

AN ABSTRACT OF THE THESIS OF

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Title WOVEN STRETCH AND NONSTRETCH FABRICS IN
CLOTHING DESIGNED FOR BOYS WITH SPECIFIED
PHYSICAL HANDICAPS

Abstract approved ✓ Signature redacted for privacy.
(Major professor)

This study was developed (1) to compare the durability and comfort of stretch and nonstretch in certain selected denim and gingham fabrics, (2) to test specific designs as to their self-help features and (3) to test special features in the designs which might be adapted easily to ready-made clothing for handicapped children.

Two shirt designs and two trouser designs were developed for boys who wore leg braces, had limited finger coordination and had varying degrees of deformity in the shoulders. These designs were then constructed into 16 shirts from woven stretch and nonstretch gingham and 16 pairs of trousers from woven stretch and nonstretch denim.

Eight boys, ranging in age from five to 12 years, were selected from the Children's Hospital School in Eugene, Oregon. Each boy had two outfits of the same design, one of stretch fabric and the other

of nonstretch. Each outfit was worn once a week for a total of 12 wearings. All garments were laundered after each wearing by a selected laundress who followed a set procedure.

The designs and special features were evaluated by two therapists and the mothers of the eight subjects during interviews with the writer. The writer also held discussions with the children. The fabrics were evaluated by the laundress and the writer by examinations of the garments after each laundering. From these evaluations the following results were apparent:

1. The woven stretch fabrics had better abrasion resistance than the nonstretch when worn over corrective appliances and retained their color and dimensional stability.
2. A pull-over style shirt with a dickey and raglan sleeves was desirable for boys who could raise their arms but had little finger coordination.
3. A shirt with a front opening with Velcro fasteners was satisfactory for boys who had limited finger coordination and could not raise their arms.
4. Raglan sleeves in shirts were desirable for boys with poor coordination and deformed shoulders.
5. Elastic at the waistband of trousers was desirable for those who needed larger trousers to fit over leg braces and pelvic bands.

6. A leg opening closed with a zipper or Velcro was desirable in trousers worn over leg braces.

WOVEN STRETCH AND NONSTRETCH FABRICS
IN CLOTHING DESIGNED FOR BOYS WITH
SPECIFIED PHYSICAL HANDICAPS

by

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WOVEN STRETCH AND NONSTRETCH FABRICS IN CLOTHING DESIGNED FOR BOYS WITH SPECIFIED PHYSICAL HANDICAPS

INTRODUCTION

As was recently reported by the Social Worker Yearbook, there are over 850,000 orthopedic physically handicapped children in the United States. The limbs of many of these children are affected by cerebral palsy, spina bifida, or muscular dystrophy. The child with limited use of his fingers finds buttons and zipper fasteners hard to manipulate. Those who have limited shoulder and arm movements have difficulty getting into ready-made clothing which usually does not fit over deformed bodies and corrective appliances.

Upon completion of a trial test of dress designs for handicapped girls, Frescura (22) recommended that further research was necessary on fabrics that would be strong enough to withstand wear over corrective appliances, and at the same time be comfortable next to the skin, absorbent, easy to care for and becoming to the child. She also recommended that there was a need for more research and trial testing of styles, design features and fasteners suitable for the physically handicapped.

At a conference held at Utah State University on October 16, 1964, Mr. Dale Ream, a paraplegic medical student at the Stanford

School of Medicine, suggested that people working in the area of clothing for the physically handicapped should develop basic methods of altering standard ready-made clothing to meet special requirements of handicapped persons. He believes that: "Such clothing would have the advantages of being in style, being readily available, relatively inexpensive and specifically tailored to the individual's needs. There is no reason why a handicapped person need not be as well dressed as his non-handicapped neighbor" (7, p. 3).

After studying the recommendations by Frescura and Ream there seemed to be a definite need for further study in designing and adapting ready-made clothing for the handicapped child. Possibly even a greater need was a study of fabrics to be worn over corrective devices since Boettke, (3) Frescura, (22) and Scott (39) all reported that there was excessive wear on fabrics worn over braces.

The woven stretch fabrics were relatively new and seemed to have the serviceable characteristics needed in such clothing. These have been described by American Fabrics as offering longer wear than the nonstretch variety, improved wrinkle resistance, more shape retention, better fit and comfort, along with enhanced texture and ease of care (49).

Stretch fabrics had their beginning in sportswear, then spread to areas of casual and evening wear. Today they are used in clothing for men, women and children. In describing stretch fabrics

for children's wear, Hamilton (24) stated:

Needless to say the application of woven stretch fabrics to children's wear is almost without limits. Nobody can twist, bend and stretch a fabric to the tearing point faster than a child. And the potential application to clothes designed for them to grow in is certainly enormous.

The writer was interested in the possibilities of the woven stretch fabrics. Its elasticity as well as its increased wearing qualities seemed to suggest its use over corrective devices. Consequently, this study developed from the interest which the writer had in woven stretch fabrics and from her desire to perform a service for handicapped children.

The purpose of this study was to compare woven stretch fabrics with nonstretch fabrics in shirts and trousers designed by the writer. The garments were made for boys who wore leg braces and had other specific types of physical handicaps. The designs were developed with the belief that they would help the child become more independent in dressing and that certain special features could be easily adapted to ready-made clothing to suit the individual's needs.

REVIEW OF LITERATURE

Development of Woven Stretch Fabrics

The technology for stretch yarns was developed by the Heberlein Patent Corporation in Wattwill, Switzerland, during the early thirties. In their research to impart the properties of wool to continuous filament man-made fibers, the torque crimp process was developed. This process put a crimp in the man-made filament, re-formed it by mechanical means and then made the reformation permanent by setting it with heat (46).

After World War II, stretch in woven fabrics was introduced by the Heberlein Company when they adapted the torque crimp process to nylon. The nylon yarns were twisted, heat-set, and untwisted to achieve a helical crimp in the yarns. The continuous filament then took on the properties of a spring; it stretched under tension and returned to normal when tension was released.

In 1947, Heberlein named the stretch yarn Helanca. Ski pants were the first garments made of this stretch yarn with the stretch being in the warp (vertical) direction.

Fashions in silk and nylon stretch fabrics were a success in Europe during 1959, when Pucci of Rome introduced his line of sportswear and leisurewear (46). With this kind of impetus woven

stretch fabrics are being used today in almost every type of wearing apparel, from active sports to evening gowns.

The most widely used fiber for stretch fabrics at present is nylon, but rapidly gaining are the polyesters, 100 percent cottons, and the new core-spun spandex yarns.

Types of Stretch Fabrics

There are basically three methods in which stretch fabrics are created:

1. Textured thermoplastic yarns which have high stretch characteristics resulting from deformation of the filaments.
2. Highly elastic cotton stretch yarns resulting from chemical changes in the cotton fiber.
3. Elastomeric core-spun yarns possessing intrinsically high stretch characteristics because of the spandex core covered by a nonelastic fiber.

Textured Thermoplastic Yarns

Textured thermoplastic yarns are made of nonelastic, continuous-filament man-made fibers which are thermoplastic (pliable when heated) and are made stretchable through reformation by one of three methods: False Twist, Knife Edge or the Stuffer Box Method.

The False Twist method makes a coil type yarn. It is a

continuous filament yarn (nylon or polyester) which is fed to a false-twisting machine and is twisted about 75 turns per inch. As it is twisted, the yarn is heat set at temperatures of 350° to 465° F. when passed through the heater box. Upon emerging from the box the yarn is twisted the same number of turns in the opposite direction. The yarn will try to return to its original twisted form; in the process it pulls itself into small resilient coils (46). The yarn now has a built-in torque or twisting force in either the "S" or the "Z" direction. For a balanced yarn, the "S" yarn is usually plied or doubled with a "Z" yarn and the result is ready for weaving.

The amount of stretch, bulk and crimp, obtained by the False Twist method can be modified by controlling the conditions of the amount of tension, twist, temperature, and heating time (34).

The Knife Edge method imparts a curl to a thermoplastic yarn. The yarn is heated and drawn across a knife edge at an acute angle. At random intervals the spiral direction reverses along the yarn and produces a balanced, torque-free yarn (46). At present this method for woven stretch fabrics is very limited due to a high royalty return.

The crimp type is produced in the thermoplastic yarns by the Stuffer Box method. This process compresses the filaments into a confined space known as the "stuffer box" where heat is applied. The emerging yarns have become heat-set in a random, zigzag

crimp (46).

Stretch yarns produced by the Stuffer Box method as well as by the Knife Edge method are reported to have good resilience, increased water absorbency and an increase in elongation. However, Gurley (23) reported that the increase in elongation was smaller than that obtained with a coiled yarn (False Twist). Sloan (44, p. 30) stated that in general, the elongation-at-break of a fabric gives a good indication of its stretch properties.

Hathorne (25) reported that excellent woven fabrics can be produced from yarns made by the Stuffer Box method. However, high royalty charges and increased production costs have limited the use of this system.

In finishing the thermoplastic stretch fabrics, softeners, antistatic agents, resins and water repellents can be applied (17, 32). The addition of softeners improves the stretch properties of the fabric, while some acrylic resins improve the recovery properties (32).

It is the twist-heat-set-untwist texturing technique that gives the best properties of stretch to the fiber; remarkable crimp, bulk, elasticity and elongation. Given such texturing, a heavy denier nylon can be stretched three times its relaxed length; lighter deniers can be stretched out to five times their length. The fiber has about three times as much bulk, a firm, slightly crisp "hand," and excellent recovery from stretch (49, p. IX).

False twisted nylon yarns have advantages such as texture,

softness and drape which can be utilized in the fabrics (25). One other characteristic is its low modulus. Modulus refers to the "stiffness of a material or its resistance to longitudinal expansion" (26, p. 5). This feature, combined with good recovery properties, contributes to the comfort of garments from these stretchable fabrics (32). Therefore, fabrics made by the False Twist method have the greatest elongation and recovery properties and are the most widely used stretch fabrics at present.

Cotton Stretch

Southern Regional Research Laboratory (SRRL) of the U. S. Department of Agriculture has carried on the main research for cotton stretch fabrics. They produce these fabrics by three basic principles:

1. Slack mercerization.
2. Crosslinking agents.
3. Heat setting of thermoplastic cotton.

Slack Mercerization. The simplest and least expensive chemical treatment for producing stretchable woven fabrics is slack mercerization. Essentially, the process involves the shrinkage of cotton fabric without restrictions of tension in a 23 percent solution of sodium hydroxide at 30° C for approximately one and one-half minutes (51). The shrinkage and crystalline

conversion become constant after one minute of immersion in the caustic solution (10).

During the mercerization process there occur many changes within the cotton fiber. It shrinks from 15 to 20 percent and at the same time it swells laterally. The secondary wall thickens and the fiber increases in diameter. The swelled fiber is now more rounded and does not have the convolutions characteristics of the untreated fiber (35, 44, 51). Sloan (44, p. 26) stated further, ". . . electron-micrographs show well-oriented fibrils in the scoured fragment as compared with the lack of orientation and the crimped appearance of the fibrils of the scoured and mercerized fragment." Other permanent changes reported by Reeves (35, p. 43) are as follows: a change in crystalline structure, reduced crystalline content, and an increase in moisture absorption, dye affinity, elongation-at-break with reduced density.

Fabrics with only filling stretch can be obtained by two methods: (1) the filling is permitted to shrink freely while the warp is held under tension and (2) the fabric is allowed to shrink completely relaxed in both the warp and filling directions, with the warp being re-stretched before drying (41). Sloan reported that better stretch properties are obtained in the filling when the warp is not allowed to shrink during mercerization (44).

The manufacturing of two-way stretch fabrics has been limited

because of the special tensionless processing equipment necessary, slow production speeds and high costs (43). Warp stretch in cotton fabrics is also limited because of the difficult processes involved.

Slack mercerized fabrics are heat-set to help prevent losing stretch characteristics during the subsequent processes and to control the finished width. The fabrics are then easily dyed before adding softeners, antistatic materials and resin treatments.

Dimethylol ethyleneurea (DMEU), a cross-linking agent used in the resin treatment of fabrics, has been found to improve the recovery of slack mercerized fabrics, impart a soft hand, increase the wash and wear characteristics, improve wrinkle resistance and decrease the tendency of these fabrics to grow during use. However, this treatment decreases tearing and breaking strength of the cotton (30, 51). The resin-treatment of slack mercerized fabrics with dimethylol ethyl carbamate (DMEC) gives a higher tearing strength, breaking strength, elongation-at-break and abrasion resistance, but has a low wrinkle recovery (42). The crease recovery is improved when a softening agent is added with a resin finish.

