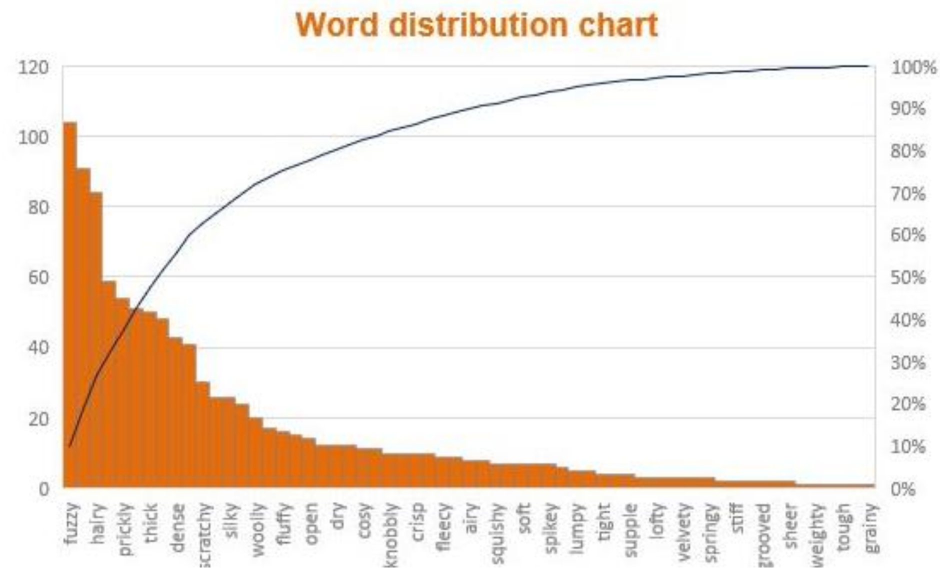


Table 7-10 Top 20 descriptive words and total word distribution chart. (The chart shows every other word in the list.)

Prickly, thick, and rough are commonly utilised terms. At first, the researcher was disappointed that she had determined so many of the fabrics to be prickly. Throughout the research project, the literature has determined prickly as a term with negative connotations and perceptions. McGregor, et al., (2015) have spent a great deal of time trying to improve prickle sensation in fabrics; indeed, even Merleau-Ponty used the sensation of prickle as an example of subjective pain (Moran, 2015, p. 228). However, in the case of this research project, the word prickle has not been utilised to determine a painful sensation or a bad feeling; instead, it has been used as an accurate description of the material being handled. It is helpful as it distinguishes between those samples which could be worn next-to-skin and those which could be used for knitwear but may not be appropriate for next-to-skin wear. The researcher referred back to the sample matrix and discovered that many of the samples described as prickly are not considered coarse.

Sample 34 (figure 7:24), a hand-manipulated tuck knitted in a BFL1/Teeswater combination, is rated as soft. The three descriptors used are fluffy, stretchy, and prickly. The fabric is aesthetically attractive and should, theoretically, be one of the softest samples. While this fabric is appropriate for wear, it is too prickly to be worn next-to-skin. Consequently, three descriptors build a more accurate picture of the fabric than one. Sample 34 is both prickly and soft handling; it has blended the yarns cohesively and is aesthetically attractive. In that respect, it is successful. However, the research reveals that sample 34 should not be worn next to the skin.

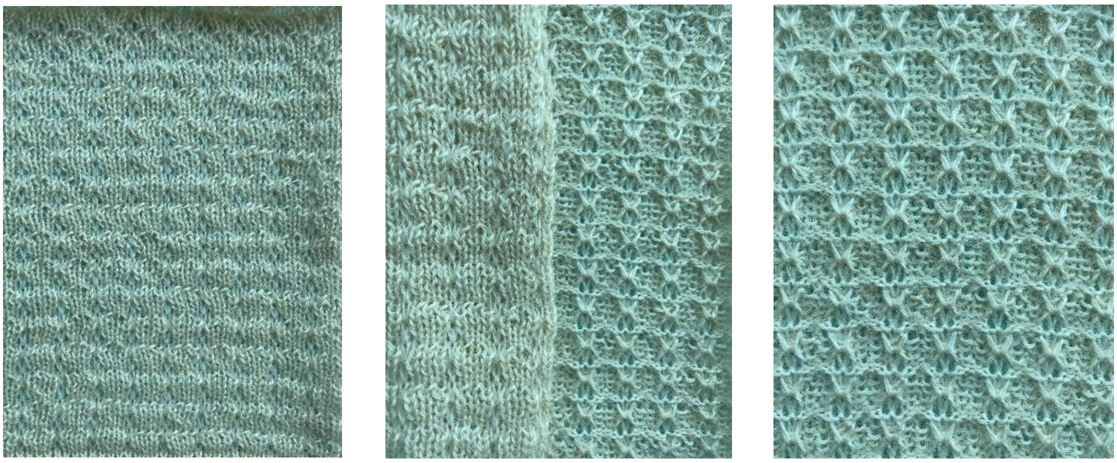


Figure 7:24 Details of sample 34, 4x4x2 hand-manipulated tuck pattern structure in BFL1/Teeswater

Sample 160 (figure 7:25) is knitted in a pattern which consistently produces samples with a soft handle, the 4x1 rib-look float jacquard, but has been described as rough, spongy, and thick. The sample is a blend of WFW and KR, the two coarsest yarns utilised during the project. The yarns have not been combined with BFL or Teeswater, nor has the pattern structure been further manipulated. Thus, it can be assumed that this yarn combination benefits from one of these applications. The terms spongy and thick are used here to describe the structure hence, the terminology used is not overtly negative. The sample is not soft, it does blend the yarns well, and it is knitted, a pattern type considered one of the most successful. Therefore, it can be determined that the pattern may have incrementally improved the handle, but as this is one of the roughest yarn combinations, it has still not created a commercially acceptable fabric.

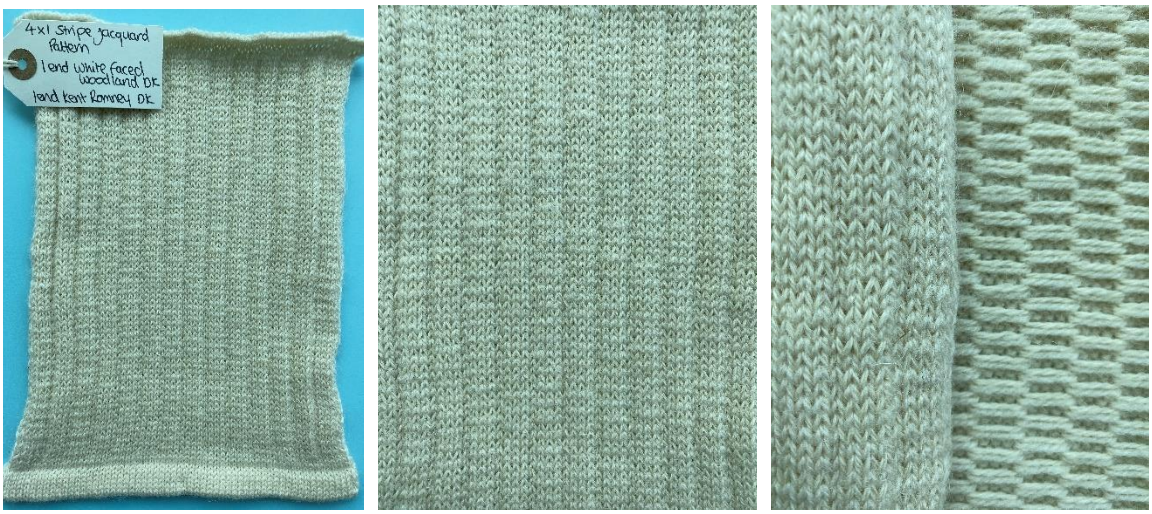


Figure 7:25 Sample 160, a 4x1 rib-look float jacquard structure in WFW/KR.

In contrast, sample 104 (figure 7:26), another float jacquard sample, is knitted in theoretically softer yarns: DH and Teeswater. However, the language describes the fabric as tight, prickly, and scratchy; when utilised together, these descriptors perceive the sample negatively; it imagines a fabric which would be uncomfortable to wear next to the skin. Both samples 160 and 104 have been ranked the same in terms of softness (355th of 367), which determines them as two of the roughest samples within the swatch library. However, the language further differentiates between these fabrics. It reinforces the findings that the 4x1 rib-look float jacquard is a more successful pattern structure than the zigzag float jacquard structures. Overall, the zigzags were considered flat with a dense cover area and little movement and volume; they have done little to improve this yarn combination.

Figure 7:26 Sample 104, horizontal zigzag 1 float jacquard structure in Tees/DH

The most frequently recorded descriptors in the sample matrix with positive connotations include smooth, drapey and silky. These words are often not associated with materials such as broad wools. This language evokes a sense of comfortable, fluid, sleek fabrics that move in response to the body and that one would be happy to wear on a cold winter's day.

Sample 307 (figure 7:27) is knitted in a 2x1 rib-look pattern, so it is very similar in construction and structure to sample 160 described above. The fabric has not been manipulated, but instead of being knitted in a KR/ WFW combination, the fabric is knitted in a KR/ BFL2 combination. The descriptors used are smooth, spongy, and cosy, evoking the perception of a soft, comforting, cosy fabric suitable for winter apparel or next-to-skin wear. The sample has met the aims and objectives; it’s soft to handle, blends well and is aesthetically interesting enough for commercial fashion.

Figure 7:27 Sample 307, a 2x1 rib-look float jacquard structure.

Sample 37 (figure 7:28) is the same hand-manipulated tuck pattern as 34 (figure 7:24), knitted in a blend of BFL1/ WFW, and the outcome is effective. The sample is rated as soft and ranked 63rd overall within the sample collection. Silky, delicate and drapey have been employed to describe the fabric's tactility. Again, this is language not always associated with British wool. Here both the yarn combination and the pattern structure have successfully improved the WFW yarn handle to create a soft fabric which has the potential for next-to-skin wear.

Figure 7:28 sample 37 a 4x4x2 hand-manipulated tuck structure.

To further explore what the language of each sample reveals, the descriptors were broken down firstly by yarn type and then again by pattern group. Table 7-11 demonstrates each pattern type's most frequently used terms.

Word	Stripe	Inlay	Tuck	Jacquard	Stripe jacc	Tuck Jacqu	Ladder	Total
fuzzy	3	16	11	65	4	4	1	104
spongy	0	12	11	48	0	19	1	91
hairy	1	10	22	41	0	10	0	84
flat	8	6	2	37	5	1	0	59
prickly	6	5	4	39	0	0	0	54
rough	13	11	12	15	0	0	0	51
thick	0	8	2	38	0	2	0	50
light	8	11	11	9	2	3	4	48
dense	4	0	5	30	2	2	0	43
smooth	6	2	0	29	3	1	0	41
scratchy	2	4	11	13	0	0	0	30
drapey	6	1	11	4	1	1	2	26
silky	3	0	3	17	1	2	0	26
bumpy	1	2	15	5	0	0	1	24
woolly	1	3	2	12	2	0	0	20
insulating	0	3	0	14	0	0	0	17
fluffy	0	0	10	4	0	2	0	16
coarse	5	3	1	6	0	0	0	15
open	1	4	2	4	0	0	3	14
limp	0	8	0	3	0	1	0	12
dry	1	3	0	6	2	0	0	12
stretchy	1	1	5	0	0	5	0	12
cosy	0	1	1	5	0	4	0	11
rigid	0	0	3	8	0	0	0	11
knobbly	1	0	7	1	0	0	1	10
furry	0	4	5	0	1	0	0	10
crisp	0	2	3	5	0	0	0	10
warm	0	1	1	6	0	1	1	10
fleecy	0	2	1	4	0	2	0	9
felted	0	0	0	9	0	0	0	9
airy	0	2	0	0	0	2	4	8
delicate	1	2	2	0	0	0	3	8
squishy	0	1	0	3	0	3	0	7

Table 7-11 A section collating the language by pattern type.

The tables were utilised to create the word clouds depicted on the following pages.

7.4.1 Yarn

The same table was created for yarn type. The columns have been split up and are presented next to the clouds so the tactile data can be viewed in two forms.

KR Top 20 words		
No	word	x employed
1	spongy	42
1	fuzzy	35
3	flat	31
4	light	26
5	rough	23
5	hairy	23
7	prickly	21
8	thick	20
9	smooth	18
10	insulating	12
11	dense	11
11	drapey	11
11	silky	11
14	open	10
15	scratchy	9
16	warm	8
16	limp	8
18	stretchy	7
19	woolly	6
19	bumpy	6
19	coarse	6

Figure 7:29 Kent Romney word cloud

WFW Top 20 words		
No	word	x employed
1	Fuzzy	41
2	spongy	31
3	flat	29
4	rough	25
5	hairy	24
6	light	22
7	prickly	18
8	thick	17
9	dense	15
9	scratchy	15
11	smooth	13
12	drapey	11
13	woolly	10
13	bumpy	10
15	dry	9
16	fluffy	7
17	crsip	6
17	coarse	6
17	cosy	6
17	rigid	6
17	limp	6

Figure 7:30 White-faced Woodland word cloud

DH Top 20 words		
No	word	x employed
1	spongy	37
1	fuzzy	34
3	flat	23
4	light	19
5	thick	18
5	hairy	17
7	smooth	16
8	thick	20
9	smooth	18
10	scratchy	14
11	prickly	13
12	drapey	11
12	dense	11
14	rough	10
14	insulating	10
16	bumpy	7
17	open	6
17	felted	6
19	knobbly	5
19	coarse	5
19	silky	5
19	crisp	5

Figure 7:31 Dorset Horn word cloud

BFL (total)Top 20 words		
No	word	x employed
1	Fuzzy	71
2	spongy	71
3	Smooth	40
4	hairy	39
4	flat	39
6	light	33
6	thick	33
8	drapey	25
8	silky	25
10	dense	21
10	bumpy	21
12	woolly	18
13	fluffy	15
14	rough	13
14	insulating	13
16	scratchy	12
16	prickly	12
18	stretchy	11
18	cosy	11
18	open	11

Figure 7:32 Blue-faced Leicester word cloud

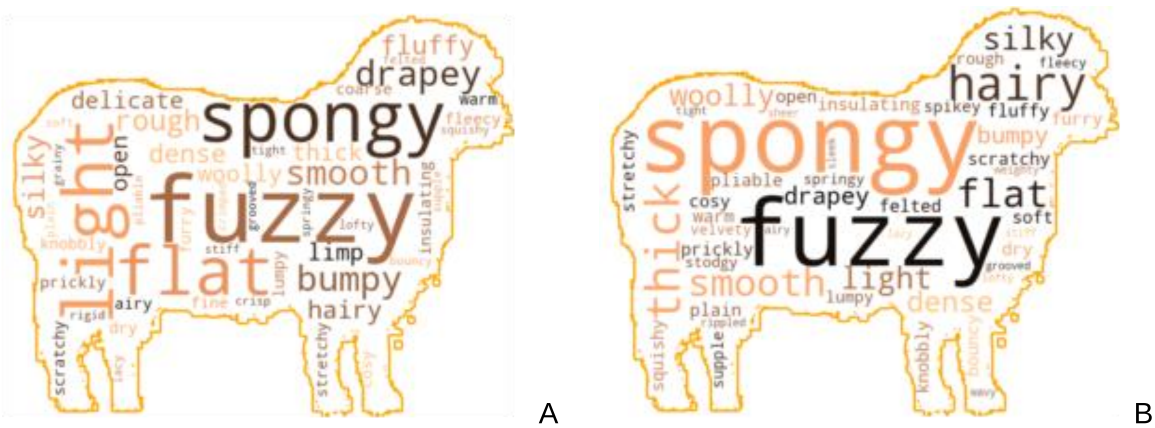


Figure 7:33 Blue-faced Leicester descriptors broken down by yarn count. Image A represents BFL1: the 2/16 Nm count fibre, and Image B represents BFL2: the 2/8 Nm fibre.

Teeswater Top 20 words		
No	word	x employed
1	hairy	79
2	fuzzy	33
3	prickly	32
4	spongy	23
5	scratchy	14
5	thick	14
7	dense	11
8	bumpy	8
8	fluffy	8
10	knobbly	7
10	rough	7
10	light	7
10	silky	7
14	spikey	5
14	drapey	5
14	flat	5
17	woolly	4
17	limp	4
17	fleecy	4
17	furry	4

Figure 7:34 Teeswater word cloud

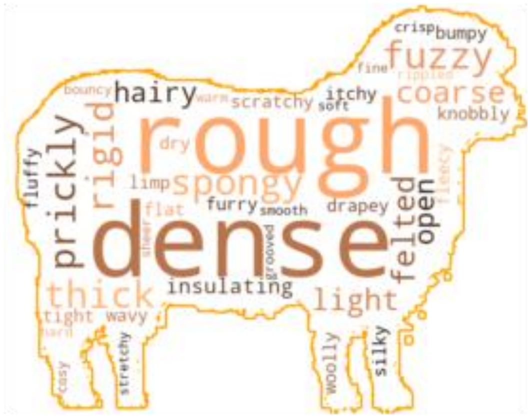


Figure 7:35 Southdown word cloud **Figure 7:36 Texel word cloud**

Each word cloud attempts to conjure a sense of the individual yarn type, its properties, and the feelings the yarn type evokes when one engages with the material. There are similarities as at least two yarn types have been combined within every sample. For example, spongy is the most prominent word in each of the KR, DH and BFL word clouds (figures 7:29, 7:31 and 7:32). However, by rearranging the language this way, differences in the yarns and a sense of their handles are revealed.

During the interviews, the candidates consistently described the Teeswater samples as hairy, rough, or prickly; the Teeswater word cloud (figure 7:34) agrees since hairy, prickly, and scratchy are prevalent. As discovered above in Chapter 7.4, sample 34 (figure 7:24) was also described as prickly, another fabric with Teeswater blended within it. Therefore, it could be determined that hairy and prickly both describe the properties of this yarn type and the sensation evoked when one comes into contact with it. This yarn has spurred the most significant emotive response throughout the research by both the researcher and those participating within the study. The samples created from this yarn have been determined as either the softest or the roughest depending on the yarn the Teeswater is combined with. The Teeswater word cloud substantiates these contradictory opinions; words such as fluffy, silky and drapey appear amongst the many words with negative connotations. This yarn is blended into the softest sample rated within the collection but can also be found in several of the coarsest. The word cloud summarises these findings simplistically and clearly with a single image.

In contrast, the research has confirmed that the BFL is the softest yarn, and every pattern handles well if an end of BFL is blended through it. This is echoed in the three BFL word clouds above (figures 7:32 and 7:33). The descriptors employed evoke a cosy, warm yarn that is appealing to wear. Two different counts of BFL were utilised; thus, two-word clouds broken down by count, were created (figure 7:33), along with the combined cloud (figure 7:32). Visually, it is easy to differentiate between these counts as one is described as light and drapey, (version A) whereas the other is thick, smooth, and spongy (version B); Some of these words are still present within version A because the researcher regularly paired this yarn with a thicker fibre to balance the overall weight, quality, and handle of the fabric.

The KR (figure 7:29), WFW (figure 7:30), and DH (figure 7:31) yarns word clouds are all visually similar, which may be because all three yarns have similar properties, and it was these yarns the researcher focused on improving throughout the practice. The DH cloud is slightly more generous than the other two, as the word rough is less prominent. This yarn is theoretically considered softer than the other two, so this is expected. The WFW, theoretically the coarsest yarn, has been determined through the project; the WFW cloud reiterates this. However, it is Southdown’s cloud (figure 7:35) that evokes the sense of a yarn which is very rough and hard to touch, but theoretically, this is not the case. In contrast, Texel’s cloud (figure 7:36) makes the yarn sound softer than it is in practice. As Table 7-7 records, the information regarding these yarns is not as accurate, as they were not sampled consistently.

7.4.2 Pattern

Figure 7:37 Stripe word cloud

Figure 7:38 Float jacquard word cloud

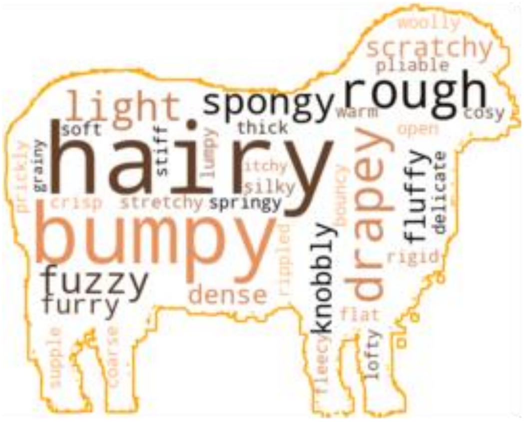


Figure 7:39 Hand-manipulated tuck word cloud

Figure 7:40 Tuck jacquard word cloud

Figure 7:41 Inlay word cloud

The exact three descriptors have been rearranged and converted into word clouds, this time by pattern type. By grouping these word clouds together, an essence of the collection is conjured up. When studying the word clouds as a group, they look similar; however, on closer examination, each cloud portrays a sense of each unique pattern type.

Figure 7:37, the stripe cloud contains the greatest proportion of terms with negative connotations but fewer words overall. The cloud emphasises the difference between the handle of the broad stripes created at the beginning and the fine single-course stripes developed towards the end of the practice. The handle of this pattern group has evolved from rough to light, from prickly to silky and from scratchy to smooth. Within this pattern type, there is a significant variation between yarn types, and a soft yarn, such as BFL, made the most negligible difference to the overall handle. Instead, the handle was more affected by the stripe's depth, i.e., the pattern structure. The different yarn types only began to influence the overall fabric handle when a suitable pattern was developed.

