AN ABSTRACT OF THE THESIS OF

JOYCE COLLEEN JEFFERS for the MASTER OF SCIENCE (Name)

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Title: AN EVALUATION OF SERVICEABILITY AND CONSUMER ACCEPTANCE OF PRE-SCHOOL BOYS' SHIRTS MADE OF BLENDED POLYPROPYLENE FABRICS

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This study was an evaluation of fabric serviceability and consumer acceptance of polypropylene blend knits. A review of literature indicates a trend toward polypropylene blend fabrics for wearing apparel, specifically for knits. The purpose of the research was to compare two experimental double knit fabrics, a 50 percent Creslan/Herculon blend and a 50 percent rayon/Herculon blend.

The double knit blends, constructed of a French piqué stitch, were developed into pre-school boys' golf-style shirts. Fabric serviceability was tested through ten weeks of actual wear by seven nursery school boys, and in the textile laboratory for abrasion resistance, wrinkle recovery and for actual thickness. Consumer acceptance was subjectively evaluated by the parents of the boys, a panel of Oregon State University Clothing and Textiles faculty members, the
nursery school supervisor, and the writer.

The results of this study indicated that consumers will accept and purchase polypropylene blend shirts on the assumptions that the fabric will 1) provide superior serviceability, 2) resist stains and wrinkles, 3) return to original appearance with limited care, 4) be obtainable in a wide range of bright colors, and 5) be within a competitive price range to shirts of comparable style and fabric. Laboratory tests correlated with natural wear testing indicating both knit blends will pill, will not absorb moisture, will be colorfast, and will increase in thickness when exposed to a fluff drying cycle. The serviceability of the Creslan/Herculon blend was evaluated as being superior to the rayon/Herculon double knit for abrasion and wrinkle resistance.
An Evaluation of Serviceability and Consumer Acceptance of Pre-School Boys' Knit Shirts Made of Blended Polypropylene Fabrics

by

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A THESIS submitted to Oregon State University in partial fulfillment of the requirements for the degree of Master of Science June 1970
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AN EVALUATION OF SERVICEABILITY AND CONSUMER ACCEPTANCE OF PRE-SCHOOL BOYS' KNIT SHIRTS MADE OF BLENDED POLYPROPYLENE FABRICS

INTRODUCTION

Technological progress, as a means to a more leisurely life has become an important part of the American philosophy. Rapid and extensive changes have transformed almost every segment of the American economy, the textile industry being no exception. Today, through scientific progress of the chemical industry, new and improved cellulosic and synthetic fibers are being rapidly developed. The use of glass fibers also has a significant role in the textile industry.

Prior to the twentieth century, fibers were obtained from natural sources with cotton, wool, flax and silk the most commonly used. With the discovery that fibers could be synthesized from simple organic substances, the technological revolution in the textile industry was given impetus and has continued through to the development of wash-and-wear finishes, fabric laminating, the knit and stretch phenomena and permanent press, to mention only a few.

While the quality of natural fibers can vary due to growing conditions, man-made fibers are uniform in quality because the production process is controlled. Therefore, any preferred characteristic in a man-made fiber may be obtained by changing the
production process. The development of man-made fibers has thus been a major contribution to the economy. Within the past 60 years, 17 different generic groups of man-made fibers have been produced (62). During the 1940's and 1950's, research was devoted to the production of numerous new fibers, with nylon, polyesters and acrylics being developed.

Consumer wants are dynamic, and consumer satisfaction requires the creation of new textile products, as well as the orientation to specific fibers and finishes. Advances in textile technology have been dramatic with the emergence of new performance concepts. The fiber producers and textile manufacturers of today are shifting from mass production to products which will meet the specialized consumer requirements (63).

Today, synthetic polymer fibers are being created and produced in many forms to meet the expanding demands. The technology required to fulfill these changing needs will continue to develop rapidly when the needs of the consumer are known by the textile industry (20). Norma Hollen and Jane Saddler stated in their book Textiles, "A fiber must be converted into a successful fabric that will please the consumer if it is to compete in the market" (28).

In the early 1960's, the polyolefin fibers developed rapidly as compared to the period from 1954 to 1960. Limited to industrial application up to this time, polyolefin fibers began to show promise
of rating consideration along with the polyamides, polyesters, and acrylics. Of the two olefin fibers, polypropylene and polyethylene, products of the petroleum industry, polypropylene is favored more for general textile use.

Polypropylene monofilaments initially made their way into applications which had been pioneered by polyethylene. These monofilaments effectively competed with other fibers in areas including fish nets, filter fabrics, and protective clothing for industry.

Potential application for polypropylene fibers extended to general textile use when fine denier multifilament yarns and staple fibers were introduced. Today the use of polypropylene in apparel is becoming diversified in such items as boot linings, hosiery, sport shirts, sweaters, work clothing, hats, coating fabric, woven and knit dress fabric, and imitation furs.

Polypropylene fiber production has increased at an average annual growth rate of 45 percent from 1960 to 1966 (41). Total fiber production for 1967 was 149 million pounds of polypropylene (44).

It was estimated that the consumption of polypropylene will increase to 770 million pounds in both 1968 and 1969 (30).

The degree to which polypropylene is actively accepted on the retail apparel market is related to its competitive position with other well-established synthetic fibers. The unique as well as flexible
characteristics offered by the polyolefins, specifically polypropylene, are beginning to occupy a significant place in the American textile industry. As any fiber meets the tests of the market, consumption will tend to increase.

The Fibers and Film Department of Hercules, Incorporated, the largest producer of polypropylene fibers, has developed multifilament and staple fibers for apparel use. *Herculon, the Hercules trademark for polypropylene olefin fiber, is being introduced in new forms specifically for apparel. Hercules, Incorporated, is producing fabrics knitted from blends of Herculon with rayons, acrylics and polyesters. Texturized fine-denier yarns for stretch apparel are also in the developmental stages.

Today consumers are showing a definite preference for plain and double knit fabrics for outerwear because of their elastic properties which allow garments to stretch under stress, and yet return to their original shape (17).

An investigation into the performance of garments constructed of polypropylene double knit blends and consumer acceptance of these blends was prompted by the writer's interest, and the availability of the fabric provided by Hercules, Incorporated. The study appeared to have merit in view of the possible future demands for polypropylene blend fabrics for wearing apparel. At the time of this study, boy's polypropylene blend knit golf shirts were not
available on the retail market.

Statement of the Problem

The purpose of this research was to evaluate the effects of physical testing, wear, and consumer acceptance of polypropylene double knit fabrics for use in children's clothing, specifically for boys.

The study was a comparison of the physical properties of the original and wear-tested knit blended polypropylene fabrics, an investigation of the serviceability and performance of garments constructed of experimental polypropylene knits, and an evaluation to determine consumer acceptance of these shirts for potential end use on the retail market.

In addition, the intent was to experiment with, and evaluate, consumer preference of two sleeve styles, the raglan and set-in types for boys' shirts.

Objectives of the Study

1. To measure the physical properties of polypropylene knit blends for abrasion, specifically pilling, wrinkle resistance and thickness.

2. To determine and compare the effects of physical testing on original and wear-tested polypropylene blend knits.
3. To identify the visual changes to the knit shirts incurred during wear and controlled laundering and drying.

4. To identify and determine which knit blend changed least in appearance after wear-testing and laundering.

5. To ascertain the degree of consumer acceptance of polypropylene blend knit fabrics for use in children's garments.

6. To test a raglan sleeve design for growth, comfort, and consumer preference in comparison to a set-in sleeve style in boys' shirts.

The Hypotheses

1. A raglan sleeve design will provide greater comfort and allowance for growth than a set-in sleeve and will be preferred by the parent.

2. Polypropylene-Creslan and polypropylene-rayon blend knit fabrics will pill after limited wearings.

3. Knit garments of Creslan or rayon blended with polypropylene will perform equally well after numerous wearings, laundering and drying cycles.

4. Polypropylene blend fabrics can be restored through laundering and drying and require very little or no pressing.

5. Consumers will generally be influenced by aesthetic properties rather than physical properties when making a final decision on
6. Consumers are interested in new fibers and fabrics obtainable at low costs and those which require limited maintenance.

7. Consumers will be enthusiastic and receptive to polypropylene knit shirts if made available on the retail market.

The Assumptions

1. Garments in the study were worn approximately the same predetermined length of time each day.

2. The experimental garments were restored each week by controlled laundering and drying.

3. The techniques for constructing the experimental garments would be comparable to methods used by manufacturing firms.

4. Polypropylene blend fabrics have a relatively low melting point and thus will require controlled laundering and drying temperatures.

5. The polypropylene blend knit shirts used in the study were wear-tested under identical conditions, specifically those activities participated in by a full-day nursery school boy.

Limitations of the Study

1. The length of time required for construction of the garments, and the amount of available experimental fabric restricted the
number of participants.

2. Subjects were selected from a particular segment rather than a cross section of the population.

3. Color selection was limited because of the experimental nature of the available fabric.

4. Laboratory tests were limited in terms of standardized methods for testing knit fabrics, amounts of original fabric remaining after the construction of garments, and available testing equipment.

5. Opinions and preferences of parents were influenced by background experiences, socio-economic level and educational achievement.

6. Ages of the boys and their ability to communicate limited, to a degree, the collection of boy's preferences and opinions.

### Definition of Terms

<table>
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<th>Description</th>
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<tr>
<td><strong>Atmosphere, Standard</strong></td>
<td>Air maintained at a relative humidity of (65% \pm 2%) and at a temperature of (70^\circ \pm 2^\circ) (3).</td>
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<tr>
<td><strong>Abrasion Resistance</strong></td>
<td>The resistance of a fabric to wear when rubbed against other surfaces (3).</td>
</tr>
<tr>
<td><strong>Bursting Strength</strong></td>
<td>The maximum resistance that a fabric has to rupture by pressure (3).</td>
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<td>Term</td>
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<tr>
<td>Creslan</td>
<td>Light, soft, bulky acrylic fiber.</td>
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<td>Compressibility</td>
<td>The ease of squeezing a fabric (3).</td>
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<tr>
<td>Condition</td>
<td>To bring a sample or specimen to moisture equilibrium with a specified atmosphere (3).</td>
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<tr>
<td>French Piqué Stitch</td>
<td>A commonly used knit stitch giving a subtle diamond effect surface.</td>
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<td>Fibrillation</td>
<td>The lightening of a fabric's color along crease lines when fiber ends are pulled out by surface abrasion (3).</td>
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<tr>
<td>Fuzzy</td>
<td>A condition of the fabric characterized by a hairy appearance due to broken fibers of filaments (3).</td>
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<tr>
<td>Hand</td>
<td>The aesthetic property of a fabric conceived through the sense of touch. The feeling of a fabric or yarn obtained by touching or handling: soft, smooth, pliable, springy, stiff, cool, warm, hard (62).</td>
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<tr>
<td>*Herculon</td>
<td>Registered trademark of Hercules, Incorporated, for its olefin fiber.</td>
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<tr>
<td>Isotactic</td>
<td>Specific molecular arrangement in space with methyl groups having the</td>
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same location and no polar groups.

**Knit**


**Man-Made Fiber**

A class name for various genera of fibers produced from fiber-forming substances which may be (1) polymers synthesized by man from simple chemical compounds, (2) modified or transformed natural polymers, and (3) glass (55).

**Olefin**

A manufactured fiber in which the fiber-forming substance is any long chain synthetic polymer composed of at least 85 percent weight of ethylene, propylene, or other olefin units (55).

**Polypropylene**

A paraffin based fiber, classified generically as an olefin.

**Polymer**

A molecular chain-like structure from which synthetic fibers are derived.

**Pilling**

Bunches or balls of tangled fibers held on the surface of a fabric by one or more fibers.
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<th>Serviceability</th>
<th>Advantageous quality of lasting or wearing well in use.</th>
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<td>Wrinkle Resistance</td>
<td>A fabric property which enables it to resist the formation of wrinkles (3).</td>
</tr>
<tr>
<td>Yarn Blends</td>
<td>A single yarn spun from a blend or mixture of different fiber species (3).</td>
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Today, man-made fibers occupy a significant place in the textile industry. The synthetic fibers are no longer regarded as substitutes for natural fibers; they have been accepted as new materials with their own particular properties. The man-made textile fibers do not have to conform to traditional standards because they are meeting the demands for industrial, military, and outer space use. In addition, man-made fibers are providing opportunities for new technological advancement in medical, industrial, and textile research.

Aesthetically, the new fibers have placed relatively few limitations on the creative engineer or designer and fabric stylist of today.

Expanded promotional campaigns, marketing techniques, an affluent society, and actual use of end products have given impetus to consumer acceptance of the new fibers.

Functional values such as strength, comfort, warmth, and ease of care are all qualities which today's consumer is demanding and ultimately purchasing.

Olefin is among the newest of the man-made fibers possessing physical and chemical properties which producers predict will make it a unique competitor on the textile market.
Historical Survey

Olefins, polypropylene and polyethylene, are open-chain unsaturated hydrocarbons possessing a single double bond, thus being capable of polymerizing (9). Olefin, derived from the Latin word oleum, meaning oil, is a generic name applied by the Federal Trade Commission to fibers originating from the gases ethylene and propylene.

In the late nineteenth century, or approximately 1875, isobutylene was the first olefin fiber to be successfully polymerized (9). Continued research was conducted, and during the 1920's, attempts were made to polymerize other olefins, specifically ethylene.

Imperial Chemical Industries, Limited of England, developed a successful polymerization method for ethylene in 1936, and additional research attempts followed to polymerize the olefin propylene. The first developmental results of this research were made available in 1952, when a type of polypropylene was made, but only oils and greases were obtained.