The SRRL laboratory defined "easy stretch" as "the percent of elongation caused by a two-pound weight on a one-inch ravelled strip of fabric where a gauge length of five inches is used" (35, p. 45). "Growth" was defined as "the percent increase in the length of the sample after being extended and load removed" (44,

p. 30). "Cyclic loading" is a process by which a test strip is exercised by loading and unloading through a determined number of cycles before measuring the elongation and growth (35, p. 45).

Reeves (35) of SRRL reported that the amount of stretch and recovery needed in fabrics varied with the end use. Approximately 12 to 15 percent "easy stretch" with good recovery of 80 percent or more may be adequate for many apparel fabrics. All-cotton stretch fabrics produced by slack mercerization have approximately 15 to 20 percent "easy stretch" in the filling with about 80 percent or more recovery. Growth after 10 cyclic loadings at 20 percent elongation is generally four to six percent. This amount of stretch provides comfort and a well fitting garment.

Cotton stretch products made by slack mercerization are superior to the other two types in cost, tensile strength, toughness, dye receptivity and general flexibility in handling and finishing (19).

Cotton yarns themselves give to these cotton stretch fabrics the advantages of low cost, good absorbency and launderability. Fisher (19) of SRRL reported that the new stretch cotton fabrics have additional advantages other than the stretch quality; they have increased abrasion resistance, strength and wrinkle resistance. The permanent set, produced by extended stretching, is low and can be removed by home laundering followed by tumble drying.

Crosslinking Agents. According to Reeves this process consists of "impregnating highly twisted plied cotton yarn with a conventional crosslinking agent and suitable catalyst and modifying agents, drying and curing at an elevated temperature then untwisting past neutral ply twist" (35, p. 42). As the yarn tries to return to its original twist it pulls itself into tiny resilient coils.

Fisher (18, 19) reported that fabrics woven from the high-stretch, textured cotton yarns were highly resilient, lower in bulk density, thicker and greater in thermal insulating qualities than comparable fabrics woven with conventional cotton yarns. These high stretch yarns have good recovery from short term deformations (90 percent recovery after being stretched 200 to 300 percent of their relaxed length). Even after prolonged static loading the original dimensions of a fabric can readily be restored when it is washed and dried. Reeves (35) stated that the strength of this yarn was generally about 50 percent, or slightly more, of that of the original nonstretch yarn, however, the abrasion resistance was greater. Fabrics woven from these crimped crosslinked yarns have had up to 100 percent elongation-at-break with over 50 percent "easy stretch."

The crosslinked yarns are superior to the other two types from the standpoint of low modulus, elongation-at-break and high stretch (19).

Heat Setting of Thermoplastic Cotton. This process chemically transforms cotton cellulose into yarns having thermoplastic characteristics. These yarns are heat crimped by any one of the three previously described processes used for crimping thermoplastic synthetic yarns (18, 19). When the yarn is under tension the crimp is pulled out, yet it returns to its original crimped state when the tension is relaxed.

These chemically modified cotton yarns have greater bulk and stretch than the original yarns. Some yarns have been produced with elongation up to 200 percent. The tensile strength is approximately 50 to 80 percent of the original yarn strength. These yarns resemble the synthetics in that they are thermoplastic, relatively hydrophobic and resistant to rot and to heat (18, 19, 35).

Elastomeric Core-Spun Yarns

Stretch yarns made by this method begin with spandex, which is a true elastomeric fiber and is defined as a segmented polyurethane. The stretchability is provided by molecular chain geometry, not fiber geometry, as is the case with heat-set stretch yarns (27).

The elastomeric core-spun yarn is "a yarn in which a non-elastic fiber sheath is spun around a core of spandex yarn" (21, p. 145). The elastic spandex filament is in an extended position

when surrounded by the sheath fibers. When the tension is released, it returns to its normal length, pulling the sheath fiber into a more compact or bulked mass which creates a textured yarn. The core-spun yarn takes on the aesthetic characteristics of the fiber used in the outer sheath. A typical core-spun yarn is made of Dacron, cotton and Lycra (trade name for DuPont's spandex fibers).

Hicks (27) described the chemical and physical properties for the spandex fiber in the following manner: it accepts dyestuff readily, has good resistance to ultraviolet radiation, oxygen, heat and oils. In addition, it is resistant to hydrolysis. Lycra also withstands moderate levels of acidity and alkalinity (21). This elastic fiber is characterized by its high breaking elongation in excess of 100 percent (usually nearer to 500 to 800 percent), low modulus of elasticity and resistance to abrasion. It also has a high degree and a high rate of recovery from stretching (27). Spandex based core yarns produce more stretch and recovery than can be produced in similar fabrics woven with 100 percent false twisted nylon.

These production methods of stretch yarns and fabrics have added both stretchability and recovery to previously rigid woven fabrics.

Direction and Amount of Stretch Needed

The end use of the fabric dictates the direction of stretch and the amount of available stretch needed. The early fabrics were made of vertical or warp stretch which was needed for stretch pants. Today the trend is to make horizontal stretch in which the filling is stretchable. Horizontal stretch gives the needed comfort and adapts to ordinary body mechanics; therefore it is satisfactory for most everyday apparel with the possible exception of trousers.

The degree of stretch required for specific end uses has been divided into two categories. One category is "power stretch" which has good extensibility and quick recovery needed for swimwear, foundation garments, ski apparel and professional types of active sportswear. Power stretch fabrics have from 30 to 50 percent stretch with no more than five to six percent loss of recovery. The other category is "comfort stretch" which offers freedom of movement needed in our everyday apparel but does not give the holding power. Comfort stretch fabrics have from 25 to 30 percent stretch with no more than two to five percent loss of recovery (49).

Hamilton (24) described apparel from woven stretch fabrics as giving better fit because the stretch fabric provides fit within the material rather than with extra material and it also will give where it is needed most--at the shoulders, under the arms and at the waist.

These fabrics also resist wear in strategic areas such as the shoulders, elbows and knees. The enhanced texture, greater comfort, improved resistance to wrinkles, more shape retention and ease of care are additional advantages to the consumers (49). It is believed that garments of woven stretch fabrics will help eliminate some of the problems with sizing, especially in children's apparel (20, 47).

Research by University Graduate Students on Stretch Fabrics

Rybicki in her study, "Distortion of Stretch and Non-stretch Fabrics During Garment Wear," used fabrics of a non-stretch, a warp stretch and a filling stretch in her garments. She stated, "In all cases, subjects ranked a stretch dress higher than a non-stretch dress in comfort during body movement. The dress made from the filling stretch fabric was considered the most comfortable of the three garments" (37, p. 42).

Results from the study carried on by McCalla indicated that "The effect of laundering on the filling stretch properties of cotton slack mercerized fabrics is greater at the initial laundering treatment." However, "after the initial laundering the effect of laundering leveled off for the varying laundering severities" (31, p. 43). She also reported that "plain weave stretch fabrics recovered after static extension faster than twill weave stretch fabrics" (31, p. 42).

Hyduk's (28) study on denim of nylon-cotton stretch and all-cotton stretch showed that nylon-cotton stretch fabric had a greater elongation than that of the all-cotton stretch. Growth was greater with the all-cotton stretch than with the nylon-cotton fabric when measured immediately after wear, one hour later and again after 24 hours. "Growth after 24 hours in the nylon-cotton stretch fabric showed little difference between the laundered and the unlaundered samples" (28, p. 48). Variations in temperature and number of launderings seemed to have little effect on the elongation and growth in either fabric after the first laundering. She concluded that "it was evident in this study that the use of stretch fabrics is advantageous in many garments where freedom of movement, comfort and 'action wear' are important" (28, p. 69).

The study of the "Serviceability of Boys' Shirts and Jeans" by Cooper (9) revealed that laboratory laundering of 100 percent cotton denim gives more dimensional change and greater color loss than home laundering.

"Boys' Jeans Made from Denims" (12) included fabrics of 100 percent cotton as well as others with 15 percent nylon in the warp yarns. These fabrics were all nonstretch. The study revealed that the addition of nylon improved the dimensional stability of the fabrics. "Fifteen percent nylon in the warp yarns of the 10-ounce denims was not sufficient to increase breaking strength in that

direction. However, advantages were shown in resistance to abrasion and in tearing strength" (12, p. 677).

Stonecipher (45) tested plain seams in a 100 percent cotton denim with a filling stretch for static breaking strength and stretch recovery. Her variables were 15 straight stitches per inch and 15 zigzag stitches per inch; she used size 50 mercerized thread and Taslon nylon thread; she stretched the fabric or let it glide during machine stitching. Results from this study showed that neither the strength nor the recovery were affected by the type of stitch, thread or method of handling the fabric. However, the elongation was affected by a plain seam of 15 straight stitches per inch when sewed with mercerized thread. To obtain the maximum extension the fabric needed to be stretched during stitching.

Upon completion of her study, Richardson (36, p. 54) found that in view of the tensile stress and recovery properties of seams "that a plain rather than zig-zag stitch be used for sewing seams in stretch fabrics, especially those which exhibit a high degree of yarn slippage."

Jameson (29, p. 37) studied different construction processes used in garments made from a core spun fabric. Seams of ten stitches per inch, number one tension setting and light presser bar pressure were compared with seams using 18 stitches per inch, number nine tension setting and heavy presser bar pressure. She

reported favorable results with a garment of stretch fabric which had simple and few design details, few seams parallel with the stretch yarns and straight design lines. She also recommended that either machine made or bound buttonholes would give better results than zippers. Her best results were with seams using tighter tension, shorter stitches and heavier pressure.

Construction of Stretch Apparel

A review of the literature on the construction of stretch apparel gave assistance in pattern and fabric selection, preparation of fabric, cutting, sewing and care.

Selection of Pattern

In order to receive the advantages that stretch fabrics offer, it is recommended that a fitted pattern with few seams, minimum number of buttonholes, set in sleeves and few details be selected (33, 40).

Patterns for stretch apparel should be the same size as needed in nonstretch garments, since stretch is for comfort, not figure control (33, 48). Slacks made of warp stretch fabrics need the regular pattern shortened in the pant leg and crotch (48).

Selection of Fabric

Stretch fabrics should be selected on the basis of amount and direction of stretch, availability and price.

Contrary to some retailers suggestions, filling stretch fabrics should be used crosswise of a garment and warp stretch in the lengthwise direction. Weller (52) stated that there are dangers in using filling stretch in the up and down direction because warp stretch needs many more ends of yarn per inch than are available in the filling stretch. When filling stretch is used lengthwise in slacks, "the quality of the stretch often suffers even though the degree of stretch may be the same" (52, p. 59).

The information given on labels is valuable and should be carefully read and the directions followed when they are given.

Preparation of Fabric

Stretch fabrics should be shrunk before cutting unless the label states that they have been preshrunk (48). Shrinking can be accomplished by steam pressing. Then place the fabric on a flat surface in as nearly a tension free state as possible. Allow the fabric to relax for approximately 24 hours before cutting so that any tension or stretch may be released (3, 16, 33, 40).

Pinning, Cutting and Marking

Place the pattern pieces so that the stretch is in the desired direction. Use small, sharp pins and place them perpendicular to the stretch of the fabric (48). This will help to prevent breaking or distorting the stretch yarns.

Cut with sharp shears using long even strokes so the fabric will be less apt to stretch (33, 40).

Mark with tailor's tacks or dressmaker's carbon and tracing wheel without teeth (40). A tracing wheel with teeth could break or fray the stretch yarns.

Machine Stitching

To prevent damaging the stretch yarns a fine needle is used for light weight fabrics and a medium size needle for fabrics of medium to heavy weight (40).

In order to keep the layers of fabric even during stitching, the presser foot should be at optimum pressure, light enough to prevent dragging on the top layer and heavy enough to provide uniform feeding (2, 3, 16).

Seams sewed in the direction of the stretch should elongate as much as the fabric. Thus, the chain stitch, a short lock stitch or a short narrow zig-zag stitch can be used in sewing apparel of

stretch fabrics. Bernier (2) and DuPont (16) both suggested at least ten stitches per inch; however, DuPont stated that good results had been obtained with fabrics that have 30 to 35 percent stretch when 14 or 15 stitches were used. Increasing the number of stitches per inch will increase the seam extensibility. Coats and Clark (40) recommended 12 to 15 stitches per inch.

Minimum thread tensions are best, but a balanced stitch formation is necessary (2, 3, 16).

Thread of nylon or Dacron is especially recommended when using the lock stitch because the cotton threads lack sufficient elasticity (3, 16, 33, 40, 48).

Handling of the Fabric

When sewing, feed the fabric slowly and evenly through the machine, avoiding pushing or pulling (3, 16, 40).

