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Circular Shirt Builder: an apparel configurator to support healthier consumption boundaries in the textiles circular economy

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ABSTRACT

The fashion industry faces urgent challenges related to overconsumption, material waste, and consumer detachment from garment lifecycles. While circular economy (CE) principles offer a promising alternative, strategies that actively engage consumers in circular practices remain underexplored. This study presents the *Circular Shirt Builder* (CSB), a physical apparel configurator designed to promote circular behaviours through modular garment design and embodied customisation. Using a Living Lab methodology, 19 participants engaged with the CSB in a stakeholder engagement platform in a retail-like setting, assembling modular shirts from a predefined library of components. The study employed a dual analysis approach: inductive thematic analysis and a deductive evaluation using the wellbeing framework for consumer experiences in the circular economy of the textile industry. Findings suggest that the CSB can foster emotional attachment, support learning about garment construction, encourage creative self-expression, and prompt reflection on consumption habits. Several wellbeing dimensions, such as playfulness, agency, and prospective thinking, appeared to be activated through the hands-on interaction. This research indicated that configurator tools grounded in circular and wellbeing principles may support long-term product use, more mindful consumption, and greater consumer involvement in transitions toward a circular textile economy.

1. Introduction

The fashion industry continues to face significant environmental and social challenges related to overproduction, material waste, and the disconnection between consumers and the garments they wear. While fast fashion offers accessibility and variety, it fosters overconsumption and short product lifespans (Bly et al., 2015a). The fashion industry has a significant environmental impact (Niinimäki et al., 2020). In the EU alone, over five million tonnes of clothing waste are generated annually, with only 1 % recycled into new clothing (Textiles strategy, 2024). Recent analyses of the UK clothing economy further highlight structural challenges: the system remains predominantly linear, with more garments incinerated or landfilled than recycled, and with very low closed-loop recycling rates despite relatively high reuse levels (Millward-Hopkins et al., 2023a). Scenario modelling suggests that modest reductions in consumption may yield greater environmental benefits than large-scale increases in recycling efficiency alone (Millward-Hopkins et al., 2023b). These challenges call for transformative change in how fashion is produced, consumed, and valued.

The circular economy (CE) presents an alternative model focused on designing out waste, keeping materials in use, and regenerating natural systems (Jia et al., 2020). Within CE, products are designed to be reused (Kant Hvass and Niinimäki, 2018), repaired (Balkenende et al., 2018), or effectively recycled (Kant Hvass and Niinimäki, 2018), with waste reframed as a valuable resource. Strategies in the textiles industry include the intentional use of sustainable materials (Rognoli et al., 2022), design for disassembly (De Fazio et al., 2021), support for material recovery through high-quality design (WRAP, 2023), and the enabling of effective recycling (WRAP, 2023). While industry-led CE initiatives are expanding, consumer engagement remains essential yet underexplored.

Consumers play a critical role in extending garment lifecycles, as their behaviours directly influence the circulation of products and materials (Wastling et al., 2018). However, current consumption patterns—driven by hedonic motives, low prices, and fast fashion's rapid turnover—often undermine long-term use, care, and emotional durability (Birtwistle and Moore, 2007). As Niinimäki et al. (2020) emphasise, systemic overconsumption is a key driver of impact on the

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environment, and shifting consumer practices is as important as redesigning production systems. For CE to be successfully adopted, consumers must be enabled and supported in valuing durability, quality (Piippo et al., 2022), care, and emotional attachment (Rognoli et al., 2022; Chapman, 2005).

Realising this transition requires individual behavioural change and systemic support from designers, manufacturers, and policymakers (Gomes et al., 2022). This paper argues that engaging consumers in experiences that are reflective, participatory, and attuned to wellbeing can foster such change. We investigate the hypothesis that intentionally addressing human wellbeing adds perceived value to textile products, thereby encouraging prolonged use and reducing excess consumption.

To promote alternative approaches to material consumption that align with CE principles, this research draws on studies linking sustainable consumption to wellbeing theories that prioritise long-term, or *eudaimonic*, wellbeing (Di Giulio and Fuchs, 2014; Huta et al., 2016). We propose that encouraging behaviours aligned with dimensions such as participation, learning, playfulness, self-expression, and attachment can support more meaningful and enduring consumer-garment relationships.

Building on prior work that introduced the Wellbeing Framework for consumer experiences in the circular economy of the textile industry (Petreca et al., 2025), this study applies that framework to a practical intervention: the *Circular Shirt Builder* (CSB)—a physical apparel configurator designed to encourage healthier consumption boundaries through modular design and embodied co-creation.

Using a Living Lab methodology (Malmberg et al., 2017), we conducted a qualitative study with 19 participants who used the CSB in a stakeholder engagement platform in a retail-like setting (Baurley et al., 2025). Through a dual analytical approach, inductive thematic coding and deductive application of the Wellbeing Framework for consumer experiences in the circular economy of the textile industry(Petreca et al., 2025), we investigated how product configuration experiences may shift consumer attitudes toward more circular and mindful relationships with clothing. This study contributes new empirical evidence to the field of circular economy research that demonstrates how wellbeing-centred and embodied design can support circular consumption behaviours in fashion retail settings.

2. Background

Overconsumption is a widely recognised obstacle to adopting circular consumer behaviour (Bly et al., 2015b), driven in part by *hedonic wellbeing*—the pursuit of immediate, short-term satisfaction (Jackson, 2005). Fast fashion's economic model reinforces this dynamic through low prices, rapid product turnover, and highly responsive supply chains, resulting in significant environmental burdens (Niinimäki et al., 2020). The disposability and ease of replacement of low-cost garments diminish perceived value, reducing emotional attachment and encouraging premature disposal (McNeill and Moore, 2015). However, research shows that when consumers are encouraged to select items that align with their personal style and preferences, they are more likely to form emotional bonds with garments and retain them for longer (Chapman, 2005; Niinimäki and Koskinen, 2011). This process can enhance personal creativity, reflection, and self-awareness (Niinimäki et al., 2017), and is reinforced when garments carry memories, narratives, or symbolic meaning (Van Den Berge et al., 2021). Recent CE research further highlights that higher garment quality, both technical and experiential, is essential for extending product lifespans and enabling recirculation (Piippo et al., 2022).