As discussed earlier, for all other pattern types, the yarn combination is the most influential factor in determining the tactility of each fabric. The other four patterns enabled consistent blending of the yarns when the right pattern variations were established: for example, small clusters of stitches. These designs were produced in response to the handle of the stripe structures generated at the beginning of the practice.

An outcome is that the word clouds of these four pattern groups are comparable, although differences can be detected. Figure 7:40, the tuck jacquard cloud stands out; again, there are fewer terms, but the words employed evoke positive emotions, which reflects the softness of this sample group and their overall ratings within the collection. If someone was interpreting this cloud without observing the fabrics first, they might imagine some very soft, comfortable fabrics that are appropriate to wear next-to-skin. It would be interesting to discover if one realises whether the fabrics are made from British wool through interpreting the language alone or whether it would be assumed that a softer fibre such as lamb's wool, merino or even cotton is being described. This may be an area for further investigation to determine whether the language used in the study is informative enough to describe a specific fibre type, such as wool or whether it is more general to textiles. Without visual and tactile responses, would this level of interpretation be challenging through language alone?

The float jacquard (figure 7:38), hand-manipulated tuck (figure 7:39) and Inlay (figure 7:41) word clouds are more predictable. They all regularly utilise the words fuzzy, spongy, hairy, rough, and thick. Figure 7:39 records that terms such as bumpy and knobbly are prevalent when describing the hand-manipulated tuck patterns; these words communicate the fabric's structure. Figure 7:41 documents light and flat are more commonly used to depict the inlay fabrics since these fabrics are more open and, in general, relatively flat. The texture is on the reverse of the fabric but is only apparent if one of the chunky yarn counts is inlaid. Therefore, the word clouds reveal that the language has formed a sense of the fabrics structure. In this instance, the research agrees with the literature that fabric handle evokes both visual and tactile responses, and the aesthetics of fabric are intertwined with the perceived handle of the material (Dolan & Holloway, 2016).

Figure 7:38, the float jacquard cloud summarises the practice undertaken in this pattern type; it was extensive, and the outcomes range from a number of the softest samples within the collection to a number of the roughest; thus, the language is diverse and varied. Generally, the language which stands out is relatively optimistic and reflects the sampling overall: fuzzy, hairy, spongy woolly and thick all describe the tactility of samples generated throughout the practice.

7.5 Explanation of Blending Yarns Through Pattern.

Throughout the research practice blending through pattern is the method used to combine yarns. This section visualises how the yarns have been combined. A number of the fabrics created have been re-knitted in colour to demonstrate the approach.

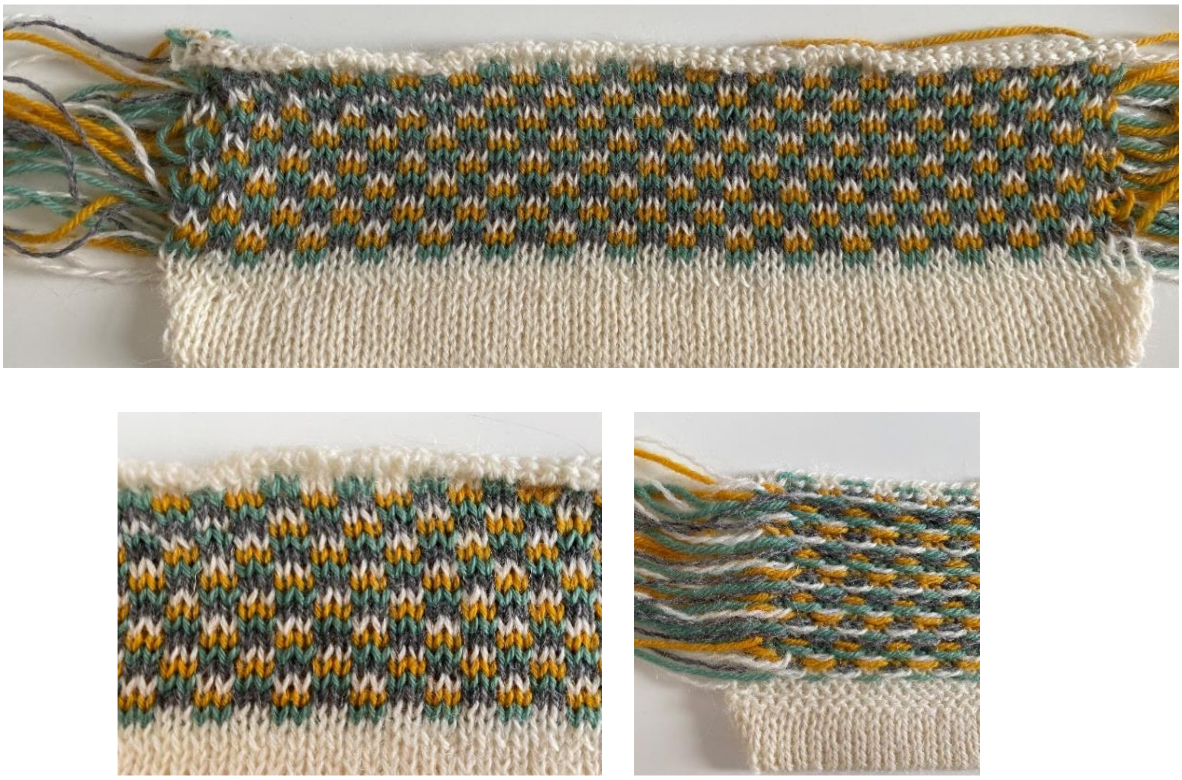


Figure 7:42 The images above demonstrate how a 2x1 rib-look pattern changes the yarn type on every course. (This is represented by four colours.)

Figure 7:42 visualises a section of a 2x1 rib-look float jacquard combining four yarn types; this could be considered the most effective method of combining yarn types to achieve a consistently well-blended fabric. However, experimentation discovered that changing an even number of yarn types on every course was unsuitable for the project because the yarn needed to be cut every course. One yarn type finishes on one side of the knit (for example, the right) but needs to start knitting again on the other side (the left) when it is its turn to knit again. This applies to all even combinations that interchange on every course. The knit was deemed inappropriate because the amount of waste produced from the ends of yarn is not sustainable, and the amount of finishing to sew all of these ends into a fabric swatch/ garment is too time-consuming and costly if the swatch was commercialised. Therefore, time was spent experimenting with different methods of blending two, three and four types of yarn, particularly during phases 3 and 4, to ensure yarns combined evenly but also ensured yarns could be used without being cut regularly.

Experimentation revealed that using an odd number of yarns was more effective and efficient when interchanging yarns every row; thus, three ends of yarn were chosen for testing because the fibres do not need to be cut on every row when exchanged. The yarns interchange throughout the fabric without any loose threads. This is demonstrated in Figure 7:43 below. The images depict the reverse of the fabrics, highlighting how the yarn types interchange on every course; this is most apparent on the inlay version as each yarn loops over the inlaid fibre.

Figure 7:43 Colour versions of samples 357, 387 and 406 recording different yarn types interchanging on every course.

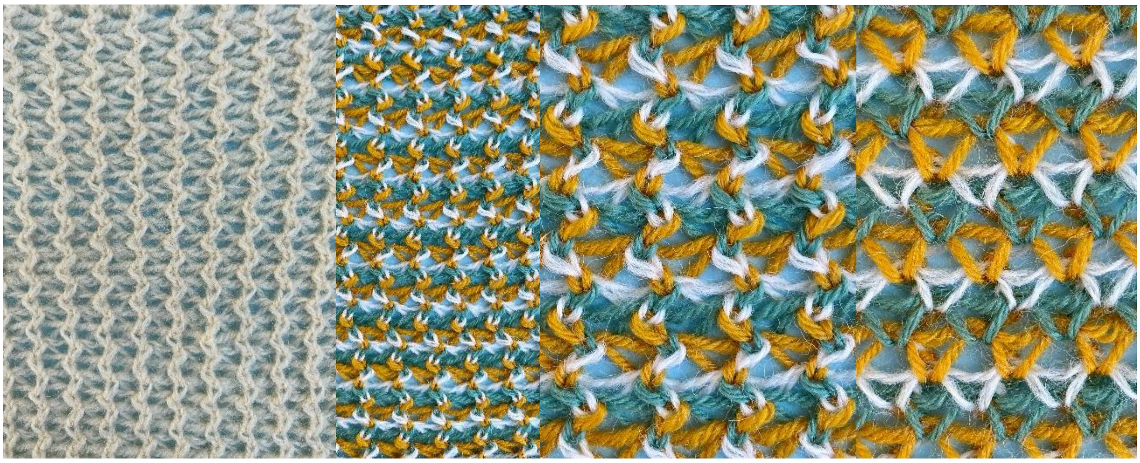


Figure 7:44 Sample 353 in ecru and colour. Three yarn types were used to knit this sample in the pattern highlighted in colour.

During phase 4 experimentation with blending three or more yarn types on every course began with the stripe pattern group. Figure 7:44 was the softest sample created; it has three types of yarn and is knitted in a 1x1 course stripe (the yarn exchanges on every course). It is a mix of DH (ecru), WFW (mustard) and BFL1 (turquoise). This sample has a soft handle, blends the yarn types effectively and looks attractive; the pattern has effectively improved the handle of the WFW yarn. Overall, this fabric has met the aims and objectives of the project, elevating a 1x1 course stripe in average handling yarns into an exciting piece of textiles which can be transformed for fashion fabrics.

As well as investigating single-course stripes, different formations of one and two course stripe structures were tested, enabling four types of yarn to be utilised. A number of the fabrics created during phase 4 can be seen below:

Figure 7:45 Sample 361 in ecru and colour to demonstrate how the yarn types combine.

Figure 7:45 combines one course of DH (mustard), two courses of KR (ecru), one course of DH (mustard), one course of BFL1 (turquoise), two courses of KR (ecru) and one course of BFL1 (turquoise) before the pattern is repeated. Again, this blend created a soft sample and can be considered a successful outcome as the proportion of BFL has been reduced within the sample while elevating the handle of the DH and the KR.

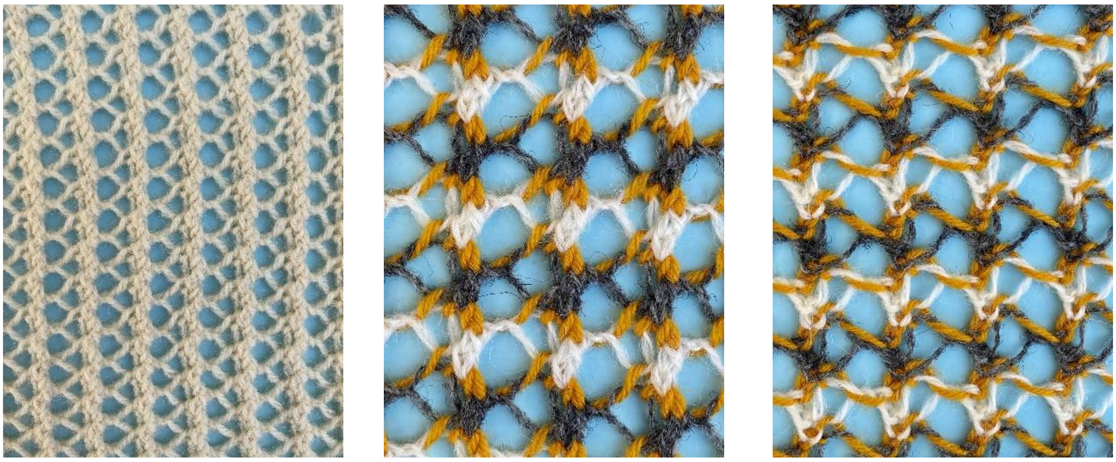


Figure 7:46 Sample 363 in ecru and colour combines two courses KR (grey), one course BFL1 (mustard), two courses WFW (ecru), one course BFL1 (mustard) and then repeats.

The structure in the two images shown in figure 7:46 is the same, but the count of the British wool yarns are thicker, which is why this open structure looks so different when knitted in colour. The blend variation is slightly different from figures 7:44 and 7:45 but still created a soft fabric. Samples 363 and 410 (another version of this structure) are rated in the top 10 samples overall. The mixture of this yarn combination and structure are very effective in creating a soft handling and aesthetically pleasing fabric.

The images presented throughout the remainder of Chapter 7 highlight many of the yarn combinations examined in 2x1 rib-look float jacquard, 4x1 rib-look float jacquard and Inlay structures. They demonstrate a proportion of the combinations possible within each pattern group and reveal the number of combinations that need to be tested to establish the most effective pattern, structure, and yarn combinations.

7.5.1 2x1 Rib-Look Float Jacquard

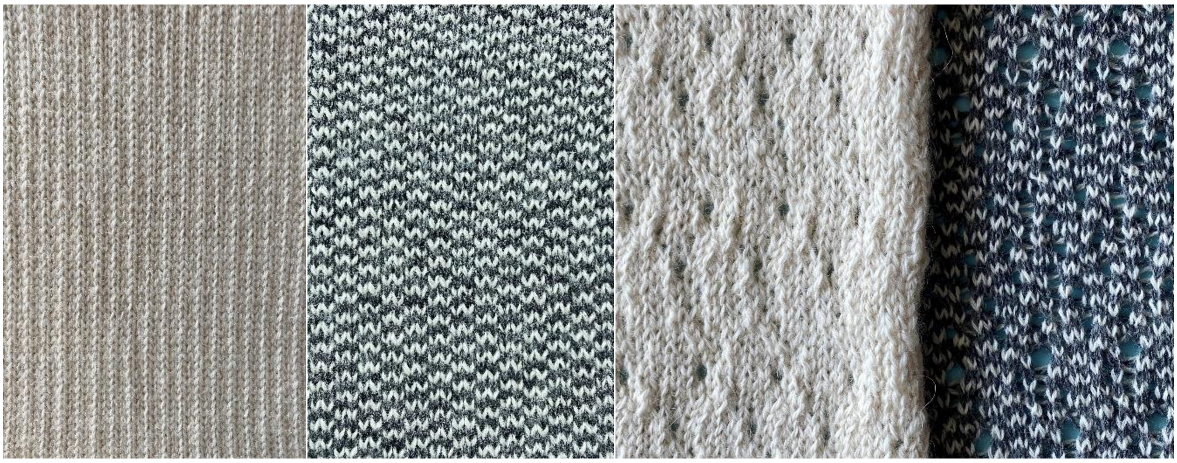


Figure 7:47 Sample 307 (left) and sample 158 (right) in ecru and colour both combine two yarn types (KR and BFL2) and (BFL2/ Teeswater). During the first two phases of practice, samples were mainly created as above, using two types of yarn.

Sample 307 is a plain 2x1 rib-look float jacquard, whereas sample 158 is a manipulated version of the same pattern. Colour has been used to differentiate between the patterns and highlight the differences a pattern's structure can make to the yarn blend. Sample 158 reveals that as hand manipulation, in this case, ladders and pointelle, are incorporated within the fabric, the structure shifts, becoming less uniform, enabling yarn types to cross over and fuse together. It was anticipated that this would improve the handle of the fabric. While sample 158 has been analysed in depth in Chapter 6.4.2.3, it was demonstrated that the fusion of the two yarn types effectively created a soft handling fabric. It was anticipated that pointelle would be an important technique to further blend the yarns together. However, when the structure is examined in colour, it is revealed that pointelle has actually changed the surface structure rather than further combined yarn types. However, in the case of 158, it has also improved the fabric's tactility, which may be due to altering the way in which the stitches align.

Figure 7:48 Sample 308 in ecru and colour combines three yarn types (KR (ecru), Teeswater (grey), BFL2 (mustard)).

Many fabrics were created using the float jacquard pattern and utilised three types of yarn, as shown in Figure 7:48, with one yarn type knitting through feeder A and two yarn types alternating through feeder B. The yarn types in feeder B were interchanged every two courses. Overall, the intention was that KR, DH and WFW would be the yarn in feeder A and different yarns would interchange through feeder B. This was to experiment with whether fabrics created in these yarn types could still be considered soft if a higher proportion of these yarns were utilised throughout the sample if the right blend and pattern type were combined.

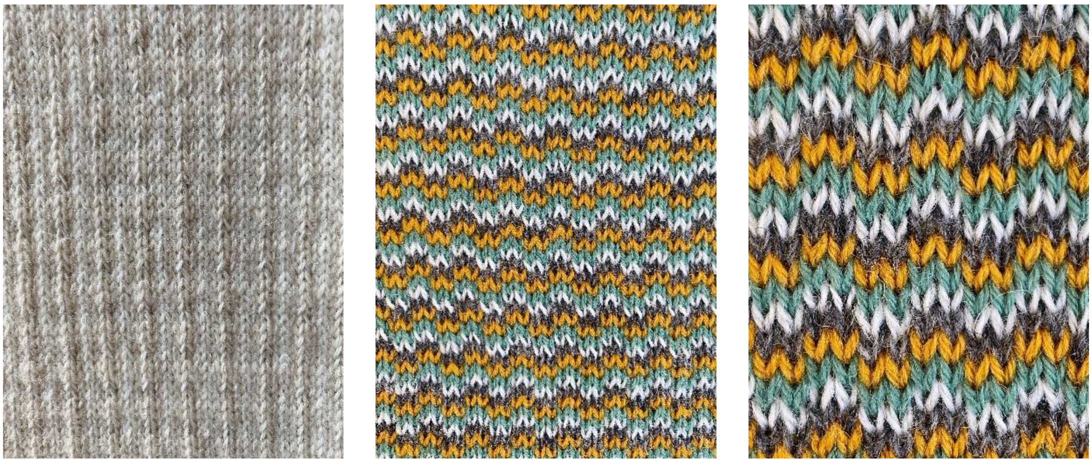


Figure 7:49 Sample 311 a 2x1 rib-look structure in a four yarn blend (DH, KR, BFL2, Teeswater) in ecru and colour.

Figure 7:50 Sample 378 a 2x1 rib-look structure with a double ladder in four yarn types (KR WFW, BFL2, KR) in ecru and colour.

Overall, the 2x1 rib-look float jacquard combined yarn types evenly, and the way in which the yarn blended was consistent when the sequence of yarn types fed into the feeders were altered. (This was not always the case for the 4x1 rib-look float jacquard, see figures

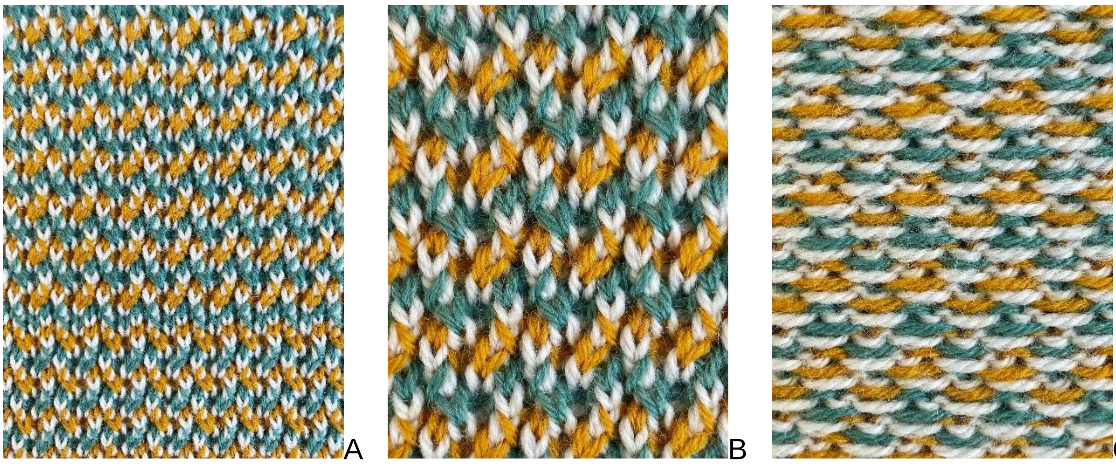
7:60 and 7:61.) Thus, right at the end of the practice, the researcher began to combine pointelle/ stripe techniques explored during phase 4 together with the 2x1 rib-look. The result was a number of intricately blended structures. Further work would be to explore these structures in more depth as they combine the yarn more evenly than the 158 structure, which the researcher chose to explore in depth during phase 3 of the practice and created several soft handling while aesthetically pleasing fabrics.

Figure 7:51 Samples 380 & 382 three and four yarn blend variations of a 2x1 float jacquard pattern with pointelle.

Figure 7:52 Sample 380 in colour demonstrates how the yarns blend in a three-yarn type variation.

Figure 7:53 Sample 382 is the same pattern as 380 but in a four yarn type variation. The images demonstrate how the aesthetics of the pattern changes as an extra type of yarn is introduced, in addition to how effectively the yarn types combine.

Figure 7:54 Sample 386 2x1 rib-look with pointelle in ecru combining three yarn types (DH, KR and BFL1).



A B C


D

E

Figure 7:55 Sample 386 knitted in colour. In ecru, samples 380 and 386 look very similar, but the colourways highlight the blend variations. This is highlighted by the images D & E, the images next to each other.

Samples 380 and 386 are knitted in the same 2x1 rib-look float jacquard structure. In both fabrics, the ecru yarn is in feeder A, and the turquoise and mustard yarns exchange every two rows in feeder B. The difference is the pointelle transfer pattern. The more open pattern of 380 has led to a slightly better softness rating, as it is more textural than sample 386. Both samples are soft, knitted in the same yarns (DH in feeder A, BFL1/ KR in feeder B), but 380 could be considered slightly more effective as it ranks 56th overall compared to 386, which ranks 62nd, but there is little between them in terms of softness. 380 is more open but feels bulkier than 386, which is lighter and possibly the more appropriate fabric for a garment. Both fabrics have the potential to be workable. It is possible that the general population would prefer sample 386 as the pattern is less obvious.