Suggestions for Special Areas

Any type of seam which does not restrict the elongation of the fabric is satisfactory for stretch fabrics. Seams which ravel may need to be overcast by machine (40, 48).

In areas where stretch is not desired (shoulder seam and buttonholes) interfacing is applied to stabilize the fabric (2, 33, 40).

The most satisfactory buttonholes are made in the opposite

direction of the stretch. If the buttonholes are to be in the direction of the stretch, stabilize the area with an iron-on interfacing.

Buttonholes may be machine made or bound (40, 48).

Apply zippers in the conventional manner (40).

To prevent the waistband from stretching cut it in the opposite direction to the stretch or stabilize it with an interfacing (40).

Hem edges may be overcast with the zig-zag stitch or may be turned and stitched. A taped edge will not give with the stretch fabric (33, 40). For invisible hemming use a loose inside hemming stitch.

Care

Pressing. Woven stretch fabrics can be satisfactorily pressed with either a dry or steam iron at temperatures in the range of 275° to 300° F (16). This is approximately the steam or wool setting on the iron.

Storage. Horizontal stretch garments can be hung on hangers just as garments made of nonstretch textiles (33). Vertical stretch garments should be stored in a drawer or on a flat shelf. Garments should relax between wearings so the fabric will be restored to its original dimensions. If stretch garments are worn several days in succession and lose their shape, they can be restored by light pressing with a steam iron or by laundering.

Clothing for Boys with Physical Handicaps

Importance of Clothing

According to Boettke (3, p. 639), "Clothing plays an important role in the growth and development of a physically handicapped child." The selection of attractive, functional clothing that a child can manage himself encourages independence in dressing and gives him confidence in doing for himself.(1, 3, 5). His clothing should be as near like that of his friends as possible and at the same time serve as a camouflage for his physical deformities. Clothing for him needs to be comfortable, durable and of easy care fabrics (7, 8).

Selection of Clothing

Self-Help Clothing for Handicapped Children (1, p. 8, 9) listed the following general ideas for purchasing clothing for a handicapped child.

1. Select simple lines and cuts that are attractive and allow extra room for body movement.
2. Select clothes that are easy to take off and put on.
3. Select openings and fasteners that are within reach and grasp of the child.
4. Select fabrics that have good wearing qualities and do not wrinkle easily or show spots or stains readily.
5. Select clothes with fabric interest such as color combinations, prints, plaids, or checks, rather than fussy details.

Clothing that fits will be safer and more comfortable for the child than a larger size for him to grow into.

Shirts

The type of shirt selected will depend on the boy's ability to move his arms. A slip-on style with an expandable neck opening (a surplice neck design or shoulder opening with grippers) gives room for it to slip over the head more easily. If he has limited range of motion, the full-length front opening will be better than a slip-on style (1).

Buttons should be flat, no smaller than the size of a nickel, have a grooved edge and be attached with a long, strong shank (1, 4, 5, 13).

Velcro may be used in place of buttons when the hands have very limited use. Velcro is described as a "nylon closure that consists of two strips of woven nylon material. One strip is made of tiny nylon hooks, and the other has a looped surface. When these two come in contact with one another, they lock or adhere" (1, p. 19). It is opened by pulling the two strips apart. The Velcro may be used as a full-length strip down the front of a shirt (8) or small pieces may be sewed on in place of the buttons. The button is then sewed on the left side over the Velcro patches (1).

Gripper fasteners which require considerable pressure are

often too difficult to match or take too much strength for the handicapped child (1).

Raglan and kimono sleeves are wider than set-in sleeves and allow more room for the child's deformed hand to enter the sleeve. Raglan sleeves are more becoming when the shoulders are involved in the handicap (1, 4, 7, 39).

A bias gusset under the arm can often be adapted to most shirt sleeves to give greater freedom of movement and added comfort (15, p. 1).

Long sleeves with a cuff opening can be adapted for weak fingers by using either a Velcro patch or an elastic cuff link in place of the button and buttonhole. To add an elastic cuff link, two buttons are sewed together on an elastic thread. The buttons are then slipped through the buttonholes on each side of the cuff. For wheelchair patients, the sleeves should be about elbow length so that they do not get in the way of the wheels (1, 7).

Trousers

Elasticized webbing at the waistline holds the garment snugly, adjusts without need of alterations and is comfortable for extended sitting (1, 13, 38).

Trousers designed with a long back and short front rise relieves the strain through the crotch and over the knees, thus

giving a more comfortable fit and a smooth lap (7, 39).

For the child with weak or limited finger use, Velcro strips may be used to replace the zipper in the fly front (1).

A trouser hook and bar may be used on the waistband in place of the button or gripper.

The most difficult part of dressing for the handicapped boy wearing leg braces is getting his trousers over his shoe and brace. To eliminate the problem, Cookman(8) has a patented full-length zipper for the side of the trousers. To adapt the regular tapered trousers to brace wearers, Cookman recommended a zipper in the inside seam of the leg starting from the cuff. Ample width is needed to make the leg wide enough to conceal the brace and the affected legs. Bare (1) suggested the use of Velcro in the inside seam to widen the leg for the shoe and brace.

Reinforcements at points of wear, such as the knee, the crotch and the sides of the leg are desirable for the boy who wears braces. The reinforcement may be made by sewing on patches of fabric or using iron-on patches (1).

For safety precautions Scott (39) recommended a simple hem for trouser legs rather than cuffs.

Wearing Quality of the Clothing

Wearing quality is of great importance for the child who wears

braces, uses crutches or a wheelchair, or has to pull and tug to get into his clothing. Boettke (3) reported that 50 percent of the mothers of handicapped children who answered her questionnaire said that assistive devices wore out or damaged clothing, with braces doing the greatest damage.

Fabrics. Fabrics for a child's wardrobe, and especially those worn over braces, must be of sturdy and durable fabrics that will take the wear and tear they will receive. Those which are wrinkle resistant will look nice on the child for a longer period of time, whether he is active or must remain in a wheelchair (1, 39). His clothing needs to be completely washable, since the handicapped child often has difficulty in coordination and spilling of food cannot be avoided. These fabrics in practical, pleasing colors that are not quick to show soil, spots or abrasive wear will be the most satisfactory (1, 7, 39). Trimmings and fasteners also need to be of materials that are durable and are capable of being laundered (4).

Construction. Seams receive especially hard wear and should be well stitched and finished. For brace wearers, the seams need to be strong, flat and smooth inside and out to protect against raveling which may interfere with latches (39). The flat fell seams are serviceable for sturdy fabrics, such as denim. For gingham, plain seams with a pinked or edge stitched finish are satisfactory.

Pockets, sleeves and zipper openings need to be reinforced with stitching or extra fabric at points of strain (4).

Stretch Fabrics for the Handicapped

A study of the literature revealed differences of opinion in the use of stretch fabrics for the handicapped. Scott (38, 39) reported that a dimensionally stable cotton knit fabric or nylon stretch allowed for unrestricted exercising, responded to body movements and permitted the use of safe, tapered legs. She suggested woven materials were better than knit when worn over braces because they fit less snugly.

During a conference on clothing for physically handicapped, Miss Linn (7) stated, "Don't use stretch fabric over any kind of braces. You need something firmer over a brace than something that will give according to the shape of your brace." Mr. Ream, a participant in the conference, agreed with Miss Linn by stating: "If it were small enough that you need the stretch characteristics, then it would show the braces very vividly and this is the thing that most people would rather not show" (7).

Research on Clothing for Handicapped Children

In surveying the research reports, the writer found that the actual development of special clothing for handicapped children was

for girls rather than boys.

In her study of "Clothing for Girls with Specified Handicaps," Frescura designed three basic dresses with self-help features. The dresses were given wear and laundry tests over a three-week period. The design features, fabric and construction were evaluated by the mothers, foster mothers and therapists. Frescura concluded that a longer trial testing period was needed. From the results of her study, she made the following recommendations:

1. Over the head designs without fasteners were desirable for the child with free shoulder and arm movement but lacking finger coordination. For those who could manage fasteners, coat style dresses were suitable.
2. Clothing fabrics need to be strong enough to withstand the wear of corrective appliances. The fabric also needs to be comfortable next to the skin, absorbent, wrinkle resistant and easy to care for.
3. Double bodices added durability and eliminated the need for facings.
4. Gussets add ease, give and durability to the underarm area (11,22).

Taylor (50) designed three dresses and a coat for girls who used braces, crutches and a wheelchair. These dresses were evaluated by 16 mothers while the dresses were being modeled in a

style review. The garments were also worn one day to school, where they were evaluated by two therapists. From this study it was found that pressure tape was the most satisfactory fastener for weak hands. To help line up squares of pressure tape, buttons were placed on top of them. A continuous strip of pressure tape may be used in place of squares. Two other findings revealed that the stitching around set-in sleeves broke easily and that machine stitched hems were preferred for these particular handicaps.

STATEMENT OF THE PROBLEM AND LIMITATIONS OF THE STUDY

A survey of the literature gave evidence of a definite need for further research on fabrics, designs and special features in clothing for the physically handicapped child.

Setting

Interest in the woven stretch fabrics and their possibilities for use in clothing for the physically handicapped child inspired the writer to visit the Children's Hospital School in Eugene, Oregon. The school serves the entire state of Oregon and is financed and administered by the Oregon Society for Crippled Children and Adults (The Easter Seal Society). It is a day school for children with neuro-muscular and/or orthopedic disabilities such as cerebral palsy, spina bifida, post polio, osteogenesis imperfecta and muscular dystrophy. Educable children between the ages of three and 15 years are accepted with 38 children in daily attendance with approximately an additional 30 on an out-patient basis. Physical, speech and occupational therapy are coordinated with an academic program.

A meeting was arranged with Miss Janet McKee, the occupational therapist at the school. Her work with the children is

concerned with the development of coordination, which includes the dressing skills. Miss McKee suggested that the entire study be designed for boys since there were more boys wearing leg braces in the school than girls.

In observing an occupational therapy class of boys, as they were learning dressing skills, the writer noted three major problems: the poor fit of ready-made clothing; the difficulty the boys encountered in dressing themselves in ready-made trousers and buttoned shirts; and the holes caused by braces in recently purchased trousers.

Purpose

The purpose of the study was threefold: (1) to compare the durability and comfort of stretch and nonstretch in certain selected denim and gingham fabrics; (2) to test specific designs as to their self-help features; (3) to test special features which might be adapted easily to ready-made clothing for handicapped children.

Hypotheses

This study was set up to test the following hypotheses:

1. Woven stretch fabrics will retain their original appearance after being worn over corrective appliances.
2. Woven stretch fabrics will have better abrasion resistance than the woven nonstretch fabrics.

3. Woven stretch fabrics will be more comfortable to the children than the woven nonstretch fabrics.
4. Raglan sleeves will aid the boys in dressing themselves.
5. Velcro patches under the buttons will aid the boys in fastening their clothing.
6. An elastic waistband will help distribute the excess fabric and will fit more closely over braces and pelvic bands.
7. An opening in the trouser leg closed with a zipper or a Velcro strip will aid in getting the trouser leg over the brace and shoe.
8. The special design features tested in these designs will be of a type which may be adapted to ready-made clothing.

Limitations

For the purpose of comparison this study was limited to stretch and nonstretch denim and gingham. Denim is a yarn-dyed cotton twill with colored warp and white filling yarns. It is made in heavier weights for overalls and lighter weights for sportswear. Gingham is a yarn-dyed plain woven cotton fabric in checks, plaids, stripes or in plain colors (14, p. 26, 39).

The children's handicaps required two different shirt designs and two trouser designs.

In some studies it was shown that the leg braces did the most

damage to children's clothing. Therefore, eight boys who wore leg braces were selected from the Children's Hospital School in Eugene, Oregon. Each boy wore two garments of the same design, but one was made of stretch and the other of nonstretch fabric. Each garment was worn 12 times.

To standardize the procedure, one person was selected to launder all garments according to a set pattern.

PROCEDURE

Selection of the Subjects

In order to determine specific dressing problems, the writer frequently visited the Children's Hospital School to observe the subject's occupational therapy classes. It was observed that the boys had difficulty buttoning their shirts, getting their deformed hands through set-in sleeves, and pulling T-shirts on and off because of the tight fitting neckline. Their garments were unattractive because shirt collars tucked into the neckline and shirt tails only partially into the trousers. The trousers were purchased large enough for the pant leg to go over the shoe and brace; therefore they were too large at the waist and were held in place with suspenders, belts or safety pins. The boys wearing belts were unable to manipulate the buckles. Even the mothers and therapists had difficulty getting the pant leg over the shoe and brace.

