

Subjective Testing for Clothing Comfort

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Abstract:

Clothing and textile products are essential materials used in daily for obtaining physiological and psychological comfort in life. Clothing comfort is a complex concept and therefore it is difficult to define and measure the phenomenon. Objective testing pertaining to the concept although measure parameters related to the comfort but there yet there are no physical instruments to measure what a wearer is thinking or feeling objectively. The real comfort of clothing is measured through subjective testing which relates to the direct measure of the individual's opinion by the use of psychological scaling techniques, like descriptor, assessment techniques of fabric hand attributes and wear trial technique. The subjective testing of comfort involves complicated processes in which subjective perception is formed with number of stimuli about clothing and external environments being communicated to the brain through sensory responses. Subjective testing can be done at fabric as well as at the garment level, using various types of measurement scales and different types of scaling techniques. Subjective testing of textile material at fabric and garment level serve as very important information for forming and understanding the concept of personal comfort.

Keywords: Clothing comfort, descriptor, psychological scaling, subjective perception, wear trial technique

I. INTRODUCTION

Comfort is a basic requirement for human clothing. The feeling of comfort is one of the key factors at the time of clothing selection. Wearer's perception of clothing comfort is influenced by various factors among which, most considered are, temperature (external), relative humidity, wind velocity, metabolism of the wearer, clothing system and its characteristics and heat exchange process between human body and environment. There is no clear cut definition of comfort because subjective perception of comfort varies from individual to individual. Slater defined comfort as "a pleasant state of physiological, psychological and physical harmony between a human being and the environment" and on the basis of this comfort categories into four group's i.e. Psycho-aesthetic, Sensorial, Ergonomic and Thermo-physiological comfort.

Clothing fulfils various functions such as adornment, status, modesty and protection and on the basis of these function it can be says that clothing plays an important role in determining the comfort level of a wearer subjectively. Number of processes determines status of wearer's comfort as:

- ❖ **Physical processes** relates to all those phenomenon that are associated with providing physical stimulus to the wearer's body like the heat and moisture transport management of clothing, clothing and wearer's body interaction, and reflection and absorption of light by the clothing.
- ❖ **Neurophysiological processes** are associated with the neurophysiological mechanisms of the sensory organs, by which sensory signals are formulated when the body and clothing interact with the nearby environment.
- ❖ **Psychological processes** comprise of the processes occurring in the brain through which subjective perceptions of any of the stimulus is formed from the obtained neurophysiological sensory signals.
- ❖ **Thermophysiological processes** are associated with the heat and moisture transport mechanism of the clothing system and the way that clothing regulates and maintain the wearer body temperature ^[1, 2, 3].

II. CLOTHING COMFORT MODELS

In 1970, Fourt and Hollies gave clothing comfort model emphasizing the role of clothing in the wearer-environment relationship. Clothing may be either part of the environment or an additional part of the body and it is necessary to a person to survive in adverse environmental condition. He only focused on protective and functional aspect of clothing not mentioned other factors i.e. social and psychological aspects. Following this, Pontrelli (1977) introduced "Comfort's Gestalt Model" and classified various variables affecting wearer's comfort such as physical, psycho-physiological, and psychological variables. The model exhibits a need to assess the perceptions subjectively and explains which aspect is affected by or affects the other aspects of comfort ^[1, 4].

III. WHAT IS SUBJECTIVE TESTING?

A subjective measure is the direct measure of the opinion of a person, though objective testing can measure the parameters which may be related to the comfort but there are no physical instruments to measure what a wearer is feeling, objectively. The subjective perceptions involve psychological processes for evaluation of comfort status. Body-clothing interactions with external and internal environments also play significant role in determining the wearer's

comfort level. The perception of clothing comfort can be measured either through psychological scaling or through descriptors and these tests can be done at fabric level as well as garment level.