Mass Configurators (MCs) have emerged as a consumer-facing solution that supports personalisation, enabling individuals to customise elements such as colour, fabric, and style (Turner et al., 2020). MCs are known to increase emotional attachment, perceived value (Franke et al., 2010), and self-expressive satisfaction (Teichmann et al., 2016). They encourage active participation in the design process, which can enhance emotional connection and post-purchase satisfaction (Piller and Tseng, 2009). However, most MCs in fashion remain digitally mediated and visually focused, limiting opportunities for embodied interaction, tactile reflection, and deeper material understanding. Moreover, MCs are rarely designed with circular ambitions. Studies suggest that easy customisation can even stimulate novelty-seeking and increased consumption (Kim and Lee, 2020). These limitations become more significant when considering that substantial reductions in environmental impact depend less on recycling technologies and more on reducing demand and extending product lifetimes (Millward-Hopkins et al., 2023a, 2023b).

While MCs are successful in meeting aesthetic preferences and increasing sales (Franke et al., 2010; Piller and Tseng, 2009; Franke and Piller, 2004), their potential to promote *circular* behaviours, such as care, repair, reuse, modularity, and longevity, remains underexplored. This creates an opportunity to reimagine MCs as tools that support circularity through meaningful, multisensory engagement rather than merely facilitating aesthetic choice.

One example of a design tool that moves beyond visual customisation is the Compositor Tool (Petreca et al., 2022), which fosters multisensory engagement and storytelling to deepen understanding of biobased materials and their life cycles. Comprising four interactive stations, it enables consumers to explore the origins and properties of materials, encouraging active participation in co-creation and material selection. Such embodied interactions have been shown to enhance sensory awareness, emotional attachment, and reflective engagement, supporting more conscious decision-making in design contexts (Petreca et al., 2019).

The Compositor Tool's emphasis on sensory interaction and material storytelling has informed the development of the Circular Shirt Builder (CSB). This physical mass configurator combines modular garment design and embodied co-creation to support healthier consumption boundaries. By foregrounding materiality, touch, and making, the CSB addresses limitations of digital MCs and integrates the wellbeing framework for consumer experiences in the circular economy of the textile industry (Petreca et al., 2025) into the customisation process.

While there is growing literature on the circular economy in the textiles industry, research continues to indicate that fashion systems remain predominantly linear, with very low rates of fibre-to-fibre recycling and substantial material losses across the supply chain (Niinimäki et al., 2020; Millward-Hopkins et al., 2023b). Improving garment quality and extending user time are therefore central strategies for enhancing durability, enabling reuse and supporting more effective material recovery (Piippo et al., 2022). These insights highlight the need to investigate how consumer-facing tools, such as configurators, can support attitudes, practices and behaviours aligned with circular principles.

Designing for eudaimonic wellbeing—by prioritising purpose, creativity, connection, and self-expression—has been shown to support deeper consumer-product relationships and long-term engagement with sustainable lifestyles (Desmet and Fokkinga, 2020). Building on this work, this study presents the CSB as a consumer experience intervention through which we hypothesise that wellbeing-oriented configurator experiences may facilitate more resilient and mindful forms of garment engagement, thereby supporting the conditions for circular behaviour.

3. The Circular Shirt Builder (CSB)

The CSB is a physical apparel configurator that facilitates consumer engagement in customising a shirt, as well as interactions relating to future care, repair, update, and upgrade. The shirt was selected for its widespread use and its gender-fluid appeal. It is designed to evoke elements of traditional tailoring in a retail setting while emphasising modularity and co-design. Furthermore, it was installed in a stakeholder engagement platform in a retail-like setting (Baurley et al., 2025).

The CSB comprises four elements arranged as follows (Fig. 1):

First, on one side of the space, a life-sized mannequin is outfitted in a

Fig. 1. The layout of the Circular Shirt Builder.

modular shirt that was specifically designed and made for the study. The modular shirt is a configurable garment that can be assembled into various styles. It comprises multiple components, each offering different design possibilities. There are two options for each of the five components of the shirt, including shirt length (short or long), shirt side (classic fit or wide belted fit), collar design (classic or standing), pocket design (welt or flap), and sleeve finish (button cuff or open) (Fig. 2).

The modular shirt combines traditional shirt-making techniques —such as a button-down placket (the strip of fabric that holds the buttons) and a collar stand (the band that supports the collar)—with adapted methods that make the shirt modular, including faced edges (clean, reinforced fabric finishes) and hidden snap fastenings that allow the components to be easily attached and removed.

Second, adjacent to this mannequin, a Modular Components Library serves as a repository of possibilities, showcasing an organised array of modular shirt components, including collars, cuffs, sleeves, and torso pieces on a wall panel (Fig. 3).

Third, opposite to this arrangement stands a full-length mirror (Fig. 1). Next to the mirror, a wall panel is adorned with five digital tablets that play (in continuous loops) videos to demonstrate the assembly and disassembly of the modular shirt using the components (Fig. 4). The close-up video shots demonstrate how the components can be attached or removed. The videos aimed to provide an instructional guide and a source of inspiration for participants. A large tailoring table is situated in the middle of the pseudo-retail space.

Finally, a wall near the exit invites visitors to take instant photos of themselves wearing their unique creations. Beneath a sign that exclaims "Flaunt Your Creation!" and rows of instant photos pinned up, showing off a diverse array of shirts worn by proud creators.

To examine our hypothesis, we employed the Living Lab methodology (McPhee et al., 2012), which allowed us to conduct the study in a setting that encourages consumer participation by closely resembling a real-life retail environment. The six-week study was approved by the local ethics committee and involved 19 participants who provided