Each child's capabilities and type of disability were carefully recorded along with the type of brace he wore. In viewing these capabilities there seemed to be two definite groups; those who had limited finger coordination and could not raise their arms, and those who had little finger coordination but could raise their arms above their heads. From this observation it was decided to develop one

shirt and trouser design for those who had limited finger coordination and another design for those who had little or none.

Miss McKee and the writer met with the mothers of the boys who wore leg braces and had difficulty dressing themselves. At this time the study was explained to them regarding the designs being developed to aid the child in dressing and the wear testing of two types of fabrics. Each mother expressed an interest in the study and a desire for her son to participate. One mother was interested in designs which would aid her in dressing her son since it was necessary for her to completely dress him because his limbs were stiff and difficult to get into any type of clothing. Another mother commented that her son's circulation was so poor he needed to wear long sleeves, and since he had little use of his hands and could not fasten the cuff, this presented another problem.

It was decided to include these two boys with their specific handicaps since this would be an opportunity to make a variation for each shirt design.

Eight subjects ranging in ages from five to 12 years were selected for the study. Of these eight, six had different types of cerebral palsy, one had spina bifida and one was a spastic. The boys were then divided into two groups: group one included those who had little finger coordination, but could raise their arms above their heads; group two had limited finger coordination and could not

raise their arms. Each group included one boy who wore long leg braces attached to a pelvic band, two boys who wore long leg braces and one boy who wore short leg braces.

Measurements

Measurements were taken of each child to determine the size of shirt and trouser pattern needed. Each standard pattern size needed changes for each child.

Group one included two boys requiring a size four pattern, one a size eight and one size 14. Group two also included two boys of size four, while the other two required size six and size ten.

Development of Design

Two shirt designs and two trouser designs with variation were developed after considering the child's capabilities and his specific physical handicap.

Shirt Design No. 1

Since group one could not use their fingers, the shirt designed was a pull-over without fasteners. Special features of this design were:

1. The shawl collar to prevent the collar from turning into the neckline.

2. A yoke with a dickey to allow extra room for the child to get his head through easily.
3. Raglan sleeves to permit room for deformed hands and to help conceal the deformed shoulders.
4. The short shirt to eliminate the tail within the trousers and to make it comfortable for prolonged sitting. (Figure 1)
5. A variation for one subject (with poor circulation and little finger coordination) had long fitted sleeves closed with a two-inch strip of Velcro. (Figure 3)

Shirt Design No. 2

Group two had limited finger coordination as well as deformed shoulders which prevented arm raising. Therefore, this design had a front opening with simple fasteners. Special features were:

1. The bias mandarin type collar to keep the collar in place.
2. Raglan sleeves to aid in dressing and to camouflage the deformed shoulders.
3. The front opening with one-inch squares of Velcro placed under the buttons to permit a pressure closing fastening.
4. A band on the lower edge to permit shirt to be worn on the outside. (Figure 2 and 4)

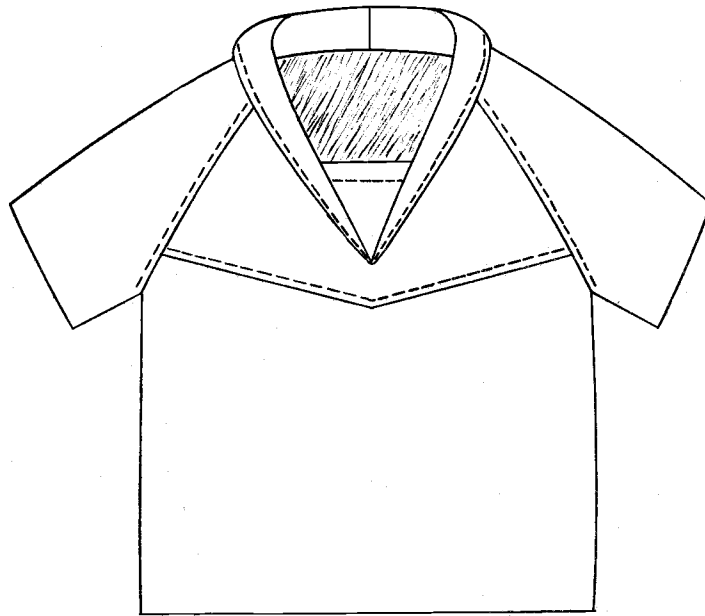


Figure 1. Shirt design No. 1.

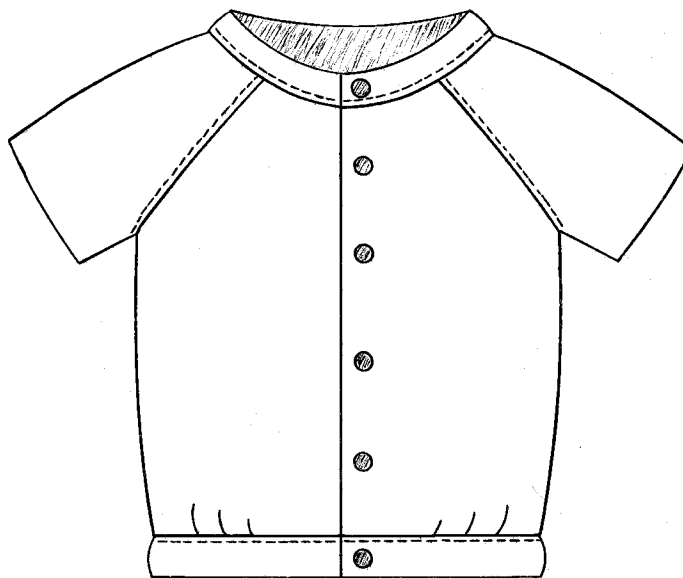


Figure 2. Shirt design No. 2.



Figure 3. Shirt design No. 1 variation.



Figure 4. Shirt design No. 2.

5. One variation to aid the mother whose child had stiff limbs was the full length back opening closed with Velcro. (Figures 18 and 19)

Trouser Design No. 1

The trouser designs did not necessarily correspond to group one or two as did the shirt designs. Several subjects who were able to get in and out of a shirt could not reach below their knees or could not raise the lower part of their body to remove their trousers. Therefore, the convenience for the person dressing the child was the factor considered. Trouser design No. 1 featured:

1. The elastic waistband to allow easy fit over braces and pelvic bands.
2. A fabric tab sewed on the zipper pull to provide the child a better grip.
3. A waistband variation (hook and a bar or Velcro square) to permit ease in manipulation.
4. Straight cut trouser legs to allow room for the braces.
5. Hems rather than cuffs on trouser legs to provide safety.
6. An inside leg opening to provide room for brace and shoe, closed by a zipper or Velcro strip, depending on the coordination of the child or the convenience of the mother.
7. A fabric tab above the zipper to provide a hold while

pulling the zipper.

8. Two front patch pockets to permit easy use. A hip pocket was added to simulate other children's trousers.

(Figure 5)

Trouser Design No. 2

This trouser was designed for the younger boys and varied from design No. 1 in the following ways:

1. No fly front.
2. Continuous elastic within the waistband.
3. Velcro openings rather than zippers in the legs.

(Figure 6)

Four subjects wore the Velcro closing in the trouser leg (Figure 7) while four boys had zippers. (Figure 8)

Development of Patterns

Basic patterns were used to develop the design patterns and were altered for each child to fit the specific measurements.

Therefore, eight different shirt patterns and eight different trouser patterns were created. (Figures 9, 10, 11)

Pretest of Designs

The garments were pretested for two weeks by a ten-year-old

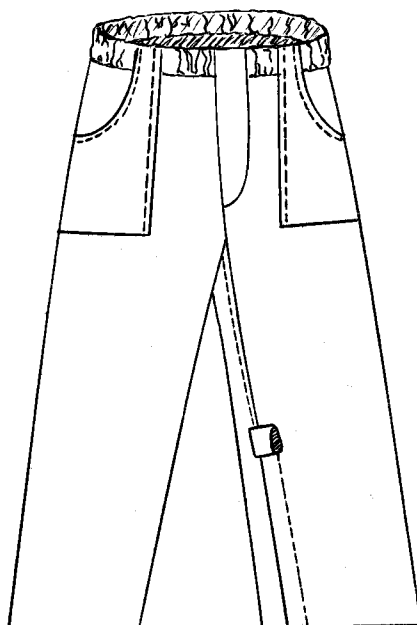


Figure 5. Trouser design No. 1.

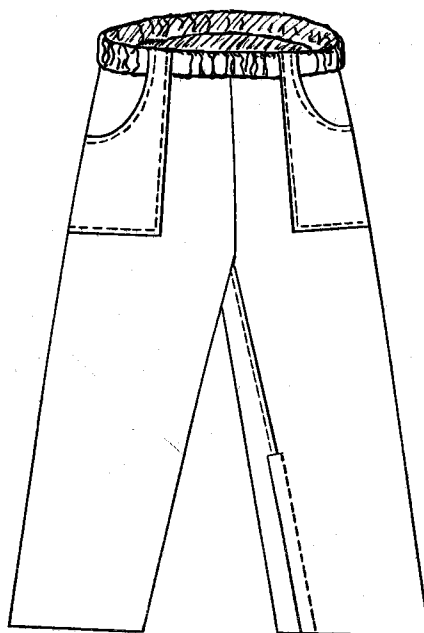


Figure 6. Trouser design No. 2.

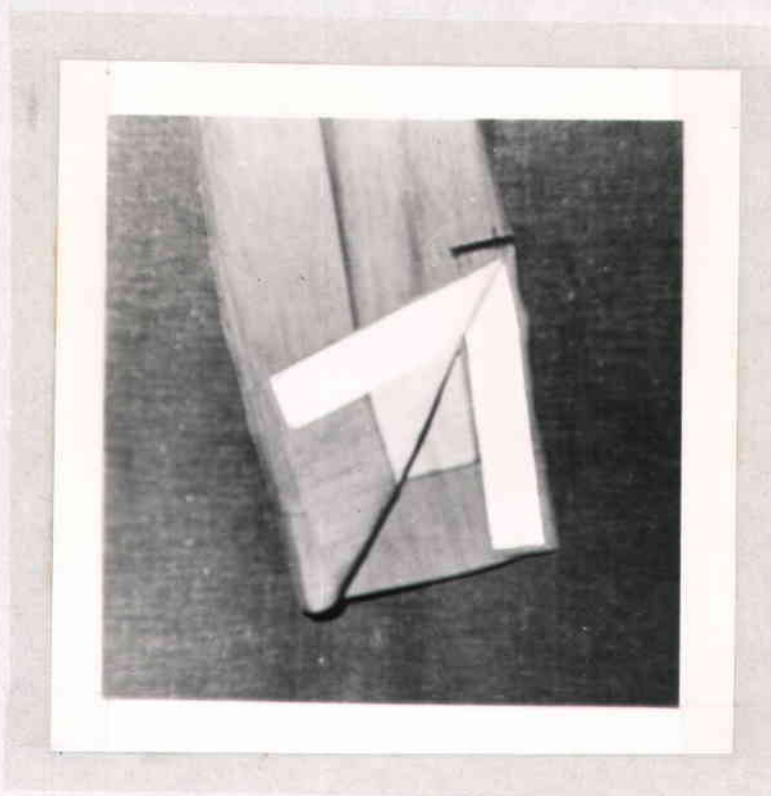
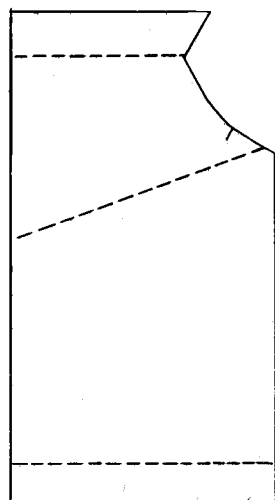


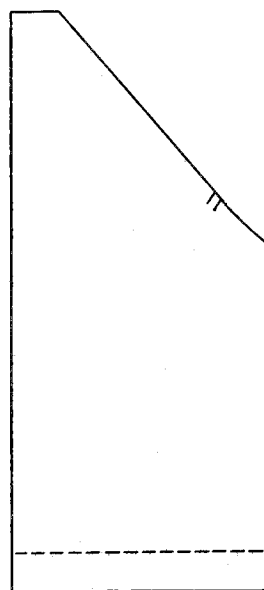
Figure 7. Trousers with Velcro leg opening.