7.5.2 4x1 Rib-Look Float Jacquard

Figure 7:56 4x1 rib-look two yarn type structures in ecru and colour. Sample 139 (BFL1/ Southdown) and sample 137 (KR/BFL2).

Figure 7:57 Sample 265 a 4x1 rib-look structure with three yarn types. KR/ ecru in feeder A. BFL/ WFW, turquoise/ mustard interchange through feeder B

Figure 7:58 Sample 371 is a 4x1 rib-look with three yarn types with a double-double* ladder structure. WFW in feeder A, BFL2/ DH interchange through feeder B.

*Double-double ladder refers to two needles being left out of action in every set of four needles. Usually, where a double ladder is inserted into the fabric, two needles have been left out of action every eight needles.

Figure 7:59 is a 4x1 rib-look four yarn type structure demonstrating the formation if feeders A and B each knit two rows then are interchanged with another two colours before the pattern is repeated.

The method of interchanging yarns utilised in figure 7:59 is the typical way to interchange yarn types when using the float jacquard pattern method. During the practice, the researcher experimented with interchanging yarns in different sequences in an attempt to interchange each yarn type on every course. However, as seen in figures 7:60 and 7:61, by interchanging the yarn on every row, the yarns blended less due to the float jacquard structure. This is more apparent in the 4x1 rib-look structure than in the 2x1 rib look or 2x2 birds-eye structure, which both still blend yarn types relatively evenly. This is visualised in figure 7:62, which is the same blend as figures 7:60 and 7:61 tested in the 2x2 check birds-eye structure (the version below is knitted in half gauge, i.e., a ladder on every other pattern and the combination is far more effective and aesthetically looks very different to sample 366. These examples demonstrate that only a proportion of the yarn blends were effective, and some combinations work in one pattern structure but not across every structure within a pattern type.

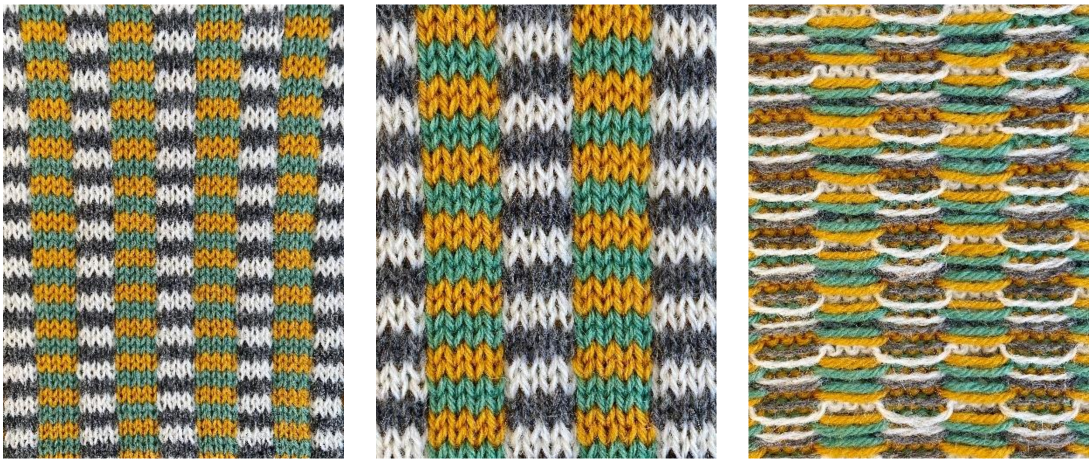


Figure 7:60 A 4x1 rib utilising four yarn types interchanging on every row.

The images in figure 7:60 demonstrate four yarn types interchanging on every course. Each yarn type moves from feeder B on its first course to feeder A on its second course, then is left out for two courses, rather than consistently blending the yarn, a vertical stripe pattern throughout the fabric. While this structure is interesting, it is not the intended outcome for the fabric.

Figure 7:60 Sample 366 a 4x1 rib-look with ladders, knitted in a four-yarn type combination.

Figure 7:61 visualises a four-yarn type combination (DH/ KR/ BFL2/ DH) with a triple ladder structure (three needles left out) running through the pattern.

Figure 7:61 Sample 376 in a four yarn combination (DH/KR/ BFL2/ DH) in ecru and colour.

Colour was utilised to demonstrate the number of blending combinations and possibilities within each pattern type and structure. Every pattern structure creates a slightly different blend combination, which has the ability to improve the handle of the overall material if suitable and corresponding yarn types are selected.

The colour images presented in Chapter 7.5.2 justify the decision to sample in ecru throughout the practice because they visualise how colour may influence those who perceive it. When colour is introduced, it is challenging to concentrate entirely on the tactility of each sample as the patterns the colours create are very compelling. These vertical stripes could be considered subjective and may not be perceived positively by everyone viewing the fabrics; thus, colour distracts from the perceiver analysing whether the yarn blend is workable and if the pattern structure has improved the fabric's handle.

On the other hand, only when the researcher began to knit some of the pattern structures in colour could she ascertain how successfully each structure combined the yarn types. She had chosen to work with pointelle to hand manipulate the structures further as she believed moving one loop onto another would further blend the yarns. However, the use of colour highlighted that one loop is being transferred onto an adjacent loop, so two of the same yarn type are sitting in the same needle; a different yarn type loops through these fibres to blend the yarn together, so the handle is affected but less than the researcher initially anticipated. By working in colour during the practice's final stages, the researcher could assess the possibilities and limitations of the different combinations before drawing conclusions. Colour revealed it was more successful to change yarns in feeders A and B every two rows than test different combinations of interchanging the yarn in different feeders on every row. It could be argued that these combinations create more innovatively aesthetic fabrics, but they are time-consuming and require concentration. Changing both yarns every two rows is both time and cost-effective while creating a more consistently blended outcome, which is what the project set out to achieve.

7.5.3 Inlay

An area where further testing would be beneficial is to further explore every blend combination possible within the inlay patterned fabrics. This is because there is the possibility to combine three or more yarns at the front with three or more yarn types at the back while varying the number of wales at the front. Many possibilities were experimented with, but every pattern structure and yarn combination is yet to be exhausted. The yarn combinations which were knitted during the practice are documented in colour below.


A


B


C

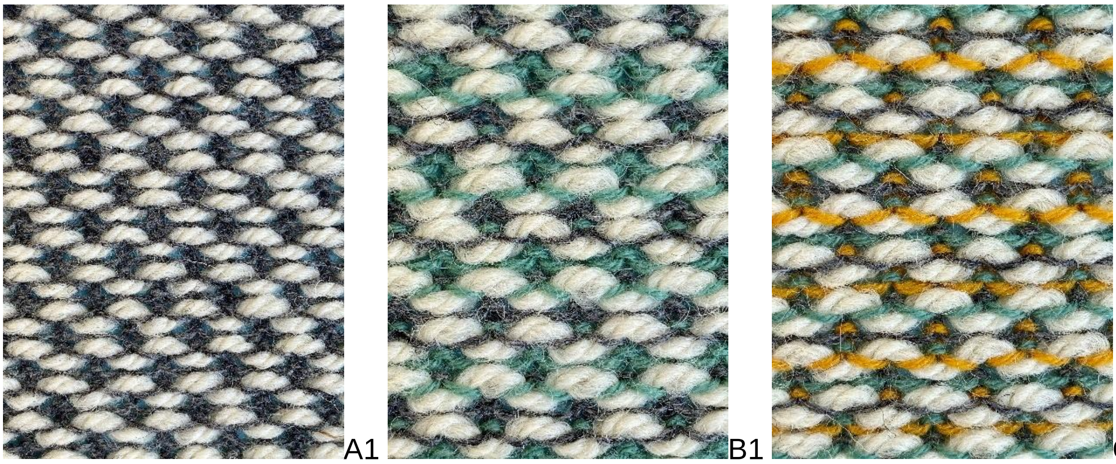


Figure 7:62 1x1 inlay structures with one yarn type inlaid on the reverse of the knit. A/A1) one yarn type knitted and one inlaid on the reverse. B/B1) Two yarn types knitted and one inlaid. C/C1 three yarn types knitted, one inlaid.

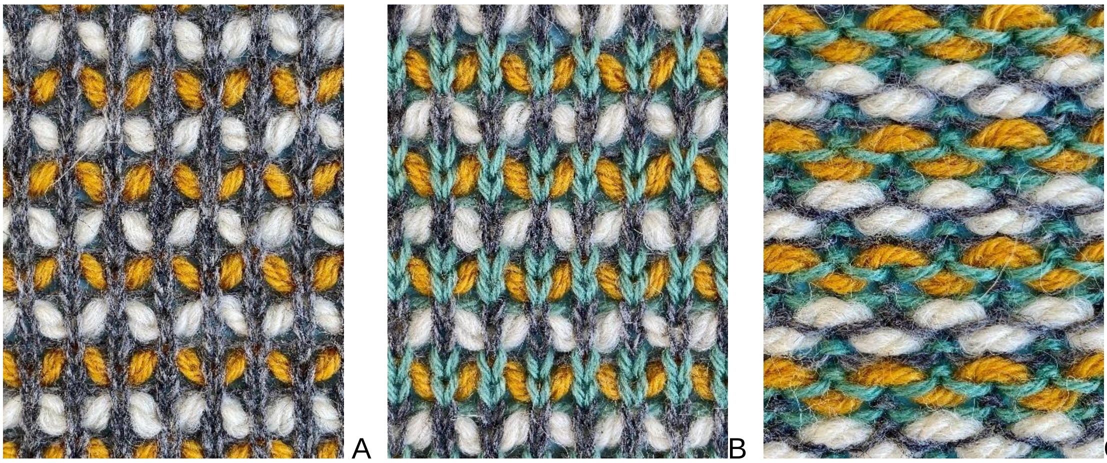


Figure 7:63 1x1 inlay structures with two yarn types inlaid through the back of the fabric. A) one yarn type at the front, B) two yarn types at the front, C) two yarn types on the reverse.

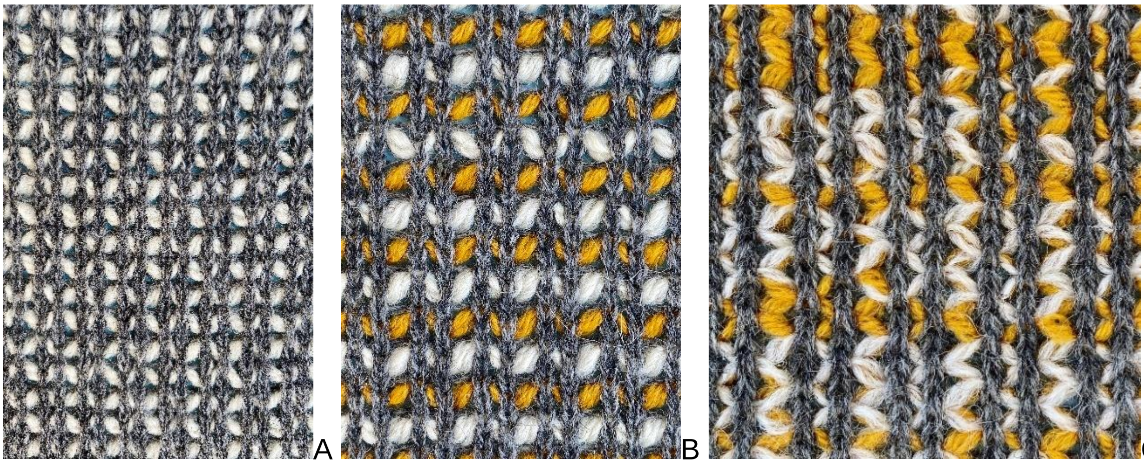
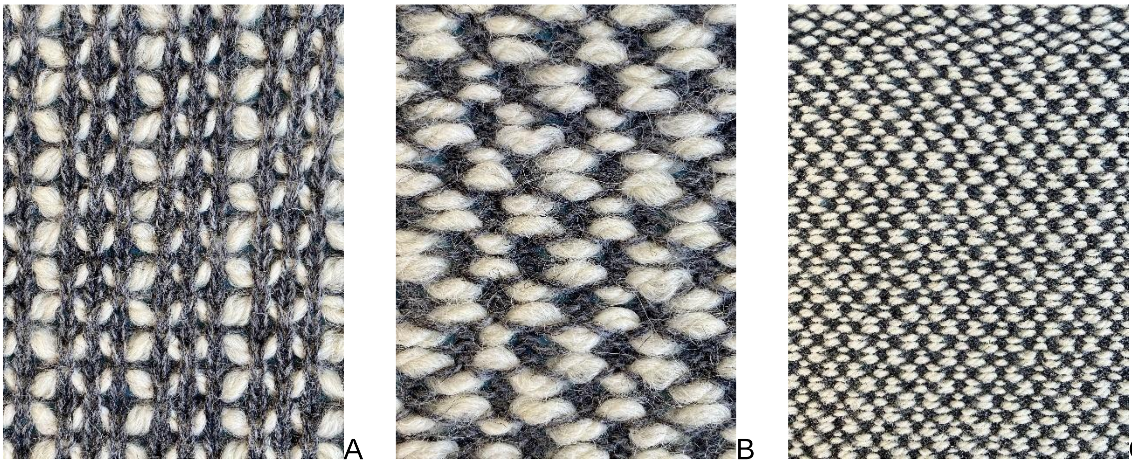


Figure 7:64 Three versions of a 2x1 inlay structure fabric. A) one yarn type inlaid on the reverse of the fabric, B) two yarn types inlaid on the reverse of the fabric on different courses. C) two yarn types inlaid together on every course through the reverse of the fabric.



A B C

Figure 7:65 A 3x1 inlay combination in two yarn types. A) front of the structure. B/C) the reverse of the structure.

The ecru versions of these samples can be found in chapter 5.3.3

8 Conclusions

Figure 8:1 Detail of the reverse of sample 389, a 1x1 stripe structure with vertical inlay.

8.1 Outcomes of the Research

The doctoral study explored how knitted textile methods could promote further use of wool fibres in commercial fashion fabrics. During the practice, a large body of knitted fabrics was created and collated into a knitted swatch library, demonstrating a wealth of information. The library consists of five main pattern types, which can then be broken down into many groups of structures; within these groups, seven yarn types have been experimented with. Several conclusions were drawn through the interpretation of these samples during chapters 5,6 and 7 of the thesis; the key findings are summarised below:

- It is possible to improve the handle of British wool fibres through knitted textile methods, as demonstrated by the creation of a substantial number of soft-handling samples presented in the swatch library.
- Blending through Pattern is an appropriate method for improving fabric handle.
- Yarn combination has the most significant impact on fabric tactility, but fabric structure is also influential in determining the tactility of the fabric.
- Openwork created soft structures, but the yarn combinations significantly influenced the outcomes and the fabrics' perceptions.
- It is challenging to differentiate between yarn's handle and pattern's handle in a single structure, but differences can be seen when comparing a group of fabrics knitted in each pattern type.
- Likewise, it is not easy to accurately interpret the tactility of a fabric without considering its aesthetics. The sense of touch and vision are intertwined in tactility.
- Pattern is subjective and evokes a different emotional response from those perceiving fabrics.
- Consumer preference is based on more than just comfort and durability. Consumers are not deterred from choosing wool fibres by ‘prickliness’ alone.
- Language is an appropriate method of interpreting both the tactile data collected from a piece of textile and a way of interpreting one perception of the fabric.
- Language can evoke an essence of a fabric.
- A success of the project was that every participant who took part in the interviews could envisage themselves wearing at least one of the fabrics next to their skin. Therefore, the practice has created several fabrics that are soft enough for wear in many combinations of underutilised British-wool fibres.

These conclusions go some way to demonstrate how the aims and objectives were met during the study. The conclusions presented during chapters 5, 6 and 7 are further summarised and explained below using the example of the tuck jacquard pattern type.

Pattern, Yarn, and Structure all Impact Fabric's Tactility

Overall, not every yarn combination was explored in every pattern structure. Creativity and exhaustive testing were balanced throughout the project to ensure the project continued to be led by making but had enough rigour to ensure the objective outcomes were reached. The KR and DH are the two yarns which benefitted the most from the blending process and the research demonstrated these yarn types could be utilised for fashion fabrics, provided they are blended with softer wool fibres such as BFL.

Throughout chapters 5, 6 and 7, the research revealed that the yarn combination has the most significant effect on the overall tactility of the fabric, but pattern and structure has the ability to improve every yarn type. Overall, the findings agreed with the literature that the pattern structures which create volume were the softest and that tuck patterns (of both kinds) were softer than stripes (Choi & Ashdown, 2000; Wiskott, et al., 2018). The tuck jacquard patterns generated created the softest fabrics. Five of these fabrics were rated in the top ten samples for softness. None of the tuck jacquard fabrics are considered coarse or acceptable; in fact, all of those rated acceptable to good (of average handle) were in yarn mixes which did not contain BFL, so in the case of tuck Jacquard pattern has noticeably improved the handle of each of the yarn types utilised. The results are recorded in Table 6-3 Phase 3 Tuck Jacquard analysis.

Generally, the tuck jacquard looks aesthetically interesting and is commercial, sample 272, the softest sample, looks very beautiful because it has been manipulated. (See figure 6:15.) The fabric innovation is in the pattern's structure itself; it is a 2x1 rib-look structure creating a series of single-faced fabrics, mimicking the properties of double-faced fabrics; the resulting handle is soft, spongy, and stretchy. The structure is perfect for the yarn types utilised and actually looks much less spongy in wool of a finer yarn count. Thus, using this pattern structure has improved the tactility, quality and the aesthetics of the yarn types chosen to explore during the research project. The success of this knitted structure as a creative, commercial fabric is confirmed as it is the same structure (using the same pattern card) as the 2x1 rib-look float jacquard structure, which also repeatedly created 'soft-handling' innovative fabrics.

When sample 276, another tuck jacquard structure, was shown to the interview participants, there was very little feedback regarding this sample, demonstrating that while these fabrics have met the aims and objectives of the project and created several 'soft handling' fabrics, they did not all evoke an emotive response, either positive or negative. (See Chapter 6.4.2.5.) The research project set out to evaluate the handle of each of the fabrics through tactility alone, but through the research, making, and interview process, it was established that it is challenging to consider tactility without aesthetics because a richer picture is formed if both haptic and visual senses are utilised. It is those samples which evoke a response either through their tactility or their aesthetics which stand out. In the case of the tuck jacquard fabrics, it was the aesthetics, not the fabric's handle, which people were less drawn to. In conclusion, it can be assumed that aesthetics are always considered when viewing structure and that consumer preference is based on more than comfort alone. Thus, as the methodology established, when one views an object, they do so through touch, vision, and movement (Husserl, 1997, p. 298).

When the research project began, the researcher anticipated that open patterns would create softer and more aesthetically appealing samples, while this is the case for sample 272, overall, the research has demonstrated that experimental or very open pattern structures are aesthetically pleasing but pattern and fabric structure ought to be balanced to created fabrics consumers are prepared to wear. This was one reason why the rib-look float jacquard structures have been sampled so extensively; the structures combined many different yarn combinations effectively and aesthetically. They look attractive but are fairly simple and not overly textural. These fabrics are suitable for commercial fashion fabrics; in addition, they mimic the structure of a rib while being produced in a single-faced structure.

Overall, the research aligns with Merleau-Ponty that those participating in the project viewed the fabric utilising multi-sensory experiences when responding to the fabrics. Their view of each fabric was formed through this multi-sensory perception (Roxburgh, 2021, p. 181). Although the colour was eliminated to encourage those viewing the samples to respond to the tactility first, aesthetics were undoubtedly considered. It was only those fabrics which first blended the yarns effectively to create a soft handle and were aesthetically appropriate for fashion fabrics which were deemed genuinely successful.

8.2 Yarn

Throughout the project, five yarns have been used extensively, and two yarns have been utilised to a lesser extent. It has been evaluated that the BFL is the softest yarn and that three of the yarns (the KR, DH and the WFW) with a rougher handle were consistently improved if blended in the correct pattern structure and yarn combination. Every yarn utilised during the project has the potential to be used in fabrics for fashion if combined correctly.

A review of each of yarns the properties is below:

8.2.1 Kent Romney

On its own, the handle of the KR utilised during the project is acceptable. However, this yarn has consistently created beautiful, innovative, soft-handling fabrics across a range of pattern types and structures. This yarn has been tested extensively in every pattern group and across each of the four phases of the practice. Overall, this yarn has benefitted the most from the doctoral research practice, and the handle significantly improved when blended with either the BFL1 or the BFL2; the combination of these two yarn types works well and can be considered a success. Overall, the KR/ DH/ BFL combinations were also relatively successful in generating fabrics with a soft handle. Six of the top ten samples of the entire collection, sequenced by softness, contain at least one end of KR.

This yarn type benefits from being knitted in thicker, textural patterns as it tends to feel limp and flat when knitted on its own in single-faced structures or very light, open structures such as the 1x1 inlay fabric. The researcher determined that many of the rib-look float jacquard patterns have less stretch and elasticity when knitted in this yarn. On the other hand, these patterns have benefitted the yarn, making it more elastic than if it was knitted in a plain structure. The handle and stretch of the KR noticeably improved when blended with another yarn in a hand-manipulated tuck pattern. The price and availability of this yarn, along with how well it has responded to being knitted in so many pattern groups, determine that this yarn would be an excellent choice if blended when creating fabrics for everyday fashion from British broad wools.