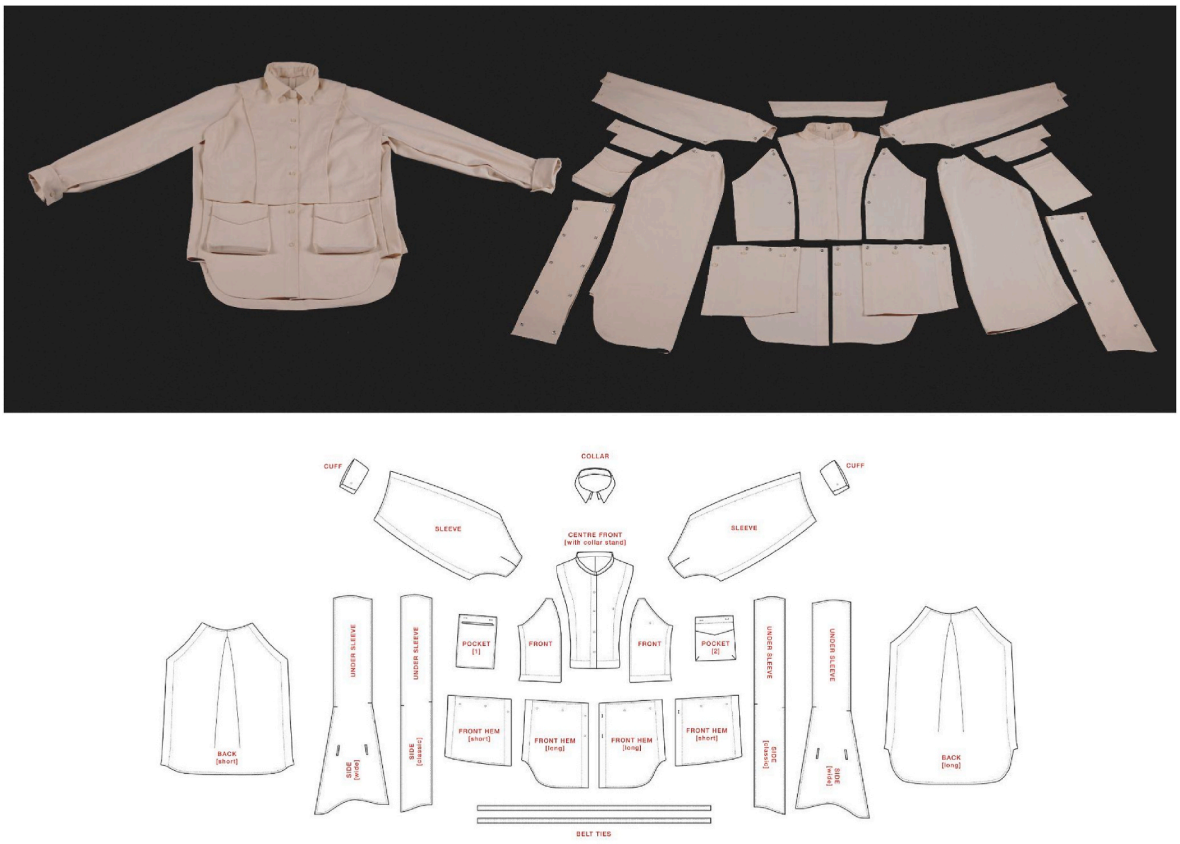

Fig. 2. The Modular shirt and its components designed by Morag Seaton.

Fig. 3. Modular Components displayed on a wall panel.

informed consent. Participants P1-P12 and P16 took part individually, while P13a-P13b, P14a-P14b, and P15a-P15b chose to participate in pairs. Because the experience was designed to emulate a typical retail interaction, we did not collect demographic data, as such information is

Fig. 4. Five digital tablets on a wall panel.

not usually requested during shopping experiences. The only information requested was regarding participants' background knowledge of textiles and making, which was included as part of the experience as a way to establish how much new knowledge the participants should expect to receive from taking part. Based on this information, we categorised participants into three categories according to their knowledge level: no knowledge (P6, P7, P11, P12, P16), working knowledge (P1, P3, P5, P8, P9, P10) and knowledgeable (P2, P4, P13a, P13b, P14a, P14b, P15a, P15b).

The participants were initially invited to familiarise themselves with the CSB through free exploration of its elements. This included examining the attachment and detachment of modules to understand the connection system, viewing the instructional videos, and inspecting the fully assembled modular shirt displayed on a mannequin (Fig. 5). This introductory phase was designed to allow participants to develop baseline familiarity with the system prior to undertaking the configuration task.

Once participants had familiarised themselves with the assembly process, they were asked to modify the shirt using the available components until they reached a configuration they were satisfied with; this typically took around 30 min. A researcher was present throughout the process to offer clarifications and respond to questions as needed. After finalising their configuration, participants were invited to try on the shirt for an on-body evaluation. Concurrently, semi-structured interviews were conducted, following the guide presented in Table 1, to examine participants' perceptions of the modular shirt and its associated

Fig. 5. The Circular Shirt Builder.

Table 1
Semi-structured interview guide.

Focus	Questions
Modularity	1. Do you have any concerns about modular garments? 2. Would you replace or update modules in a garment? Which modules do you think you would change or replace most often? 3. Would you want to own every available module? 4. How do you think you would care for a modular garment?
Customisation	5. (Why) Would you like to be part of the garment design process? 6. How much control would you like over the garment's design? How does it feel to have control over a design? 7. Does this shirt give you too many design options? Or not enough?
Relation to standard shirts	8. Having put together your own garment, do you feel differently about shirts you can find on the High Street? If so, tell us how?

ecosystem. In this study, 'ecosystem' refers to the actions, practices, and services surrounding the garment, including its use, care, repair, storage, customisation, and anticipated future interactions. A think-aloud protocol was used during the activity, and all sessions were audio-recorded.

After the activity, participants were invited to photograph their customised shirts, which were printed using an instant-print technique, and to take them away or add them to the dedicated wall in the exhibition space.

To facilitate analysis after the study, all data were transcribed verbatim so that the researchers could familiarise themselves with the data. The data were analysed using two distinct approaches: an inductive (bottom-up) method, which aimed to observe the most prominent themes using Thematic Analysis, and a deductive (top-down) approach that employed the wellbeing framework for consumer experiences in the circular economy of the textile industry (Petreca et al., 2025) to delve deeper into the data, specifically interrogating discrete wellbeing concepts that were identified in the participants' experiences in the bottom-up stage. These approaches are described in more detail below.

(i) **Inductive approach:** A Thematic Analysis was conducted to identify the most important themes, which followed Braun and Clarke's (Braun and Clarke, 2006) guidelines. Coding was conducted using QSR International's NVivo 1.7.1 software. The semi-structured interview guide (Table 1) was used to structure the analysis, with the focus on the themes that emerged. This was done to produce a high-level picture of participants' shirt-building experience, particularly with respect to their perceptions and anticipated behaviours regarding modularity and customisation.

(ii) **Deductive approach:** The data was further analysed by employing the wellbeing framework for consumer experiences in the circular economy of the textile industry ((Petreca et al., 2025)) to gain deeper insights through two key steps: (i) utilising the concepts within the wellbeing framework (Petreca et al., 2025) to analyse the data further, and (ii) adding nuance to the wellbeing elements that started to emerge from the inductive analysis with the aid of the structure provided by the wellbeing framework. This framework comprises 16 wellbeing dimensions, presented in Table 2.