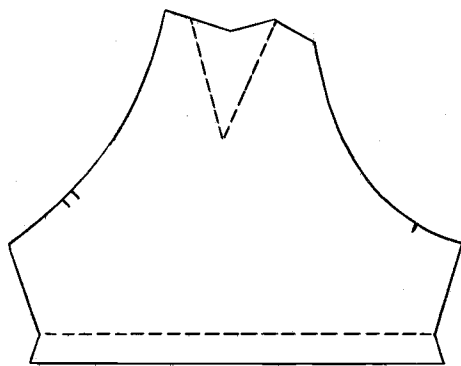
Figure 8. Trousers with zipper leg opening and fabric tab.



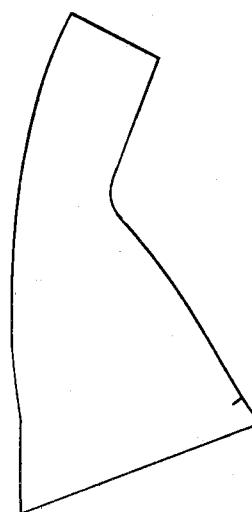
Front



Back



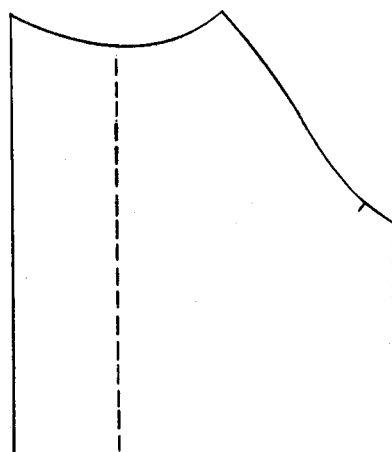
Sleeve



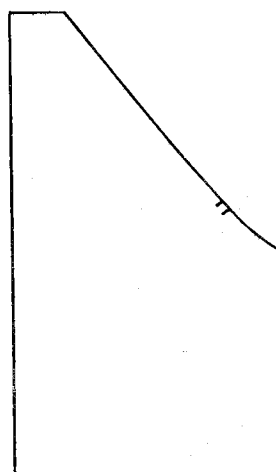
Collar and Yoke

Figure 9. Shirt design No. 1 size four.

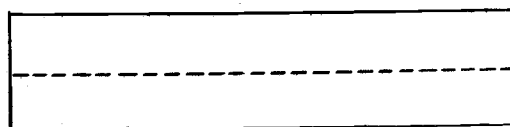
Scale: $3/16 = 1$ inch



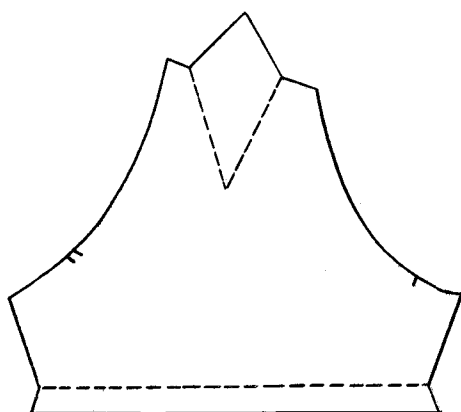
Front



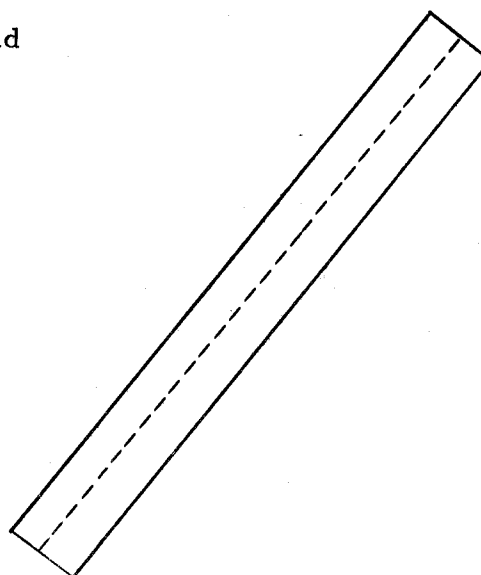
Back



Band



Sleeve



Bias Collar

Figure 10. Shirt design No. 2 size four.

Scale: $3/16 = 1$ inch

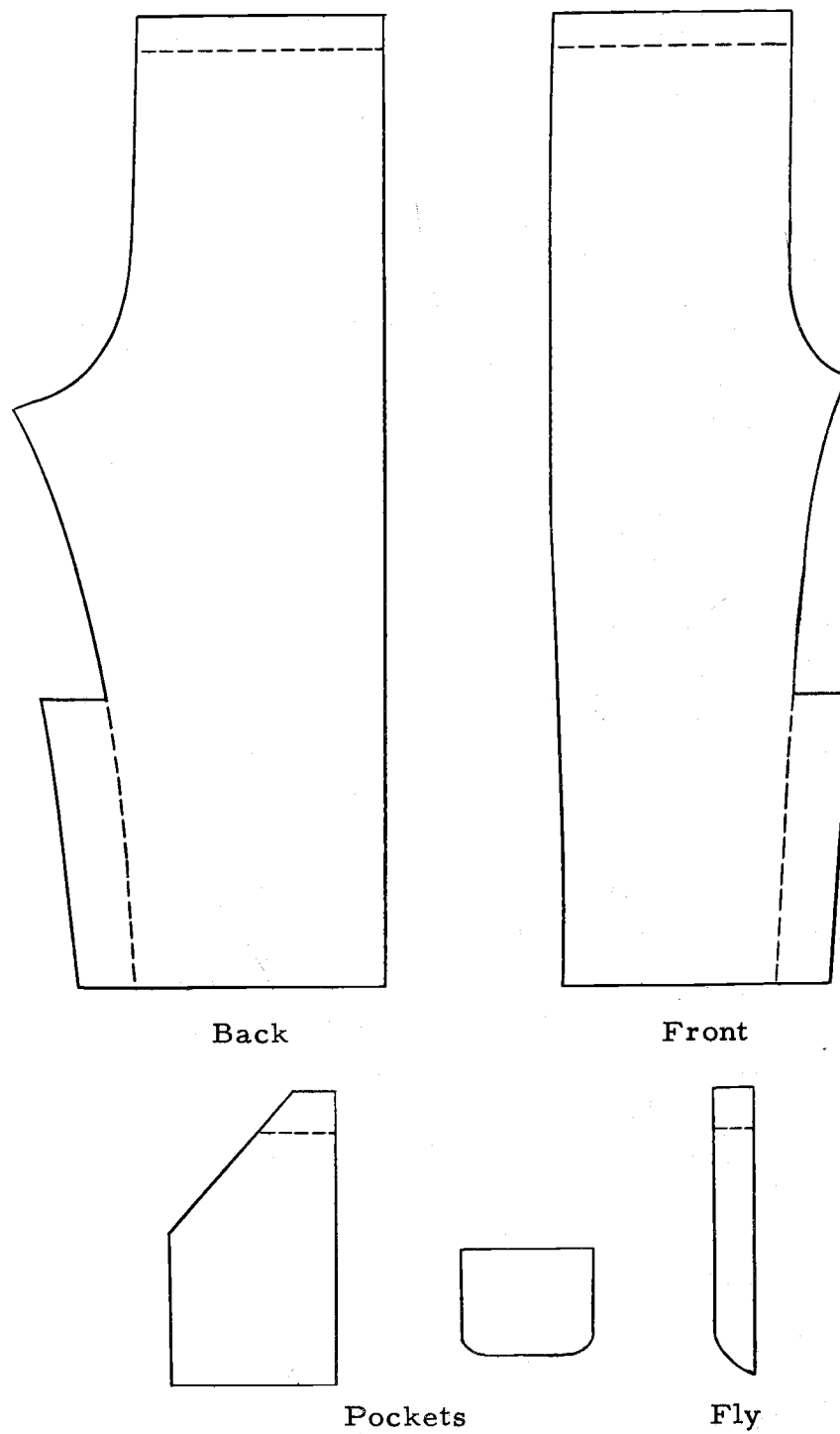


Figure 11. Pattern pieces for trouser design No. 1 size four.

Scale $3/16 = 1$ inch

boy in Albany, Oregon. He was selected because polio had left his right arm deformed with limited finger use.

Shirt Designs

Originally shirt design No. 1 was made with a Peter Pan collar which would not stay in place during dressing. Therefore, the shawl collar was pretested and found to be satisfactory.

Two ready-made shirts were purchased to pretest fasteners for shirt design No. 2. Both shirts had front openings, Peter Pan collars and set-in sleeves. One shirt was of regular length while the other was shorter. For testing, the buttons were replaced with hooks and bars on one and squares of Velcro on the other. Buttons were then sewed on top to simulate a buttoned shirt. From the trial period the following points became evident:

1. The Velcro squares were easier to fasten than the hooks and bars.
2. The shirt with a shorter tail was preferred to the longer.
3. The Peter Pan collar was difficult to keep straightened.

From this pretest, design No. 2 was further developed with the mandarin type collar, band at lower edge and the Velcro squares for fasteners.

Trouser Designs

Three pairs of trousers in size four were constructed. One pair had a continuous elastic waistband and a fly front. The second pair had a fly front and an elastic waistband which fastened with a hook and bar. The third pair had a fly front and an elastic in the back of the waistband with a Velcro closure.

Subjects requiring size four tried on the different trouser styles. It was found that the boys who were old enough for a fly also needed the waistband which would open to give more room to get in and out of the trousers. The waistband with elastic all the way around was more satisfactory when worn over braces and pelvic bands than the elastic only in the back. The finger coordination determined the fastener at the waistband.

The findings from this pretest were then used in trouser design No. 1: the fly front with a zipper closure and the elastic waistband with a hook and bar or Velcro closure.

Selection of Fabrics

Approximately twenty-five fabric companies were written. The writer explained the study and asked for information on their woven stretch fabrics suitable for shirts and trousers. There was such little response that the writer decided the fabrics would have

to be purchased locally. Stores in Corvallis, Eugene and Portland, Oregon, were canvassed. J. C. Penney Company in Portland was the only store which had a supply of stretch fabrics in weights and colors suitable for children's clothing. Samples of these were purchased in stretch and non-stretch gingham and denim fabrics.

Laboratory Tests

In the laboratory the stretch gingham and denim fabric samples were compared with the nonstretch for weave, yarn count and weight.

Selected for use in the shirts was a plain woven checked gingham of stretch and nonstretch fabric. A twill woven denim was selected in a stretch and a nonstretch fabric for the trousers. These two weaves were selected because of their availability and recognized durability.

Similar yarn counts in the comparable stretch and nonstretch fabrics were needed to receive reliable testing results during the wear period. The yarn count was taken in five places on each fabric. Each count was made at least one-tenth the width of the fabric from the selvage.

The stretch gingham averaged a count of 103 warp yarns and 57 filling yarns per inch compared to the nonstretch which averaged

84 warp yarns and 56 filling yarns per inch.

The stretch denim averaged 77 warp yarns with 54 filling yarns while the nonstretch had an average count of 67 warp yarns and 44 filling yarns per inch.

Since fabrics of similar weights were necessary for the wear test, five samples of the fabrics, each measuring two inches square, were weighed on an analytical balance.

The stretch and nonstretch gingham samples weighed identically at 1.28 grams or 2.92 ounces per square yard.

The weights of the stretch and nonstretch denim were similar; the stretch samples weighed 2.49 grams or 5.66 ounces per square yard, while the nonstretch weighed 2.46 grams or 5.61 ounces per square yard.

Gingham Fabrics

The stretch gingham was a mercerized yarn dyed 100 percent cotton, with a crease resistant finish. It had approximately 20 percent horizontal stretch which had been imparted to the fabric by the Slack Mercerization process. It was machine washable with a maximum residual shrinkage of two to three percent. The width of the fabric was 37 inches. (Figure 12)

The nonstretch gingham was of a fine combed, 100 percent cotton with a wash and wear finish that required little or no ironing.

It was machine washable with a maximum residual shrinkage of one percent. This fabric was 36 inches wide. (Figure 13)

Denim Fabrics

The stretch denim was of 75 percent cotton and 25 percent nylon. The nylon filling yarns had been deformed and heat set giving the fabric a horizontal stretch. The label stated that this fabric was Sanforized and machine washable with maximum residual shrinkage of one percent. Little or no ironing was recommended. This fabric was 41 inches wide. (Figure 14)

The nonstretch denim was a yarn dyed 100 percent cotton with a maximum residual shrinkage of one percent. This label carried the statement "dries quickly." The width of this fabric was 37 inches. (Figure 15)

Preparation of Test Garments

Designs were altered, patterns were completed and the fabrics were purchased following the pretest and laboratory tests.

Preparation of the Fabric

Each piece of fabric was preshrunk by steam pressing. Special care was taken with the stretch fabrics to prevent distortion. No shrinkage was evident in any of the fabrics.