8.2.2 White-Faced Woodland

Theoretically, this is the coarsest yarn used during the practice, and it felt that way when knitted up. The yarn was used extensively during phase1 and 2; thus, during the reflection period, many samples knitted in a blend of this yarn type were consistently rated acceptable or acceptable to good, lower than many of the other yarn combinations. Consequently, fabrics containing WFW required further development. Phases 1 and 2 revealed blending KR and WFW together was not a successful combination. Thus, during phases 3 and 4, WFW was combined as one of three or four yarn types in order to try to improve its tactility and its appeal. This method was more effective and generated several softer handling fabrics. Therefore, it can be concluded that this yarn works best as one of three yarn types. A balance of a soft handling yarn such as the BFL or Teeswater and mixed with either the DH or the KR; to offset its roughness. This yarn is less common than the KR, so utilising it in a combination of three or more yarn types is an effective way to use the available yarn without requiring more fibre than may be available.

8.2.2 Dorset Horn

This yarn has potential because of its natural properties; it is not too hairy and not an obviously 'woolly' fibre. It has an 'acrylic-like' quality, which may appeal to those who do not like the appearance of wool. This yarn has a softer handle than the KR or WFW and is notably improved when blended with BFL. Overall, mixing it with KR or WFW did not improve the handle of the DH or produce noticeably softer fabrics; however, when the DH was utilised as one of three yarns, i.e., KR/ DH and BFL in a suitable pattern type and structure, it created many soft fabrics. This yarn was not used in the first phase of sampling; therefore, the yarn was not tested in some of the more experimental fabrics, which were less effective, which will help the yarn's overall softness ratings. Experimentation began once the practitioner had a clearer idea of each pattern's capabilities. The DH is an excellent, versatile yarn; it is not too harsh, it is soft, and widely available, making it suitable for commercial knitwear.

8.2.3 Blue-faced Leicester

This yarn does not require blending with another yarn to improve its handle. It is soft. Particularly the 2/16Nm sock weight version (BFL1), which was utilised when the project began. The 2/8Nm version (BFL2) was sourced later during phase 2 of the practice.

Having worked with this yarn extensively, the researcher concludes this is a yarn that the UK should promote as its version of merino wool rather than trying to breed merino in the UK or importing large amounts of merino from other countries. While the project determined merino wool to be softer than BFL, it is not a locally sourced fibre, and the sheep are often still intensively farmed; thus, BFL offers an alternative: a soft handling yarn, locally sourced and farmed using fewer intensive practices. The researcher acknowledges that since the beginning of this project, the properties of this yarn are better known and, more importantly, better promoted. Several yarn and knitwear producers are already making and creating this yarn, such as Laxton's sheep-soft yarn (Laxtons, 2022), West Yorkshire Spinners (West Yorkshire Spinners, 2022) and Herdwear, who produce ethically-made knitwear in 100% BFL fibres (Herdwear, 2022) and supply some small high-street retailers. This is good news as it means everyday fashion is beginning to consider British wool's prospects. Perhaps if the project started again, the researcher wouldn't choose this yarn because its properties are now recognised and are undoubtedly soft enough to be utilised in fashion fabrics.

However, this yarn has been utilised repeatedly to improve the handle of every other yarn type. Therefore, it is the most utilised yarn throughout the project and has enhanced the handle of every other yarn to a certain extent, depending on the pattern. It is this yarn which the researcher would recommend blending with the coarser yarns. Every sample in the top forty samples, sequenced by softness, contains at least one end of BFL, which in itself communicates the yarn's tactility. Thus, it has been invaluable to the research project as it has enabled the coarser yarns to become soft enough to be considered for fashion. This is also promising news for commercial knitwear, as BFL fibres are more expensive than the coarser fibres of KR/ WFW or DH. Thus the approach of blending these yarns types together through pattern creates a more affordable outcome.

8.2.4 Teeswater

Another yarn to reconsider if beginning the project again is the Teeswater. The yarn is expensive; the fleece price per kg has doubled since the project commenced and is now around £5.00 per kg. The BFL is more costly; however, the BFL has proved its value during the project, whereas the Teeswater has had more mixed results throughout the project. Theoretically, it is the second softest yarn after the BFL, and when these two yarn types are combined, they produce some very lustrous, soft samples. However, many ‘prickly’ fabrics have been created in this yarn type, depending on the yarn type it was blended with and the pattern structure it was knitted in. Figure 7:34 Teeswater word-cloud highlighted the difference between samples produced in this yarn. The most common words used to describe the fibre include hairy, spikey, and prickly, but silky, spongy, and fluffy were utilised to a lesser extent.

It is the hairiest yarn of the project and could be considered more of a specialist yarn rather than an everyday yarn. The interviews confirmed this, as it was this yarn which was not received well by the participants. It could be considered the wrong type of yarn to introduce to a person who has yet to experience wearing wool or has negative preconceptions of the handle of wool fibres, making this yarn less commercially viable.

8.2.5 Southdown

The doctoral research has yet to do this yarn justice, as it was impossible to source it in a suitable bulk count. During Chapter 4, this yarn was considered the most appropriate for the project based on its theoretical properties. Still, the most important consideration was selecting the correct count of yarn for the machine. The yarn performed well when blended with the BFL1, partly because it is the softest yarn and because it is a finer count, offsetting the chunkier count to create some workable fabrics. However, this was very dependent on the pattern type. Overall, the tension selected to knit the yarn is too tight (usually knitted on tension 10, the loosest tension), creating very dense fabrics. Sample 39, which was presented to the interviewees, was an example of this. (See Chapter 6.4.2.2.)

8.2.6 Texel

There needs to be more of this yarn utilised to objectively compare it to a yarn such as the KR, which theoretically has similar properties. Where the yarn has been combined, there is a significantly even spread of sampling between acceptable/ acceptable to good and soft, as Table 7-7 demonstrates. Thus, the yarn has the potential to create soft-handling fabrics if blended with another suitable yarn type. The reason for only developing a small number of samples in this yarn is the same as the Southdown, except the count of this yarn is even thicker, which is why the researcher did not attempt to knit with this yarn, instead combined it through inlaying techniques. As a result, this yarn was always on the reverse of the fabric, next to the skin. Twenty-six samples were created in a blend of this fibre none were rated as soft next to the skin, sixteen were considered acceptable next to the skin, and ten were deemed uncomfortable; thus, this fibre would further benefit from being blended with another softer wool when inlaid on the reverse of the fabric.

8.3 How the Aims of the Research Have Been Met?

The project's aims have been met by creating a wide and diverse body of sampling demonstrating the potential of wool fibres for commercial fashion fabrics.

- To inform knitwear designers of the most desirable wool blends and pattern combinations from the yarns selected for the project.

A comprehensive swatch library was created using creative knitted textiles methods which combined craft and design work. The collection demonstrates that blending through pattern is an appropriate method of improving fabric tactility through the analysis of the sample collection documented throughout the thesis. The sample matrix was developed to collate, sort, and order the tactile data to be easily interpreted. In this way, the most desirable fabrics were determined rationally, although subjective methods of data collection were used to gather this data: ‘the sense of hand’ and interpretation through meaningful language. Table 7-8 records that the most desirable yarn blends are BFL/ Teeswater, KR/DH/BFL1 and BFL2/ KR. This knowledge is available for other knitwear design professionals to utilise within their practice. The data recorded within the sample matrix also revealed the most effective patterns for combining yarn types cohesively in order to create soft-handling fabrics. These patterns have been discussed throughout the results in chapters 5, 6 and 7 and in chapter 8.1.

- To enable textile design practitioners to make informed decisions regarding their yarn choices before designing and developing appropriate feeling sustainable garments.

The swatch library exhibits both soft and not-so-soft British wool combinations because many yarn combinations and pattern types were tested. Thus, the knitwear designer is informed of many different British wool combinations and can choose which fabric they believe is most appropriate. Through sorting the tactile data into different categories, the appropriateness of each yarn type and pattern structure is revealed. Interpretation and visualisation methods were chosen to be appropriate for knitwear design professionals to inform and support their practice. The entire sample matrix can be viewed in Appendix 6.

- To develop a method of combining yarns effectively so that fibre types can be further utilised for commercial fashion.

Through extensive testing, combining different British wool fibre types together, it became apparent that blending through pattern is an effective, appropriate, and new method of combining fibre types, which has the possibility to be expanded to different fibre types. Chapter 8.4.1 explains how this method of knitting has contributed to knowledge and offers designers a new, flexible way to work and blend fibres only sometimes associated with commercial garments.

- To explore the language utilised to describe wool and softness.

Language has been explored throughout the thesis, firstly through collating the sensory descriptors in chapter 2.3, then through the philosophical, methodological approach in chapter 3.3 and again during the interviews and throughout the analysis and interpretation by the research of each sample. The sensory descriptors were used as one method to interpret the handle of each sample; this interpretation was recorded within the sample matrix (See Appendix 6) to enable an overall sensation of each pattern group and fabric type. The outcomes of the doctoral study reveal that the language researched, collated, and used during the project is appropriate, accessible, and understandable. The language visualised the emotional response to the sampling created; this was visualised through the word clouds.

8.4 Contribution to Knowledge

The research project envisions the possibilities of British wool. The methods undertaken have created new knowledge in the form of a knitted swatch library. The swatch library has been made to visualise and communicate a body of tactile knowledge.

8.4.1 Using Blending through Pattern as a Method for Improving a Fibre's Tactility

Chapter 7.5 visualises and analyses the effectiveness of a selection of different blending approaches undertaken throughout the practice in order to combine yarn types together in various patterns and structures. The approach is referred to as 'blending through pattern'. The research practice discovered that this method of combining multiple yarn types within a single knitted pattern structure was an effective and new way of thinking about how pattern has the ability to improve the tactility of fibres not always deemed appropriate for commercial fashion. Currently, this method of combining or 'blending' fibre types utilised is not used commercially but has the potential to offer a new and flexible approach to blending in the future as it allows for fibres to be combined at the making stage of fabric rather than the fibre processing stage, therefore adding further flexibility in the making process and allowing a greater number of people to undertake the process. Theoretically, this approach allows for coarse fibres or variations of the same yarn types with varying colour or handle to be combined and used. Although this study focuses on breed-specific wool fibres, it is anticipated that some methods of combining yarn types through pattern can be replicated in other fibre types or blend combinations in order to improve the handle of many different materials when combined.

The research practice revealed that the 2x1 rib-look float jacquard, in particular, produced many soft and aesthetically pleasing innovative materials; the same structure, when used in a different pattern type (the 2x1rib-look tuck jacquard), created the softest samples within the collection. Both of these patterns are considered commercial and can be replicated on a larger scale or with computerised machinery.

While this approach of blending through pattern to some extent challenges current blending methods and how commercial industry currently combines fibre types, it offers an alternative to be explored further in the future in order to make further use of underutilised materials, overlooked because of their tactility or in some cases because of the variations within the yarn. For commercial fashion to utilise this approach, industry would need to be open to using many types of yarn or breeds with variations between handles. (See chapter 8.5.1)

8.4.2 A Guide for Knitwear Practitioners

The swatch library has been created as a guide to enable knitwear designers and practitioners to better understand British sheep's wool as an affordable, sustainable yarn that can be used as a fibre for fashion fabrics. It is anticipated that the use of breed-specific wools within the collection will further facilitate a designer's understanding of the possibilities of working with local materials in their design practice and why and when they are appropriate. The most desirable blends are articulated throughout the thesis and summarised in Table 7.8. Thus, the thesis articulates the knowledge visualised within the swatch library. The swatch library, although very broad, can be edited by the researcher in order to visualise this information shown in the thesis or to the needs of the practitioners viewing the collection. Thus, the collection is most useful when used in conjunction with someone who is able to explain the potential each of the swatches offer and how they are improving the individual yarn types. (I.e., the researcher.)

The practice also explored how to interpret the handle of the fabrics' created, so the fabric's tactility could be understood by those perceiving them in person and those who may only see imagery or descriptions of the samples. The thesis interpreted this tactility through the use of language. To do this, consumer perceptions of wool handle were considered through literature, philosophy, the sense of touch and language, and a series of individual interviews. The outcomes were a word bubble of sensory descriptors, which informed the research and the interview participants of the language appropriate to describe wool handle when engaging with a knitted artefact. This knowledge has been articulated throughout the thesis to inform and explain the materials created. It was discovered through analysing the language in Chapter 7.4 and examining the word clouds created that the language utilised throughout the thesis managed to evoke a sense of individual samples, the yarn types and the pattern structures experimented with throughout the practice.

8.5 Limitations of the Study

8.5.1 Sourcing Suitable Yarns in the Correct Count:

The research aimed to experiment with underutilised British wool yarn combinations. One problem was the ability to source the yarns in the correct count and on a cone. Some yarns originally selected were replaced because the yarn was unavailable in the market. Enquiries were made regarding sourcing the Southdown in the correct count, but the MOQs[14] were far too big for a small research project like this. Likewise, although some craft retailers sell balls/skeins of some of the yarns in finer counts, the quantities were too small, and it would have been very costly to purchase the number of balls required to conduct the research effectively.

Two consignments of yarn were purchased over the project, both from the same supplier. It was observed in two of the yarn types that although the batches of yarns were the same in terms of count and type and sourced from the same spinner, the yarns were not the same. The researcher discovered that the Teeswater and the KR looked and handled differently. This can be seen during the project and is visualised in figure 8.2. The ecru shade of these yarns is slightly different; the first batch is darker.

Wool cannot be completely identical as fleece varies from sheep to sheep and season to season. The second batch of Teeswater felt hairier and somewhat thicker than the first cone utilised. This may have impacted some of the findings, but it is helpful to see the variations, as they will occur if these yarn types were to be used in commercial fabric production. However, blending through pattern still offers a way to utilise variations in yarn type if commercial companies are preferred to shift their thinking and acknowledge that not every fabric needs to be identical, perfect, or uniform and variations in fabric texture, colour, and handle should be considered ways to make a commercial garment unique.

[14] MOQs refers to minimum order quantity. A supplier will usually state the minimum order quantity to make production viable. In the case of the company, which produced the yarn used during this project the MOQ was 10kg per yarn type.

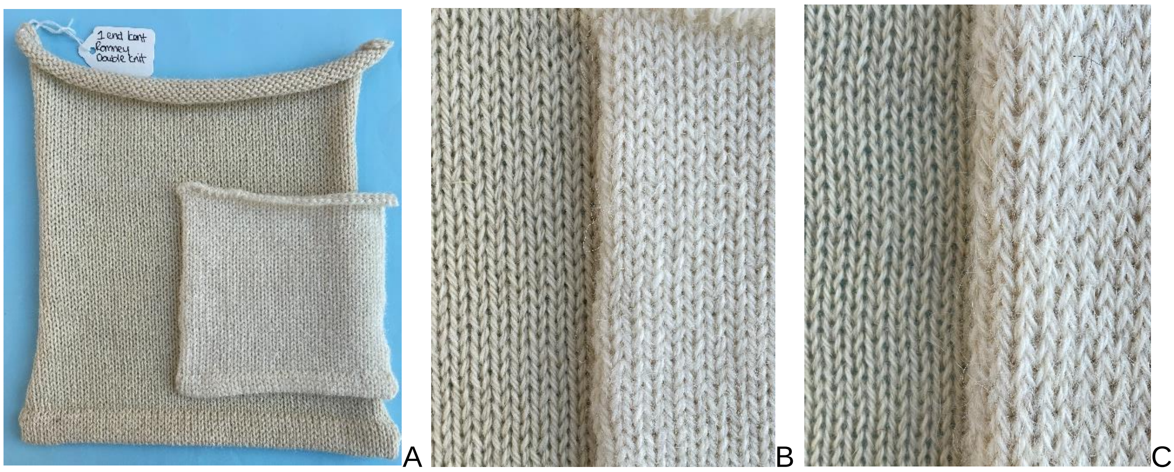


Figure 8:2 Images A &B) demonstrating the difference in two Kent Romney yarns. Image C) is a close-up of the differences between the two Teeswater yarns. The colour variation and the amount of hair is very prevalent.

8.5.2 Time and Resources

This was the most significant limitation, as there needed to be more time and resources to sample every yarn combination in every pattern type. Before the practice, decisions regarding which pattern types to utilise were made to ensure that time was used effectively, as it would not have been possible to sample every type of weft-knitted pattern. For example, there are 28 combinations of two yarns; thus, if every yarn combination was knitted for every pattern variation, a minimum of 28 samples would be required per structure and across every pattern type. With more time, further pattern structures would have been explored.

8.5.3 The Front and Reverse of the Fabric.

Throughout the study, the face of the fabric has been considered the front of the fabric, and the back of the fabric has been considered the reverse of the fabric this is for consistency when assessing the tactility of each sample. It also shaped the pattern types selected for the project, as pattern types were chosen with the intention that less of the hairy/ coarse yarn types would sit next-to-skin, i.e., tuck patterns naturally form concave/ convex bubbles, allow little pockets of air on the reverse of the material, or inlay fabrics which allow for different and possibly softer yarns to be inlaid on the reverse of the fabric. One limitation of this method of stating which side of the fabric is the front is that designers selecting the fabrics may prefer the reverse of the fabric as the face when they are designing a garment. Therefore, further work may be required in order to edit the sample collection before it is presented to designers in order to present the softness of each side of the fabric rather than its overall tactility. This would share further knowledge of the softness of each side of the fabric and enable designers to make their fabric selections accordingly.

8.5.4 Remote Working

At the beginning of the research project, this was not a factor. However, many changes that have impacted the course of the doctoral study were influenced by factors outside the researcher's control. Working from home throughout 2020 and 2021 due to the pandemic meant the researcher had no access to industrial machinery, restricting some of her choices of patterns chosen to experiment with during the project. (2020/2021 were the years when most of the practice occurred). For example, rib structures would have been sampled so that they could have been compared with the single-faced float jacquard and tuck-jacquard structures. Meeting in groups and exhibiting work was also restricted, thus, the participant engagement within the study was changed to accommodate this.

8.6 Opportunities for Further Research

The doctoral research presents several ideas which have been explored thoroughly. However, the study only focuses on a small number of yarn types and pattern structures, so the opportunity for further research is vast and varied.

A good starting place for further research would be to develop a number of the more effective ideas and yarn combinations onto industrialised machinery in double-bed techniques. It would also be exciting to experiment with different gauges of machinery and different yarn counts to determine whether the results are the same. As the research established, the correct gauge of machinery for the count of yarn experimented with is a significant factor.

Another next step would be to develop more effective fabrics into garments and conduct wearer trials to discover whether a wider audience would consider wearing these fabrics as garments and whether the textiles are comfortable next to the skin. Experimenting with different garment types would determine which fabrics are most suitable for which garment. Depending on the outcomes of the wearer trials, another step could be investigating the same yarn types but dyed yarn rather than ecru to discover how different dyes affect the yarn's tactility and softness. Again, any swatches deemed soft would need to be knitted into garments and experimented with during some wearer trials. If using dyed yarns, further research is required to establish the sustainable impacts of each dye type.

Pattern development could have carried on indefinitely; it was down to the practitioner to determine when it was time to stop and reflect on the practice. Thus, there is potential for further experimentation in different pattern types and combinations, even on the same gauge and machine. The research determined that more exhaustive investigation could occur with the inlay patterns.

Another way to utilise the knowledge gained from the doctoral research would be to experiment in the same pattern types but in different underutilised sustainable fibres, such as linen, hemp or even different recycled combinations. An exciting contribution to the future of sustainable materials could be to develop and exhibit a pattern library for every sustainable yarn type, which designers, academics, and practitioners could use as a design resource for the future. Suppose the research was undertaken on the same machinery. In that case, it could be possible to experiment with different yarn types and even synthetic fibres, as it is easy to disassemble and rework fabrics in this gauge.

On the other hand, the project could be taken in a different direction by looking more closely at each of the yarns utilised during the doctoral research and investigating the potential for the expansion of each yarns market. For example, are the yarns based close to spinners and producers? Is there enough of each yarn to be used for commercial fashion fabrics? For example, the researcher was keen to work with the Southdown fibre as its attributes were very suited to the project. However, when it came to sourcing the yarns, they could not find fibre in a suitable count.

A slightly different line of enquiry would be to undertake a similar project knitting each local wool in local patterns to promote each local breed, then combining and manipulating the patterns with each breed; this could be undertaken as a design project to start with, to scope ideas.

