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Clothing comfort may be affected by how a garment feels against the skin, by how it fits the body, and by the feeling one has while wearing the garment. Research by Smith (1985) revealed certain causes of skin sensations experienced when wearing garments next to the skin, including fabric surface and other parts touching the body, such as labels, seams, zippers and trims. Perceived problems with clothing labels causing skin irritation were noted by 44 percent of respondents to a 5-state questionnaire (Davis, Markee, Dallas, Harger, and Miller, 1990). Smith (1986) found that over 65 percent of those people interviewed had cut labels out of garments because the label corner was sticking into the skin. When consumers remove irritating labels, they also remove important information on fiber content and garment care methods contained on the labels. This practice could lead to improper care and damage to clothes.

The purpose of this study was to investigate the relationship between certain clothing labels and skin sensations, using a subjective comfort rating scale. The perceived sensorial comfort of seven different labels was evaluated through

repeated laboratory wear trials in a controlled environment. The wear study protocol consisted of a beginning stabilization period, non-strenuous reaching and moving activities and an inactive reading period, for a total wearing time of 30 minutes.

Ten female subjects wore a knit polo shirt in which a label was sewn in the back neckline. Seven labels were selected, typical of labels used in garments made in the United States. The polyester labels differed in fabric construction, edge treatment and finish. Each subject wore each label, for a total of seven wear periods. A complete randomized block design was used.

Subjects were asked at the beginning and end of each testing period to complete a semantic differential scale on their subjective evaluation of the garment label. Subjects were asked to consider two sets of polar adjectives, stiff/flexible and prickly/smooth, and indicate the intensity of these two sensations and the level of comfort associated with these sensations.

Statistical analyses included analysis of variance, and LSD multiple range test to determine differences between groups. The four dependent variables were the perceived intensity and the level of comfort related to both the prickliness and stiffness of the labels. Independent variables included labels and rating period, while the subjects served as a block.

Results showed no differences between the participants' ratings at the beginning and end of each wear trial. Therefore, any further wear testing of labels could be made using the initial perceptions of the subjects. A longer

wear protocol would not be necessary. Significant differences were seen in the perceived comfort related to prickliness for different labels ($F(6, 54)=2.10$, $p=.07$) and the intensity of prickliness for different labels ($F(6,54)=1.98$, $p=.09$). The least prickly, most comfortable label was a satin weave, noncoated, printed loop label with woven selvage sides (mean rating=4.50, where 5=most comfortable and 1=most uncomfortable).

The intensity of the prickly/smooth sensation was also recorded by the subjects. The label perceived as giving the most intense sensation of smoothness was the same label that rated as the most comfortable due to prickliness. This was the satin weave, noncoated label with woven sides and a folded bottom forming a loop (mean=4.65).

Results of this research should prove beneficial to apparel manufacturers, as well as to producers of clothing labels. Eventually, consumers may benefit by having more comfortable labels used in clothing.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

PERCEIVED SENSATIONS OF CLOTHING LABELS ON SKIN

CHAPTER I

INTRODUCTION

Clothing surrounds us, literally, everyday of our lives. Comfort affects all aspects of our existence. Clothing comfort often influences our selection of clothing and our activities. Clothing comfort may be affected by how a garment feels against the skin, by how it fits the body, and by the feeling one has while wearing the garment. Each of these sensations is elicited by certain psychological and physical stimuli and contributes to the overall judgment of clothing comfort.

Some garments feel comfortable, while other garments may not. Comfort involves a complex combination of properties. In the Oxford English Dictionary (1961), comfort is defined as well-being, or freedom from pain. Slater (1985, p. 4) defined comfort as "a pleasant state of physiological, psychological and physical harmony between a human being and the environment". If we feel a pain, an itch, are too warm, or feel afraid, we may readily communicate our discomfort.

Certain fabric properties and garment styles may cause sensations of discomfort in a portion of the population (Smith, 1985, 1986b; Davis, Markee, Dallas, Harger & Miller, 1990). Research by Smith (1985) at the Shirley

Institute, England, revealed certain causes of skin sensations experienced when wearing garments next to skin. She found that not only was the fabric considered in clothing comfort, but also any other part of the garment that was touching the body, such as labels, seams, trims and local areas of fit. Local irritation could be caused by sewn-in garment labels and to a lesser degree by abrasion associated with a seam. Smith (1985) noted that several cases of "label prickle" could be attributed to the stiff, sharp corners that were present on labels and to the label edges that were heat-sealed. Davis, Dallas, Markee, Miller and Harger (1990) investigated health problems attributed by consumers to textiles for a selected household sample from five western states. From 1,785 usable questionnaires, results showed 44.3% of respondents perceived problems with clothing labels that caused skin irritation.

An important finding by Smith (1986a) was over 65% of people interviewed had cut the labels out of garments that they wore next to their skin. This was attributed to two main factors, either discomfort due to the label corner sticking into the skin or the tendency of the label to hang outside the garment.

By removing irritating labels, consumers also remove important information such as fiber content and care information. This practice could lead to improper care and damage to clothes. It is important that label manufacturers produce more comfortable labels and that apparel manufacturers use comfortable labeling materials in ready-to-wear clothing.

Purpose of Study

Apparel manufacturers' use of uncomfortable labels attached to clothing has apparently created a widespread problem among consumers. The present study investigated the relationship between certain clothing labels and perceived skin sensations, using a subjective comfort rating scale completed by wearers at the beginning and end of a wear trial. Various types of clothing labels were placed in the back neckline of a knit polo shirt. The perceived sensorial comfort levels of the selected garment labels were evaluated during repeated laboratory wear trials in a controlled environment. The findings of this study will be beneficial to apparel manufacturers, as well as to producers of clothing labels. Eventually, it is hoped that consumers will benefit by having more comfortable labels in ready-to-wear clothing.

Objectives

The objectives of this study were to assess the sensorial comfort levels of prickliness and stiffness associated with different garment labels having a variety of construction forms and edge treatments, and to examine the relationships between the perceived intensity of prickliness and stiffness sensations and the degree of comfort associated with these two sensations.

Assumptions

1. The label at the back neck area was a commonly used, representative

location for placing the label. This location provided accurate information about the label's perceived sensation of skin comfort.

2. The protocol allowed for enough variety of reaching movements so that there was sufficient skin contact with the polo shirt and the neck label. This movement were not so vigorous as to be considered exercise, nor work up a sweat.

3. The subjects, female students ages 18 to 30 at Oregon State University, were representative of females of this age group.

4. The information provided by the respondents was accurate and complete.

5. Laundering of shirts, with labels removed, between certain wear periods will not effect the perceptions related to labels. Because of short wearing times and minimal activities, the garments were laundered only twice during the wear trials. Before laundering the current label was removed by unstitching; after laundering a label was restitched in place. Each subject had her own shirt, and all shirts were laundered a similar number of times at the same wear interval.

6. An overemphasis on garment label sensations perceived by the subject should not occur, because comfort evaluations for certain other locations of the knit shirt were requested in addition to the label.

Null Hypotheses

Based on information in the review of literature, the following null hypotheses were formulated for the garment labels of polyester having different

edge treatment and applied finish categories:

Null Hypothesis 1 There are no differences in the sensations of prickliness and stiffness perceived immediately and the sensations perceived at the end of a wear trial among the garment labels.

Null Hypothesis 2 There are no differences in the comfort related to the perceived prickliness among the garment labels.

Null Hypothesis 3 There are no differences in the intensity of perceived prickliness among the garment labels.

Null Hypothesis 4 There are no differences in the comfort related to the perceived stiffness among the garment labels.

Null Hypothesis 5 There are no differences in the intensity of perceived stiffness among the garment labels.

Null Hypothesis 6 There are no differences between comfort related to prickliness and the intensity of prickliness of garment labels.

Null Hypothesis 7 There are no differences between comfort related to stiffness and the intensity of stiffness of garment labels.

CHAPTER II

REVIEW OF LITERATURE

Introduction

People are concerned about the comfort of their clothing. A garment which is not comfortable is very seldom worn. Over the past forty years much research has dealt with the subject of clothing comfort. In this chapter, the topics reviewed include United Stated (U.S.) label information, labels in clothing, the concept of comfort in clothing, skin sensations due to clothing, terminology for skin sensations, responses of nerves in skin, fabric surface characteristics affecting skin sensations, fabric and fiber composition affecting skin sensations, and comfort assessment scales, including numerical scaling with individual terms, numerical scaling with polar adjectives and rank scaling.

U.S. Label Information

The United States Federal Trade Commission (FTC) regulates several laws on clothing labels: the Wool Products Labeling Act of 1939, the Fur Products Labeling Act of 1951, the Textile Fiber Products Identification Act of 1959 (revised in 1986), and the Permanent Care Labeling Act of 1972 (revised in 1976). Labels provide a variety of information for consumers regarding the textile product they are buying and how to care for clothing after purchasing. A

variety of required and voluntary information may be produced on the label: fiber content, manufacturers' or distributors' identification, promotional logo, slogan, country of origin, and care instructions (Ford, 1986).

Under FTC rules each textile garment with a neck must have the care label affixed to the inside center of the back neck midway between the shoulder seams. Care labels must be firmly stitched to the garment and must remain legible through 50 wash cycles.

Labels in Clothing

Researchers at United Kingdom's (U.K.) Shirley Institute used a questionnaire to determine the British public's attitude toward the comfort and discomfort properties of fabrics and garments (Smith, 1986b). One of the most surprising results from the survey was the fact that garment labels were identified as a major source of discomfort. Well over half of the people interviewed removed these labels regularly because of either physiological discomfort when a corner of the label stuck the skin or psychological discomfort when a label hung outside the garment.

In Smith's research (1987), 100 subjects were asked to state which label's corner was the sharpest. Smith placed the corner of each label consecutively onto the skin of the forearm, taking care not to touch the arm with the metal mounting plates. From the subjects' rating of the labels' sharpness, she found that the labels with heat sealed edges were sharper than the woven edged

labels. The most uncomfortable, sharpest label was the highly finished label which was used for children's next-to-the-skin clothing.

Smith (1986b) reported that the discomfort from garment labels often occurred from the folded corner where the ending can prick the skin. The woven selvage edge of a garment label was usually comfortable. But the heat-sealed edge, found on 90% of labels in the U.K., caused irritation to the skin. The heat-fused edge, which could crack at a fold, was very uncomfortable in wear.

Findings in the U.S. by Davis, Dallas et al. (1990) supported Smith's findings in the U.K. Davis, Dallas et al. (1990) analyzed dermatological health problems attributed to textiles by consumers in five western states. From a sample of 1,785 questionnaires, 44.3% percent of the respondents indicated problems with clothing labels that caused skin irritation. Results showed that the climate was related to the comfort of the labels. The people living in dry or temperate climates noted more discomfort than those living in tropical climates. In addition, age and sex were factors in the garment label comfort. The respondents over the age of 65 perceived more problems with garment labels than did younger respondents, and females perceived more problems with garment labels than did males.