In 1954 Karl Ziegler, professor at the Max Planch Institute in Germany, discovered and developed a new technique for the polymerization of ethylene. Many years of research had been spent by Karl Ziegler on the systematic study of catalysts that would
polymerize ethylene into high molecular weight polymers. This specific new process allowed the polymerization of ethylene at lower pressures and temperatures, thus yielding polymers of higher molecular weight. With the development of low-temperature polymers a higher degree of crystalline quality resulted, affecting the physical properties of the polymer.

Prior to the time of Ziegler's discovery, Professor Guilio Natta, Director of the Institute of Industrial Chemistry at Milay, Italy's Polytechnic Institute, had been doing extensive research. Professor Natta and his colleagues discovered that crystalline polymers could be obtained using certain Ziegler-type catalysts which resulted in the polymerization of propylene to linear polypropylene (9).

In conjunction with Professor Ziegler, Guilio Natta filed the first polypropylene patent application in 1954. In 1963, these two men, Ziegler and Natta, were awarded the Nobel Peace Prize for Chemistry for their work toward the development of the olefin textile fiber.

For Nobel Peace Prize winner Guilio Natta, the new polymer has provided few surprises in that it has fulfilled all his expectations. Professor Natta indicated that because of the low price of the raw material, polypropylene is the polymer of the future (44). The polymerization process developed under the direction of the
Ziegler-Natta team has been recognized as a remarkable development in polymer chemistry.

After six years of experimentation, polypropylene fibers were developed for commercial use in Italy under the trade name Meraklon by Montecantini. In addition to Italy, countries which have produced polypropylene on a large scale basis are Japan and England.

The first commercial production of olefin monofilaments in the United States was in 1949, limited however to specific industrial use (9).

In 1962, Hercules, Incorporated first produced multifilament polypropylene fibers for textile uses. Hercules, Incorporated, through its extensive research and marketing promotion, has developed into one of the largest domestic producers of polypropylene, using the trade name Herculon. Additional trade names for domestically produced polypropylene fibers include: Marvess by Phillips Fibers Corporation, a subsidiary of Phillips Petroleum Company; Polycrest, UniRoyal Fiber and Textile, Division of UniRoyal, Incorporated; and Polyloom by Chevron.

It is thought that the initial momentum behind the development of polypropylene originated from the potential the fiber offered as a plastic material (7). Polypropylene has been considered unique among the synthetic fibers; it is the only one made from a basic polymer which is also a large volume plastic (16).
Polypropylene is similar to polyethylene, but the increased temperature resistance, strength, better surface finishes and greater stiffness give it advantages over polyethylene. As an end product of the petroleum industry, olefin is derived when petroleum gas is converted into pellets and then melt-spun. After extrusion, the olefin filaments crystallize immediately upon cooling, which consequently affects the way in which polyolefin fibers are spun. Polypropylene has two crystalline forms, monoclinic and hexagonal.

Professor Natta continued an investigation, using x-ray and infra-red methods which showed differences in the steric structure of the polymers. The polypropylene molecule consists of a long chain of carbon atoms and appendages of methyl groups which stand out from the sides of the chain. Professor Natta separated polypropylene into a number of polymers using differences in their solubility as a basis. Differences were also found in the density and the melting points. Some polymers crystallized while others remained amorphous.

Upon recognition of these basic types of structures, Guilio Natta named the structures isotactic, syndiotactic, and atactic (9).

Isotactic Polypropylene has all the methyl groups on the same side of the backbone plane.

Syndiotactic Polypropylene has methyl groups on alternate sides of the plane.
Atactic Polypropylene has methyl groups distributed in random fashion on both sides of the plane. Isotactic and syndiotactic polymers are crystalline because of their orderly structure while atactic polypropylene is irregular and amorphous.

Polypropylene, unlike the natural fibers, has no polar group, and, until the discovery of isotactic polypropylene, the presence of polar groups was considered essential for the production of fibers with high tensile strength (51). This isotactic polymer has a sufficiently high melting point of approximately 345°F. to justify transformation into a fiber (7).

Since the discovery of stereospecific polymerization methods, every attempt has been made to develop polyolefins which can be spun into textile fibers (51). The fibers spun from polyolefins will vary according to the size, type, and arrangement of the crystals.

Fiber manufacturers use a polymer which is about 97 percent stereogulated and has a molecular chain length of approximately 8000 polypropylene molecules (30). The isotactic index for commercial polypropylene is over 90 percent (9).

It is predicted that isotactic polypropylene will have a sound future because of the high bulk that originates from the irregular pattern of the fibers, and its potential to serve in a wide range of textile applications.
Identification of Polypropylene Fibers

The appearance of polypropylene fibers is found to be smooth, featureless, and usually, circular in a cross section.

Polypropylene can be distinguished either as an isolated fiber or in fabrics by administering one or more of three basic tests. These are:

Measuring Melting Point

A melting point is reached when the filament begins to flatten or distort under light pressure and at a temperature of about 167°C.

When a flame is brought up to a polypropylene yarn, the fiber melts and retracts. Continued flame contact creates a blue and yellow flame similar to a candle. When extinguished, a characteristic asphalt odor is given off.

Determining Solubility

Polypropylene fibers are completely soluble in boiling meta-xylene. With the exception of saran and polyethylene, no other fibers have this property. These two fibers, however, are not commonly found in textile deniers.
Measuring Density

One of the most useful methods of identification is density. The olefins (polypropylene and polyethylene) are the only two textile fibers that will not sink in water containing a trace of wetting agent or ammonia.

Physical Properties of Polypropylene

Polypropylene resins have gained increased acceptance in the manufacturing of textiles. Polypropylene fibers are particularly interesting not only economically, but because of their unique physical and chemical properties. Polypropylene fibers possess a combination of characteristics which allow extensive use throughout the textile field, and provide a wider range of properties which are more than just marginally different from those of well-established fibers. Specific physical properties of polypropylene are primarily dependent upon crystallinity and molecular weight (9).

Specific Gravity

The specific gravity of polypropylene fibers varies with the degree of crystallinity. Commercial polypropylene fibers are the lightest of all commercial textile fibers with a specific gravity range of 0.90 - 0.91 (9). Low specific gravity potentially gives the
fiber 65 percent more coverage per pound as compared to cotton and 20-30 percent more coverage than most synthetics (47). Thus, an important characteristic of polypropylene is its low specific gravity even in the crystalline form since fabrics are sold by the yard and not by weight (48).

**Moisture Absorption**

The effects of moisture on polypropylene appear to be insignificant. Polypropylene is a paraffinic hydrocarbon which does not absorb water. As moisture has no effect on tensile strength, degradation of fibers does not occur (9).

**Shrinkage**

Shrinkage of polypropylene fibers is related to the treatment the fibers receive during processing. Multifilament yarns may shrink between 0 and 10 percent after being subjected to boiling water for twenty minutes.

**Dimensional Stability**

The dimensional stability of polypropylene is excellent. Moisture regain of the fiber due to its paraffinic nature is almost nonexistent. Water repellency enables the fibers to retain high stability through repeated launderings. Polypropylene fibers also
retain their shape in changing conditions of moisture and humidity.

**Thermal Properties**

The nature of the polymer and crystallinity determine the softening points of specific polypropylenes. Polypropylene fibers soften at $150^\circ$ C. and melt in the $160^\circ - 170^\circ$ C. range. Polypropylene fibers melt and flow at about $167^\circ$ C. (26).

For practical purposes general flexibility of polypropylene fibers is satisfactory because flexibility is retained to temperatures of $70^\circ$ C.

While the low softening point of the fiber is a major drawback for textile application, the development of isotactic polypropylene raised the softening point, thus improving its use for textile fibers. Low melting points affect the iron-ability and hot processing such as in the polypropylene cure.

However, in laboratory tests, it was found that when a minimum of 20 percent of polypropylene was blended with cotton, the fabric could be pressed or ironed without apparent damage.

**Thermal Conductivity**

Polypropylene has the lowest thermal conductivity of all commercial fibers and is considered the warmest fiber. Thermal
insulation characteristics are determined by the amount of air entrapped in a fabric. Thermal conductivity relative to 1.0 air comparisons are:

<table>
<thead>
<tr>
<th>Fiber</th>
<th>Thermal Conductivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polypropylene</td>
<td>6.0</td>
</tr>
<tr>
<td>PVC Fiber</td>
<td>6.4</td>
</tr>
<tr>
<td>Wool</td>
<td>7.3</td>
</tr>
<tr>
<td>Cellulose Acetate</td>
<td>8.6</td>
</tr>
<tr>
<td>Viscose</td>
<td>11.0</td>
</tr>
<tr>
<td>Cotton</td>
<td>17.5 (9)</td>
</tr>
</tbody>
</table>

Flammability

Polypropylene is a hydrocarbon and will burn. However, when exposed to flame, the fiber melts and draws away from the flame, extinguishing itself. Polypropylene fabrics exceed the requirement of Class I of the American Society for Testing Materials standard for flammability for textile fabrics. Flammability characteristics are also influenced by the types of fabric construction, additives, blending with other fibers and specific fabric finishes.

Effect of Sunlight

Polypropylene fibers will deteriorate on exposure to light. The addition of stabilizers which absorb ultra-violet light, however, will provide a degree of protection. Repeated laundering may result
in the loss of these stabilizers.

**Abrasion Resistance**

Polypropylene and polyethylene blend fibers have a high resistance to abrasion when dry and greater resistance when wet. A blend containing polypropylene fibers increases the abrasion resistance as the proportion of polypropylene increases. Abrasion resistance is influenced by the molecular weight of the polypropylene and the spinning and processing conditions.

**Crease and Flex Resistance**

The ability for polypropylene to resist crease formation varies with the molecular weight of the polymer and with the spinning and drawing conditions. The crease resistance of the fibers is similar to that of wool, although polypropylene does not lose its high crease resistance when wet.

Polypropylene fibers have excellent flex resistance and recovery from bending. The combination of high flex resistance with excellent loop and knot-strength is important in the production of knitted goods.

The hand and draping characteristics of polypropylene depend largely on the weaving and finishing of the fabrics.
Chemical Properties of Polypropylene

The resistance of polypropylene fiber to most chemicals, acids, alkalis, organic solvents and bleaches is unparalleled. The material is soluble only in hot chlorinated and aromatic hydrocarbons (16). Prolonged exposure to specific chemicals such as acetone, nitric acid, or sodium hydroxide may extract stabilizers.

The paraffinic hydrocarbon possesses valuable properties of cleanability and stain resistance; however dyeing then becomes more difficult.

The fibers are not subject to insect attack since they cannot be digested by insects. When the fiber becomes a barrier, it is merely cut through by the insect.

Polypropylene fibers will not support the growth of mildew or fungi.

Wash-and-Wear Characteristics

Polypropylene is unusually resistant to soiling. The two primary factors influencing this characteristic are: 1) electrostatic attraction and 2) chemical inertness (9).

Polypropylene fibers show little tendency to accumulate charges of static electricity through friction during use. Unlike other synthetic fibers they do not attract dust and dirt to the extent
that most man-made fibers do.

Polypropylene fibers do not react chemically with the substances encountered in general wear, nor the common solvents, greases and oils. Staining does not readily take place, and, when it does, it is generally superficial. Stains are held in the fabric by capillary action and are readily removed by laundering or dry cleaning.

Laundering can be conducted without difficulty using temperatures up to 212°F. Because of negligible water absorption, polypropylene dries quite rapidly. When a reduction of temperatures in excess of 260°F. is necessary, drying time is increased.

Additional care is required when ironing and pressing because the softening point is lower than for most apparel fabrics.

Dry cleaning is satisfactory when trichloroethylene at temperatures below 50°C. is used (9).

Dyeability

As might be surmised from polypropylene's imperviousness to water and lack of chemically active groups, it is difficult to dye. Polypropylene, being a nonpolar polymer, has no dye sites (47).

It was related in Ciba Review 1964/3 that polypropylene fibers do not dye readily because of their comparatively high crystallinity
and the resultant impermeability of their structure. Not only do these fibers absorb no water, they also lack an adequate number of dye bonding groups.

In 1965, it was suggested that affinity of polypropylene for dyes could be improved by adding basic polymers. By 1966, it was stated that hydrophobic alizarine dyes penetrated well into polypropylene fibers and combined equally well with metal residues (40).

Scientists at both the U. S. Rubber Company and the Fibers Division of Hercules, Incorporated, developed systems for building a basic polymer dye receptor into the fiber, followed by treating (33).

A new version of Meraklon by Montedison of Italy was introduced and identified as dyeable with acid, premetalized, chrome and vat dyes. Dr. P. Susani of Polymer S. P. A. indicated that with suitably selected dyestuffs, good general fastness and satisfactory color depth could be attained (38). It was stressed that when dyeing wool-Meraklon blends, attention must be given to the difference in dyeing rates of the fibers.

Melt-coloring or pigmentation is used to produce colors in slit and fibrillated polypropylene film. This technique is the most extensively developed and will probably continue to be used (37). The pigments are added to the polymer before extrusion in melt-coloring, and these colors are economical. Pigmentation provides color
permanence that has not been attainable any other way (32). Light stability and colorfastness are unchanged for the life of the yarns, and even distribution of pigments prevents color change or crocking.

Despite a great deal of investigation on the part of dyestuff and fiber researchers, limited progress has been made toward finding a means to obtain all-around colorfastness, which is essential. The coloring method is dependent to some extent on the end use and conditions to which the fibers will be exposed. The majority of polypropylene fibers used in 1968 were either uncolored or solution dyed.

Bulletin FD-15 of the Fiber Development Department of Hercules, Incorporated, stated:

In fabrics incorporating Herculon as a dye resist, any suitable dyestuff and procedure necessary to obtain the desired shade on the fabric being dyed is recommended except those procedures requiring the use of copper salts to develop shades, and/or dye-fixes containing copper (24).