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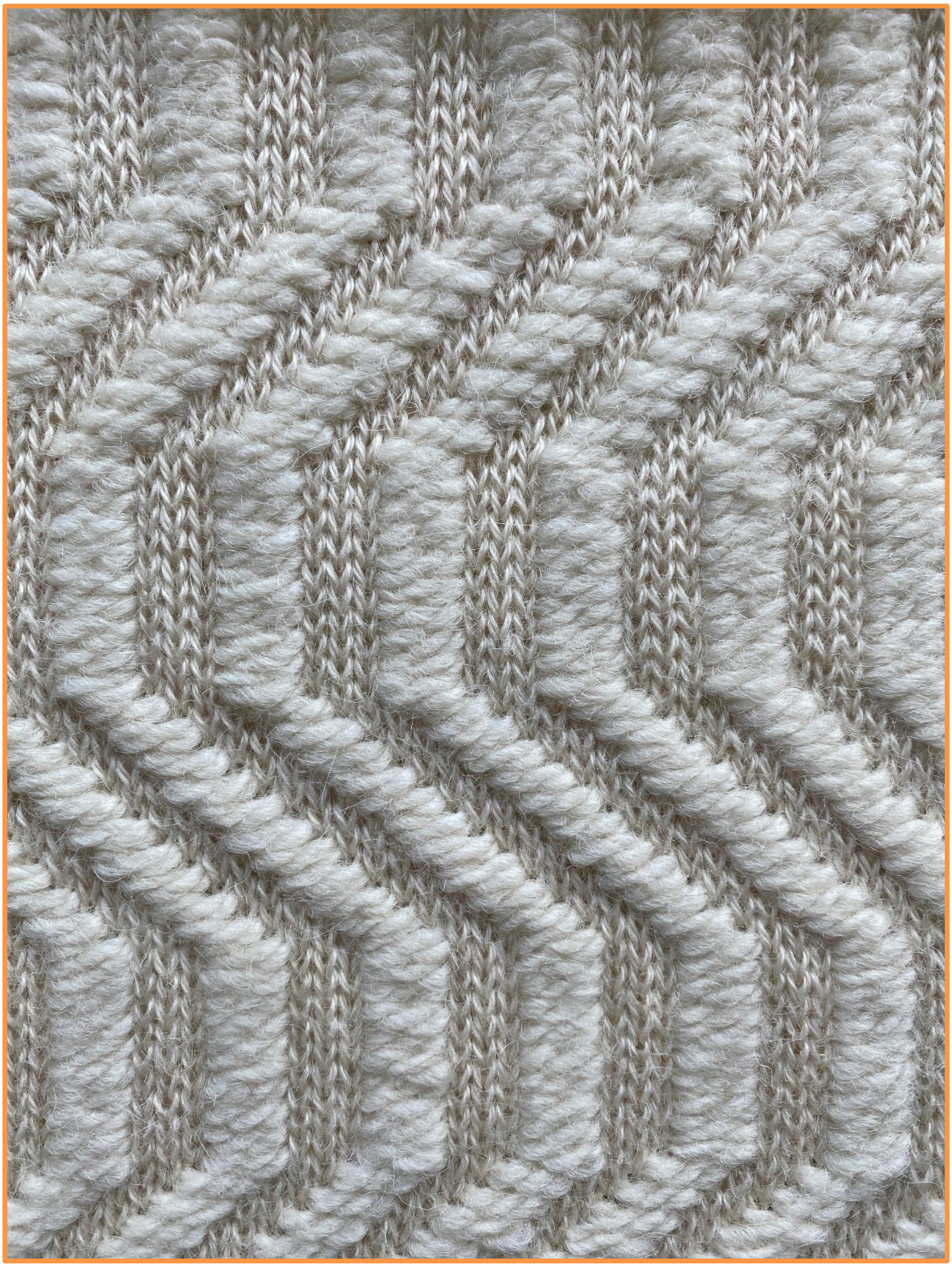

Figure 8:3 Figure Detail of sample 24 in/out inlay weave

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Figure Details of sample 123 Horizontal dot zigzag

8.7 Sheep breeds table

The table was compiled to show the diversity of British sheep breeds and all of each sheep's valuable information. The table is split across four pages. Data was sourced from (British Wool, 2010)

Grade of Wool / Fibre Type	Sheep	Usual Fleece usage	Fleece handle *	Fleece Colour	Staple Length	Micron Range	Bred for meat	Further information
Fine	Berrichon du Cher	Japaense Futons and blended for apparel	Very Soft	Creamy/ White	4-6cm	29-30.5	Yes - lamb	specialist flocks throughout UK
	British Rouge	Wool blends for Apparel	Soft	White/ Creamy	4-7cm	30 -32	Yes/ Cheese	specialist flocks throughout UK
	Charollais	Japaense Futons and blended for apparel	Very Soft	Creamy/ White	4-6cm	29 - 30.5	Yes - lamb	Throughout the UK
	Clun Forest	Japaense Futons	Very Soft	White/ Creamy	5-8cm	29.5 -31.5	?	Welsh borders
	Dorset Down	Knitting yarns and Bedding	Soft	White	5-8cm	30 -32	Yes - lamb	Mainly in SW ** Short fibre wool is dense, white and springy and c
	Dorset Horn/ Poll Dorset	Bedding and knitting yarns	Crisp/ Soft	White	8-10cm	33-34	Yes - lamb	Mainly in SW England ** High quality dense wool
	Hampshire Down	Hand kniting yarns, cloth blends, futons	Soft	White	5-8cm	31-33		specialist flocks throughout UK
	Ile de France	Wool blends for Apparel	Soft	White/ Creamy	5-10cm	30 -32	Yes - Primariliy meat	small numbers throughout UK
	Norfolk Horn	knitting yarns, bedding and hand spinning	Soft/ Medium	White/ Creamy	7-10cm	32-34	?	Rare - around E.Anglia
	Oxford Down	Japaense Futons and blended for apparel	Soft/ Medium	White/ Creamy	6-10cm	31.5 - 33.5	Breeding	Throughout the UK - particularly the midlands
	Portland	Hand spinnig or blended for apparel	Soft/ Medium	White/ Creamy	5-9cm	31-35	Yes	** Rare breed SW Eng
	Ryeland	Blends with other White wool for Knitwear and Woven cloth	Soft	White	5-8cm	30 -32	Yes - orgninally bred for wool	Throughout the UK
	Shropshire	Blended with overseas wool for Woven cloth and Knitwear	Soft	White/ Creamy	6-10cm	31-33	?	West Midlands
	Southdown	Blended with other fine wool for clothing	Very Soft	Creamy/ White	4-6cm	29-30.5	?	S.E England and specialist flocks throughout the UK
	Suffolk	Blends for Knitwear and Cloth and Japanese Futons	Soft	White/ Creamy	5-10cm	31-34	Yes - prime cutes	Throughout the UK
	Vendeen	Blends for Knitwear and Cloth	Soft	White	4-7cm	30-32	Yes - prime cutes	small numbers throughout UK

Medium	Beltex	Knitwear and Woven cloth prodominently carpets	Soft/ Medium	White/ Creamy	5-12cm	31-34	Yes	Throughout UK
	Bleu du Maine	In blends for clothing	Medium/ Soft	White/ Creamy	7-13cm	32-34.5	?	small numbers throughout UK
	Border Milksheep	Blended into kniting yarns which require natrual elasticity	Medium/ Soft	White	10-15cm	32.5-35	Yes	Throughout UK - popular in Northern Eng, Scottish borders and lowlar
	British Milksheep	in Knitting Yarn blends	Medium/ Soft	White/ Creamy	8-14cm	32 - 34.5	Yes -lambs	** Prolifi specialist flocks thoughout UK
	Cambridge	Blended for apparel and Hand knitting yarns	Soft/ Medium	White/ Creamy	6-12cm	32-33.5cm	Yes	Welsh borders
	Devon Closewool	Carpet blends	Crisp/ Soft	White	10 -15cm	34-35	?	SW England
	Friesland	knitwear & cloth blends	Medium/ Soft	White/ Creamy	10 -15cm	33-34.5	Dairy ewes	specialist flocks throughout the UK
	Halfbred -Scotch	Carpets, knitwear, tweed cloths	Medium	White/ Creamy	8-15cm	32.5 - 35	?	Throughout the UK
	Halfbred -Welsh	Carpet blends	Medium	White/ Creamy	8-14cm	32.5 - 35	Yes - lambs	Throughout the Uk - esp Wales
	Llanwennog	Blends for hand-knitting, knitwear and Tweed cloth	Soft/ Medium	Creamy/ White	6-10cm	31.5-34	Yes	Mid Wales
	Lleyn	Carpet blends	Soft/ Crisp	White	6-12cm	31-34	Yes	Throughout the UK
	Romney (Kent Romney)	Knitwear, blankets, Carpets	Soft/ Sheen	White/ Creamy	10-17cm	31.5-34	Yes	SE England
	Texel	Knitwear and Woven cloth prodominently carpets	Soft/ Medium	Creamy/ White	7-14cm	31 - 34.5	Yes	Throughout the UK
Cross	Masham	Blended with other lustrous wools for specialist yarns. Carpets	Soft/ Demi -Lustre	White/ Creamy	12 - 25cm	33.5-35	?	Hills of Northern England
	Mule - North of England	Carpets	Medium/ soft	White/ Creamy	10 -20cm	30-32.5	Yes & Dairy	Throughout the UK
	Mule - Scotch	Carpets	Medium	White/ Creamy	10-22cm	30.5 -33	Yes	Throughout the UK
	Mule - Welsh	Carpets	Soft/ Medium	White/ Creamy	10-18cm	29-32	Yes - Prime lambs	Throughout the UK
	Scottish Greyface	Carpets	Medium	White/ Creamy	12-24cm	31-33	Yes - Prime lambs	Scotland/ Northern England
Lustre	**Blue-faced Leicester**	Knitwear, hand-knitting & fine woven cloths	Lustrous & Silky	Creamy/ White	8-15cm	26-26.5	Yes	North East England now all over UK
	Cotswold	Carpet blends, Soft furnishings, Craft kniting	Smooth & Lustrous	Creamy/ White	15-25cm	35-38	?	Rare - Cotswolds
	Devon & Cornwall longw	Carpets	Medium/ Demi- Lu	Creamy/ White	20-25cm	40-42	?	South West
	Greyface Dartmoor	Carpets	Medium/ Demi- Lu	Creamy/ White	15-20cm	40-42	?	Rare - SW
	Leicester Longwool	Hand Spinners	Smooth & Lustrous	Creamy/ White	20-25cm	35-38	?	Rare - E Midlands
	Lincoln Longwool	Carpets	Lustrous	Creamy/ White	15-30cm	35-38	?	Rare - East UK
	Teeswater	blended for knitting wools	Silky and Lustrous	White/ Creamy	15-30cm	32.5-34	?	North East
	Wensleydale	Hand knitting and Upholstery yarns	Silky and Lustrous	White/ Creamy	15-30cm	32.5-34	?	Throughout UK
	Whiteface Dartmoor	Carpets	medium/ lustre	Creamy/ White	15-20cm	38-42	?	Rare - SE
Hill	Beulah Speckled Face	cloth, knitting yarns, carpets	Soft/ Medium	White/ Creamy	8-14cm	32-33	lambs and Milk	Mid Wales

Hill	Beulah Speckled Face	cloth, knitting yarns, carpets	Soft/ Medium	White/ Creamy	8-14cm	32-33	lambs and Milk	Mid Wales
	Brecknock Hill Cheviot	Carpets, tweed cloth, knitting wool	Soft	White	8-12cm	30.5-33		Mid Wales
	Cheviot	Carpets, tweed cloth, knitwear, blankets	Soft	White	8-12cm	30.5-33	Yes	Cheviots, Southern scotland, northern England, S.Wales. Crsip white lustrous wool
	Derbyshire Gritstone	Carpets	Soft/ Medium	White	8-10cm	31-33	Yes	Peak district/ Pennines
	Exmoor Horn	Cloth and carpets	Medium/ crisp	White	8-12cm	33+	Yes	South West
	Hill Radnor	Tradtional welsh woollens and carpets	Soft/ Medium	White/ Creamy	8-14cm	31.5-33	?	Mid Wales
	Kerry Hill	Upholstery and furnishing fabrics	Medium/ Soft	White/ Creamy	6-12cm	31.5-33	Yes	Welsh borders/ Central England
	Lonk	Carpets	Medium/ Soft	White	10-15cm	32-33	Yes	The Pennines
	North Country Cheviot	Knitwear, Tweed cloths, carpets, blankets	Very Soft	White	6-12cm	30-33	Yes	the Cheviots - crisp lustrous wool, very versitile
	Shetland	Fair-isle knitwear, clothing	Very soft & Silky	White	5-10cm	30-31	Yes	Shetland Islands
	Welsh Hill Speckled Fac	Carpets	Soft/ Medium	White/ Creamy	7-12cm	32-33	Yes	North and Mid Wales
	White-Faced Woodland	Carpets	Medium/ Soft	White	10-15cm	32-33	Yes	Not many - Pennines and Peak district
Mountain	Blackface	Carpets	Medium/ Harsh	White	15-30cm	35+	Yes	Scottish highlands, NE, Thoroughout UK
	Dalesbred	Carpets	Medium/ Harsh	White	13-20cm	35+	Yes	Pennines, Lancashire, Yorkshire
	Rough Fell	Carpets	Harsh/ Medium	White	15-30cm	35+	Yes	Cumbria, Northern Pennines
	South Wales Mountain	Carpets	Harsh/ Medium	White	5-10cm	35+	Yes	South Wales
	Swaledale	Carpets	Medium/ Harsh	White	10-20cm	35+	Yes	Northern England
	Welsh Mountain	Carpets	Medium/ Harsh	White	5-15cm	35+	Yes	Welsh hills
Naturally Coloured	Badger-faced Welsh Mo	Carpets	Medium/ Harsh	cream or black	7-10cm	33-35	?	Specialist flocks mid Wales
	Balwen	Craft use	soft/ Harsh	black/ dark grey	5-10cm	33+	?	Mid Wales
	Black Welsh Mountain	speciality wool	soft	Black	6-10cm	32-35	Yes	Mid Wales
	Boreray	Craft use	soft/ Harsh	Grey/ Black	6-12cm	35+	Yes	Isle of Boreray
	Castlemilk Moorit	Craft use	Very soft/ silky	Brown	6-12cm	30-31.5	?	SW Scotland
	Hebridean	craft use/ hand spinning	soft/ Harsh	Black	5-15cm	35+	?	Throughout Uk - used in conservation schemes
	Herdwick	Carpets/ rugs, sometimes knit and cloth	Harsh	Black/ Grey	10-20cm	35+	?	Lake District
	Jacob	carpets, clothing, hand spinning	soft/ Medium	Black and White	8-15cm	32-34	?	Throughout the UK.
	Manx Loaghtan	Hand Spinners	Very soft and silky	Brown	6-12cm	30-31.5	?	Isle of Man
	North Ronaldsay	Hand Spinners	soft/ Harsh	Grey/ Black	4-8cm	32-35	?	Isle of Ronaldsay - Rare breed
	Shetland Coloured							
	Soay							
	Zwartbles							

8.8 Swatch Information Sheets

Examples of the swatch information sheets were created to record information regarding the sample. Each sample has its own information sheet for reference. Four examples are below:

Multi 1x1 striped sample

Swatch number: 1

Yarn 1: Teeswater (1st cone)

Yarn 2: White-faced Woodland (1st cone)

Yarn 3: Blue-Faced Leicester (sock)

Gauge: Standard domestic

Tension: 8

Number of ends of yarn: 3, 1 of each

Number of stitches in swatch: 60

Number of rows in swatch: 81

Hem finish: All needle 6x6 cast on.

Pattern: 1x1x1 one row in each yarn, change and repeat

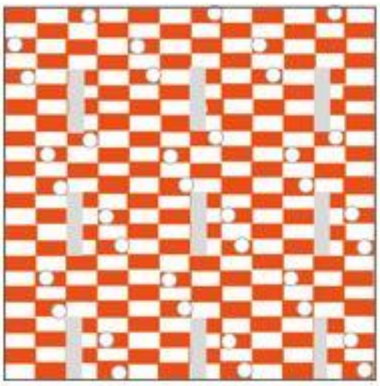
Reflections on sample v1: *(07.08.2020)*

(E.g. was the swatch easy to knit? What is the hand feel like? Is the stitch and overall swatch as imagined? Any other comments…)

- None of the stripe samples were very successful as the yarns have not really been blended. Of all of the versions, the 1x1 stripe has worked best, as changing the yarn every row allowed the softer handled yarns to combine with the coarser yarns more successfully
- Handle: This sample feels good as two softer yarns have been blended with one coarser yarn. This sample has probably worked the best of all the stripe samples knitted to date.
- Stitch: Plain knitting – nothing to comment on the sample itself. Further sampling in different blends and manipulation required to see if handle can be improved further.
- Overall swatch: Good. A plain stripe has potential.
- Would I knit this again? **Yes.**

Where to go next…

- Redesign/ Rework sample
- **Rework stitch pattern - innovation**
- Rework in a different yarn blend
- **Knit the same swatch again in a different yarn blend**
- **Keep sample for group reflection/ swatch Library**
- Could this swatch be knitted into a garment? **Yes/No** - **Possibly**



<u>**2x1 rib look jacquard with ladder & pointelle**</u>

Swatch number: 158

Yarn 1: Blue-faced Leicester (3ply)

Yarn 2: Teeswater

Gauge: Standard domestic

Tension: 9

Number of ends of yarn: 2, 1 of each type above

Number of stitches in swatch: 66

Number of rows in swatch: 79

Hem finish: All needle 6x6 cast on.

Pattern: The simple 2x1 jacquard pattern has been manipulated to create more interest, further blend the yarns, and create more texture. Pointelle knitted every other row on alternating in needles of the jacquard. Knit 2, transfer 1 eight times. After 8 rows knit one row, so the needles change in to out then repeat transfer before knit 2 and transfer 1. This version has an additional ladder in and out of the knit every four rows, as shown above.

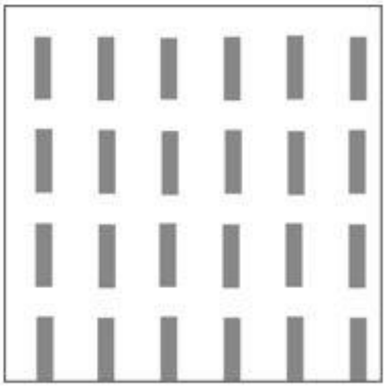
Reflections on sample v1: *(15.09.2020)*

(E.g. was the swatch easy to knit? What is the hand feel like? Is the stitch and overall swatch as imagined? Any other comments…)

- This plain jacquard is quick to knit. However, this version is much slower as there is a lot of manual needle transfer across a lot of different needles throughout the sample. The overall effect is very successful though, creating a well-blended up open sample with plenty of movement and drape.
- Handle: This sample is very good/ soft. It is the softest sample in this group The sample is very soft to touch and soft next to skin. It has created a an open, well blended sample with some texture. This sample demonstrates that more manipulation may be effective. The sample is smooth and has some drape.
- Stitch: The stitch is complicated but has been successful in blending the yarns evenly, throughout the sample, front and back. See above for stitch pattern.
- Overall swatch: very soft. This version is a version developed for the plain 2x1 knit in the same yarn. I now need to knit this version in different yarn blends and try different manipulated versions in this yarn.
- Would I knit this again? **Yes and re-work and manipulation.**

Where to go next…

- **Redesign/ Rework sample**
- **Rework stitch pattern – manipulation/ experimentation.**
- **Rework in a different yarn blend**



4x4x2 tuck stitch knit

Swatch number: 39

Yarn 1: White-faced Woodland

Yarn 2: Southdown

Gauge: Standard domestic

Tension: WFW tension 8.1, Southdown tension 10

Number of ends of yarn: 2, 1 of each type above

Number of stitches in swatch: 60

Number of rows in swatch: 103

Hem finish: All needle 6x6 cast on.

Pattern: Needle set up as below: (star = knit, v = tuck)

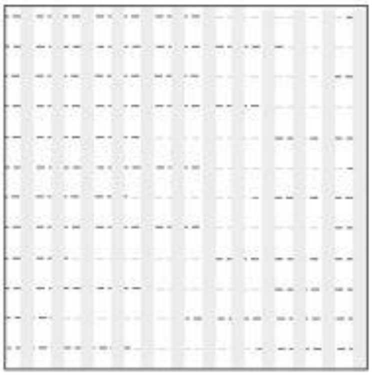
```
      v       v       v       v       (Tuck where V is)
* * * * * * * * * * * * * * * *       (keep repeating)
```

Knit four rows tuck stitch in WFW and two rows plain (no tuck) in Southdown all the way up the sample.

Reflections on sample v1: *(05.08.2020)*

(E.g. was the swatch easy to knit? What is the hand feel like? Is the stitch and overall swatch as imagined? Any other comments…)

- This sample was difficult to knit. However, all of the hand manipulated tuck stitches are slow to knit. In hindsight the WFW should have been knitted on a looser tension (around tension 9) and this probably would have improved the sample a lot. The knit is textural and uniform.
- Handle: The sample feels quite dense; there is a little movement but not much. It does not really look or feel like a fabric for fashion. The overall handle is still quite rough. Neither of the yarns seem to have improved massively through blending and washing.
- Stitch: The stitch on this sample has worked well, from an aesthetic perspective but not from a blending perspective, the tactility of the sample needs improving. The stitch needs to be opened up further to make the fabric lighter and add more stretch to the fabric.
- Overall swatch: Acceptable
- Would I knit this again? **No.**



1X1 Inlay sample

Swatch number: 58

Yarn 1: Kent Romney

Yarn 2: Texel

Gauge: Standard domestic

Tension: 9

Number of ends of yarn: 2, 1 of each. Texel woven in from floor on every other row.

Number of stitches in swatch: 60

Number of rows in swatch: 71

Hem finish: All needle 6x6 cast on.

Pattern: 1x1= one needle in one needle out, creating an open laddered effect all the way up the sample. The inlay is woven under and over the needles before knitting the row. This sample = woven on every other row (even).

Reflections on sample v1: *(19.08.2020)*

(E.g. was the swatch easy to knit? What is the hand feel like? Is the stitch and overall swatch as imagined? Any other comments…)

- The inlay samples are relatively quick to knit, they allow for a 2nd yarn to be introduced and blended into the fabric. The inlaying opens up the knit, so that some of thicker yarns can be knitted without the samples becoming too dense or heavy. (Making the fabrics more commercial).The knit feels chunkier than some of the other inlay samples but the swatch is still fairly open. The inlaying has created an interesting pattern, which shows through to the front of the swatch.
- Handle: The handle is acceptable. The handle of the 1x1 samples are better than the 2x1 samples, which may demonstrate that open knits are more successful. The sample feels bouncy and open with some softness, the Texel improves the handle. This knit still has some movement, even with the weave through the back.
- Stitch: Very simple knit stitch. It is the inlaying, which is providing the blending and innovation. The inlaying almost creates a jacquard look – an easy way to bring pattern to the fabric. The patterning is more successful on the more open (1x1 inlay knits). This stitch can be further manipulated for more interest.
- Overall swatch: Acceptable. Possibly further innovation required to make the sample more exciting.
- Would I knit this again? **Yes**

Where to go next…

8.9 Sensory narratives, supporting document.

The journal articles and the words collated to create the word bubble used throughout the thesis, which references wool language. This language supports the findings of Chapter 2.3.5

The words and phrases to describe wool handle were taken from the following journal articles. This is a reasonably comprehensive list taken from a small collection of textile journals. These words have been used to construct the narrative and descriptions of the knitted fabrics created to date.