Umbach (1985) evaluated visually the edge treatments of garment labels, as seen in electron microscope photographs at 80x magnification. He found that the woven edge labels were comfortable and the heat-sealed labels were

uncomfortable due to their sharply jagged edges. The corners of the folded woven labels did not cause discomfort, while the corners at the folded heat-sealed labels caused irritation of the skin.

The usual way for consumers to solve the problem of irritating labels is to cut them out of the garments. However, by removing the irritating labels, consumers also remove important fiber content and care information.

Concept of Comfort in Clothing

Comfort has long been researched and is an extremely complex subject. In the Oxford English Dictionary (1961) comfort is described as "a state of physical and material well-being, with freedom from pain and trouble, and satisfaction of bodily needs; the condition of being comfortable." Fuzek and Ammons (1977, p. 121) defined comfort as "the sensation of contentment, well-being, and the absence of unpleasant feelings". Slater (1985) defined comfort as a pleasant state of physiological, psychological and physical harmony between a human being and the environment. DeMartino (1984, p. 516) defined clothing comfort as "when the skin temperature is 33° C to 35° C and no liquid perspiration is present." He stated that clothing comfort is a result of many interactions between physical, psychological and physiological factors. When we feel comfortable, other factors such as skin irritation or clinging of fabric are absent.

Generally speaking, the literature classifies clothing comfort into two or

three categories: (a) physiological comfort, (b) psychological comfort, and (c) physical comfort, listed separately or combined with physiological comfort. In the "Comfort's Gestalt" proposed by Pontrelli (1977), key parameters may cause a person to feel comfort or discomfort. This model included three categories: physical, psycho-physiological, and a filter. The physical variables involved the environment, transport properties, level of activities and the garments. The psycho-physiological involved parameters such as state of being, end-use and occasion of wear, fashionable style, tactile aesthetics and fit. The filter was described by Pontrelli (1977, p. 75) as "stored modifiers" and consisted of all past experiences, expectations and fantasies. The comfort or discomfort response depended upon the interaction between these physical, physiological and psychological stimuli and the stored modifiers of each person, both conscious and subconscious. In Pontrelli's model, there would be a favorable comfort response when the garment was properly tailored, the fabric satisfied garment requirements, the environment did not cause undue stress, and the subject had a positive emotional state.

Smith (1986b, p. 23) stated that "comfort is a neutral sensation, when we are physiologically and psychologically unaware of the clothing we are wearing" while discomfort is "a situation when we are conscious of the garments we are wearing and the experience is unpleasant." Such a discomfort sensation can range from the extreme case of an allergic reaction to less painful sensations.

A categorization system for clothing comfort was proposed by Smith

Table 1

Smith's Categorization System for Clothing Comfort: Psychological Discomfort and Physiological Discomfort[a].

Psychological Discomfort
Aesthetics
Color
Prejudice
Fashion
Suitability for an occasion
Fabric construction and finishes
Garment style flatters your figure and fits properly

Physiological Discomfort
(1) Sensorial discomfort (what the fabric/garment feels like when worn next to the skin)
Allergy
Tickle
Prickle
Initial cold feel of the fabric
Abrasion of the fabric
Loose fibers are shed
Wet fabric clings to the skin
(2) Thermo-physiological discomfort
Too warm
Too cold
Transport of sweat away from the skin
(3) Garment fit
Tight fit overall
Tight local areas (e.g. waistbands)

[a]Smith, 1986b, p. 23

(1986b), as shown in Table 1. She suggested that discomfort when wearing clothing can be distinguished as either psychological or physiological discomfort. She defined psychological discomfort as an unpleasant sensation in which people are conscious of the garments they are wearing. Physiological discomfort was described as the response of the human physical body to stimuli. Smith's system proposed that physiological discomfort included sensorial discomfort, thermo-physiological discomfort and unsatisfactory garment fit. The sensorial discomfort of clothing was a contact sensation which resulted from the fabric or garment worn next to the skin. Skin sensations produced by next-to-skin clothing and labels would include stiff/flexible, prickly/smooth, heavy/light, and snug/loose, according to Smith.

Since clothing is in direct contact with the skin, clothing comfort can be described as an extension of body physiology which enables the body to accommodate to changes in the environment without a sense of stress. Singh (1986) described comfort as including three major factors: physiological, psychological, and physical. Singh believed the most important factor of all was physiological comfort, which depended on the skin temperature, skin sensitivity, and the moisture on the skin. Because the skin acts as a boundary between the body and the environment of ambient air and clothing, the skin was a major component of physiological comfort.

Skin Sensations Due to Clothing

Skin comfort is one of the most important requirements of clothing worn next to the skin. Mayfield (1987) stated that skin sensations arise through the triggering of sensory nerve receptors in or near the skin by contact of the fabric surface with the skin. Some studies have investigated the skin sensations from wearing garments next to the skin. Smith (1985) stated that the type of skin sensations produced by next-to-skin apparel was a major factor in determining the overall comfort of a garment. Skin sensations encountered ranged from the relatively mild tickle and wet-cling sensation to the more severe discomfort associated with an allergic reaction. Skin sensations came not only from the fabric but from any part of the garment that was touching the body, for instance, labels, seams, trimming, and "local fitting" (Smith 1985, p. 35).

In Davis, Markee et al.'s (1990) study, they investigated the nature of the perceived discomfort of dermatological problems. From a telephone follow-up survey of 185 people who earlier reported skin problems related to textiles, 82% of respondents reported textile-related skin problems. Most respondents perceived itching and rash to be the most severe and most persistent symptoms. Of the 152 people who reported skin symptoms, 36% reported that the whole body was affected, followed by arms (31%), neck (20%), legs (18%), chest (12%) and back (11%).

Terminology for Skin Sensations

Certain terms have been used in apparel research to express skin sensations (see Appendix A). Smith (1985) used the following terms in wear trials: local fit, tickle (like a feather), prickle (pin pricks), scratchiness (sand-paperish), wet cling, tack cling, fiber shedding and local irritation. Brand (1964) described terms such as scratchy, cold, warm, and heavy. Hollies, Custer, Morin and Howard (1979) found that participants used the terms stiff, sticky, nonabsorbent, clammy, damp, clingy, rough and scratchy in describing the perceptions of wearing sensations. Howorth and Oliver (1958) investigated the frequencies that descriptive words were used and found that 86% of all decisions were made using the terms smoothness, softness, firmness, coarseness, thickness, weight, warmth, harshness and stiffness. Behery (1986) used stiffness, smoothness, fullness and softness to describe men's winter suit fabrics, and used stiffness, crispness, fullness and softness, anti-drape stiffness to describe men's summer suit fabrics. Garnsworthy, Gully, Kandiah et al. (1988) stated that for the sensations which caused discomfort and resulted from interactions between fabric and skin, prickle and itch were probably the most commonly encountered and disliked sensations. Barker and Scheininger (1982) used the terms stiffness, stretchiness, smoothness, weight, and thickness in describing participants' perceptions of subjective testing. DeMartino et al. (1984a) suggested terms to describe the feel of clothing such as clingy, sticky, scratchy, picky, soft, stiff, heavy, light and hard.

Response of Nerves in Skin

The skin is the largest organ of the human body, covering a 1.6 to 1.9 square meter area in adult men and containing 5.9% of their weight. Human skin is the location of all tactile sensations produced by contiguous clothing (Singh, 1986).

There are three types of nerve groups located in the skin surface which provide different responses when the skin is stimulated: nerves in the touch group that relay pressure and vibration, nerves in the thermal group that relay warmth and coolness, and nerves in the pain group (Garnsworthy, Gully, Kandiah et al., 1988; Garnsworthy, Gully, Kenins et al., 1988). The nerve receptors of the touch group respond to mechanical displacement of the skin of hairs on the skin. The assessment of fabric texture depends on information gained by this group of senses. The nerve receptors of the thermal group maintain steady background levels of activity in their associated nerve fiber under ambient temperature conditions. There are two kinds of thermal receptors, warm and cold. Information is transmitted from the receptors to the brain via small diameter, slowly conducting nerve fibers. The nerve receptors of the pain group are responsible not only for sensations of frank pain, but also sensations of pinprick and itch. These receptors respond variously to tissue damage and to potentially damaging mechanical, thermal and chemical stimuli. Skin irritation such as itchiness can be masked by simultaneous activity of scratching or rubbing, set up in the touch group of nerves. Prickle cannot be

felt if the fabric is rubbed or wiped over the skin, if the skin is uncomfortably cold, or if the skin contact area is smaller than about one square centimeter (Garnsworthy, Mayfield, et al., 1985).

Garnsworthy et al. (1985) reported that the major stimulus of a fabric would be protruding fiber ends capable of bearing loads of approximately 100 mg or more. A fiber which contacted the skin over a large area, such as by lying along the surface, could not support the very high forces that were required to excite the pain nerve receptor. Such fibers would only excite the much more sensitive receptors of the touch group. Later studies showed that prickle caused by fabric was due to stimulation of pain receptors below the outer skin (Garnsworthy, Gully, Kandiah et al., 1988; Garnsworthy, Gully, Kenins et al., 1988).

Fabric Surface Characteristics Affecting Skin Sensations

Mayfield (1987) stated the nature of the fabric surface will have a marked effect on the sensations perceived. The fabric surface may not be a homogeneous, smooth, and featureless plane. Woven or knit fabric has a number of ridges formed by yarns, arranged periodically in two dimensions. If the yarn is spun instead of filament, it will be covered with a large number of fibers protruding out of the yarn bulk. The surface fibers have a finite stiffness, tend to separate the fabric bulk from the skin, and act as the load transmitting medium in low compressional load regions. Length and stiffness distributions of these surface fibers have a primary importance in tactile comfort. These are

supposed to be largely responsible for the "feel" of clothing (Yoon & Buckley, 1984; Yoon et al., 1984).

When clothing fabrics touch the skin surface, sensations of softness or roughness are aroused. These sensations can be modulated by moving fabric across the skin surface (Gwosdow, Stevens, Berglund, & Stolwijk, 1986). Garnsworthy, Gully, Kenins et al. (1988) reported that the prickle stimuli from the fabric surface originated from protruding fiber ends that exerted loads of 75 micrograms of force (mgf) or more against the skin, compared to earlier findings of 100 mgf or more (Garnsworthy et al., 1985).

