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Date: July 6, 2019
THE USE OF HIGH-WHORL SPINDLES TO CREATE

KNOT, SNARL, SPIRAL AND BOUCLÉ

NOVELTY YARNS

Jo-Anne Leslie Tabachek

Olds College Master Spinners In-Depth Study

Submitted to Olds College: July 2012

BOOK 1
I dedicate this work to my husband, Edward Tabachek, whose beautiful spindles were used throughout this In-Depth Study. He always encouraged me throughout my six Levels of the Master Spinner programme, drove us to Olds College from Manitoba, “hung out” while I attended classes, learned to spin and enjoyed the friendship of spinners. His beautifully woodturned spindles were always a pleasure to use.
ABSTRACT

Novelty yarns requiring special manipulation during plying were spun using only high-whorl spindles. The four novelty yarns included knot, snarl, spiral and bouclé. The literature review showed there was no standard method for spinning any of these yarns using a spinning wheel. Authors used different amounts of twist and directions of twist for spinning each of the component singles yarns (core, wrapper, binder) and for plying the component yarns together. As many different techniques as possible were used and compared in the spinning of twelve knot, snarl, spiral and bouclé yarns.

It was possible to spin all the singles and ply the four types of yarn using only high-whorl spindles; however, it took more time to ply them compared to plying them with a spinning wheel or compared to plying regular plied yarns with a high-whorl spindle. Bouclé yarns took the most time to ply. Different ways of manipulating the singles were explored in an attempt to make the plying process more efficient. The more frequent the knots, snarls or loops, the more time was required to ply the yarns.

There were advantages and disadvantages to spinning each type of yarn using different plying directions for the component single yarns. SZS yarns had the advantage over ZZS yarns because SZS yarns did not lose their core twist during plying to the point of disintegration the way that ZZS yarns did.
# TABLE OF CONTENTS

Abstract 2  
Table of Contents 3  
Introduction 4  
Twist and Grist 5  
Hand Spindles 8  
  Supported Spindles 8  
  Suspended or Unsupported Spindles 10  
Novelty Yarns 14  
  Novelty Yarns vs. Designer, Fancy or Art Yarns 14  
  History of Novelty Yarns 15  
  Confusion in Names of Novelty Yarns 15  
  Novelty Yarn Components and Selection of Appropriate Fibres 17  
  Core 17  
  Wrapper 17  
  Binder 18  
  Use of Commercial Yarns as Core or Binder 18  
  Spinning Novelty Yarns with a Spinning Wheel vs. a Hand Spindle 19  
  Knot Yarn 20  
  Snarl Yarn 22  
  Spiral Yarn 24  
  Bouclé Yarn 26  
  Using Novelty Yarns 28  
    Novelty Yarns for Knitting 28  
    Novelty Yarns for Weaving 29  
    Articles to Make with Novelty Yarns 31  
    Calculating Yards of Single and Plied Yarns Required 31  
Materials and Methods 32  
  Spinning Single Yarn for Novelty Yarns Using High-whorl Spindles 32  
  Plying Techniques for Novelty Yarns Using High-whorl Spindles 34  
  Measuring and Finishing Yarns 37  
Results and Discussion 38  
  Binder vs. Cable for SZS Yarns 38  
  Knot Yarn Results 39  
  Snarl Yarn Results 53  
  Spiral Yarn Results 69  
  Bouclé Yarn Results 83  
Conclusions 98  
References 101  
Appendix 1. Specifications of high-whorl spindles used in this study 104  
Appendix 2. Commercial yarns used in weaving and knitting samples 105  
Appendix 3. Weaving draft #1 (Supplementary Weft) 106  
Appendix 4. Weaving draft #2 (Supplementary Weft, 3/1Twill and Tabby) 107
INTRODUCTION

Many exciting commercial yarns are being manufactured which have distinctive textures. These yarns are evident in any local knitting supplies store. The interest in knitting has increased tremendously. In Canada, a new generation of knitters is present (Clayton, 2006) and I have seen the formation of knitting groups in yarn stores in a number of Canadian cities. In the United States, a survey of craftspeople shows that, “73% of knitters (the largest needlearts group) noted they had started or increased knitting since 2000.” (The National Needlearts Association 2005, p. 5), and that, “Knitters and crocheters are most likely to spin: 14% of knitters and crocheters spin…” (p. 96). New spinners, who may also be knitters, may have seen and/or used a wide variety of commercial novelty yarns and may want to spin similar types of yarns. Many people are introduced to spinning by using hand spindles and may continue to spin with spindles exclusively or as an alternative to a spinning wheel. The knowledge of how to spin novelty yarns with only a hand spindle would expand the types of yarns that can be created by both new and experienced spindle spinners.

When I first considered using high-whorl spindles to spin novelty yarns, I knew this would be possible to achieve for some yarns. Some novelty yarns are easy to spin with a high-whorl spindle, such as those created through carding and blending (heather, garnetted) or through plying techniques (marl, cable, Navajo plying) (Varney, 1987). However, I was intrigued with using high-whorl spindles to spin novelty yarns that are based on unusual manipulation during plying (knot, snarl, spiral, and bouclé yarns). This in-depth study focuses specifically on creating these four novelty yarns using only high-whorl spindles.
TWIST AND GRIST

Creating novelty yarns requires a thorough understanding of grist and twist (both in the direction of twist and the amount of twist) and how twist and grist relate to the choice of fibre. If spinners understand twist and grist, it is possible to create unconventional yarns that are consistent and repeatable. Some yarns, such as snarl, bouclé and spiral, require spinning 2 or 3 different single yarns, each requiring a specific grist and twists per inch. Other yarns, such as knot and snarl yarn, require spinning singles with greater than normal twist.

Amos (2001, p. 467) defines twist as, "Rotation about a common longitudinal axis. ... one end of the item being twisted is fixed, or non-rotating, relative to the other, or working end." Thus, twist is imparted into fibres by having one end of the fibre (the fibre source) fixed with the other end of the fibre receiving twist from the working end (the spindle). When twist is coming from a spindle turning clockwise, a Z-twist is imparted on the fibres. When twist is coming from a spindle turning counterclockwise, an S-twist is imparted on the fibres. If the twisted fibres slant in the same direction as the centre part of the letter Z, it is Z-twist (Fig. 1). If the twisted fibres slant in the same direction as the centre part of the letter S, it is S-twist.

Fig. 1. Z and S twist.
Most single yarn is spun with Z twist, although flax is often spun with S twist because flax fibre has a natural S twist (Irwin, 2001). When two or more Z-spun singles are plied together, they are plied with S twist, although some novelty yarns do not follow this convention. Twist is determined by the number of rotations allowed to accumulate in a given length of yarn. It is measured as the number of twists per inch (tpi). The twists per inch in a plied yarn can be measured by letting a length of freshly spun single ply back on itself. The twists per inch in this plied yarn can be measured by laying the yarn on a ruler and counting the number of “bumps” in one inch and dividing by the number of plies (Fig. 2).

![Twist measurement diagram](image)

11 bumps per inch / 2 plies = 5.5 twists per inch

Fig. 2. Measuring twists per inch.

It is essential for singles to be “freshly spun” as the twist can become set very quickly when a single sits on the spindle or bobbin (Olds College, 2007). If the twist becomes set in the single, even for a few minutes, and it is then plied back on itself, the active (real) twists per inch will be underestimated. When freshly spun yarn is plied or when it folds back on itself, the yarn loses twist to become balanced. If the yarn measures 5.5 tpi after plying, the singles, before plying, contained 1.5 to 2 times that amount, or 8.25-11 tpi.

In addition to measuring twists per inch, another method of assessing twist is by measuring the “angle of twist” which refers to the angle the fibres lie in a singles or plied yarn. An angle guide, such as the one in Ross’s (1983) book, can be used to measure the angle of twist. Irrespective of the diameter of the yarn, the more tightly a yarn is spun, the higher its angle of twist and the harsher the feel of the yarn (Ross, 1983, 1988). The less tightly a yarn is spun, the lower the angle of twist and the softer the feel of the yarn. Yarns with a high angle of twist (greater than 29°) are able to withstand abrasion and this makes them suitable for embroidery and warp for
weaving. Yarns with a lower angle of twist (12-20°) are soft and suitable for a soft knitting yarn while yarns with 21-29° angle of twist are excellent for knitting hard-wearing garments. Thin yarn requires a higher number of twists per inch to reach the same angle of twist compared to thick yarn (Ross, 1983).

Grist is the diameter or thickness of the yarn and it can be measured as either the diameter of the single or of the plied yarn. It is measured as wraps per inch (wpi). Grist is governed by the diameter of each fibre and the number of fibres the spinner allows into the drafting zone. Drafting with a low number of fibres results in a thin yarn (high wpi) while drafting with a high number of fibres results in a thick yarn (low wpi). Ross (1988, p. 94) defines grist as, "The size of a yarn. Formerly, and still sometimes, expressed as its length per unit weight". As more twist is added to a yarn, the fibre compresses, the grist decreases (wpi increases) and the yarn shortens in length. Conversely, when twist is removed from compressed yarn, the yarn expands and the yarn lengthens.

Fibre length and coarseness, as well as yarn grist and twist, are all inter-related. Fine diameter fibres, especially wool, are shorter than coarse diameter fibres. Fine diameter, short fibres are suited to spinning thin yarns but thin yarns need to be spun with more twists per inch to produce stable yarns where the fibres are "locked" in by the twist and will not drift apart (Ross, 1983). Fine diameter wool fibres have more crimp and more scales giving them a duller appearance while long wool fibres are coarser but have fewer scales making them more lustrous (Field, 1995).

Fine wool breeds, including Merino, Polwarth, Rambouillet and Corriedale (Fournier & Fournier, 1995), have finer, shorter, crimpier fibres. Adult mohair, longwool and crossbred wools, including Blue-faced Leicester, Coopworth, Romney, Lincoln, Masham, Teeswater and Wensleydale, have longer, coarser and more lustrous fibres. Other fine fibres include silk, alpaca, kid mohair, cotton, cashmere, camel, bison and synthetics.
HAND SPINDLES

Hand spindles are spinning tools with an ancient history. Spindles have been used for at least 10,000 years and their history has been documented (Hochberg, 1977). Spindles were made all over the world using materials that were available in that locale and invented to spin whatever fibres were available in that part of the world. Spindle whorls were made of wood, stone, clay, shell, metal and other materials while spindle shafts were generally made of wood, metal or bone. In general, spindles consist of a whorl, a shaft and sometimes a notch or hook at or near the end of the shaft (Fig. 3).

![Diagram of spindle parts](hook, whorl, cop, shaft)

Fig. 3. Parts of a high-whorl (suspended) spindle.

Hand spindles can be divided into two major categories, depending on whether the spindle is supported during spinning or hangs suspended in the air while spinning:

**Supported spindles**

A supported spindle spins while the end of the spindle is supported on the ground, in a shallow bowl or on the spinner’s thigh. The whorl is located near the base of the spindle, keeping the center of gravity low (Fig. 4). Supported spindles are
used for spinning woolen long draw from a woollen preparation (rolag or puni). Most supported spindles are ideal for spinning short and/or delicate fibres such as cotton, camel, cashmere and bison (Franquemont, 2009). Some authors say that it is more difficult to spin short or delicate fibres with a suspended spindle because these fibres tend to break more easily under the weight of the spindle (Delaney, 1998). However, one experienced spinner says she has no difficulty in spinning these fibres with suspended spindles (C. Nimetz, personal communication, September 19, 2012). Using a high quality spindle makes this easier to achieve. Franquemont (2009) says it is "tricky" to accomplish at first, but it can be done.

![Fig. 4. Supported spindles and a spinning bowl.](image_url)

Some supported spindles, such as Navajo and Salish spindles, have large whorls and medium to long shafts and are made to spin while supported on the ground while the spinner is seated on the ground or on a low seat. Navajo spindles are used to spin wool or mohair (Muller, 1995) while Salish spindles are used to spin nettle or wool (Loughran-Delahunt, 1995).
Suspended or unsupported spindles
A suspended spindle spins while suspended from the yarn (Fig. 5). Suspended spindles can be divided into two groups depending on the position of the whorl. High-whorl spindles have the whorl positioned near the top of the spindle, while low-whorl spindles have the whorl positioned near the bottom of the spindle (Franquemont, 2009).

![Fig. 5. High-whorl (left) and low-whorl (right) spindles.](image)

High- and low-whorl spindles are used for spinning medium to long fibres that are strong enough to bear the weight of the spindle. They can be used to spin wools from short Merino wool to long Lincoln and Wensleydale wool, as well as mohair, silk, alpaca, synthetics and many other fibres. They are used for spinning worsted from a worsted preparation (combed top) or semi-worsted from a carded preparation or from the fold. Throughout this in-depth study, only high-whorl suspended spindles were used.
Choosing a spindle is influenced by the weight of yarn to be spun – a lighter weight spindle for spinning fine yarn and a heavier spindle for thick yarn (Franquemont, 2009). This is not simply due to the capacity of the spindle; it is due to physics. The weight of a spindle is related to the diameter of the whorl and the material from which it is made. A high-density whorl made of rosewood produces a heavier spindle than a spindle with a whorl of equal diameter made of a low-density wood, such as lacewood. Heavy spindles tend to spin longer than light spindles, although heavy spindles require more energy to put in motion.

Rim-weighted spindles tend to spin for a longer time, but more slowly, than centre-weighted spindles, making rim-weighted spindles suited to spinning thick yarn requiring lower twists per inch. The speed of rotation and length of time a spindle rotates are influenced by the location of the weight of the whorl. If the weight of the whorl is more concentrated around the outer rim, the spindle will rotate for a longer period of time. When a rotating spindle runs out of energy, it slows and then starts to back spin – that is, it begins to spin in the opposite direction. When this happens, it removes the twist in the yarn, weakening the yarn to the point where it breaks.

For fine yarn, it is best to choose a spindle that is not so heavy that it breaks the yarn before the yarn has sufficient twists per inch to give it strength. It is best to have a spindle that spins fast to put enough twists per inch into the yarn quickly and long enough so it does not start to back spin. For thick yarn, it is best to choose a spindle that is heavy enough to stay in motion for a long time and one that has a wide enough whorl to hold a sufficient quantity of thick yarn. It is good to use a spindle that spins for a long time even at a slower speed of rotation. It is easier to create a wider range of yarns with a heavier spindle compared to a lighter weight spindle. Creating novelty yarns often requires spinning two or more different singles with different fibres, grists and twists. Having a variety of spindle weights can be a great help in spinning these singles.
There are many reasons for a person to choose to spin with a hand spindle. Spindles are simple low-technology tools that can be used by people of all ages and all levels of experience and expertise. Spindles are often used in teaching people how to spin. Spindles are less expensive than a spinning wheel. Although spinning with a spinning wheel may produce yarn faster, spinners may choose to continue spinning with spindles because they are very portable, allowing a spinner to spin in places where they would be unable to use a spinning wheel. In addition, spindles have a wonderful tactile feel, adding a meditative quality to the spinning.