We present our findings in two sections, one for inductive and one for deductive insights. For the inductive insights, we report findings under four overarching themes that characterised participants' experiences of the CSB. To provide deductive insights, we report findings aligned with the wellbeing concepts emphasised in the CSB.

Table 2
Definitions of wellbeing dimensions from the wellbeing framework for consumer experiences in the circular economy of the textile industry (Petreca et al., 2025).

Wellbeing Concept	Definition
Playfulness	Playfulness is the inclination to engage in fun, spontaneous, and creative activities. However, its manifestation varies across individuals and is often more accessible in social interactions with familiar individuals.
Enjoyment and Pleasure	Enjoyment and pleasure are closely related to emotional states influenced by a garment's functional fit, emotional resonance, and aesthetic appeal. While enjoyment refers to the overall emotional satisfaction derived from these factors, pleasure arises from specific positive experiences that can foster an emotional connection with the clothing item.
Engagement - Participation	Engagement and Participation refer to the direct involvement of consumers in sustainable practices, amplified and facilitated through interactions with stakeholders toward a common goal.
Agentive/Sense of Control	The feeling of agency—characterised by active, autonomous, and proficient engagement in interactions, participation, or collaborative creation—often emerges from sharing skills and resources and challenging traditional consumption practices.
Bodily & Sensory	Sensory and bodily factors refer to the perception of the physical properties of textile materials that significantly affect the wearer's embodied experience.
Learning (curiosity awareness)	Learning constitutes an active engagement in acquiring skills and knowledge.
Attachment	Attachment is an emotional bond formed through a sense of connection and affection, influenced by key factors such as meeting expectations, functional utility, and aesthetic appeal, and further strengthened by the investment of effort and positive usage experiences.
Effort	Effort is defined as a subjective escalation in mental or physical activity to achieve a specific goal, characterised as a voluntary and purposeful process.
Affordability	Affordability in sustainable fashion refers to the cost-effectiveness of products, a key concern for consumers, which can be offset by perceived long-term value and quality.
Prospective- Self	Prospective self concerns one's ability to envision future results and take proactive steps to bring about change before it occurs.
Community	Community refers to groups that share interests and a commitment to respecting individual differences and to supporting one another's wellbeing and group integrity.
Self-Worth	Self-worth in fashion consumption has traditionally relied on social acceptance and external validation. However, for sustainable fashion consumers, it is more internally driven, rooted in material comfort and the expression of non-conformist values, emphasising autonomy and self-esteem.
Optimism	Optimism is a forward-looking emotional state focused on achieving favourable outcomes, particularly in the contexts of climate change and the Circular Economy. However, it is one aspect of a complex emotional landscape that includes pessimism and fear, and should be balanced against these other responses to achieve a nuanced perspective.
Self-Expression	In sustainable fashion, self-expression is about aligning style choices with personal values. This often involves "anti-consumption" strategies such as buying fewer, higher-quality, or second-hand items. By resisting fast fashion and choosing sustainable brands, consumers articulate their identity while expressing their style.
Competence	Competence refers to a consumer's skill and confidence in making informed choices about product use and acquisition, as well as their ability to engage in specific circular practices, such as renewal and repair.
Caring	Caring can be described as emotional attachment and practical action directed towards garments, people, and the environment. While it aims for sustainability and longevity, personal benefits often overshadow environmental concerns. The act of caring can also stem from values such as thrift and waste avoidance.

4. Results

4.1. Inductive insights: The Circular Shirt Builder as a multifaceted tool

We report on our findings through five overarching themes that characterised how the CSB was experienced by participants, namely as a tool for (i) learning about clothes, (ii) revealing preferences around clothes, (iii) balancing participation in design, (iv) tailoring co-design for diverse audiences, and (v) thinking about interaction with garments. For each theme, we include a table linking themes to codes and providing examples of supporting quotations.

4.1.1. A tool for learning about clothes

The modular shirt provided a basis for *comparison with regular shirts*, leading participants to a heightened *understanding of the garment construction*. Moreover, one participant (P9) reported that the activity heightened their curiosity about the manufacturing process for clothing. Participants acknowledged the significance of actively engaging in the process of disassembling and reconfiguring the garment, which led to a *feeling like designing*, (Table 3). Consequently, a sense of *accomplishment* in the final garment emerged.

Table 3
Codes associated with the theme 'A tool for learning about clothes'.

Theme	Codes	Example quotes
A tool for learning about clothes	Comparison with regular shirts	"Yeah. I feel like I love the idea of being able to adapt it. It becomes like more than one shirt. The looking at a normal shirt bit little of the, I see a bit of a waste. Whereas this has like, this could be three different shirts. Which is cool. Endless, endless shirts." (P2)
	Understanding the garment construction	"I think even for someone who doesn't have any kind of experience of, stitching, of garment design or construction, it's quite, it's quite accessible. Isn't, it's quite kind of easy to change," and "guess it, it's kind of opening up new ways of, of thinking about clothing and adapting it, kind of the longevity and rather than looking at what is the other new, what is, it is a different shirt that I could buy". (P4)
	Feeling like designing	"Yeah, definitely. I mean it's very few pieces and parts, but still you do get a sense of agency like, oh I decided to put that pocket there. It's kind of, you know, fun cuz it's a little bit wonky and a bit lopsided. Yeah, I kind of like that. Yeah. Cause I haven't seen a shirt like that." (P11)
		"Rather than, I guess, what's the word? Customising or something. It feels like it's, it feels like I'm making it myself (P10)"
	Accomplishment	"Oh definitely. Yeah, definitely. And people would be like for Exactly. People would be like, where's that from? And you'd be like, well I put it together. Yes. My brain. Yeah. I'm a genius. Exactly (P10)"
	Curiosity regarding the manufacturing process	"It'd be interesting to see how many things Paul Smith has in his workshop and how he mix and matches them" (P9)

4.1.2. A tool for revealing preferences about clothes

Participants reported that the CSB enhanced their awareness of their textile and clothing preferences. The modular shirt also worked as a tool for introspection, catalysing participants' reflections on their life experiences with clothes, as evidenced in Table 4.

4.1.3. A tool for balancing participation in the customisation of shirts

Participants expressed the need for greater flexibility to enhance customisation further. Whilst participants appreciated the additional input they could provide on the shirt design, they also expressed frustration with the limitations imposed by the predetermined component design, as reported in Table 5.

