Crowdsourcing an Emotional Wardrobe

Abstract
Selecting clothing online requires decision making about sensorial experiences, but online environments provide only limited sensorial information. Inferences are therefore made on the basis of product pictures and their textual description. This is often unreliable as it is either based on the designer’s understanding of the product or deprived of perceptual content due to the difficulty of expressing such experiences. Using a purposely built website that combines and cross references multi-modal descriptive media, this study investigates the possibility of using crowdsourcing mechanisms and multi-modal language to engage consumers in providing and using enriched descriptions of tactile experiences of garments.

Keywords
Crowdsourcing, affective computing, design research.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Design, Experimental, Human Factors
Introduction

The aim of this research is to create a space for people to share tactile and emotional perceptions of clothing and textiles with other consumers and with designers. Creating a rich dialogue between designers and consumers and amongst consumers will help bridge these spaces, enabling all parties to contribute to a deeper understanding of consumers’ needs and desires. However, it is not clear if and how consumers can articulate their feelings toward their clothing. The popularity of fashion blogging is growing, but still limited in its media and descriptive content. Lindstrom [1] demonstrates that current market research practices are often flawed as consumers’ feedback is more of what they feel is expected. Zaltman [2] notes they are generally limited to giving verbal feedback. Whilst intelligent wardrobe systems have started to incorporate crowdsourced information (e.g., [3,4]), there is a limited understanding on how they could help people to provide and share richer descriptions of clothing in terms of tactile and emotional feel. It is also not clear if and how consumers can articulate their feelings toward their clothing. Our study aims to build such understanding. In particular, we aim at exploring: how consumers communicate about clothing and if a multi-modal language may aid the communication of their sensorial experience; how people feel about sharing their emotional experience of handling garments; and how people would make use of crowdsourced descriptions of perception of garments. A purposely designed website (www.wardroblemalfunction.org.uk) was used to enable participants to experience the concepts before being interviewed. The website allows the users to upload photos of their own garments and describe their sensorial and emotional experience when touching them using a multimodal language. It also allows users to browse other people’s uploaded descriptions. Before presenting our work, we briefly review related literature justifying our questioning and approach.

Related work

The social and emotional aspects of clothing

Stead et al. [5] comment that fashion is an emotional discipline and that clothing is a form of social communication. De la Haye and Wilson [6] state that “With the development of mass production, fashionable clothing has become central to mass culture in the widest sense as a means whereby individuals express themselves and construct identities”. However ‘Fashion’, as distinct from clothing, is a key means of expressing group identities. Sproles et al. [7] describe fashion as a behaviour that is briefly adopted by a significant segment of a social group and regarded as contextually appropriate. Others (e.g., [8]) however, propose more fluid systems in which we all form multifaceted allegiances, constructed through appearance and changed at will. This kind of evolving, self-organisation of disparate individuals, around shared ideals and interests, fits with online social networking structures. Therefore it would seem that by crowdsourcing an emotional wardrobe a useful tool could be created to allow users to digitally articulate, and organise around, the same kinds of emotional and sensory needs that fashion fulfils in the physical realm.

In examining the role of the wardrobe, Rode and Harris [9,10] found that the choice of clothing to wear and the organisation within wardrobes were socially constructed. They suggest that future technologies should be used to complement existing social
encounters, such as calling friends for clothing advice, with additional visual aids. On a similar line of investigation, Shen et al. [4] built a scenario-oriented recommendation engine to help users select an outfit from a wardrobe. They incorporated the emotional significance of clothing by allowing users to annotate garments in a wardrobe with descriptions regarding how that garment makes the user feel when wearing it. A similar work is presented in [3] where a smart wardrobe system was developed which crowdsourced recommendations for outfits from a user’s social network connections. Though only limited testing was conducted, results were promising in terms of responses from the crowd to proposed outfits.

Textiles as a complex sensorial experience
The crowdsourcing approaches presented above focus on either proposing outfits or on text-based self-report to communicate feelings about clothing. A question to be asked is if these approaches are sufficient to describe such complex phenomena. Designers make use of a very rich sensorial language to communicate the emotions they feel or that they want to convey through the product that they are designing. Moodboards [11] for example are a typical approach to represent the complexity of these emotional and sensorial experiences (see Figure 1). In a contextual inquiry study, carried out prior to this work, interviews with two designers show that their digital communication with consumers is generally impoverished and lacking such complex sensorial components. To compensate for this, they resort to posting printed images and textile swatches, which is a slow and expensive process. Due to these costs, designers rarely communicate with the end consumer. One of the designers stated that “Only via the website would we ever have contact with customers. They send us images of people wearing t-shirts saying ‘Oh can you make this one for us’”. A crowdsourcing system provides an opportunity for designers to learn about their end consumer if a sufficiently rich language were made available. The next question is then whether consumers will be able to use this enriched language to share their experiences.