Thus the fiber producer assumes the responsibility of providing colors desired by the consumer.

The multiple differences in fabrics when they are ready for the consumer are the result of variations in the fiber, fiber combination, yarn construction, weave and finish. There seems to be no limit to the number of blends being produced by means of combining different fibers. Manufacturers are continuing to develop
more blends because they want fabrication, specific characteristics for better quality and price advantages for each fiber.

Darragh and Johnson indicated that all man-made textile fibers have been produced in essentially the same manner. The major advances have resulted from the development of new polymers, and fiber combinations, not essentially from process changes (11).

General Properties of Rayon

Rayon is the oldest and most widely used of all the man-made fibers. As defined by the American Standard of Textile Materials, "rayon is a generic term for man-made fibers, monofilament and continuous filament yarns composed of regenerated cellulose with or without lesser amounts of non fiber-forming materials" (3). Originally a substitute for silk, rayon is an example of extended research and man's ability to perfect a textile fiber. Today there are approximately 200 different rayon fabrics on the market (1).

In 1840, a chemical process for dissolving wood pulp was invented by F. G. Keller. Through continued research, the French scientist, Count Hilaire de Chardonnet produced the first man-made textile fiber.

The viscose process is the most commonly used, safest, and perhaps least expensive method of producing rayon. As the
industry continued to develop, rayon became an established competitor of natural silk. In 1923, the National Retail Dry Goods Association selected the name "Rayon" to denote all fibers formally known as artificial silk (37).

Today improved chemical and physical properties are the primary factors in the resurgence of rayon, along with the shortage and pricing conditions of cotton. With the introduction of modified or high wet modulus rayon an improved market has developed. Because modified rayon can be mercerized, sanforized, and resin-treated it is being combined with cotton, polyester, and polypropylene for use in apparel and home furnishing fabrics. Rayon blends well with other fibers, both natural and synthetic. Fabrics made with rayon have an acceptable feel or hand, are moisture absorbent and thus comfortable.

Strength of Fiber

Rayon is stronger dry than wet; however, wet rayon will return to original strength upon drying.

Viscose and cuprammonium rayons have a dry breaking strength of approximately two grams per denier with a 30 to 60 percent strength loss when wet (37). When changes in molecular structure are made, improvements in crystallinity are then obtained, resulting in more desirable properties.
Hygroscopic Moisture

Moisture regain for apparel rayons is 11 percent under standard temperature and humidity conditions. This property is advantageous if high moisture absorbency is desired.

Thermal Properties

Rayon, being a cellulosic material, burns with a characteristic odor of burning paper. Viscose rayon will scorch and char if ironed at temperatures above 350°F and decomposes at 350°F to 400°F. (37).

Exposure to Light

Rayon loses strength upon exposure to sunlight as do other cellulose fibers. Conditions affecting the degree of loss are dependent upon humidity, temperature, intensity of exposure and applied finishes. Rayon generally has about the same resistance to sunlight as cotton.

Biological Resistance

Mildew and bacteria will grow on rayon, although clothes moths do not attack the cellulosic fiber.
Affinity for Dyestuffs

Viscose and cuprammonium rayons have good affinity for dyestuffs. With the use of appropriate dyestuffs, most rayons have good color and can be colorfast to light and laundering.

Wash-and-Wear Development

The important promotion of wash-and-wear fabrics, and the newer man-made fibers have perhaps contributed to a slight decrease in rayon consumption for wearing apparel. Rayon, like cotton, requires resin treatment if it is to retain creases in pleats and resist wrinkling. These fibers, however, have a bright future because modified rayons can be treated for crease resistance and shrinkage control and possess good tensile strength when wet.

Rayon fibers produced by any of the three processes have been important in the production of knit fabrics. Spun or filament yarn is becoming more important in sweaters, knitted shirts and outerwear. Blending or combining of fibers for knitting yarns produces desirable aesthetic and physical properties in addition to providing a less expensive and stronger product.

Review of Creslan Properties

An acrylic is defined by the Federal Trade Commission for
the Textile Fiber Products Identification Act as a manufactured fiber in which the fiber forming substance is any long-chain synthetic polymer composed of at least 85 percent by weight of acrylonitrile units (56). Acrylics are developed from a special group of vinyl compounds, specifically acrylonitrile. By using different types of monomers to copolymerize with the acrylonitrile, fibers with specific softening points and attractions for particular types of dyes may be produced.

The American Cynamid Corporation began research work on acrylic fibers and conducted extensive investigations while the fibers were still in the experimental stage, identified only by code. In 1959, American Cynamid Corporation introduced Creslan in a staple fiber form.

The acrylic Orlon is a dry spun fiber, meaning that it is extruded into a warm chamber where the solvent evaporates. Creslan is wet spun, and the spinning solution is extruded into a bath which removes the solvent and solidifies the fibers. Heat setting for both yarn or fabric form is necessary for good stability. The physical and chemical properties of Creslan are essentially much like those of Orlon and Acrilan.

**Thermal Properties**

Creslan is a thermoplastic and will burn or melt upon exposure to flame or heat. Considered moderately flammable, Creslan
has a recommended safe ironing temperature of $300^\circ F$. It will
stick at a temperature of $408^\circ F$. (37).

Density

One of the early claims for this fiber is its extra softness, low density and its ability to be made into bulky yarns or fabrics. Fine fibers of Creslan blended with wool produce fabrics of a cashmere-like texture and hand.

"Creslan" is American Cynamid's trademark for one acrylic fiber, and is available in staple or tow and sold only as an acrylic. The trademark "Creslan" is reserved for use with fabrics containing this fiber which have met the producers' specified end use standards and requirements. Creslan added to or blended with polypropylene increases wear resistance and stability for the fabric. When the fiber is blended with polypropylene, it helps in overcoming disadvantages of polypropylene such as low melting and softening points, and limited dyeability.

Consumers are selecting 100 percent acrylics and acrylic blends for a variety of reasons including shape retention, resistance to abrasion, hand and ease of care. Excellent resistance to sunlight, to pressed crease retention, and to moths are also of importance to the consumer.
Moisture Regain

One of the limitations of the Creslan fiber is its low moisture regain or absorption. This characteristic property would limit its use for items of wearing apparel requiring absorption. Moisture regain conducted under standard conditions is 1.5 percent for Creslan (34).

Biological Resistance

Creslan maintains excellent advantages over attack by insects. The fiber is resistant to wearing and biological factors such as mildew.

Exposure to Sunlight

Creslan does not have the same resistance to sunlight as do rayon and polypropylene, although acrylics withstand exposure to sunlight much better as compared to nylon fibers.

Wash-and-Wear Properties

Creslan fibers or fabrics resist stains, wash easily, and may be wetcleaned or drycleaned, depending upon the dye, finish, design application and garment construction. Creslan is resistant to bleaches, dilute acids and alkalies, and may be bleached in a
chlorine type solution.

Hand

Creslan has a desirable wool-like hand although it tends to feel slightly drier than comparable acrylic fibers. Creslan also tends to have a slightly crisper and firmer hand than other acrylics.

Dyeability

In early developmental stages, the acrylic fibers including Creslan were considered difficult to dye, but new methods and techniques have corrected this condition. Type 61 Creslan can be dyed with basic solutions to obtain brilliant, high shade colors. Today, Creslan is easily dyed. Because of its whiteness, it will also produce clear pastels.

Knit Fabrics for Apparel

Although weaving is the most common method of constructing fabric, knitting is the second most common process for fabric manufacture. In knitted fabric a continuous yarn or set of yarns is used to form loops. The loops form rows and each line is caught into the previous row, obtaining support from the loops above and below.

Knitted construction is rapidly increasing in volume for both
outer wear and as home furnishings. The principle reasons for this increase appear to be that knits are lower in price, production of knit goods is two to five times faster than woven fabrics and physical properties of knitted fabrics are increasingly more popular for sportswear and general wearing apparel. Comfort of knit goods is superior to the rigid woven fabric structure as the knit adapts itself to the changing or moving shape of the wearer. Body heat is controlled through openness of knit, and bulky knit fabrics are good insulators. The few disadvantages of knit fabrics such as excessive stretch, tendency to run or snag and shrinkage are being corrected by the manufacturers.

Types of Yarns

Since the object of knitting is to construct an elastic, porous fabric, the yarns are more loosely twisted than they are for weaving. For sportswear spun yarn is more popular than filament yarn because the spun yarn has a warmer, more absorbent, softer texture. Yarns for knitted fabrics should be regular in diameter since thin places in yarns cause breaks that may weaken an entire fabric. Blending of yarns provides the opportunity for developing fabrics with specific desired properties at a much lower production cost.

Knits are practical, serviceable, and no more expensive than woven materials. Because the yarns are loosely spun, they are
soft, comfortable due to elasticity, and enjoyable to wear. Knit fabrics are porous, provide ventilation and do not stick to the skin when damp. Ease of care, durability, pliability and stretchability are all characteristics which are readily chosen by the consumer. Knit fabrics and knit wearing apparel are becoming very popular with mothers for children's wearing apparel.

Although woven goods comprise a larger percentage of goods on the market than knit goods, knitted fabrics have achieved increasing importance in fashion apparel. Knitted goods are being developed, designed, cut and tailored to resemble woven fabrics. Knitted fabrics have become more suitable for many products than woven goods.

Double knit refers to two fabrics, knitted double and held together with occasional binding stitches. Characteristically these fabrics are a fine-ribbed structure, possessing good draping quality and dimensional stability and are similar to woven fabric.

Many double knit fabrics are a manufactured variation of the plain interlock construction. The double fabric is constructed of two separate 1 x 1 rib fabrics so that the wales of one fabric lie between those of the other on both the face and back. A plain knit appearance is observed from both sides. While the interlock type of construction is ideal for quality T-shirts, sport shirts, gloves and children's play clothes, much of the circular filling knitted
material is used for women's dresses and suits.

Double knits most commonly used for outerwear are of French or Swiss double piqué construction. In each fabric alternate yarns form loops on the back and not on the face of the cloth.

**French Piqué Construction**

In knitwear, polypropylene blends offer freedom from wrinkling, no springing after sitting, easy-care laundering and limited or no pressing. Many products being developed are proving that knitted apparel is one of the most promising end use areas for Herculon or polypropylene yarns (28).

**Future Potential for Polypropylene**

Versatility is the key to popularity of fibers. With the largest use today being in the blended yarns, it is recognized that polypropylene/rayon and polypropylene/Creslan blends are developing a
competitive position on the textile market. Polypropylene fibers lend themselves to desirable textile operations. They can be spun, crimped, textured, blended, and used for knitted materials.

Polypropylene is the least expensive of the man-made fibers. This is perhaps the most important of all the polypropylene features. Price application and ease of care provide polypropylene advantages in competition with other fibers where technical differences are marginal. In many end products the consumer has sacrificed style and fashion in order to obtain garments requiring little care (18).

Because of the low specific gravity of polypropylene, very light textiles can be produced which have good elastic properties and will not felt. There is outstanding flexibility in the characteristics or properties offered by the polyolefins.

American Society for Testing Materials Committee 13 on Textile Materials has organized a new task force on polyolefin ribbon yarn and its products. Of primary interest are extruded polypropylene and polyethylene (43). The purpose of the committee is to develop standards for yarns, fabrics, bags, rope, twine and carpet backing.

Cook stated that the position polypropylene will ultimately attain in the textile industry will be dependent upon the success with which the fibers are able to compete on merit with other fibers and on the price the consumer must pay (9). Fortess indicated that the
major fabric developments during the next ten years will result from the creation of variants in the major fields rather than be developments of new polymer fibers (18).

Blends of various fibers will increase in importance because the blending of specific amounts of fibers such as polypropylene and Creslan, for example, will give the consumer a fabric that will produce more desirable end use properties. The newer man-made fibers are giving increased wearing quality, crease and wrinkle resistance and ease of care to fabrics in which they are used, thus meeting consumer demands. For polypropylene blends to become known in the apparel area, much promotion directed toward the consumer is needed. Weiss stated that accelerated technological innovation will require industry to provide more guidance to the consumer (18). "Consumerism is the voice of those who received commenting on the conduct of those who provide" (9, p. 18-22).

Gordon emphasized that the major function of the consumer is to guide and control the production of goods and services which are to satisfy consumer wants (20). Thus one may say the purpose of the economy is to produce goods and services in the right quantity, quality and price for maximum consumer satisfaction. In order to carry out this process of guiding and controlling, consumers must become better informed and exercise intelligent choice in the selection of goods and services on the market.
Role of the Consumer

Today's consumer has an unprecedented opportunity for selection and a definite need for information on which to base his choices of available textile materials and products. The consumer needs to visualize the end use requirements for a fabric or textile product, then make a selection. When we consider the total responsibility of clothing the family, we cannot neglect the interaction of aesthetics, fashion, style, comfort and the relationship of quality, price and balanced performance to the end product.

The introduction of man-made fibers ushered in an era of achievement that is still accelerating. Current developments in fabric formation, dyeing, finishing, blending and easy-care finishes are all evidence of a technology of quality and quantity. When the gap between expectation and realization becomes too large in the eyes of the consumer, dissatisfaction results. Accelerated technological innovations will require that manufacturers and producers provide more guidance for the consumer through accurate labeling and educational promotions. Retail textile products provide unlimited opportunities for pleasure, comfort, and decoration. Each consumer is then challenged to select wisely and to use well the products being manufactured. In addition to beauty, suitability and serviceability must also concern the consumer.
Today it is necessary for the consumer to know the fiber or fiber content as well as the specific finishes a textile product possesses. In many cases identification may only be necessary to determine the type and degree of care a product requires. On specific occasions, the consumer may wish to verify or refute some statement made in the labeling or performance of the fabric.