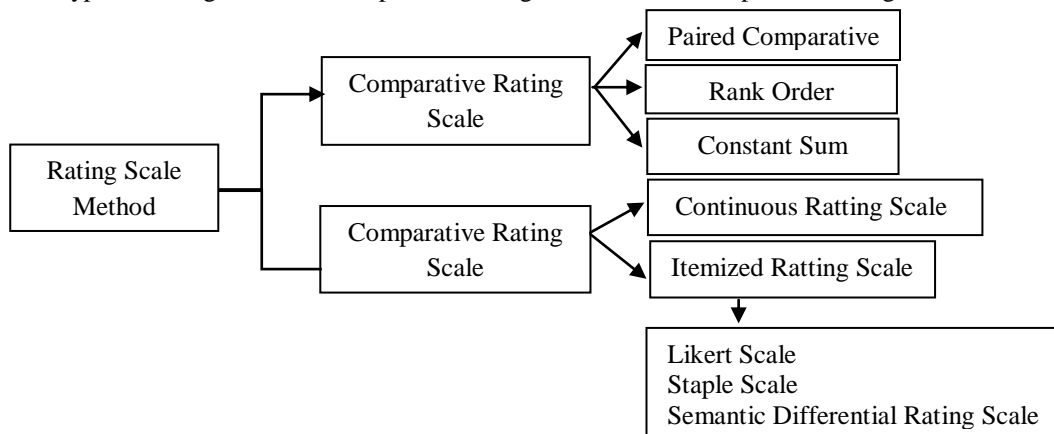
1. Psychological scaling: It is the process of making judgments based on individual words or language collected from experience. The number does not always correspond to the 'real' numbers that are obtained from objective measurement. In research; all four types of level of measurements have been applied.

- **Nominal:** A scale in which the numbers or letters assigned to objects serve as labels for identification or classification and that numbers have no values. For instance, we assign 0 to wool and 1 to silk. The number 1 does not mean a superior position to the number 0. The rule for nominal scales is that all members of a class have the same number and no two classes have the same number.
- **Ordinal:** It comprises numbers or symbols used to rank the objects according to their characteristics but the intervals of the scale are not equal. For example: In the evaluation of softness of **different types of natural fibres** and silk fibre get 2nd rank and cotton get 10th rank than it cannot be said that silk is five times softer than cotton respectively in order of most to least preferred. It only ranks the items from highest to lowest.
- **Interval:** This scale not only classifies and orders the measurements but also specifies the distance between each interval on the scale is equal. For example: on the comfort properties of merino wool by scoring them on 5 point scale from 1 to 5 (1= Excellent, 2= Very Good, 3= Good, 4= Poor, 5= worst)

Merino Wool	Excellent	Very Good	Good	Poor	Worst
Thermal					
Softness					

- **Ratio:** It is the highest level scale that permits the researcher to classify, rank-order the objects and compare the intervals.

2. Rating Scale method: It is one of the most important methods which are frequently used for subjective evaluations. There are two types of rating scales i.e. comparative rating scale and non-comparative rating scale.



a. Comparative rating scales: In this scale, some standards are provided to the respondent during rating time. It is further divided into three categories: paired comparison, rank order and constant sum.

- ❖ **Paired comparison:** Respondent is presented with two objects at a time. Then asked to select one object in the pair according to some criterion. It is used only when few items are compared. **For example:** Compare the softness property of merino wool with angora wool and Pashmina wool with angora wool:

Wool	Merino Wool	Angora Wool
Merino Wool	-	
Pashmina Wool		-

- ❖ **Rank Order:** Respondents are presented with several objects simultaneously. Then asked to rank them according to some criterion. **For example:** Rank the following wool according to their softness-

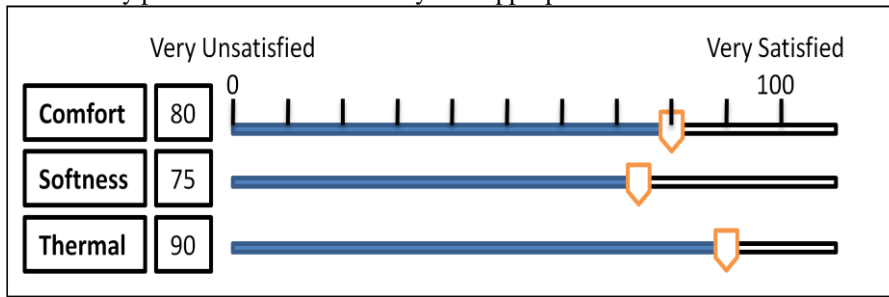
Wool	Rank
Merino Wool	3
Angora Wool	1
Pashmina Wool	2

- ❖ **Constant Sum:** Respondents are asked to allocate a constant sum of units among a set of stimulus objects with respect to some criterion. **For example:** The points are given out of 20 to each attributes-

Attributes	Number of points	
	Merino wool	Angora wool
Thermal	15	14
Fineness	18	17
Softness	18	19

b. Non-comparative rating scales: In this rating scale, not standard provided to the respondent during rating time. This scale can be categories into two ways: continuous and itemized non-comparative rating scales.