Since the 1990's, there has been increased popularity in spindles. A number of books have been published specifically on the topic of spindles (Delaney, 1998; Franquemont, 2009; Gibson-Roberts, 1998; Hochberg, 1977). On-line groups such as Yahoo groups “Spindlers” and “Spindlitis” emerged in 2001. They are dedicated to spindle spinners, having over 3,744 and 1,472 members respectively as of December 18, 2011 (Yahoo, 2011). “Ravelry” is a popular Yahoo group with 7,756 members in a sub-group dedicated to spindlers as of the same date (Ravelry, 2011). Videos on spindle spinning are readily available for purchase or as short video clips on YouTube (too numerous to reference).

In the 1990's, there were very few woodturners producing spindles but today many skilled craftspeople produce them, making it much easier to purchase a good quality spindle that spins well. Throughout this study, a range of different sizes and weights of high-whorl spindles were used (Fig. 6). These spindles were all made by Edward Tabachek, well-known for making well-balanced spindles. These spindles were all the same style of rim-weighted spindle enabling standardization of the spinning of the four types of novelty yarns and allowing me to be aware of other differences among spinning these yarns.
Fig. 6. Different sizes of spindles used. From the top: Tabachek Plying, Deluxe, Compact Deluxe and Mini high-whorl spindles.

While I did not use spindles made by other makers (Fig. 7), there is no reason why they could not be used to make these novelty yarns.

Fig. 7. High-whorl spindles made by (from left to right) Stephen Kundert, Tom Forrester, Edward Tabachek, Jonathan Bosworth and Adam Mielke.
NOVELTY YARNS

Novelty Yarns vs. Designer, Fancy, or Art Yarns

Throughout this thesis, knot, snarl, spiral and bouclé yarns are called “novelty yarns” (Amos, 2001; Field, revised 1995; King, 2009; McCuin, 2007, 2009; Wingate, 1979). Other authors refer to these yarns as “designer yarns” (Mushka, 2009; Varney, 1987), “fancy yarns” (Gong and Wright, 2002; Lawrence, 2003; Ross, 1983) and “art yarns” (Boggs, 2011; North, 2010).

Lawrence (2003) defines fancy yarn as, “a yarn that is made with a distinctive irregular profile or a construction that differs from basic single and folded yarns, the objective of which is to enhance the aesthetics of the end product with respect to visual and textural properties.” Ross (1983, p. 74) refers to fancy yarns as, “... having deliberately introduced irregularities in their construction, such as variations in thickness and unevenly combined component threads forming loops, projections, slubs, etc. which provide texture in the final fabric produced, whether by knitting or weaving.”

Amos (2001, p. 448) defines novelty yarn as, “Yarn of a class designed to have an unusual appearance or character.” He refers to novelty yarn as, “Imperfectly spun or constructed yarn.” I do not think of novelty yarns as imperfectly spun or constructed if the spinner intends to spin yarns in a non-traditional manner.
History of Novelty Yarns

According to Merriam-Webster’s on-line dictionary (Merriam-Webster, 2012), the first known use of boucle yarn was in 1886. Most novelty yarns were developed after the 1940’s (McCuin, 2005). Today, novelty yarns are produced commercially in spinning mills using complex machinery that has rollers, tensioning devices and ways of feeding each single or plied yarn independently at a specific speed and tension (Gong and Wright, 2002). Machines allow for more than one yarn to be fed independently during the same process (Gong and Wright, 2002). For example, when the ring system is used to spin boucle, two fine yarns are fed under tension at the same time as a low-tension thicker yarn which forms the loops. The two fine yarns remain separated on either side of the thicker yarn until the precise time when the three yarns converge and twist, with the loops secured between the two fine yarns. Producing a boucle yarn with a spindle or a spinning wheel requires a number of separate operations and the ability to tension and twist all the yarns correctly.

Confusion in the Names of Novelty Yarns

The literature on novelty yarns uses a confusing array of names for the same yarn (Table 1). For example, knot yarn is also referred to as “knop” (Amos, 2001; Ross, 1988), “knot, seed or knop” (Varney, 1987), “Turkish knot” (McCuin, 2005, 2007), “knotted” (Mushka, 2009), “seed” (Olds College, 2007), “nub” (Bryant and Klein, 2001; Wingate, 1979) or “stacks” (Boggs, 2011). Snarl yarn is referred to as “snarly” yarn (Olds College, 2010), “snarls or frise” (Walsh, 2006), “ewelash” (not eyelash) (King, 2009), “worms” (North, 2010) or “twists” (Boggs, 2011). Spiral yarn is called “bead” (Field, 1995) or “seed” yarn (McCuin, 2007). Boucle yarn is referred to as “loop” yarn (Ross, 1988; Varney-1987), “curled loop” (Ross, 1983) or “loopy boucle” (Varney, 1987). Mushka (2009) spun “kese” yarn that was a type of knot or boucle. It is necessary to read the author’s description of how each yarn is made before the reader understands the connections among the names.
Table 1. Comparison of names used by different authors to denote the same yarn. An "x" indicates the author used the name shown in the left-hand column. When an author used a different name than the one shown in the left-hand column, the different name is shown.

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<td>Knot</td>
<td>x</td>
<td>knop</td>
<td>knop, seed or knot</td>
<td>x</td>
<td>Turkish knot</td>
<td>Turkish knot</td>
<td>knop</td>
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<td>Snarl</td>
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<td></td>
<td></td>
<td>x</td>
<td>snarl or frise</td>
<td>ewelash</td>
<td>worms</td>
<td>twists</td>
<td>x</td>
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<td>Spiral</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>seed, wrapped spiral</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td>x</td>
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<td>x</td>
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<tr>
<td>Bouclé</td>
<td>curled loop</td>
<td>loop</td>
<td>loopy bouclé</td>
<td>x</td>
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<td>x</td>
<td>x</td>
<td>kese</td>
<td>(knot or boucle-like)</td>
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A number of terms are used to describe the components of novelty yarns:

**Core** – This is the single or plied yarn that is usually spun to a fine grist and a high twist. Textile books refer to it as the “ground or foundation” (Kadolph, 2010) or as the “base (or central yarn)” (Ross, 1988, p. 31). It is held taut, in line with the orifice and must have the strength and degree of twist not to disintegrate while the wrapper is being manipulated during plying. Some core yarns are spun in the opposite direction to the wrapper and with a lower twist than normal so that they will increase in twist and decrease in grist during the plying process.

Since the core is spun to a fine grist and high twist, a short fibre is appropriate, including fine wools such as Merino and Polwarth as well as cotton or synthetics such as rayon. Slippery fibres such as rayon or silk make a suitable core for bouclé where the wrapper is pushed along the core to form loops but these fibres may be too slippery for a spiral yarn. Sometimes a commercial plied yarn is used for the core. McCuin (2007) used commercial 20/2 cotton yarn (plied S) as the core for a hemp bouclé yarn and Mushka (2009) used commercial Z-plied crochet cotton for the core for kese yarn (bouclé) with a flax wrapper. There are commercial spiral yarns with cores as fine as sewing thread and others that use yarns with several plies of fine cotton as the core.

**Wrapper** – This is the single that is often spun at a thicker grist and lower twist compared to the core. It is often referred to as the “effect” or “fancy” yarn, especially in textile books (Kadolph, 2010). Ross (1988, p. 31) sometimes refers to the wrapper as the “decorating (or looping yarn)” as she does in her description of bouclé. When plying, the wrapper is often held at an angle to and more loosely than the core, so that it wraps around the core. The wrapper is more visible than the core and the fibre needs to be carefully selected. Since the wrapper is spun to a thick grist and low twist, a long fibre is appropriate. Varney (1987) was unable to spin bouclé with well-defined loops until she tried using a stiff fibre such as commercial
mohair top for the wrapper. She says carded preparations of long-staple lustrous wool and mohair top make fluffy loops. Ross (1983) suggests Wensleydale wool for the wrapper for bouclé. Commercial bouclé yarns are made with a wide variety of fibres for the wrapper, including wool, silk, mohair, flax and synthetics as well as cotton.

Sometimes, both singles are alike with no difference in twist or grist and have the same function, alternately trading places as the core and wrapper.

**Binder**— If a third single or plied yarn is needed to balance an unbalanced 2-ply yarn, a fine binder yarn is spun in the same direction as the 2-ply yarn was plied. Ross (1988, p. 31) sometimes refers to the binder as the “wrapping yarn” as she does in her description of bouclé. A short fibre is appropriate because this is a fine single. The binder can be contrasting in fibre and/or colour or it can be chosen to blend with the wrapper to be less noticeable. If a shiny binder is wanted, fibres such as silk, rayon, metallics or other synthetics can be used. Sometimes sewing thread is suggested as a binder (Varney, 1997) and can be mercerized cotton or polyester.

### Use of Commercial Yarns as Core or Binder

Some authors use commercial yarn as the core or binder in their novelty yarns (Boggs, 2011; McCuin, 2005, 2009; Mushka, 2009; Varney, 1987). Boggs (2011) explained that, before using commercial thread or yarn, it should be spun in the direction opposite to the direction it will be spun in the yarn. By doing this, the commercial yarn will return to its original state. Mushka (2009) also added extra twist to commercial thread and yarn in her wrapped spiral and beaded cable yarns.
Spinning Novelty Yarns with a Spinning Wheel vs. a Hand Spindle

For each of the four novelty yarns studied here, there are many differences between how each author describes making them with a spinning wheel including the direction of twist for each component and the direction of plying. These differences will be discussed later. Many authors (Table 1) give instructions on spinning specific novelty yarns using a spinning wheel but only McCuin (2007) mentions spinning any of these four novelty yarns with a hand spindle. She says, “Seed yarn can be made on a hand spindle or a wheel.” (p. 124), and by “seed” yarn she is referring to spiral yarn made by plying together a firm thin single (core) and a soft thick single (wrapper). For Turkish knot yarn she says (p. 125), “...that because you need two free hands, this is a difficult yarn to create on a hand spindle” and that wrapped spiral yarn “cannot be made on a hand spindle” (p. 124). For bouclé, she says, “...bouclé yarns can only be made on a spinning wheel, not on a hand spindle” (p. 128). The fact that the spinner in McCuin’s book uses only a low-whorl spindle and never a high-whorl spindle may have influenced these statements about the inability to spin these novelty yarns with a spindle. High-whorl spindles are easier to “park and draft” (hold the spindle between one’s knees while drafting or manipulating the singles) compared to low-whorl spindles. This allows the spinner to use both hands to manipulate the plies when creating novelty yarns with a high-whorl spindle.

For clarity, I have assigned specific Z and S directions to each step for spinning singles, as well as plying and replying yarns. Some authors do not state specifically which direction yarns are being spun. Often, they use the terms “clockwise” or “spin to the right” for Z and “counter clockwise” or “spin to the left” for S. I have used their descriptive terms and/or photographs to assign twist directions to their statements.
Knot Yarn

Knot yarn is characterized as a yarn with raised knots or nubs along its surface. Fairchild’s Dictionary of Textiles refers to manufactured knot yarn (nub or knop yarn) (p. 400) as, “A novelty yarn containing slubs or lumps which are introduced intentionally. Coarse, hard twisted, single yarn forms the nubs, the foundation yarn is delivered slowly at intermittent speed while the delivery of the coarser, hard twisted yarn is quicker and continuous, resulting in the intermittent accumulation of this thread. The effect thread may be of different color and/or material.”

Ross (1988) refers to knot yarn (knop yarn) as a 2-ply yarn made with singles of different colours. A binder of yarn or sewing thread can be added to secure the knots (Gong and Wright, 2002). Creating the knots during plying is done by holding the two singles in separate hands, holding the core taut and in line with the orifice. The wrapper is held more loosely and at an angle to the core. The wrapper is moved up and down along the core, building up a knot on the core. Then the 2-ply yarn is taken up onto the bobbin and a section of normal 2-ply yarn is created before forming the next knot. Boggs (2011) recommends building up the knot (which she calls a “stack”) carefully, with the wraps sitting tightly next to each other rather than letting the wrapper jump up and down from top to bottom repeatedly, an action that can cause a knot with loose ends. She also anchors the knot by letting the core yarn wrap around the base of the knot.

Knot yarns can differ in the direction of twist of the component yarns, in the use of a binder, if one yarn forms all the knots or if core and wrapper yarns alternate in forming the knots. They can also vary in the size and frequency of the knots.
There are two main ways to make this yarn:

a) ZZS: Most authors refer to knot yarn as being made ZZS (Amos, 2001; Boggs, 2011; Field, 1995; Olds College, 2008, 2010; Mushka, 2009; Ross, 1988; Varney, 1987). Two Z-spun singles are plied S to create a balanced yarn with either one or both singles being used to form knots during plying. If the 2-ply yarn has too much twist, both Varney (1987) and McCuin (2007) suggest using a fine yarn such as sewing thread as a binder to ply a second time, but in the opposite direction, to create a balanced 3-ply yarn. Alternatively, McCuin (2007) recommends cabling the 2-ply yarn back on itself to balance the yarn.

As S ply twist is being added, the taut core single is losing Z-twist. If it loses enough Z-twist, it can weaken and break. To overcome this problem, the single should be spun with firm, or extra twist (McCuin, 2007; Varney, 1987) or the single used to form the knots should be alternated (Amos, 2001; Field, 1995; Varney, 1987). If using only one of the singles (the wrapper) to form all the knots, Ross (1988) recommends giving the core extra twist. However, Mushka (2009) used only one of the singles to make all the knots and produces a stable yarn even though she spins both singles with the same grist and the same degree of Z twist.

b) SZS: An alternate method for knot yarn is to spin an SZS yarn. (Ross, 1983, 1988) uses a low twist S core (4 tpi, 20 wpi) and a high twist Z wrapper (8 tpi 20 wpi) and plies them S, using only the wrapper to form knots. By plying in the same direction as the core, twist is added to the low twist core and removed from the high twist wrapper. With this method, which uses the same single to form all the knots, the core does not become weak or disintegrate during plying.
Snarl Yarn

Snarl yarns are characterized as having tightly twisted sections of yarn projecting from the yarn's surface. Snarl yarns can be made in several ways that differ in the direction of twist of the component yarns, in the use of a binder, if one yarn forms all the snarls or if core and wrapper yarns alternate in forming the snarls. They can also vary in length and frequency of the snarls, and whether the snarl is formed singly or in groups of snarls. Fairchild's Dictionary of Textiles defines manufactured snarl yarn (p. 543) as, “A novelty ply yarn made by twisting hard spun thread with thread that has less twist. The hard twist thread is delivered at a faster rate, producing projecting tightly twisted loops or kinks.”

