

Part 1: Athlete's satisfaction with their uniform: Identifying design criteria for optimizing figure skating dress.

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Appropriate functional properties in athletic uniforms are an essential factor for ensuring wearers' safety and comfort as well as promoting their performances in the game (Troynikov & Wardininisih, 2011). In other words, considering the impact of different sporting events and each circumstance is important for selecting an appropriate uniform. Figure skating is presented as a unique combination of sports, art, and athleticism (Han et al., 2018). For this reason, figure skating is popular as a sport around the world, but it is very dangerous and experiences high injury rates (Saunders et al., 2013). Physically, figure skating is one of the sports that the possibility of physical injury as it requires a unique combination of artistic ability, speed, agility, flexibility, and power. Also, an ice-skating rink should be maintained at -3°C to -4°C for figure skaters, who train at least 4 to 6 hours per day, six times per week, for 10 to 11 months per year statistically. Given this environmental condition, many figure skaters are at high risk of a range of dermatological injuries related to mechanical factors as they are exposed to cold temperatures and infectious agents (Tlougan et al., 2011). As the two major problems affecting figure-skating athletes are skin conditions resulting from specific physiological effects of cold exposure as well as physical injury resulting from acute muscular-skeletal effects from the physically demanding postures, it is necessary to identify the design criteria for figure skating uniform (FSU) and improve the supplement point. Thus, this study aims to understand the figure skaters' needs/demands about their uniform (dress) related to the major range of motions of a figure skater and to identify design criteria to perform a new FSU design based on ergonomic aspects (both physical and psychological concerns).

In this study, mix-method research conducted to obtain a better understanding of the research problem and to lead high inference quality: (1) qualitative method: data form both focus group interview and personal interviews and (2) quantitative method: data of a thermal camera. The mix-method supported the research validity through quantitative data to justify the conceptual information such as values, opinions, and behaviors. As well as, the research reliability enhanced by integrating qualitative paradigms. By considering the various circumstance of the target users, FEA (functional, expressive, and aesthetic) consumer needs model (Lamb & Kallal, 1992) was based to profile the design criteria. The FEA model helped to understand the user's demands and to identify the design criteria for the further designs of the figure skating uniform which have diverse themes.

For the qualitative research method (focus group interview and individual interviews), 20 skaters recruited from the ice- link in Mt. Pleasant for the focus group interview. Also, two coaches and three club skaters recruited for the individual interview. According to both focus group interview and individual interviews results, most athletics, who were dissatisfied with

current figure dress. 80 percent of the respondents point out the material and thermal problem, and the rest of others mentioned the fit activity (mobility?), durability, and esthetic. Furthermore, in terms of the main requirements of their future figure skating dress, of those who consented to participate, 70 percent of respondents indicated about the functional textile such as thermal protect, compression, and tactile comfort, 30 percent pointed out the design details such as symbolic express, esthetic, and wearing sensation.

When it comes to the quantitative method, a thermal camera was conducted to determine body temperature on the specific body section on how to differentiate between before and after exercise. The result of the thermal camera showed that the general body temperature after an exercise is lower than the temperature before an exercise (see Figure 1).

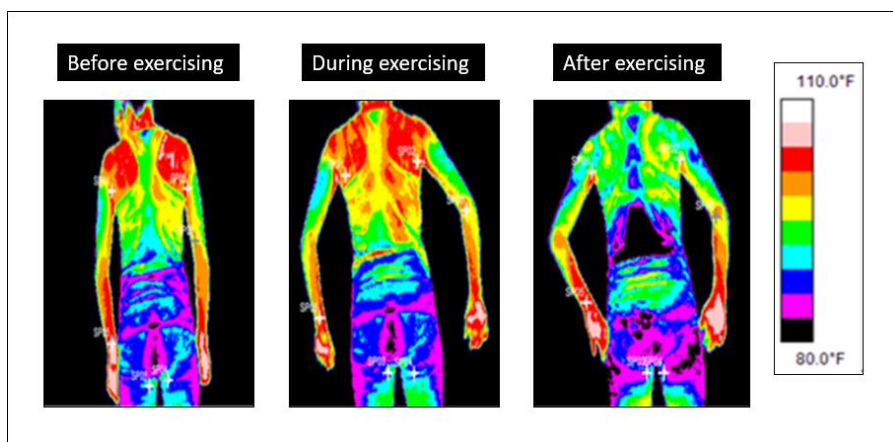


Figure 1. Result of Thermal Camera

According to the thermal camera test, people felt cold after they have exercised which was the phenomenon from the effect of the evaporation. Also, the result showed that the body temperature is getting lower during exercising, and the more the body sweats, the more the temperature falls. Particularly, the specific points on the body such as the shoulder, arm, back, hip, and thigh were the most important points to be evaluated not only the thermal insulation but also moisture permeability. In short, there is a definite possibility that thermal comfort is one of the important properties of sportswear. Especially, figure skating athletes have been always exposed at a low temperature. Thus, these specific thermal points were helpful in generating maximally useful data for not only establishing the design detail point of FSU but also determining the design criteria of FSU.

Table 1. Interaction Matrix of Design Criteria

Design Criteria	Waterproof	Symbolic (Nationality)	Functionality/Protection	Art/Beauty	Elasticity/Compression	Lightweight	Fit/Shape	Thermal comfort	Tactile comfort	Decorative detail	Strength/Durability	Activity/Movement
1. Waterproof												
2. Symbolic (Nationality)	○											
3. Functionality/Protection	∑	○										
4. Art/Beauty	○	∑	○									
5. Elasticity/Compression	○	○	∑	○								
6. Lightweight	○	○	∑	○	○							
7. Fit/Movement	○	○	∑	○	∑	○						
8. Thermal comfort	∑	○	∑	○	○	○	○					
9. Tactile comfort	○	○	∑	○	∑	○	○	∑				
10. Decorative detail	√	∑	√	∑	√	X	√	○	√			
11. Strength/Durability	○	○	○	○	○	○	○	○	○	X		
12. Activity/Movability	○	○	○	○	○	∑	∑	○	○	√	○	

* (Legend: ∑- synergy, ○-no conflict, √- accommodation, X-conflict)

The proposed investigation into the users’ needs and understanding of the design criteria will be used not only for identifying the essential requirements of FSU for athletes, but also for improving sportswear in the sports apparel industry. In addition, this study contributes to establishing a workable design standard to use valid criteria for a consumer-focused functional design in the apparel industry.