❖ **Continuous non-comparative rating scale:** It is also known as graphic rating scale. Respondents are required to make a mark at any point on the scale that they find appropriate.



❖ **Itemized non-comparative rating scale:** The respondents are provided with a scale that has a number or brief description associated with each category. This scales can be in the form of:

Itemised Graphic Scale	Itemised Verbal Scale	Itemised Numeric Scale
☺ Favourable	Completely satisfied	-3
	Somewhat satisfied	-2
☹ Indifferent	Neither Satisfied nor dissatisfied	-1
	Somewhat dissatisfied	0
	Somewhat dissatisfied	+1
	Somewhat dissatisfied	+2
☹ Unfavourable	Completely dissatisfied	+3

✚ **Likert scale:** It is designed to study how strongly respondent (subject) agree or disagree with statements on 5 or 7 point scale.

Strongly disagree	1
Disagree	2
Neither agree nor disagree	3
Agree	4
Strong agree	5

✚ **Stapel scale:** It is a vertical unipolar rating scale with 10 categories ranging from -5 to +5, without neutral (zero) point. It mainly used for analysing the attitude of the respondent towards the object.

✚ **Semantic Differential Scale:** It is a 7 point rating scale (either -3 to +3 or 1 to 7 scale) with end points associated with bipolar labels that have semantic meaning.

Descriptor	Extremely	Very much	Some What	Neither Both	Some What	Very much	Extremely	Descriptor
Soft	3	2	1	0	-1	-2	-3	Hard
Smooth	3	2	1	0	-1	-2	-3	Rough
Cool	3	2	1	0	-1	-2	-3	Hot

Scales to Measure Direct Responses

❖ **Hollies** used a number of itemized rating scales for the sensations derived from participants;

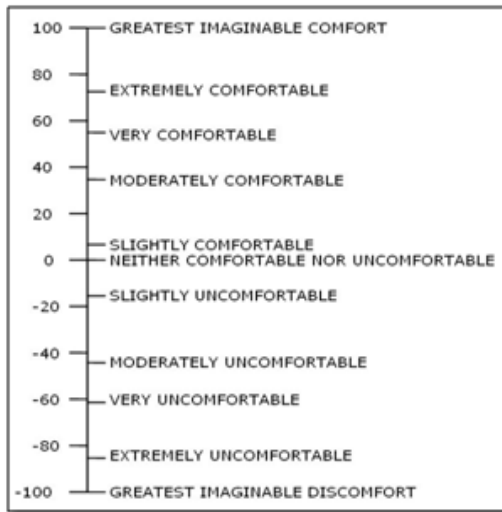
Hollies' Four point Scale (1977)
4= Partially
3=Mildly
2= Definitely
1= Totally

Hollies' Five point Scale (1979)
1 Totally uncomfortable
2
3
4
5 Completely comfortable

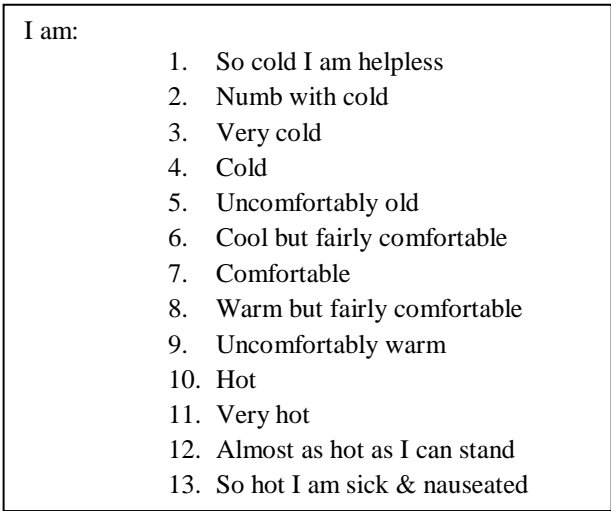
Source: Y. Li, *The Science of Clothing Comfort*, Textile Progress, 2001

❖ **Comfort Affective Labeled Magnitude (CALM) Scale**

The scale was developed at the Individual Protection Directorate, US Army Natick Soldier Center, Natick, MA. The value of points in scale ranges from -100 to 100 where -100 represents greatest imaginable discomfort and 100 represents greatest imaginable comfort.



