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Braille Communicative Tools and the Readiness of Visually Impaired Consumers in South African Apparel Retail: A Socio-material Inquiry into Inclusive Design

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Abstract
This paper critically explores the Braille Communicative Tool (BCT) as a material and cultural innovation within South African apparel retail, examining its role in enabling visually impaired consumers' autonomous engagement with garment information. Drawing on an adapted Unified Theory of Acceptance and Use of Technology (UTAUT) framework, the research investigates how perceptions of utility, social support, and enabling environments influence readiness to adopt the BCT. Employing a qualitative-dominant mixed-methods design comprising workshops, focus groups, and simulated retail observations with 60 participants drawn from three South African provinces the findings indicate that the BCT functions not merely as an assistive device but as a catalyst for inclusive sensory engagement, autonomy, and social dignity within a historically visual centric commercial space. Implications for inclusive design, disability rights, and sensory culture within South African material culture studies are discussed.

Keywords: accessibility, Braille communicative tools, material culture, visually impaired consumers, inclusive retail, South Africa.

1. Introduction

The act of selecting apparel is not solely economic but deeply embedded in visual culture, where colour, texture, pattern, and signage operate as semiotic systems directing consumer choice (Funkquist et al., 2024). This visual economy of retail

marginalises those with visual impairments who lack access to dominant ocular codes, thus constraining their autonomy and participation in consumer culture (Beudaert, 2024). The South African retail landscape has historically under-addressed the needs of visually impaired consumers, perpetuating normative visuality and spatial exclusion (Ramatla & Mastamet-Mason, 2013).

The Braille Communicative Tool (BCT), locally developed and patented by Ramatla (2014), intervenes materially in this exclusion by embedding tactile Braille labels on garment swing tags and care labels. Unlike conventional assistive technologies that rely on electronic or auditory components, the BCT is a direct material communication tool repositioned in the tangible form of the garment, fostering multisensory interaction and bridging gaps in retail accessibility.

This study interrogates the readiness of South African visually impaired consumers to adopt the BCT, understanding this adoption process through a socio-material lens that accounts not only for functional utility but also identity negotiation, social validation, and cultural inclusion. It addresses a gap in both local disability inclusion discourse and global material culture scholarship concerning assistive technology as a transformative cultural artefact.

Cultural innovation, as understood here, refers to the transformation of retail practices, meanings, and consumer experiences through the integration of inclusive design principles that challenge dominant visual-centric norms. In the apparel retail context, this involves rethinking how clothing information such as pricing, sizing, and care instruction is communicated, shifting from exclusively visual signage toward tactile and multisensory systems embedded in the garment itself. From a socio-material perspective, innovation of this kind does not reside in the artefact alone but emerges through the dynamic interaction between people and material objects: in this case, between visually impaired consumers, retail staff, and the garments and tags that mediate their encounter. The BCT thus represents both a practical design intervention and a cultural statement about whose sensory experiences retail environments are designed to accommodate.

2. Literature Review

Extant scholarship has documented the lived challenges faced by visually impaired individuals in activities requiring perceptual autonomy, such as garment selection, identifying critical barriers, including the inaccessibility of colour cues and tactile texture differentiation (Gallagher, 2020). Concurrently, assistive technologies worldwide have evolved from early inventions such as Kurzweil's reading devices (1976) to modern audio labellers and assistive technology clothing patterns recognition for visually impaired people (Yang et al., 2014). In South Africa, the BCT has emerged as a uniquely contextual innovation, reflecting both technological ingenuity and responsiveness to local socio-cultural conditions (Ramatla, 2014). The embedded tactile markers of the tool align with the principles of inclusive design, seeking not only functionally accessible technologies but also those that reinforce cultural identities and sensory diversity.

The unified theory of the acceptance and use of technology (UTAUT) is a model that explains the factors influencing an individual's acceptance and use of technology. It is designed to help researchers and practitioners understand why some individuals are more likely to adopt and use new technologies than others. While the UTAUT model (Figure 1), developed by Venkatesh et al. (2003), has been widely used to evaluate consumer technology adoption, its use in assistive technology adoption must consider additional socio-cultural dimensions (Saini, 2025). *Performance expectancy* and *effort expectancy* are significant but are deeply mediated by *social influence* and *facilitating conditions* contingent upon local cultural acceptance and infrastructural support (Venkatesh et al., 2012). The UTAUT model is used in various contexts, such as consumer technology adoption, workplace technology use, and educational technology adoption (Saini, 2025). New technologies should be subjected to testing and approval before being used or even adopted (Felgner & Henschke, 2018). This aligns with the present study, in which the BCT was tested at the South African Bureau of Standards for effectiveness prior to its use by visually impaired consumers in South Africa. The UTAUT is a theoretical model that can help to explain how individuals with disabilities, such as visually impaired consumers, adopt and use disability-related technologies. These insights foreground the importance of examining assistive tools such as the BCT within broader cultural and sensory contexts rather than mere technical acceptance.

2.1 Assistive Technology in Line with Visually Impaired Consumers in the Apparel Retail Space

Visually impaired individuals face numerous challenges in retail environments, which underscores the need to evaluate and improve store design and service delivery (Yu et al., 2015). In Africa, visual impairment affects a substantial portion of the population. According to Lewallen and Courtright (2001), approximately 26.3 million people in Africa live with some form of visual impairment, of whom an estimated 20.4 million have low vision and 5.9 million are classified as blind representing approximately 15.3% of the global blind population at that time. More recent global estimates are available from the World Health Organization (2026), though continent-specific breakdowns should be drawn from updated regional epidemiological sources.

Assistive technology is broadly understood as any tool or device adapted to enhance the functional abilities of individuals with disabilities in their daily activities (Bonanno et al., 2025). Various forms of such technologies are selected and utilised to improve productivity and overall quality of life (Scherer, 2011). However, these tools often remain limited to functional assistance. In contrast, the BCT moves beyond this traditional scope by not only enabling access to product information but also redefining the retail experience. It fosters independence, supports informed decision-making, and challenges visually dominant retail systems, positioning it as both a socio-material and cultural innovation rather than merely an assistive device. Table 2 presents a summary of assistive technologies for visually impaired people globally.