In a study of fabric-evoked prickle by Garnsworthy, Gully, Kandiah et al. (1988), the sensory thresholds were determined for 55 people (28 males and 27 females) whose ages ranged from 20 to 60 years. Garnsworthy and colleagues found that fiber ends on the fabric surface readily indented the skin, increasing pain receptor response and the sensation magnitude of prickle. The fiber properties which influenced the probability of a wool fabric causing skin irritation were fiber diameter and projecting length. Results showed that a fiber diameter of 21 micrometers or less would not be perceived as causing skin discomfort by most people under normal conditions. Finer, longer fibers were less likely to cause prickle because they bent easily. Similar facts were presented by Smith (1985). She stated that a prickle sensation was caused by coarse, stiff fibers protruding from the fabric surface.

Garnsworthy, Gully, Kandiah et al. (1988) found that the fabric properties

influencing prickle were hairiness, structure, the cover factor and the processing route. Processes such as brushing reduced the fabric's propensity to prickle by increasing the length of surface fibers.

Fabric and Fiber Composition Affecting Skin Sensations

DeMartino et al. (1984a) suggested that studying the relationship between fiber properties and comfort performance of fabric should involve (a) determination of physical properties of the fabric, (b) subjective assessment of fabric comfort, (c) correlation of the data by statistical methods in psychometrics, and (d) correlation of the fabric physical properties with the properties of the fiber.

Clulow (1984) questioned members of the Shirley Institute staff regarding fibers and fabrics they avoided due to allergy, discomfort, appearance or any other factor. Two-thirds of the participants said that wool, especially Shetland and the coarser wools, caused a rash or irritation. A higher proportion of men than women said they found nylon to be uncomfortable due both to static cling and its non-absorbency.

In the telephone follow-up study by Davis, Markee et al. (1990), consumers were questioned about the types of fibers, fabrics and surface textures they perceived to be associated with dermatological health problems. From a sample of 185 people who earlier reported skin problems related to textiles, 90% believed that the textile fibers caused their skin problems. Wool was the most

offending fiber, followed by polyester and nylon. Wool blends and 12 other blends were believed to cause problems. From those who responded that they had skin problems related to textiles, 29% avoid wearing certain fabrics they believed caused skin irritation, such as lace, textured and smooth double knits, corduroy and nubby fabrics. Twenty-one percent of the total 185 people reported that skin contact with household textiles also caused skin or health problems.

For structure of fabric, woven fabrics were more prickly than knitted fabrics because of the tighter construction of the former. Fiber ends were likely to be less rigidly anchored in knitted fabric because of the looser yarn construction (Garnsworth, Gully, Kandiah et al., 1988).

Other factors causing prickle were the cover factor and chemical processes. Lower cover fabrics reduced prickle by reducing the surface density of fiber ends. Also, chemical processes that modified the surface properties of wool fiber showed some promise in reducing prickle. However, processes such as shearing increased prickle, since it shortened fiber ends and greatly increased their buckling loads, generating many new prickle stimuli (Garnsworthy, Gully, Kandiah et al., 1988). Hollies (1980) noted that certain finishing agents used for clothing purposes could cause skin problems due to chemical transfer.

Moisture, perspiration on the skin or the application of skin moisturizers significantly increased prickle by softening the skin (CSIRO, 1988). Singh (1986) stated that it was generally believed that man-made fibers were not

comfortable to human skin because man-made fibers could cause skin problems. These skin problems included not allowing air and moisture to escape, not removing sweat satisfactorily, stimulating the production of sweat and odor, absorbing sebum from the skin and then allowing resorption into the skin, and causing allergic reactions.

Comfort Assessment Scales

Hollies (1977) termed psychological scaling the process of making judgments based upon human perception. The psychological scaling process would be best understood by referring to decision making in everyday life. Psychological scaling could be applied to many different areas of scientific and commercial measurement and would be useful to textiles or clothing, especially in evaluating human perception of comfort.

Subjective testing inevitably is less precise than objective instrumental testing where an instrument and pointer can give an exact reading on a scale. Both Ellis and Garnsworthy (1980) and Howorth and Oliver (1958) mentioned several approaches to investigating the subjective judgment of product quality. One approach was the scaling of subjective judgment in which numerical scores were awarded on some arbitrary subject scale. Two types of numerically scored subjective rating scales included individual sensation terms and sets of polar adjective terms. A third approach used ranking of garments, without assigning numeric scores.

Numerical scaling with individual terms

Hollies (1977) used individual sensation scaling terms in his comfort investigations. Each comfort description term could receive a Likert-type score from 1 to 5, with 1 being totally uncomfortable and 5 being completely comfortable.

DeMartino (1984) investigated comfort sensations where participants evaluated blouses using a subjective comfort rating chart. Perceived individual sensation terms were rated for intensity on a scale of 1 to 4, with 1 being totally comfortable and 4 being partially uncomfortable.

Numerical scaling with polar adjectives

Brand (1964) developed a system for selecting polar adjective rating scales. This system involved four major steps for the subjective measurement of basic elements for fabric aesthetic character. First, polar-word adjective pairs were selected. Second, numerical scales were established with reference to specific fabric aesthetic components. Third, word scales were related to the aesthetic concepts and to fabric physical properties by statistical techniques. Finally, the word scales were replaced by fabric physical properties.

Bogaty, Hollies and Harris (1956) used polar adjectives to measure sensory harshness on a numerical scale of 1 to 6. For example, participants were asked to judge, with their eyes closed, the handle of a sample of whipcord with respect to harness or softness using 1=very soft, 2=soft, 3=moderately soft,

4=moderately harsh, 5=harsh and 6=very harsh.

In comparison, Winakor and Kim (1980) used a 99-point scale to judge nine polar adjective pairs, where 1 equalled strong agreement with the left adjective and 99 equalled strong agreement with the right adjective. The nine polar adjective pairs were limp/crisp, scratchy/silky, fine/coarse, light/heavy, smooth/rough, thin/thick, firm/sleazy, hard/soft, and flexible/stiff. They found the advantages of the 99-point scale were the fine gradations, high sensitivity, and large amount of information provided.

Lundgren (1969) suggested using four polar pairs of adjectives with "+" and "-" information content. The four pairs were roughness/smoothness, stiffness/flexibility, heaviness/lightness, and coldness/warmth. Plus and minus response to stimuli could be assigned to either term.

Rank scaling

A third approach to comfort assessment scaling was to rank the articles or garments in order of quality by using intercomparison, without assigning scores to the magnitudes of these differences. Such an ordered arrangement was called a "ranking". Fuzek and Ammons (1977) investigated garment comfort using rank scaling. In this study, each participant received two garments for comparison. Because each participant had only two garments to rate, the subjective evaluation was easier; however, a much larger number of participants was involved.

In Barker and Scheininger's study (1982), the subjective test entailed ranking the fabrics in an ordered hierarchy for a particular, predefined characteristic. In this way, twelve fabrics were ranked from 1 to 12 in each category from stiffest to most flexible, and from roughest to smoothest. Similarly, the test fabrics were ranked by hand preference.

CHAPTER III

METHODOLOGY

The purpose of this study was to determine if differences existed in the perceived sensorial comfort of wearers during repeated wear trials of a garment containing different polyester labels that varied in edge treatment and applied finish. The degree of perceived sensation was recorded both at the beginning and end of a 30 minute wear trial, using polar adjectives in a Likert scale rating chart.

The methods used in this study are described under the follow headings: garment, labels, subjects, research design, wear study protocol, description of the comfort rating chart, and statistical analyses.

Garment

Ten knit polo shirts of 65% polyester and 35% cotton were purchased in the same color, one for each of ten subjects. During the wear study protocol, each subject repeatedly wore the same polyester/cotton knit polo shirt with only the attached label at the back neckline being changed. The shirt was purchased in the size usually worn by the subject, fitting closely but not too restrictively. The polo style shirt was selected for two reasons. First, the collar could be opened to allow subjects to easily slip on and off the garment preventing stretching of

the label area and neckline. Second, when buttoned during the wearing period, the neck placket style of the polo shirt allowed the label to lie in close contact with the skin of the wearer. Before the wear trials, the garment was laundered twice to remove spinning oils and any dirt. The laundry procedure used was an eight minute delicate wash cycle with warm wash and cool rinse and a 40 minute tumble dry period, removing promptly from dryer. The appropriate test label was machine stitched careful in place before each trial period using 50% polyester and 50% cotton thread. At the end of each trial a seam ripper was carefully used to remove the stitching thread holding in the back neck label. During the wear trials, the garment was laundered two times to remove body oil and perspiration. The laundry procedure used was the same as the pre-trial laundering described above.

Labels

Seven types of labels were chosen. Labels were obtained from two major U.S. label manufacturers. For each label type, ten randomly selected specimens were evaluated, one for each of the ten subjects. Only polyester labels were selected in this study because polyester was the most widely used fiber for labels. Others fibers such as cotton, acetate and nylon are used much less commonly for labels.

The seven labels varied in their form, coating, construction and edge treatment. Various forms of the label included: (a) a single layer of fabric, (b) a single layer with two short, folded-back edges, and (c) a double layer of fabric

or a loop. Coating categories were: (a) uncoated, and (b) coated. Coatings include water-based acrylic or solvent-based urethane that are durable and do not wash out. The construction of the label included (a) a nonwoven label and (b) woven labels, including plain taffeta weave, rib weave, twill weave and satin weave. Edge treatments at the bottom and sides varied, and included: (a) a folded fabric edge (either at the bottom, e.g. looped; or at the sides, e.g. short, folded-back edges); (b) a woven selvage edge on a single layer fabric, (c) a heat-sealed fabric edge which is either (1) heat slit by hot wire, or (2) hot knife cut by a heated knife blade (thermoplastic fibers such as polyester are easily cut by a hot wire or blade that melts through the fibers), and (d) a straight cut edge cut by a sharp, cold knife blade. The seven labels are described in Table 2. Specimens and photomicrographs of each are located in Appendix E.

Subjects

College students at Oregon State University were asked to volunteer as subjects in this study. Subjects completed a preliminary questionnaire regarding their age, sex, usual knit shirt size, and perceived levels of skin sensitivity (Appendix B). Only female students between the ages of 18 to 30 were selected in order to limit variations in perceived sensations due to differences in sex and age range. Ten participants were selected and asked to sign a participation agreement form. To compensate each student for her time, a coupon for a food item was given at the completion of the study.

Table 2

Description of Seven Labels Used in Study

	Labels
Form of labels	
Flat single	D, E, F, G
Flat folded	B
Loop	A, C
Construction of label	
Plain weave	A, B, F
Rib weave	E
Satin weave	C
Twill weave	D
Nonwoven	G
Coating of label	
Uncoated	A, B, C, D, E
Coated	F, G
Edge treatment of label	
Folded sides and woven selvage bottom	B
Straight cut sides and straight cut bottom	F, G
Heat-sealed sides and folded bottom	A
Heat-sealed sides and woven selvage bottom	D
Woven selvage sides and folded bottom	C
Woven selvage sides and heat-sealed bottom	E

Note. All seven labels were 100% polyester fiber.
Examples of the labels and photomicrographs are included in Appendix E.