It has been estimated that by 1970 the United States will have over 208 million consumers (20). The concept that the role of the consumer is to guide the economy toward the production of goods and services still exists. Reflection and observation illustrate, however, that many consumers are unprepared for this economic responsibility. Therefore, in addition to the production responsibility, manufacturers must assume part of the role in educating the consumer.

Continued research is being conducted by the manufacturer to determine what the consumer wants and will pay for. Comparisons are being made to study the consumer's social, psychological and economic behavior, and to determine what he will accept. Labarthe concludes that the consensus is that the average consumer tends to make textile selections more on the basis of aesthetics or appearance factors rather than on the basis of durability or potential performance in service.

Troelstrup indicated that economists assume consumers are
rational buyers, while psychologists and sociologists insist purchasing power is socially oriented (58). The consumer exercises his economic vote every time he buys, and, because of the uneven distribution of our dollar system, consumer influence varies. Studies indicate influences motivating consumers are desire for status, conformity, prestige and power. Thus the producer must satisfy the consumer in order to remain in the market.

Aesthetic qualities or properties defy testing ratings, become subjective reactions, and to a degree depend upon consumer preference and ability to select wisely. More recently objective reactions are being rated because the minimum or limited care fabrics have made the consumer demand serviceability in the man-made fibers.

Aesthetically, textile products have emerged to meet consumer needs, while the more recent products are attempting to meet consumer demands for performances in wear and in cleanability. Consumers, however, must accept the challenge provided by the many types of textile products, learn to understand, use and appreciate them.

Because clothing plays an important role for an adult in our society, it is believed to be equally important for the young child. Children who are oddly or unattractively dressed can become self-conscious and develop retiring personalities (21). Educators have related a child's clothing to his action in learning situations. Child
psychologists have stressed the importance of loose, simple garments for children in order that they may move freely.

Children enjoy bright, clear colors, and this element is a factor in whether a child likes or dislikes a garment. Pleasing combinations of colors in a child's wardrobe are important because there is a relationship between attractive appearance and individual security. Thompson and Rea indicated colorful, well-fitting, comfortable garments, attractively combined contribute to a feeling of well-being and self-confidence (57).

While the child must be able to relate to the garment as a personal possession, the mother will generally consider factors such as required care, appropriateness for the occasion and her own preference for a design.

In a 1950 study by Kenally on the preferences of 50 mothers selecting specific articles for pre-school children, it was learned that practical aspects of children's clothing were most important to homemakers. Psychological factors and concern for children's preferences in clothing were considered to be less important (36).

Buying practices and factors influencing choice were studied by Willett. The 50 mothers interviewed considered durability and serviceability of the fabric as being the most important properties. Fabric and styling were rated as most important by mothers of girls, whereas fabric, durability, and serviceability were indicated as most
important by mothers of boys. Construction, color, price and durability were considered very important by three-fourths of all mothers. Performance characteristics were considered before appearance in the selection of all garments. Care required, followed by appearance factors, was rated next.

Over half of the mothers reported that their children helped select their clothing. Boys were given greater opportunities in the selection of sport shirts and dress pants while girls were allowed to select shorts and dresses. Willett noted that children from larger families were allowed even more choice in the selection of their clothing than children from small families.

A general review of literature indicates that clothing is considered important in the life of a child, and his wishes in clothing are respected to a greater extent than in previous years. Practical characteristics such as recommendations for care are considered more important than psychological requirements although mothers state they use psychological factors such as color and fashionable design when making selections. Such research must then indicate to the producer that a combination of the above two characteristics, ease of care, and fashionable design, would provide a product readily accepted by the consumer.
PROCEDURE

In order to determine specific types of garments most frequently worn by pre-school boys, the writer visited several nursery schools in the Eugene area to observe the subjects, their daily apparel and the types of similar activities in which they participated. It was observed that 22 out of 30 boys wore some type of knit shirt as opposed to a woven fabric on the days the writer was present. In discussing this observation with the mothers and nursery school directors it was noted that comfort, ease in dressing and ease of care were the primary reasons for selection of knitted shirts. Style preference was a secondary factor as was color when mothers were randomly questioned about the reasons for selection.

While viewing the pre-school boys there seemed to be common activities in which they all participated. Therefore, it was decided to develop one shirt design with two variations, a set-in sleeve and a raglan sleeve. The first step in the procedure was to obtain specific knit fabrics for comparison of serviceability and consumer acceptance. The second part of the procedure was to determine the type of shirt style and draft a pattern for each shirt and sleeve design. Upon completion of garment construction and the development of a shirt questionnaire, boys were selected to wear the shirts. During the third stage of the study the knit shirts were worn daily
by the subjects and laundered and evaluated each week by the writer. Periodic evaluations for apparent visual change were made by the writer and a panel of faculty members. The parents were also asked to rate the fabrics and styles for preference during the fifth week of wear and at the end of ten weeks of wear. The fourth method in the procedure was to compare the physical properties of the original and wear-tested fabrics. Because the consumer maintains such an influential role in today's economy the concluding section was to determine the degree of consumer acceptance of the experimental knit fabrics for potential retail acceptance and evaluate if there was a consumer preference among the two sleeve designs.

Selection of Fabric

The writer contacted the Fibers and Film Division of Hercules, Incorporated, regarding the possibility of obtaining suitable knit materials for the study on pre-school boys' shirts. A prompt and interested reply was received. Through the courtesy of Hercules, Incorporated, Fibers and Film Division and the End Use Development Supervisor, in Research Triangle Park, North Carolina, experimental knit blend yardage was contributed and became the basis for the study.

Research has proved that a more acceptable and suitable apparel fabric is obtained when polypropylene is blended with other
fibers than when used alone. Therefore, the two types of experimental double knit fabrics used for the study were (1) 50 percent Herculon, 50 percent rayon blend in grey, and (2) 50 percent Herculon, 50 percent Creslan blend in bright blue and brown as seen in Figures 1, 2, and 3. The tubular fabrics were French piqué interlocking construction. The fabrics were 33 inches in width and no finishing agents were applied.

The limited color range of muted hues resulted from the particular research being conducted by Hercules, Incorporated, at the time the study began. Research work was being done primarily on pigmented polypropylene in combination with other dyeable fibers. It was noted that a limited line of pigmented colors was to be developed, allowing an extensive range of colors to be obtained from dyeing other fiber components.

**Selection of Shirt Style**

Shirts may be classified according to the occasion for which they are worn. Because sport shirts vary in style, are intended for active sports or casual wear, a comfortable easy-care fabric is recommended.

For the younger boys, a longer shirt that will either remain tucked into the pants or one that can be worn over the pants is considered most appropriate by those mothers participating in the
Figure 1. Original rayon/Herculon blend fabric sample.

Figure 2. Original blue Creslan/Herculon blend fabric sample.

Figure 3. Original brown Creslan/Herculon blend fabric sample.
study. Convertible collars, and open-neck styles with short or long sleeves are preferred by the growing boy.

In addition to size and workmanship, the careful buyer is generally interested in the appearance of the shirt, its comfort, serviceability, suitability and ease of care. United States Department of Agriculture studies suggest that feel and appearance have been the shopper's guide to quality garments and fabric, but recommend that workmanship be the major consideration with appearance and fabric hand being secondary factors. Wingate stated requirements or criteria for good workmanship which the consumer should consider when making shirt selections include:

1. Seams stitched firmly and finished or bound at the edges.
2. Seams free from puckers.
3. Buttons that are firmly secured and those which will not melt.
4. Buttonholes firmly bound and evenly cut.
5. Sharp, even, neatly sewn collar points.
6. Matching thread, with no loose thread ends.
7. Serviceable machine hems (63).

Selection of Subjects

A conference was arranged with Mrs. Ernest Schulke, director of the Peter Pan Day Nursery School in Eugene, Oregon. Her
background as a registered nurse, devoted interest in young children, Mr. Schulke's occupation as a professional artist with Walt Disney and the definite need for a day nursery in the northeast section of Eugene, resulted in the development of the school. Their interest in young children was not only concern for adequate daily care and supervision, but the development of the child as a total person by providing opportunities in decision making, acceptance of responsibilities, care of equipment and socialization with other children while at nursery school.

Introductory letters explaining the type of study and the need for participants were distributed to each family having a four- or five-year-old boy attending the day nursery school (Appendix A). Ten sets of parents met the established criteria. Each family was contacted through an interview, and the procedure to be followed and the responsibilities of the parents and subjects were explained.

Because of the limited amount of experimental yardage and the size of the boys, the number of participants was reduced from ten to seven. Seven subjects who were four years old and approximately the same physical stature were selected for the study.

**Measurements**

Measurements were taken for each of the seven boys to determine the shirt pattern size required. The subjects were found to be
of comparable size ranging in height from 42 to 46 inches and weighing 39 to 47 pounds.

It was observed by using a pre-test garment that knit shirts cut from a standard size 6 commercial pattern were too large for the boys, while a pattern drafted from a size 6 ready-made garment produced a more attractive, comfortable fit acceptable to the writer and to the mothers. Each of the seven boys was measured for change in body size at the end of the wear period for comparison of size relationship to acceptable fit and comfort.

**Development of Shirt Design**

One shirt design was developed, and a variation in sleeve style was made. The purpose of the sleeve style variation was to determine consumer preference and acceptance of the style No. 1 shirt with set-in sleeve or the style No. 2 shirt with raglan sleeve.

**Style**

A size 6 golf-style shirt was designed and drafted. Each shirt had short sleeves with a sleeve band, convertible collar and a two-button front placket opening as seen in Figures 4a and 4b.

**Design No. 1**

Design No. 1 featured a straight cut body with short, set-in
Figure 4. (a) Diagram of shirt design No. 1.

(b) Diagram of shirt design No. 2.
sleeves. The collar, sleeve bands and placket opening were made of a double thickness of the same fabric because coordinating ribbed knit fabric was not available (Figure 5a and 5b).

Design No. 2

Shirt design No. 2 was developed with short raglan sleeves to permit ease of movement as well as growth and to provide a basis for consumer comparison of sleeve styles (Figure 6a and 6b).

Length of Wear-Test Period

Each subject wore four shirts weekly. Two shirts were of the rayon/Herculon blend with one style being design No. 1, and the second shirt being design No. 2. Two Creslan/Herculon blend shirts in design No. 1 and design No. 2 completed the shirt series for each boy.

This wearing procedure was established for a ten week period or 40 wearings. With the exception of one child who missed two days of school, 26 of the 28 shirts were worn 10 times or approximately 130 hours. The warmth of the fabric, season of the year and termination of day nursery school for five of the seven subjects because of summer vacation for their parents, limited the wearing period to the specified ten weeks.
Figure 5. (a) Photograph of subject wearing design No. 1. Rayon/Herculon blend fabric.

(b) Photograph of subject wearing design No. 1. Creslan/Herculon blend fabric.
Figure 6. (a) Photograph of subject wearing design No. 2. Rayon/Herculon blend fabric.

(b) Photograph of subject wearing design No. 2. Creslan/Herculon blend fabric.
Development of Shirt Pattern

A commercial knit shirt in a size 6 was used as a basis for the development of style No. 1 shirt. A slight variation in the size of the sleeve band was made to compensate for the amount of stretch obtainable from a double band of the original fabric as compared to a single layer of ribbing. The body of style No. 1 shirt was used to develop style No. 2, and pattern modifications were made to draft the raglan sleeve variation. The style of the shirt as well as the sleeve band remained the same for both designs.

Construction of Test Garments

Preparation of Fabric

Because the fabric was experimental, the yardage was examined for any unusual visual characteristics. Each fabric blend was placed on a long table, with care being taken to prevent distortion, and allowed to relax for 24 hours. No pressing or treatment for shrinkage was conducted prior to pattern layout.

Cutting

The fabric was refolded to avoid using the original vertical folds. The patterns were placed on the fabric in a vertical direction. Pins were placed perpendicular to the wales of the knit, and sharp
shears were used for cutting.

**Machine Stitching**

Belding Corticelli mercerized thread, size 50, was used for stitching all seams. The decision was made by the writer not to use a stretch thread for greatest extensibility because suitable matching thread was not obtainable for all three colors of knit fabric.

All machine stitching was conducted with a White home sewing machine model No. 674. A size 14 machine needle and a slightly loosened tension were used throughout the construction procedure. A narrow overcast seam was used in all sections of the shirt to simulate ready-to-wear and mass production procedure. The straight seams were first stitched with a stitch length of ten stitches per inch and then zig zagged with a 3 to 4 setting depending on thickness of seam. The fabric was fed slowly and evenly through the machine to avoid stretching or inconsistency in stitching.

**Wear-Test Procedure**

Twenty-eight garments were constructed for the study; seven with raglan sleeves and seven with set-in sleeves cut from each of the two fabrics. Each boy received one shirt of each of the four types for a total of four shirts. The garments were labeled with the child's name, fiber blend, and style number for identification.
purposes by the parent and the writer.

Each set of four shirts was distributed to the seven subjects in the study with a letter of instructions to the parents (Appendix B). The boys wore each style and blend of shirt Tuesday through Friday for ten weeks. The shirts were put on at home and worn all day at nursery school and until bedtime, resulting in an average of 13 hours per wearing.

Although each boy was required to wear one of the shirts each day, no criteria for style or color was pre-established; thus the wearer made the daily selection.

The wearings were limited to one shirt per day because the mothers indicated that their sons wore a clean shirt daily. The nursery school director, however, noted that the experimental shirts could have been worn a second day because the fabric did not generally appear soiled or wrinkled.

Each subject identified his four shirts in a brightly colored individualized box each Monday as he left the day nursery. The shirts were worn during the week and returned by the wearer on Friday. The fourth or "Friday" shirts were taken off by the school supervisor just prior to the subject leaving for the weekend. Each Friday, the writer picked up the shirts for laundering and returned them on Monday morning.