Table 2: Presentation on assistive technologies for visually impaired people globally

Global trends in assistive technology	**Assistive technology encompasses**	**Coverage of assistive technology**	**Expansion frequency of the assistive technology**	**Networks that will use the assistive technology**	**Prospects of the assistive technology**
United States: Handheld scanner for visual impairment (Kurzweil, 1990)	A scanner that reads codes, converts them into electrical signals, stores barcode information, and provides audible feedback	Used in business environments, the shipping industry, and inventory-control systems, with the ability to erase unwanted information	Intended for catalogue registration and information storage for commercial purposes	En-Vision America Inc.	Can be improved by incorporating raised Braille symbols positioned relative to the barcode imprints
Australia: Support technology for visual impairment (Shilkrot et al., 2014)	Screen readers, magnifiers, electronic Braille devices, and Braille printing technologies for educational use	Used in institutions of higher learning, including universities and technical colleges	Accessible in various environments for visually impaired users	RRA: Royal Society for the Blind	Requires continuous modernisation in line with the latest technological advancements
Middle East: OrCam (Waisbourd et al., 2015)	A device that scans text, converts it into audio output for visually impaired users, and tracks finger positioning during reading	Wireless technology used for product and facial recognition	Also capable of gesture recognition and identifying time and date from a wristwatch	Assistive devices are distributed in 39 countries around the world	Could be further developed to improve colour- and product-recognition functions
China: Clothing pattern recognition device (Yang et al., 2014)	An automatic clothing-pattern identification device for visually impaired users	Assists users in selecting apparel with complex patterns, prints, and colours	Uses audio description to communicate garment information	Non-government organisations (NGOs) such as the China Association for the Blind and institutions of higher learning, such as universities	Requires faster feedback response capabilities
Europe: Apparel obstacle detector for visual impairment (Bach-y-Rita et al., 1969)	Obstacle detection and guidance alerts for visually impaired users	Uses ultrasonic sensors, vibration motors, and intelligent textiles for indoor and outdoor navigation	Supports maximum detection range and may contribute to the development of GPS-assisted devices	Organisations that work with blind individuals in Europe and geographic information systems	Could be further developed through integration with GPS, RFID cameras, and vocal guidance systems

USA: Elita (EI) (Freedom Scientific, 2017)	EI Braille is a portable PC that creates notes, reads e-mail, uses Microsoft apps, and can access the Internet	Used for educational purposes in schools, workplaces, and home environments	EI Braille is a full-featured portable PC that supports Windows 10 and is accessible through JAWS	Freedom Scientific(US) distributed globally including through blindness organisation in USSR & E Europe such as VOS	Requires regular software updates in line with technological developments, which may necessitate additional training for visually impaired users
United Kingdom: Obstacle detector (Dodds et al., 1981)	Obstacle detection and spatial-awareness technology capable of locating moving and stationary objects for visually impaired people	Identifies openings, such as doors, and provides information about surrounding objects	A portable, wireless device that delivers tactile and audio feedback through multiple sensory channels and is powered by a rechargeable battery	University of Glasgow and the Royal National Institute of the Blind (RNIB)	Requires additional user training for effective operation
Africa: High-tech and low-tech assistive technology (Asare, 2022)	Screen readers, magnifiers, electronic Braillers, and Braille-print technologies for educational purposes	Used in institutions of higher learning, such as universities and technical colleges	Accessible through university information centres, such as libraries, for educational purposes	Educators work with the Ghana Federation of the Disabled (PROMOAFRICA), which promotes the rights of people with disabilities in Africa	Requires periodic updates in line with the latest technological advancements after five years
South Africa: Braille clothing communicative tool for visual impairment (Ramatla, 2014)	Clothing communicative tools, including swing tags and care labels, displaying price, colour, fabric composition, size, brand name, and country of manufacturing	Used in apparel retail stores, shopping environments, and apparel aftercare service	Intended for use in department stores and apparel retail environments in South Africa	South African National Council for the Blind (SANCB): South African Consumer Rights Commission (SACRC): South African Bureau of Standards (SABS)	Should be continuously improved and extended into multisensory application devices for soft furnishings

Assistive technology, as discussed in this section, has been adapted primarily to improve the daily functioning and independence of individuals with disabilities. Globally, a wide range of assistive technologies for visually impaired individuals reveals both shared features and contextual differences, although this discussion focuses specifically on those relevant to this research paper. For instance, handheld scanning devices developed in countries such as the United States and areas such as the Middle East demonstrate similar capabilities in converting printed text into audio output (Ortega et al., 2021; Selvaraj & Bhalaji, 2018). These technologies can also interpret information embedded in apparel labels, offering potential benefits for visually impaired consumers. In addition, such devices are often applied in sectors such as shipping and inventory management for cataloguing and data storage and may even support personal clothing organisation in domestic settings. Other innovations, such as European-designed systems, focus on navigation by detecting obstacles and providing alerts (Bahadir et al., 2012). Similarly, tools developed in the United Kingdom can identify both moving and stationary objects, assisting users in navigating retail environments through mobile assistive technology. These developments represent emerging trends and technological innovations for individuals with disabilities (Hakobyan et al., 2013; Shafik, 2025). These technologies typically rely on sensors, vibration mechanisms, and intelligent textiles. They are complemented by systems from Canada and the United Kingdom that provide environmental feedback, such as detecting open doors and identifying objects in indoor spaces (Andrews & Grace, 2019; Chanana et al., 2017; Kapsalis et al., 2024). In Australia and Africa, there are notable similarities in the development of both high- and low-tech solutions, including screen readers, magnifiers, electronic Braillers, and Braille printing technologies, particularly within educational contexts (Butler et al., 2017).

However, while these assistive technologies enhance functional capabilities, they largely remain task-oriented and do not fully address the experiential and participatory dimensions of retail engagement. In contrast, this paper foregrounds embossed Braille integrated into apparel swing tags and in-stitch care labels as a communicative tool. This approach supports both in-store decision-making and post-purchase garment care (Ramatla, 2016). The South African BCT is designed not only to provide accessible information, such as price, colour, fibre content, size, and brand, but also to transform the shopping experience into one that is more autonomous and inclusive. Critically, the BCT transcends the traditional boundaries of assistive technology by shifting from a purely functional aid to a socio-material system embedded within the retail environment. Through its integration with institutional networks such as the South African National Council for the Blind (SANCB) and related governmental bodies, the BCT operates at a systemic level, reshaping retail communication practices and challenging visually dominant norms. In doing so, it moves beyond assisting individuals to actively reconfiguring the cultural and structural conditions of apparel retail, positioning itself as both an inclusive design strategy and a catalyst for broader South African social change.

