Using physiological measures to capture wear experiences after running

X.J. ZHANG[#1], Y.Y. WANG[#1], Y. WANG[1], Y.Q.LIU*[1], Y.ZI*[2]

1.National Engineering Laboratory for Modern Silk, College of Textile and Clothing Engineering, Soochow University, Suzhou 215123, China

2.Department of Emergency, NO. 463 Hospital of PLA, Shenyang 110041, China

Abstract

Galvanic skin response is always regarded as a direct and convenient method of recording the activities of sympathetic nerve, and we therefore researched into people's emotional reaction when the body has a contact with wool and acrylic fabrics. Our results showed that wool felt more soft and smooth than that of the acrylic fabric, and wool also performed better in the absorption of moisture. The skin resistance of wool fabric was lower than that of acrylic fabric if the respondent sat in a tranquil condition and the variation amplitude of this resistance also changed little for wool fabrics. This meant that wool may have a broader prospect for sporting garments. Sportswear can also affect people's emotion in two ways. One was that the friction between bodies and garments may have a direct effect on emotional changes. Another influence was that garments may present a balancing action if people sweated excessively or the external temperature changed.

1. Introduction

As a daily necessity, clothing can affect people's emotions when it contacts with human body. Galvanic skin response is the most effective means to measure these emotional changes [1]. The potential difference of skin may increase or decline if the body is stimulated by visual, audible, tactile or other sensory factors, and this phenomenon is seen as galvanic skin Tarchanoff reflection. Galvanic skin response can be used as an indirect indicator of sympathetic activity [2, 3], due to the fact that the sweat gland action is affected by the inside and outside temperature of the body, as well as the physical and psychological activity. Some researchers had analyzed the characteristic of electromyogram EMG and the variation of electro-cortical potential through electromyography EMG and electroencephalographic sensor, so they were able to research on the physiological reaction when the respondents touched the garments [4-6].

Because of the lack of research on using skin resistance value as a comfort index to evaluate the contact between human body and sportswear, our study was to utilize the principle of galvanic skin response to assess the respondent when the skin touched sporting garments, by which we were able to provide data reference for analyzing the comfort of these garments. The majority of research on evaluating the emotional variance is to stimulate the different emotion of the respondent with some external factor such as music [9], video and photograph [7, 8]. Garments can balance the variance of external circumstance if people sweat a lot or the environment temperature changes and this is another influence. Relevant researchers devise a method to test the skin potential and electro-dermal effect, which is an indirect index to characterise respondents' perspiration and emotional changes when they plays physical activities [10], watches emotional movies [11] and sweats [12].

2. Experimental Work

2.1. Materials

A female is more sensitive to external stimulus than a male, because she has a thinner stratum cornerum. It explains why females were chosen to be tested in this research. Average age of the ten respondents was 22-year-old, from Soochow University, and they were healthy and right-handed students. The two knitted outerwear (wools and acrylic fabrics respectively) were used in this experiment, because they have different properties in hygroscopic degree and flexibility. References are given in the following table1.

Table 1. Basic description of the sportswear.

Sample	Composition	Fabric structure	Density (root / 5 cm)	
			warp	Weft
1	100% wool	plain stitch	65	70
2	100% acrylic	plain stitch	60	65

2.2. Experiments

At the first stage, the equipment called Spirit Nexus-16B (Netherlands Spirit-Ming) and the correspondent software (Bio-trace + version 1.20, Mind media B.V. Nether-lands) were used to collect data.75% surgical ethanol can extract fat from the finger-end of the left index finger. And ring-finger until the solvent evaporated completely, and then place the transcutaneous electrical sensor on the processed finger-end [13, 14]. Next, the left hand of respondents flat on the sofa and enable them to feel comfortable. They rested with eyes closed for about 10 minutes and laboratory should be kept quietly, and laboratory personnel cannot move around freely. The raw value of the skin resistance was subsequently recorded after respondents calm down. The following stage is that one knitted outerwear was worn by laboratory personnel appeared in front of the at 1 meter and walked towards the respondents slowly. They have to observe the outerwear about 15 seconds and then rest for 5 seconds, during which time experimenters squatted down to approach the respondents. Afterwards, the respondents continued to touching the outerwear 15 seconds with the right hand and then allowed them to relax for about 15 minutes after the end of these experiments. This experiment is shown in first picture of figure1(a) .