There are many methods to spin snarl yarns:

a) ZZS (or alternatively SSZ) with no binder. Both Ross (1988) and King (2009) describe making 2-ply snarl yarns with a Z-spun core and Z-spun high twist wrapper and plying S while forming the snarls with the high twist wrapper. Ross’s singles are fine with a highly twisted wrapper (15 tpi) and she recommends that the snarls be neither too long nor too frequent to avoid the wrapper running out of twist. North (2010) uses two medium grist Z-spun singles and plies S while forming long snarls (which she calls “worms”).

Thinner grist areas accumulate more twist in a yarn and Boggs (2011) uses this to advantage in her snarl yarns (which she calls “twists”). Sometimes she spins these thinner areas with a different colour fibre. During plying, she watches for these higher twist thinner areas and folds these sections into snarls. Boggs also anchors all her snarls by wrapping the non-snarl single once around the base of the snarl while the base of the snarl is still being pinched together.
b) ZZZ then plied S with a Z-binder: Varney (1987) and Olds College (2007) describe spinning snarl yarn with a fine Z-spun core and a very over-twisted Z-spun wrapper which is less fine to medium weight. These are plied together in the same direction as the singles (Z) while forming a snarl by pulling up a small section of wrapper, letting it double back and securing the snarl where it meets the 2-ply yarn. This produces a very energized 2-ply yarn that is stabilized by plying it S with a fine Z-spun binder yarn. With this method, only the wrapper forms the snarls. An alternative to using a binder is to cable snarl yarns together in the opposite direction (S) to create a bulkier yarn with lots of snarls.

c) SZZ with a binder: Another version of snarl yarn is to spin a fine lower-twist S core and a fine to medium over-twisted Z wrapper (Olds College, 2010). These singles are plied together with Z twist using only the wrapper to form the snarls. The 2-ply yarn is then plied in the opposite direction (S) with a fine Z binder yarn to create a 3-ply yarn. I tried this method but I did not like either the appearance of the 2-ply yarn or the difficulties I experienced in plying it. The low twist core became even more fluffy in appearance as it lost its S-twist during plying and the core often broke when its twist became too low.

d) SZS with a binder or cabled: No reference was found for an SZS snarl yarn, but it produces a better yarn than the SZZ method. A low S-twist core yarn and a high Z-twist wrapper yarn are plied S with the wrapper forming snarls. By plying these two singles S, the low S-twist core gains twist, compacting and shortening the core yarn while the high Z-twist wrapper yarn loses twist and increases in grist, making the two singles more similar in grist. The core does not lose twist and become weak enough to break as it does with SZZ. The 2-ply yarn could be plied Z with a fine S binder yarn or cabled Z for a “super snarl” 4-ply yarn.
Spiral Yarn

Spiral yarns are characterized as 2-ply yarns with contrast in grist and twist between the two singles with the thinner single as the core and the thicker single as the wrapper (Ross, 1988). To ply, the core is held taut in one hand and in line with the orifice and most authors describe holding the wrapper more loosely in the other hand and at an angle to the core. The thick wrapper spirals around the thin core as the core shortens in length. Ross (1988) suggests “working close to the orifice” when plying this yarn.

Fairchild’s Dictionary of Textiles defines manufactured spiral yarn (p. 551) as, “Novelty yarn with a pronounced spiral effect obtained by twisting together two yarns of different counts and/or twists, direction of twist, or a single and a doubled yarn. The fine yarn is usually given a hard twist and the heavy yarn a slack twist; in spinning, the heavier yarn is wound spirally around the fine yarn. Different colored yarns may be used for considerably varied effects.”

Spiral yarns can be spun in several ways that differ in the direction and amount of core twist and the grist of the single yarns:

a) ZZS: Most authors describe spinning spiral yarns ZZS with a fine Z core and thick Z wrapper, then plying S (Amos, 2001; Boggs, 2011; McCuin, 2007; Olds College 2007, 2010 and Ross 1983, 1988). Ross (1983) calls this “thin and thick spiral yarn” and suggests a core of 25 wpi with a 30° angle of twist and a wrapper of 13 wpi and 21-24° angle of Z twist. McCuin (2007, p. 124) calls this “seed yarn” and says, “Seed yarn can be made on a hand spindle or a wheel.”

b) SZS: Another method is to spin an SZS yarn, plying S with a fine S core and thick Z wrapper (Field, 1995; Ross 1983, 1988; Varney, 1987). Ross (1983) refers to this yarn as “S&Z spiral yarn” while Field (1995) calls this “bead” yarn. As with knot and snarl yarns, plying in the same direction as the core adds more twist to the low twist core as twist is removed from the high twist wrapper. This increases the bulkiness of the thick wrapper and decreases the grist of the fine core, accentuating the size
difference. It also prevents the core from disintegrating during plying which could occur with a ZZS spiral yarn. Ross (1983, 1988) mentions that the core should be spun with a very low or even a minimum amount of S twist with the wrapper having a moderate amount of Z twist.

c) ZZS with wrapper and core trading places:
A third method requires the core and wrapper to be the same grist and twist and spun Z (McCuin, 2007; Ross, 1983). The singles are plied S into a ZZS yarn with the wrapper and core trading places, alternately wrapping around each other for several inches. Ross refers to this as “cloud yarn”. McCuin, who alternates singles every 6-8”, refers to this as “wrapped spiral” yarn and says, “Wrapped spiral yarn cannot be made on a hand spindle.” (p. 124). Gong and Wright (2002) refer to “cloud or grandelle yarn” and say the change from one yarn to another can be sudden, producing a sudden change in colour in which one colour completely “clouds” the other, or it may be gradual, producing a blended appearance in colour.

Spiral yarns are usually 2-ply yarns, but when excess twist is inserted during plying, the plied yarn can be cabled to produce “corkscrew” yarn (Ross, 1983). The only reference found for a 3-ply spiral yarn (Olds College, 2008) describes making a yarn that appears to be what is commonly known as “corespinning” (Varney, 1987) where unspun fibres are wrapped around a fine Z core while spinning Z, then plied S with a fine Z binder.

Spiral yarns can also be spun with one fine smooth single and one single with slubs. McCuin (2007) calls this “flame” yarn and plies it with even tension. Ross (1983) calls this “slub spiral” yarn with a thick low twist Z slub core and a fine S wrapper, plying S to decrease the slub twist and increase the wrapper twist. The thin wrapper is held at a high angle to the core when the wrapper passes over a slub and in a normal ply position for the rest.
Bouclé Yarn

Bouclé yarn is characterized as yarn with loops. Bouclé yarns vary in the size, shape and frequency of the loops, as well as the amount of contrast between the loops and the core and binder yarns. Bouclé yarn begins just like a spiral yarn with the core held taut and in line with the orifice of the spinning wheel, while the wrapper is held more loosely and at 45-60° up to 90° relative to the core. Some authors recommend plying with the core and wrapper positioned on opposite sides (Field, 1995; McCuin, 2007). The wrapper spirals around the core and can be pushed along the core for more loops or held at a lower angle for fewer loops. The amount of twist in the wrapper determines the size and shape of the loops with higher twist resulting in smaller, more definite loops and less twist producing larger, softer loops (McCuin, 2007). Varney (1987) recommends mohair top for the wrapper to achieve defined loops, while Ross (1983) recommends lustrous longwool such as Wensleydale and says the wrapper should be twice the thickness of the core or binder. The core can also be fine commercial yarn (McCuin, 2007).

Plying with a binder balances the 2-ply's twist and holds the loops in place. The binder can be rayon or fine silk (Boggs, 2011; McCuin, 2007) or sewing thread (Field, 1995; McCuin, 2007; Varney, 1987). Varney recommends letting the looped 2-ply wrap loosely around the binder while King (2009) holds the binder and 2-ply together. Alternatively, the looped 2-ply yarn can be cabled to produce a very loopy yarn (McCuin, 2007; Varney, 1987).

Authors differ in the direction of twist for the core with one group using the core and wrapper with the same twist and others using the core and wrapper with opposite twists:

a) ZZS: Most authors describe using a fine Z core and a thick Z wrapper and plying S, before using an S binder and plying Z to balance the twist (Olds College 2007, 2008; Ross 1983, 1988; Varney, 1987).
Amos (2001) describes plying S with three Z singles (2 fine high twist and 1 thicker singles) at once, holding the two fine singles taut in one hand while the other hand holds the wrapper, "jogging" the wrapper back and forth to create loops. Amos' method sounds similar to the method used in the machine production of bouclé. Fairchild's Dictionary of Textiles defines commercial bouclé yarn (p. 74) as, "A rough, curly, knotted yarn with two fine foundation threads twisted together with a thicker, hard-twisted yarn which is delivered at a quicker rate than the foundation threads and is twisted with the former group in the opposite direction at half the number of turns per inch."

b) SSZ: King (2009) makes her bouclé yarn as SSZ but the principles are the same for an SSZ yarn as for a ZZS yarn.

c) SZS (or ZSZ): Another method for bouclé yarn is to use a fine S core and thick Z wrapper and ply S. Boggs (2011) uses SZS for bouclé and refers to McCuin's (2009, p. 95) advice for classic bouclé, "One yarn spun left, one yarn spun right; one thick yarn, one thin yarn; one low-twist yarn, one high-twist yarn." Not all of the other references for SZS bouclé follow this guideline. In contrast, King (2009) suggests a low twist S core (rather than firm twist) and a high twist Z wrapper, plying S, holding the core taut and the wrapper at 60 to 90°. Field (1995) recommends using a fine firm S-twist core and a wrapper with lower Z-twist, plying S, holding singles on opposite sides.

McCuin (2007) suggests using a 2-ply commercial yarn for the core. From McCuin's description, I assume that the 2-ply core could be plied S or Z. If the 2-ply core is S, the yarn would be spun SZS, while if the core is Z, the yarn would be spun ZSZ. In either case, plying increases the twist of the core, making it stronger and decreases the twist of the wrapper, making it easier to form loops rather than snarls.
Using Novelty Yarns

Novelty yarns with a lot of texture are best used as trim or accents in either knitted or woven items and are best used in moderation. Not only is this a matter of showing their texture best by contrast with smooth yarns, but it is also a matter of economics. Novelty yarns take a lot more time to produce compared to regular yarns. Some novelty yarns require three plies, each made differently, and the manipulation of the yarns during plying slows down the plying process considerably. When these yarns are made with a spindle rather than a spinning wheel, even more time is required to spin the single yarns and to ply them. Yarns such as knot, snarl and bouclé all have projections and these projections require extra yards of that single. When a lot of time has been invested in producing yarn, it is wise to choose projects and techniques that show them off to their best advantage.

Novelty Yarns for Knitting

Bryant and Klein (2001) state that bouclé loops and knots in knot (nub) yarns will generally end up on the reverse (purl) side of stockinette stitch. When knitting with bouclé yarns, they recommend garter stitch, reverse stockinette and slip-stitch patterns to show off the texture to advantage. For knot yarns, they recommend using reverse stockinette and garter stitch. Their book has wonderful photographs comparing the appearance of garter, stockinette, reverse stockinette, moss and slip stitch when knitted with different novelty yarns. Throughout their book, they show two versions of the same garment knitted with different novelty yarns. Their garments use novelty yarns to advantage in conjunction with smooth yarns. They show novelty yarns used in blocks, in regularly-spaced patterns, in bands of increasing widths up the sleeves and body into full use across the yoke. Bryant and Klein (2001) state that wool and mohair bouclé yarns hold their shape well while cotton and rayon bouclé yarns are “limp” and need to be knitted with smaller needles than usual in order to make the final fabric firmer. They recommend using smaller knitting needles than usual when knitting with nub (knot) yarns for the nubs to sit together closely.
Novelty Yarns for Weaving

Using small amounts of novelty yarn as weft can produce dramatic effects as contrast against smoother warp and/or weft yarns. One striking example of this is a commercially woven scarf I saw that had a smooth black wool warp. The weft was also black wool except for wide bands of white "thick and thin" yarn bordered on each side by one row of a shiny pale-coloured bouclé yarn. Small amounts of novelty yarns produce a dramatic effect. Due to the bulkiness of some novelty yarn, it may be necessary to wind the weft on a rag or stick shuttle rather than winding it on a bobbin for use in a boat shuttle.

Novelty yarns can be used in the warp, but special care needs to be taken for this to be successful, as explained in an article by Gaynes (1992) on "mixed warps". She recommends using repeating patterns across the warp and using not more than 2 or 3 ends of any different type of yarn together. The sett (the number of warp ends per inch) depends on the weave structure, grist and type of yarn. All yarns must be able to pass through the heddles and the reed (beater) without sticking to minimize abrasion of the yarns. When the treadles are pressed to create the shed (opening for the weft to pass through), the warp yarns must not stick together. Yarns used as warp must be strong enough to withstand warp tension and the abrasion of the heddles and reed. Gaynes recommends weaving samples to ensure that the correct sett, beat, and weave structure have been chosen and to wash and finish the samples to ensure that all the yarns work together.

Weave structure is an important consideration in choosing a technique that shows off a novelty yarn to its best advantage. Plain weave is generally not a good choice. In plain weave, each row of weft passes over one warp end and under one warp end and the next row of weft is the reverse, that is, under one warp end and over one warp end. The maximum weft float is only one end which does not allow a novelty yarn to show well.
In contrast, twills are weaves where each weft pick passes over or under more than one warp thread in the sequence (van der Hoogt, 1993). Twills create diagonal designs and are well-suited to clothing fabrics because they drape well. A 2/2 twill, where the weft passes over 2 warp ends and under 2 warp ends, is excellent for fabrics where both sides are visible and reversible (e.g. scarf). A 3/1 twill, where the weft passes over 3 warp ends and under 1 warp end, is excellent for fabrics where only one side is visible (e.g. clothing). On the right side of a 3/1 twill fabric, the weft floats over 3 warp ends. If the warp is set at 10 ends per inch, as used in samples for this study, the novelty yarn floats will be 0.33" long with a 3/1 twill compared to 0.2" long with a 2/2 twill.