3. Theoretical Framework

This study employed the UTAUT framework (Figure 1) as a foundational analytical tool while enriching it with perspectives from disability studies and sensory material culture. In the context of this study, *performance expectancy* is understood as the anticipation that the BCT enables independent navigation and decision-making in apparel retail, challenging the dominance of visuality. *Effort expectancy* extends beyond technical usability to encompass the embodied literacy of Braille and the sensory labour involved in tactile engagement.

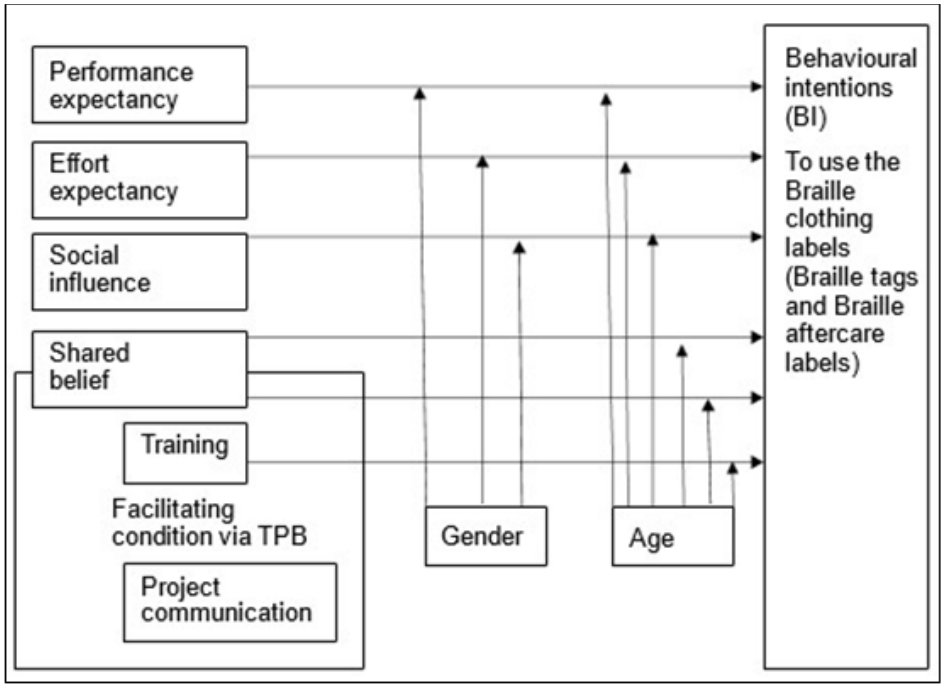

Figure 1: UTAUT model—adapted from the UTAUT (Venkatesh et al., 2023)

Social influence captures the critical role of family, peers, and retail staff in affirming the legitimacy of BCT use, reflecting local norms and social support networks. *Facilitating conditions* address the necessary physical (e.g., Braille tags), institutional (e.g., staff training), and cultural (e.g., Braille literacy programmes) resources required for sustainable uptake. Combined, these dimensions situate the adoption of the BCT as a socially embedded, materially mediated process shaping consumer subjectivities and transforming the sensory politics of retail spaces in South Africa (Chong, 2013; Venkatesh et al., 2012).

The main objectives of this research were:

1. To examine the readiness of visually impaired consumers in South Africa to adopt Braille communicative tools (BCT) within apparel retail settings, focusing on autonomous shopping experiences.
2. To explore the socio-material dimensions of BCT adoption, analysing how tactile engagement reshapes consumer interaction with garment material culture and retail space.

3. To assess the effectiveness of BCT in conveying key apparel information (e.g., size, colour, price, care instructions) to visually impaired shoppers, identifying content completeness and usability.
4. To investigate the psychosocial impacts of BCT usage, including empowerment, identity affirmation, and perceived inclusion within South African retail.
5. To identify enabling conditions, social influences, and potential barriers affecting BCT uptake through the adapted UTAUT framework contextualised for South African settings.

The importance of including different age groups in this study is that they may have varying levels of comfort and understanding of assistive technologies (Theodorou & Meliones, 2023). For instance, younger individuals may adapt more quickly to such devices due to increased exposure to technology, while older individuals may face challenges (Fox & Connolly, 2018).

In terms of gender in relation to shopping behaviours and preferences, choices are often influenced by gender (Falchetti et al., 2018). Men and women might prioritise different aspects of the shopping experience, such as style, practicality, or ease of use of the assistive device (Yu & Rahman, 2018). Visually impaired men and women might select various aspects of the shopping experience, such as style, practicality, or ease of use of the assistive device for apparel shopping, as these preferences often align with differing social roles, cultural expectations, or individual lifestyle needs. The study also investigates the participants' backgrounds in terms of their visual impairments and how these conditions have evolved. Additionally, Research Question 1 examines the use of assistive technologies among the participants, highlighting the types of technologies employed and the frequency with which they are used. The sample comprised 60 individuals, each providing valuable insights on the challenges and resources available to those with visual impairments. The next section presents the data findings and discusses age distribution.

The study seeks to attribute observed outcomes to the BCT's design and usability by maintaining consistent training conditions and using standardised observation criteria across all three sites. While demographic factors such as age, gender, and Braille literacy proficiency inevitably shape individual experiences, the research design aimed to account for these influences through triangulation and cross-site comparison rather than to eliminate them. Acknowledging this complexity strengthens rather than diminishes the credibility of the findings, situating them within a realistic appraisal of the socio-material conditions under which the BCT operates and highlighting how contextual factors interact with assistive technologies to influence the shopping experiences of visually impaired consumers.