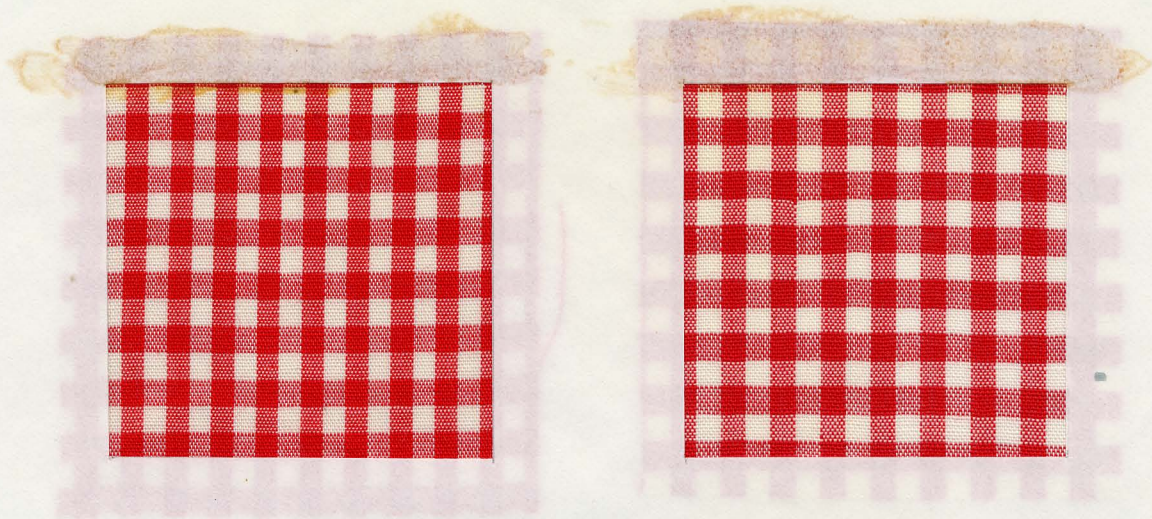


Figure 12. Stretch (A) gingham. Figure 13. Nonstretch (B) gingham.

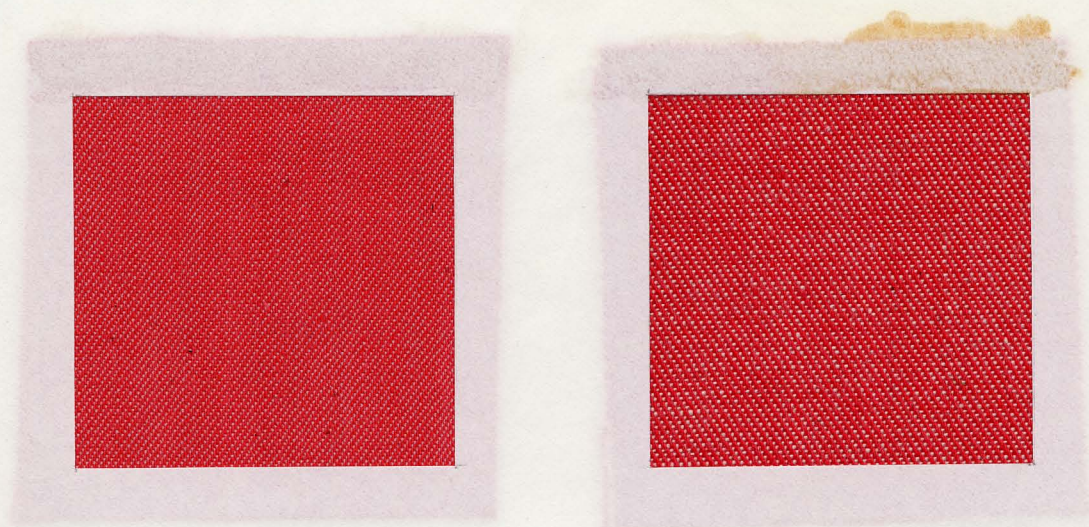


Figure 14. Stretch (A) denim. Figure 15. Nonstretch (B) denim.

The stretch fabrics then were laid on a flat surface without tension and allowed to relax for 24 hours before laying the pattern.

Pinning and Cutting

The patterns were laid on the fabrics so that the stretch would run horizontally. Pins were placed perpendicular to the stretch of the fabric. Sharp shears were used to cut all fabric pieces.

Machine Stitching

Stretch Fabrics. Taslan textured nylon thread was used in stitching all seams in order to receive the greatest extensibility.

All stitching was done with a size 14 needle, minimum thread tension, light presser foot pressure and 15 stitches per inch. A narrow zig zag stitch of the same length was utilized in the stretch direction when stitching hems. The fabric was fed slowly and evenly through the machine to prevent stretching.

Nonstretch Fabrics. Mercerized sewing thread number 50 was used to stitch the nonstretch fabrics. These were stitched with a size 14 needle, a medium thread tension, medium presser foot pressure and 15 stitches per inch.

Construction Procedure

Shirt Design No. 1. Flat fell and welt seams were used to

provide durability. The shawl collar and the yoke were top stitched. A zig zag stitch was used to make a bar tack at the center front of the yoke as a reinforcement. The hems in the sleeves, dickey and lower edge of the shirt were sewed with a narrow zig zag stitch to allow maximum stretch.

Shirt Design No. 2. The same kind of seams were used as in shirt design No. 1. The bias collar and band were top stitched. The Velcro strips were trimmed on the ends with a razor blade to remove the hooks and loops where stitching was to be done. This allowed for firmer stitching. The inch squares of Velcro were then machine stitched into place. The buttons were sewed on the outside of the shirt.

Trouser Designs. Flat fell seams were used in constructing all the trousers. Since the waistband was a part of the trouser pattern it was folded to the inside and stitched. A one-inch elastic was used within the band. All zippers were metal. Velcro strips of six to eight inches were stitched into the inside leg seam. A wide bar tack was stitched above the leg openings. Matching fabric pieces were constructed and sewed on the zipper pulls. Hooks and bars were hand buttonhole stitched while Velcro squares were machine stitched. Raw edges around the fly front and leg openings were overcast by machine to prevent raveling. The one and one-half to two-inch hems were machine stitched. Patch pockets were

top stitched.

Fittings and Alterations

After the nonstretch garments were completed they were taken to Eugene and tried on the children. Shirt design No. 2 seemed too high in the neckline, therefore it was lowered. The boy wearing size 14 had been a size 16 when measured two months earlier. Therefore, his complete outfit had to be remade. Minor alterations were made also in the garments. At this point the stretch fabric garments were constructed.

Total Garments

A total of 32 garments were constructed, 16 shirts and 16 trousers. Each child had two outfits of the same design, one of stretch fabric and the other of nonstretch. Each garment was labeled with the child's name and the letter A (stretch) or B (nonstretch).

Wearing Procedure

The 32 garments were distributed to the eight subjects in the study. A letter of instructions to the mothers accompanied the outfits. (Appendix 1)

The boys wore each outfit once a week for a period of 12 weeks

with an average of 12 hours per wearing.

The wearings were limited to once a week for each outfit because the garments were distributed to the children at the school on Mondays. This left three days for them to wear each outfit one time. Then on Friday the garments were returned to the school and delivered to the selected laundress.

The wearing period was originally set up for eight to ten weeks. At the end of this time the writer decided that a few more wearings would give more contrasting results. Therefore the wearing period was extended to 12 weeks at which time a decided difference was seen in the fabrics.

Laundry Procedure

Once a week for 12 weeks each garment was laundered and ironed by the same individual.

The garments were laundered in an agitator type automatic home washer. One-half cup of a low sudsing bio-degradable laundry compound was used in the wash water of 125° F. Sixteen shirts were laundered at one time for a period of eight minutes, while the trousers were laundered for 12 minutes. The garments were rinsed at 125° F. for ten minutes, going through four spinning rinses, one regular rinse and four spray rinses.

The garments were dried in a tumble type home dryer. The

drying temperature was approximately 145° F. for a period of 20 minutes for the shirts and 30 minutes for the trousers.

A five-inch sample of each different piece of fabric was included in each laundry procedure with the corresponding garments. These samples were included as a means of evaluating the appearance and the dimensional stability of the fabrics which had been laundered but not worn. All samples were zig-zagged around the edges to prevent raveling. Identical samples of the fabrics were kept as controls.

All garments were pressed by a steam iron at temperatures ranging from 275° to 300° F. The garments were ironed in the warp direction to prevent stretching.

Any needed repairs which would not affect the testing were made by the writer.

Method of Evaluation

Evaluation during the wearing period involved the following persons: the occupational therapist who evaluated the self-help features; the laundress who kept charts on the wearing characteristics of the garments; the mothers who evaluated the designs and fabrics subjectively in an interview with the writer; and the writer through observations of the children and discussions with them.

Miss McKee, the occupational therapist, kept a chart on the

self-help features of the designs which aided the child and those which were too difficult for him to manipulate. She also evaluated the appearance of the garment design and fabric on the child.

(Appendix 2)

The laundress examined the garments each week after each washing and ironing. A particular note was made as to the degree of abrasion, tears and repairs needed. The abrasion was evaluated as to the first signs of wear (broken yarns in one direction), fabric thin but no holes present and holes (yarns broken in both warp and filling directions). Tears were distinguished from holes by firm edges while holes due to wear had frayed edges. The location of the worn place, tears and repairs on the garments and the date on which it was observed were recorded. Records of the findings were kept weekly on separate charts for the shirts and trousers. The charts included the child's name and letter A and B which correspond to the label in the child's garments. (Appendix 3, 4, and 5)

After the first, fourth, and final launderings the laundress also submitted a subjective evaluation of the design features and fabrics. (Appendix 6)

Following the final washing, the laundered fabric samples were compared with the control samples to evaluate changes in color and appearance and to determine change in dimensions of the fabric.

Each garment was examined every two weeks by the writer. Following the twelfth wearing she examined each garment and counted the number of places showing broken yarns in one direction and those with broken yarns in both directions.

The writer visited the Hospital School every three weeks to observe and talk with the children during their occupational therapy class. She observed the fit and appearance of the garments on the child and the child's dressing procedures. (Figures 16 through 23) She discussed with each one his likes and dislikes concerning the garments, comparative comfort between the stretch and nonstretch apparel and his enjoyment in wearing the outfits.

During the tenth week of the wear period the writer interviewed the occupational therapist, the physical therapist and each child's mother ("mother" includes foster mothers). The interview was based on a questionnaire developed to evaluate the designs and fabrics of the two outfits each boy wore. A part of the questionnaire was related to the adaption of ready-made clothing to their specific needs. (Appendix 7)

Thus the designs, special features and fabrics were evaluated by two therapists, the laundress, eight mothers and the writer through observations and examinations recorded in chart form, discussions with the children and interviews aided by a questionnaire.



Figure 16. Pelvic band and long leg braces.



Figure 17. Shirt and trouser design No. 1 of nonstretch fabrics.



Figure 18. Pelvic band and long leg braces.



Figure 19. Wheelchair subject dressed in variation of shirt design No. 2 with trousers of design No. 1 of nonstretch fabric worn over pelvic band and long leg braces.



Figure 20. Wheelchair subject in long leg braces.



Figure 21. Wheelchair subject dressed in design No. 1 shirt variation and trousers of stretch fabrics worn over long leg braces.



Figure 22. Short leg braces.



Figure 23. Shirt design No. 2 and trouser design No. 1 in stretch fabrics worn over short leg braces.

RESULTS

The following results are based on the evaluation of the designs, special features and fabrics by the therapists, the laundress, the mothers and the writer. These evaluations resulted from observations of the children, examinations of the fabrics and interviews with children, mothers and therapists.

Designs Evaluated by Therapists

The occupational therapist evaluated the designs as to the special features which aided the child in dressing and the appearance of the garments on him.

Shirt Design No. 1

Special features in this design which aided the child were the neckline and the raglan sleeves. One child in this group could not dress himself but the same features assisted the person dressing him. The child in the long sleeves at first had difficulty with the Velcro closure but later did learn to fasten it himself.

The therapist felt that the design features gave an attractive appearance and that the garments fitted well. Because of a necessary substitution in the wear test after the garments were made Subject 5 was getting too large for his shirt by the eighth wearing.

Shirt Design No. 2

The special feature which aided the child was the Velcro under the buttons. One child had difficulty in lining up the pieces of Velcro at first, but learned after a few wearings. It was found that no features were too difficult for the children to learn during the wear period. The back Velcro opening variation of this design, made to assist the mother, was evaluated as helpful.

Miss McKee felt that four of the shirts from design No. 2 were neat and attractive in appearance while four shirts were too large in the neckline.