The supervisor decided to develop a pattern of responsibility
for each of the wearers to assume during the ten-week period. Each subject would select his personalized box on Monday when leaving the nursery school and return it on Friday. When it was time to leave on Friday, each boy was reminded to remove the shirt, fold it and place it in the box. The supervisor observed a variety of actions and abilities as the boys placed the shirts back into the boxes. Because the subjects were eager to please, they carefully folded and refolded until the lid would fit onto the box.

Laundry Procedure

Once a week for ten weeks each garment was laundered, examined, mended if necessary, measured and folded by the writer. The garments were grouped and laundered according to fiber blend with each group containing 14 shirts. Conditions which simulated the procedure followed by today's consumer were considered and used as much as possible. Each set of shirts was laundered in a 1967 General Electric, single speed agitator type home washer, model No. WA 640 E, designed for permanent press fabrics. Three-fourths cup of bio-degradable laundry compound was used in a wash water at approximately 150-160°F. Fourteen shirts were washed at one time for a nine minute period with the control set for permanent press. The garments were then rinsed for nine minutes in a water temperature of approximately 110-112°F.
The rinse cycle consisted of two regular rinses and one spray rinse and spin cycle.

The shirts were dried in a three-speed General Electric home dryer. The tumble dryer had a three-speed control panel for fluff, delicate and high combined with a timed or permanent press cycle. The rayon/Herculon blend garments were dried for 28 minutes on a high temperature set at approximately 145-150°F, then were subjected to a ten minute fluff cycle.

The drying conditions for the Creslan/Herculon shirts were modified because this blend required less time for thorough drying as determined by pretesting. The Creslan/Herculon shirts were dried for a period of 23 minutes at approximately the same temperature of 145-150°F. and also fluffed for ten minutes.

Each group of shirts was removed immediately from the dryer upon completion of the fluff cycle. Each shirt received shaking to release wrinkles. The shirts were then examined for any apparent visual change, flattened by hand on a table, measured for shrinkage and hung on a hanger for 24 hours. The sets of shirts were refolded and placed into the individual boxes for the next wear period. The shirts received no steaming or pressing during any of the laundering periods.

Prior to the wear-test period each shirt was measured and outlined for the purpose of establishing a shape pattern. Every
other week, or a total of five times, the shirts were re-measured, outlined and compared to the original shape to determine if there was a definite shrinkage pattern. While the procedure used was subject to human error the method did provide the writer with opportunity to conclude that the degree of shrinkage for both fiber blends was less than 1/8 inch for ten laundering cycles.

**Evaluation Methods During Wear-Test Period**

Evaluation of the shirts during the wearing period involved observation of the boys while wearing the shirts; a subjective comparison of the general appearance and original shape of the shirts; and the use of a rating scale and interviews. The boys' reactions to the shirts; resistance to stains, pilling and wrinkling, noticeable fiber static, apparent change in fabric texture, hand, and the designs of the shirts also received evaluation. In addition the visual changes which occurred in the fabrics after laundering were analyzed.

**University Panel Evaluations**

A panel of University faculty members was asked to subjectively evaluate the shirts for visual characteristics and change in fabric which occurred during the wear-test period. The panel was composed of three members of the Department of Clothing, Textile
and Related Arts at Oregon State University. One faculty member was in clothing construction and taught a course in design and construction of children's clothing. A second panelist represented the area of clothing selection and was also the mother of a pre-school boy, thus evaluating the shirts in two capacities. Textile identification and research was the specialized area of the third panel member.

The shirts were examined and evaluated by each panel member prior to the wear-testing, at the end of the fifth week of wear, and at the termination of the ten week wear period. Identical conditions were simulated for each of the three evaluations. The shirts were divided into three groups according to fiber and color. A regrouping was made in order to place each boy's shirts together to determine if there were differences in degree of wear. The shirts were spread, flattened and placed right side up on a long table. The collars were folded and the front plackets were buttoned. Each group of shirts was examined under natural lighting, then under artificial overhead lighting. The surface characteristics were all judged at approximately eight feet or at the same distance from the windows. The shirts were folded lengthwise, and held up to the light so that the surface could be viewed at eye level.

The purpose of evaluating the shirts prior to wear was to allow the panel to establish criteria to use later when making comparisons of the original and wear-tested fabrics after five and ten weeks
of wear. Color was the only visual subjective difference prior to the wear-testing period.

In addition to identification of surface characteristics, color and hand, the panel evaluated the method of construction used throughout the garments to determine consistency of technique. While the fiber blend was not an influencing factor in construction of the shirts, the writer observed that the rayon/Herculon knit was easier to manipulate.

Parent Evaluations

Prior to the wear-test period, the parents and writer met to discuss the purpose of the study and to identify information to be obtained. The fabric characteristics were reviewed and the categories for fabric evaluation were identified in order to establish a common vocabulary for the evaluations (Appendix C).

A randomized block design procedure was used to analyze data on the respondents' opinions of the experimental fabrics. The Creslan/Herculon fabrics were divided into separate colors to determine if color would influence fabric characteristics and thus parent opinion. The Creslan/Herculon and the rayon/Herculon fabrics were compared for general appearance, retention of original shape, resistance to pilling, apparent change in color, resistance to wrinkling, hand or fabric feel, noticeable fiber static, resistance to
shrinkage, apparent change in fabric texture, and resistance to stain (Appendix D).

An analysis of variance was conducted to determine the significance of the difference between means.

The analytical scheme for calculation of analysis of variance was computed for both the one percent and five percent levels of significance. Rating the shirts by blend and using the 0.01 and 0.05 as levels of significance, differences in fabric were calculated. Each respondent could score or rate the fabric blends a possible low of 1 and a possible high of 5 for each category.

Laboratory Testing of Physical Properties

Selected laboratory tests and measurements were utilized in collecting the data to use in evaluating the serviceability of the Creslan/Herculon and rayon/Herculon knit fabrics. The comfort and appearance factors of the shirts were assumed to be important to the consumer. Likewise, the durability, or serviceability, of garments as revealed by changes in such physical properties as abrasion resistance, wrinkle resistance and thickness ultimately influences the consumer's satisfaction.

Analyses of the three selected physical tests were conducted on the assumption the fabric, although experimental, was typical to that being developed by the manufacturer at the time this study
originated. Using a completely randomized block design, an analysis of variance in determining the significant difference between means was applied.

**Abrasion Resistance - Accelerator Method**

The mechanical test for abrasion resistance was made to evaluate the resistance of the original and wear-tested fabrics to abrasion or wear. The test specimens were subjected to flexing, rubbing, compressing and stretching. Frictional abrasion was achieved throughout the body of the fabric in a random path by driving the specimen against an abradant liner within a chamber. Evaluations were made on the basis of weight loss of each specimen.

Five 3-3/4 x 3-3/4 inch specimens were prepared in each of the original and wear-tested fabric blends. The pinked edges of the 20 specimens were coated with a thin, even layer of Vulcanal adhesive and allowed to dry at room temperature. The specimens were then conditioned for a 24 hour period at 65 ± 2% relative humidity and 70 ± 2°F.

A type AB 7 Accelerator was used to conduct the abrasion resistance tests. A No. 250 grit abrasive liner was inserted into the Accelerator and a finish-free cotton specimen, 4-1/2 x 4-1/2 inches was used to break in the abrasive liner at a maintained speed of 3000 R.P.M. for 12 minutes.
The prepared and conditioned rayon/Herculon original and wear-tested fabric specimens were exposed to five minutes of frictional movement at a test pattern speed of 3000 R.P.M. with a powerstate reading of 45 for a 50 cycle alternating current power supply.

Testing conditions for the Creslan/Herculon fabric blend specimens were conducted using an identical procedure and varying the powerstate from 45 to 50 cycles.

The tested specimens were removed from the Accelerator chamber and detritus from the test specimen and liner chamber was removed. The specimens were conditioned for 24 hours at 65 ± 2% relative humidity and 70 ± 2°F, and re-weighed on an analytical balance to ± 0.001 grams. (AATCC 93-1959-T)

Wrinkle Recovery

There are various methods for measuring the recovery of fabrics from creasing, however, the Monsanto Wrinkle Recovery procedure, AATCC 66-1959T is recommended. Wrinkle recovery properties are tested to determine the recovery of fabrics from creasing. A test specimen is creased and compressed under controlled conditions of time and load. The specimen is suspended in the test instrument for a controlled recovery period after which the recovery angle is calculated or measured.
Twelve test specimens 1.5 x 4 centimeters in both warp and filling or wales and courses were cut randomly throughout the original experimental fabric and the wear-tested fabric. An increase over the recommended number of specimens was made to provide additional data for comparison because of the interlocking construction of the experimental fabric. The 24 original and wear-tested rayon/Herculon specimens and the 24 Creslan/Herculon original and wear-tested fabric specimens were prepared free from wrinkles, in the flat, and conditioned for 24 hours at 65 ± 2% relative humidity and 70 ± 2°F.

Using a Monsanto Wrinkle Recovery Tester, the test specimens were individually placed between the specimen holder leaves with one end flush with the long metal strip. The exposed end of the specimen was looped back to the guide line of the metal specimen holder and inserted into the plastic press. The end-edge of the plastic press jaw was put into firm contact with the specimen so that the guide line on the short metal leaf, the exposed end of the specimen, and the end-edge of the fabric were aligned, forming a 1/16 inch crease from the end of the metal leaf.

The press jaw was inverted and a load of 500 grams was applied for a five minute period of time. The exposed end of the specimen holder was inserted into the Monsanto Wrinkle Recovery Tester mount. The press was carefully and rapidly removed
allowing the specimen holder to be properly aligned on the mounting shelf.

The crease of the specimen was lined up with the center of the instrument disc and the dangling specimen was even and parallel to the vertical guide. To compensate for gravitational pull, adjustment to maintain specimen alignment during the five minute recovery period was made to the vertical guide line four times during the first minute and once each minute during the remaining period. Final adjustment of the dangling specimen was made exactly at the end of the recovery period. Wrinkle recovery value was read from the protractor scale by means of the vernier with a $0^\circ-180^\circ$ line and in A position for the protractor. The crease recovery angle was reported by averaging the individual wale and course readings to the nearest degree and identifying the value as face or back.

**Thickness Measurement**

The ASTM designation: D1777-60T is a method for determining thickness of all types of knit, woven, and non-woven textile materials. For apparel application thickness properties assist in characterizing materials and aid in determining bulk and warmth.

Thickness is a physical property calculated by measuring the distance between two parallel surfaces while exerting a specified pressure. The pressure is applied by the presser foot and
measured in pounds per square inch as determined by the specific sample. Ten test specimens 1.5 x 4 centimeters were randomly selected from each of the original and wear-tested fabrics.

A C and R apparatus for measuring thickness by Custom Scientific Instruments, Incorporated, model No. CS55-003 was used to conduct the measurements. The thickness tester had dimensions appropriate to the samples and permitted the gradual application of the specific pressure within ± 5 percent. The anvil had a greater dimension than the presser foot diameter, thus insuring that all portions of the specimen were in contact with the anvil. A .037 inch diameter circular presser foot was used for the knit specimens.

Each conditioned specimen was placed on the anvil and the presser foot was brought into contact with the face of the fabric. A gradual increase of load was applied with a full load of .100 being reached within five seconds. To insure a stable condition before reading the thickness scale a time interval of ten seconds was used. The dial was read to the nearest 1/1000 inch and a mean from the measurements was calculated.
PRESENTATION AND DISCUSSION OF DATA

This study was conducted to determine the serviceability and consumer acceptance of two polypropylene blend double knit fabrics for pre-school boys' shirts. The following series of subjective evaluations was a result of observation of the boys as they wore the shirts, examination of the shirt fabrics during the wear-test period, interviews with the boys' parents and objective analysis of the physical properties of the shirts after mechanical testing.

Evaluations, Observations, and Reactions

Parental Evaluation of Raglan Sleeve vs Set-in Sleeve

The intent of the writer in providing the boys with shirts of two different sleeve styles was to determine if there was a style preference on the part of the boys' parents. Although six out of seven parents rated the raglan sleeve higher on a rating scale of 1-5 than the set-in sleeve style, only three of the seven parents indicated a preference for the raglan sleeve design. These three respondents indicated they would purchase shirts with raglan sleeves for their pre-school boys because they (1) preferred the appearance, (2) considered the raglan sleeve to provide fewer restrictions during play, and (3) concluded that the raglan sleeve provided an extended growth feature without appearing too large.
Subjective reasons given by four of the seven parents for not preferring the raglan sleeve were: (1) the raglan sleeve design made the child appear more round shouldered, (2) the raglan design was unfamiliar to the parents, and (3) the raglan sleeve would have a tendency to make the boy appear more effeminate.

Observations and Evaluations by Nursery School Supervisor

The day nursery school supervisor expressed the opinion that the experimental shirts were attractive in appearance, typical in style of garments worn to nursery school by pre-school boys, and acceptable for the daily activities of the participants.

Because of the necessity to take off the shirts each Friday before leaving, the nursery school supervisor had the opportunity to observe the degree of ease or difficulty the wearers had in removing the shirts. With the exception of one of the seven wearers, the boys had no difficulty in removing the shirts unassisted. The supervisor attributed the difficulty of undressing for the one subject to the size of his arms in relation to the sleeve band, to which the writer would concur. As previously stated, the sleeve bands were constructed of the same fabric used in the shirt, and therefore, the bands provided little stretchability.

Although the mothers had the boys wear an undershirt or
T-shirt under the knit shirts, it was the recommendation of the supervisor, both to the mothers and to the writer, that the subjects became too warm, and an undershirt was not necessary.