The research involved three workshops conducted in Pretoria, Durban, and Upington between August 2022 and October 2023, held on weekends to accommodate participants' availability through supporting organisations. A peer-reviewed training manual guided a structured three-day programme, covering clothing concepts, Braille

label usage, and a simulated shopping experience, followed by focus group discussions and evaluations to assess learning outcomes. While the training included baseline and post-assessments, it did not sufficiently differentiate participants based on Braille literacy or demographic factors, which may have affected learning effectiveness. Overall, the workshops served not only as a data collection method but also as a key intervention space that generated valuable experiential insights into the usability and relevance of the BCT.

This study employed observation as a key data collection method, defined as a systematic and selective process of examining interactions as they occur in real time (Bryman & Bell, 2007; Creswell & Poth, 2018). It was particularly appropriate for gaining empirical insight into fashion retail environments and consumer behaviour (Alexander & Alvarado, 2014). Following the training phase, a mock retail environment was created to simulate a realistic shopping experience, where the visually impaired participants handled Braille-labelled garments. Structured observation sessions, lasting 60 to 90 minutes, were conducted across all sites by both the researcher and a trained assistant using a predefined checklist. Observations focused on participants' navigation, interpretation of Braille labels, decision-making ability, confidence levels, time taken to decode information, and reliance on assistance. To ensure reliability, both observers independently recorded data and later reconciled discrepancies through discussion. While the researcher acknowledged potential observer bias due to their dual role, this was mitigated through the inclusion of an independent assistant and the use of standardised criteria. The observation checklist enabled systematic documentation of behaviours, making the mock retail setup a critical space for assessing the real-time usability, functionality, and user confidence associated with the BCT.

Focus groups emerged as an extension of the training process, where ongoing discussions between the researcher and participants generated rich insights into their attitudes, challenges, and experiences. As a data collection method, focus groups are particularly useful in assessing the potential acceptance or rejection of a new product (Harwood, 2013). In this study, three focus groups were conducted with visually impaired consumers across the three provinces to evaluate the usability and acceptance of Braille clothing labels. The approach enabled the capturing of participants' feelings, beliefs, and reactions, insights not easily obtained through other methods (Krueger, 2014). Additionally, focus groups were considered an appropriate data collection method because they enabled the informal social interactions that are often important among visually impaired individuals when sharing experiences and perspectives. Data analysis commenced early in the research process and was conducted manually using a coding manual to organise, manage, and interpret the text-based data (Schedl, 2012). Verbatim transcriptions captured not only participants' words but also non-verbal cues, while a statistician processed quantitative data through coding and categorisation (Krippendorff, 2018). The study applied systematic coding procedures open, axial, and selective coding—to develop themes aligned with the research questions (Hennink et al., 2017). This was supported by analytic memos linking empirical data to theoretical insights (Garousi & Felderer, 2017). Ultimately,

the analysis identified patterns related to the readiness of visually impaired consumers to adopt the BCT, informing its potential implementation in future retail environments.

The study used a qualitative-dominant mixed-methods design to foreground participant experience and interpretive depth. Sixty visually impaired adults, balanced for gender and drawn from Pretoria, Durban, and Upington through purposive and snowball sampling, participated. The research combined:

- Training workshops: practical, hands-on sessions teaching the interpretation of Braille tags and labels, facilitating embodied learning.
- Simulated retail exercises: controlled shopping simulations where participants navigated garment selections using the BCT, enabling detailed observational data capturing decision processes and tactile engagement.
- Focus groups (n = 30): group discussions capturing collective insights, social dynamics, and shared understanding of BCT usability and desirability.
- Semi-structured interviews (n = 60): in-depth interviews eliciting individual narratives around sensory experience, psychosocial impacts, and adoption readiness.

Ethical clearance was granted by Tshwane University of Technology [#:REC2022/07/007], and standard procedures for informed consent, confidentiality, and respect for participant agency were rigorously observed. Trustworthiness was ensured via triangulation, member-checking, and thick description to enhance validity and transferability.

The principal researcher, Aubrey Ramatla, is both the inventor and patent holder of the BCT (Ramatla, 2014), which creates a potential conflict of interest that warrants explicit acknowledgement. To mitigate bias, the study employed multiple data collection methods, engaged an independent observation assistant, and subjected findings to member-checking and peer review. Supervisory oversight from co-authors at Tshwane University of Technology provided an additional layer of critical distance. Readers should nonetheless interpret the findings with awareness of this positionality, recognising that the researcher's deep familiarity with the tool may simultaneously have enhanced methodological sensitivity and introduced advocacy-oriented framing. No external commercial interest in the BCT exists at the time of publication.

5. Interpretation and Discussion of Results According to the Research Objectives

The discussion outlines clear practical implications for apparel retailers. This includes the development of inclusive design guidelines that integrate Braille into product information systems, such as embossed swing tags and in-stitch care labels that communicate essential details like size, price, and fabric composition. Retailers should also consider embedding the BCT into everyday retail practices by training staff, adapting store layouts for tactile navigation, and incorporating accessible signage to enhance independent shopping experiences. Furthermore, the integration of the BCT calls for supportive policy frameworks that promote accessibility standards in the apparel industry, encouraging collaboration with organisations for the visually

impaired and alignment with national and international disability inclusion policies. Collectively, these measures position the BCT not only as a design intervention but as a strategic tool for fostering inclusive, equitable, and consumer-centred retail environments.

> **Objective 1:** To examine the readiness of visually impaired consumers in South Africa to adopt Braille communicative tools (BCT) within apparel retail settings, focusing on autonomous shopping experiences.

Among the 30 participants assessed in the performance expectancy phase, 93% (28 of 30) rated the BCT as easy to use following training. In a separate evaluative question, 67% identified the swing tag as particularly user-friendly for accessing product details such as price, size, and colour, while 33% favoured the inner care label for post-purchase guidance. Regarding future use intent, participants expressed a strong willingness to adopt the BCT independently in real retail settings, with several noting that the training had been decisive in building their confidence (Saini, 2025). These figures should be read as measuring distinct dimensions of readiness usability, feature preference, and adoption intent rather than as a single progressive funnel (Venkatesh et al., 2012).