4.1.4. A tool for tailoring customisation to a range of audiences

Notably, there is a correlation between participants' level of familiarity with garment design and manufacturing techniques and their excitement about the shirt-building activity. For participants who expressed familiarity with garment manufacturing, the CSB was perceived as a comprehensive customisation tool with a low challenge. In contrast, participants who were less familiar with garment manufacturing perceived the activity as one of designing and achieving high engagement, as reported in Table 6. This highlights the need to consider a range of audiences when designing a garment that will serve as a platform for people to customise and to interact cyclically.

4.1.5. A tool for thinking about interaction with garments

The modular garment was found to evoke a greater sense of care than conventional clothing items, presenting an opportunity for different washing methods, such as spot-washing or washing discrete modules (P13a & b, 14a, P3, P7). However, with respect to storage, most participants chose to preserve the garment in its assembled form, as with their regular clothing (Table 7). The modular garment creates opportunities for new interactions, offering alternatives to conventional ways of garment use.

Table 4
Codes associated with the theme 'A tool for revealing preferences about clothes'.

Theme	Codes	Example quotess
A tool for revealing preferences around clothes	Enhanced awareness of textile preferences	"I don't like that thick silky material. (…) I was actually surprised cuz I didn't know that beforehand. Oh really? But you know, like these gowns and things like that. Yeah. I'm not into, yeah, this just makes me feel like I'm dressing up as a fish or something. (…) Coldness, maybe it's the coldness of the fabric or something like that. I see. Yeah. I'm realising something as I talk to you." (P11)
	Enhanced awareness of clothing preferences	"I feel it's nice to see I have things in pieces to put them together. And as with the fabrics, you surprise yourself with what adding the collar does or what adding the cuff does to the shape. It changes the whole weight as well as the balance of an item. (P9)"
		"I think it's enough to kind of get me thinking about what I like in a shirt for sure. (P11)"
	Life experiences with clothes	"You can even tie them both around the bottom. Like how people do with trench coats." (P13b)
		"I'm trying to think of the shirts that I have. And I probably don't wear many shirts." (P9)

Table 5
Codes associated with the theme 'A tool for balancing participation in shirt co-design'.

Theme	Codes	Example quotes
A tool for balancing participation in shirt customisation	Need for greater flexibility	"Cause I feel like the number of options is just basically put the shirt on. I can make it bigger or smaller. That's kind of what I feel like with this setup … I want like Lego bricks. Like I want little patches" (P1) "I'd like to be able to make the back as short as the front." (P2) "yeah, you could do contrast. Contrast I guess as well. It's not necessarily the components. You could also change the fabric, the colour." (P4) "I do wish for more different types of pockets. There is only two types of pockets." (P6)
	Frustration	"I guess the problem is, how much do you want to make it dictating that it goes, because obviously there's a way to put the shirt together the way it was. (P1)"

Table 6
Codes associated with the theme 'A tool for tailoring customisation to a range of audiences'.

Theme	Codes	Example quotes
A tool for tailoring customisation to a range of audiences	Basic customisation for designers	"I think yes. Because in general, like if you are not a designer is when you do have a sense of what it should look like. Yeah. And it gives people so much freedom to put it together and it's fun. Kind of like having fun with designing. Of what you want to write. So I think people will get more engaged if there's something (P14a)" "it's not really my design. The end of the day I just put them together. (P7)"
	Design for non-designers	"Yeah. It plays a very important role for consumers to actually get involved in this bit as well. Yeah. And design their own garments if possible. (P14b)" "Yeah. It feels, because it's so hands on cuz it's not like I'm telling someone what to do. I'm doing it myself so I can kind of experiment. So it really does feel like I'm designing it.(P10)"

4.2. Deductive insights: wellbeing emphasised through the Circular Shirt Builder

Following the inductive data analysis, we examined the nuanced ways in which participants' experiences with the CSB intersected with various dimensions of wellbeing, guided by the wellbeing framework for consumer experiences in the circular economy of the textile industry (Petreca et al., 2025). The deductive thematic analysis enabled us to identify specific dimensions of wellbeing that were activated during the CSB experience. The analysis also provided evidence on how particular aspects of the experience can be designed to strengthen or moderate these wellbeing-related effects. The terms in bold correspond to the participants' articulated sentiments and are mapped onto the wellbeing dimensions defined in the wellbeing framework (Petreca et al., 2025).

Playfulness emerged as a key dimension, with six participants (P1, P11, P13a, P13b, P14a, P14b) finding joy and freedom in disassembling and reassembling the modular shirt. This process was viewed not only as an enjoyable activity but also as a means to explore personal preferences through creative design. Participant 14a "It gives people so much freedom to put it together, and it's fun." Nevertheless, in some instances, participants encountered difficulties establishing appropriate module connections, which led to frustration and a sense of being overwhelmed. This emphasises the positive impact of playfulness on consumer experiences that require a reflective attitude.

Table 7
Codes associated with the theme 'A tool for thinking about interaction with garments.

Theme	Codes	Example quotes
	Sense of care	"I think because I've put so much effort into designing it in the store, I'd really see it as an investment piece. So I think a lot about it before I bought it. But then once I bought it, I'd be taking a lot of care of it. So I think I hand wash It. (P10)" "Now, like it just spill something on the top, or like the front or a pocket, you just chuck it that in the wash, like you spot clean and stuff like that instead of having to do the whole garment" (P16)
	Novel interactions with garments	"Very interesting. Cause I've never thought of having a shirt that comes in pieces" (P9) "for example, to go out and also for a casual, like you can just remove them and then you'll have multiple, so it'll be very easy to just have a stylish shirt rather than have like couple of them" (P5) "Yeah. I feel like I love the idea of being able to adapt it. It becomes like more than one shirt. Looking at a normal shirt, a little bit of, I see a bit of a waste. Whereas this has, like, this could be three different shirts. Which is cool. Endless, endless shirts (P2)".

The wellbeing dimension of **Future Thinking** was expressed by three participants (P2, P6, P9). Participant 6 reported difficulty thinking prospectively due to a lack of experience that would help them to draw parallels. "I've never had that kind of experience. It's a little bit hard to imagine." The tangibility of the modular shirt facilitated the conceptualisation of its multiple uses, suggesting a shift in perception from viewing clothing as disposable to viewing them as adaptable and multifunctional. For example, P2 said, "I feel like I love the idea of being able to adapt it. It becomes like more than one shirt. Looking at a normal shirt, I see a bit of a waste. Whereas this has like, this could be three different shirts." Also, the experience prompted new possibilities, as Participant 9 said: "I've never thought of having a shirt that comes in pieces." This shift highlights the CSB's role in fostering a more sustainable and imaginative relationship between consumers and their garments.