The supervisor observed that the wearers arrived at school with the top shirt button closed rather than open in a convertible manner. Five of the seven subjects would consistently wear their shirts over their trousers, while two of the subjects tucked the shirts in. It was learned those boys wearing shirts on the outside dressed themselves and received assistance only in buttoning the shirt, while the other two boys received careful parental supervision and assistance during dressing.

Social development was an additional aspect of the wear period for the subjects as viewed by the supervisor. The wearers were pleased to be part of a special group and indicated peer approval when seeing another child wearing the same shirt. According to the supervisor, identification of the shirts was based on color rather than style.

The boys expressed concern more readily when an accident would occur to the experimental shirt as opposed to "other" shirts worn during the first few weeks of wear-testing.

Reactions of the Boys

While it was difficult to obtain specific opinions, the subjects
indicated general feelings to the supervisor and parents. According to the supervisor and parents, the boys did not at any time express dissatisfaction in having to wear the shirts. It was, however, necessary for the parents to determine each week that they did not wear the same blue, brown or grey shirt for two days. Color was the method of identification for the subjects, and the blue shirts were without a doubt preferred by all seven boys. It was noted that additional pride was shown when taking the shirts home because the brightly colored boxes were personalized and the boxes received attention from other children at nursery school and at home.

University Panel Evaluations

Panel Comparisons of Fabrics Prior to Wear-Testing

The panel members determined that the rayon/Herculon blend fabric characteristically had a smooth, firm, flat hand, while the Creslan/Herculon knit displayed a thicker, loftier feel. The blue and brown colors of the Creslan/Herculon fabrics appeared richer and more appealing to the eye than did the rayon/Herculon grey color. The blue Creslan/Herculon fabric tended to wrinkle more than the brown Creslan/Herculon knit. In comparison to the Creslan/Herculon the rayon/Herculon blend appeared to wrinkle more; however, wrinkling was not objectionable in either blend.
The panel members qualified this analysis by indicating the possible influences color and light could have on optical judgment.

Panel Evaluations After Five Weeks of Wear-Testing

It was the opinion of the panel that, after five weeks of daily wear or approximately 65 hours of exposure to natural wear conditions, there was not a noticeable difference in the general appearance of the shirts on the basis of fiber content. When comparing the groupings of four shirts according to boys, three of the seven shirt groups showed more noticeable wear indicating that some boys wear their shirts harder than others.

Changes in shirt appearance based on construction techniques were limited. The panel observed a more pronounced ripple along the machine hemline in both shirt blends although this was identified prior to the wear-test period. It was the opinion of the panel members and the writer that the machine stitch length should have been longer for the shirt hems. After five wearings and launderings, the collar points had a tendency to curl.

Analysis of the Creslan/Herculon blend shirts indicated that there was noticeable pilling. Because of the difference in light reflection the pilling on the blue shirts made of Creslan/Herculon blend was more obvious than on the brown Creslan/Herculon. To the naked eye, pilling was less noticeable on the rayon/Herculon fabrics;
however under magnification there were more pills or balls of fuzz per inch on the rayon/Herculon blend shirts than on the Creslan/Herculon shirts. Specific places where pilling occurred were at the collar breakline and in the abdomen area as seen in Figures 7, 8, and 9. In neither fiber blend was obvious pilling detected under the arms.

The panelists gave an above average or "very good" rating to both fiber blends for resistance to wrinkling. It was determined that the rayon/Herculon blend appeared to wrinkle more than either the blue or brown Creslan/Herculon knits. Although the panel members observed no apparent change in any of the three colors, the blue Creslan/Herculon shirts showed fibrillation or whitening along the seams of the sleeve band due to friction.

**Fabric Analysis by Panel After Ten Weeks of Wear-Testing**

Using the fabric evaluation scale (Appendix D) and comparing the original fabric blends, the panel identified the same changes in the fabric properties that had been observed after five weeks of wear-testing. The panel did not detect noticeable changes in the shirts worn for 130 hours as compared with 65 hours of wear-testing. While the panel could not compare the shirts worn five weeks and ten weeks side by side, the ratings were not appreciably different
Figure 7. Photograph of rayon/Herculan control shirt illustrating no pilling.
Figure 8. Photograph of rayon/Herculan wear-tested shirt illustrating pilling.
Figure 9. Photograph of Creslan/Herculan wear-tested shirt illustrating pilling.
between the five and ten wearings and thus were not significantly different statistically.

Retention of the original fabric shape was good, indicating minimum shrinkage. The panelists did identify puckering at the side seams and along the front placket seams. The clothing selection panelist and mother did not, however, find the shrinkage unusual or objectionable.

Ratings for fabric texture continued to reveal no additional change. The Creslan/Herculon blend maintained a wool-like, lofty hand, while the rayon/Herculon fabric continued to feel flat and soft.

Changes in color were not apparent for either the brown or grey blends, however the blue Creslan/Herculon shirts continued to show a whitening along the sleeve band seams.

Parents' Evaluation of Fabrics

The parents were asked to evaluate the shirts subjectively through an interview with the writer and objectively through the use of a rating scale.

The final interview with the parents at the end of the wear-test period revealed consumer opinion and preference only. A series of questions was directed to each boy's parent or set of parents for the purpose of identifying influences which affect consumer opinion and selection of pre-school boys' shirts (Appendix E). In response to
how the experimental shirt fabric compared to fabrics of previously purchased ready-made garments, the parents expressed a positive reaction. The shirts would receive consumer consideration because the fabric was different. The fabrics were identified as being attractive, durable, and rich-looking in appearance. The fact that the fabric returns to its original appearance with little care was indicated as most important to the mothers.

While the blue colored fabric was preferred by four parents and all the boys, the grey color was considered acceptable by all seven and preferred by three parents. The brown color was considered the least desirable, and five of the seven parents indicated they would not select brown shirts for a pre-school boy. The parents indicated that reds, golds, blues and greens were those colors consistently selected and purchased. Knits with a striped pattern were also preferred when selecting shirts.

It was the opinion of the parents that the style of the shirt was very acceptable. A suggestion for specific improvement was coordinated ribbing for the collar, neckline and sleeve bands. A second consideration for a preferred shirt style was the classic pull-over shirt or crew neckline and short sleeves, thus providing ease in dressing at this age level.

The weight or construction of the knit fabric was indicated as being heavier than in any previously selected knit shirt. Two of the
seven mothers felt the fabric was harsh to the hand; however, no apparent irritation to the skin was observed. One mother stated in her opinion the fabric did not cling to the body as knits characteristically should. Each of the respondents indicated that the fabric would be ideal for the winter and early spring; however, it would be too warm for summer and fall wear. Opinions expressed were that the closely knit construction of the shirt limited the amount of ventilation the wearer received, and the fiber blend did not absorb perspiration rapidly. It was the feeling of the parents the fabric would become more acceptable if the fabric was lighter in weight.

Pilling was the only specific visual change the respondents identified as being noticeably apparent. When questioned about the obvious pilling, it was considered not objectionable by six of the seven mothers. The basis for this decision was that pilling is a problem the consumer must accept with the synthetic fibers.

In comparing the fabrics objectively and subjectively, the parents indicated no apparent preference for one fiber blend over another. Statistical analysis indicated no significant difference in the parent's ratings of the three groups of shirts (Table 1). Color was identified by the parents as the factor influencing their preference most and not the fiber blend or the wear performance.

Fabric properties which the respondents named as being most acceptable were the fabric hand, resistance to soil, stain, and
Table 1. Analysis of variance for rating of shirts by parents.+

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<tr>
<th>Shirt Properties</th>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>Mean Square</th>
<th>F-Ratio</th>
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<td>8.23812</td>
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+ Sample form illustrating procedure followed in finding no significance in the opinion of the boys' parents.

**Significant at 1 percent level.
wrinkling; and ease of care. The seven respondents were working mothers who had a limited amount of time to care for fabrics and garments. The fabric properties previously identified were those qualities preferred and selected by the boys' mothers. It was therefore the opinion of the parents that shirts of either blend would be readily accepted by mothers of pre-school boys if placed on the retail market in a price range comparable to that of other golf-style shirts.

Laboratory Test Results

Abrasion Resistance

Wear and laundry abrasion are factors which contribute to the degradation of textiles. The effect of abrasion was evaluated on the basis of loss in weight. From one wear interval to another the percentage loss in weight of the rayon/Herculon specimens followed a significantly predictable pattern. The original rayon/Herculon fabric was lighter in weight, 14.842 grams for 80 square inches or five specimens, totaling 8.48 ounces per square yard. In comparison, the Creslan/Herculon blend knit weighed 17.032 grams or 9.732 ounces per square yard (Table 2). There was not a significant difference in the weight of the two fabrics after wear (Table 3).

The percentage loss in weight of fabrics of each fiber
Table 2. Analysis of variance for weight of original Creslan/Herculo
lon fabric compared to the rayon/Herculon fabric.

<table>
<thead>
<tr>
<th>Source</th>
<th>Degrees of Freedom</th>
<th>SS</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>fabric</td>
<td>1</td>
<td>.4796094</td>
<td>.4796094</td>
<td>14.9270128**</td>
</tr>
<tr>
<td>error</td>
<td>8</td>
<td>.256043</td>
<td>.0321303</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>9</td>
<td>.7366524</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant at the 1 percent level.

Table 3. Analysis of variance for weight of wear-tested Creslan/
Herculon fabric compared to the rayon/Herculon fabric.

<table>
<thead>
<tr>
<th>Source</th>
<th>Degrees of Freedom</th>
<th>SS</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>fabric</td>
<td>1</td>
<td>.001638</td>
<td>.001638</td>
<td>.204647</td>
</tr>
<tr>
<td>error</td>
<td>8</td>
<td>.064036</td>
<td>.008004</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>9</td>
<td>.065674</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
composition was somewhat greater after wear-testing than for the original fabrics (Table 4). At the five percent level of significance, F-ratio 5.32, the rayon/Herculan knit suffered significantly greater loss in weight as a result of abrasion for both the original and the wear-tested fabrics (Tables 5 and 6).

Comparison of the original Creslan/Herculan blend to the wear-tested Creslan/Herculan blend revealed no significant difference in weight loss. The original rayon/Herculan compared to the wear-tested rayon/Herculan fabric revealed a significantly greater loss in weight (Tables 7 and 8).

Wrinkle Recovery

There was a significant correlation between the subjective evaluation of the fabric blends by the parents and the physical testing data. The original Creslan/Herculan fabric had a significantly greater wrinkle recovery than the rayon/Herculan blend for both warp and filling direction regardless of whether the specimens were folded face to face or back to back (Table 9).

The wear-tested Creslan/Herculan fabric had greater filling-wise wrinkle recovery than the rayon/Herculan blend regardless of which direction the fabric was folded (Table 10). In the warpwise direction of the wear-tested fabric the rayon/Herculan blend had a slightly greater wrinkle recovery when folded back to back.
Table 4. Analysis of variance of loss in weight during abrasion of original Creslan/Herculon compared to the rayon/Herculon fabric.

<table>
<thead>
<tr>
<th>Source</th>
<th>Degrees of Freedom</th>
<th>SS</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>fabric</td>
<td>1</td>
<td>.002132</td>
<td>.002132</td>
<td>7.53368*</td>
</tr>
<tr>
<td>error</td>
<td>8</td>
<td>.002266</td>
<td>.00283</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>9</td>
<td>.004398</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at the 5 percent level.

Table 5. Analysis of variance of loss in weight during abrasion of wear-tested Creslan/Herculon compared to the rayon/Herculon fabric.

<table>
<thead>
<tr>
<th>Source</th>
<th>Degrees of Freedom</th>
<th>SS</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>fabric</td>
<td>1</td>
<td>.019625</td>
<td>.019625</td>
<td>8.062859*</td>
</tr>
<tr>
<td>error</td>
<td>8</td>
<td>.019474</td>
<td>.002434</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>9</td>
<td>.039099</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at the 5 percent level.

Table 6. Percentage loss in weight of fabrics after abrasion.

<table>
<thead>
<tr>
<th>Fiber Content</th>
<th>Original Fabric</th>
<th>Wear-Tested Fabric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rayon/Herculon</td>
<td>7.07</td>
<td>9.05</td>
</tr>
<tr>
<td>Creslan/Herculon</td>
<td>5.28</td>
<td>6.29</td>
</tr>
</tbody>
</table>
Table 7. Analysis of variance for abrasion of original Creslan/Herculon fabric compared to the wear-tested Creslan/Herculon fabric.

<table>
<thead>
<tr>
<th>Source</th>
<th>Degrees of Freedom</th>
<th>SS</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>fabric</td>
<td>1</td>
<td>0.0023</td>
<td>0.0023</td>
<td>0.335</td>
</tr>
</tbody>
</table>

Table 8. Analysis of variance for abrasion of original rayon/Herculon fabric compared to the wear-tested rayon/Herculon fabric.

<table>
<thead>
<tr>
<th>Source</th>
<th>Degrees of Freedom</th>
<th>SS</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>fabric</td>
<td>1</td>
<td>0.0005</td>
<td>0.0005</td>
<td>31.812**</td>
</tr>
</tbody>
</table>

**Significant at the 1 percent level.
Table 9. Analysis of variance for wrinkle recovery of original Creslan/Herculon fabric compared to the rayon/Herculon fabric.