Although no statistically significant gender differences in technology use were observed, the slightly higher engagement of women may reflect gendered patterns in retail participation and assistive technology adoption in South Africa's socio-cultural environment (Lteif et al., 2025). The near equal distribution of congenital (53%) and acquired (47%) visual impairment enriches the diversity of sensory histories influencing Braille proficiency and tool usage. Congenitally visually impaired participants demonstrated stronger Braille literacy, supporting findings from disability studies emphasising lifelong embodied sensory adaptation (Gallagher, 2020; Ramatla & Mastamet-Mason, 2013). The high prevalence of total blindness (73%) alongside widespread daily use of assistive technologies such as screen readers, smartphone applications, and Braille note takers confirms the critical relevance of the BCT as a tactile, non-visual complementary tool within an established assistive technology ecosystem (Butler et al., 2017; Ramatla, 2014).

> **Objective 2:** To explore the socio-material dimensions of BCT adoption, analysing how tactile engagement reshapes consumer interaction with garment material culture and retail space.

Participants valued the tactile access to garment details through Braille swing tags and care labels. Swing tags were praised by 67% of participants for immediate product information (size, price, colour), while 33% appreciated inner labels for care guidance, revealing a multisensory engagement across the consumer decision timeline. This embodied interaction supports the objective of understanding the socio-material effects of the BCT. It enables users to transcend reliance on visual or companion assistance, fostering autonomy and reconfiguring apparel retail materiality (Funkquist et al., 2024). Psychosocially, participants reported enhanced autonomy,

social inclusion, and respect, linking the materiality of the BCT with identity affirmation and social participation core socio-cultural transformations envisioned by the objective (Toole, 2017).

> **Objective 3**: To assess the effectiveness of the BCT in conveying key apparel information (e.g., size, colour, price, care instructions) to visually impaired shoppers, identifying content completeness and usability.

Over half of the participants (53%) confirmed that the BCT sufficiently communicated essential apparel information, supporting independent purchase decisions and fulfilling a critical accessibility need (Ramatla, 2014). However, reported gaps included missing information on the country of manufacture and fabric or gender. This highlights limitations that must be addressed to meet consumers' full informational and cultural expectations, reflecting the emphasis of the objective on thorough content assessment (Beudaert, 2024). The clear user preference for Braille swing tags as an immediate source of critical data demonstrates the tool's successful usability design, while inner labels supplement post-purchase care needs, confirming effectiveness across retail stages (Yang et al., 2014).

> **Objective 4**: To investigate the psychosocial impacts of BCT usage, including empowerment, identity affirmation, and perceived inclusion within South African retail.

Participants identified psychosocial benefits aligned with this objective: 40% recommended the BCT for empowerment and independence; 20% found it enhanced social value and quality of life. Use of the BCT lessened dependence on sales personnel, reshaped self-perceptions, and embedded users in inclusive consumer identities (Ramatla & Mastamet-Mason, 2013). These responses encourage theories positioning assistive technologies as cultural artefacts enabling social dignity and belonging (Saiel, 2025).

> **Objective 5**: To identify enabling conditions, social influences, and potential barriers affecting BCT uptake through the adapted UTAUT framework contextualised for South African settings.

Training workshops established strong facilitating conditions, resulting in high ease of use (93%), addressing effort expectancy (Chong, 2013). Social influences manifested via participants' alignment of BCT use with their social identities and expectations for independence (Venkatesh et al., 2012). Barriers emerged in calls for audio alternatives (17%) and content completeness, indicating the importance of multimodal solutions and iterative tool refinement to ensure broad accessibility in local contexts (Butler et al., 2017).

> **Objective 6**: To provide recommendations for integrating BCT and complementary multisensory accessibility features to promote inclusive retail in South Africa.

Participants proposed integrating Braille with other assistive technologies, aligning with inclusive design principles that advocate a multisensory approach (Butler et al., 2017). Positive user experiences and autonomy gains advocate for retail policies mandating BCT incorporation into labels and staff training, advancing multisensory, accessible retail environments as envisaged by this objective.

The following discussion analyses visually impaired consumers' experiences with the BCT through selected constructs of the UTAUT, namely, performance expectancy, social influence, effort expectancy, and facilitating conditions. The discussion foregrounds how the availability of clear and tactile product information such as size, colour, price, and care instructions creates enabling conditions that support independent decision-making in apparel retail environments. By examining users' perceptions of usability, social value, and environmental support, this section illustrates how the BCT facilitates autonomous shopping, reduces reliance on external assistance, and enables meaningful sensory engagement in the absence of visual cues. Collectively, the findings demonstrate how supportive material conditions and effective tool design shape readiness to adopt the BCT and contribute to more equitable and inclusive retail experiences for visually impaired consumers.

5.1 Performance Expectancy

Thirty participants evaluated the ease of use and user-friendliness of the BCT in a retail environment. In the ease-of-use category, almost all the participants indicated that the tool was very easy to use (28/30 or 93%). This was primarily because of the training they received and the clarity of the uncontracted Braille. Uncontracted Braille refers to a Braille writing system where each word is spelled out letter by letter without the use of abbreviations. This high percentage reflects the effective design of the tool, which aligns with the performance expectancy aspect of the UTAUT model. Participants found the technology beneficial for completing tasks independently (Venkatesh et al., 2003). One participant noted that: "*It was easy to use since I was trained on the Brailled label contents*" (P1) (also echoed by P2, P5, P8, and P10). In contrast, a few participants (2 or 7%) raised the concern that the swing tag lacks sufficient descriptive details regarding the garment type (P14 and P23). This concern about the lack of descriptive details suggests that while the tool's core functionality is strong, refinements in certain areas could enhance user satisfaction.

5.2 Social Influence

Almost a quarter of the participants (6 or 20%) endorsed the social value and quality of life theme. These participants noted that the BCT improved their shopping experience and uplifted their social identity and overall quality of life. One of the participants mentioned: "*Yes, I will recommend an innovative component that will enhance our quality of life to the other visually impaired colleagues*" (P11). This insight suggests that beyond its practical benefits, the BCT plays a role in improving how visually impaired people perceive themselves as valuable customers, a finding consistent with the social influence construct in the UTAUT (Venkatesh et al., 2003). Some of the participants (P12, P19, P23, P24, and P25) echoed similar observations, highlighting a more

significant benefit of the tool. The high percentage of positive responses in the time efficiency and empowerment themes indicates that participants overwhelmingly appreciated the tool's ability to make shopping faster and more autonomous. These results suggest that the BCT effectively meets the needs of visually impaired consumers by reducing dependency on sales assistance and streamlining the shopping process.