Emotions as physiological responses
Emotion could help communicate peoples’ perceptions of textiles, but emotion itself can be communicated in different forms: subjective self-report and objective physiological measures. Fox [12] states that problems with emotion self-report include a mistrust of introspection and that emotions are not experienced as discrete units. Physiological measures represent an alternative to self-report. Damasio [13] states that emotions are not simply cognitive, but are also experienced physically and are in turn influenced by our physiology. An advantage of physiological measures is that they are taken during interactions and do not rely on a cognitive filter through which emotion is judged. However, physiological measures do not reliably represent discrete emotions and hence a question on how to share such information emerges.

Gaver et al. [14] argue that ambiguity in design is useful where the source data of a system is itself uncertain. In this case, rather than contriving imprecise physiological data into discrete emotions, thus misleading users, they suggest passing the ambiguity of the data to the users, who will be best placed to fill in the gaps, interpret and appropriate the data themselves. Similarly, in [15] the authors argue that emotions are communicated subtly and thus require
interpretation and sense-making rather than over-simplification. They suggest an ambiguous approach which is evocative instead of didactic to establish an interpretive relationship between user and artefact, encouraging close personal engagement. In line with these ideas, Stead et al. [5] developed “The Emotional Wardrobe”: clothing which responsively displayed an autonomous representation of the wearer’s emotion which was detected via biosensors within the clothing. They conclude that the Emotional Wardrobe expresses the inside on the outside thus creating a new and untapped form of communication.

**Methodology**

To address these questions a website ([www.wardrobemalfunction.org.uk](http://www.wardrobemalfunction.org.uk)) was built as a tool to allow people to experience the concept of providing and sharing multi-modal perceptions of their clothing. People were first asked to use the website and then take part in a semi-structured interview. The website was used as a tool to gather insight on the ways such communication can be empowered and used. Thus it should not be considered a finished artefact and will merit further design development for public usage.

The website was designed with the support of fashion designers who identified the elements of the multi-modal language they typically use to communicate tactile perceptions of textiles. The website consists of a front end to collect information and then share it for site users (see Figure 2). This information ranges from description of consumers emotions regarding items of clothing to the possibility to express these feelings through images and physiological sensors. Words and images (Figure 1) were used as they constitute the typical language used by designers in building moodboards to convey their sensorial perceptions of the product they are designing. Physiological responses were chosen as they provide an implicit means to convey one’s emotional responses overcoming the difficulty of making these explicit. A wireless wrist band Affective Q-sensor ([http://www.affectiva.com/q-sensor](http://www.affectiva.com/q-sensor)) was used to this purpose as it is not intrusive.

**Table 1:** Garment information asked by the website (see Figure 2)

<table>
<thead>
<tr>
<th>Question</th>
<th>Multi-modal Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How does it make you feel?</td>
<td>Drop down list: Amused, angry, bored, contemptuous, disgusted, fearful, happy, joyous, interested, proud, sad, shamefull, surprised</td>
</tr>
<tr>
<td>2. How does it feel to touch?</td>
<td>Drop down list: Clingy, coarse, cool, crisp, crumpling, dry, elastic, fine, flat, flexible, flowing, grainy, greasy, hard, harsh, heavy, light, limp, matte, non-stretchy, organic, relief, resilience, rigid, rough, shiny, sleek, slippery, smooth, snapping, soft, solid, spongy, stiff, supple, synthetic, thick, thin, warm</td>
</tr>
<tr>
<td>3. Which image best represents the fabric?</td>
<td>Dialog box of 40 images</td>
</tr>
<tr>
<td>4. Upload images of your fabric</td>
<td>File uploader</td>
</tr>
<tr>
<td>5. Colours</td>
<td>Text field</td>
</tr>
<tr>
<td>6. Fibre content (%) value</td>
<td>Drop down lists : Cotton, polyester, elastane, lycra, rayon, wool, silk, bamboo, polyamid, nylon, acrylic, viscose, cashmere</td>
</tr>
<tr>
<td>7. Notes</td>
<td>Text field</td>
</tr>
</tbody>
</table>

Whilst the participants were made to believe that their physiological data was automatically recorded, stored and displayed and could be later browsed by any other user, actually a Wizard-of-Oz approach was used. The purpose was to make the participants believe that their physiological changes were captured and shared to facilitate the discussion on the opportunities and implications of this tool during the interview. The visual
representations of the physiological changes were in fact triggered by the participants’ choice of emotion and hand feel words, entered while adding their garments. The emotion word determined the color and the speed of the animation, whereas the shape of the animation reflected the hand feel word. Figure 3 shows an example where a set of animated yellow triangles is used to represent the “interest” of the participant in handling the garment and the “crispiness” of it. In Figure 2, the green color of the triangles represents instead “shameful”. The mapping is based on a literature review and a pilot study.