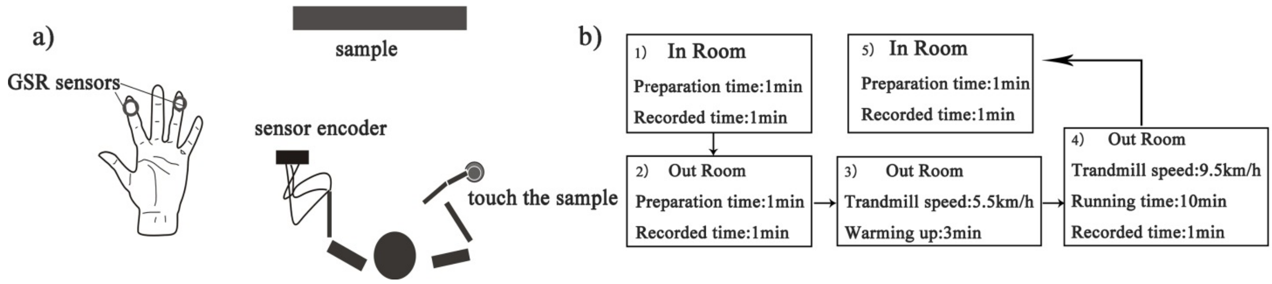

Figure 1. The experimental flow chart of touching and movement

In the next step, the respondents adjusted to the environment for about one minute in a room, and then recorded the skin's resistance for another one minute. Subsequently, the respondents went outside the room and they were allowed one minute to adapt to the outside environment. The skin's resistance was recorded in another one minute (Table2), which was similar to the former process. Then the speed of the treadmill was set at 5.5km/h which enables the respondents to warm up in 3 minutes, after which the respondents ran 10 minutes at the speed of 9.5km/h. The skin's resistance was recorded in one minute after this running. Next, the respondents went back to the room and the skin's resistance was recorded in one minute again. The experiment process is given in second picture of figure1(b) .

Table 2. Experimental environment.

indoor	**room temperature**	25°C± 2°C
	relative humidity	20% -30%
outdoor	**outside temperature**	10°C ± 5°C
	relative humidity	80% -90%

3. Results and Discussion

Wool fabrics had a smooth and soft hand feeling. After 5 seconds, the resistivity of the skin which contacted the wool fabric dropped and maintained steadily after the tenth second (Figure 2). However, because of the irritating hand feeling of acrylic feeling, a successive excitement of sympathetic nerve and a strong galvanic skin response appeared when the respondents touched these fabrics.

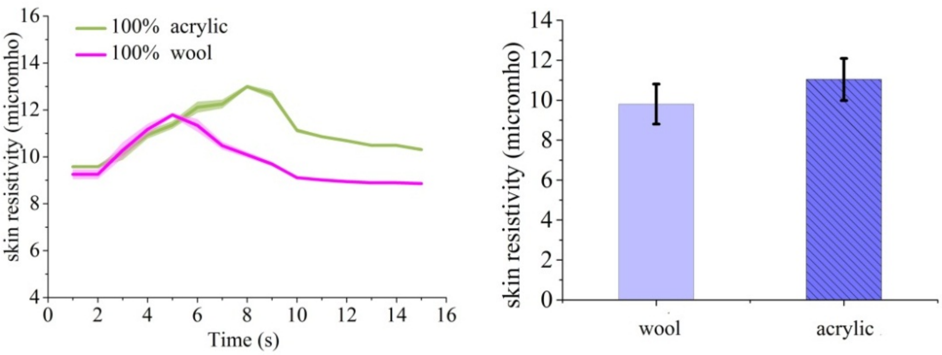

Figure 2. The dynamic skin resistivity during the touch of sample1and sample 2.

Under the same temperature and humidity, the skin resistivity and standard deviation of wearing wool specimen was lower than that of wearing acrylic specimen. Since wearing acrylic specimen was less comfortable than wearing wool specimen, the excitement of sympathetic nerve and psychogenic sweating were induced, which contributed to an increase of the skin resistivity. When the humiture changed, the skin resistivity and the standard deviation also increased significantly and this was the case particularly for acrylic specimen. It was also noticeable that the standard deviation of wearing wool specimen was lower than the figure for wearing acrylic specimen (Figure 3).