5.3 Effort Expectancy

Effort expectancy concerns the degree to which participants found the BCT straightforward to engage with in practice that is, whether the cognitive and sensory demands of using Braille-labelled garments felt manageable. The high ease-of-use rating reported in Section 5.1 speaks to this construct as well, but the effort expectancy dimension is more specifically illuminated by participants' accounts of the learning curve associated with the tool. Several participants noted that while Braille literacy was a prerequisite, the use of uncontracted Braille spelling each word in full without abbreviations significantly reduced the interpretive effort required, making the BCT accessible to those with varying levels of Braille proficiency. In the user-friendly features category, the analysis revealed that most participants (67%) found the swing tag particularly user-friendly, attributing this to its clear presentation of crucial product details such as price, size, and colour. For instance, one participant commented: "*I find the swing tag to be user-friendly because I can read the price, size, and material used*" (P3). Conversely, a third (33%) of the participants preferred the inner label for its comprehensive care instructions, as exemplified by the statement: "*The inner Braille label is very good as it explains on how to care for the clothes you have bought*" (P1). This reinforces the tool's value in post-purchase maintenance. Consequently, participants highlighted the tool as a practical and empowering aid for shopping, reinforcing its potential to support accessibility in clothing retail environments.

5.4 Facilitating Conditions

Half of the participants (14 or 46%) indicated that the BCT provides adequate information, ensuring they can shop independently without further assistance. Therefore, these participants felt completely supported by the tool's clear presentation of essential product details such as size, colour, price, and care instructions. For instance, one participant remarked: "*The BCT gives me satisfactory information that helps me to buy clothes independently referring to size, colour, and price*" (P1) (also echoed by P6, P10, P11, P12, P14, P16, P17, P18, P20, P21, P23, P26, and P30). This underscores the tool's effectiveness in conveying the necessary information. This finding aligns with the performance expectancy and facilitating conditions constructs of the UTAUT (Venkatesh et al., 2003). By ensuring that visually impaired shoppers have access to the same level of product information as sighted customers, retailers demonstrate a commitment to equity and accessibility (Yuan et al., 2017). This uniformity advances a sense of respect and validation, reinforcing the idea that visually impaired people are valued members of the customer base. Most participants could complete their shopping decisions independently without external assistance (80%), illustrating the tool's effectiveness in facilitating an independent shopping experience. This observation resonates with the facilitating conditions construct of the UTAUT, which

suggests that a supportive environment is represented by an effective tool and promotes higher rates of independent task completion. Furthermore, integrating tactile exploration into the shopping process emphasises the unique advantage of the BCT, which compensates for the absence of visual cues by facilitating detailed sensory interaction, which is essential for garment evaluation (Ramatla, 2016).

6. Conclusion of Discussion

Aligned with the research objectives, this study positions the BCT as a transformative socio-material innovation within South African apparel retail. It advances autonomy, dignity, and inclusion for visually impaired consumers by embedding tactile knowledge directly into garment material culture, thereby reconfiguring access and participation in a historically visual-centric retail environment. Achieving widespread adoption will require enhancing content completeness and developing multimodal accessibility strategies responsive to diverse sensory abilities, fostering an equitable sensory retail culture. These implications speak to the study's core aim of bridging assistive technology, material culture, and disability inclusion to inform future retail design and policy.

One of the key contributions of this study is its empirical emphasis on enhancing accessibility for vulnerable groups, especially visually impaired consumers within the South African retail context. By investigating the real-world use of the BCT in apparel shopping environments, the study provides grounded evidence on how assistive technologies can support greater independence, autonomy, and informed consumer decision-making. It is also a pioneering contribution to South African research, as it represents one of the first formal evaluations of a tactile labelling system designed specifically for visually impaired shoppers in clothing retail settings. The study further contributes to social justice and inclusive design discourse by aligning its objectives with principles of equity, accessibility, and empowerment, as informed by the social model of disability and the UTAUT framework. Through structured training and observational methods, it demonstrates how factors such as perceived ease of use, effort expectancy, and facilitating conditions shape the adoption and effectiveness of assistive technologies.

Another significant contribution is the analysis of the link between Braille literacy and the effectiveness of the BCT, revealing that users with higher levels of Braille proficiency benefit more substantially from the tool. This highlights the importance of targeted capacity-building and training to bridge the gap between technology availability and user competence. In addition, the study identifies key systemic enablers and barriers to implementation, including staff readiness, in-store spatial accessibility, and the availability of user training, and proposes a practical framework to guide retailers and policymakers in integrating the BCT into retail environments.

Finally, by applying the UTAUT model specifically the constructs of performance expectancy, effort expectancy, social influence, and facilitating conditions—to disability and retail assistive technology, the study extends its theoretical relevance while also offering practical insights for advancing inclusive retail strategies.

7. Limitations and Future Research

The limited sample size and the use of simulated retail environments limit the generalisability of the study. Future research should encompass extensive fieldwork within operational retail settings and involve longitudinal studies to assess enduring adoption patterns. Insights from ethnographic sensory studies, design history, and disability theory could deepen understandings of multisensory consumer experiences and inform policy interventions.

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9. References

Alexander, B., & Olivares Alvarado, D. (2014). Blurring of the channel boundaries: The impact of advanced technologies in the physical fashion store on consumer experience. *International Journal of Advanced Information Science and Technology, 30*, 29–42.