Research Design

A split-plot design was used in this research project. The subjects served as blocks. Each of the seven labels was randomly assigned to each of the 10 subjects. Thus, the experimental unit was one label with one subject. The time period was used to divide each experimental unit into two sub-plot units, i.e. the beginning of the rating period and the end of the rating period.

The seven different labels were placed in each subject's shirt one at a time in a random order. Thus, each subject evaluated each of the seven types of labels inserted at the back neckline of her polo shirt, with a total of 70 label specimens were evaluated. Ten specimens of each label were randomly selected from the lot of 40 supplied by the label manufacturers and were randomly assigned to a subject.

Wear Study Protocol

Each participant wore the same polo shirt eight different times. The first wear period was a trial run to familiarize the subject with the complete procedure and rating scale. For each of the following seven wear cycles a new and different label was inserted.

The wear protocol consisted of several steps designed to simulate normal wearing conditions. The wear trials were completed in the textile conditioning lab, Room 330B of Milam Hall. This location allowed each subject to perform the wear protocol in the same controlled physical environment. The

conditioning room was maintained at a temperature of 21° C ± 1° C (70° F ± 2° F) and relative humidity of 65% ± 2%. The directions given to the subjects are shown in Appendix C. Only one subject at a time was tested.

The subject entered the conditioning room and read quietly for a 10 minute stabilization period, then changed into her polo shirt in the foyer of the conditioning room. The shirt neckline was open to allow her to slip it on. The subject was asked to button the collar placket closed at the beginning of the wear period, so that the shirt and label at the back collar fit closely and touched the skin at the neckline. After reentering the conditioning room, the participant completed the first Comfort Rating Chart that asked for her initial perceptions when wearing the knit shirt (see Appendix D). Then she was asked to complete several specific but non-strenuous activities for appropriately 10 minutes, after which she was to be seated and read quietly for approximately 15 to 20 minutes. After the end of the wear period, which totalled 30 minutes for each person, each subject completed a second Comfort Rating Chart, identical in content to the first, before removing the shirt. Completing the questionnaires at the beginning and the end of the wear trial allowed comparison of initial and final perceptions about each label. Answering the Comfort Rating Chart took approximately two to four minutes.

Description of Comfort Rating Chart

Prior to selecting the polar adjectives used in this study, this researcher

compiled a list of contact skin sensation terms used in previous clothing comfort research. These contact skin sensation terms were grouped into categories under the headings of thermal, static, moisture, weight, fit and surface sensations. A list of definitions for these terms, as defined in previous research, is presented in Appendix A. From this list the researcher selected two representative terms from the surface category: stiff and prickly. These two terms were deemed important comfort categories for normal wear during low activity. Terms in the other categories (thermal, static, weight, moisture, and fit) were not selected, as such terms were less relevant to comfort of a garment label and more relevant to comfort during an exercising mode, when perspiration would be a factor. The Comfort Rating Chart is shown in Appendix D.

In order to avoid having the subjects focus unduly on the label itself and raise their sensitivity to that component, a total of five garment areas were rated: (a) the fabric itself at the back shoulder blade area, (b) the front placket area, (c) the seams at both underarm sides, (d) the collar around the back neck area, and (e) the label at the back neck. The other four areas were not changed; only the label was manipulated in this wear test project.

On the Comfort Rating Chart subjects were asked to indicate: (a) the intensity of two sensations, prickly/smooth and stiff/flexible, and (b) the level of comfort associated with each sensation. A 5-point Likert-type scale was used in all perception ratings. Only the end points were described with terms. For

rating the comfort of both prickliness and stiffness, the rating scale was 1= very uncomfortable and 5= very comfortable. The intensity rating of the prickly/smooth sensation was 1= very prickly and 5= very smooth, while the intensity rating of the stiff/flexible sensation was 1= very stiff and 5= very flexible.

Statistical Analyses

The decision to use either categorical analysis or analysis of variance was made after the data were collected on the Comfort Rating Chart and examined for normal distribution using the Kolmogorov-Smirnov test. Seven null hypotheses were analyzed. The four dependent variables were (a) the perceived comfort related to prickliness, (b) the intensity of perceived prickliness, (c) the perceived comfort related to stiffness, and (d) the intensity of the perceived stiffness. Independent variables included labels and rating period, while subjects were used as a block. Results were presented using mean scores and frequencies. The paired t-test for differences between means was used to determine if differences existed between the two testing periods, i.e. immediate rating and final rating. Analysis of variance (ANOVA) was used to determine if the label variable was a significant main effect. Analyses using least significant difference (LSD) multiple comparison were made to determine where significant differences existed between groups. The results were interpreted at the .10 level of probability for paired t-tests, analysis of variance tests, and LSD

multiple range tests. The chi-square test was used to determine where significant differences existed between the perceived intensity of the sensation and the degree of comfort associated with that sensation, at .10 probability level. The Statgraphics (1987) computer software program was utilized for the Kolmorgorov-Smirnov statistical analysis, paired $\underline{t}$-test, and chi-square analyses and SAS (1985) was used for ANOVA and LSD.

CHAPTER IV

RESULTS AND DISCUSSION

The purpose of this study was to investigate the relationships between certain clothing labels and skin sensations, using a subjective comfort rating scale. Ten female students were used as subjects in this study. The perceived sensations of prickliness and stiffness of seven different labels (Table 2) were evaluated through repeated laboratory wear trials in a controlled environment. Each subject wore each label, for a total of seven test periods. A pre-test wearing was used to acquaint subject with the testing protocol. Participants were asked to complete the comfort rating scale at the beginning and the end of each wear trial, or twice for each label. Response frequencies were calculated, and tests for normal distribution were completed. Results of paired *t*-test, ANOVA, LSD multiple comparison and chi-square analyses were used to test hypotheses.

Frequencies for Perception of Prickliness and Stiffness

Two sets of polar adjectives, prickly/smooth and stiff/flexible, were selected for study of garment label comfort next to the skin. A Likert-type scale was used, with 1 being very prickly or very stiff and 5 being very smooth or very flexible. Frequencies were calculated for both the intensity and comfort of

these two sensations for garment labels as perceived by the ten subjects. The means and standard deviations are shown in Table 3. Every subject answered all questions, for a response rate of 100%.

Prickly/Smooth Perceptions of Labels

Participants were asked to consider the prickly/smooth sensation for garment labels at the back neckline. Both the degree of comfort associated with prickliness and the intensity of the sensation were recorded by each subject.

When participants considered the degree of comfort related to prickliness, they rated label G the lowest (mean=3.5, where 1 is most prickly and 5 is most smooth), while label C was rated the highest (mean=4.5, see Table 3). Label C was an uncoated, satin weave, loop label with woven selvage sides and a folded bottom edge, while label G was a coated, nonwoven, flat, single layer label having straight cut sides and bottom (see descriptions in Table 2, p.27).

For the intensity of prickliness, the label receiving the lowest mean score was label E (mean=3.65) while the label with the highest mean score was label C (mean=4.65, see Table 3). Label E was an uncoated, rib weave, flat, single layer label with woven selvage sides and a heat-sealed bottom and label C was the uncoated, satin weave, loop label with woven selvage sides and a folded bottom (see descriptions in Table 2, p.27). In both comfort and intensity of prickliness, label C received the highest rating of the seven labels, even though this loop label was a double layer of fabric.

Table 3

Means and Standard Deviations of Ratings for Garment Labels: Perceived Intensity of and Comfort Related to Prickliness and Stiffness

Perceived Sensation	Label[a]	Mean	S.D.
Prickly/Smooth			
Comfort related to sensation[b]	C	4.50	0.69
	A	4.10	1.07
	D	4.05	1.15
	B	3.90	1.07
	F	3.75	1.16
	E	3.65	1.04
	G	3.50	1.24
Intensity of sensation[c]	C	4.65	0.59
	A	4.15	1.04
	F	3.95	1.05
	D	3.85	0.99
	B	3.75	1.11
	G	3.75	1.16
	E	3.65	1.09
Stiff/Flexible			
Comfort related to sensation[b]	C	4.40	0.60
	A	4.20	1.00
	D	3.95	1.00
	B	3.95	0.89
	F	3.90	0.85
	E	3.80	1.15
	G	3.55	1.15
Intensity of sensation[c]	A	4.20	1.00
	C	4.00	1.21
	E	3.85	0.88
	B	3.70	1.13
	D	3.65	1.39
	G	3.35	1.35
	F	3.30	1.45

[a]n = 20 (10 subjects rated each label twice, at beginning and end of wear period).
[b]Rating of 5 = very comfortable and 1 = very uncomfortable.
[c]Rating of 5 = very flexible or very smooth and 1 = very stiff or very prickly.

Stiff/Flexible Perceptions of Labels

Frequencies for the second set of polar adjectives, stiff/flexible, were calculated and are shown in Table 3. Again, both the comfort related to stiffness and the intensity of that sensation for the labels were recorded by the participants. When participants considered the comfort related to stiffness, label G was rated the lowest (mean=3.55, where 1 is most stiff and 5 is most flexible), while label C was rated the highest (mean=4.40). Label G was a nonwoven single layer with a coated finish, having straight cut sides and a straight cut bottom. Label C was a satin weave, noncoated loop label with woven selvage sides and folded bottom (see descriptions in Table 2, p.27).

For intensity of stiffness/flexibility, label F received the lowest rating of stiffness (mean=3.30), while label A was rated highest in flexibility (mean=4.20). Label F was a flat, single layer, coated plain weave label with straight cut sides and bottom edge, and label A was a plain weave, uncoated loop label, with heat-sealed sides and a folded bottom edge (see descriptions in Table 2, p.27).

Results of Normal Distribution Test

The Kolmogorov-Smirnov test (Statgraphics, 1987) was used to test for normality of the sample distribution. The results of Kolmogorov-Smirnov test (Table 4) showed that in only four cases there was reason to conclude that the distribution was not normal (significance level of .05).

Table 4

p-values of the Kolmogorov-Smirnov Normality Tests of Garment Label Ratings

	Prickliness		Stiffness	
Labels	Comfort	Intensity	Comfort	Intensity
A	0.06	0.06	0.07	0.07
B	0.07	0.48	0.28	0.52
C	0.01	0.00	0.06	0.16
D	0.06	0.34	0.15	0.22
E	0.02	0.09	0.11	0.30
F	0.08	0.11	0.15	0.32
G	0.39	0.02	0.50	0.50

Note. if $p > .05$ the null hypothesis of normality is not rejected.