The “3/1 Twill and Tabby” technique (Appendix 4), used in one of the samples in this study, consists of alternating rows of novelty yarn and smooth yarn. The novelty yarn is woven in a 3/1 twill sequence while the smooth yarn is woven in a plain weave sequence, which creates a stable ground weave behind the novelty yarn. This is called a supplementary weft technique where removal of all the novelty weft yarn would leave a stable plain weave of smooth yarn (van der Hoogt, 1983). There are a variety of these supplementary weft techniques, and they are good to use with textured or expensive yarns, where the weaver wants as much of that yarn as possible to show on the surface of the cloth (Farling, 2002). The supplementary weft structures used in this study are simple 3- and 4-shaft weaves (Appendix 3 and 4, respectively) set at 10 ends per inch. One technique results in the novelty yarn floating over 5 warp threads before being tied down by a warp thread to give floats of 5/10" = 0.50" long (Appendix 3). The other technique results in novelty yarn floats of 3 ends or 3/10" = 0.33" long (3/1 Twill and Tabby, Appendix 4).

While ideal or maximum float length depends on the yarn and function of the fabric, Alderman (2004) recommends a maximum of 1/8" or less for upholstery, 1/4" for clothing that must withstand abrasion or snagging, and 1/2" for dressy scarves.
Articles to Make with Novelty Yarns

- scarf - novelty yarn used as "stripes" throughout the scarf or towards both ends of the scarf.
- shawl
- gloves - novelty yarn used as a border at the wrist, or above the cuff
- hat - novelty yarn used as a border or band of several rows
- headband
- sweater, vest, top or jacket
- bags - tote bag, evening bag
- afghan
- toys, knitted or sewn with handwoven fabric.

Calculating the Yards of Single and Plied Yarns Required

When designing yarn for a particular project, it is essential to spin samples of yarn and to use these yarns to knit or weave finished samples. Since novelty yarns require additional time to create, it is wise to spend time calculating the yards required for a project. Making samples will help to establish the desired frequency and size of knots, snarls or loops. Extra yarn is required for the wrapper yarns used to produce knots, snarls and loops and both the frequency and the size of the projections have an effect on the amount required. For example, if you want a snarl yarn with 1" long snarls every 3", this works out to 36/3 = 12 snarls per yard. The extra amount required for the snarls is 12 snarls x 2" per snarl (i.e. 1" long x 2 plies) which equals 24" extra per yard or 24+36 = 60" of wrapper for every 36" of finished yarn. In other words, you need 60/36 = 1.67 times as much wrapper yarn compared to the yards for the core or binder yarns. For a project that requires 100 yd of snarl yarn, approximately 1.67 x 100 = 167 yd wrapper yarn, 100 yd core yarn and 100 yd binder yarn is needed.
MATERIALS AND METHODS

Spinning Singles for Novelty Yarns Using High-whorl Spindles

High-whorl spindles were chosen that met the needs of the single to be spun. That is, a spindle was selected that spun well for the type of fibre, staple length, twist and grist of the single (Fig. 8). The dimensions of each spindle (weight, whorl diameter and shaft length [length below the whorl]) are provided (Appendix 1). As stated before, the spindles were made by Edward Tabachek, well-known for making spindles.

![High-whorl spindles](image)

Fig. 8. High-whorl spindles used in this study. Clockwise from top: Plying Walnut, Deluxe Maple, Deluxe Purpleheart, Compact Deluxe Holly, Deluxe Striped Maple and Walnut, Mini Cherry, Deluxe Imbuya, Deluxe Koa.
A quill was secured to the spindle shaft before spinning (Fig. 9). A sheet of 3"x3" Post-It™ Note was rolled along the shaft flush with the underside of the whorl and secured with a strip of masking tape. If the shaft was long, second or third sheets of paper were slipped under a corner of the preceding sheet and rolled along the shaft and secured also. It was essential to test removing the empty quill to ensure it could be removed easily later. Masking tape was used to secure the lower edge of the quill to the shaft.

![Fig. 9. Quills - ready to be used on a spindle and easily removed for plying.](image)

The spindle with its attached quill was weighed before starting to spin and when finished. Subtracting the weights gave an accurate weight of singles. Once sufficient single was spun, the quill could be slipped off the shaft ready for plying. All plying was done from yarn on quills, whether this was singles being plied or 2-ply yarn being plied with a binder, or 2-ply yarns being cabled together.

While there are many ways to spin with a high-whorl spindle, these are the methods I used. If I used commercial top, a length of top was removed and split lengthwise into several strips and predrafted keeping all the strips oriented in the same direction. The predrafted fibre was wound around my left wrist, in a clockwise direction. I spun with the fibre source wrapped around my left wrist with my left hand controlling the fibre and not letting the twist into the fibre source. I drafted with my
right hand and spun the spindle with my right hand. I preferred to spin from a seated position on a sofa. For Z-twist, I spun the spindle up the outside of my right leg or up the inside of my left leg with the reverse direction for S-twist.

It was best to build up the cop away from the underside of the whorl. If the cop was built too closely to either end of the quill, the yarn slipped off the end of the quill when it was removed from the spindle. It was best to leave ¾"-1" of the quill bare at both ends and to build up a tapered slope for the first and last inch of the cop. The cop was wound in a purposeful way, gradually moving down the quill and gradually back up but with more of the singles built up in the middle of the cop.

**Plying Techniques for Novelty Yarns Using High-whorl Spindles**

For plying, two lazy kates were used because the quills of yarn often needed to be positioned in different locations relative to the spinner. One kate was a Majacraft which held the quill almost horizontal and the other was handmade and held the quill vertical (Fig. 10, 11). Plying was done from a seated position (16-17”) with both kates at “coffee table” height (16-17”). The yarns had to be tensioned and since the yarns were on quills rather than bobbins, the normal tensioning devices on lazy kates could not function. When using the horizontal kate, the yarn was passed through an upper yarn guide. If the quill rotated too fast, allowing too much yarn to feed off and snarl up, the rotation was slowed by putting masking tape on the rod holding the quill. If more tension on the single was needed, the yarn was routed under one of the cup hooks (on the horizontal kate) or around empty rods on either kate. Basically, if more tension was needed, the yarn was routed around more places in its path towards the spinner. A Tabachek plying spindle (Fig. 6, 8, Appendix 1) was used to ply all the yarns in this study. For each type of novelty yarn, the two singles or the binder and 2-ply yarn needed to be located in specific places relative to the spinner. This is discussed in the Results section.
Fig. 10. Horizontal lazy kate (Majacraft) with extra tensioning device as used to ply knot and snarl yarns. The yarn travels from the quill up through the yarn guide, under a cup hook on the lazy kate before passing through the loop of a binder clamp clamped to a loaf pan weighted down with a bottle of water.
Fig. 11. Lazy kates as used for plying spiral and bouclé yarns. Horizontal kate by Majacraft (right) and handmade vertical kate (left). Masking tape was applied to the rods on the kate (right) to slow down the rotation of the quills of singles. Note the path of the wrapper on the kate on the right – it travels from the quill under the cup hook up through the guide and then to the spindle. On the left, the core travels from the quill through the loops of a binder clamp clamped to the middle rod, then around the upper rod and to the plying spindle. The normal rod (upper left in the photograph) was replaced by a longer steel rod with a wooden disc at its end to overcome the problem of the yarn slipping off the top of the rod when the spindle was being moved vertically during plying.
Measuring and Finishing Yarns

Wraps per inch were measured with an inch gauge. Single or plied yarn was wrapped around a 1" section of the gauge. I was careful not to pull the yarn tight or to pack the wraps too tightly.

Twists per inch were measured on plied or folded yarns. The number of bumps in one inch of plied yarn was divided by the number of plies (Fig. 2). For single yarns, a section of singles was allowed to fold back on itself and the number of bumps in one inch was counted and divided by two. This is the value that was recorded, although the single yarn, when spun, had 1.5 to 2 times that number of twists per inch.

Length and weight - Weight of yarn (grams) was measured on an Ohaus triple beam balance. After removing a skein of yarn from a niddy noddy, the yards were measured by multiplying the number of strands in the skein by the length of one revolution of relaxed yarn.

Yards per unit weight - For single yarns, a length of yarn was allowed to fold back on itself, placed on a McMorran balance and shortened in length until the folded yarn balanced. The length, in inches, of balanced yarn multiplied by 100 gave the yards per pound of folded yarn. This was converted into yards per gram folded yarn and yards per gram single yarn.

  e.g. 12.5 inches of folded yarn means 1250 yards per pound folded yarn = 2.75 yards per gram folded yarn = 5.50 yards per gram single yarn.

For plied yarns, the length (yards) and weight (grams) of the skein were used to calculate yards per gram and multiplied by 454 to obtain yards per pound.

Finishing Yarns - All skeins of yarn were washed in warm water (approx. 30° C) with Dawn dish detergent, soaked at least 30 minutes before squeezing out the water and rinsing at least twice in lukewarm water. Water was squeezed out and skeins were hung to dry with no weight.
RESULTS AND DISCUSSION

Binder vs. Cable for SZS Yarns

I cabled all SZS yarns rather than using a binder. Early in this project, when I tried using a binder with SZS yarn, it resulted in yarn I did not like. Fig. 12 shows a low S-twist pink core and a higher Z-twist purple wrapper (1). Plying S makes the core contract in grist and length as it travels through the centre of the spiraling wrapper (2). When this 2-ply yarn is unbalanced enough to have 3-4 tpi twist and is plied Z with an S-twist binder, the 3-ply yarn has areas where the core and wrapper lay side by side at very low angles (4). The binder appears to be the only thing holding the core and wrapper together. When you examine the yarns, you can see that the core remains slanted S and the wrapper slanted Z. It could be cabled (3), but much more ply twist (6-8 tpi) was needed in order to use a fine binder successfully (5).

![Fig. 12. SZS yarns when cabled or plied with a binder.](image)

1. Singles: New Zealand Corriedale sliver:
   Core (pink) spun S (folded 12 wpi, 2-2.5 tpi)
   Wrapper (purple) spun Z (folded 12 wpi, 3-4 tpi)

2. Plied S to 3-4 tpi (not balanced)

3. Cabled Z with two 2-ply yarns (#2)

4. Plied Z with 3-4 tpi 2-ply yarn (#2) and binder
   Binder = cultivated silk spun S (folded 40 wpi, 5-6 tpi)

5. Same as #4 but 2-ply had 7-8 tpi S twist before plying Z with silk binder
Knot Yarn Results

I spun three knot yarns to show different ways of spinning them. Knot Yarn #1 and #2 were spun ZZS with Knot Yarn #1 alternating singles for the knots while Knot Yarn #2 and #3 used only the wrapper for knots. Knot Yarn #2 had a binder and Knot Yarn #3 was spun SZS and cabled. Knot Yarns #1, #2 and #3 increased in bulkiness.

The quills containing the two singles were placed on a horizontal lazy kate positioned on a coffee table directly in front of me with each single being tensioned by traveling through the upper yarn guide and under a hook (Fig. 10). The two singles were held in separate hands. To form each knot, I spun the spindle and parked it quickly between my knees. While I held one single taut and vertical in one hand, the other hand held the other single more loosely and at an angle to the core. I created the knot by wrapping the second single back and forth over the 2-ply, not over the core as sometimes described (Varney, 1987). The length of the knot varied with the three yarns. I had to spin the spindle more than once in order to get the knot wrapped 3 times (Knot Yarn #1) but later I reduced this to 2 wraps (Knot Yarn #2). When the knot was complete, I pinched the top of the knot with my right hand, brought a length of both singles together and pinched them together with my left hand, allowed excess S twist into that length of 2-ply by releasing the pinch of my right hand. I spun the spindle with my right hand and made the next knot. If the knots were formed close together, I made 2-3 knots before winding on. I found I could make the second and third knots with the spindle spinning but the first knot had to be created with the spindle parked between my knees. When I spun Knot Yarn #3, I was able to form all the knots with the spindle in motion. However, Knot Yarn #3 (an SZS yarn) resulted in a lot of excess twist and this may have resulted in part from keeping the spindle in motion while making the knots.
More singles were required to form the knots and this length increased, as the length of the knot and the frequency of the knots increased, from 1.5 to 2.0 times more than the length of finished yarn. The 2-ply knot yarns were plied at 10-12 yd/hr.
**Knot Yarn #1**

This yarn was designed to be a 2-colour fine yarn spun ZZS (Z core, Z wrapper, S plied) with long knots which alternated in colour. I used Merino wool because it is a short, fine, crimpy fibre, suited to being spun finely with high twist and I had both black and white Merino. I spun both singles with a Z twist of 4.5-7 tpi and 16-20 wpi when folded.

Firm or extra Z twist is needed in both singles (McCuin, 2007; Varney, 1987) because, as one single is being plyed S and manipulated to create the knot, the other single is losing twist. This loss of twist was evident, with the single used as the core expanding in grist as it lost twist. With this yarn, both singles alternated in being used to form the knot and this helped equalize the amount of twist lost by the two singles.

This yarn was plied at 12-13 yd/hr. Knots were made 6-8" apart at the beginning of plying and 10" apart later. If the black and white Merino were plied into a normal 2-ply yarn, it would measure 4.41 yd/g but when the singles were plied into a knot yarn, the knot yarn was 3.01 yd/g before washed. This difference (1.40 yd/g) is due to the extra yards required to create the knots = 1.40 yd/g (2-ply) x 25.2 g (2-ply) = 35.3 yd extra 2-ply = 70.6 yd extra total singles.

That is, when both singles are used equally to make the knots for this yarn, 35.3 yd extra of each single is needed to produce 75.3 yd 2-ply knot yarn (before washed) for a total of 110.6 yd of each single which is 1.47 times the yards required for a normal plied yarn (110.6 / 75.3).
Knot Yarn #1 (ZZS)

Core and wrapper the same except for colour of wool:
   Fibre: Merino wool top, black and white, staple length = 5-6"
   Source: Celeigh Wool, Millet, AB
   Top split several times and predrafted

Spun Z worsted short forward draw

Spindle: Deluxe Imbuya, 37.3 g (black Merino)
Spindle: Deluxe Koa, 34.2 g (white Merino)

Single A: Black Merino wool
   Single: 30-32 wpi, 33°
   Folded 2-ply: 16-18 wpi, 4.5-7 tpi, 25-30°, 4.18 yd/g, 1900 yd/lb

Single B: White Merino wool
   Single: 30-36 wpi, 25-30°
   Folded 2-ply: 18-20 wpi, 5-7 tpi, 25-30°, 4.63 yd/g, 2100 yd/lb

Plied S, creating knots with alternating a black knot and then a white knot.