Optimism was notably intertwined with enjoyment and the playful dimension of the experience. Ten participants (P4, P5, P7, P9, P10, P11, P13a, P13b, P14a, P14b) expressed explicitly a positive outlook on the potential for modularity in clothing to introduce longevity and versatility. Nevertheless, all participants demonstrated a similar sentiment. For instance, Participant 11 conveyed their positive outlook regarding the process, saying, "I really like this. I would like to do it more often, actually." Another participant showed optimism in relation to how modularity offers a fresh perspective to consuming: "I guess it's kind of opening up new ways of thinking about clothing and adapting it for longevity, rather than looking at what is the other new, what is a different shirt that I could buy (P4)." This outcome suggests that CSB may support circular behaviours among consumers, reinforcing the notion that such behaviours are actionable and readily adoptable.

The theme of **Engagement/Participation** revealed a sense of empowerment among participants, who felt a deep sense of ownership

and creative control over the design process. Four Participants (P10, P11, P14a, P14b) experienced a **sense of agency** and **creative** control, which fostered **sustained engagement** in the shirt-building activity. Participant P11 said, "I feel I have more agency over this. I feel that it's my own creation." In addition, the **playfulness** and sense of design further promoted engagement in the shirt-builder activity as participant P14a explained, "kind of like having fun with designing what you want to do. So I think people will get more engaged […]." These findings suggest that maintaining a balance between various components of wellbeing, including agency, playfulness, and effort, is crucial for sustaining engagement in a consumer experience.

Effort, both cognitive and physical, was identified as a significant aspect of the CSB experience. Ten Participants (P1, P2, P5, P6, P7, P9, P10, P15a, P15b, P16) found that understanding how the modules of the shirt connected required a significant level of cognitive exertion, which sometimes led to feelings of **frustration** and **being overwhelmed** (refer to the concept of playfulness). For example, Participant 1 questioned the guidelines for the task, stating, "It's kinda hard to tell whether I am doing right or wrong. Is there a right or wrong?" Participant 2 also expressed uncertainty about the experience, remarking, "I feel that something is wrong." Participants with greater knowledge of garment construction appeared to find the cognitive effort less burdensome. This might suggest that the level of cognitive effort is inversely proportional to participants' prior understanding of clothing manufacture. Moreover, the cognitive effort was not isolated from the temporal investment. Participant 10 noted the relationship between **effort** and care, stating, "I think because I've put so much effort into designing it in the store, I'd really see it as an investment piece. I thought a lot about it before I bought it. But then once I bought it, I'd be taking a lot of care of it." This suggests a potential correlation between invested **effort (time spent and cognitive effort)** and subsequent care for the item. Furthermore, trying on the modular garment was beneficial for identifying individual preferences, although it required greater cognitive and physical effort. Participant 10 encapsulated this sentiment: "It's a bit difficult to do it on your own body." The garment's modularity was also perceived to reduce the effort required for maintenance and cleaning. For instance, Participant 7 mentioned the ease with which stained modules could be removed and washed: "If you drop wine here, you would just take this part off and wash. Yeah. If it's easy to do that." However, participants also indicated the need for a more user-friendly connection system. Finally, some participants viewed modularity as a novel approach to clothing that required greater cognitive effort but also yielded higher **satisfaction**. Participant 9 exemplified this by stating, "The trouble with me is that I always make within my comfort zone and I find it very difficult to do things that are different. So experimenting in that way … It makes it more of a special shirt." These variations highlight the importance of accommodating diverse user experiences and levels of expertise, suggesting that facilitating understanding and usability could enhance the experience.

Learning was a beneficial outcome of the experience, as participants discovered new design preferences, and gained insights into garment construction. For example, Participant P11 discovered a new design preference and expressed, "It's not my style necessarily, but it's kind of funky as well […] Oh. I like this a lot, actually". Participant P9, when asked how many shirt modules they would purchase, replied that they would only buy the ones they needed, stating, "Because you do not know whether it's gonna be what you want. I'm liking the cuff". Deconstructing and reconstructing the shirt was identified as a particularly beneficial aspect of the activity, as it facilitated participants' **understanding** of the garment. As Participant P9 noted, "Very interesting, cause I've never thought of having a shirt that comes into pieces". Similarly, Participant P1 expressed, "I think it's very liberating to be able to kind of deconstruct this shirt. Taking it apart and seeing how I felt, I made a big mess". This finding suggests that shirt modularity might facilitate understanding of how a garment is made. Additionally, participants found the deconstruction aspect of the activity to be **playful** and **engaging**. Based on the findings, providing opportunities to learn during the shopping experience may help consumers become more aware of their preferences and slow the buying process. Additionally, gaining a better understanding of how clothes are made could improve their appreciation for the effort that goes into creating a garment.

Self-expression and **Creativity** were highlighted by participants who appreciated the opportunity to personalise their garments. Four participants (P10, P11, P13a, P13b) acknowledged that the CSB provided a means to express their moods, emotions, and preferences. Participant 10 stated, "Depending on what I want that day I can change the collar." Modularity enabled the participants to identify their preferences. Participant 11 noted, "So there's so many parts that you can sort of put your own emotion feeling into like, oh, I really like the collar or I don't like it. Or can start to think what would be my favourite shirt." Additionally, Participant 13b remarked, "I think I would definitely be more excited about a modular one just because I feel like I could leave my own sort of imprint on it. Like, what's the right word? Like I could add like my own touch." These findings suggest that the CSB contributes to self-expression, which is associated with other wellbeing dimensions, specifically **pleasure**, **playfulness**, **creativity**, and **attachment**. The findings of this study suggest that by rearranging CSB components, customers' needs for self-expression and novelty can be addressed without increasing the volume of material in circulation.