Results of Hypotheses Testing

Results of testing the seven null hypotheses are presented in this section. All the tests were interpreted at .10 probability level. Hypothesis 1 was tested by the paired t-test. Hypotheses 2, 3, 4 and 5 were tested by ANOVA, where the subjects served as the block. In hypothesis 1, the rating period was the independent variable, while in hypotheses 2, 3, 4, and 5 the label was the independent variable. Where significance was noted, the LSD multiple comparison test was used to determine differences between groups. The chi-square statistic was used to test hypotheses 6 and 7.

Paired t-test Results of Rating Differences Between Beginning and End of Wear Trials

The first null hypothesis stated that there would be no differences in the sensations of prickliness and stiffness perceived immediately and the sensations perceived at the end of a wear trial of the garment labels. The paired *t*-test procedure was used to test this hypothesis, and results shown in Table 5. The *p* values indicated that the null hypothesis should not be rejected at the significance level of .10. There were no differences in the immediate sensation perceived and the sensation perceived at the end of a wear trial for the garment labels for all four levels of sensation. Therefore, the data for immediate sensation and end-of-wear-trial sensation for each level were combined for all further hypotheses tests.

Table 5

Paired t-test of Ratings at Beginning and End of Wear Trials

Sensation	d.f.	*t*-value	*p*
Comfort related to prickliness	69	-1.23	.22
Intensity of prickliness	69	-1.47	.15
Comfort related to stiffness	69	0.77	.44
Intensity of stiffness	69	0.90	.37

ANOVA Test Results of Comfort Related to Prickliness

The ANOVA test results for comfort related to the degree of prickliness are presented in Table 6. Null hypothesis 2 stated that there would be no differences in the comfort related to the perceived prickliness among the garment labels. A significant difference was found ($p=.07$) in the comfort related to the perceived prickliness among the garment labels and therefore null hypothesis 2 was rejected. Results of the LSD multiple comparison range test are shown in Table 7. Label C was different from the other six labels. Label C was perceived as the most comfortable, least prickly label (mean=4.50), and was the uncoated satin weave, loop label with woven selvage sides and folded bottom.

Table 6

ANOVA of Perceived Comfort Related to Prickliness

Source	d.f.	M.S.	F-value	p
Block (subjects)	9	8.93		
Label	6	2.21	2.10	0.07*
Block*Label	54	1.06		
Time	1	0.86		
Time*Label	6	0.21		
Error	63	0.21		

* Significant at $p \leq .10$

Table 7

Multiple Range Analysis (LSD) of Comfort Related to Prickly Sensation

Label	Mean	Homogeneous Group[1]	
G	3.50	a	
E	3.65	a	
F	3.75	a	
B	3.90	a	
D	4.05	a	
A	4.10	a	
C	4.50		b

[1] Groups with the same letter are not significantly different from each other

ANOVA Test Results of Intensity of Prickly/Smooth Sensation

The third null hypothesis stated that there would be no differences in the intensity of the perceived prickliness among the garment labels. The ANOVA test results for the intensity of prickly/smooth sensations for the seven labels are presented in Table 8. The results indicated a significant difference was found ($p=.09$) in the degree of perceived prickliness among the garment labels, and null hypothesis 3 was rejected.

To distinguish where the differences existed, the label means were compared using the LSD test, with the results presented in Table 9. The labels E, B, G, D, F and A did not differ significantly from each other and were in one group, but label C differed from this group. Label C (mean=4.65) was perceived as being the least prickly of the seven labels, and was an uncoated satin weave, loop label with woven selvage sides and folded bottom.

Table 8

ANOVA of Intensity of Perceived Prickly/Smooth Sensation

Source	d.f.	M.S.	F-value	p
Block (subjects)	9	6.85		
Label	6	2.36	1.98	0.09*
Block*Label	54	1.20		
Time	1	0.58		
Time*Label	6	0.16		
Error	63	0.17		

* Significant at $p \leq .10$

Table 9

Multiple Range Analysis (LSD) of Intensity of the Perceived Prickly Sensation

Label	Mean	Homogeneous Group[1]	
E	3.65	a	
B	3.75	a	
G	3.75	a	
D	3.85	a	
F	3.95	a	
A	4.15	a	
C	4.65		b

[1] Groups with the same letter are not significantly different from each other

ANOVA Test Results of Comfort Related to Stiffness

Null hypothesis 4 stated that there would be no differences in the degree of comfort related to the perceived stiffness among the labels. The ANOVA

results are presented in Table 10. The results showed that the null hypothesis should be accepted and the differences in comfort related to the perceived stiffness among the garment labels were not significant.

Table 10

ANOVA of Perceived Comfort Related to Stiffness

Source	d.f.	M.S.	F-value	p
Block (subjects)	9	7.70		
Label	6	1.50	1.71	0.34
Block*Label	54	0.87		
Time	1	0.06		
Time*Label	6	0.08		
Error	63	0.11		

ANOVA Test Results of Intensity of Stiff/Flexible Sensation

The ANOVA test results for the intensity of the stiff/flexible sensation for garment labels are presented in Table 11. Null hypothesis 5 stated that there would be no differences in the intensity of perceived stiffness among the garment labels. The p was .11, which suggested that null hypothesis 5 should be accepted at the significance level of .10. Results indicated that no significant differences existed in the degree of perceived stiffness among the garment labels.

Table 11

ANOVA of Intensity of Perceived Stiff/Flexible Sensation

Source	d.f.	M.S.	F-value	p
Block (subjects)	9	13.80		
Label	6	2.15	1.85	0.11
Block*Label	54	1.16		
Time	1	0.58		
Time*Label	6	0.16		
Error	63	0.15		

Results of Chi-Square Tests Comparing Intensity Sensations with Comfort Sensations

To compare the perceived intensity of the sensation and the comfort related to the perceived sensation, the chi-square analysis was used instead of the t-test because the normal distribution test showed 4 out of the 28 distributions were not normal. In order to get large enough expected values, 3 x 3 frequency tables were used in the chi-square tests. In the 5-point Likert scales, 1 and 2 were combined together while 4 and 5 were combined together (Tables 12 and 13).

The results of the chi-square tests (Table 14) indicated both hypothesis 6 and 7 should be rejected. Null hypothesis 6 stated that there are no differences between the perceived prickliness and the comfort related to the perceived prickliness of the labels. Null hypothesis 7 stated that there are no differences between the perceived stiffness and the comfort related to the perceived

Table 12

3 x 3 Frequency Table of Perceived Prickliness

	Comfort Related to Prickliness[a]			
	1 & 2	3	4 & 5	Total
Intensity of Prickliness[b]				
1 & 2	16	0	0	16
3	4	14	6	24
4 & 5	0	6	94	100
Total	20	20	100	140

[a] 1 = very uncomfortable, 5 = very comfortable
[b] 1 = very prickly, 5 = very smooth

Table 13

3 x 3 Frequency Table of Perceived Stiffness

	Comfort Related to Stiffness[a]			
	1 & 2	3	4 & 5	Total
Intensity of Stiffness[b]				
1 & 2	7	17	4	28
3	4	15	6	25
4 & 5	0	0	87	87
Total	11	32	97	140

[a] 1 = very uncomfortable, 5 = very comfortable
[b] 1 = very stiff, 5 = very flexible

stiffness of the labels. For both prickliness and stiffness there were significant

differences between the subjects' perception of the comfort of that sensation and their perception of the intensity of that sensation.

Table 14

Chi-Square Tests for Perceived Prickliness and Stiffness

Perceived Sensation	Chi-Square	d.f.	p
Prickliness	161.829	4	.0000*
Stiffness	103.420	4	.0000*

* Significant at $p \leq .10$

Scanning Electron Photomicrographs of Labels

The scanning electron microscope (SEM) is a helpful tool in revealing the physical surface characteristics of the object being examined. In a previous study by Smith (1986b), photomicrographs had been taken of labels. Smith found that the most uncomfortable labels had heat sealed edges, compared to more comfortable labels that had woven edges. Photomicrographs showed sharp hard corners and rough melted edges on the heat sealed labels.

The scanning electron microscope was used in this project to take photomicrographs of the corners of the seven garment labels (shown in Appendix E). These photomicrographs were taken at 50x magnification in order to show the physical surface and edges that were characteristic of the labels. The four components of labels: form, construction, coating and edge

treatment (described in Table 2, p.27) will be discussed in connection with the surface characteristics visible in the photomicrographs and the ratings of perceived prickliness and stiffness for the labels.

Form of Labels Shown in Photomicrographs

Three types of label forms occurred in this study: flat single, flat folded and loop (Table 2). Even though label C was a looped, double layer, it was perceived as the smoothest, least prickly label, and the most comfortable label related to prickliness (Tables 7 and 9). When label C was folded into a loop, a rounded bottom edge was formed (see Figure 6). However, label A also was a loop label but was in the group of 6 labels that was perceived as less comfortable due to prickliness. The flat single and flat folded labels were all in the less comfortable group.

Construction of Labels Shown in Photomicrographs

The seven labels had various construction methods, including plain weave, rib weave, twill weave, satin weave and nonwoven (Table 2). In this study label C was perceived as the smoothest, least prickly label (mean=4.65) and the most comfortable label related to prickliness (mean=4.50) and was the only satin weave label. The floating yarns of a satin weave are evident in the photomicrograph, Figure 6, and may have contributed to the perception of comfort and smoothness.

Coating of Labels Shown in Photomicrographs

Labels F and G were the only two coated labels in the project, while the other five were uncoated. The coated finish was applied to provide more body and give a smooth surface for printing. Labels F and G (means of 3.75 and 3.50 respectively) were in the group of 6 labels perceived as less comfortable due to prickliness. The coating on labels F and G is apparent in Figures 12 and 14. It seems likely the coating increased the prickliness of these labels. However, some uncoated labels were also in the more prickly group.

Edge Treatments Shown in Photomicrographs

Labels can be manufactured initially in long narrow strips or in large flat widths of fabric. Woven selvage edge labels are constructed on narrow tape looms. Woven selvage edge strips can be cut to the appropriate length by a hot knife or a straight edge blade, and may be used flat as a single layer or folded as a loop label. In contrast, large flat widths of woven or nonwoven label fabric can be manufactured on a broad loom and then cut into long, narrow, rolled strips by heated wires or straight blade cutting. Then individual labels would be cut by hot knife or straight blade cutting.

Four major categories of edge treatments could be seen in the SEM photomicrographs: (a) folded edge, (b) woven selvage edge, (c) heat-sealed edge, and (d) straight cut edge. These four types of edge treatments existed in various combination for the sides and the bottom of the label (see Table 2).

The first type of edge treatment was the folded edge. The fold provided a smooth, bent edge, as seen in labels A, B and C (Figures 2, 4 and 6). The folded edges on labels A and C were at the bottom, so those two labels formed loops. In contrast, label B had a 1/4 inch fold at each side (i.e. end folded) and did not form a complete loop. Sometimes the end folded label may be stitched down onto the garment at the folded edges.