Andrews, S., & Grace, J. (2019). Sensory products for sensory beings. In *Design research for change showcase catalogue* (pp. 100–101). Lancaster University. https://www.designresearchforchange.co.uk/wp-content/uploads/2019/09/DR4C_Showcase_2019_Catalogue_digital_LRes.pdf

Asare, E. (2022, April 13). One hundred years after voice-assisted technology was invented, Ghana finally has its own—Meet Abena AI, the 'Twi Siri'. *EdwardAsare.com.* https://edwardasare.com/100-years-after-voice-assisted-tech-was-invented-ghana-finally-has-its-own-meet-abena-ai-the-twi-siri/

Bach-y-Rita, P., Collins, C. C., Saunders, F. A., White, B., & Scadden, L. (1969). Vision substitution by tactile image projection. *Nature*, *221*, 963–964. https://doi.org/10.1038/221963a0

Beudaert, A. (2024). Fifty shades of Braille: Motivations, challenges and cultural significance in visual impairment. *Journal of Consumer Marketing, 41*(3), 357–367. https://doi.org/10.1108/JCM-12-2023-6477

Bahadir, S. K., Koncar, V., & Kalaoglu, F. (2012). Wearable obstacle detection system fully integrated into textile structures for visually impaired people. *Sensors and Actuators A: Physical, 179*, 297−311. https://doi.org/10.1016/j.sna.2012.02.027

Bonanno, M., Saracino, B., Ciancarelli, I., Panza, G., Manuli, A., Morone, G., & Calabrò, R. S. (2025, July). Assistive technologies for individuals with a disability from a neurological condition: A narrative review on the multimodal integration. *Healthcare*, *13*(13), Article 1580. https://doi.org/10.3390/healthcare13131580

Bryman, A., & Bell, E. (2007). *Business research methods.* Oxford University Press.

Butler, M., Holloway, L., Marriott, K., & Goncu, C. (2017). Understanding the graphical challenges faced by vision-impaired students in Australian universities. *Higher Education Research & Development, 36*(1), 59–72. https://doi.org/10.1080/07294360.2016.1177001

Chanana, P., Paul, R., Balakrishnan, M., & Rao, P. V. M. (2017). Assistive technology solutions for aiding travel of pedestrians with visual impairment. *Journal of Rehabilitation and Assistive Technologies Engineering*, *4*. https://doi.org/10.1177/2055668317725993

Chong, A. Y.-L. (2013). Predicting m-commerce adoption determinants: A neural network approach. *Expert Systems with Applications, 40*(2), 523–530. https://doi.org/10.1016/j.eswa.2012.07.068

Compas, S. M. (2023). *Surviving dystopia: Desiring disability and deliberate cripping in apocalyptic film*

(Doctoral dissertation, University of California, San Diego). https://escholarship.org/uc/item/26k0n4g5

Creswell, J.W. & Poth, C.N. 2018, *Qualitative inquiry and research design: Choosing among five approaches*, 4th edn, SAGE Publications, viewed 15 June 2026, https://us.sagepub.com/en-us/nam/qualitative-inquiry-and-research-design/book246896.

Crowston, K., Allen, E. E., & Heckman, R. (2012). Using natural language processing technology for qualitative data analysis. *International Journal of Social Research Methodology, 15*(6), 523–543. https://www.tandfonline.com/doi/abs/10.1080/13645579.2011.625764

Cruz, C. D. (2013). Genes: A software package for analysis in experimental statistics and quantitative genetics. *Acta Scientiarum Agronomy*, *35*(3), 271–276. https://www.researchgate.net/publication/260772574

Dodds, A. G., Armstrong, J. D., & Shingledecker, C. A. (1981). The Nottingham obstacle detector: Development and evaluation. *Journal of Visual Impairment & Blindness, 75*(5), 202–206. https://doi.org/10.1177/0145482X8107500503

Falchetti, C., Ponchio, M. C., & Botelho, N. L. P. (2018). Understanding the vulnerability of blind consumers: Adaptation in the marketplace, personal traits and coping strategies. In S. Dunnett, K. Hamilton, & M. Piacentini (Eds.), *Consumer vulnerability* (pp. 107–128). Routledge.

Fearnley, C. J. (2022). Mind mapping in qualitative data analysis: Managing interview data in interdisciplinary and multi-sited research projects. *Geo: Geography and Environment, 9*(1), e00109. https://doi.org/10.1002/geo2.109

Felgner, S., Ex, P., & **Henschke**, C. (**2018**). Physicians' Decision Making on Adoption of New Technologies and Role of Coverage with Evidence Development: A Qualitative Study. Value in Health, 21(9), 1069–
1076. https://doi.org/10.1016/j.jval.2018.03.006

Fox, G., & Connolly, R. (2018). Mobile health technology adoption across generations: Narrowing the digital divide. *Information Systems Journal*, *28*(6), 995-1019. https://doi.org/10.1111/isj.12179

Freedom Scientific. (2017). *ElBraille portable braille device.* https://www.freedomscientific.com/training/braille/elbraille

Funkquist, E., Hasan, R., & Lennkvist, L. (2024). Visual cues in consumer clothing decision-making. *Fashion and Textiles*. https://doi.org/10.1186/s40691-024-00378-8

Garousi, V., & Felderer, M. (2017, June). Experience-based guidelines for effective and efficient data extraction in systematic reviews in software engineering. In *Proceedings of the 21st international conference on evaluation and assessment in software engineering* (pp. 170-179). http://dx.doi.org/10.1145/3084226.3084238

Gallagher, C. M. (2020). *Yet another (mis)representation of disability: A critical content analysis of blindness/vision impairment in young adult literature* (Master's thesis, University of North Carolina at Chapel Hill). ProQuest Dissertations & Theses Global

Hakobyan, L., Lumsden, J., O'Sullivan, D., & Bartlett, H. (2013). Mobile assistive technologies for the visually impaired. *Survey of Ophthalmology*, *58*(6), 513–528. https://doi.org/10.1016/j.survophthal.2012.10.004

Harwood, M. L. (2013). *A novel method to assess consumer acceptance of bitterness in chocolate products* [Master's thesis]. Penn State University.

Hennink, M. M., Kaiser, B. N., & Marconi, V. C. (2017). Code saturation versus meaning saturation: How many interviews are enough? *Qualitative Health Research*, *27*(4), 591–608. https://doi.org/10.1177/1049732316665344

Kapsalis, E., Jaeger, N., & Hale, J. (2024). Disabled-by-design: Effects of inaccessible urban public spaces on users of mobility assistive devices–a systematic review. *Disability and Rehabilitation: Assistive Technology*, *19*(3), 604–622. https://doi.org/10.1080/17483107.2022.2111723

Khan, Z. P. (2024). *Opinion of blind and visually impaired patients and caretakers on Braille labelling on medical care products packaging in India*. Swiss School of Business and Management Geneva. https://repository.e-ssbm.com/index.php/rps/article/view/499

Krueger, R. A. (2014). *Focus groups: A practical guide for applied research*. Sage Publications.