Trouser Design

Special features which aided the children were the zippers and Velcro in the leg openings and the fabric tabs on the zipper pulls. These same features were an aid to those dressing the child.

Miss McKee again felt the trousers presented a neat appearance and that they fitted well. Before the end of the wear period one child had outgrown the length of his trousers.

Evaluation of Fabric Wear

The laundress and writer evaluated the stretch and nonstretch fabrics for the amount of abrasion which appeared during the wearing

period.

Abrasion on Shirts

The two long sleeved shirts were the only ones which showed any type of wear. After the fifth wearing the elbows in the non-stretch (B) fabric showed some signs of wear and after nine wearings appeared thin at the elbow. The stretch (A) fabric did not appear worn after 12 wearings.

Abrasion on Trousers

It was apparent that abrasion on the lower legs of the trousers were caused by leg braces except for Subject 7 where the pelvic band caused abrasion to the hip section and upper side leg.

The denim fabrics did not follow any pattern in the degree of abrasion. The stretch (A) fabric had broken yarns earlier in the wear period than the nonstretch (B) fabric. Fewer of these broken yarns in fabric A developed into holes compared to fabric B. Both trousers of Subject 7 were so worn that the broken yarns were too numerous to count, however, it was evident there were many more broken yarns in the nonstretch (B) than in the stretch (A) for this subject. (Table I)

Fabrics of nonstretch (B) not only had a greater number of holes but they were larger in size than the stretch (A) fabrics.

Table I. Degree of Abrasion in Stretch and Nonstretch Fabrics
and Number of Wearings

	Fabric	Degrees of Abrasion		
		First Signs	Fabric Thin	Holes
Subject 1	A	3rd	5th	4th
	B			
Subject 2*	A			
	B			
Subject 3	A	2nd		
	B	2nd		
Subject 4	A	9th	9th	12th
	B		9th	
Subject 5*	A			
	B			
Subject 6	A			3rd
	B			3rd
Subject 7	A	1st		2nd
	B	1st		2nd
Subject 8	A	5th		3rd
	B			

First signs - broken yarns in one direction

Fabric thin - fabric very thin

Holes - yarns broken in both warp and filling

* No signs of wear-inactive wheelchair subjects

Four pairs of fabric B trousers developed holes as compared to three pairs of fabric A in which one pair had only one hole. In most cases there were more holes in the nonstretch fabric than in the stretch. In three cases four times the number of holes appeared while in another case there were two and one-half times as many.

(Table II)

Tears and Repairs

Minor repairs were made during the wear period. The interfacing on the front opening in fabric B of one subject was repaired and a zipper damaged during the laundry procedure was replaced. Two pairs of trousers and two long sleeved shirts were short for the children toward the end of the wear period, due to the child's growth. The hems were not lengthened during this time.

Effect of Laundering and Ironing

The stretch (A) and nonstretch (B) fabrics in both the gingham and denim retained their color and good appearance. There was no noticeable change in the garments from any of the control samples.

The laundered five-inch samples of stretch gingham which had not been preshrunk had an average shrinkage of one-sixteenth of an inch in the warp and three-sixteenths of an inch in the filling direction after 12 washings. The nonstretch gingham samples did

Table II. Number of Broken Yarns and Holes in Stretch and Non-stretch Trousers after 12 Wearings

	Fabric	Broken Yarns		Holes	
		Places	Number Yarns	Number	Inches
Subject 1	A	2	2 warp	none	
		2	2-3 filling		
	B	2	1-3 warp	2	1/8
		1	1 filling	2	1/4
Subject 2	A	none		none	
	B	none		none	
Subject 3	A	6	1 warp	none	
		2	2-3 filling		
	B	2	1-3 filling	none	
Subject 4	A	2	1 filling	1	1/4
	B	1	3 filling	none	
Subject 5	A	none		none	
	B	none		none	
Subject 6	A	15	1 warp	2	1/16
		1	1 filling	1	3/16
	B	7	1-2 warp	7	1/16
		6	1-2-3 filling	5	1/4
	A	yarns too numerous to count		17	1/16
				12	1/8
				1	1/4
				4	3/8
Subject 7	B	yarns too numerous to count		45	1/16
				31	1/8
				6	1/4
				3	3/8
	A	yarns too numerous to count		3	1/2
				2	5/8

Table II. (Continued)

	Fabric	Broken Yarns		Holes	
		Places	Number Yarns	Number	Inches
Subject 8	A	3	1 warp		
	B	4	1 warp	2	1/16
		7	1-2 filling	1	3/16
				1	1/4

Broken yarns - yarns broken in one direction

Holes - yarns broken in both warp and filling

not have any change in the warp but had one-eighth of an inch in the filling. The stretch and nonstretch denims did not have any dimensional change in either direction.

The garments in both stretch (A) and nonstretch (B) fabrics kept their shape and did not have any noticeable change in dimensions.

Stains on nonstretch gingham became less apparent than the original stain but were not removed during the laundry procedure. Stains on three pairs of stretch denim were removed from two pairs after two launderings. Grass stains on one pair of stretch denim remained.

The stretch gingham looked slightly wrinkled after ironing. It was found that this fabric ironed smoothly when it was slightly damp, but the procedure was not changed. The nonstretch gingham and both denim fabrics ironed smoothly.

Some of the bias collars on shirt design No. 2 were difficult to press. Other design features on the shirts and trousers pressed easily.

Discussions with the Children

All the children liked the outfits and enjoyed wearing them. They were unable to determine any differences in comfort; both outfits were comfortable.

The boys liked the shirt designs because they could dress themselves in these. Shirt design No. 1 was a favorite of all the subjects. The Velcro under the buttons on design No. 2 fascinated them and they liked to show people how it worked. One child did not like the neckline on this design because his was too large. They especially liked the band on the shirt design No. 2 because it need not be tucked into the trousers.

All the children liked the Velcro and zipper openings in the trouser legs because it was possible to dress themselves; they could now get the trousers over their braces and shoes. The children who could not dress themselves liked the features because the person dressing them could get the trousers on more easily. The boys also liked the zipper tabs because it saved them struggling with the zippers. One child expressed how "great" the elastic waistband was because now he did not have to wear suspenders. Another child

liked the elastic because his mother did not need to put safety pins in the waistband.

Interviews

Following the tenth wearing but before the twelfth, the designs, special features and fabrics were evaluated by eight mothers and the occupational therapist. The evaluations were made during an interview by the writer.

General Appearance

The following is a summary of the responses which the writer obtained on the appearance of the garments, the designs and the special features which could adapt ready made clothing for the handicapped child.

All persons interviewed responded unanimously that the boys liked wearing the garments and if any preference was shown in the two outfits, it was due to the color of the outfit. The therapist stated, "They talked about the colors and liked the checks too." The mothers each reported that the child would have liked to wear the outfits more often than once a week because they were easier for him to handle.

Again they were all in agreement that they liked the appearance of the garments on the boys. Two mothers said they liked them,

but would prefer the neckline higher for the mandarin style collar.

The response from the occupational therapist was, "The colors were well chosen for the child's coloring and the outfits looked neat."

Seven mothers and the therapist thought the children were comfortable in both outfits. One mother thought her child was not comfortable in the shirts near the end of the wear period, as they were getting too tight in the shoulders. However, she said she realized the shirts had been made for another child that moved from Eugene.

Fabrics

Four of the mothers and the therapist felt that one denim fabric did show soil more readily than the other fabric. In each case they thought it was the color rather than the fabric because they were comparing tan trousers with red ones and light blues with dark blues. The therapist reported the light blues especially showed soil before the others.

The mothers were undecided as to whether one fabric wrinkled more easily than the other. One mother commented, "Stretch looks nice and neat all the time." The therapist felt that denim fabric B showed wrinkles more readily than A.

Two mothers felt the fabric B (nonstretch) denim showed signs of wear earlier than fabrics (A). The other mothers responded "no"

or "undecided." The therapist felt that she did not notice a difference except in Subject 6 and 7 where the braces were beginning to wear through the B trousers quite early in the wear period.

The mothers and therapist responded alike that one fabric did not handle more easily than the other when dressing. They also agreed that neither fabric revealed the braces. One mother preferred A but commented that stretch fabric smooths around the brace and it is more noticeable. Everyone felt that the fabrics were equally comfortable to the child.

Shirt Design No. 1

The majority felt that the neckline had a "good" appearance and a "good" fit. One mother reported a poor fit because it was made for another child. Each person thought the neckline was an aid to the child in dressing. The therapist answered, "The neckline looked and fit well, as well as made for easy dressing."

Everyone reported the sleeves had a "good" appearance, a "good" fit, and that they aided the child in dressing. Responses were, "looks nice" and "gives more room to go over the head and stiff arms."

The dickey was also rated "good," fitted well and aided the child in dressing. One mother felt the dickey made it easier to get over the child's head.

Shirt Design No. 2

The responses were divided in evaluation of the neckline. Answers were "fair" and "good" in appearance. Two felt the neckline was a little low and needed to be closer to the neck of the child. All persons felt the fit was good and the neckline did aid in dressing. Two mothers commented they liked the neckline because it did not fall off the shoulders.

The raglan sleeves were rated "good" in appearance, fit and as an aid to dressing. One mother said, "the sleeves gave more room."

The front opening was also "good" in appearance and fit. Mothers reported the Velcro under the buttons aided the child in dressing. Their replies were: "He could fasten his own shirt." "Helps because his arms are so stiff." "A lot faster for dressing." The occupational therapist gave the following response. "Some had difficulty matching the small squares of Velcro. Maybe one long strip would have been easier for them."

Mothers commented on the shirt length for both designs. "Good to have a shirt only to the waist for a child in the wheelchair." "The shirt length was wonderful."

Trouser Designs

All liked the appearance and fit of the waistband. The following responses were recorded as given by the mothers. "I really liked it, so much easier for him to keep up and he did not have to bother with suspenders." "Makes it easy to toilet him." "Elastic band makes pants neater and more comfortable." "Helps hold them up." "Allowed for extra fabric to fit over diaper." The waistband and fastener were an aid to all the children except one who could not hook the fastener. The one comment was that the child could fasten the Velcro on the belt. The therapist responded, "Both the Velcro and large hooks worked well."

The zipper and Velcro in the leg opening were well liked. One mother remarked they were not noticeable. Everyone felt they were definitely an aid to the child in dressing. "He can dress himself with these but not regular trousers." "He liked them because he did not have to work so hard to get his trousers on." "Helps him dress and the tabs on the zippers were helpful." "Easier to get over shoes and braces." "Greatly helps with braces." "I liked the Velcro legs." "Helped so much in self dressing, tabs very good." One word expressed the therapist's view, "Great."

Adapting Special Features to Ready-made Garments

Those interviewed were questioned about the special features for adapting ready-made clothing to the needs of the physically handicapped child. They all felt that Velcro stitched under the buttons on ready-made shirts would aid the child in dressing.

The mothers all felt the elastic added to the waistband of ready-made trousers would make the child more comfortable. The therapist did not think it would make any difference.

The responses were unanimous that elastic sewed into ready-made trousers would make them fit better. A mother said, "I have to fasten his other trousers in the back with safety pins to keep them up, so they would fit much better."

The mothers who knew children with pelvic bands and the therapist answered the elastic waistband applied to ready-mades would make the pelvic band less noticeable. One commented, "it fits around the top so no one can see it." The other mothers were undecided.

When asked if they thought zippers and Velcro stitched into the leg seam of ready-made trousers would aid the child in dressing, everyone responded favorably. Two mothers commented, "definitely" and one mother said, "especially when the trousers had to be changed often."

These are general responses given during the interviews.

"Velcro still good after many washings." "Possibly heavier fabric could have been used." "The best made shirts I have ever seen. The way I pull it on and off, anything else would have come apart the first time." She decided the design and fabric probably were factors but still liked the construction.

Physical Therapist

The writer interviewed the physical therapist at the Children's Hospital School. Each day she was in contact with the children while they were there for therapy. The braces were removed during this time.

She especially liked the Velcro opening in the trouser leg because the child could do it himself. The leg openings "helped terrifically because the trousers did not have to be removed to put on or remove the braces." "The Velcro was great for the youngsters and the speed for me was wonderful." The subject with long sleeves had been unable to use any type of fasteners but he could use the Velcro.

She commented, that, "handicapped children were messy, but these clothes seemed to launder well."

She felt the looseness of the legs helped prevent wear when the child was crawling.

The physical therapist's rewarding statement was, "Always looked forward to days they wore them."

SUMMARY AND CONCLUSIONS

This study was developed (1) to compare the durability and comfort of stretch and nonstretch in certain selected denim and gingham fabrics, (2) to test specific designs as to their self-help features and (3) to test special features in the designs which might be adapted easily to ready-made clothing for handicapped children.