The second type of edge treatment was the woven selvage, seen in labels B, C, D and E (Figures 4, 6, 8 and 10). This treatment produced a very smooth edge, as noted visually in the photomicrographs. In labels B and D the woven selvage appeared at the label bottom, while in labels C and E the woven selvage was at the sides. Label C was perceived as the smoothest, least prickly label (mean=4.65) and the most comfortable label due to prickliness (mean=4.50) and incorporated both a woven selvage side edge treatment (as well as a folded bottom edge forming a loop). Other labels having woven selvage edges were combined with side end folds (label B), heat-sealed sides (label D) and a heat-sealed bottom (label E). These latter three labels were in the more prickly, less comfortable group labels.

The third type of edge treatment was heat sealed. This produced a melted edge seen at the sides of labels A and D and at the bottom of label E (see Figures 2, 8 and 10). Thermoplastic fibers such as polyester must be used in order to be heat sealed. Heat sealed label edges can be cut in two different ways. First, the heat-sealed label may have been cut with a hot wire (i.e. heat

slit). This process is used on broadloom woven label fabrics to slit the wide cloth into narrow label widths. These narrow strips are rolled up and later cut apart into individual labels. Secondly, the heat sealed label may have been cut with a hot knife blade (i.e. hot knife cut). This action occurs when the label roll is cut into individual labels. The label roll will have selvage edges that are either woven edges (woven on narrow tape looms) or heat slit edges (woven on a broadloom and slit into strips). Problems with a heat sealed edge treatment can include excessive melting and jagged edges when the temperature is too high and the cutting speed is not correct. Additionally, cracks may occur when such labels are folded or bent. Note the jagged, melted protrusion in the hot knife cut edge in label E (Figure 10). All of the labels having heat sealed edges were in the more prickly, less comfortable group of labels.

The fourth type of edge treatment was straight cut made by a cold knife blade (i.e. unheated). Straight cuts are used to cut the label roll into individual labels. Raveling of the cut, free yarns may be a problem. Using coated labels such as labels F and G (Figures 12 and 14) lessens raveling. The problem of raveling is less relevant when the straight cut edge will be sewn eventually inside a garment seam, or when the straight cut edge is folded under. Labels F and G had straight cut edges and were in the more prickly, less comfortable group of labels.

Label C was perceived as significantly more comfortable (mean=4.50) and less prickly (mean=4.65) than the other labels. Label C had woven selvage

sides with a folded bottom edge forming a complete loop. In the SEM photomicrograph of label C (Figure 6) the smoothness of the woven selvage sides is apparent, as well as the curved effect of the folded bottom loop edge. Both factors may have contributed to its less prickly, more comfortable sensation.

The other six labels were grouped together statistically as being less comfortable and more prickly than label C. Edge treatments for these six varied.

In this study, the three labels having heat-sealed edges (A, D and E) varied from 4.10 to 4.05 to 3.65 in their rating of perceived comfort related to prickliness, although these differences were not statistically different. However, all three labels were in the less comfortable, more prickly group. This finding supports the statement of Smith (1986b) that discomfort from garment labels may arise from heat-sealed edges. Hard edges or corners and jagged, rough edges can occur when label edges are heat sealed. When more yarn is present, the melted edge may be larger and harder. As can be seen in the SEM photomicrographs for labels A, D and E (Figures 2, 8 and 10), not all melted edges produced jagged surfaces. Labels A and D (Figures 2 and 8) showed smooth melted edges, while label E (Figure 10) showed a jagged melted edge. It is important to note that in this study not all hot knife cut labels formed rough, jagged surfaces. Quality control over the cutting process would appear critical in its success.

Summary of Results

No differences were seen between the subjects' initial ratings of the labels and ratings at the end of the 30 minute trial wear period so these ratings were combined for further analyses. Significant differences were found in prickliness for the seven labels, when subjects identified perceptions of both comfort related to prickliness and intensity of that prickliness. The label perceived as most comfortable and least prickly was a satin weave, uncoated, printed loop label with woven selvage sides. Stiffness perceptions for the seven labels were not found to be significantly different. Differences were noted, however, between the subjects' ratings of the perceived comfort related to the sensation and the perceived intensity of that sensation, both for prickliness and for stiffness.

Labels having heat-sealed edges varied in their visual jaggedness, as seen in the SEM photomicrographs in Appendix E. While jaggedness was noted in one instance, two other labels with heat-sealed edges were smoother. Quality control of this process would seem essential.

CHAPTER V

CONCLUSIONS

Clothing comfort is important to us, affecting our daily lives. Garment labels are a small portion but an important factor in our clothing, influencing the comfort of the garment we wear. Garment labels are required by U.S. law and provide care instructions, fiber content, producer's name or registered number, garment size and country of origin. In Smith's study (1986b), over 65% of the people interviewed in the U.K. had cut labels out of garments because the labels were irritating their skin. The study by Davis, Dallas et al. (1990) reported 44.3% of U.S. respondents had problems with labels causing skin irritation. It is important for apparel manufacturers to use comfortable labels attached to the clothing.

In this study seven labels with various label forms, coating, constructions and edge treatment combinations were chosen to investigate the relationship between certain clothing labels and skin sensations. These labels were stitched into the back neckline of a cotton knit polo shirt. Ten female students ages 18 to 30 participated in this study. The wear trials were completed in the textile conditioning lab where temperature was maintained at 70° F $\pm$ 2° F and relative humidity at 65% $\pm$ 2%. The wear study protocol consisted of a beginning stabilization period, non-strenuous reaching and moving activities and

an inactive reading period for a total of 30 minutes. Data were collected by a subjective Comfort Rating Chart. Two sets of polar adjectives, prickly/smooth and stiff/flexible, were selected to study garment label comfort next to skin. A Likert-type scale was used, with 1 being very prickly or very stiff and 5 being very smooth or very flexible. Each subject wore each of the seven labels. Subjects were asked to complete the Comfort Rating Chart at the beginning and the end of the wear trial.

Hypotheses were tested by analysis of variances (ANOVA), LSD multiple comparison tests and chi-square analyses.

Null Hypothesis 1. There are no differences in the sensations of prickliness and stiffness perceived immediately and the sensations perceived at the end of a wear trial among the garment labels.

At the 90% confidence level no significant differences were found for the sensations perceived by subjects at the beginning and the end of the wear trial. Therefore, the null hypothesis was accepted and data were combined for the rest of the analyses testing.

Null Hypothesis 2. There are no differences in the comfort related to the perceived prickliness among the garment labels.

The null hypothesis was rejected since differences were found between the subjects' perceptions of prickliness for different labels, using a 90% confidence level. The order for the seven labels, from highest rating to lowest rating for comfort related to prickliness, was: label C (mean=4.50), label A (mean=4.10),

label D (mean=4.05), label B (mean=3.90), label F (mean=3.75), label E (mean=3.65) and label G (mean=3.50). The LSD multiple range analysis test showed that label C was different from the other labels, and was the most comfortable label for smoothness/prickliness (mean=4.50). The other six labels were different from label C but not from each other, because the differences between the mean score of these six labels were very small.

Null Hypothesis 3. There are no differences in the intensity of perceived prickliness among the garment labels.

The null hypothesis was rejected at the 90% confidence level. The order for the seven labels, rated highest to lowest in perceived smoothness/prickliness, was: label C (mean=4.65), label A (mean=4.15), label F (mean=3.95), label D (mean=3.85), label G (mean=3.75), label B (mean=3.75) and label E (mean=3.65). The result of LSD multiple range test showed label C differed from the other labels, but the other six labels were in the same group. Label C was an uncoated, satin weave label with woven selvage sides and a folded bottom edge forming a loop, and was perceived as the smoothest, least prickly label. The other six labels were not different from each other, but were more prickly than label C.

Null Hypothesis 4. There are no differences in the comfort related to the perceived stiffness among the garment labels.

At the 90% confidence level no differences were found among the labels when subjects perceived comfort related to the degree of stiffness. Thus, the

null hypothesis was accepted.

Null Hypothesis 5. There are no differences in the intensity of perceived stiffness among the garment labels.

The null hypothesis was accepted, since at the 90% confidence level no differences were shown among the labels when subjects rated their perception of the intensity of stiffness.

Null Hypothesis 6. There are no differences between comfort related to prickliness and the intensity of prickliness of garment labels.

This null hypothesis was rejected since at the 90% confidence level there were differences between the subjects' perceived comfort for prickliness and their perception of the intensity of prickliness for garment levels.

Null Hypothesis 7. There are no differences between comfort related to stiffness and the intensity of stiffness of garment labels.

Again, differences were found at the 90% confidence level between the subjects' perceived comfort for stiffness and their perceived intensity of stiffness of garment labels. Therefore, the null hypothesis was rejected.

Summary

Four of the seven null hypotheses were rejected at the 90% confidence level. Differences were found for the subjects' perceived prickliness sensations in both in the comfort related to prickliness and in the intensity of prickliness/ smoothness of the garment labels.

Label C was perceived as the most comfortable label (mean=4.50) and the smoothest, least prickly label (mean=4.65) among the seven labels. This label was an uncoated, satin weave, loop label with woven selvage sides and a folded bottom edge. The results also revealed that heat-sealed edge treatments were in the less comfortable, more prickly group, as were the coated labels and the nonwoven label. Even though the heat-sealed edge treatment is an easy and inexpensive way to cut the labels, controlling the process seems critical for acceptance.

Significant differences were also noted between the perception of comfort related to prickliness and the intensity of that sensation. And for stiffness perceptions of labels, there were also significant differences between comfort and intensity. This means that even though the subjects rated a label intensely prickly or stiff, they would not necessarily carry over this rating to the perception of comfort.

Three null hypotheses were accepted when differences were not found at the 90% confidence level. No differences were found in the sensations of label prickliness and stiffness perceived immediately and at the end of the wear trial. Therefore, data from these two testing periods were pooled for further analyses. It appears that any further wear testing of labels could utilize a shorter wear period, since the initial perception of the participant does not appear to change after wearing longer.

Differences were not found among labels for either the perceived stiffness

related to comfort level or the intensity of that perceived stiffness. The reason could be that the label was a small portion in the garment, and that for such a small surface area it was hard for the subjects to perceive sensations of stiffness.

The results showed that label C, an uncoated, satin weave, loop label having a woven selvage edge and folded bottom, was the most comfortable, least prickly label of the seven labels evaluated. However, this label would be two to three times more expensive than labels using the heat-sealed or straight cut edge treatments, because these latter methods are much faster to produce. Apparel manufacturers should be aware of public demands for comfort of garment labels and consider the benefit of the added expense. Label manufacturers could produce more comfortable labels by using woven selvage edge treatments compared to other edge treatments, as well as by considering satin weave and folded loop labels. When heat-sealed labels are selected for economical reasons, quality control of the cutting process becomes essential.