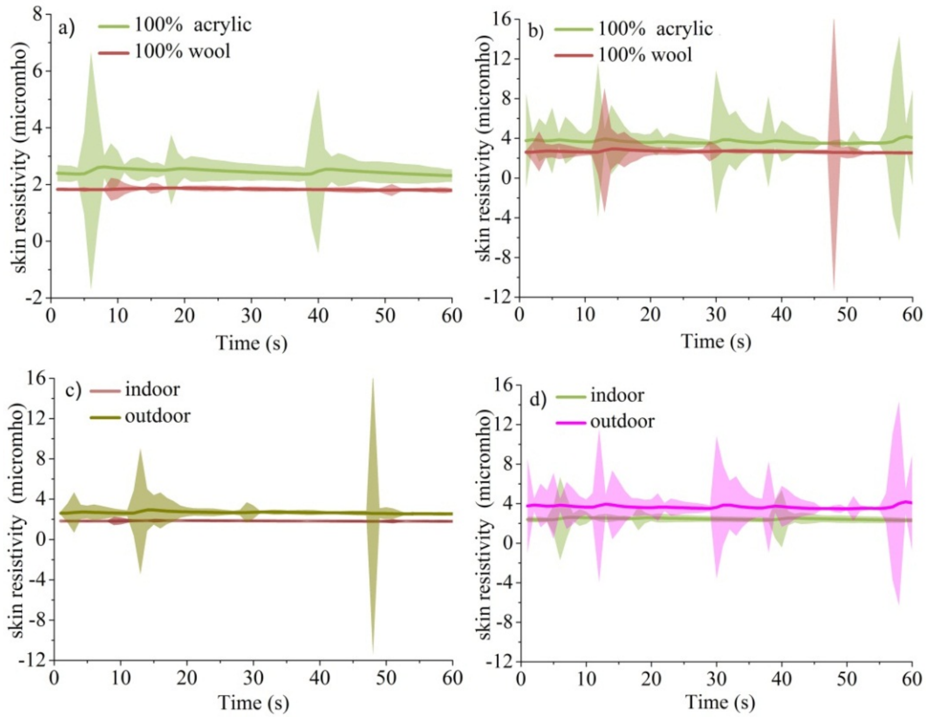

Figure 3. The variation of skin resistivity in a tranquil condition. a) indoor skin resistivity of sample 1 and sample 2. b) outdoor skin resistivity of sample 1 and sample 2. c) indoor and outdoor skin resistivity of sample 1.d) indoor and outdoor skin resistivity of sample 2.

Clothing functioned as a bridge the human body and external circumstance when the respondents sweated a lot after exercise. The skin resistivity of wearing acrylic specimen varied between 10 and 12 micromho, while the skin resistivity of wearing wool specimen remained stable (Figure 4).

At the initial stage of sweating, the surface of wool had not started to absorb moisture owing to the hydrophobicity of wool's scale layer; however, the acrylic specimen had absorbed a large amount of moisture. Under the condition of continuous sweating, the acrylic specimen reached to saturated state earlier than wool specimen. Acrylic specimen was not able to adjust the sultry feeling brought by the humidity inside it, because the acrylic specimen sticked to human body tightly. However, for wool specimen, moisture flowed freely through it then the humidity inside it could be adjusted by absorbing or letting out moisture. Therefore, the discomfort caused by profuse sweating could be avoided.

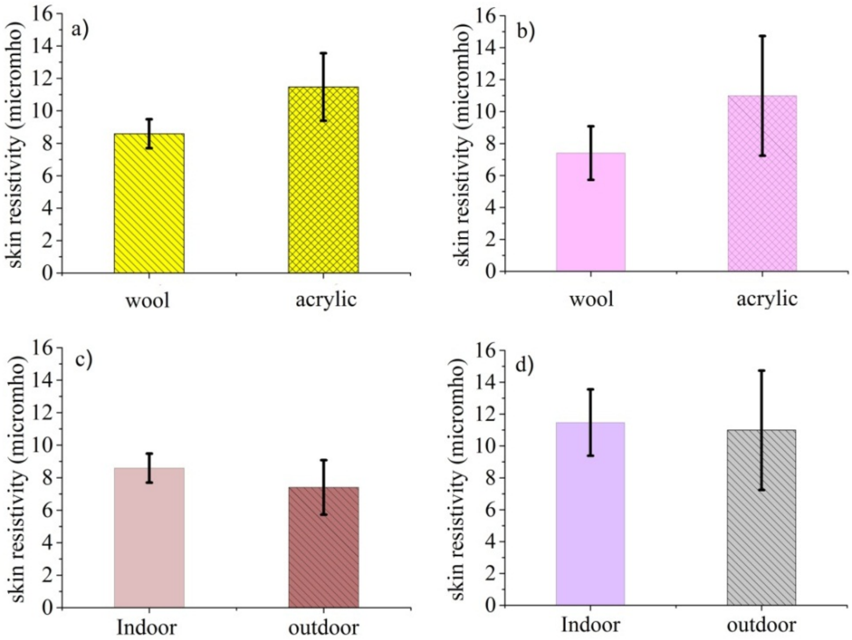

Figure 4. The variation of skin resistivity after running. a) indoor skin resistivity of sample 1 and sample 2 . b) outdoor skin resistivity of sample 1 and sample 2. c) indoor and outdoor skin resistivity of sample 1. d) indoor and outdoor skin resistivity of sample 2.

4. Conclusion

The skin resistivity of the wool fabric is lower than that of the acrylic fabric when the respondents sit in a tranquil condition. This is because the wool fabric performs better in balancing the humiture between bodies and the environment. And the variation amplitude of this resistivity also changed little for wool fabric. It means that wools may have a broader prospect for female sportswear. Their emotion can be affected in two ways. One is that the friction between bodies and garments may have a direct impact on emotional changes. Garments may also present a balancing action if these respondents sweat excessively or the external temperature changes and this is another effect. This is particularly the case in sports events; the property of moisture absorption of the clothing material can have a direct effect on female players' emotion. Galvanic skin response reaction has made it possible for us to measure the emotional feeling when sporting garments contact the skin, which holds the key to carry out research on the comfort of female sportswear.

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Author Information

Corresponding Author
*Email: shliuyq@163.com; ziying008@hotmail.com
Author Contributions
#These authors contributed equally.

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