Enjoyment and **Pleasure**, derived from creating a personalised garment, were linked to a sense of pride and accomplishment among eight Participants (P7, P9, P10, P11, P13a, P13b, P14a, P14b). Participant 10 exemplifies this sentiment, stating, "People would be like, where is that from? And you would be like, well, I put it together. My brain. I am a genius." Similarly, Participant 13a articulated that a modular garment offers greater excitement as it allows for the addition of a personal touch, stating, "I think I would definitely be more excited about a modular one just because I feel like I could leave my own sort of imprint on it. Like, what is the right word? Like, I could add like my own touch." The enjoyment derived from the experience may shape participants' perceived value of the garment, which, in turn, could influence how they care for it.

Bodily & Sensory experiences were noted, yet only two participants (P7 and P11) explicitly articulated this aspect of the experience. Participant P7 recognised that accurately assessing the fit of the modular garment depended on trying it on the body. As Participant P7 stated, "You have to actually try it to know [if] it's a good fit or not". Participant P11 was surprised to discover a dislike for the silky material when in contact with their body. Participant P11 stated, "I was actually surprised 'cuz I didn't know that beforehand". Incorporating the body's sensory capabilities into the experience can provide consumers with information about the look and feel of textiles gained through direct interaction with textile materials. This aspect is particularly important for clothing, as garments constantly come into contact with the body and their feel can influence whether we choose them.

The activity fostered **Attachment** to the garment. According to five participants (P7, P10, P11, P14a, P14b), this leads to a more significant and meaningful connection. The **time** invested in the activity appears to be related to the attachment formed with the item. Participant 11 notes that the activity enabled them to develop an emotional connection with the garment through the customisation process. They said, "I feel that it's my own creation. I feel like I spend more time with this than I think. So I'm creating, almost developing like an emotional connection with it. Okay. Because I remember all the different parts that I put together and this story I guess around what, what we've been doing and what we've been talking about. So, it's like, more meaningful for me." Additionally, participants believe that the **effort** put into designing the garment influences attachment. Participant 10 commented that they would consider the piece an investment, given the time and care invested in its design and therefore would take good care of it. "I think because I've put so much effort into designing it in the store, I'd really see it as an investment piece. So I think a lot about it before I bought it. But then once I

bought it, I'd be taking a lot of care of it. So I think I hand wash It." This indicates that attachment may have positive consequences, such as consumers retaining the garment for longer. Participant 7 stated that they would keep the garment for as long as possible because of the authentic experiences and the deeper connection it evokes. "Just kept it for sure. I would keep them for, for as long as I can because that, like you said, those are genuine experiences and you have deeper connection with the item, and when you have them, you, you try to wear them on special official, like it's a basketball shoe. So l only wear it for like games that I'm dedicated to I wouldn't wear it because Yes. Yeah. It has like shoes has that durability. So if you wear it for a long time, it's not gonna get that friction. Yeah. And performance." The study revealed that embodied customisation positively affected the formation of an attachment between the consumer and the product.

Fig. 6. Instant pictures from participants' shirts.

Community engagement emerged as a potential area for expansion. Five participants (P2, P3, P4, P5, P9) expressed a desire to participate in the activity with friends, and with guidance from a professional. The motivations for engaging with friends varied, such as having fun or seeking validation, as can be seen from Participant P1, "If I was with friends, yes. Then I'd have a little bit more fun and I'd be rocky." And Participant P4, "when you were going to a changing room, you're asking people's opinion. That's true. Does this fit? Does this fit? And you can actually change it while you've got somebody there to hear their feedback". Participant 11 expressed a desire to perform this activity in a communal space alongside others engaged in similar activities, while still designing independently. "I think I would prefer to have something where I can play around with stuff like you were saying, like having flowers or having additional elements. Yeah. But alone. But then maybe with others who are doing a similar kind of thing. Okay. Like almost like a workshop.". However, two participants (P2, P1) felt **uncomfortable** building the shirt in the presence of others. "I probably wouldn't feel like comfortable to just, like, do that in the store (P2). During the sessions conducted in pairs, the participants sought confirmation from their peers; for example, Participant P13, when asked, "That's the side bit, isn't it?" their partner confirmed, "Yes, it is." This finding suggests an opportunity to explore collaboration as a means of building **communities**. In addition, the mural featuring instant photographs was well received by participants and could be utilised to foster communities around modularity, as shown in Fig. 6.

Self-worth and a **sense of mastery** were evoked through the experience. Participant 10 expressed delight in the opportunity to design and showcase their creation to friends, stating, "I put it together. I'm a genius." Similarly, Participant 13 expressed satisfaction in leaving their own unique mark on the garment, saying, "I could leave my own sort of imprint on it … add my own touch." These findings highlight the importance of allowing consumers to feel competent and proud of their creations.

Lastly, regarding **affordability**, three participants (P4, P10, P15) emphasised the importance of cost—participants 15 and 4 noted price as a factor in their decision to purchase a modular garment. Participant 4 mentioned the cost-effectiveness of the garment, stating, "I am happy with the quality and the fabric and the fit of it. And it was just one part, and it was cost-effective." Surprisingly, the available time was not mentioned as an impediment to the experience.

5. Discussion

The CSB was conceptualised and designed to address the need for strategies to promote consumer adoption of, and sustain, circular practices for garments. This study investigates how modular garments (in this study, a shirt; it could be any garment) can provide a customisation platform that integrates cognitive and sensory engagement with circular practices in MC design. This approach directly addresses the need to extend garment lifespans, reduce consumption and waste, promote sustainable consumption practices, and foster wellbeing through healthier consumption boundaries.

5.1. Customisation as a pathway to wellbeing

The CSB experience engendered a creative space for consumers to customise shirts according to their preferences. Our study confirms that such an experience promotes many interlinked wellbeing dimensions. We observed that certain wellbeing dimensions appeared more prominently than others - namely, playfulness, optimism, effort, enjoyment, pleasure, and attachment. This pattern suggests that it may be possible to intentionally shape aspects of the experience to foreground particular dimensions of wellbeing, although this needs further investigation. For instance, playfulness stood out as a particularly influential dimension, intersecting with enjoyment, competence, sense of control, and engagement. This indicated that supporting one dimension of wellbeing may also satiate others, contributing to a more holistic sense of wellbeing within the experience.

5.2. Perceived co-design vs. customisation

Our findings indicate that prior experience in garment construction shaped participants' perceptions of the CSB process. Novice participants—those with little or no familiarity with garment-making—perceived the experience as co-design, feeling that they were genuinely contributing to the creation of the shirt. Participants with more familiarity with garment-making and styling, by contrast, engaged less deeply, perceiving the activity more as customisation than proper design involvement. This divergence underscores a crucial insight for designing inclusive circular experiences: the level of complexity must be calibrated to different audiences. For novices, a hands-on, structured approach enhances their sense of authorship and engagement, while for experienced participants, the challenge may need to be heightened to maintain a sense of creative agency and ownership.