These words were also used to form the word bubble given to the participants during the individual interviews.

Journal article 1 (McGregor, et al., 2015)

- dry / drier (as in feeling drier)
- greasy
- thickness/ thicker
- coarse/ coarser
- rough
- smooth/ smoothness
- fabric mass
- fabric thickness
- soft / softer
- loose
- tight/ tightness
- cool
- warm
- light
- heavy
- fabric prickle
- bending
- rigidity
- density/ yarn linear density
- clean
- hairy
- sensation
- plasticity
- silkier
- itch / itchy
- prickle

Journal article 2: (Mcgregor & Naebe, 2013)

Effect of fibre, yarn and knitted fabric attributes associated with wool comfort properties.

- tactile comfort properties
- tactile comfort ratings
- prickle ratings
- prickle
- yarn tenacity
- yarn elongation
- softness/ soft
- friction
- thickness
- compressibility
- supple
- springy
- thinner
- elastic
- uniform
- stronger

Journal article 3: (Carrera-Gallissa, et al., 2016)

Correlation Analysis between the Kawabata System (KES-F) and the UPC Ring Methods of Fabric Analysis.

- stiffness
- smoothness
- fluffiness
- warmth
- brightness
- drape
- bending resistance
- roughness
- compressibility
- fabric feel.
- formability
- bending rigidity
- friction tests
- tensile tests
- shear tests/shear
- compression tests
- bending tests
- elongation
- surface

Journal article 4: (Jeguirim, et al., 2010)

Sensory and instrumental techniques evaluating the effect of structure parameters on the tactile properties of knitted fabrics.

- tactile properties
- yarn count
- gauge
- tactile quality
- compression
- surface properties
- sensory quality
- tactile feeling
- tensile
- shearing
- bending
- softening
- bleaching
- dyeing
- bio-polishing
- cold
- warm
- thin
- thick / thickness
- light
- heavy
- supple / suppleness
- rigid
- soft
- granular
- sticky
- grooved
- greasy
- slippery
- falling
- crumple-like / crumpling
- responsive
- elastic
- touching
- smooth
- mellow
- relaxation
- roughness
- density

Journal article 5: (Naylor, 1992)

The role of coarse fibres in fabric prickle using blended acrylic fibres of different diameters (compared to wool).

- blending
- prickle

- prickliness
- prickle sensation
- fabric pressure (on the skin)
- buckle
- coarse
- dry finish

The article focuses on prickle, so it only discusses one fabric property.

Journal article 6: (Civille, et al., 2004)

Development of terminology to describe the hand-feel properties of paper and fabrics.

- hand/ handle/ hand-feel/ hand-feel properties
- softness
- harshness
- intensity
- strength
- geometrical properties
- moisture properties/moistness
- thermal properties
- stiffness
- resilience
- compression
- fuzzy/ fuzziness
- gritty/ grittiness
- cool
- warm/ warmth
- roughness
- graininess
- thickness
- lumpy/ lumpiness
- gather
- fullness
- tensile stretch
- tensile extension
- hand or fabric friction

Journal article 7: (Mahar, et al., 2013)

A review of fabric tactile properties and their subjective assessment for next-to-skin knitted materials.

List one: Written language used by the academics throughout the article.

- itchy
- prickly
- lightweight
- soft to touch
- softness

- fabric handle
- tactile properties
- aesthetic properties
- rough/ roughness
- smooth/ smoothness
- harsh/ harshness
- pliability
- crimped
- interloped
- stability
- thick/ thickness
- fabric stability
- compressibility
- drape
- taliorability
- bulking
- puckering
- tensile properties
- bending properties/ bending rigidities
- surface properties
- shrinkage
- shear test/ shear
- tactile comfort
- buckling
- flexibility
- stiffness
- stretch
- heavy
- clean
- hairy
- cool
- warm
- greasy
- loose
- tight
- light

List two of the language used by the survey participants when describing the handle of the fabrics presented to them.

- abrasive
- crisp
- dry
- greasy
- hairiness
- fine
- itchy
- moist
- oily
- peach skin
- prickly
- raspy
- rough
- scroupy
- scratchy

- silky
- sleazy
- sleek
- slick
- slimy
- slinky
- slippy
- smooth
- soapy
- sticky
- waxy
- wet
- bally
- bare
- clean
- coarse
- even
- felted
- flat
- fluffy
- furry
- height
- lustrous
- natural
- raw
- shear
- slubby
- sweaty
- synthetic
- texture
- woolly
- drape
- drippy
- firm
- flowed
- fluid
- hard
- harsh
- limp
- loose
- non-stiff
- open construction
- rigid
- shear stiffness
- slack
- soft
- stable
- stiff
- tight
- body
- bulkiness
- compressible
- density
- full

- gutsy
- heavy
- lean
- light
- lofty
- paperiness
- sponginess
- stodgy
- thick
- thin
- weighty
- cool
- warm
- stretchy
- non-stretchy
- elasticity
- resilience
- Expensive

Journal article 8: (Yim & Kan, 2018)

A statistical analysis of low-stress mechanical properties of warp knitted fabrics.

- handle
- roughness
- smoothness
- harshness
- pliability
- thickness /thicker
- tensile
- shear
- bending
- compression
- crispness
- fullness
- softness / soft/ soft-feeling
- weight
- extensibility
- brushed
- plain
- shiny
- rigidity
- heavier /heaviness
- bulkier
- denser
- elastic
- lighter
- porosity
- stiffness/ stiffer

Journal article 9: (Xue, et al., 2017)

Development of a method based on fuzzy comprehensive evaluation and genetic algorithm to study relations between tactile properties and total preference of textile products.

- tactile properties
- fabric hand
- glossy
- smooth / smoothness
- roughness
- softness
- fullness
- delicacy
- flexibility
- lightness
- resiliency
- fuzzy
- crisp
- flexibility
- fullness
- thickness
- bulky
- frivolous
- warmth
- drape

Journal article 10: (Sztandera, et al., 2013)

Identification of the most significant comfort factors for textiles from processing mechanical, hand-feel, fabric construction, and perceived tactile data.

- Handle
- Tactile
- Thermal comfort
- Durability
- Roughness
- Grainy
- Gritty
- Fuzzy
- Thickness
- Stretch
- Springiness
- Fullness/ volume
- Stiffness

Journal article 11: (Das, et al., 2017)

Studies on handle behaviour of Eri Silk/ Wool blended Fabrics developed for winter wear application.

- Warmth

- Lustre
- Strength
- Fineness
- Density
- Uncomfortable
- Itchy
- Thickness
- Crimp
- Stiffness
- Drape
- Roughness
- Soft
- Bulky
- Firmness
- Smoothness

Journal 12: (Jimba, et al., 2020)

Visual ratings of “softness/hardness” of rotating fabrics

- Softness
- Hardness
- Drape
- Tactile
- Touch
- Texture
- Aesthetics
- Tensile
- Strength
- Silky
- Rigidity

List of popular words: the number of times the below terms are referenced within the twelve articles. (Not the number of times in total, i.e., handle is used in 5 of the 12 articles.)

- Thick/ thickness = 9
- Soft/ softness = 9
- Rough/ roughness = 8
- Smooth/ smoothness = 7
- Stiffness = 7
- Warm/ warmth = 6
- Light/ lightweight = 6
- Handle = 5
- Compressibility = 5
- Fullness = 5

- Cool = 4
- Heavy = 4
- Rigidity/ ridged = 4
- Prickle/ Prickly = 4
- Drape = 4
- Prickly/ Prickle = 4
- Greasy = 3
- Itchy/ itch = 3
- Grainy/ granular = 3
- Harsh/ harshness = 3
- Fuzzy/ fuzziness = 3
- Flexibility = 3
- Gritty = 2
- Dry = 2
- Coarse/ coarseness = 2
- Loose =2
- Tight/ tightness = 2
- Clean = 2
- Hairy = 2
- Supple = 2
- Springy = 2
- Stronger = 2
- Crisp/ crispness = 2
- Stretch =2
- Crimped = 2
- Thin/ thinner = 2
- Elastic = 2
- pliability

All other words are only referenced in one article:

- Plasticity
- Mellow
- Uniform
- Fluffiness
- Brightness
- Sticky
- Grooved
- Slippery
- Crumpling
- Lumpy
- Bulky
- Brushed
- Weight
- Plain
- Shiny
- Dense
- Glossy
- Delicate
- Lustre
- Fineness
- Uncomfortable
- Firmness
- Hardness
- Silky

8.10 Interview information provided to participants as part of the sample packs.

Along with the 14 samples detailed in Chapter 6.2, the following documents were provided to the interview participants.

Re-fashioning a sustainable classic.”

A Practice-based exploration of the potential for specific wool blends and stitches to encourage further use of wool fibres in mainstream commercial garments.

What is the research project about?

This research project focuses on one specific area of the fashion and textiles industry: The Knitwear Industry. Specifically, the research intends to focus on the potential of elevating British sheep’s wool for mainstream fashion garments that everyone can wear. This is to take an in-depth look at one under-researched area of sustainability within the fashion and textiles industry.

Knitwear, specifically the woollen industry, was once one of the UK’s biggest industries. Today this industry has all but disappeared. This is due to globalisation and the general decline of the manufacturing sector in the UK. Globally, in recent years wool has begun to make a tiny comeback within the high-end fashion market, the Asian market, and craft knitters. However, wool is an underused material in the UK for fashion garments, despite the abundance and variety of sheep breeds and materials within the British Isles.

Resurgence in craft knitting is beginning to occur in the UK, despite the decline in manufacturing as more small local businesses, spinners, and farms turn their hands to knitting yarns, selling skeins of British wool in various blends. The research proposes to examine whether or not this trend could be replicated and scaled up for the mainstream market. The research intends to investigate in depth a number of these yarns sold on the craft market and promote them through innovative textile design. The doctoral research study proposes that sustainable British wools could have real potential as a sustainable fibre for the future if the fibres are developed and utilised appropriately.

The ambition is that during the research study, the above will be addressed through different knitting yarns in various knitted stitches to discover whether how these yarns are knitted together improves the overall quality and tactility of the fabric. A key reason to look down this line of enquiry is that wool is often overlooked for a range of other fibres due to its rough and itchy handle and because it can be very warm to wear. Many native British breeds of sheep produce coarser fleeces due to colder weather conditions. Thus, these yarns are not seen as favourable as their finer, softer counterparts. (Merino/ Lambs-wool). The research intends to promote these yarns through knitted textile design.

What are the overall aims of the project?

The doctoral research encourages design academics and practitioners to use British sheep’s wool in their creative design process. This will occur through practice-based research and experimentation in knitted textile designs. It is hoped that this research will enable the following:

- To inform knitwear designers of the most desirable wool blends and stitch combinations in the chosen yarns for the project.
- To enable textile design practitioners and academics to make informed choices regarding their yarn choices before designing and developing appropriate feeling sustainable garments.
- To encourage clients to see the value of British sheep's wool as an affordable, sustainable yarn that can be used in fashion products.
- To understand the consumer perception of the 'softness' of knitted products about yarn and stitch type
- To explore the language used to describe woollen swatches.
- To disseminate key findings to a broader public audience

The aims will be accomplished through practice-based research in which a comprehensive knitted swatch library with supporting notes and instructions will be developed. This library can be used as inspiration by knitwear design professionals working at different market levels within the knitwear industry. The aspiration is that the swatch library should encourage design academics and practitioners to use British sheep's wool within their designs. The research aims to inform knitwear designers of the most desirable wool blends and stitch combinations in the chosen yarns available to create an appropriate feeling sustainable garment that can be worn repeatedly. The library should demonstrate that wool ought to be more (or as) suitable than either its synthetic counterpart or blending several different fibre types. By blending the fibres by design rather than at the material stage, it should be possible for every fabric to be disassembled at the end of the fabric's life. Thus, recycling and reusing the fibre becomes easier. If the project is successful, these ideas should be transferable across other knitted fibres.

The intended outcome of this research project is to exhibit the swatch library alongside supporting wearable garment components in several stitch combinations. The goal is to deliver transferable insight in the form of a tool kit (The swatch library) for fashion designers and academics, which visualises optimum stitches and blends of yarns to use in knitwear.

What is my role within the project?

As a participant in the research project, the researcher is looking for you to express your objective opinions of the samples presented to you. In particular, the researcher is looking to find out the following: How you view the models, your thoughts on the tactility of each of the samples, and whether you would consider wearing a garment made from the fabrics in front of you. Your opinions are vital to the project to give the research study further rigour and to confirm the data already gathered and several assumptions already formulated by the researcher. The researcher values your honest opinions and will take the time to listen to you describe your thoughts on each sample. Your thoughts and ideas will be recorded, and the data will be transcribed and added to the study.

The researcher is also interested in the language you use to describe the samples and whether it is the same or different to the language used within the fashion and textiles industry. Please talk in a way you feel comfortable, using only words that come naturally to you.

Thank you for taking the time to take part in the research project.

“Re-fashioning a sustainable classic.”

“A Practice-based exploration of the potential for specific wool blends and stitches to encourage further use of wool fibres in mainstream commercial garments.”

Questions to be covered during the online discussion:

Section 1: What is wool?

1. What are your opinions of wool? (Do you have any preconceived thoughts about the fibre?)
2. Is wool a fabric which you would choose to wear? (Y/N) and what are your reasons for this?
3. How would you describe softness?
4. In your experience, what is soft?
5. Do you have any insights into describing roughness or hardness?

Section 2: The sample collection.

6. Can you try to rank the samples in front of you from 1 -14 in order of softness (1 being the softest and 14 being the roughest/ hardest.)
7. Talk me through your decision making process when ranking the sampling? (What are your reasons for ranking the samples in this way?)
8. Are there any samples which stand out to you? If so, why is this? (Which are your favourites and why?)
9. Can you choose a maximum of three descriptive words to describe each of the samples in front of you?
10. Looking at the list of words on the screen, are there any further words you would choose to describe each of the samples?
11. Would you wear a garment made of any of these fabrics next to your skin? Y/N. Again, what are your reasons for wearing/ not wanting to wear these fabrics?

Section 3: Handle versus Aesthetics.

12. Do you think the look of the samples influenced your decision making when ranking the samples from hard to soft? Why is this?
13. Do you think the look of the samples influenced your decision-making when choosing a favourite sample? Why is this?
14. When considering buying a garment, what is more important to you: the look of the garment or the materials the garments are made from? What are your reasons for your choices?
15. Do you find it’s harder or easier to review the samples when there is no diversity or range in colour in front of you?

Thank you so much for taking the time to answer the questions above!

8.11 Transcribed Interviews

The interviews were transcribed in full.

1st interview 28th April (9-10 am UK time)

Julia: Can you tell me a bit about what you think about wool as a fibre for fabric and fashion?

Participant: " It's a more sustainable option and long-lasting, compared to the acrylic option; in my/ her experience, the acrylic option will always bobble and doesn't last that long, whereas if I buy something vintage made from better fabrics, it tends to last a lot longer. "

"It's warm, heavy, and itchy, doesn't have as much movement, is more durable and would last a lot longer."

J: Have you bought any garments that are wool based?

P: " I think I have a jumper that I bought 2nd hand that I really like, but I tend to wear it when I know it's going to be cold as I know it's going to warm me up.

J: Would you choose to wear a wool fabric, knowing it's made of wool? Or would you think it's a bit itchy, it's a bit heavy, it's a bit hard?

P: I have started to look at the fabric when purchasing, so I may go for it because of that. Or if it's something I liked, I would have a feel of the garment, try it on, or if I really liked it, I would still purchase it, so even if it is a little uncomfortable, I would still wear it. Also, with jumpers, you often wear stuff underneath, so that I wouldn't think too much about it. I wouldn't always have it next to my skin.

J: The focus of the project and something I talk a lot about throughout my PhD is the handle and how the fabric feels. So, the first thing I want to know from you is how you would describe soft or softness. When you think of soft, how would you describe it?

P: "Umm, I think when you wear something, but you are unaware you are wearing it, it's more of an effortless wear, comfort, lightweight, airy, breathable."

J: In your experience, what is soft? It doesn't have to be a jumper.

P: Umm, probably like silks and stuff like that, jerseys, t-shirts, PJs, and the stuff you do wear for comfort, like loungewear. Yeah.

J: And to you, how would you describe rough or hard? What are your perceptions of roughness?

P: A garment that is very stiff, so not a lot of movement, or if there's a texture that's umm, it's hard to describe.

J: "Maybe don't think of fashion; what to you is rough or hard to handle?

P: Maybe like a very thick jacket or coat that you can't move in; it feels very stuffy, and the texture on your skin is itchy/ irritating.

2nd section – less discussion and instead ordering the samples from softest to hardest.

J: asking what was your decision-making process when ranking the samples?

P: “Trying to think about the general feeling of the samples and if I was to wear them, the weight, the thickness, the texture, and some of the patterns within the (sample) as that changed the feel of the sample as well. I tried not to allow the aesthetic of it to affect the way it felt when trying to compare them all.

J: “Are there any samples that stand out and why?

P: “325- the Merino wool sample, which was for its softness and lightness. What else did I like, 299 (I can’t read what I’ve written)? Oh, I wrote because it was soft and thin, had a unique pattern, and had a lot of movement. 58 - Because it was very airy and light, I also put 39, even though that was my last one. (Sample, the participant, ranked the coarsest) I loved the look of it anyway, so even though that was rough to me, if I were to see a jumper looking like that, I probably would purchase it because I really like the look of it.

The following section is written down.

325: stretchier than the others and the softest

326: this one is very airy, light, thin flexible.

309: quite thick, just that

1: quite delicate…. Am I using the correct type of words here? (Me: I want you to use whichever words you use.) thin, with a lot of movement.

58: Again, airy, intricate, see-through.

299: Quite thick and sturdy, still a lot of movement even though it’s quite thick

276: thick, quite comforting, warm, winter look.

108: This one is quite tight, with less movement, a bit more restrictive, maybe.

328: thick, holey, airy, see-through.

180: thick, warm, like sturdy, less movement.

158: this one is a bit more rough, coarse, thick, and textured.

21: Very airy, thick, and rough; not very wearable,

291: light but thick at the same time, very textured, umm, got a lot of shape.

39: Very thick, comforting, lots of shape and texture, sturdy.

J: I’ve just sent you a jpeg image in the chat, and there is a load of words on there; sorry, this is a bit repetitive. I was going to ask you to go through everything again using the words on the screen. No rush: take your time, using the words on the screen, some positive and negative words, go back through and choose a maximum of three words and see what you think.

P: Ok, so….

325: clean, silky, spongy.

326: thin, fluid, fine

309: insulating, soft, strong

1: stretchy, limp, springy

58: open, sheer, light

299: crisp, textured, thin

276: strong, stretchy, warm

108: rigid, tight, and clean

328: open, lumpy, fuzzy

180: stodgy, plain, clean

158: grainy, lumpy, and bristly

21: open, hairy, dry

291: harsh, coarse, and lofty

39: rippled, resilient, rigid.

J: Thank you, that was quite a list. (I now take a bit of time to explain where the words have come from and how I ranked the samples when I did the same before the interviews.)

P: Once I was reading that list, I wondered, how have I not thought of all these words?

J: Would you wear a garment made of any of these fabrics next to your skin, and why.

P: "Yes, definitely I would; some of them are definitely soft enough to be worn next to the skin and are stretchy, airy, breathable, but yeah, probably the lighter ones but even the last one, even though I've marked it the least soft, I would probably wear it just because I like the look of it. I think, give or take, you often choose something less comfortable for the aesthetic.

J: If you had to pick three apart from the merino and the acrylic, which ones would you say, ok, I would wear these? Or can you make me a jumper in these?

P: Umm, 299, 309 and number 1? (Me: why)

1 – it is nice, light, airy, quite plain, and has lots of movement and stretch, so it would be comfortable to wear.

309 – Again, it's pretty light but has more thickness; it's also stretchy, so it would still be comfortable, and I like the stitching. I like the look and feel of that. (The stitch)

299 – I like the aesthetic of this one. I like that it's thick and very stretchy, and also because of the way it's been knitted, quite a lot of air, not all over but in sections, so I feel like it's pretty breathable/ comfortable.

J: Are there any that wouldn't want anywhere near your skin, and why?

P: Maybe 291: this to me feels like, I can't think what it is umm like a bag umm (Me, you mean like a macramé hemp bag.) Yeah, yeah, that's what it feels like. It feels a bit too rough, and the stitch is too see-through. You tend to wear a knit for more coverage, so I would really wear a see-through knit — maybe a bit too much texture.

Probably as well number 21 for similar reasons, and maybe it's personal preference, but when I wear knitwear, it's for comfort and coverage, so I'm not that keen on the large spacing, and yeah, it's a little bit rougher.

The third section of the interview: Begins with me describing why I have kept all the samples neutral and why I am asking the following questions:

Question 12:

P: "I think I have tried not to let this happen, but I do believe the ones that look less comfortable, feel less comfortable, just because of my perception in my head, if somethings thicker, something is lumpier, it will feel bad on my skin, so I do associate those things with feel without even feeling them, but then again there were a lot of thick ones, which if id looked at them without feeling them I might have thought they were hard, but I ended up ranking them high through touch, so I try not to.

J: I think it's difficult.

P: Or you don't realise what you are doing?

J: As a design student, you are naturally drawn to the aesthetics of things, so trying not to associate aesthetics is very hard. Do you think the look of the samples affected the look of those that you chose as your favourite samples?

P: I don't think so, no? When I was doing the process, I was feeling one, then feeling the next one and not really looking because I was trying to be umm, and because I was feeling so many, I was starting to question it, so I wasn't really looking I was trying to home in on the texture of it.