CALM Scale



McGinnis' Thermal Scale

Source: Y. Li, The Science of Clothing Comfort, Textile Progress, 2001

❖ **McGinnis' Thermal Scale (1979)**

13 point interval scale was developed by McGinnis while working in Army Natick Laboratories. In this scale the interval between each point are not defined properly [1,8,9,10,11,12,13].

2 Comfort Sensory Descriptors

Sensory descriptors are used to gather subjective feeling/sensation of the wearer. Hollies reported that participants experienced different sensations when sweating occurred. The experienced descriptors felt by the participants were enlisted as Heavy, loose, lightweight, stiff, sticky, non-absorbent, cold, clammy, clingy, damp, picky, rough and scratchy. David *et al.* in his study reported some of the “bipolar descriptors” as- coarse-fine, harsh/hard-soft, rough-smooth, cool-warm, stiff-pliable and rusty-quiet for evaluating men's winter suiting fabrics [1]. Bernard *et al.* (2009) also reported polar descriptors in Table 2, which are also used in clothing comfort evaluation.

Polar pair	Fabric Properties
limp-crisp, flexible-stiff, firm-sleazy	Bending
scratchy-silky, fine-coarse, smooth-rough	Frictional
thin-thick, hard-soft	Compression
light-heavy	Area density

IV. ASSESSMENT TECHNIQUE OF SUBJECTIVE TESTING COMFORT

❖ **Assessment Techniques of Fabric Hand Attributes**

Assessment of fabric hand attributes are mainly used for analysing the clothing comfort before a garment is prepared and worn by the wearer. Therefore the assessment of fabric hand is important. The concept of “fabric hand” was introduced by the textile and apparel industry. Fabric hand refers to the sum total of all the sensations experienced by the individual when the textile material is touched. Both subjective and objective attributes can be used to obtain in-depth details of fabric hand. A standardized detailed guideline for subjective assessment of the fabric has been published by AATCC, which prescribes how the specimens have to be prepared and handled [1, 5, 7]. Valatkiene *et al.* (2006) perform blind subjective evaluation method in which a “black box” was used. This method helps in reducing the influence of fabric appearance on the assessment of the fabric hand attributes. She also prepared the list of attributes and its assessment technique, which is given in Table 2.

Attribute	Assessment Technique
Hardness	Place the fabric on the base of “black box” followed by compressing it 3 times. After that hold the sample in between the fingers and bend the corners.
Stiffness/ smoothness/ softness	Hold the sample between two fingers in one hand and sweep it with the palm of other hand from top to bottom.

Stretchability (warpwise and weftwise)	Stretch the sample 3 times in the same direction by holding the edges of the samples with both hands.
Resiliency (warpwise and weftwise)	Stretch the sample 3 times in the same direction by holding the edges of the samples with both hands and left to return back to initial position.
Flexibility	Hold the sample with thumb and index finger so that it falls down across knuckles

❖ Wear Trial Technique

Perceptions of sensory comfort of clothing involve various sensory channels i.e. visual, auditory, smell, taste, and touch. Out of these senses skin plays an important role to sense comfort level of the clothing. Fabric properties such as type of fibre, yarn, fabric structure, fitness of the garment, surrounding environmental conditions i.e. temperature, humidity, wind velocity etc as well as the type of activity are performed by the wearer are directly affect the perception of the wearer and most of the sensations are generated only when the wearer wear the cloth. The main purpose of the wear trial is to gather information from the respondent at garment level. Therefore, wear trial is an important technique for clothing comfort research. Hollies *et al.* developed a wear trial experimental technique:

Various sensory descriptors were generated from the responses of the respondents, after that testing conditions were selected to maximize the perceptions of various sensations. Attitude scales were designed to obtain various sensory responses for a particular item/garment. According to predetermined protocols, wear trials were conducted under controlled testing conditions and data was collected and analysed ^[1]:

V. CONCLUSION

Clothing and textiles fulfil physiological and psychological comfort of human beings and, more fundamentally, ensures conducive physical conditions for our body. The concept of clothing comfort is measured by both subjective and objective means. Objective testing measures the parameters directly related to the comfort yet there are no physical instruments to measure subjective thinking/feeling of a wearer. Subjective testing measures the real comfort of clothing and applies direct measure of the individuals' opinion by employing psychological scales, through descriptor, assessment techniques of fabric hand attributes and wear trial techniques. From the consumer's comfort point of view, subjective testing of textile material at fabric and garment level is very important. Through subjective testing researcher obtain opinions of the wearer which can be a tool for formulating and understanding personal thermal comfort parameters of clothing in different environmental conditions.

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