Custom Paralympic Shooting Jacket: A Single-Case Virtual Product Development Project

Kayna Hobbs & Kristen D. Morris, Colorado State University

Keywords: sportswear, activewear, 3D design, adaptive apparel, disability, Paralympic shooting

Paralympic Shooting is a sport requiring intense accuracy and mental discipline. According to the Paralympic Committee (n.d.), athletes must control their breathing and heartrate for higher performance and score. There are only a limited number of companies that create custom Paralympic shooting jackets. The process these companies use to create custom jackets are fairly repetitive: athletes print a company measurement form, gather the various body measurements that are required, send the measurements in, and receive their jacket in a few months. While it is fairly easy for able-bodied athletes to find shooting jackets that meet their various needs, disabled athletes have their own set of clothing needs which may not align with those of the able-bodied population (Bragança et al., 2018). Furthermore, the currently available clothing for the disabled population, even specifically designed for the niche, does not seem to satisfy all people within the population, because of individual diversity in user needs, such as wheelchair users who participate in athletics. That is, there is a dearth in current market offerings for wheelchair athletes, which lends a specific focus of this study. Shooting jackets, in particular are highly regulated garments because of the potential for significant performance improvement via certain jacket elements. For example, tightly fitted jacket allows the athlete to gain artificial body support in competitions (International Shooting Sport Federation, 2017). Paralympic Shooting athletes typically have their jackets custom made in order to adhere to a strict set of regulations put forth by International Shooting Sport Federation (2017) and World Shooting Para Sport organization (2017). The purpose of this research was to develop a custom shooting jacket for a Paralympic Shooting athlete (a single case for this study) who uses a wheelchair and has qualified for the upcoming Paralympics. The jacket was developed based on the comprehension of the athlete's functional, expressive, and aesthetic needs (Lamb & Kallal, 1992), through a User-Centered Design (UCD) process (Watkins & Dunne, 2015). Prototyping of the jacket was facilitated by 3D body scanning and virtual garment simulation. The following two RQs guided this study: What are the athlete's functional, expressive, and aesthetic needs for the custom shooting jacket (RQ1)? And, how do the FEA needs inform the jacket design process (RQ2)?

Methods

An exploratory single-case study approach was adopted in this research to investigate and explore the needs and values of the end-user in real-world context (Yin, 2014). Data were collected in multiple interactions with the participant, starting with a semi-structured interview aimed at understanding her FEA needs as they would relate to her Paralympic Shooting jacket.

The interview was transcribed verbatim and subjected to narrative and thematic analyses (Braun & Clark, 2006; Faulkner, 2018; Riesmann, 2008). Next, the participant's anthropometric data was gathered via 3D body scanning using a hand-held scanner (Occipital Structure Sensor). The 3D data were cleaned and processed using Meshmixer and used to create a half-scale body form of the participant's upper torso in a seated position (Morris, Aflatoony, & Romine, 2018; Vuruskan & Ashdown, 2017). The half-scale dress form was utilized to drape the jacket pattern on an anthropometrically accurate version of the participant's body. The specific jacket design features were then developed from the interview data and analysis. Finally, the jacket was prototyped virtually in CLO3D (www.CLO3D.com, n.d.) and feedback obtained from the athlete further guided the jacket design process.

Results

The narrative analysis of the interview data brought to light the emotional connection the participant feels to her shooting jacket. In Paralympic Shooting, the athlete gains a great deal of functional enhancement in performance from their jacket. This is due, in part, to the stiff and rigid nature of the jacket aiding the athlete in maintaining a stationary position, thus improving potential for higher shooting scores due to higher accuracy. The participant stated that the jacket has the potential to "win [her] the Paralympics", indicating just how important of a garment the jacket is to a Paralympic shooter's success as an athlete. The thematic analysis of interview data allowed for insights into the design needs for Paralympic Shooting jacket. The themes were developed a priori from the theoretical framework and inductively from the interview. From the interview, the themes that emerged were: Functional, Expressive, Aesthetic, Consumer, and Improvements. The theme of Improvements was developed to house direct suggestions for jacket design, for easy retrieval during design ideation.

Subthemes of *History of Jacket* (*Consumer* parent code), *Appearance* (*Aesthetic* parent code), *Colors* (*Aesthetic* parent code), and *Body Fit* (*Functional* parent code) were the top four most prominently applied codes. The *History of Jacket* subtheme prominence indicated that the participant valued the story and history of her jacket, as the jacket has a unique role in her athletic performance. Furthermore, for this athlete, being a young female adult, *Aesthetic Needs* informed the jacket design more than *Functional* or *Expressive Needs*. An in-depth examination of excerpts in the thematic analysis was valuable during the design process of the jacket, in which the athlete was allowed to give feedback on the progress. Based on the qualitative data analysis, and half-scale patternmaking, a jacket design was developed through an iterative design process. The finalized jacket design was virtually prototyped in CLO3D (Figure 1).

Figure 1: Finalized 3D virtual prototype of Paralympic Shooting jacket.

Implications and Future Research

The outcomes of this research are expected to benefit researchers and industry alike in navigating the unique and in-depth process of development of high-satisfaction custom sportswear for disabled and wheelchair athletes. Aspects of this research, such as deeply exploring and understanding the user's needs, as well as utilization of 3D body scanning and virtual garment simulation technologies, may be applicable to a large amount of sportswear development for disabled users, whether custom-made for the user or in mass-manufactured production. As with all research, there are limitations to this project. Continual and ongoing research is required to identify and solve problems that exist in all areas of accessibility and adaptability for the entire disabled population.

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