Two shirt designs with variations and two trouser designs were developed for boys who wore leg braces and had specific handicaps. These designs were then constructed into 16 shirts from woven stretch and nonstretch gingham and 16 pairs of trousers from stretch and nonstretch denim.

Eight boys, ranging in age from five to 12 years, were selected from the Children's Hospital School in Eugene, Oregon. Each boy had two outfits of the same design, one of stretch fabric and the other of nonstretch. Each outfit was worn once a week for a total of 12 wearings. All garments were laundered after each wearing by a selected laundress who followed a set procedure.

The fabrics and designs were evaluated during the wear period. The laundress and the writer evaluated the fabrics for appearance and the degree of abrasion. The occupational and physical therapists, the eight mothers and the writer evaluated the designs and special features (self-help and adaptibility).

The results of this wear test gave definite evidence that both woven stretch and nonstretch gingham and denim fabrics used in this study retained their color and dimensional stability after being worn over corrective appliances. Therefore, the hypothesis that the stretch fabrics would retain their original appearance was verified.

The nonstretch fabrics showed wear earlier in the wear period and had many more holes of a larger size than the stretch fabrics. The hypothesis that the woven stretch fabrics would have better abrasion resistance than the nonstretch fabrics was thus substantiated.

The hypothesis stating that the woven stretch fabrics would be more comfortable to the children than the nonstretch fabrics, however, was not substantiated because the children felt that all the garments were comfortable and could not determine a difference in the fabrics. It was found that measuring comfort with children was very difficult.

The children liked their outfits and enjoyed wearing them. Part of this satisfaction may have come from the color of the garments as well as the special features in the designs. From the results of this study there was definite evidence that the following special features did aid the children in dressing themselves: the raglan sleeves; the Velcro squares under the buttons; the fabric

pulls on the zippers and especially the trouser opening with a zipper or Velcro closure. The evaluations also indicated that the special features of the shawl collar, the short shirt tails and the elastic in the waistband did improve the appearance of the tested garments. These findings supported the hypotheses concerning the special features.

Two mothers rated the bias collar on shirt design No. 2 as having a poor appearance because they felt that the collar would look better if it fitted closer to the child's neck. Two of the boys also indicated they would prefer a higher neckline on this design.

The writer recommends that the neckline on shirt design No. 2 be raised and that a fitted mandarin style collar be used in place of the bias collar to improve the ease of ironing.

The hypothesis stating that special features tested in these designs would be of a type which could be adapted to ready-made clothing, was substantiated by the following favorable results: the Velcro square stitched under the buttons in the ready-made shirts would aid the child in dressing; the elastic added to the waistband of ready-made trousers would make them fit better, make the pelvic band less noticeable and would be more comfortable to the child; and the zipper or the Velcro stitched into the leg seam of ready-made trousers also would aid the child in dressing.

The results of this study makes it possible to make certain

recommendations for many physically handicapped children:

1. Woven stretch fabrics are desirable in clothing for boys with leg braces, because they are more durable and wrinkle resistant than the nonstretch fabrics, comfortable, easy to care for and have good dimensional stability.
2. A pull-over style shirt with a dickey and raglan sleeves is desirable for boys who can raise their arms but have little finger coordination.
3. A shirt with a front opening with Velcro fasteners is satisfactory for boys who have limited finger coordination and can not raise their arms.
4. Raglan sleeves in shirts are desirable for boys with poor coordination and deformed shoulders.
5. Elastic at the waistband of trousers is desirable for those who need larger trousers to fit over leg braces and pelvic bands.
6. A leg opening closed with a zipper or Velcro is desirable in trousers worn over leg braces.

The writer feels there is a need for more research on durable fabrics which are more available than the stretch fabrics. The comfort of the stretch fabrics could possibly be studied with better results on older subjects.

The shirt design No. 2 could be further tested by raising the

neckline and comparing a bias collar with a fitted mandarin collar.

The writer would like to recommend that the special features used in this study be adapted and tested in ready-made clothing in order that easily understood procedures could be developed for meeting specific needs of handicapped children. This information would be of importance to mothers as well as others who work with children of limited physical abilities. The child would also be encouraged toward independent dressing and therefore gain confidence in doing for himself.

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APPENDICES

APPENDIX 1
LETTER TO MOTHERS

Dear _____:

Last fall I talked with you about the designs for these shirts and trousers. Now they are ready for your son to wear.

Would you please have _____ wear each outfit, one day a week. Then on Thursday or Friday send both outfits to school with him. These garments will be laundered, ironed, and repaired, then returned to you on the following Monday.

To prevent stains such as from urine, rinse them in cool water, then squeeze but please do not wring the garment.

Thank you for your cooperation. I am looking forward to meeting with you at the end of this study, to discuss your ideas and opinions of the design and fabric.

If there are any further questions, please see Miss Janet McKee or please feel free to call me collect at 752-2768 in Corvallis.

Sincerely,

Marilyn L. Reeves

APPENDIX 2

EVALUATION OF DESIGN FEATURES BY
OCCUPATIONAL THERAPIST

DESIGN #1		FEATURES WHICH	FEATURES TOO	DRESS SELF	APPEARANCE	COMMENTS
Pull Over Shirt		AID IN SELF-HELP	DIFFICULT	(DATE)		
David	Shirt					
	Trousers					
Emery	Shirt					
	Trousers					
Jimmy	Shirt					
	Trousers					
Larry	Shirt					
	Trousers					

DESIGN #2		FEATURES WHICH	FEATURES TOO	DRESS SELF	APPEARANCE	COMMENTS
Shirt With		AID IN SELF-HELP	DIFFICULT	(DATE)		
Brian	Shirt					
	Trousers					
Glen	Shirt					
	Trousers					
John	Shirt					
	Trousers					
Tony	Shirt					
	Trousers					

APPENDIX 3

INSTRUCTIONS FOR LAUNDRY SHEETS

Each chart is for one week's record.

There are separate sheets for the shirts and trousers.

The letter A and B is printed in each garment along with the boy's name.

The letter on the garment should correspond to the letter and line of information on the chart.

I. Degree of Abrasion

First signs - fabric starting to show wear, broken threads.

Fabric thin - but no holes

Holes - fabric has broken, due to wear.

Select the column which best describes the worn place. Write in this column the location of the worn place. Example: knee, seat or underarm.

II. Tear (usually has firm edges)

If the tear is located where the brace could have pinched the fabric and this appears to be the case, then write in the BRACE column the location of the tear.

Any tear caused by other means, write the location (pocket, sleeve, etc.) under OTHERS.

III. Repairs Needed

Check the term which describes the location of the needed repair. (May need to write in others).

APPENDIX 4. LAUNDRESS EVALUATION

SHIRTS	DEGREE OF ABRASION					TEARS			REPAIRS NEEDED		
	1ST SIGNS	FABRIC THIN	HOLES	BRACE	OTHERS				Broken Seam	Hem	Pocket
BRIAN	A								Tear	Zipper	Velcro
	B								Broken Seam	Hem	Pocket
DAVID	A								Tear	Zipper	Velcro
	B								Broken Seam	Hem	Pocket
EMERY	A								Tear	Zipper	Velcro
	B								Broken Seam	Hem	Pocket
GLEN	A								Tear	Zipper	Velcro
	B								Broken Seam	Hem	Pocket
JIMMY	A								Tear	Zipper	Velcro
	B								Broken Seam	Hem	Pocket
JOHN	A								Tear	Zipper	Velcro
	B								Broken Seam	Hem	Pocket
LARRY	A								Tear	Zipper	Velcro
	B								Broken Seam	Hem	Pocket
TONY	A								Tear	Zipper	Velcro
	B								Broken Seam	Hem	Pocket

APPENDIX 5. LAUNDRESS EVALUATION

TROUSERS	DEGREE OF ABRASION				TEARS		REPAIRS NEEDED		
	1ST SIGNS	FABRIC THIN	HOLES	BRACE	OTHERS		Broken Seam Tear Zipper	Hem Velcro	Pocket
BRIAN	A								
	B								
DAVID	A								
	B								
EMERY	A								
	B								
GLEN	A								
	B								
JIMMY	A								
	B								
JOHN	A								
	B								
LARRY	A								
	B								
TONY	A								
	B								

WEEK _____

APPENDIX 6

COMMENTS ON LAUNDRYING AND IRONING

DESIGN	BOY'S NAME (A or B)	FIRST WEARING	FOURTH WEARING	LAST WEARING
COLLAR				
DICKEY				
FLY FRONT				
LEG OF TROUSERS				
SLEEVE				
WAISTBAND				
OTHERS				

EXAMPLE:
 LITTLE OR NO
 IRONING
 SOIL EASILY
 REMOVED
 STAINS HARD
 TO REMOVE
 RETAINS COLOR

FABRIC

APPENDIX 7

QUESTIONNAIRE

DESIGN

☐ Pull over
☐ Front opening
☐ Zipper legs
☐ Velcro legs

This questionnaire is to evaluate the designs and fabrics of the two outfits the boys are wearing.
The designs were made especially for each child's capabilities.

- | | | |
|---|-----|----|
| 1. Does the boy like wearing his outfits? | Yes | No |
| Why? | | |
| 2. Does he prefer one outfit over the other? | Yes | No |
| Why? (if "yes") | | |
| 3. Does he want to wear them more often than scheduled? | Yes | No |
| 4. Do you like the appearance of these outfits on the boy? | Yes | No |
| Why? | | |
| 5. Does the child seem comfortable when wearing these garments? | Yes | No |
| Why? (if "no") | | |

FABRIC

Placed in front of you are two cards: Marked A or B with a color corresponding to each outfit the boy is wearing.

The following questions are in relation to the two different gingham (A or B) used in the shirts; and the two different denims (A or B) used in the trousers.

1. Does one fabric soil more readily than the other? Yes No Undecided

If yes, which?	Gingham	A	B
	Denim	A	B

Comments:

2. Does one fabric wrinkle more easily than the other? Yes No Undecided

If "yes," which?	Gingham	A	B
	Denim	A	B

Comments:

3. Does one fabric show signs of wear earlier than the other? Yes No Undecided

If "yes," which?	Gingham	A	B
	Denim	A	B

Comments:

4. Is one fabric more easily handled when dressing than the other? Yes No Undecided

If "yes," which?	Gingham	A	B
	Denim	A	B

Comments:

5. Does one fabric reveal the braces more than the other? Yes No Undecided

If "yes," which?	Gingham	A	B
	Denim	A	B

Comments:

6. Does the child appear to be more comfortable in one fabric

than the other?

Yes No Undecided

If "yes," which?

Gingham

A B

Denim

A B

Comments:

DESIGN

Please rate the appearance and fit of the different design features on the shirts and trousers. Does the design feature aid or hinder the child's dressing? Please comment on your answers.

FEATURE	APPEARANCE				FIT				AIDED DRESSING		HINDERED DRESSING	
SHIRT												
Neckline	(A)	Good	Fair	Poor	(A)	Good	Fair	Poor	Yes	No	Yes	No
	(B)	Good	Fair	Poor	(B)	Good	Fair	Poor				
Comments:												
Sleeves	(A)	Good	Fair	Poor	(A)	Good	Fair	Poor	Yes	No	Yes	No
	(B)	Good	Fair	Poor	(B)	Good	Fair	Poor				
Comments:												
Front Opening	(A)	Good	Fair	Poor	(A)	Good	Fair	Poor	Yes	No	Yes	No
	(B)	Good	Fair	Poor	(B)	Good	Fair	Poor				
Comments:												
TROUSERS												
Waistband	(A)	Good	Fair	Poor	(A)	Good	Fair	Poor	Yes	No	Yes	No
	(B)	Good	Fair	Poor	(B)	Good	Fair	Poor				
Comments:												
Leg Closure	(A)	Good	Fair	Poor	(A)	Good	Fair	Poor	Yes	No	Yes	No
	(B)	Good	Fair	Poor	(B)	Good	Fair	Poor				
Comments:												

The following questions are related to adapting ready-made clothing to the needs of the child, by using velcro, zippers, and elastic.

1. Do you think that velcro stitched under the buttons on ready-made shirts would aid in dressing?
Yes No
2. Do you think that the use of elastic in the waistband in ready-made trousers would influence the following:
 - a. Would the child be more comfortable wearing the trousers?
Yes No
 - b. Would the trousers fit better?
Yes No
 - c. Would the pelvic band be less noticeable?
Yes No
3. Do you think that zippers or velcros being stitched into the leg seam of ready-made trousers would aid in his dressing?
Yes No