Finished yarn:
   73.46 yd, 25.2 g, 14-16 wpi, 5-7 tpi between knots, 21-25°,
   2.92 yd/g, 1323.4 yd/lb, 2.1% shrinkage

Knitted sample:
   Knot yarn - simple drop stitch (Mon Tricot and Hamilton-Hunt, 1971)
   Black Florica 2-ply wool (Appendix #2) - garter stitch.
1. Single A: Merino wool top, dyed black
2. Single B: Merino wool top, white
Knot Yarn #2

This ZZS yarn was designed to be a thicker yarn and have less contrast than Knot Yarn #1, with only one of the singles used to create all the knots and to have shorter heavier knots than Knot Yarn #1. It was also designed for the 2-ply to be plied Z with an S binder thread. I chose Corriedale and New Zealand wools because they were not as fine or crimpy as Merino and were suited to a slightly heavier yarn. I carded red and wine New Zealand wool with white Corriedale to create a pink semi-worsted preparation for the wrapper and spun it at 14-15 wpi and 4-5 tpi folded. I used white Corriedale top for the core and carded it so the two singles would spin more similarly. Ross (1988) suggests adding extra twist to the core if only the wrapper is used to make all the knots. I added as much twist to the core yarn as possible, almost to the point of its kinking. I spun the core at 14-16 wpi and 4-5 tpi folded.

The core and wrapper were plyed S, using only 2 wraps of the wrapper up and down the 2-ply to create the knots compared to 3 wraps in Knot Yarn #1. Knots were made at 4-6” intervals. The core lost a lot more twist compared to Knot Yarn #1. The white core yarn appeared thicker than the pink wrapper because the core expanded as it lost its Z twist while the wrapper was being manipulated to create all the knots. The core needs to be spun thinner in order to add more twist to the core.

I added more S twist during plying than for Knot Yarn #1 but found I still had to add extra S twist to the 2-ply before plying with a binder - enough S twist so the 2-ply had 5-6 tpi. I used sewing thread as a binder and gave it extra S twist before plying with it (Boggs, 2011; Mushka 2009). The binder was placed on a vertical lazy kate on my left and the 2-ply was placed on a horizontal lazy kate in front of me. Both yarns were tensioned through a guide and/or around pegs or hooks on the lazy kates. The 2-ply and binder were plyed Z with the 2-ply held vertically with the right hand and the binder held at an angle with the left hand. The angle was controlled by the left thumb and index finger and was increased as the binder passed over the knot. The binder removed ply twist from the 2-ply but helped support the looser pleyed yarn.
**Knot Yarn #2 (ZZS)**

Core: Fibre: Corriedale wool top, white, staple length = 7"
Source: Legacy Studio, Cochrane, AB
Hand carded, rolled into batts (not rolags) and predrafted for a semi-worsted preparation.

Spun Z worsted short forward draw
Spindle: Deluxe Maple, 47.5 g (43.5 g plying spindle was not heavy enough and tended to backspin but a 47.5 g deluxe spindle worked well)

Single: 24-28 wpi, 25-35°
Folded 2-ply: 14-16 wpi, 4-5 tpi, 26-31°, 2.09 yd/g, 950 yd/lb

Wrapper: Fibre: New Zealand fine wool top (35%), 26% wine, 9% red, staple length 5-6” and Corriedale wool, white (65%)
Source of New Zealand wool: Aurelia Wool and Fibre, Merritt, BC
Hand carded to blend and rolled into batts (not rolags) for a semi-worsted preparation. Predrafted.

Spun Z worsted short forward draw
Spindle: Deluxe Maple, 47.5 g (I had to put on a new quill once the weight reached 66 g because it was too difficult to join on a new fibre batt. The speed of rotation also slowed as the weight increased.)

Single: 24 wpi, 21-25°
Folded 2-ply: 14-15 wpi, 4-5 tpi, 14-21°, 2.01 yd/g, 912 yd/lb

Binder: Coats & Clark 37% mercerized cotton 73% polyester pink thread.
60 wpi, 3-ply, plied Z

Binder was spun S to give it enough active twist to fold back on itself at 3 tpi.
Spindle: Mini Cherry, 17.1 g

Plied S for a ZZS 2-ply yarn, then plied Z with binder.

Finished yarn:
56.83 yd, 34.3 g, 11-12 wpi, 3.3 tpi between knots, 2.5 tpi for binder,
21-25° (14-30°), 1.66 yd/g, 752.3 yd/lb, 4.6% shrinkage

Knitted sample:
Knot yarn – linen stitch (Bryant and Klein, 2001) using a slip stitch whenever I came to a knot.
White Florica 2-ply wool (Appendix #2) - garter stitch and stocking stitch.
KNOT YARN #2

1. Core: Corriedale wool
2. Wrapper: New Zealand wool top, 26% wine, 9% red & Corriedale wool, white (65%)
3. Binder: Coats & Clark mercerized cotton & polyester thread
KNOT YARN #2
Knot Yarn #3

This yarn was designed to be spun SZS, to have only the wrapper create all the knots and to be a colourful cabled yarn with lots of knots. I used black Merino wool for the S core (20 wpi and 3-5 tpi) and a multicolour Polwarth wool top for the Z wrapper (14-16 wpi and 3.5-4 tpi). With an SZS yarn, by plying in the same direction as the core, twist was added to the low twist core and removed from the high twist wrapper (Ross 1983, 1988). The S core did not become weak or disintegrate during plying S. Ross (1983; 1988) spins both singles for her SZS knot yarn at 20 wpi with 4 tpi and 8 tpi for her low S core and high Z wrapper. If I spun this yarn again, I would try spinning a lower twist core and a higher twist wrapper and/or spinning a finer core. The final yarn had a rough texture along the non-knot sections due to the core having a lot of “mini snarls” caused by excess twist. The core could have been spun thinner but with the same amount of S twist in the single or it could have been spun with lower S twist. During plying S, the core would have increased in S twist without having excess twist. This would have resulted in fewer mini snarls in the core and a softer feel to the yarn.

The Z wrapper lost a lot of twist as I ployed S and made all the knots with the wrapper. I tried winding on after making every knot to reduce the amount of twist entering the wrapper. Eventually, I stopped and added more twist to the wrapper to ensure it was at least 4 tpi when folded. For this yarn, I made the knots with the spindle always spinning. This could have been a source of both problems in plying this yarn. It added excess S twist to the core and it removed too much twist from the wrapper. It might have been better to use the slower technique of spinning the spindle S, catching it between my knees and making the knot, spinning it again and finishing the knot, then using any excess twist for the next length of 2-ply. The slower method might also have resulted in better knots, because some knots were more loosely wrapped than desired. Boggs (2011) makes her knots in a precise “stack” and anchors each knot with a final wrapping around the base of the knot. Rather than using a binder, I added extra S twist to the 2-ply yarn before plying it Z to create a “super-knot” dense cabled yarn (McCuin, 2007).
Knot Yarn #3 (SZS Cabled Z)

Core:
  Fibre: Merino wool top, dyed black, staple length 5"  
  Source: Celeigh Yarns, Millet, AB  
  Top split and predrafted

  Spun S worsted short forward draw  
  Spindle: Compact Deluxe Holly, 28.0 g

  Single: 32 wpi, 27-30°  
  Folded 2-ply: 20 wpi, 3-5 tpi, 14-21°, 7.21 yd/g, 3275 yd/lb

Wrapper:
  Fibre: Polwarth wool top, dyed multicolour, staple length 3"  
  Source: Rovings, Winnipeg, MB  
  Split into narrow strips and predrafted

  Spun Z worsted short forward draw  
  Spindle: Deluxe Purpleheart, 43.0 g

  Single: 28 wpi, 25°  
  Folded 2-ply: 14-16 wpi, 3.5-4 tpi, 14-21°, 2.84 yd/g, 1289 yd/lb

Plying: Plied S forming knots with the spindle in motion. Added extra S twist before plying two 2-ply yarns together to form a 4-ply cabled yarn. Added extra S twist to be 6-7 tpi before cabling two 2-plies together with Z twist to create a 4-ply yarn.

Finished yarn:
  20.9 yd, 29.3 g, 9-10 wpi, 4 tpi, 21-27° (range 17-30°), 0.71 yd/g, 323.8 yd/lb, 0% shrinkage

Woven sample:
  Knot yarn – see Appendix #3 for weaving draft  
  White Florica 2-ply wool (Appendix #2).
1. Core: Merino wool top, dyed black
2. Wrapper: Polwarth wool top, dyed multicolour
KNOT YARN #3

[Image of a knotted yarn sample with a bag of yarn below]
Snarl Yarn Results

I spun three snarl yarns using different directions of twist. Snarl Yarn #1 was spun ZZS, Snarl Yarn #2 was spun ZZZ and Snarl Yarn #3 was spun SZS. Snarl Yarn #1 had an S binder and Snarl Yarn #2 had a Z binder while Spiral Yarn #3 was cabled to produce a “super-snarl” yarn. Snarl Yarn #1 had two singles with similar grist and twist and alternated singles to form the snarls during plying. Snarl Yarn #2 and #3 had finer core yarns and thicker wrapper yarns and used the wrapper to make all the snarls. Different fibres were used, including wool, alpaca, silk and synthetics.

Snarls were made during plying with the two singles positioned the same as in plying knot yarns with both singles on a lazy kate opposite me and holding both singles in opposite hands (Fig. 10). Techniques for forming the snarls varied with each of the three yarns and different techniques were used for plying with the binder or cabling.

Snarls used 1.6-3.0 times more singles compared to normal 2-ply yarns. Plying the snarl 2-ply yarns took 5-12 yd/hr while plying the 2-ply and binder together was faster at 29-38 yd/hr.
Snarl Yarn #1

This ZZS snarl yarn was designed to produce a yarn with snarls made from the two single yarns alternately. I chose wine Corriedale wool top for one singles and a blended roving of black alpaca and green Merino wool for the other singles. These fibres had different preparations and staple lengths (6" versus 3-3.5") but I spun both Z to folded grists of 14-16 wpi and twists of 4-4.5 tpi. Several authors describe spinning ZZS snarl yarns (Boggs, 2010; King, 2009; North, 2010; Ross, 1988).

To ply snarl yarn, the two singles were positioned as they were to ply knot yarn with both singles on a horizontal lazy kate in front of me (Fig. 10). I held the two singles in separate hands. I used my left hand to pinch the 2-ply where I wanted the snarl to be located, while I spun the spindle S with my right hand, and parked the spindle between my knees. I placed my right index finger over the tensioned wrapper and then under it to form a loop close to where my left hand was pinching the 2-ply. Then, I transferred the folded wrapper (snarl) to the pinched spot and released the snarl loop. I used my right hand to pinch the snarl where it met the 2-ply to hold it in place, while my left index finger picked up the wrapper, placed it against the core and started to form a length of 2-ply yarn. I added ply twist for a length of normal 2-ply and wound the yarn onto the spindle. Then, I was ready to make the next snarl with the other single yarn. Even though the two singles alternated in forming the snarls, I used the same hand to create the snarls.

Initially, I formed 3 or 4 snarls 3" apart adding twist between snarls but not winding on between snarls. However, sometimes all of the snarls would suddenly disappear between the hook and all the snarls I had just formed, leaving loosely spiraled yarn along the entire length. I could feel this happen because the spindle dropped a few inches as the length of yarn increased when the snarls pulled out. Having the two singles alternate in forming snarls contributed to this problem. To prevent these disappearing acts, I had to ensure I added sufficient twist in each section of 2-ply after forming each snarl. Even then, snarls needed to be made longer than desired because some of the snarl still slithered into the 2-ply. Towards the end of plying...
this yarn, I tried winding on after every snarl rather than after 2 to 4 snarls. I thought this would be time-consuming, but it was faster and ended the frustration of having snarls disappear. The twist in the yarn appeared more even and it reduced the amount of excess twist building up. Plying time, when I made 3 snarls between wind-ons, was slow at 9.1 yd/hr. Plying time when I changed the technique and made 1 snarl per wind-on was 12.6 yd/hr.

I carded copper Angelina synthetic with black Merino wool top for a fine sparkly binder yarn and spun it S at 23 wpi and 5-7 tpi folded. When I started to ply Z with the S-binder, I had insufficient S twist in the 2-ply and this caused all the snarls to disappear – they simply slithered into the 2-ply. When extra S twist had been added to the 2-ply, plying with the binder went smoothly. I plied while holding both the binder and 2-ply together in one hand. Plying time with the binder was 29 yd/hr.

I tried Boggs' (2011) method of anchoring every snarl. To do this during plying, a snarl is looped back through the 2 plies, pinching the 2 plies together and adding ply twist to hold the snarl in place. This worked in keeping the snarl from disappearing or shortening in length and kept the 2-ply near the snarl smoother. On the downside, anchoring each snarl slowed down the plying process and did not seem practical if snarls were spaced close together. I found that a binder was still needed to hold the snarls in place; otherwise, short snarls pulled out of place. Some authors do not use a binder for snarl yarn (Boggs, 2011; King, 2009; North, 2010) although the yarn in the photograph in North's book looks cabled. Boggs makes her snarls longer and much less frequently, which results in less build up of excess twist.

Angelina gave the binder a harsh feel but the plied yarn had a much softer hand after it was washed. I envision this yarn used for a knitted boa wrap or scarf. I knit the sample using reverse stocking stitch with the snarl yarn and alternating bands of either stocking stitch or garter stitch with black commercial wool yarn. I like the effect of the sparkly background behind the non-sparkly snarls.
Snarl Yarn #1 (ZZS with an S binder plyed Z)

Single A: Fibre: Corriedale wool, dyed top, Red Zinger, staple length 6”
Source: Legacy Studio, Cochrane, AB
Top divided into lengthwise strips and predrafted

Spun Z worsted short forward draw
Spindle: Deluxe Imbuya, 37.3 g (Striped woods 32.1 g not heavy enough)

Single: 24-28 wpi, 27-30° (added twist almost to the point that the yarn kinked)
Folded 2-ply: 14-16 wpi, 4-4.5 tpi, 25-30°, 2.75 yd/g, 1250 yd/lb

Single B: Fibre: Black alpaca (90%) and dyed green Merino wool (10%), roving staple length 3-3.5”
Source: Ancient Arts Fibre Crafts, Calgary, AB

Spun Z worsted short forward draw
Spindle: Deluxe Imbuya, 37.3 g

Single: 22-24 wpi, 30-33° (added twist almost to the point that the yarn kinked)
Folded 2-ply: 14 wpi, 4-4.5 tpi, 25-30°, 3.08 yd/g, 1400 yd/lb

Binder: Fibre: Merino wool top (86%), dyed black, 5-6”
Source: Celeigh Wool, Millet, AB
Fibre: Angelina, copper (14%), 4”
Source: Legacy Studio, Cochrane, AB
Hand carded to blend, rolled into batts and predrafted

Spun S worsted short forward draw
Spindle: Deluxe Striped woods, 32.1 g

Single: 36 wpi, 14-18°
Folded 2-ply: 23 wpi, 5-7 tpi, 14-21°, 6.17 yd/g, 2800 yd/lb

Plied S forming snarls with alternate wrapper yarns. Added extra S twist in the 2-ply before plying Z with the S binder.