<table>
<thead>
<tr>
<th>Direction</th>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>warp/face</td>
<td>fabric</td>
<td>1</td>
<td>1564.09</td>
<td>1564.09</td>
<td>141.125**</td>
</tr>
<tr>
<td></td>
<td>error</td>
<td>10</td>
<td>110.83</td>
<td>11.083</td>
<td></td>
</tr>
<tr>
<td></td>
<td>total</td>
<td>11</td>
<td>1674.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>warp/back</td>
<td>fabric</td>
<td>1</td>
<td>234.15</td>
<td>234.15</td>
<td>20.752**</td>
</tr>
<tr>
<td></td>
<td>error</td>
<td>10</td>
<td>112.83</td>
<td>11.283</td>
<td></td>
</tr>
<tr>
<td></td>
<td>total</td>
<td>11</td>
<td>346.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>filling/face</td>
<td>fabric</td>
<td>1</td>
<td>168.75</td>
<td>168.75</td>
<td>30.042**</td>
</tr>
<tr>
<td></td>
<td>error</td>
<td>10</td>
<td>56.17</td>
<td>5.617</td>
<td></td>
</tr>
<tr>
<td></td>
<td>total</td>
<td>11</td>
<td>224.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>filling/back</td>
<td>fabric</td>
<td>1</td>
<td>33.34</td>
<td>33.34</td>
<td>3.135</td>
</tr>
<tr>
<td></td>
<td>error</td>
<td>10</td>
<td>106.33</td>
<td>10.633</td>
<td></td>
</tr>
<tr>
<td></td>
<td>total</td>
<td>11</td>
<td>139.67</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant at 1 percent level.
Table 10. Analysis of variance for wrinkle recovery of wear-tested Creslan/Herculon fabric compared to the rayon/Herculon fabric.

<table>
<thead>
<tr>
<th>Direction</th>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>warp/face</td>
<td>fabric</td>
<td>1</td>
<td>.09</td>
<td>.09</td>
<td>.0296</td>
</tr>
<tr>
<td></td>
<td>error</td>
<td>10</td>
<td>30.83</td>
<td>3.083</td>
<td></td>
</tr>
<tr>
<td></td>
<td>total</td>
<td>11</td>
<td>30.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>warp/back</td>
<td>fabric</td>
<td>1</td>
<td>96.34</td>
<td>96.34</td>
<td>5.4947*</td>
</tr>
<tr>
<td></td>
<td>error</td>
<td>10</td>
<td>175.33</td>
<td>17.533</td>
<td></td>
</tr>
<tr>
<td></td>
<td>total</td>
<td>11</td>
<td>271.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>filling/face</td>
<td>fabric</td>
<td>1</td>
<td>126.75</td>
<td>126.75</td>
<td>8.7113**</td>
</tr>
<tr>
<td></td>
<td>error</td>
<td>10</td>
<td>145.50</td>
<td>14.550</td>
<td></td>
</tr>
<tr>
<td></td>
<td>total</td>
<td>11</td>
<td>272.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>filling/back</td>
<td>fabric</td>
<td>1</td>
<td>234.09</td>
<td>234.09</td>
<td>46.0535**</td>
</tr>
<tr>
<td></td>
<td>error</td>
<td>10</td>
<td>50.83</td>
<td>5.083</td>
<td></td>
</tr>
<tr>
<td></td>
<td>total</td>
<td>11</td>
<td>284.92</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant at 1 percent level.

*Significant at 5 percent level.
Comparing both original and wear-tested blend fabrics the mean values indicated that the wrinkle recovery of each fiber blend in each direction of the fabric decreased as a result of wear and laundry, except for the warp direction of the rayon/Herculon fabric folded face to face (Table 11).

Table 11. Mean degrees of wrinkle recovery for original and wear-tested fabric.

<table>
<thead>
<tr>
<th></th>
<th>Original Fabric</th>
<th>Wear-Tested Fabric</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Creslan/Herculon</td>
<td>Rayon/Herculon</td>
</tr>
<tr>
<td>warp/face</td>
<td>128.3</td>
<td>105.6</td>
</tr>
<tr>
<td>warp/back</td>
<td>144.6</td>
<td>136.0</td>
</tr>
<tr>
<td>filling/face</td>
<td>138.3</td>
<td>131.7</td>
</tr>
<tr>
<td>filling/back</td>
<td>137.8</td>
<td>134.5</td>
</tr>
</tbody>
</table>

The original Creslan/Herculon fabric compared to the wear-tested Creslan/Herculon fabric indicated a significant difference at the one and five percent levels of significance. Wrinkle recovery of the wear-tested Creslan/Herculon blend decreased in both the warpwise and fillingwise directions (Table 11). When comparing the original rayon/Herculon knit to the wear-tested rayon/Herculon knit little or no significant difference between the two fabrics in the warpwise direction was obtained. A significant difference at both the
one and five percent levels was indicated for the fillingwise direc-
tion (Tables 12 and 13). This decrease in recovery from wrinkling
was interpreted to be related to the change that occurred in the hand
of the fabrics during the laundering cycles.

While the Creslan/Herculan wrinkle recovery decreased sig-
nificantly in comparison to the rayon/Herculan blend, the Creslan/
Herculan blend continued to maintain a higher degree of wrinkle re-
covery for both the original and wear-tested fabrics.

The American Standards Association has set a recovery angle
of 115 degrees in both warp and filling directions as the minimum
standard for a fabric to be labeled resistant to wrinkling. As calcu-
lated, the mean angle of recovery for both fiber blends exceeded the
minimum L-22 standard in all but three cases. These three included
the warpwise direction folded face to face for all fabrics except the
original Creslan/Herculan blend.

**Thickness Measurement**

In testing the two fiber blends for differences in fabric thick-
ness, the original Creslan/Herculan and the rayon/Herculan blend
fabrics both had mean thickness readings of 0.059 inches. The
wear-tested Creslan/Herculan specimens increased in thickness to
a mean of 0.065 inch while the wear-tested rayon/Herculan had a
mean thickness of 0.067 inch (Table 14). The writer subjectively
Table 12. Analysis of variance for wrinkle recovery of original Creslan/Herculon fabric compared to the wear-tested Creslan/Herculon fabric.

<table>
<thead>
<tr>
<th>Direction</th>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>warp/face</td>
<td>fabric</td>
<td>1</td>
<td>3.6875</td>
<td>3.6875</td>
<td>320.016**</td>
</tr>
<tr>
<td>warp/back</td>
<td>fabric</td>
<td>1</td>
<td>8.2875</td>
<td>8.2875</td>
<td>241.576**</td>
</tr>
<tr>
<td>filling/face</td>
<td>fabric</td>
<td>1</td>
<td>17.0375</td>
<td>17.0375</td>
<td>28.250*</td>
</tr>
<tr>
<td>filling/back</td>
<td>fabric</td>
<td>1</td>
<td>5.7687</td>
<td>5.7687</td>
<td>42.123**</td>
</tr>
</tbody>
</table>

**Significant at 1 percent level.
*Significant at 5 percent level.

Table 13. Analysis of variance for wrinkle recovery of original rayon/Herculon fabric compared to the wear-tested rayon/Herculon fabric.

<table>
<thead>
<tr>
<th>Direction</th>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>warp/face</td>
<td>fabric</td>
<td>1</td>
<td>17.4875</td>
<td>17.4875</td>
<td>1.376</td>
</tr>
<tr>
<td>warp/back</td>
<td>fabric</td>
<td>1</td>
<td>20.5375</td>
<td>20.5375</td>
<td>18.761*</td>
</tr>
<tr>
<td>filling/face</td>
<td>fabric</td>
<td>1</td>
<td>3.1375</td>
<td>3.1375</td>
<td>130.139**</td>
</tr>
<tr>
<td>filling/back</td>
<td>fabric</td>
<td>1</td>
<td>9.9500</td>
<td>9.9500</td>
<td>63.392**</td>
</tr>
</tbody>
</table>

**Significant at 1 percent level.
*Significant at 5 percent level.
attributed the increase in the mean thickness of both wear-tested fiber blends to the ten minute fluff cycle each shirt received as part of the weekly laundry procedure.

Table 14. Mean thickness comparison of Creslan/Herculan and rayon/Herculan.

<table>
<thead>
<tr>
<th>Fiber Content</th>
<th>Original Fabric</th>
<th>Wear-Tested Fabric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creslan/Herculan</td>
<td>0.059 inch</td>
<td>0.065 inch</td>
</tr>
<tr>
<td>Rayon/Herculan</td>
<td>0.059 inch</td>
<td>0.067 inch</td>
</tr>
</tbody>
</table>
SUMMARY AND CONCLUSIONS

This study was conducted to determine the serviceability and consumer acceptance of two polypropylene blend double knit fabrics for pre-school boys' shirts. The objectives were: (1) to measure the physical properties of polypropylene knit blends for abrasion, specifically pilling, wrinkle resistance and thickness, (2) to determine and compare the effects of physical testing on original and wear-tested polypropylene blend knits, (3) to identify the visual changes to the knit shirts incurred during wear and controlled laundering and drying, (4) to identify and determine which knit blend changed least in appearance after wear-testing and laundering, (5) to ascertain the degree of consumer acceptance of polypropylene blend knit fabrics for use in children's garments, and (6) to test a raglan sleeve design for growth, comfort, and consumer preference in comparison to a set-in sleeve style in boys' shirts. To relate findings of consumer preference toward acceptance of the experimental fabric as a possible retail product the following hypotheses were formulated:

Hypotheses

1. A raglan sleeve design will provide greater comfort and allowance for growth than a set-in sleeve and will be preferred by the parent.
2. Polypropylene-Creslan and polypropylene-rayon blend knit fabrics will pill after limited wearings.

3. Knit garments of Creslan or rayon blended with polypropylene will perform equally well after numerous wearing, laundering and drying cycles.

4. Polypropylene blend fabrics can be restored through laundering and drying and require very little or no pressing.

5. Consumers will be influenced by aesthetic properties rather than physical properties when making a final decision for garment selection.

6. Consumers are interested in new fibers and fabrics requiring limited care.

7. Consumers will be enthusiastic and receptive to polypropylene knit shirts if made available on the retail market.

A three-part procedure was used to obtain information concerning the serviceability of the fabrics. The experimental fabrics were developed into 28 size 6 golf-style shirts for seven day nursery school boys. Each boy received four shirts—two rayon/Herculon and two Creslan/Herculon blend knits. Each shirt was worn once each week for a series of ten weeks or approximately 130 hours. The serviceability of the shirts was evaluated subjectively by a panel of University Clothing and Textiles faculty members, by the boys' parents, by the day nursery supervisor, and by
the writer. In addition, the boys' parents objectively evaluated the fabric blends using a 5-point rating scale. Specific properties evaluated were: (1) general appearance, (2) shape retention, (3) resistance to pilling, (4) color change, (5) wrinkle resistance, (6) fabric hand, (7) fiber static, (8) shrinkage, (9) stain resistance, and (10) fabric texture. A second category for shirt style was included to determine a consumer preference for the set-in sleeve or raglan sleeve design.

Maintenance of the shirts during the ten week wear period was conducted by the writer under controlled laundering and drying conditions similar to those used by the consumer.

Using laboratory equipment, the physical properties of abrasion resistance, thickness and wrinkle resistance were compared. To analyze the data the parents' rating scale, comparing the two fiber blends, was computed using an analysis of variance. Significance was calculated at the one percent and five percent levels. The following conclusions were summarized from the results of the study.

Hypothesis 1 was valid for only three of the seven respondents and thus did not hold true for this group of mothers. It was the opinion of the three respondents, the panel members and the writer, the raglan sleeve design would provide greater comfort and more allowance for growth for the pre-school boy. However, four mothers
indicated they did not prefer the raglan sleeve over the set-in sleeve style and therefore, would not make such a selection if given a choice.

Hypothesis 2 was supported by subjective examinations of the shirts by the parents, the panel members and the writer. After five wearings, pilling was detected on both fiber blends. The degree of pilling was judged subjectively by comparing the three colors as related to the fiber blend of the wear-tested shirts. The blue Creslan/Herculon swatches were easily identified for pills or balls of fibers. When comparing the blue Creslan/Herculon to the rayon/Herculon or grey fabric it was determined that the rayon/Herculon samples contained more fuzz formations per square inch. A comparison of the three fabric colors, blue, brown, and grey, continued to substantiate that the rayon/Herculon blend pilled the most and the brown Creslan/Herculon pilled the least.

There was no significant difference between ratings of the two blends of fabrics on the basis of general appearance, shape retention, resistance to pilling, wrinkling, shrinkage, noticeable fiber static and resistance to stain. The fabric serviceability of both the Creslan/Herculon and the rayon/Herculon knits was identified by the consumer as being superior to previously purchased knits. Each blend was considered to be potentially competitive to fabrics presently on the retail market, therefore, Hypothesis 3 was supported.
Hypothesis 4 stating both fiber blend knits could be restored to original appearance through laundering and drying, as well as require little or no pressing was substantiated. Total restoration of the fabrics was achieved and in the opinion of the parents and the writer the hand of the fabric improved as the number of launderings increased. It was the writer's subjective judgment that at no time during the wear-test period did the shirts need additional touch-up pressing after being laundered. To further reinforce this, the seven mothers indicated ease in caring for clothing as one of the most important factors they considered prior to garment selection and purchase.

Hypotheses 5 and 6 were subjectively supported by the attitudes and opinions expressed by the parents during the wear-test period and in the final interview, no statistical measurement was used. According to those respondents interviewed it was the writer's subjective conclusion that consumers are influenced by aesthetic properties when making retail choices. Secondary influences of easy-care, fiber content, and price are then considered. Limitations of these conclusions include the number of the participants in the study and the particular population segment from which the respondents were selected.

The receptiveness of consumers to polypropylene blend fabrics as used for the wear-tested shirts was objectively and subjectively
substantiated by the parents, the nursery school supervisor, the University Clothing and Textiles panel and the writer, thus confirming Hypothesis 7.