Recommendations

There are still several aspects about garment labels that have not been investigated. For further research, the thread used to sew in the labels needs to be considered. Other things about the label itself, such as amount of surface area touching the skin, weight, size, and the fiber content, also are very important and could be investigated. This study used new labels, and for

further investigation the labels could be washed several times before being worn and evaluated.

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APPENDICES

APPENDIX A

SUMMARY OF CONTACT SENSATION TERMS USED IN PREVIOUS TEXTILE STUDIES:

Contact sensation terms used in pervious studies were identified. Six categories for those contact sensation terms were established: thermal, static, moisture, weight, fit and surface contact sensations. The exact term used was identified, and the researchers who used this term are listed. When the author defined the term used, that definition is given quotations.

1. **Thermal terms:**

Warmth - Ellis & Garnsworthy (1980), Lundgren (1969), Peak (1975)

Coldness - Lundgren (1969), Peak (1975)

2. **Static terms:**

Clingy - Hollies et al. (1979), Smith (1985)

Staticy - Hollies et al. (1979)

3. **Moisture terms:**

Damp - Hollies et al. (1979)

Clammy - Hollies et al. (1979)

Non-absorbent - Hollies et al. (1979)

4. **Weight terms:**

Heaviness - An assessment (1966), Lundgren (1969), Brand (1964), Winakor & Kim (1980)

> Definition: "The quality of a fabric to demonstrate bulk or mass". (An assessment, 1966, p. 31)

Weight - Ellis & Garnsworthy (1980), Barker & Scheininger (1982), ASTM (1989)

> Definition: "The heaviness of the fabric". (Barker & Scheininger, 1982, p. 616)

Definition: "The force exerted on a body by gravity". (ASTM, 1989, p. 50)

Thickness - Ellis & Garnsworthy (1980), An assessment (1966), Barker & Scheininger (1982), ASTM (1989), Winakor & Kim (1980)

Definition: "The distance between the top surface of the fabric and the bottom surface. If this distance is small, the fabric is thin". (Barker & Scheininger, 1982, p. 616)

Definition: "The quality in a fabric as related to its density or weight per unit volume as based on measurement of thickness and fabric weight". (An assessment, 1966, p. 31)

Definition: "The distance between one surface and its opposite". (ASTM, 1989, p. 45)

5. **Fit terms:**

Snug - Hollies et al. (1979)

Loose - Hollies et al. (1979)

6. **Surface terms:**

A. Smooth vs Rough terms:

Smoothness - Ellis (1980), An assessment (1966), Barker & Scheininger (1982), Behery(1986), Winakor & Kim(1980), Lundgren(1969), Peak(1975), ASTM (1989)

Definition: "Smoothness suggests a fabric surface that feels free from roughness. The surface of a smooth fabric will offer little resistance to slipping when rubbed". (Barker & Scheininger, 1982, p. 616)

Definition: "The low divergence of the fabric surface from planeness". (An assessment, 1966, p. 31; ASTM, 1989, p. 40)

Prickle - Smith (1985), Garnsworthy et al. (1988), Oxford (1961)

Definition: "Pin-pricks". (Smith, 1985, p. 36)

Definition: "A pricking or goading sensation". (Oxford,1961, p. 876)

Definition: "having the quality of a sensation like many very gentle pin-pricks. Itch is usually a component or after sensation of prickle and initiates a desire to scratch the skin for relief". (Garnsworthy et al., 1988, p. 1).

Definition: "Prickly - having a sensation as of many pricking points smarting, as if full of prickles".. (Oxford, 1961, p. 876)

Coarseness - Ellis & Garnsworthy (1980), An assessment (1966), Winakor & Kim (1980)

Definition: "The surface quality of a fabric which reflects its unevenness or its three dimensional plane. The ASTM definition is the surface friction or high resistance to slipping offered by the surface of a fabric". (An assessment, 1966, p. 30)

Scratchy - Hollies et al. (1979), Winakor & Kim (1980), Smith (1985), Garnsworthy (1988)

Definition: "Sand-paperish". (Smith, 1985, p. 36)

Rough - Winakor & Kim (1980), Lundgren (1969), Peak (1975), Stockbridge & Kenchington (1957), ASTM (1989)

Definition: " A descriptive term for a fabric surface which has the feel of sandpaper". (ASTM, 1989, p. 37)

Definition: "Roughness implies bodily discomfort when worn next to skin". (Stockbridge & Kenchington, 1957, p. 27)

Harshness - Ellis & Gransworthy (1980), Brand (1964)

Definition: "Bite when bite is undesirable. Thus, a harsh tweed would be described as having bite, but a bitey gabardine would be described as harsh". (Brand, 1964, p. 796)

B. Pliable vs Stiff terms:

Softness - Ellis & Gransworthy (1980), An assessment (1966), Winakor & Kim (1980)

Definition: "The quality in the fabric which permits ease of squeezing or compression. This quality usually reflects itself in the bulk or body of the

fabric". (An assessment, 1966, p. 31)

Firmness - Ellis & Gransworthy (1980), An assessment (1966), Winakor & Kim (1980), Brand (1964)

Definition: "The opposite quality in a fabric of softness; or the resistance to squeezing or compression. Since it is the opposite of softness, the bulk or body is involved". (An assessment, 1966, p. 31)

Hard - Winakor & Kim (1980), Brand (1964)

Definition: "Dense and lacking in compressional resilience". (Brand, 1964, p. 796)

Stiffness - Ellis & Gransworthy (1980), Barker & Scheininger (1982), Behery (1964), Lundgren (1969), Peak (1975), Brand (1964), ASTM (1989), Winakor & Kim (1980)

Definition: "Stiffness is the resistance to bending. If the fabric can bends easily, it is flexible and not stiff". (Barker & Scheininger, 1982, p. 616)

Definition: "Resistance to bending". (ASTM, 1989, p. 42)

Flexibility - Lundrgen (1967), Winakor & Kim (1980), ASTM (1989)

Definition: "That property of a material by virtue of which it may be flexed or bowed repeatly without undergoing rupture, easy of bending". (ASTM, 1989, p. 23)

APPENDIX B

VOLUNTEER QUESTIONNAIRE

JOIN US

This is an AIHM research project to study garment comfort. We need your help! Come and join us! Just one hour at a time, for eight different sessions. During the one hour session, you will have time to read and study while wearing a particular knit shirt. The sessions will be individually scheduled at a time convenient to you this Winter term. With your help we will learn more about garment comfort problems.

To thank you for volunteering for this project you will get a coupon for pizza at the completion of this project.

Yes! I can join this project!

Name: _____

Age: _____

Major: _____

Usual shirt size: _____

Address: _____

Telephone: _____

Are you sensitive to skin irritation when wearing clothing?

Yes, Very Sensitive				No, Not sensitive At all
1	2	3	4	5

Please mark (X) if you are busy (class, work, lunch, etc.). Leave blank the times you are free. I will contact you then to set up appointments.

	M	U	W	H	F
8:30					
9:30					
10:30					
11:30					
1:30					
2:30					
3:30					
4:30					

Any further question, please contact Liling Cho (753-4112) or Dr. Simpson (737-0996). Thank you!

APPENDIX C

INSTRUCTIONS FOR WEAR TRIAL

Folder #1 Instructions

1. When you come in the conditioning room, please sit down and set the timer for 10 minutes. You may read from one of the magazines or your homework.

2. After 10 minutes please put on the knit shirt provided. Step out into the conditioning foyer to dress. Take off your own shirt, but keep on your bra. Put on the shirt, button all of the buttons at the neckline placket, and tuck the shirt into your jeans or skirt.

3. When dressed, come out and ask me for the first rating chart (yellow). Go back into the conditioning room to fill it out.

4. When finished, place this chart in the folder labeled Rating Chart #1.

Please go to folder #2 for the next set of instructions.

Thank you.

Folder #2 Instructions

1. When you finish with the yellow rating chart, please set the timer again for 10 minutes. Now you will do some "light activities" involving movement of arms and body, described below, #2-6. Whenever you hear the timer ring, you must STOP these actions ! (You do NOT need to finish all these activities.)

2. Pick up the fabric samples from the second shelf and hang each of these pieces on the rack provided.

3. Then pick up the books and magazines on the table, one at a time, and place these items on the top shelf.

4. Remove the fabric samples from the rack and stack in the box provided.

5. Take the books and magazines off the top shelf and replace them back on the table where they were originally.

6. STOP when the timer rings.

Please go to folder #3 for the next set of instructions.

Thank you.

Folder #3 Instructions

1. For the last 15 to 20 minutes of your wearing trial period, you may sit quietly and read from the books, magazines or your homework.

2. You will be told by Liling when to stop reading. (i.e. when your total wearing time is completed.) Do NOT set your timer.

3. She will bring you a second rating chart and ask you to complete it.

4. After completing this rating chart (blue), you may take off the knit shirt, place it on the hanger and get dressed. The wear trial period is over. When you leave the room, please return the blue rating chart and your knit shirt to Liling.

Thank for your participation today !

APPENDIX D

COMFORT RATING CHART

COMFORT RATING CHART

Date:_____ Participant:_____ #_____

For the knit shirt you are now wearing, please rate both of the following aspects:

1. the intensity of these sensations: stiffness and prickliness
2. the level of comfort associated with these two sensation

*** Consider these locations: the fabric itself, the front placket area, the underarm seams, the collar, and the label.

** Rate each by circling an appropriate number. There are no right or wrong answers.

INTENSITY of STIFF-FLEXIBLE SENSATION for:

	VERY STIFF				VERY FLEXIBLE
A. Fabric itself at back shoulder blade area:	1	2	3	4	5
B. Front placket area:	1	2	3	4	5
C. Seams at both underarm sides:	1	2	3	4	5
D. Collar around back neck area :(not the label)	1	2	3	4	5
E. Label at back neck:	1	2	3	4	5

INTENSITY of PRICKLY-SMOOTH SENSATION for:

	VERY PRICKLY				VERY SMOOTH
A. Fabric itself at back shoulder blade area:	1	2	3	4	5
B. Front placket area:	1	2	3	4	5
C. Seams at both underarm sides:	1	2	3	4	5
D. Collar around back neck area :(not the label)	1	2	3	4	5
E. Label at back neck:	1	2	3	4	5

Use comfort scale of:

1 = very uncomfortable
2 = somewhat uncomfortable
3 = OKAY
4 = somewhat comfortable
5 = very comfortable

COMFORT related to the degree of STIFFNESS:

		VERY UNCOMFORTABLE	SOMEWHAT UNCOMFORTABLE	OKAY	SOMEWHAT COMFORTABLE	VERY COMFORTABLE
		1	2	3	4	5
.....	A. COMFORT of stiffness for Fabric itself at back shoulder blade area:					
.....	B. COMFORT of stiffness for Front placket area:	1	2	3	4	5
.....	C. COMFORT of stiffness for Seams at both underarm sides:	1	2	3	4	5
.....	D. COMFORT of stiffness for Collar around back neck area :(not the label)	1	2	3	4	5
.....	E. COMFORT of stiffness for Label at back neck:	1	2	3	4	5

COMFORT related to the degree of PRICKLINESS:

		VERY UNCOMFORTABLE	SOMEWHAT UNCOMFORTABLE	OKAY	SOMEWHAT COMFORTABLE	VERY COMFORTABLE
		1	2	3	4	5
.....	A. COMFORT of prickliness for Fabric itself at back shoulder blade area:					
.....	B. COMFORT of prickliness for Front placket area:	1	2	3	4	5
.....	C. COMFORT of prickliness for Seams at both underarm sides:	1	2	3	4	5
.....	D. COMFORT of prickliness for Collar around back neck area :(not the label)	1	2	3	4	5
.....	E. COMFORT of prickliness for Label at back neck:	1	2	3	4	5

APPENDIX E

LABEL SPECIMENS AND SCANNING ELECTRON PHOTOMICROGRAPHS

Figure 1. Label A.