Finished yarn:
45.9 yd, 30.4 g, 11-12 wpi, 3.5-4.5 tpi (2-ply) and 2.5-2.75 tpi (binder), 25-30° (2-ply) and 14-21° (binder), 1.51 yd/g, 684.9 yd/lb, 0.4% shrinkage
Yarn had a much softer hand once washed.

Knitted sample:
Snarl yarn - reverse stocking stitch (which puts all the snarls on the front side)
Black Florica 2-ply wool (Appendix #2) – stocking stitch and garter stitch.
1. Single A: Corriedale wool, dyed red
2. Single B: Black alpaca (90%), dyed green Merino wool (10%)
3. Binder: Merino wool top (86%), dyed black Angelina (14%), copper
Snarl Yarn #2

This yarn was designed to be a ZZZ snarl yarn with only the wrapper forming the snarls and with a Z binder plied S. Varney (1987) and Olds College (2007) describe spinning snarl yarn with a fine Z core and a very over-twisted Z wrapper of less fine to medium weight.

I chose a Merino wool / silk blend for the Z wrapper (folded at 14 wpi and 4-5 tpi) so the silk would add sheen to the snarls. I chose Corriedale wool for the Z core because it was fine enough to spin a fine core (folded at 20-22 wpi and 6-6.5 tpi) and was a suitable colour to blend with the wrapper. I wanted a binder with sheen but found white cultivated silk had too much contrast, so I blended cultivated silk with the Merino wool / silk blend used for the wrapper.

Plying Z with a fine Z core and a medium Z wrapper worked very easily in forming snarls with only the wrapper. I could make 4 to 6 snarls 2" apart before winding on to the spindle, with none of the snarls disappearing as they did with the ZZS Snarl Yarn #1. I could even make bunches of snarls close together as long as twist was added after each snarl. I plied the 2-ply from a horizontal kate placed in front of me with the core on the left and the wrapper on the right with both singles tensioned through yarn guides and loops of binder clamps (Fig. 10). I formed snarls in the same way as for Snarl Yarn #1 except that Snarl Yarn #1 used both singles to form snarls, while Snarl Yarn #2 used only the silk-Merino wrapper for snarls. With Snarl Yarn #1, I found it best to add ply twist and wind on after every snarl. With Snarl Yarn #2, I wound on every 6-7" after 4 snarls were formed being sure there was 3-5 tpi in the 2-ply area to keep the snarls in place. Later, I found I could make the snarl, leave it, make the next section of 2-ply and add twist without having the snarl move. This saved the step of adding twist when the snarl was formed and then again in making the 2-ply.
The very energized Z 2-ply needed to be plied S with a Z binder to balance the twist. This produced a yarn in which the core, wrapper and binder all slanted in the same direction in comparison with Snarl Yarn #1 in which the binder slanted in the opposite direction to the core and wrapper. For plying the 2-ply and binder, I plied with the Z binder on my left tensioned around two rods on the vertical lazy kate, and the Z 2-ply tensioned only through the yarn guide on the horizontal kate opposite me. I held the 2-ply and binder together in one hand to ply them. The 2-ply was very energized and needed to be tensioned well before placing it against the binder. Cabling two 2-ply snarl yarns together to produce a super-snarl 4-ply yarn also worked.

The finished yarn had many tiny bumps along the wrapper even though I was careful not to add excess Z twist during plying while forming the snarl. I wound on more often and was careful to tension the 2-ply yarn well when plying with the binder. One might think that the wrapper and/or core had too much singles Z twist and plying Z added to that twist causing these tiny snarls to form. However, my first samples for this yarn used singles with less twist (2.5-3 tpi folded) where I formed snarls with both singles but the resulting snarls had insufficient twist. Only additional sampling at different twists per inch could determine if there is an ideal amount of wrapper twist to form good snarls without having these additional tiny snarls/bumps.
Snarl Yarn #2 (ZZZ with a Z binder plyed S)

Core:
Fibre: New Zealand Corriedale wool sliver, light blue, staple length 4-4.5”
Source: Legacy Studio, Cochrane, AB
Split lengthwise into narrow strips and predrafted

Spun Z worsted short forward draw
Spindle: Deluxe Striped woods, 32.1 g

Single: 36-40 wpi, 27-33°
Folded 2-ply: 20-22 wpi, 6-6.5 tpi (5.5-7 tpi), 21-27°, 4.30 yd/g, 1950 yd/lb

Wrapper:
Fibre: Merino wool (80%) dyed blue-green, Silk (20%) top, staple length 3-4”
Source: Legacy Studio, Cochrane, AB
Split lengthwise and predrafted.

Spun Z worsted short forward draw
Spindle: Deluxe Koa, 34.2 g, which became too heavy when yarn plus spindle reached 57 g and a new quill had to be placed on the spindle.

Single: 24 wpi, 21-27°
Folded 2-ply: 14 wpi, 4-5 tpi, 18-25°, 1.98 yd/g, 900 yd/lb

Binder:
Fibre: Same Merino-silk blend as wrapper but blended with white cultivated silk for a 53% Merino wool 47% silk blend
Hand carded to blend, rolled into batts and predrafted

Spun Z worsted short forward draw from a semi-woolen preparation
Spindle: Mini Cherry, 17.1 g

Single: 44 wpi, 33-39°
Folded 2-ply: 28-32 wpi, 7-9 tpi, 18-21°, 10.35 yd/g, 4700 yd/lb

Plied Z forming snarls with only the wrapper.

Finished yarn:
39.3 yd, 27.4 g, 15-16 wpi, 3-4 tpi (2-ply) and 2.5-4.5 tpi (binder), less than 7 to 14° (2-ply) and 33-39° (binder), 1.43 yd/g, 651.0 yd/lb, 4.65% shrinkage

Woven sample:
Snarl yarn – see Appendix #4 for weaving draft of 3/1 twill and tabby
White Florica 2-ply wool (Appendix #2).
1. Core: New Zealand Corriedale wool sliver, light blue
2. Wrapper: Merino wool (80%)
dyed blue-green, Silk (20%) top
3. Binder: Same merino-silk blend as wrapper but blended with white cultivated silk for a 53% merino wool 47% silk blend
Snarl Yarn #3

This snarl yarn was designed to be an SZS snarl yarn using only the wrapper to form the snarls and to be cabled to form a "super snarl" 4-ply yarn. I could find no reference for making a snarl yarn SZS like this one, but it produced a better yarn compared to the SZZ method of making snarl yarn described by Olds College (2010). The latter SZZ yarn uses a fine lower-twist S core and a fine to medium over-twisted Z wrapper, plying them Z using only the wrapper to form snarls. This removes twist from the core and adds twist to the wrapper. Then, the 2-ply yarn is plied S with a fine Z binder yarn. I tried this method but I did not like either the appearance of the 2-ply yarn or the difficulties I experienced in plying it. The low twist core became even more fluffy in appearance as it lost its S-twist during plying and the core often broke when its twist became too low.

I chose Corriedale wool top for the core and spun it at 7-8 wpi and a low twist of 1.5-1.75 tpi folded. I chose multicolour dyed Polwarth wool top for the wrapper and spun it at 11-12 wpi and 3.5-4 tpi folded. The core appeared to be thicker than the wrapper but by plying the two singles in the same direction as the core, the low S twist core gained S twist, compacting and shortening the core, while the high Z twist wrapper lost twist and increased in grist, making the two singles more similar in grist.

I positioned the two singles on a horizontal lazy kate in front of me with the core on the left and the wrapper on the right (Fig. 10). This was the last snarl yarn that I spun and I discovered I could make the snarls with a different method that was much easier and faster. With this method, I formed the snarls over my left fingers, rather than over my right fingers. I pinched the 2-ply with my left thumb and index finger, and kept my left middle finger beside my left index finger. I picked up the wrapper with my right hand and brought it over my left middle and index fingers. My right fingers pinched the 2-ply and wrapper together in front of my left fingers (i.e. beside the left index finger). This formed the loop right along the core. I slipped my left index and middle fingers out of the loop, which plied back on itself into a snarl. I used my right hand to pinch the core and the base of the snarl together to keep the
snarl in place. I used my left index finger and thumb to place the next sections of singles together, and slid my fingers along the 2-ply. Then, I released my right hand and could use it to spin the spindle to add ply twist when it was needed. I found I could form 3 snarls before the wrapper became too slack to form any more, at which point more S twist was needed. This yarn was plied at 12.0 yd/hr plus the time for cabling.

Instead of using a binder to balance the ply twist, I made a cabled yarn by plying Z with two 2-ply S snarl yarns for a "super snarl" 4-ply yarn. One 2-ply was positioned on my left and the other was positioned in front of me.
Snarl Yarn #3 (SZS and cabled)

Core:
Fibre: Corriedale top, dark grey, staple length 6"
Source: Louet
Hand carded the top to be more woollen, rolled into batts and predrafted

Spun S worsted short forward draw
Spindle: Deluxe Maple, 31.1 g

Single: 14-18 wpi, 14-18°
Folded 2-ply: 7-8 wpi, 1.5-1.75 tpi, 10-14°, 1.38 yd/g, 625 yd/lb

Wrapper:
Fibre: Polwarth top, dyed multicolour, staple length 5"
Source: Rovings, Winnipeg, MB
Split lengthwise in very narrow strips so the colours would repeat often

Spun Z worsted short forward draw
Spindle: Deluxe Striped woods, 32.1 g. Weight became too heavy at 50 g, so I put on a new quill.

Single: 20-22 wpi, 25-30°
Folded 2-ply: 11-12 wpi, 3.5-4 tpi, 18-25°, 2.31 yd/g, 1050 yd/lb

Plied S forming snarls.

Cabled by plying Z with two 2-ply snarl yarns.

Finished yarn:
12.24 yd, 22.5 g, 9 wpi, 3 tpi, 14-21°, 0.54 yd/g, 247.0 yd/lb, 6.4% shrinkage

Knitted sample:
Snarl yarn - reverse stocking stitch (which puts all the snarls on the front side)
Grey Florica 2-ply wool (Appendix #2) – stocking stitch and garter stitch.
1. Core: Corriedale wool, dyed grey
2. Wrapper: Polwarth wool, dyed multicolour
THE USE OF HIGH-WHORL SPINDLES TO CREATE
KNOT, SNARL, SPIRAL AND BOUCLÉ
NOVELTY YARNS

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Olds College Master Spinners In-Depth Study
Submitted to Olds College: July 2012
Spiral Yarn Results

I spun three spiral yarns using different methods to produce three bulky yarns. Spiral Yarn #1 was spun ZZS while Spiral Yarn #2 was spun SZS with both having a thin core and a thick wrapper. Spiral Yarn #3 was a variant of the ZZS yarn where the two singles were spun with the same grist and twist but alternated in being the core and wrapper.

Spiral yarns are plyed while holding the singles in opposite hands so both singles can be tensioned differently and held at different angles. I positioned both singles at coffee table height on opposite sides of me with the core on my left on the vertical kate and the wrapper on my right on the horizontal kate (Fig. 11). While I pinched off the twist on the 2-ply with my left hand, I spun the spindle with my right hand and caught the spindle quickly between my knees, making sure the back of the spindle hook was directly in front of me. Then, I held the core taut in my left hand and in line with the back of the spindle hook and kept the twist pinched out of the yarn source. I held the wrapper loosely in my right hand and at an angle to the core with the angle varying with the specific yarn. I let the wrapper spiral along the core. I tried to keep the plying twist out of both singles sources as much as possible for the ZZS yarns because the core tended to lose its Z twist while the wrapper was being manipulated. The wrapper would also lose its Z twist if care was not taken. In an SZS yarn, allowing S twist into the low S core is not a problem.
Spiral Yarn #1

This yarn was designed to be a 2-colour bulky yarn spun ZZS (Z core Z wrapper S plied) with a thick grey wrapper and thin multicoloured core. Most authors describe spinning a spiral yarn ZZS (Amos, 2001; Boggs, 2011; McCuin, 2007; Olds College 2007, 2010 and Ross 1983, 1988).

I chose Corriedale wool as the Z wrapper because it had a long enough staple for a thicker single yarn. Spinning a thick wrapper (folded at 7-10 wpi, 2 tpi) with a high-whorl spindle was easier from a less aligned preparation so I carded the top. Fibres drafted too easily from a worsted preparation, producing too fine a wrapper and making it difficult to make secure joins.

I chose Polwarth wool for the Z core because it was a fine fibre, shorter than Corriedale and I liked the multicolour preparation with its frequent, consistent colour changes. The core is often spun very fine and with a very high twist for a spiral yarn, but this did not show the colour changes I envisioned, so I spun the core at 14-16 wpi and 3.5-4 tpi folded. Ross (1983) states that the core should be spun 2-4 tpi higher than the wrapper which I estimate as 1-2 tpi higher in a folded sample.

I plied S keeping the core taut in my left hand and in line with the back of the spindle hook. I held the wrapper loosely in my right hand and at a 30-45° angle to the core (usually 30°), letting the wrapper wrap around the core. I used two lazy kates with the core on my left and the wrapper on my right (Fig. 11). I increased the wrap angle to 90° if the wrapper became thin while increasing the tension on the wrapper and decreased the angle if the wrapper became too thick. The wrapper yarn compacted a lot when the plied yarn was washed.
Spiral Yarn #1 (ZZS)

Core:
Fibre: Polwarth wool top, dyed multicolour, staple length 5"
Source: Rovings, Winnipeg, MB
Split lengthwise in very narrow strips so the colours would repeat often, predrafted
Spun Z worsted short forward draw
Spindle: Deluxe Striped woods, 32.1 g

Single: 24-26 wpi, 21-25°
Folded 2-ply: 14-16 wpi, 3.5-4 tpi (3-4.5), 18-25°, 3.58 yd/g, 1625 yd/lb

Wrapper:
Fibre: Corriedale wool top, dyed light greys, staple length 6-7"
Source: Make One Yarn Studio, Calgary, AB
Hand carded and rolled into batts and predrafted
Spun Z semi-worsted short forward draw
Spindle: Deluxe Maple, 47.5 g

Single: 12-16 wpi, 17-22°
Folded 2-ply: 7-10 wpi, 2 tpi (1.5-2.5), 22°, 1.01 yd/g, 550 yd/lb

Plied S keeping core in left hand taut and in line with the hook. Held wrapper loosely in right hand and at a 30-45° angle to the core (usually 30°), letting the wrapper wrap around the core.