Differences between the physical properties of the two experimental blend knits were limited. In comparing the original fabric thickness of the Creslan/Herculon and the rayon/Herculon the measurement was identical. When the wear-tested specimens of the Creslan/Herculon and the rayon/Herculon were compared the rayon/Herculon blend was found to be slightly thicker; however, all of the wear-tested specimens increased in thickness in comparison to the original specimens. The writer attributed this change in the fiber property partially to the ten minute fluff period the shirts were subjected to each week as part of the drying cycle.

In comparing the original Creslan/Herculon and rayon/Herculon blends, the Creslan/Herculon had a significantly greater wrinkle recovery for both warpwise and fillingwise directions. The wear-tested Creslan/Herculon compared to the rayon/Herculon wear-tested fabric continued to have a greater wrinkle recovery for the fillingwise direction while the warpwise direction of the rayon/Herculon blend had a slightly greater recovery when folded back to back. The mean wrinkle recovery values of each wear-tested fiber blend decreased due to wearing and laundering.

Abrasion effects were based on the loss in weight. The
original rayon/Herculan fabric was lighter in weight in comparison to the Creslan/Herculan and suffered greater abrasion weight loss for both the original and the wear-tested fabrics. Degradation by abrasion for the original and wear-tested Creslan/Herculan knit did not indicate a significant difference in weight loss of the two fabrics after wear.

Little or no apparent visual change resulted after the blue Creslan/Herculan blends were subjected to the abrasion test, while the original and wear-tested samples of the brown Creslan/Herculan displayed significant discoloration or lightening. In comparison the rayon/Herculan original and wear-tested specimens revealed only a slight degree of apparent color change.

In conclusion, the findings supported six of the seven hypotheses formulated at the beginning of the study. The polypropylene blend shirts were judged to perform satisfactorily in use as preschool boys' shirts. In actual or natural wear the shirts were evaluated as being superior in appearance and comfort. Fabric serviceability was a quality preferred by the parents. Ease in caring for the fabrics, resistance to stain, and no touch-up pressing after drying were fiber or fabric properties which the consumers were seeking and ultimately demanding.

Using the subjective evaluations of the mothers of the seven boys, the day nursery school supervisor, the Clothing and Textile
University panel and the objective physical testing data, it is the opinion of the writer that the knit shirts blended of either Creslan/Herculan or rayon/Herculan would provide satisfactory performance and serviceability for today's consumer.
RECOMMENDATIONS FOR FUTURE STUDY

Polypropylene blend knit fabrics are a relatively new development of the textile industry. Since the consumer continues to need information regarding the performance of new products, the following suggestions are made for further study if polypropylene continues to be used in fabrics of this type.

1. A comparison of polypropylene blend knits with one or more other knit blends presently being developed.

2. A comparison of polypropylene blend knit shirts retailing in the same price range as cotton knit shirts of comparable style and fabric construction.

3. A study parallel to this research comparison involving a larger population segment and using fiber blends of only one color.

4. A study to determine a possible variation in knit construction to improve fabric weight and coordinated ribbing.

5. A study of consumer interest and satisfaction of polypropylene apparel serviceability presently sold on the retail market.

6. A study to develop methods of introducing new fiber blends to the consumer for the purpose of determining preference and fabric recommendations.
Parent recommendations to the manufacturer were:

(1) The development of a fabric lighter in construction which would enable year-around wear.

(2) The production of a coordinated ribbing to be used at the neckline and sleeves.

(3) The development of a color range acceptable for children's wearing apparel such as brighter colors.
BIBLIOGRAPHY


March 7, 1968

Dear Nursery School Parents:

I am currently conducting a research study on boys' shirts in order to complete a masters degree program in clothing and textiles at Oregon State University. As part of my study I have constructed two types of boys' knit shirts similar in style to a man's golf shirt. The differences are in the sleeve design and fiber content of the fabric.

In order to continue with my project, it is necessary for me to obtain actual wear results by involving seven little boys who would wear a size 5 or 6 ready-made shirt. Each boy would have four shirts, two with a set-in sleeve design, and two with a raglan sleeve design, to wear one each day, Tuesday through Friday for ten weeks. The project will begin on March 25 and end on June 4, 1968.

The shirts will be brought to the nursery school on Mondays to be taken home that day by you and worn the next four days by your son. Each Friday, you will return the shirts, including the one your son would be wearing that day to the nursery school. The shirts will then be laundered over the weekend, re-boxed and brought to the nursery school Monday morning to begin another week of wear.

The parents who participate in this project will be asked to meet with me once at the beginning of the wearing period. We will discuss the items on an evaluation sheet which you will be asked to complete. This evaluation sheet will be completed at the end of the ninth week.

If you feel you would be willing to participate in this study and your son wears a size 5 or 6 knit shirt, would you please complete the next page, turn it in to the nursery school director by March 13, 1968, and I will contact you in the near future.

Thank you for your cooperation regarding my request and I hope that you and your son will feel you will be able to assist with this project. I will look forward to receiving your response and meeting some of you.

Sincerely,

Joyce Jeffers
Graduate Student
Clothing and Textiles Department
Oregon State University
NAME: ________________________________

ADDRESS: ________________________________

_____________________________________

TELEPHONE NUMBER: ________________

MY SON’S NAME: ____________________________

AGE: _____ HEIGHT: _____ WEIGHT: ____

SHIRT SIZE: ________________________________

The most convenient time for me to have a 30 minute conference at
the nursery school with you is: (Please Circle)

Monday, March 18, 1968 3:30-4:00; 4:00-4:30; 4:30-5:00 P.M.
Tuesday, March 19, 1968 3:30-4:00; 4:00-4:30; 4:30-5:00 P.M.
Wednesday, March 20, 1968 4:30-5:00 P.M.
Thursday, March 21, 1968 3:30-4:00; 4:00-4:30; 4:30-5:00 P.M.
Friday, March 22, 1968 3:30-4:00; 4:00-4:30; 4:30-5:00 P.M.

If there is no convenient time listed above, and an evening conference
is preferred, please indicate a date and time during the week of
March 18-22, 1968. __________________________________
### CALENDAR FOR WEARING SHIRTS

<table>
<thead>
<tr>
<th>Month</th>
<th>Dates</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>March</td>
<td>25* 26 27 28 29 ✓</td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>1* 2 3 4 5 ✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8* 9 10 11 12 ✓</td>
<td></td>
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<tr>
<td></td>
<td>15* 16 17 18 19 ✓</td>
<td></td>
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<tr>
<td></td>
<td>22* 23 24 25 26 ✓</td>
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<td></td>
<td>29* 30</td>
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<td>May</td>
<td>1 2 3 ✓</td>
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<td>6* 7 8 9 10 ✓</td>
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<td></td>
<td>13* 14 15 16 17 ✓</td>
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<td></td>
<td>20* 21 22 23 24 ✓</td>
<td></td>
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<tr>
<td></td>
<td>27* 28 29 30 31 ✓</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>3 4 ✓</td>
<td>end of wearing period</td>
</tr>
</tbody>
</table>

* Pick up shirts  
✓ Return shirts
May 20, 1968

Dear Parents:

Attached, please find the evaluation which you have been asked to complete.

The shirt evaluation has three major categories: fabric, style, and comfort in addition to a section on general opinions or conclusions. Please evaluate each shirt and complete all areas in each group. The same rating scale should be used with 5--excellent, 4--very good, 3--good, 2--fair, and 1--poor.

In order to avoid any inconvenience over a holiday weekend, the boys will wear their shirts on Monday, May 27th, to make up for Thursday, May 30, 1968. Mrs. Schulke has offered to see that they are put on upon arrival at nursery school.

Each of you have been most cooperative during the past ten weeks while these shirts have been worn, and I cannot begin to express my sincere appreciation and thanks enough for the additional time you have devoted to this study.

In conclusion to this part of my thesis research, it will be necessary for me to meet once more with you on an individual basis at which time I will direct some final questions. Any comments or opinions which may have been expressed by your son will also be valuable.

I realize the varied and busy schedules most households have at this time of year and I hope we can arrange a time which will be most convenient to you and your family. Mr. and Mrs. Schulke have consented to allow us to meet at the nursery school office for this final discussion.

Because most people are in a hurry and ready to go home when you stop for your sons, I am asking that you select a convenient time on the attached schedule. This discussion will take 30-40 minutes at the very maximum.

Thank you again and I will look forward to discussing your opinions regarding the fabric and the style of shirts. Prior to coming, would you please obtain the height and weight of your son.

Yours very truly,

Joyce C. Jeffers
<table>
<thead>
<tr>
<th>NAME</th>
<th>PHONE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Monday, May 27, 1968</strong></td>
<td>7:00-7:30</td>
</tr>
<tr>
<td></td>
<td>7:35-8:05</td>
</tr>
<tr>
<td><strong>Tuesday, May 28, 1968</strong></td>
<td>7:00-7:35</td>
</tr>
<tr>
<td></td>
<td>7:35-8:05</td>
</tr>
<tr>
<td></td>
<td>8:05-8:35</td>
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<tr>
<td><strong>Monday, June 3, 1968</strong></td>
<td>7:00-7:30</td>
</tr>
<tr>
<td></td>
<td>7:35-8:05</td>
</tr>
</tbody>
</table>
APPENDIX C

Appearance

Stylish
Collar is smooth, lays flat
Seams free from puckers
Front opening appears smooth, and in proportion to body size
Resistance to pilling
Wrinkle resistance
Apparent changes from laundering—fading, pilling, shrinkage, stretching
Changes in feel of the fabric after laundering

Fit

Sleeve seams fit shoulder width
Raglan sleeve seams do not pull; are not too full
Sleeve band width looks boyish
Sleeve band circumference adequate for arm size
Collar hugs the neckline
Collar lays flat; does not curl up
Collar roll in proportion to neck length
Front opening adequate for head size
Buttonhole placement and button size functional for small fingers
Shirt length in proportion to trunk length
No flair at shirt hemline

Comfort

Suitable for activities of age level and sex
Collar and neckline do not bind when buttoned
Sleeves do not bind at underarms or in shoulder areas
No apparent strain lines from neckline to underarm seams
Side seams have adequate "give" for movement
Adequate amounts of ease and stretch through shoulder and chest area
Fabric is adequate for both indoor and outdoor wear
Fabric not too warm, fabric "breathes" for circulation
Fabric feels smooth to skin, no irritations
APPENDIX D

NAME ____________________________

SON'S NAME ____________________________

Fabric Evaluation

<table>
<thead>
<tr>
<th></th>
<th>Blue</th>
<th>Brown</th>
<th>Grey</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Appearance</td>
<td>54321</td>
<td>54321</td>
<td>54321</td>
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<tr>
<td>Retention of Original Shape</td>
<td>54321</td>
<td>54321</td>
<td>54321</td>
</tr>
<tr>
<td>Resistance to Pilling</td>
<td>54321</td>
<td>54321</td>
<td>54321</td>
</tr>
<tr>
<td>Apparent Changes in Color</td>
<td>54321</td>
<td>54321</td>
<td>54321</td>
</tr>
<tr>
<td>Resistance to Wrinkling</td>
<td>54321</td>
<td>54321</td>
<td>54321</td>
</tr>
<tr>
<td>Hand or Feel of Fabric</td>
<td>54321</td>
<td>54321</td>
<td>54321</td>
</tr>
<tr>
<td>Noticeable Fiber Static</td>
<td>54321</td>
<td>54321</td>
<td>54321</td>
</tr>
<tr>
<td>Resistance to Shrinkage</td>
<td>54321</td>
<td>54321</td>
<td>54321</td>
</tr>
<tr>
<td>Apparent Change in Fabric Texture</td>
<td>54321</td>
<td>54321</td>
<td>54321</td>
</tr>
<tr>
<td>Resistance to Stain</td>
<td>54321</td>
<td>54321</td>
<td>54321</td>
</tr>
</tbody>
</table>

Shirt Style Evaluation

General Appearance of Shirt
Please indicate which style by circling 1 or 2

(1-2) 54321 (1-2) 54321 (1-2) 54321

Sleeve Style
(1-2) 54321 (1-2) 54321 (1-2) 54321

Sleeve Length
(1-2) 54321 (1-2) 54321 (1-2) 54321

Sleeve Band
(1-2) 54321 (1-2) 54321 (1-2) 54321

Collar and Neckline
54321 54321 54321

Front Opening
54321 54321 54321

Length of Shirt
54321 54321 54321

Shirt Fit Evaluation

Sleeve Style
(1-2) 54321 (1-2) 54321 (1-2) 54321

Sleeve Length
(1-2) 54321 (1-2) 54321 (1-2) 54321

Sleeve Band
(1-2) 54321 (1-2) 54321 (1-2) 54321

Front Opening
(1-2) 54321 (1-2) 54321 (1-2) 54321

Size to Body Structure
(1-2) 54321 (1-2) 54321 (1-2) 54321
APPENDIX E

Final Parent Interview

1. In your opinion how does the fabric of the shirts that have been worn compare to other knit shirt fabrics you have purchased?

2. What suggestions would you make in reference to fabric, color, and if desired, patterns in the fabric?

3. Do you feel the comfort and appearance of the shirt would be improved with the use of coordinated ribbing for the collar, neckband, and sleeve bands?

4. Do you feel the shirt needs to be longer in length and if so how much longer?

5. Does your son prefer to wear his shirt tucked into his trousers?

6. Which sleeve style has the better appearance in your opinion? Why? What suggestions can you make for improvements?

7. Does this shirt style allow your son to dress himself easily? What style do you generally prefer?

8. Can you describe any visual changes that have occurred in the fabric during this wearing period?

9. In your opinion, should the weight of the fabric used for this shirt size be improved?

10. Can you share with me any comments or opinions your son has mentioned?

11. If the construction of this shirt included ribbing and a wider range of colors would you select this product for your son from a retail store?

12. Can you share any other comments or opinions you have had?

13. With no reservations would you honestly tell me what you have concluded about the fabrics?