5.3. A reflective tool for consumption habits

The CSB experience was not merely about designing a modular shirt; it also served as a reflective tool that prompted participants to reconsider their broader consumption patterns, particularly observed in relation to findings on wellbeing pertaining to learning, attachment, and effort. This insight suggests that customisation and co-design experiences can catalyse more sustainable behaviours beyond the immediate interaction, reinforcing circularity as a mindset rather than a one-time action.

5.4. Fostering creativity and self-awareness in sustainable consumption

Existing literature suggests that promoting sustainability in consumer choices increasingly aligns with fostering personal creativity and self-awareness (Niinimäki et al., 2017). Our empirical findings support this, revealing that participants gained deeper insights into their stylistic preferences compared to traditional, pre-assembled shirts, particularly observed in the wellbeing findings related to self-expression and creativity (P10, P11, P13a, P13b). This heightened awareness encourages more mindful selections, potentially leading to garments with greater personal significance and reduced disposability.

5.5. Modularity as an educational and behavioural catalyst in circular fashion

The modular nature of the shirts in the CSB experience introduced an educational component. By dissecting a shirt into its components, participants better understood which specific elements appealed to them and the complexity of its construction and manufacturing. Such an understanding could have downstream effects on consumption patterns, particularly in (i) reducing impulsive buying and promoting choices more congruent with individual taste and (ii) greater awareness of how production effort is (or is not) reflected in garment cost, encouraging conscious valuation of craftsmanship and fair pricing in the industry.

While this study focused on modularity as an enabler of circular consumption, it raises an important question: Could similar emotional investment be transferred to traditional, non-modular garments? While participants may develop an attachment to modular and conventional shirts, non-modular designs offer fewer opportunities for repair and alteration, limiting their long-term circular potential.

5.6. Emotional investment and the intention-action gap

Participants displayed considerable emotional investment in their customised shirts, as evidenced by findings on wellbeing related to attachment (P7, P10, P11, P14a, P14b), consistent with prior research

linking meaningful consumer engagement to long-term retention (Bly et al., 2015b). However, the well-documented intention-action gap suggests that stated commitments to garment care and longevity do not always translate into actual behaviour. Further research is needed to quantify the impact of emotional attachment on actual sustainability outcomes.

5.7. Extending MCs through enhanced embodied engagement

CSB extends digital customisation platforms by incorporating embodied engagement, a critical factor in deepening consumer understanding of textiles and circular practices. The embodied aspect of the CSB experience introduces a playful element that enhances engagement. This heightened engagement motivates participants to invest more thoroughly in the experience, further deepening their understanding and commitment to circular choices.

5.8. Empowering retail professionals for circularity

Unlike traditional MC tools, CSB was designed to promote garment longevity rather than fuel excessive consumption. Our study revealed that participants desired a wider selection of modules, suggesting that greater customisation fosters creativity and attachment. However, this presents a paradox: increased options may also drive overconsumption (Kim and Lee, 2020). To mitigate this risk, facilitators of the experience must actively guide consumers toward sustainable behaviours. It is paramount to equip retail professionals with expertise in circularity. Consumers often seek guidance on sustainable choices, creating an opportunity for retail professionals to facilitate circular practices. The rise of circular fashion suggests new employment opportunities, emphasising the importance of specialised roles within the retail sector.

6. Conclusion

This study explored the CSB as a physical apparel configurator to support consumer engagement with circular fashion practices through modularity and embodied interaction. The findings suggest that the CSB can shift consumers from passive consumption toward more active, reflective participation in garment creation, fostering emotional attachment, learning about garment construction, and awareness of consumption habits. By encouraging personal investment and slowing the decision-making process, the CSB illustrates how configurator tools can be reoriented from sales-driven customisation toward healthier consumption boundaries.

A key contribution of this research lies in the application of the wellbeing framework for consumer experiences in the circular economy of the textile industry(Petreca et al., 2025) to both the design and analysis of the experience. The results indicate that wellbeing dimensions such as playfulness, enjoyment, agency, competence, and attachment are central to sustaining engagement in circular experiences. These findings reinforce the role of wellbeing as a critical driver for supporting longer garment lifetimes and more mindful consumption, complementing technical and material strategies for circularity.

The CSB extends existing MC models by introducing embodied engagement into the customisation process. Physical interaction with modular components enabled participants to learn through making, reflect on personal preferences, and develop a stronger sense of ownership over the garment. This embodied dimension enhanced engagement and contributed to greater appreciation of effort, craftsmanship, and care. Factors closely linked to product retention and longevity.

Despite these contributions, the study has limitations. The relatively small and homogeneous participant sample limits the generalisability of the findings, and the study captured intentions and perceptions rather than long-term behavioural outcomes.

Future research should extend this work in several directions. Longitudinal studies are needed to examine whether the observed emotional attachment and reflective intentions translate into sustained behaviours, such as prolonged use, repair, and reduced replacement. Broader participant diversity—including variations in age, socio-economic background, cultural context, and fashion literacy—would enable a more robust understanding of how different consumer groups engage with configurator-based circular interventions. Further studies should more explicitly foreground material engagement by investigating how tactile qualities and material storytelling interact with modular design to influence perceived value and care. Finally, testing the CSB in real retail environments would enable evaluation of scalability, the role of retail professionals in facilitating circular practices, and the integration of such tools into existing retail and circular business models.

Collectively, these findings demonstrate the potential of embodied, wellbeing-oriented configurator tools to promote healthier consumption boundaries. By aligning circular design strategies with human experience and meaning-making, tools such as the CSB offer promising pathways to extend garment lifetime and foster more resilient consumer-garment relationships within a circular textile economy.

CRediT authorship contribution statement

Ricardo O'Nascimento: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft. **Bruna Petreca:** Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Supervision, Validation, Writing – original draft, Writing – review & editing. **Morag Seaton:** Methodology, Writing – review & editing. **Sharon Baurley:** Conceptualization, Funding acquisition, Methodology, Writing – review & editing.

Declaration of competing interest

The authors declare no conflict of interest.

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Data availability

https://researchonline.rca.ac.uk/id/eprint/6412.

Transcription of the semi-structured interviews for Circular Shirt Builder (Original data) (RCA repository)

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