Finished yarn:
45.38 yd, 26.7 g, 7-8 wpi, 3.25 tpi (2.5-4 tpi), 15-18°, 1.70 yd/g, 771.6 yd/lb
6.9 % shrinkage

Woven sample:
Spiral yarn – see Appendix #3 for weaving draft
Black Florica 2-ply wool (Appendix #2).
SPIRAL YARN #1

1. Core: Polwarth wool top, dyed multicolour
2. Wrapper: Corriedale wool top, dyed light grey
SPIRAL YARN #1
**Spiral Yarn #2**

This yarn was designed to be spun SZS (Field, 1995; Ross 1983, 1988; Varney, 1987) (as opposed to ZZS) and to be plied S with a fine rayon 2-ply core, with a very low S ply twist, and a thick Z wrapper.

I chose Corriedale wool for the wrapper because the fibre was long enough for a thick yarn and had sufficient crimp for a fairly solid thick yarn. As with Spiral Yarn #1, spinning a thick yarn (folded at 6-7 wpi, 1.5-2 tpi) was easier from a less aligned preparation, so I carded the top and formed rolags (not batts as in Spiral Yarn #1).

I chose rayon for the core because it was white, smooth, fine and shiny and contrasted well against the dull, crimp, dark purple wool wrapper. I wanted to use a slippery core for this yarn in comparison with the wool core used in Spiral Yarn #1. I spun the rayon Z and plied it with extremely low S twist (Ross 1983, 1988), knowing that the plying process would add additional S twist. Even in areas where the core in the spiral yarn still has low twist, I like the reflective appearance of the two plies of rayon laying side by side. I have seen commercial spiral yarn where the cotton core consisted of four fine singles with little plying twist evident in the core in the finished yarn.

I plied S, in the same direction as the core, with the 2-ply rayon core held taut in my left hand and in line with the back of the hook. I held the wool wrapper loosely in my right hand at a 45° angle to the core, letting the wrapper wrap around the core. I used two lazy kates with the core on the left and the wrapper on the right (Fig. 11). Plying in the direction of the core added twist to the low twist core and removed twist from the high twist wrapper. This increased the bulkiness of the thick wrapper and decreased the grist of the fine core, accentuating their size difference.
Spiral Yarn #2 (SZS)

Core:
Fibre: Rayon (Bright viscose), white, staple length 6-8"
Source: Sun Bench Fibres, Chilliwack, BC

Spun Z worsted short forward draw
Spindle: Mini Cherry, 17.1 g

Single: 38-40 wpi, 27°
Folded 2-ply: 20-24 wpi, 5-7 tpi, 21-27°
Plied S on a spindle using very little S twist to be
40 wpi, 1.5-2.5 tpi, 7-10°, 7.9 yd/g, 2850 yd/lb

Wrapper:
Fibre: New Zealand wool top, dyed purple, staple length 5.5-6"
Source: Aurelia Wool & Weaving, Merritt, BC
Hand carded and rolled into rolags for a woollen preparation

Spun Z semi-worsted short backward draw
Spindle: Deluxe Purpleheart, 43.0 g

Single: 12-14 wpi, 27-33°
Folded 2-ply: 6-7 wpi, 1.5-2 tpi, 14-21°, 0.94 yd/g, 425 yd/lb

Plied S keeping 2-ply rayon core taut in left hand and in line with the hook. Held wool wrapper loosely in the right hand and at a 45° angle to the core, letting the wrapper wrap around the core.

Finished yarn:
24.52 yd, 16.4 g, 6-7 wpi, 3.2 tpi (2.5-3.75), 25-33° for wrapper, 18-25° for core,
1.50 yd/g, 678.8 yd/lb, 3.0% shrinkage

Knitted sample:
Spiral yarn - garter stitch
White Patons Classic Merino 4-ply wool (Appendix #2) – stocking stitch and garter stitch.
SPIRAL YARN #2

1. Core: Rayon (Bright viscose), white
2. Wrapper: New Zealand wool top, dyed purple
**Spiral Yarn #3**

This yarn was designed to be spun ZZS with both singles the same grist and twist and to alternate the two singles during plying as core and wrapper every 4-6".

I wanted a yarn that resembled “cloud yarn” (Gong and Wright, 2002; Ross, 1983) and “wrapped spiral yarn” (McCuin, 2007). The photograph in Ross’s book and the sketch in Gong and Wright’s book show yarns that are closely wrapped but when I plied a sample that way, I did not care for the effect. When I knit with that yarn, bumps occurred on the reverse side wherever the closely wrapped areas produced a larger loop. Perhaps a finer yarn would have changed this, but I chose to spin two thick Corriedale wool singles. I alternated the two singles as core and wrapper, but did not create extremely closely wrapped areas. Gong and Wright (2002) state that in “cloud or grandelle yarn” the change from one yarn to another can be sudden, producing a sudden change in colour in which one colour completely “clouds” the other, or gradual, producing a blended appearance in colour.

As with the wrapper for Spiral Yarn #2, I carded the fibre and rolled it into rolags for a more woollen preparation for spinning thick Z singles (7-8 wpi and 2-2.5 tpi when folded). I plied S with the singles on lazy kates on opposite sides of me. The core visibly lost twist as the wrapper was being held at a 45° angle and spiraled around the core. Then the wrapper and core traded functions and the other single lost twist. Since both singles had the same twist and grist, there was no fine core with a “reserve” of Z twist. Both singles need to be spun with enough twist in order to maintain a stable yarn during plying.

When I used my right hand to spin the spindle, I used my left hand to pinch off the twist where the two singles met in order to keep the plying twist out of the singles until I had spun and caught the spindle and was ready to manipulate the wrapper. Every time I wound on, I alternated the singles that were to be wrapper and core. It took 2-3 spins of the spindle to spiral the 4-6” length to be wound on.
You can see the grey core running through the centre of the white spiraling wrapper. Then, they exchange places and the white yarn becomes the core, running through the centre of the grey spiraling wrapper. The core and wrapper have different angles of twist in the final 2-ply yarn with 10-14° for the core and 25-39° for the wrapper.

This yarn was plied at 12.3 yd/hr, a slow process, compared to plying the same singles into a normal smooth 2-ply yarn that plied at 43.1 yd/hr. When knit, this normal smooth yarn produced a fabric with a smooth surface, whereas the spiral yarn produced a textured surface. This thick spiral yarn is suitable for knitting a winter toque.
**Spiral Yarn #3 (ZZS Both Singles alternate in being wrapper and core)**

**Single A:**  
Fibre: Corriedale wool top, dark grey, staple length 4.5-5"  
Source: Louet  
Hand carded and rolled into rolags for a woollen preparation  

Spun Z semi-worsted short backward draw  
Spindle: Deluxe Purpleheart, 43.0 g  

Single: 13-14 wpi, 27-30° (range 25-33°)  
Folded 2-ply: 8 wpi, 2-2.5 tpi, 25-27°, 1.21 yd/g, 550 yd/lb

**Single B:**  
Fibre: Corriedale wool top, white, staple length 5.5-6"  
Source: Legacy Studio, Cochrane, AB  
Hand carded and rolled into rolags for a woollen preparation  

Spun Z semi-worsted short backward draw  
Spindle: Deluxe Purpleheart, 43.0 g  

Single: 13-14 wpi, 30° (range 25-33°)  
Folded 2-ply: 7-8 wpi, 2 2-2.5 tpi when folded (range 1.75-2.5 tpi), 29-32°, 1.27 yd/g, 575 yd/lb

Plied S keeping core in one hand taut and in line with the hook.  
Held wrapper loosely in the other hand and at a 45° angle to the core, letting the wrapper wrap around the core. Alternated letting one single act as core for 4-6", and then allowing the other single to act as core, then winding 2-ply onto spindle before switching singles.

**Finished yarn:**  
36.46 yd, 33.6 g, 6-7 wpi, 2.9 tpi (2.75-3.25 tpi), 25-39° for wrapper, 10-14° for core, 1.09 yd/g, 492.6 yd/lb, 3.84% shrinkage

**Knitted sample:**  
Stocking stitch with garter stitch borders.
1. Single A: Corriedale wool top, dyed grey
2. Single B: Corriedale wool top, white
SPIRAL YARN #3
**Bouclé Yarn Results**

I spun three bouclé yarns using different methods. Bouclé Yarn #1 and #2 were spun ZZS and had binders, while Bouclé Yarn #3 was spun SZS and cabled.

Most authors describe using a fine Z core and a thick Z wrapper and plying S, before using an S binder and plying Z to balance the twist (Olds College 2007, 2008; Ross 1983, 1988; Varney, 1987). Boggs (2011) and Field (1995) use SZS for their bouclé and King (2009) uses ZSZ. Plying in the same direction as the core increases the twist of the core, making it stronger, and decreases the twist of the wrapper, making it easier to form loops rather than snarls.

I used different fibres for the three bouclé yarns. Bouclé Yarn #1 had a bamboo core and long wool Wensleydale-Teeswater wrapper, Bouclé Yarn #2 had a Corriedale wool core and mohair wrapper and Bouclé Yarn #3 was all silk. Both Bouclé Yarn #1 and #2 had wool binders while Bouclé Yarn #3 was cabled. The three yarns differed in the size of the loops with mohair forming large loops, Wensleydale-Teeswater forming medium loops and silk forming small loops. I made several samples using different fibres before deciding which fibres to use. Each fibre formed a different kind of loop with Blue-faced Leicester wool forming soft, medium loops. Both Masham wool and adult mohair formed stiff distinct loops. The amount of twist in the wrapper had an impact on the loops. Too much twist in the wrapper produced snarls rather than loops while too little twist resulted in the wrapper losing too much twist during plying and not forming loops. Ross (1983) recommends long lustrous wool like Wensleydale for the wrapper’s loops while Varney (1987) recommends mohair top. Both of these fibres worked well.

McCuin (2007) says, “...bouclé yarns can only be made on a spinning wheel, not on a hand spindle” (p. 128). As stated earlier, the fact that the spinner in McCuin’s book used only a low-whorl spindle, and never a high-whorl spindle, may have influenced these statements about the inability to spin these novelty yarns with a spindle. High-whorl spindles are easier to “park and draft” (holding the spindle
between one's knees while drafting or manipulating the singles) compared to low-whorl spindles. This allows the spinner to use both hands to manipulate the singles when creating novelty yarns with a high-whorl spindle.

Bouclé yarns are a type of spiral yarn with the singles held in the same way during plying (Fig. 11). The core and wrapper are positioned on opposite sides and are held in opposite hands with the core held taut and in line with the back of the spindle hook, while the wrapper is held more loosely and at an angle to the core, allowing the wrapper to spiral along the core. With bouclé, the wrapper is then pushed along the core to form loops that are later held in place with a binder or cabled. Plying Bouclé Yarns #1 and #2 was very slow. However, when I plied Bouclé Yarn #3, I changed the plying technique for creating the loops and used my left hand to form the loops rather than my right hand in an effort to keep the ply twist out of the wrapper. The change in technique was also much faster, producing a looped 2-ply in 30% less time. After reading McCuin (2009) again, I realized that she also recommends pushing the loops with the left hand. Making the looped 2-ply was very slow at 3.9 to 6 yd/hr but was faster for Bouclé Yarn #3 at 7 yd/hr once I changed the method of forming the loops. Bouclé Yarn #1 and #2 used 2.9 and 1.9 times more wrapper than core while Bouclé Yarn #3 used 4.7 times more.

Varney (1987) recommends letting the looped 2-ply wrap loosely around the binder while King (2009) holds the binder and 2-ply together. I prefer holding the binder and 2-ply together. The looped 2-ply yarn can also be cabled to produce a very loopy yarn (Varney, 1987; McCuin, 2007), and I used this technique for Bouclé Yarn #3.
**Bouclé Yarn #1**

This yarn was designed to be spun ZZS with an S binder plied Z. I wanted a slippery core that the loops would slide easily along and chose grey bamboo top. I spun it at 26-28 wpi and 7 tpi folded. High twist was needed for the core – if the twists per inch were lower than this, the core broke during plying. For the wrapper, I chose a Wensleydale-Teeswater wool cross that had been dyed shades of brown. It was a longwool lustrous wavy fibre with a staple length of 7-8". I spun it at 10-12 wpi folded and a low twist of 1.75-2.5 tpi folded. I chose brown Polwarth wool fleece for the binder because it was a fine crimpy fibre that could be spun into a fine high twist single at 18-24 wpi and 6-8 tpi folded and its colour blended with the wrapper and core.

I plied S with the core on my left and the wrapper on my right with the core held taut in my left hand and the wrapper held loosely in my right hand. The wrapper was held at a 90° angle to the core just as for a spiral yarn. I pinched the 2-ply together with my left hand where the singles met, spun the spindle with my right hand, then parked the spindle between my knees to free up both hands. I let the wrapper spiral along the core, then formed loops by pushing the wrapper along the core with my left hand and was ready to spin the spindle again. Loops formed easily with a few snarls forming where the wrapper had too much twist. Loops were tiny if the wrapper was thin and were larger if the wrapper was thick. The wrapper loops moved easily along the slippery bamboo fibre core. Before plying with the S binder, I added extra S ply twist to the 2-ply to be 6-8 tpi.

This yarn required 2.9 times more wrapper than core. Plying the 2-ply was very slow at 3.9 yd/hr (including adding extra twist for the binder) while plying with the binder was done at 21.7 yd/hr. I liked the loopiness of this yarn, but plying time would be faster with less frequent loops.
Bouclé Yarn #1 ZZS

Core:
- Fibre: Black Diamond Bamboo top, staple length 5-6"
- Source: River City Yarns, Edmonton, AB

Spun Z semi-worsted from the fold using short forward draw
- Spindle: Compact Deluxe Holly, 28.0 g
- Single: 60 wpi, 25-27°
- Folded 2-ply: 26-28 wpi, 7 tpi, 18-25°, 7.65 yd/g, 3475 yd/lb
- Core broke during plying if tpi was lower than this.