J: question 13:

A lengthy discussion around sustainability – is not necessarily needed for the thesis.

J: question 14:

P: "I think definitely having no colour diversity was a better option because you don't want any more variables to distract from. Already the aesthetic was different, and we're trying not to think of that. If the colour was added, there might be variations that may change your opinion. There are many underlying things you don't realise your brain tells you.

2nd interview: 29th April (9-10 am UK time)

The beginning is me describing the project in more detail.

Question 1:

J: What are your perceptions of wool?

P: it takes a lot of care, and if it is looked after, it can last for years and years. It can pill depending on the type of wool, and it can be challenging to wash some people may think it can only be worn in winter, like Autumn/ winter, and there is a preconceived idea that it is very expensive and very itchy.

J: Do you like wool garments, or is it something you wouldn't choose to wear?

P: No, I do; I like wool garments; I think there is something quite luxurious about wearing wool.

J: Do you have many in your wardrobe (Wool garments), or maybe there are more woven wools than knitted wools?

P: I've got one wool coat, but mam's got loads of wool coats. She loves wool coats. I've probably got more… Ummm, we'll probably talk about this further along, but my buying habits have entirely changed since doing this master's; I would buy wool lookalike coats, whereas I wouldn't do that now. But that's come from doing my master's.

J: It's made you think more about what is on the label.

P: Probably wool is quite off-putting to vegans; I'm not sure.

J: There are pros and cons with wool. The arguments for and against farming and the use of land. It doesn't necessarily mean that one fibre is suitable and one is wrong. Interestingly, you would wear it now.

P: It's funny you said your mum would because I think my parents/ grandparents would. That's why I want to aim the project at the younger generation because I think how you grew up or what you were taught influences you. For me and definitely for you, in schools nothing was really taught about materials, so you don't really think about it, and you don't think what's in the shops, whereas our parents' generation was a bit more and they liked wool because that was available.

J: Question 3 – How would you describe softness?

P: easy to handle, not harsh or hard to touch, soft on the skin and almost like tempting to wear.

J: If you were describing soft, it doesn't necessarily have to be a fabric; how would you generally describe soft?

P: I'd think of duvet/ pillows, umm, cotton wool, things like that.

J: if you were talking about fabric, would you describe it as soft or hard

P: Yeah, I would initially say that there is so much more you could say about things like that. It's quite an easy term to say if something is hard or soft or not soft, so I think I would start by saying that and then find other words to use for it.

J: As an opposite, how would you describe hardness or roughness? And would you use it to describe fabric at all?

P: In my head, I have a preconceived idea that some man-made wool can be quite rough on your skin, and that causes it to be a little bit itchy. But that is definitely a preconceived idea, something that is actual fact. I probably would have said this before doing my undergrad, before touching fabrics and understanding the composition and the weave and things like that, whereas if you understand it more, it's down to the fabrics that are impacting that.

J: So, when you were at school, and you went shopping, you wouldn't necessarily look at the label, but you wouldn't buy wool because it's hard, or it's itchy, or it's rough.

P: or if I felt one (a garment) in a shop, and then you think that all wool is like that until you do something like a fashion degree where you understand it's more complex and you understand how many different types there are. When you're younger, you think there is one standard of what wool is, but there are so many variations that you learn about lots.

Part 2:

J: Ranking the samples: (When asked to describe the samples, the participant said it was tough.)

P: 325 –it's beautiful. You can tell it's luxury. It's like if worn, you could tell it drapes really nicely. If worn as a jumper. It's so soft it's silky. It's so nice.

P: When I initially did it, I thought 326 was the 2nd, but when we were talking, I thought that was the Acrylic, so that almost changed my opinion but maybe made me think it's not the softest one. When I initially went through the samples, I thought it was quite soft, but looking back, it was like, oh, actually, is it? But then I was wondering if our chat was influencing me.

Me: You should go with your initial opinion.

P:

1. 326 – This feels less natural than the cheaper wool you get. It doesn't feel as natural as the others do. Even though it's soft, it doesn't feel as luxurious as the others do.
2. 309 – This is also very soft; the pattern is a lot denser, a lot more compact, and very tight-knit. So it feels very tight. It's quite fancy when you feel/ grip it. It's also quite thick.
3. 180- This was very nice as well; it was very soft. It is obviously very soft, not as soft as the Merino one, but it feels quite light and airy. It wouldn't be too much to wear.
4. 328 – also quite soft, feels very light, and if you were to wear it, it would feel soft to wear, unlike wearing a heavy jumper.
5. 158 – This is very tight and quite heavy; I think it would maybe drape nicely, but it would depend on the garment. Similar to some of the others, you have to feel it.

Denser, but it still feels soft. It's heavier wool, but it's still really soft. Say if you were going walking, it's a jumper you would want to wear because it's comfortable, but it's going to keep you quite warm.

6. 276 – It feels thick; you've got to grip it quite hard; it's just quite dense.
7. 1 – I would say this is very light, very stretchy, very durable and would withstand quite a lot.
8. 108 – I would say this is middle, it's soft, but because it's denser and more compact, it makes it feel a little bit heavier. It's bouncy and stretchy, but maybe it would be a little bit harder on the skin, not hard, but just not as soft.
9. 58 – The pattern is quite lovely, obviously very loose compared to the others; I don't think it would feel heavy or not nice to wear, but it's just thicker. This would be nice as a jumper for going walking.
10. 21 – This one is rougher, I would say, not as soft. Due to the pattern, it's a lot airier, it's not as tight as the other ones, and the knit is much looser. It wouldn't give a heavy feeling because it's a loose-knit. It wouldn't feel heavy at all.
11. 299 – I would say it feels light, airy, and lighter.
12. 291 – This was quite hard, and it's not as soft on the skin. I feel like you have to grab it a bit more to know what it feels like due to the pattern; it's more irregular and a bit bumpy. I don't know if people would like that on the skin as much if it's not smooth.
13. 39 –This was very tough. It has a lot more structure to it. The pattern heavily influences that. It's very tight, very close-knit, and compact, which is why I think the pattern influences it.

J: What was your decision-making process when you were going through them? What were your reasons?

P: The pattern actually did quite influence my decision-making because it changes the texture and composition of the wool; I don't know how to describe it; it's not just like you have wool yarn. It's been knitted a certain way, and the way that it's been knitted and the texture of that knit influences how hard or soft it is. So that's what I was thinking and obviously looking at, the smoother and flatter the pattern, the softer the fabric, in my opinion.

J: So, you think the more textured samples were, the harder or rougher or

P: Yeah, but that may be because they are more closely compact, so it may make the samples harder or tougher compared to if they were more loose-knit.

J: Were there any samples which stood out to you, and if so, why?

P: 325 because I thought it would drape really well, and it would feel like you weren't really wearing a wool jumper because it was so soft. I feel like it would give a cocooning effect.

J: Were there any others you liked?

P: No, that sample was the stand-out one.

J: If you were to look through again, were there any others which you liked the handle of and why?

P: I would have said 309. It depends on the type of wool for a certain type of garment. It would be different if you wanted for a jumper, a shawl, or the type of garment you needed it for.

J: So, if you think of the samples as a fabric, not as garments, which I know is difficult as knit is just for garments, just think looking at the fabric, which is your favourite, which is your favourite?

P: I would have said 309 and 326.

J: and what is it about these two samples that you like?

P: I like the structure of it; I think it would be nice to wear.

I have put the descriptions of the samples above by the numbers: see above.

J: Sample 158 is made with the two softest yarns, but they are quite thick, which is probably why you think they are less soft than some of the yarns with a finer ply.

P: That's what I mean – it comes down to the finest of the yarns and how they are knitted together. I think you sometimes think very loose knits will be softer because they aren't tightly woven together. When things are tightly woven together, you get more of a structure and more body to the sample.

J: explaining words/ word bubbles/journal articles.

Going back through the sample's pic, a maximum of three words to describe the samples.

P:

326 – oily, waxy, coarse

180 – firm, insulated, brushed (hairy)

276 – bouncy, stretchy, elastic

299 – spongy, fluid, loose

328 – delicate, springy, textured

325 – lustrous, velvety, silky

309 – insulating, strong, dry

21 - loose, coarse, gritty

291 – lumpy, rigid, rough

58 – textured, grooved, firm

1 – crisp, dry, thin

108 – weighty, stodgy, tight

158 – loose, fluid, spongy

39 – heavy, stodgy, lumpy.

J: Would you wear any of these swatches next to your skin

P: Definitely 325

J: Obviously, I know a lot of knitwear you would wear a t-shirt or something underneath, but there are still a lot of places like your arm and neck where the yarn is touching your skin directly, and people probably won't buy the fabric unless they like the feel of it all over.

(Gap in the recording here.)

J: The last few questions are about aesthetics, and I think by this point, you can tell if the aesthetics have influenced you, and I don't believe you have massively. The last few questions are about handle vs aesthetics.

Question 12:

P: Yeah, that bit where I said about the pattern influenced it. Like number 39, obviously, it's got a very structured pattern, and little squares make it very compact together, so it feels tighter, which then makes the texture feel harder, so I would say the way you knit the fibres would influence that.

J: What do you think about the look (of the samples)? Do you think those samples you picked out had anything to do with the look, or were they purely chosen for how they felt?

P: I think the looser ones feel looser and were maybe softer as you don't have the bulk of them being tight together, so, like, the looser the knit, the softer it might be. I don't know if that's just me, though.

J: Question 14:

P: So now it's the materials the garment was made from, but if you asked me that a few years ago, that probably wouldn't have been the case. I think studying and from an ethical point of view makes it almost more appealing if you know that it came from a better source and has been sourced correctly. To me now, studying that appeals way more to me than when I was 18 or 16 or something like that. I'd definitely say the material the garments are made from and not the look of it.

J: Do you think if you went into a shop do you think you'd look at it and go oh, I like that, then look at the materials or

P: Yeah, I think I would, but that is what I was saying before as fashion students, aesthetics are really important, and I think something would appeal to me, but then it would be what's it made out of, where is being sourced, how is it being made, those types of questions.

J: Final questions (explaining why the project is all in ecru.)

P: I didn't find it harder because when they were all the same colour, it made you study them more because it didn't cause biased decision-making. Say if there were a really bright colour, your eyes would be drawn towards that, or if there was my favourite colour, that might have swayed me to go with that one. All one colour didn't cause any biased decision-making and made me focus on the texture and the weave. Ecru colour made the project feel the project feel more organic.

J: Explain why colour is subjective.

P: Yeah, definitely, because they are all so similar, there is no influence of colour; it makes you look at them more, makes you feel them more, and engages you more.

Interview 3: (30th April)

J: Question 1

P: No, normally, when I look for things, I only look for natural fibres over polyester. A lot of the knitwear I own is wool or mohair or some mix,

J: If you think about wool as a fibre, what do you think about it? Like warm or itchy or you know…

P: A bit itchy usually, unless it's been treated somehow, but raw, it's usually quite itchy, but yeah, warm, definitely warm.

J: Is it something you would want to put next to your skin? Like obviously, you are wearing a t-shirt right now, but if you put a jumper over the top, it's still can be itchy at the neck or the arms.

P: Yes, normally the neck or chest; normally, my arms are fine. But this bit (Pointing to the neck shoulder blade area.)

J: So, it is something you consider wearing but find it can be a bit itchy.

J: So, I've just touched on this, but… Question 2:

P: I would choose to wear it; I think it's from experience working in design and stuff that natural fibres tend to last longer than man-made fibres.

(Break in the interview.)

J: Take some time to explain the samples sent and the next part of the interview, explaining why Merino and acrylic have been included. – Then, ask the participant to rank the samples from softest to hardest.

P:

1. 325 – The Merino one is the softest.
   It's really soft; it's quite lightweight. I don't know if it would be that warm, though, being lightweight.
2. 326 – Soft, really lightweight, quite airy.
3. 309 – Quite soft, but it's got a bit of thickness to it, a bit of warmth.
4. 1 – I would say it is very light and quite see-through
5. 58 – I would say quite textural and airy but relatively light.
6. 158 – Again quite soft, with a bit of scratchiness, but it's quite lightweight
7. 21 – holey, airy, but quite scratchy

8. 299 – it's quite lightweight and quite soft, but it's still got a little bit of scratchiness to it.
9. 328 – I would say it would keep you quite warm, but it has a little ventilation and holes and is pretty soft.
10. 276 – is very airy because it's got quite big holes in; I don't know, umm, I would say it's a little scratchy, and I would say it stretched more on one side.
11. 180 – I would say it is quite stiff because it's a tight weave. Umm, it's quite a mid-weight and slightly scratchy.
12. 291 – it's pretty decorative but delicate and looks like it would easily catch on things. And it seems really airy, but it's still quite thick.
13. 108 – Umm, I would say it's not that stretchy. It's quite tight, and it's quite like rough.
14. 39 – It's very dense, has little stretch, and is quite abrasive.

J: What are your reasons for ranking them the way you did?

P: Umm, the ones with more texture are more abrasive than those with smoother texture.

J: Is there any reason for that?

P: I don't know if it isn't like the hair isn't, the fibres aren't like, I can't think of the word, are a bit more open, where they've got more holes that the fibres are coming out of and being like tightly knitted together.

J: And are there any you would pick out as your favourites and why?

P: Ummm, I quite like 309 because it's got a bit of weight, and it's soft and possibly 328 because it has got that little bit of texture, but it hasn't made it rough.

J: Are there any in particular that you didn't like?

P: Umm, it's more the tuck stitch one because it would sit too heavy and boxy; it would be good for, like, more outwear, more a heavyweight jacket or something.

J: That's one thing everyone has agreed on so far, that that is the roughest one, and it is.

So, going back through the samples, can you describe each one using a maximum of three words to describe how they feel?

P: (See above next to the ranking for the description.)

J: fab, you'd really thought about that and were flying through the descriptions. Now I'm going to send you a jpeg. (Now describe the jpeg and why I want the participant to do it next.)

P: umm, right, so I'll start at the end.

39 – I would say it is coarse, rippled, and quite grainy

291 – Crumply, bristly, and possibly aggravating

108 – Felted, dense, prickly

180 – Dense, relatively strong, a little granular

276 – Itchy, airy, open

158 – Hairy, soft, possibly gritty

299 – Quite lofty, loose, possibly limp

328 – Open, bristly, cool

58 – Rippled, limp, textured

1 – Slight ripple, a little bit hairy, quite limp

309 – Quite soft, strong, quite springy

21 – Quite knobbly, hairy, open

326 – Light, soft, but quite limp

325 – Quite supple, maybe lustrous, and I think it would be quite drapey on a garment.

J: (Me saying thank you and a bit of babble) Are there any of these fabrics that you would wear as a garment next to your skin?

P: Without things underneath?

J: Yeah

P: Probably more the merino, umm, that sample 325. Maybe 158.

J: Why 158:

P: It's quite hairy, but the weave is quite tight on the back, so I don't think it would irritate us as much. I think that would be all right; it depends on which side you would use. That side is hairier than the other side. (Gap) and sample 309 because, again, I think it's pretty soft on one side, and I don't think it's going to irritate as much.

J: So, sample 158 is actually the sample, which is made with the two softest yarns, but interestingly I don't think everyone thinks the sample is as soft as it is probably because the Teeswater yarn is very, very hairy, so when you can feel all the hairy, so when you can feel all the hairs rubbing it's probably the Teeswater. The Blue-faced Leicester yarn is the UK's comparable yarn to the Merino, but it's not as expensive and is more readily available. But I think the problem is the Teeswater is very hairy, so everyone is like, oooh, it feels too itchy.

P: but that's what I thought. I don't know why?

J: Because all the hairs are on the top?

P: Yeah.

J: That's the main section about the samples. Do you have any other comments from looking through them?

P: The Acrylic one is quite soft, but I think it's quite rough in a way because it feels quite plastic. It doesn't have hair or fibre. It feels quite, yeah. It's soft when you rub against it, but when you start rubbing it in your hands, it's quite soft that way.

J: I think because I've been knitting with wool for so long, I went to knit with it and was like, this is so much more difficult to knit with, I went to wash it, and obviously it was fine, but steaming it, the wool samples are quite robust they can take quite a lot of steam, and you can pin them. I had forgotten how Acrylic gets all the steam marks on it. It would be best if you definitely were a bit more careful with it. It's definitely not as sturdy or hardy as wool fabrics.

P: No

J: (me explaining why the last section of the interview is relevant to the project), then question 12.

P: Ummm, I think there was a couple; where are they? Sample 328 I think I liked the look because it's quite laddery, and I quite like that. And also, I do quite like the one that I put as the roughest one, which was the tuck stitch, sample 39, because I think it would be quite remarkable as a contemporary piece, so I don't know if it has informed us because I haven't put it higher because of it, but I do quite like the style of it.

J: And do you think the samples' look influenced the choice of your favourite ones?

P: Umm, possibly again, yeah!

J: Are there any reasons why?

P: Umm, I don't know if it's because, as a man, you don't want as much, like usually when people think about knitting and stuff, they usually think quite an older adult, quite a grandma and quite lacy and stuff and if you're a man you don't usually look for that kind of aesthetic in a top. I think I'm more into the plainer ones, with subtle bits of lace holes and stuff in, than the really lacy ones.

J: So, when you're considering buying a garment, what's more important to you, the look of the garment or the materials the garments are made from, and why?

P: Umm, it's definitely the look, but I strongly go off the material as well. Usually, when I go shopping, and I see something, and I like it because of the look of it, if I don't like the fabric or the construction or handle, I still won't buy it because I want to go off that a bit as well.

J, and what are the fabrics that put you off? What wouldn't you buy?

P: Umm, I'm not into tweeds; Ummm, I don't really like fake leather because it's still got that shiny plastic vibe, and I generally stay away from any t-shirts and stuff that are polyester.

J: And if you were buying knitwear, do you check what for what it's made of, or do you assume?

P: I usually do, more for a winter jumper. If I look for a winter jumper, I try to avoid anything with acrylic in it because it obviously doesn't keep you warm. It depends on what's the season.

J: So, the final question…. Now an explanation of why the project was knitted in ecru, then asking the question?

P: Umm, easier; I think the ecru colour brings out more of the texture of the knit

J: Obviously, all the samples are ecru, but can you see a difference in the yarns when you are looking at them?

P: no, I can see a difference. I can see that some of them were like they have bigger holes. You can see a thicker yarn or thick bits of yarn surrounding the hole umm, and you can see a slight colour difference on some samples between yarns.

Interview 4: 5th May

J: Question 1:

P: So, I have eczema, so preconceived would probably go back to my childhood where I remember my mum putting a woollen jumper on me, and I remember it just not feeling good on my skin. Umm, that was due to my eczema, and that would maybe irritate my skin condition and make me itch more, so I think I've probably stayed away from it a bit. As I get older, I probably love the feel of the knitwear, especially real wool, but I've always got a polo top or long-sleeved that doesn't irritate my sensitive skin.

J: So, you would say you wouldn't wear it next to your skin, really?

P: Probably not, no.

J: Are there any wool fabrics you would choose to wear, just generally not next to your skin?

P: Ummm, it's funny because polyester makes you sweatier, and it's not as breathable as wool, so probably having cotton next to my skin than having 100% wool on top is perhaps my best approach.

J: For you, how would you describe soft and softness? What makes you think of soft?

P: Umm, I would say soft is the way you feel, the way you touch; it's non-abrasive. That's a good question, what is soft? It's kind of like fur-like but smooth and coherent in its pattern, I would say. Notably, fine in some cases, umm… I think, yeah, it, I think of a pure texture. I automatically think of cashmere as being very soft.

J: In your experience, what is soft? What things do you associate with soft? Have you just said cashmere? Is there anything else?

P: Umm, I would say fur, animals; I have a kitten at the minute, so my kitten is soft. And I suppose it's the way it goes down, the texture when you rub it up and down. It still bodies that same kind of feel.

J: As an opposing thought, can you say harshness or roughness? What do those words mean to you?

P: Yeah, Ummm umm, a rawer fibre can be rough. Some interior fabrics can have a rough surface. Weaving has a rougher, tougher context to it. Ummm, something that is quite coarse. Or are you talking about actual objects?

J: No, when you hear those words, what do you associate with them? It doesn't necessarily have to be fabric. When you think of rough, is it always a fabric, a carpet, or something like that?

P: Umm, Yeah, I don't know why, but I do think of more angular sharp objects or like a sieve, umm, that kind of texture. Or it's interesting having the kitten; he's really into the scratching pole, which is a rough texture and things that kind of bristle or makes a noise when you touch it.

J: Cool, that's some really good descriptions.

I am now explaining more about the project before starting part two.

Can you rank the samples from 1 – 14 in the order of softness? (1 being the softness and 14 being the hardness) (Now an explanation about the control samples)

P: So, what I've done is put them in three piles: a soft one and a middle pile, and I'll go through them right now to ensure they're all in the right order.

So, the softest, I would say, is sample 325.

1: 325 – extremely soft, protective, insulating.

2: 1 – really soft, natural, fine

3. 326 - extremely light; it reminds me of sportswear quite a bit, insulating, a very different texture, familiar but not necessarily as nice.

4: 309 – Very neat, smooth, quite thick

5: 328 – quite fur-like, it has texture to it, insulating, and it's pretty thick.

6: 158 – It reminds me of jumpers I see in high street stores; it's soft; it could almost be an acrylic kind of feeling to it. And a little bit mottled in its pattern.

7: 58 – Reminds me of a baby's blanket. Again breathe-able, soft, plush

8: 276 – Farne Island knit; I know it's nothing like it, but it reminds me of a Farne Island knit. (Me: Do you mean a Fair-isle knit?) Fairisle, that's it. Laddered, breathable.

9: 180 – A little bit scratchy, woven tightly, itchy, concealed

10: 299- Finer, there is give in it, stretch/ stretchy.