Note. Label A is a loop, plain weave, uncoated label with heat-sealed sides and folded bottom edge treatment.

Figure 2. Photomicrograph of label A.

Note. Shown is left edge of label at left hand side of photo, and bottom of label at right hand side of photo, at 50x power.

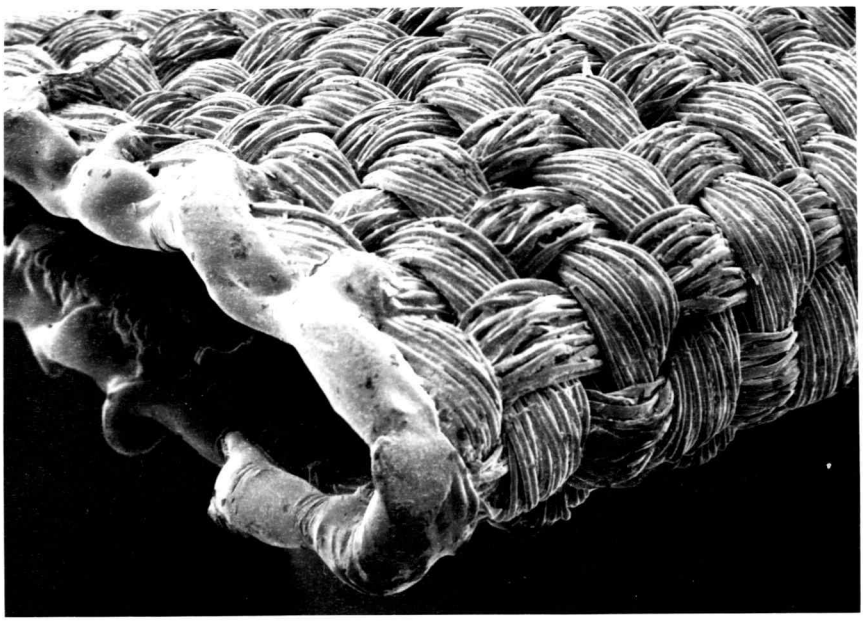

Figure 3. Label B.

Note. Label B is a flat folded, plain weave, uncoated label with folded sides and woven selvage bottom edge treatment.

Figure 4. Photomicrograph of label B.

Note. Shown is left edge of label at left hand side of photo, and bottom of label at right hand side of photo, at 50x power.

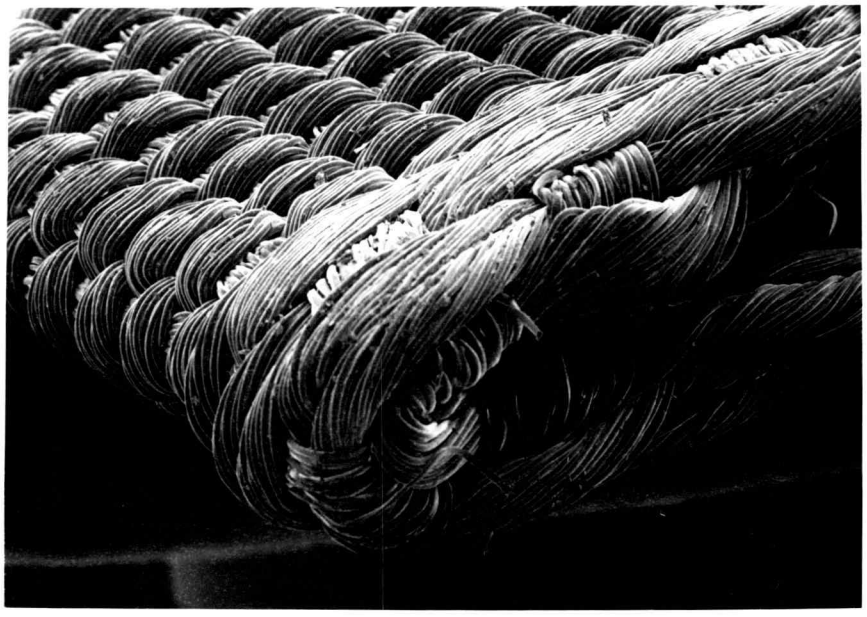

Figure 5. Label C.

Note. Label C is a loop, satin weave, uncoated label with woven selvage sides and folded bottom edge treatment.

Figure 6. Photomicrograph of label C.

Note. Shown is left edge of label at left hand side of photo, and bottom of label at right hand side of photo, at 50x power.

Figure 7. Label D.

Note. Label D is a flat single, twill weave, uncoated label with heat-sealed sides and woven selvage bottom edge treatment.

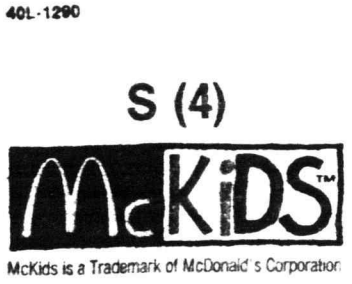

Figure 8. Photomicrograph of label D.

Note. Shown is left edge of label at left hand side of photo, and bottom of label at right hand side of photo, at 50x power.

Figure 9. Label E.

Note. Label E is a flat single, rib weave, uncoated label with woven selvage sides and heat-sealed bottom edge treatment.

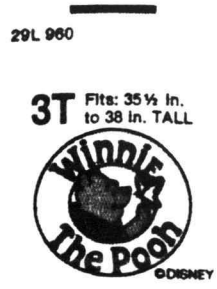

Figure 10. Photomicrograph of label E.

Note. Shown is left edge of label at left hand side of photo, and bottom of label at right hand side of photo, at 50x power.

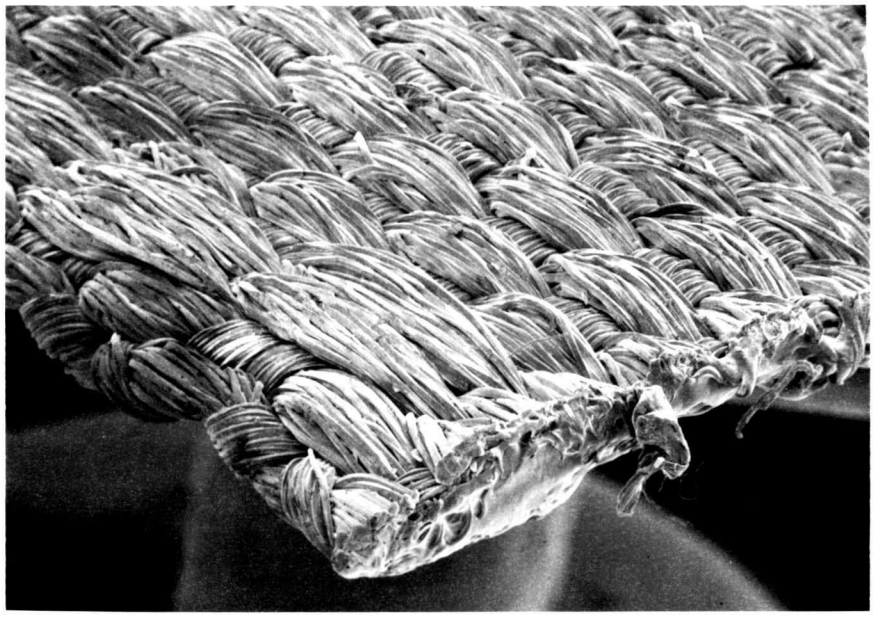

Figure 11. Label F.

Note. Label F is a flat single, plain weave, coated label with straight cut sides and straight cut bottom edge treatment.

Figure 12. Photomicrograph of label F.

Note. Shown is left edge of label at left hand side of photo, and bottom of label at right hand side of photo, at 50x power.

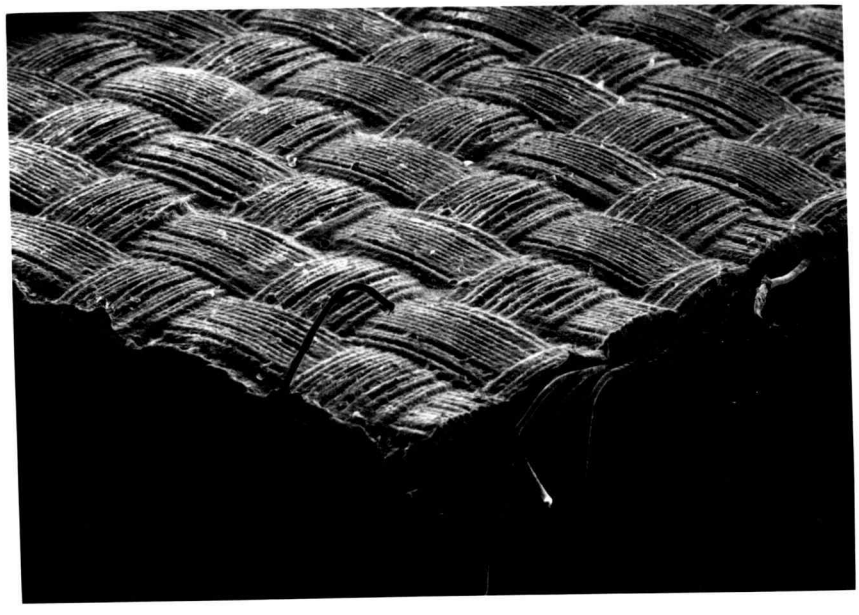

Figure 13. Label G.

Note. Label G is a flat single, nonwoven, coated label with straight cut sides and straight cut bottom edge treatment.

Figure 14. Photomicrograph of label G.

Note. Shown is left edge of label at left hand side of photo, and bottom of label at right hand side of photo, at 50x power.