Wrapper:
- Fibre: Wensleydale-Teeswater dyed sliver, staple length 7-8"
- Source: Fleece Artist, Nova Scotia
- Sliver split and predrafted slightly

Spun Z worsted short forward draw
- Spindle: Deluxe Maple, 47.5 g, then Koa 34.2 g when the maple spindle became too heavy at 65 g
- Single: 16-20 wpi, 18-25°
- Folded 2-ply: 10-12 wpi, 1.75-2.5 tpi, 14-18°, 1.32 yd/g, 600 yd/lb

Binder:
- Fibre: Brown Polwarth fleece, staple length 3"
- Source: Rovings, Winnipeg, MB
- Flick carded and spun from the butt end

Spun S worsted short forward draw
- Spindle: Mini Cherry, 17.1 g
- Single: 40 wpi, 27-33°
- Folded 2-ply: 18-24 wpi, 6-8 tpi, 20-25°, 5.40 yd/g, 2450 yd/lb

Plied S with core and wrapper pushing wrapper along core to form loops. Added extra S ply twist to 6-8 tpi before plying binder and 2-ply Z.

Finished yarn:
- 24.54 yd, 27.0 g, 16 wpi, 2.5-4 tpi, 7-21°S (2-ply) 18-27°Z (binder), 0.91 yd/g, 412.6 yd/lb, 3.1% shrinkage

Knitted sample:
- Bouclé yarn - garter stitch which put equal number of loops on both sides
- White Patons Classic Merino 4-ply wool (Appendix #2) – garter stitch.
1. Core: Black Diamond Bamboo top, grey
2. Wrapper: Wensleydale-Teeswater sliver, dyed browns
3. Binder: Brown Polwarth fleece
**Bouclé Yarn #2**

This yarn was designed to be spun ZZS with an S binder plied Z. It was spun the same as for Bouclé Yarn #1 but with different fibres. I chose Corriedale wool top for the core to try using a non-slippery fibre for the core. I spun it at 16-18 wpi and 3.5-4.5 tpi folded. When plying S, the Z core lost twist and I had to add extra twist to the core to ensure it was 4-5 tpi folded. This was the maximum twist I could insert at this grist without having the single "kink" up. I chose adult mohair top for the wrapper, a coarse fibre with a staple length of 5". I spun it at 15-16 wpi and 2-2.5 tpi folded for a wrapper with low enough twist to form the loops during plying. I chose Corriedale wool top for the binder in a colour that was slightly different than the core. I spun it at 20-24 wpi and 4-5 tpi folded.

I plied Bouclé Yarn #2 S in the same way as for Bouclé Yarn #1, plying S with the core on my left and the wrapper on my right, pushing the wrapper along the core with my left hand to form loops. I became more conscious of keeping the ply twist out of the Z core to prevent it losing so much twist that it would break. I ensured that I pinched the 2-ply together where the singles met to keep S twist out of the core. I allowed the wrapper to spiral unaided at 90°, just giving it a little tug if it started to wrap too loosely. Loops were spaced at about 1.5 loops per inch. The mohair wrapper did not slide easily on the Corriedale wool core; silk, synthetic or bamboo (as in Bouclé Yarn #1) would have been better. This yarn was plied at 4.5 to 6 yd/hr and used 1.9 times more wrapper than core. After knitting with this yarn, I think the loops could have been spaced further apart and this would have decreased the time required to ply it.

The 2-ply needed additional S twist before it could be plied Z with the binder. It was better to add this twist after making the 2-ply than during the making of the 2-ply. If I tried to add this amount of twist during plying, the core broke. Therefore, I added extra S twist to the finished 2-ply until it was 4-5 tpi. Adding this twist had a negative result because the round mohair loops doubled up into figure 8's which did not return
to their original state when plied Z with the binder. This problem did not occur when I added extra twist to the 2-ply on Bouclé Yarn #1. Perhaps this was influenced by either the “hairiness” of the mohair loops compared to the Wensleydale-Teeswater wool loops or by the larger size of mohair loops.
**Bouclé Yarn #2 (ZZS with S-binder plied Z)**

Core:
- **Fibre:** New Zealand Corriedale top, dyed mauve, staple length 4''
- **Source:** Ashford from Legacy Studio, Cochrane, AB
- **Split lengthwise and predrafted**

Spun Z worsted short forward draw
- **Spindle:** Deluxe Striped woods, 32.1 g

- **Single:** 32 wpi, 25-30°
- **Folded 2-ply:** 16-18 wpi, 3.5-4.5 tpi, 14-21°, 3.06 yd/g, 1389 yd/lb

Wrapper:
- **Fibre:** Adult mohair top, staple length 5''
- **Source:** Shuttleworks, DeWinton, AB
- **Predrafted**

Spun Z worsted short forward draw
- **Spindle:** Deluxe Imbuya, 37.3 g, switched to lighter weight (32.1 g) striped spindle when total weight exceeded 51 g. Spun the wrapper on 2 quills and joined them together during plying.

- **Single:** 22 wpi, 25-30°
- **Folded 2-ply:** 15-16 wpi, 2-2.5 tpi, 18-21°, 1.5-1.6 yd/g, 690-725 yd/lb

Binder:
- **Fibre:** New Zealand Corriedale top, dyed blue-grey, staple length 5''
- **Source:** Ashford from Legacy Studio, Cochrane, AB
- **Split lengthwise and predrafted**

Spun S worsted short forward draw
- **Spindle:** Deluxe Striped woods, 32.1 g

- **Single:** 40 wpi, 25-30°
- **Folded 2-ply:** 20-24 wpi, 4-5 tpi, 18-25°, 4.13 yd/g, 1875 yd/lb

Plied S with the core and the wrapper.
- I added extra S twist to the 2-ply until it was 4-5 tpi before plying Z with the binder.

**Finished yarn:**
- 46.9 yd, 43.3 g, 13-14 wpi, 3-3.5 tpi (2-ply and binder), 7-14° (2-ply), 16-25° (binder), 1.08 yd/g, 491.7 yd/lb, 0.8% shrinkage

**Knitted sample:**
- Bouclé yarn – reverse stocking stitch which put most loops on front side
- Navy Florica 2-ply wool (Appendix #2) – garter stitch.
BOUCLE YARN #2

1. Core: New Zealand Corriedale top, dyed mauve
2. Wrapper: Adult mohair top, white
3. Binder: New Zealand Corriedale top, dyed blue-grey
Bouclé Yarn #3

This yarn was designed to be spun SZS with the wrapper forming the loops and then to be cabled. I spun both the core and wrapper with silk. I chose silk for the core because I wanted a strong, slippery fibre for the loops to slide along. I chose multicoloured Tussah silk for the wrapper because silk is lustrous and lightweight and I wanted a bouclé that would be completely different from Bouclé Yarn #1 and #2. I spun the core S at 24-28 wpi and 5-6 tpi folded. I spun the wrapper Z at 12 wpi and 3 tpi folded.

I plied S, with the core on my left and the wrapper on my right. The wrapper was held loosely and at 45-60° to the core, which was held taut and in line with the back of the spindle hook. I spun the spindle S and parked it between my knees while I pushed the wrapper along the core to form loops. In plying this final yarn for this study, I found I had to change my plying technique in order to keep the S twist out of the Z wrapper. I used my left hand (instead of my right hand) to push the loops along the core while my right hand pinched the wrapper and guided the spiraled yarn. When the right hand was needed to spin the spindle, the left hand pinched both singles where they joined. Using this method decreased plying time by over 30% and kept the ply twist out of the wrapper.

Additional S twist was added to the 2-ply to be 6-8 tpi before two 2-plies were plied Z into a 4-ply cable yarn. The yarn is a very lightweight bouclé yarn with loops all along its length. It had the highest wrapper to core ratio, using 4.7 times more wrapper than core. Time was 5.4 yd/hr with the slower method (making loops with right hand) and 7.0 yd/hr with the faster method (making loops with left hand).
Bouclé Yarn #3 SZS Cabled Z

Core:
  Fibre: Tussah silk top, staple length 10"
  Source: Golden Willow, Regina, SK

  Spun S semi-worsted short forward draw from the fold
  Spindle: Compact Deluxe Holly, 28.0 g

  Single: 48-52 wpi, 21-27°
  Folded 2-ply: 24-28 wpi, 5-6 tpi, 18-21°, 9.14 yd/g, 4150 yd/lb

Wrapper:
  Fibre: Tussah silk, dyed, staple length 4-6"
  Source: Treenway Silk, SaltSpring Island, BC
  Split and predrafted

  Spun Z worsted short forward draw
  Spindle: Deluxe Koa, 34.2 g

  Single: 24-28 wpi, 18-21°
  Folded 2-ply: 12 wpi (12-16), 3 tpi (2-3.5), 8-14°, 4.74 yd/g, 2150 yd/lb

  Plied S, pushing the wrapper along the core to form loops. Additional S twist was added to 6-8 tpi in the 2-ply before it was cabled Z into a 4-ply yarn.

  Finished yarn:
    23.0 yd, 14.9 g, 9-10 wpi, 3-5 tpi, 5-10° (core), 7-21° (wrapper),
    1.54 yd/g, 700.8 yd/lb, 5.1% shrinkage

Woven sample:
  Bouclé yarn – see Appendix #3 for weaving draft
  White Florica 2-ply wool (Appendix #2).
BOUCLÉ YARN #3

1. Core: Tussah silk top
2. Wrapper: Tussah silk, dyed
Novelty yarns that require special manipulation during plying, specifically knot, snarl, spiral and bouclé yarns, can be spun using only high-whorl spindles. More time is required to ply these yarns with a spindle compared to spinning regular plied yarns or compared to producing them with a spinning wheel.

Knot, snarl, spiral and bouclé yarns consist of two or three component yarns – a core, a wrapper and sometimes a binder yarn. There are many methods for creating these four yarns that differ in the direction and amount of twist of the components as well as the direction of plying the component yarns together. For example, snarl yarn can be spun ZZS, ZZZ, SZS or ZSZ using the appropriate binder or cabling direction to stabilize the yarn. An SZZ yarn resulted in the S core disintegrating when plied Z.

Plying the core and wrapper in the same direction as the core (SZS or ZSZ) reduces the chance of the core breaking while manipulating the wrapper during plying.

A variety of fibres can be used, including wool from different breeds of sheep, mohair, alpaca, silk and synthetics, as long as the fibre properties meet the qualities required for the core, wrapper or binder yarns.

Access to spindles of different weights makes it easier to spin these yarns. Most binder and core yarns were spun on 28-32 g spindles with a few spun on a 17 g spindle. Spindles for wrapper yarns varied widely in weight depending on the novelty yarn and fibre. Most medium grist wrapper yarns for snarl, bouclé and knot yarns were spun on 34 to 37 g spindles and thicker wrapper yarns for spiral yarns were spun on 43 to 47.5 g spindles. All plying was done on a larger 47.5 g spindle.
The spinner should change to a lighter spindle when the weight of the yarn has a negative impact on the spinning dynamics of the spindle.

Use of a quill to hold the yarn facilitates moving the singles to a different spindle. It also facilitates placing the yarn on a lazy kate for plying.

The location of the lazy kates relative to the spinner and the ability to tension the single and plied yarns are very important and affect the ease and success of plying. Both wrapper and core singles should be placed in front of the spinner for plying knot and snarl yarns. The core and wrapper should be placed on opposite sides of the spinner for plying spiral and bouclé yarns. The binder and 2-ply yarn can be placed on one side of the spinner for plying. Alternatively, the binder can be placed on one side and the 2-ply can be placed in front of the spinner.

For knot, snarl and bouclé yarns, more singles are needed for the wrapper compared to the core or binder yarns. The amount of additional yarn needed depends upon the frequency and size of the knots, snarls or loops, but for the yarns spun for this study, 2 to 4.5 times more yarn was required for the wrapper than for the core or the binder. For spiral yarn, approximately 10% more yarn is required for the wrapper than for the core.

Making samples of yarn and using the washed yarn to make samples that duplicate the technique to be used for the intended article (knitted, woven, crocheted) is important. This permits the spinner to estimate the required amounts of each single yarn and to space the texture components at appropriate intervals during plying.

For knitting, garter stitch, reverse stocking stitch, yarn over, drop stitch and slip stitch techniques are good techniques for novelty yarns when you want the texture to show on the upper side. Novelty yarns contrast well with plain yarns.
For weaving, supplementary weft techniques work well and show the maximum amount of texture on the upper side. These techniques allow the novelty yarn to float over several warp threads while still having a firm plain weave ground of smooth contrasting yarns as warp and weft. Twills, such as 3/1 twills, are also suitable techniques.
REFERENCES


http://groups.yahoo.com/group/spindlitis/messages
### Appendix 1. Specifications of high-whorl spindles used in this study.

<table>
<thead>
<tr>
<th>Type of Tabachek high-whorl spindle</th>
<th>Whorl wood</th>
<th>Spindle weight (g)</th>
<th>Whorl diameter (inch)</th>
<th>Shaft length below whorl (inch)</th>
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<td>Mini</td>
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<td>Compact Deluxe</td>
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<td>Deluxe</td>
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<td>Plying</td>
<td>Walnut</td>
<td>42.5</td>
<td>3.5</td>
<td>10.875</td>
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Appendix 2. Commercial yarns used in knitted and woven samples.

1-4 Florica wool (made in Finland), 2-ply, off-white, grey, navy, black

5 Patons Classic Merino wool, 4-ply, off-white
Appendix 3. Weaving draft #1 (Supplementary Weft).

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# = Begin draft on right with warps threaded on shafts 2 and 3.
* = End draft on left with warp threaded on shaft 2.

Warp: Commercial 2-ply wool, Florica brand (Appendix 2)
Wefts:
  / = Tabby weft: same as warp
  P = Pattern weft: novelty handspun (spiral, knot or bouclé)

Sett: 10 ends per inch (epi)
Beat: Beat very lightly at 10 picks per inch (ppi).
Appendix 4. Weaving draft #2 (Supplementary Weft, 3/1 Twill and Tabby).

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P  P  diagonal treadling

P  P  columns" treadling

P

End draft on left with warp threaded on shaft 1.
Use a floating selvedge on both sides.

Warp: Commercial 2-ply wool, Florica brand (Appendix 2)
Wefts:
/ = Tabby weft: same as warp
P = Pattern weft: novelty handspun (snarl)

Sett: 10 epi
Beat: Beat very lightly at 10 ppi.