Krippendorff, K. (2018). *Content analysis: An introduction to its methodology* (4th ed.). SAGE Publications. https://collegepublishing.sagepub.com/products/content-analysis-4-258450

Kurzweil, R. (1990). *The age of intelligent machines*. MIT Press.

Lewallen, S., & Courtright, P. (2001). Blindness in Africa: Present situation and future needs. *British Journal of Ophthalmology*, *85*(8), 897–903. https://doi.org/10.1136/bjo.85.8.897

Lteif, L., van der Sluis, H., Block, L. G., Cian, L., Patrick, V. M., & Scott, M. L. (2025). Creating equity by design: A conceptual framework for marketplace inclusion. *Journal of Public Policy & Marketing, 44*(2), 214–231. https://doi.org/10.1177/07439156251315371

Marcus, B., Weigelt, O., Hergert, J., Gurt, J., & Gelléri, P. (2017). The use of snowball sampling for multi-source organizational research: Some cause for concern. *Personnel Psychology, 70*(3), 635–673. https://doi.org/10.1111/peps.12169

Ortega, A., Tobar Quevedo, J., De la Cruz Guevara, D., & López López, A. (2021, June). LECTO: A smart assistant for people with visual impairment for reading texts in Spanish. In M. Botto-Tobar, H. Cruz, A. Díaz Cadena, & B. Durakovic (Eds.), *XV Multidisciplinary International Congress on Science and Technology* (pp. 198–209). Springer.

Ramatla, A., & Mastamet-Mason, A. (2013). The decision-making processes of visually impaired consumers in an apparel retail environment. In *Proceedings of Design Education Forum of South Africa (DEFSA): Conference Design Cultures: Encultured Design* (pp. 220-229). Vanderbijlpark. https://www.defsa.org.za/2013-defsa-conference

Ramatla, A. (2014). *Braille clothing communicative tool for the blind (Patent No. 00217)*. Tshwane University of Technology, South African Department of Science and Technology.

Ramatla, A. (2016). *The decision-making processes of visually impaired consumers in an apparel retail environment* [Master's thesis]. Tshwane University of Technology.

Saiel, M. F. (2025). Enhancing social inclusion of elderly and disabled individuals through assistive technology: A multidisciplinary approach. In *Computer vision and Internet of Everything (IoE) for societal needs* (pp. 147–172). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3693-8272-1.ch007

Saini, M. (2025). Exploring the socio-cultural barriers in acceptability of assistive technology. In *Advances in assistive technologies* (pp. 17–22). Springer Nature Singapore. https://doi.org/10.1007/978-981-97-5726-8_2

Schedl, M. (2012). *On the use of the web and social media in multimodal music information retrieval* (Doctoral dissertation]. Johannes Kepler University.

Scherer, M. (2011). *Assistive technologies and other supports for people with brain impairment*. Springer.

Selvaraj, C., & Bhalaji, N. (2018). Enhanced portable text-to-speech converter for visually impaired. *International Journal of Intelligent Systems Technologies and Applications, 17*(1–2), 42–54. https://doi.org/10.1504/IJISTA.2018.091586

Shafik, W. (2025). Emerging trends and technological innovations and people with disabilities and the marginalized. In *Global sustainable transition with inclusion: A focus on the people with disabilities and the marginalized* (pp. 293–325). Springer.

Shilkrot, R., Huber, J., Liu, C., Maes, P., & Nanayakkara, S. C. (2014). *Finger reader: A wearable device to support text reading on the go*. MIT Media Lab.

Stevenson, A., & Waite, M. (Eds.). (2011). *Concise Oxford English dictionary: Book & CD-ROM set*. Oxford University Press.

Struwig, F. W., & Stead, G. B. (2001). *Planning, designing, and reporting research*. Pearson Education.

Theodorou, P., & Meliones, A. (2023). Gaining insight for the design, development, deployment, and distribution of assistive navigation systems for blind and visually impaired people through a detailed user requirements elicitation. *Universal Access in the Information Society, 22*(3), 841–867. https://doi.org/10.1007/s10209-022-00885-9

Toole, J. C. (2017). *Student departure at West Point: An examination within a total institution* (Doctoral dissertation, University at Albany, State University of New York). https://doi.org/10.54014/VEQ4-C79E

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425–478. https://doi.org/10.2307/30036540

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly, 36*(1), 157−178. https://doi.org/10.2307/41410412

Waisbourd, M., Ahmed, O., Siam, L., Moster, M. R., Hark, L. A., & Katz, L. J. (2015). The impact of a novel artificial vision device (OrCam) on the quality of life of patients with end-stage glaucoma.

Investigative Ophthalmology & Visual Science, *56*(7), Article 519. https://iovs.arvojournals.org/article.aspx?articleid=2335212

Wilkinson, S. (2015). Focus groups. In J. A. Smith (Ed.), *Qualitative psychology: A practical guide to research methods* (3rd ed., pp. 199–221). SAGE Publications.

World Health Organization. (2026, February 10). *Blindness and vision impairment*. https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment

Yang, X., Yuan, S., & Tian, Y. (2014). *Assistive clothing pattern recognition for visually impaired people*. *IEEE Transactions on Human-Machine Systems, 44*(2), 234–243. https://doi.org/10.1109/THMS.2014.2302814

Yu, H., & Rahman, O. (2018). Inclusive apparel shopping experiences for older consumers in China: Product attributes and retail environment. *International Review of Retail, Distribution and Consumer Research, 28*(5), 531–553. https://doi.org/10.1080/09593969.2018.1509800

Yu, H., Tullio-Pow, S., & Akhtar, A. (2015). Retail design and the visually impaired: A needs assessment. *Journal of Retailing and Consumer Services, 24*, 121–129. https://doi.org/10.1016/j.jretconser.2015.03.001

Yuan, C. W., Hanrahan, B. V., Lee, S., Rosson, M. B., & Carroll, J. M. (2017). I didn't know that you knew I knew: Collaborative shopping practices between people with visual impairment and people with vision [Conference session]. *Proceedings of the ACM on Human-Computer Interaction*, 1(CSCW) (pp. 1–18). https://doi.org/10.1145/3134753