Patent Analysis of Adaptive Apparel Innovations from 1990 to 2020

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Patents provide a good measure of the foci of innovation in various industries (Katila, 2000). Recently, there has been an increased interest in innovations for adaptive apparel in the apparel industry. Adaptive apparel is "clothing designed specifically for people with disabilities who find it difficult to dress independently or those with sensory issues who are sensitive to certain textures and materials" (Moniuszko, 2018). As the modern fashion industry moves toward greater inclusivity and representation of people with disabilities, so too do the adaptive apparel options available in the market (McBee-Black & Ha-Brookshire, 2021). And so, the authors were curious if patents were being granted for adaptive apparel innovations and if there were noticeable parallels between patent activity for adaptive apparel innovations and market activity. Therefore, the authors conducted a content analysis of all apparel patents published from 1990 to 2020 targeted toward people with disabilities to achieve this goal. This 30-year span coincides with the passing of the Americans with Disabilities Act (ADA.gov, n.d.).

Several apparel scholars have utilized patents as a measure of innovations in the fashion industry. Specifically, apparel historians (i.e., Keist & Marcketti, 2019; Peteu & Gray, 2009) examined utility patents to track how garments' functionality evolved and understand how inventors addressed clothing problems for target user groups. Both Peteu and Gray (2009) and Keist and Marcketti (2019) found patents to be valuable primary evidence resources that provide an alternative viewpoint from traditional sources like popular press and academic writings. Furthermore, Abbas et al., (2014) note that with increasing volumes of patent information available, professionals are interested in patent analysis to determine "technological vacuums and hotspots" (p. 3). This study aimed to understand the patent landscape - vacuums and hotspots - for adaptive apparel innovations.

The authors used the Google Patents database to search garment-related patents targeted toward people with disabilities. The patent search was bound by the years 1990 to 2020 and only included U.S. patents written in English. Both design patents and utility patents were included in the patent search. However, only utility patents emerged in the data set. Using the United States Classification (USPC) system, this study searched for patents within *Section A: Human Necessities* and the *A41 Wearing Apparel,* *A42 Headwear,* and *A43 Footwear* classes. These are the three patent classes relevant to apparel or garments, or accessories worn on the body. Data were collected between June 2020 and July 2020. The authors conducted a thematic qualitative text analysis, as described by Kuckartz (2014), to understand the patent landscape. A first-round search using 20 unique search terms and their synonym (i.e., "disability" with synonym "disabled"). The search resulted in 470 patents. Next, the second author cleaned the data set, removing patents that were not directly related to disability, leaving 215 patents in the data set. The authors then proceeded with a second-coding process to determine sub-categories of the novelty claimed (target feature) and themes therein. The outcomes of the second-coding process were are presented in the results (Kuckartz, 2014).

Based on the data analysis, the authors found increased trends in patenting innovations oriented to the disability community from 1990-2019, with a spike in 2015 and sustained interest since then. These patent trends also parallel the increased availability of adaptive apparel on the market (McBee-Black & Ha-Brookshire, 2021). The target audience for 61% of the patents (n = 131) in this data set was the disability community in general, described in the patent art as being for "people with disabilities." People with diabetes (n = 43)were the top disability when a specific disability was identified. In other words, most of the patents found in this research were targeted towards a very broad group. The next closest target groups were people who use a wheelchair (n = 8), people with limb differences (including amputees) (n = 8), people with mobility difficulties (not requiring a wheelchair) (n = 7), and people with sensory processing disorders (n = 5). The remaining 13 patents were spread over 12 disabilities. In the data set, there were 18 different types of garments patented. The top three most patented garments were undergarments – briefs (n = 45), bibs, (n = 43), and socks (n = 34). The remaining 93 patents were spread across 15 garment categories.

When looking at the patents' novelty claimed in this data set, six themes emerged from the data analysis. The themes were *safety* (n = 47), *donning and doffing* (n = 46), *cleanliness* (n = 41), physical and physiological *comfort* (n = 36), *toileting* (n = 26), and *other* (n = 19). The main foci of innovation within *safety*were ulcer prevention (n = 9), foot health (n = 7), and moisture management (n = 7). Regarding *donning and doffing*, inventors focused on alternative ways of dressing (n = 9), alternatives to buttons (n = 8), and easy dressing for tight-fitting garments (n = 7). The focus of *cleanliness* were head and body coverage (n = 12), food capture (n = 10), and disposable bibs (n = 7). Regarding *comfort*, innovation was focused onpreventing chafing (n = 10), tactile stimulation (n= 5), and thermal comfort (n = 5). And the main focus of patents for *toileting* were access to genitals (n = 8), moisture management (n = 6), and independence (n = 5). Within “other” the top target features were educational garments (n = 3), medication storage (n = 3), and shapewear (n = 3). Furthermore, when looking at the data through the lens of disability, there emerge clusters of patents regarding the type of garment, disability, and novelty claimed. For example, the most common patents for people with diabetes were socks and compression socks. These patents focused on safety (foot health, moisture management, and ulcer prevention) and comfort (chafing prevention and size adjustable). Another example is that the patents targeting people who use wheelchairs were mainly for undergarments – briefs centering on donning and doffing, expressly alternative ways of dressing.

Through the content analysis, the authors observed that there had been a focus on the "disability community" in general – leaving an opportunity to dispel the disability monolith stereotype and develop patentable innovations that address specific needs of people with a variety of disabilities. Aside from the “general” group, there were only 43 patents for the most prominent target group, diabetes, and only one to eight patents for the remaining 17 disabilities noted in this study over the thirty-year timeframe. Furthermore, in this study, the authors observed that the types of garments patented were predominantly innerwear that addressed safety, donning and doffing, cleanliness, comfort, and toileting. These themes parallel design solutions found in some adaptive apparel on the market. However, adaptive apparel brands rarely address all six of these solutions within one brand offering. The ones that do (i.e., Silverts.com) are more function-forward with less of an aesthetic focus, which can be a barrier to social participation (Kable et al., 2017). The authors acknowledge some manufacturers forego patents, going straight to commercialization, and some design ideas are not patentable. Therefore, this study may only be capturing a portion of the innovative solutions targeted to people with disabilities. A content analysis of adaptive apparel features on the market is needed to capture innovations that are not patented and thereby not captured in this study. However, this study does create a snapshot of the foci of innovation of garment-focused inventions for people with disabilities. This study provides insight into how past inventors sought to solve garment-related issues for the disability community. Although there is patent activity regarding adaptive apparel, the landscape is not oversaturated, leaving opportunities for apparel researchers and designers who seek to improve garment design and eliminate clothing obstacles for people with disabilities.

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