11: 108 – Shrunken – this sample reminds me of a jumper my mum had and shrunk, but it's not shrunk. Short, warm, it's really thick.

12: 21 – Crisp, hang on, not crisp. Ummm, quite fuzzy, holey, and breathable.

13: 291 – A little bit abstract in its pattern, middleweight and new

14: 39: 3D-like, structured, tight

12. 38 Into the interview

J: Can you talk me through your decision-making process? Why have you ranked them the way you have? Why do you think some are softer than others?

P: As I went about it, I was looking at how it felt and how it feels against my own skin. I think roughness is in the structure as well. Whereas I found the textures of the first one I chose were very close-knit, it was a smoother surface. As I went on, the rougher knits made the textures feel a bit coarser against my skin.

J: Did you have any favourites, and if so, why?

P: I would say that my favourite is, it's really strange because I really love number 39 even if it has the roughest feel; I find the pattern beautiful and yeah, and I loved the ribbing on number 1, I think that's really nice.

J: Were there any that you didn't like? Like touching them or from a hand-feel point of view.

P: I suggest 21. Ummm, maybe it's the irregularity and the holes maybe, and I would find it hard to err, I would find it hard to wear. I associate wool with being warm and cosy, and I think those protruding holes in it, I think it defeats the point.

J: Any others which you had any particular thoughts about? Either neutral, good, or bad.

P: Umm, I would say that I really liked number 291's pattern; I think it's a really beautiful pattern and constructed really nicely. However, the yarn was just a bit too rough for my skin. I don't know if two much of a difference between the two different types, perhaps.

J: …. Asking her to go through the samples and describe them. Descriptions are added next to the list above.

J: talking about the words and journal articles and asking the participant to go through the samples again, describing the words off the sheet? – these words are below:

P: Ok, right.

325 – Springy, pliable,

1- light, loose, open

326 – (Strong, sorry, no, I can take this one back) firm, clean, and supple

309 – Stiff, smooth, plain

328 – Springy, wrinkled, textured

158 – Crimped, textured, strong

58 – Springy, open, mellow

276 – Resilient, woolly, bouncy

180 – Itchy, tight, bristly

299 – Pliable, loose, knobbly

108 – harsh weighty, thick

21 – loose, brushed, light

291 – rigid, wavy, strong

39 – knobbly, aggravating, firm

J: Cool, thank you. I know we are running out of time, so would you wear a garment made out of any of those fabrics next to your skin?

P: Yeah, definitely. Yeah, I mean, just because I can't wear some of the materials, I would still wear something that was better made for longevity, and also, it's a nice insulating fabric to keep me warm.

J: If there were any, you could pick out a few for you to wear with a t-shirt underneath rather than directly next to your skin.

P: Yep, I love 39 even though it's not the softest, number 1 and number 58, which would be really nice to wear. (She may mean sample 325 when she says number 1 here.)

J: Cool. I will skip the end questions, but just one last one. Do you think the look/ the aesthetics of the samples have influenced your decision-making in any way when you've been doing this, or do you think it's purely about the handle?

P: The sensory feeling of it overtakes your judgement of wool. I think when we are choosing woollen clothing, your sensory indicators take over, even though I know for a fact I would probably wear a polo top underneath, so then the sensory side of it shouldn't really take over my thought process or not of whether or not I should but a jumper that was made of wool. Does that answer your question?

J: I was curious whether the look of the sample, the actual aesthetic of it, influences your decision-making. So, there may be one that looks nice to you, but it's whether you'd pick that as your favourite because you like it rather than the feel of it.

P: Err, definitely, the aesthesis of the pattern played into it. I would definitely say there are different patterns and prints which I would associate with memories that help me think if that's the case.

Interview 5: 6th May

Discussion at the beginning about where the samples were knitted.

J: Question 1

P: So, I have, like, both sides, like a good and a bad preconception of it. I started off looking at my project, looking at wool that is what I wanted to look at naturally and locally sourced wool. I love that it's a natural fibre. My first thoughts are that if sheep need to be sheared, surely, it's sustainable that we are using the wool rather than it going to waste umm. Still, when I talked to Alana about it, she said I should look at the other side, like promoting over farming, umm, issues with using a lot of land and resources, umm, so I have mixed opinions of it.

J: I think there are with every fibre. Think particularly about wearing the fibre. If you went into an average shop on the high street, would you pick up a wool garment, or does it feel too itchy for you? Is it too warm?

P: I think I would, but I think I would maybe go for cashmere because I do find it quite itchy or maybe Merino…. But yeah, I think I would go for a wool garment.

J: So that answers that question. Is Wool a fabric you would choose to wear?

P: Yeah.

J: Would you be happy with it next to your skin?

P: Yeah

J: Do you find any particular types of wool irritating?

P: Sometimes, if it were just pure wool, I would find it quite irritating on my skin.

J: Ok, I want to know how you would describe softness. When you think of softness, what is soft to you? It doesn't necessarily have to be a fabric; what do you like?

P: How I would describe it would be like something that feels nice on your skin and something that is gentle on your skin. Umm, and what I think of when I think of things being soft is fleece, fur, or feathers.

J: And as an opposite. How would you describe roughness or hardness? What is rough or hard to you?

P: Something that is not pleasant on the skin. Something that is uneven or hard or something like sandpaper.

J: Are there any fabrics that you naturally think are rough or hard?

P: Ummm, maybe something like PVC leather that isn't very flexible, or you can't move in.

J: great.

(Gap in the interview.)

Then I described the next part of the project and got the participant to rank the samples in order.

P: So, the first softest one was….

1. 326 – Light and airy and very fine.
2. 325 – Very gentle, quite dense, soft.
3. 58 – Textured, a bit scratchy, quite flexible.
4. 328 – quite flexible and quite loose
5. 1 – Quite itchy and quite hairy.

   (J: Would you want this one next to your skin, or is it too itchy?

   P: Maybe it is a bit too hairy.)

6. 276 – Quite Chunky, dense

7. 158 – I didn't really like this one due to how it looks, and I found it quite messy. I know that isn't how you have knitted it but the actual stitch. But I think it's a bit chunkier than the first few ones.
   J: Do you have any other words which you could use to describe it?
   P: I find it quite like distressed, umm

8. 309 – I liked this one as well. I think this is quite a nice thickness, umm, not too like airy, but not too chunky as well. This one is quite nice on the skin; I wouldn't say it was itchy. Umm, and I think this one looks very neat the way the stitches are:

9. 299 – I think the stitches on this one make it quite sturdy. It's very stretchy. But I think it's a bit too firm.

10. 21 – very airy, quite irritating on the skin

11. 108 – Quite firm, not much stretch. I think it could be quite uncomfortable to wear.

12. 291 – The one I didn't like is too textured, and I think it would also be scratchy and uncomfortable on the skin. I think it's pretty uneven; that's what I don't like about it.

13. 180 – I like how this one looks. Like I think it's very neat and looks very nice on a garment, but I think it's too firm and hard, and there's not a lot of stretch. It's quite rough.

14. 39 – Same as the last one, I think this would be so uncomfortable to wear. It's pretty uneven on one side, and I don't think it would be nice against the skin: there's not a lot of movement.

J: OK, so what was your decision-making process? Why did you rank them the way you did?

P: I think it was because if it was like maybe a liner yarn or something a bit more flexible, then I thought I perceived it as soft, rather than the last one, which is very compact, and I didn't think that felt very nice on my skin.

J: Were there samples which stood out to you?

P: Ummm, yes. Number 1, Ummm

J: What was it about number 1?

P: It was more aesthetical. I think it looks so neat and lovely, and still, it's quite flexible and airy. It's got a little bit of a nice stretch. And I did like 325 as well, which was the merino.

J: And was there any reason why you like that one particularly?

P: Just the softness, and it wasn't very itchy on the skin.

J: Were there any samples you really didn't like and why? Or found unpleasant to touch.

P: Sample 291 was too textured and a bit too scratchy. And also, the last one, 39, was too firm and hard.

J: If you don't mind, I want you to go back through the samples and use three words to describe each.

P: (Descriptions listed above next to the words)

J: Sending and describing the jpeg of words sent through and asking the participant to go through and describe the samples again.

P:

326 – plain, thin, quite dry

325 – fine, fluid, delicate

58 – quite knobbly, crisp,

328 – loose, open, springy

1 – itchy, sleek, light

276 - open, scratchy, lumpy

158 – quite hairy, springy, loose

309 – crisp, clean, smooth.

299 – lumpy, stretchy, open

21 – very loose, bulky, itchy

108 – quite firm, resilient, spikey

291 – lumpy, bristly, aggravating

180 – tough, limp, gritty

39 – rough, stiff, hard.

J: Of all these fabrics, are there any which you would wear next to your skin?

P: I would say the Merino, 325 Ummm and 309

J: Why would you choose 309

P: I like the medium weight of it, and it's not as prickly.

(Gap in the video)

J: Do you think the samples' look influenced your decision when ranking the samples from soft to hard?

P: Yeah, I think so. I guess maybe number 1; it's quite itchy, but I like the look of it, so maybe that's why I put it softer. I think that would be pretty uncomfortable. But I think perhaps the other ones haven't been influenced by the design of it.

J: It's a similar question, but do you think the samples' look influenced the ones you think are your favourite?

P: Yeah, I chose 309 for one I would wear. I think it's pretty soft, and I like the feel of it, but I also think the look of it has influenced it as well. Then maybe I wouldn't say I like the look of the ones with some holes in them, say 328. I think that one is pretty nice on your skin, but I wouldn't say I like the look of it.

J: That's interesting

When you're going shopping and when you are buying a garment, what is more important to you, the look of the garment or the materials, and why?

P: I think I would firstly be attracted to something because of the look of it, but I know in the past, if I bought a 100% wool jumper, it wasn't something I would usually reach for because I feel it would be pretty itchy on my skin. So maybe I would, perhaps the look of it would be more important than the material.

J: Yeah, and once you like the look, you look at the materials?

P: Yeah

(A little gap in discussing the MA)

J: Last question and an explanation of it.

P: I think easier because there wasn't, like, umm, because they were all the same, and that was easier to judge and have opinions on. It was easier to compare them to each other because they were all the same.

Interview 6: 6th of May

J: What are your preconceptions of wool?

P: I do love wool; I wear a lot of wool jumpers in the winter. They are a lot warmer than anything synthetic. And I don't think something in cotton or knit looks a lot better than a random synthetic fibre which doesn't necessarily look that nice. I do also like the old-school look of it, In a general way. I like wool because it is also more sustainable. I try to have an ethical clothing consumption, well consumption in general, and while I'm far from being perfect, I still do buy t-shirts in H&M and stuff like that, but I try to choose materials that can be sustainable.

J: (A brief answer to the above before asking how the participant would describe softness.)

P: Is it in the context of clothing or any context?

J: So, I guess how you describe it would be in clothing; I'm then going to ask you what your experience of soft is, so that may not be in clothing.

P: In clothing, that would be the feeling on my skin would be smooth and comfortable, and hopefully something soft would make me feel comfortable and cosy, and I think that would bring a lot of comfort; something soft is comfort or links with the warm wool almost creating a little bubble of protection around you.

J: In your experience, what is soft?

P: Ummm, silk is really soft, I have a lot of silk scarves, and it's really warm and lovely to wear. What else is soft….? I do, Ummm, like a lot of fluffy textures again. That's part of being cosy and comfortable, umm. What I think is super soft, quite random, is the leaves of a plant in general. I do like that feeling when you touch them, and it's really smooth and nice. I think, in general, smooth surfaces; I quite like that.

J: Cool, that's a really good description. And as an opposite, how would you describe roughness or hardness? Or what do you associate with those things?

P: Ummm, to me, almost something itchy, something that is not really flexible or malleable, umm, something that you don't necessarily feel comfortable in. Roughness or hardness makes me think of wearing wet jeans; you don't feel comfortable and can't move. Roughness, you know what it makes me think of. You know that grey thing on sponges, to scratch the pans on the inside when you've cooked to clean them? That texture I hate, and clay pots when they aren't smooth, that texture gives me chills. I wouldn't say I like that; that really grainy texture.

A gap in the interview, then describing the samples.

P:

1. 325 – Umm, it's soft and feels a bit thick; it has a thickness not all of them have. It feels warm; it feels cosy. It feels comfortable.

2. 326 - Soft, quite light, and smooth.
3. 158 - Warm, thick, comfortable
4. 291 - It is very pretty. Airy, comfortable, soft
5. 21 – Airy, it's not itchy, but you can feel the fibres on the skin, umm, and it is relatively light.

6. 58 – Comfortable, feels cosy, warm
7. 309 – Thick, I love it, warm, but at the same time, it does feel light somehow.
8. 328 – Cosy, feels warm, you can feel the fibres, and it's not itchy again.
9. 276 – This is thicker, a bit itchy, and comfortable.
10. 1 – This feels rough, not as nice on the skin as the others, and almost makes me think of something a bit medieval.

J: What, like chainmail?

P: Yeah, almost; I imagine if that were made of wool, that would be the feeling on my skin.

11. 299 – This is not really mailable, it has that kind of roughness about it, but it is light.
12. 180 – Umm, this one feels a bit compact, heavy, and itchy.
13. 108 – This one is quite hard, not as much as the next one; it feels like if you were to wear it, it would just stay in place. Almost the opposite of fluid; I don't know what the word would be.
14. 39 – Hard and rough. If you were to make a jumper in it, it would stand on its own. It does feel warm, and if it is a bit rough, it feels that it could be quite warm.

J: What was your decision-making process when you were doing this?

P: I just put them on my arm. It wasn't easy because there were so many of them to figure out. So, I just tried them on my arm to see how they would feel. Most of them are comfortable. Even the last one, I do like it. I don't know if it's because I'm used to wearing wool.

J: Do you have any which stood out to you? Do you have any favourites?

P: Do you mean in terms of pattern?

J: No, generally, I guess.

P: I like 21 with the pattern; that's lovely and quite different from what we tend to see. I really like 328, umm and 108.

J: What was it about those two? Was it the pattern or the feel?

P: Yeah, the pattern, yeah, I could see myself wearing something with that. I do tend to wear stuff, or I like stuff that's a bit original, or I wear a lot of flowers or stuff like that or more old-school clothing. I like the fact that it's not the type of pattern you would see everywhere.

J: And the handle doesn't put you off with any of them?

P: No, I also like that the pattern is quite irregular. It doesn't look symmetric. One I actually like, but I think the inside I quite like is the 58. I think the inside, or what I think is the inside, looks amazing.

J: Well-knit can be put/ worn both ways

P: Yeah

J: If all the fronts were softer than the backs, I suggest switching them because I want to have the softer side next to the skin.

Fab, some good answers.

Then explain the next question. The participant's reply and descriptive words are above.

(Interesting last interview as views are quite different to the other participants who preferred the plainer 'more commercial' patterns. This participant chooses the more original creative patterns and would prefer to wear them)

J: Talking about where the words came from.

P: words from 325

325 – It feels velvety, shiny, and Lofty

326 – Thin, smooth, glossy

158 - Fibrous, textured, stretchy

291 – Sheer, spongy, dry

21 – Sheer, light, lacy

58 – Dry, woolly textured

309 – Warm, firm, lofty

328 – Delicate, loose, warm

276 – Flat, fibrous, mellow

1 – Scratchy, very stretchy, loose

299 – Fibrous, brushed, hairy

180 – Tight, plain, stiff

108 – Insulating, fuzzy, warm

39 – Dense, uncomfortable, hard

J: Are there any samples you would choose to wear next to your skin and why?

P: I definitely wouldn't mind the control samples, the 158.

J: Is there any reason for that one?

P: It feels really soft, and you don't really feel the fibres. I don't think that after a day, it would feel itchy or anything. It really also feels warm, so you wouldn't need an extra layer compared to some that feel a bit lighter.

Let me check the others… This one is def number 328. I don't think I would mind number 1. Somehow, I see it more as a summer top.

J: Are there any you really wouldn't wear? They're too scratchy or itchy or….

P: Definitely 39. No, I think the others are wearable. Ummm, 309, but not because of the material, but it feels plain somehow; that is why. But no other than that, I would probably wear them all.

J: Me explaining the 3rd section of the questions, followed by asking question 12.

P: I did try to do it on the way they felt on my skin, but umm yeah, but actually no, not necessarily, but there are some that I put wrong that I do entirely like, like the one before last, for example… the 108. I really like it, but then I really like the look of it, umm, so probably a bit of both.

J: Do you think it's hard to look at the handle and not just look at the aesthetics?

P: Yes, definitely.

J: So, when you consider buying a garment, what is more important to you, the look of the garment or the materials it's made from?

P: Hmmm… I wish I could say it's fully the material it's made of, but I think it's a bit of both. I try to use sustainable materials or things I know can last longer. So, I don't mind paying a bit more money so things will last a long time if it's a suitable material, but if it doesn't look nice, I won't buy it.

J: I think it is very hard to have one without the other, and I think you will always be drawn to the look and then look at the label inside and see what it's made of.

P: Yeah.

J: Explaining the final question and asking it…

P: I found it easy… well, it's more difficult in the sense that it's more difficult to remember where we put each one, which one was the hardest, and which one was the softest. So, it was more difficult in that sense. Still, I think it was better in that it helped me to focus on the actual material and not get distracted by, you know, I wouldn't say I like this colour so that I will put it with the hard materials, so I didn't have that because it was all the same colours.

8.12 Sampling Matrix in full

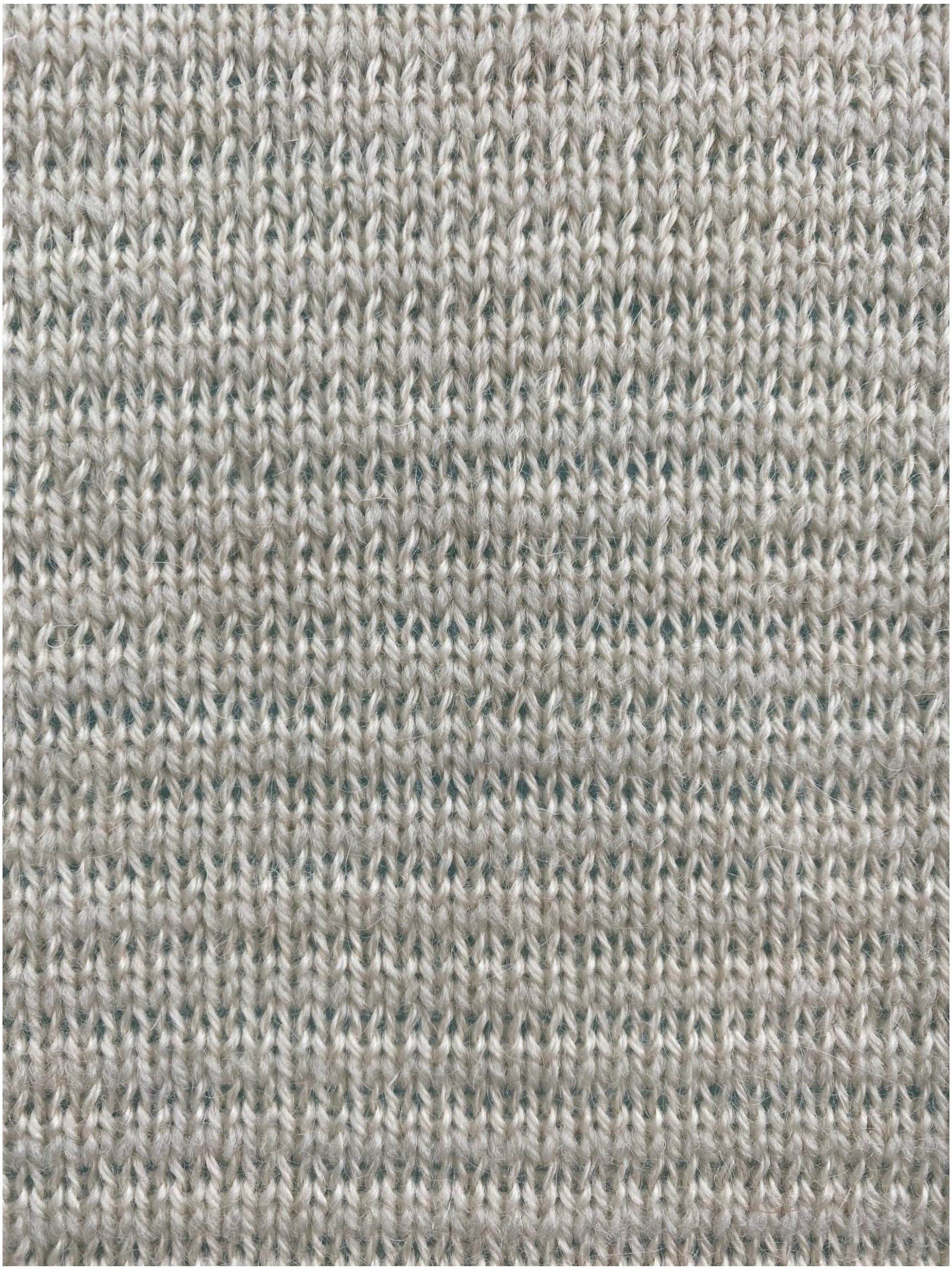
This link can be used to download a copy of the sampling matrix file.

https://523c6efc-c19a-4367-b279-0cec13b3636a.filesusr.com/ugd/1a08c0_5c1c149255254c1c8df4c5968c5086c5.xlsx?dn=Sampling_matrix_final_20221130.xlsx

8.13 Examples of the standout fabrics created in each pattern group, enlarged.

All images can be found online at https://juliamarywilmott.wixsite.com/newyarnblends

Stripe



1x1 three-colour stripe: Sample 1

Sample 158

Sample 328

Sample 56

Sample 272