**Figure 3:** Screenshot of uploaded garment. The same information is visible by user browsing the site.

Table 1 summarises the information asked about the garment by the website to the user. A collection of texture images (Figure 1) were supplied by seventeen design students at University of the Arts, London to represent the texture terms, “cool”, “flexible”, “rough”, “smooth”, “stiff”, “thick”, “thin” and “warm” (chosen from a prior review of literature on textile handling and rating). Five images per term were carried forward for use on the site. These were chosen as the most representative of each term in an online survey of thirty English speaking participants with little or no design training (our target population). Figure 2 is a screenshot of the webpage which allows users to add and describe garments to the collective wardrobe. Once added, the described garment can be viewed in the ‘Browse’ section of the site by other users of the website (Figure 3).

**Procedure**

Twenty participants were recruited. Their ages ranged from 20 years to 51 years, ($\mu=28.45$, $\sigma=8.33$), split between 11 females and 9 males. Participants were screened to be native English speakers so as to mitigate cultural differences and to ensure participants could easily choose words from the website to accurately represent their reactions to the tactile perception of the textiles the garments are made of. Participants were requested to bring “two casual tops” to the experiment session. For this investigation a homogeneous sample of clothing was desired.

A biosensor was fitted to each participant’s non-dominant wrist. Participants were then briefed on the experiment. Particularly, they were made aware of the measures the biosensor was supposedly recording and that a simple animated visualisation of those measures would be shown to them on the right hand side of the website once their data was uploaded. A control garment was used to run through the experimental procedure and ensure that the participants were
familiar with the procedure and the website. The experimental procedure consisted of asking participants to feel the garment for one minute and think about how the garment felt to touch and how it made them feel. After one minute, the participants entered their perceptual data on the website. The physiological data would then (supposedly) be uploaded and a representation would appear on the website. After the control garment, participants were requested to take digital photos of the garments they brought with them and repeat the same procedure followed for the trial garment. Finally participants were encouraged to browse other peoples’ added garments and information on the website. By clicking on the browse link (see Figure 3), the participants are presented with all garments uploaded and can browse their descriptions. After using the website, participants took part in a semi-structured interview which was audio-recorded. The interview data was analysed using grounded theory and the McCarthy & Wright’s affective framework [16].

Interview results
The systematic analysis of the interviews identified three main themes: Language of feel, use of physiological data including ethical issues, and decision making. These themes will be discussed in the following subsections.

Language of feel
The 'language of feel' was explored with participants: how they currently communicate about clothing and how the website could help them in the future. Other than traditional forms of communication such as talking, more abstract and contemporary forms of communication were identified. These included social self-expression via clothing, communication regarding clothing via social networks and interpretive communication via ambiguous imagery. Some participants mentioned using clothing to express their emotions, for example P17 said that "You identify what you wear with your emotions... You project [your emotions] on to the way you behave, the way you talk, the way you dress". This concurs with Stead et al. [5] who comment that fashion is an emotional discipline and that clothing is a form of social communication.

At the same time, some participants reported a difficulty in selecting only one, or any, emotion in relation to their clothing. Figure 4 shows the frequency of use of the emotion words. Emotions are complex, and perhaps asking participants for a single word from a set of twelve was too simplistic. A more appropriate emotion taxonomy may be required. One way to create such a taxonomy would be to mine emotion words from online fashion reviews and forums as well as to let people enter their own words.

Most participants engaged with the ambiguous relationships between garments and chosen texture images. For example, P17 discussed their interpretations of another participant’s texture image choice: "Since these belong to people, it made me work out the kind of people that wear that... This person probably thinks [...] that it is really cool because she chose the ice cubes." P18 gave instead their thoughts on another participant’s texture image choice: "I'm looking to see why it says rough... [Points to the texture image] If that shirt feels like that on your skin, I would not wear that shirt". P14 summed up participants’ general reactions: "nothing beats touching the materials... [if] I cannot buy a material personally, seeing these descriptions and seeing these images
would be helpful.” This demonstrates that words and images chosen by participants provide a rich description of the garment.

Using physiological data
Most participants (95%) expressed an interest in seeing their own physiological data regardless of their interest in clothing, suggesting that this may be a good incentive to draw people to contribute to the site. 65% of participants were interested in comparing their own physiological data over time or across different experiences. Participants were eager to see their physiological data as a means to correlate their subjective interpretation of how they feel to the way an objective biosensor interprets how they feel.

As well as analysing their own data, participants were also keen to compare their data with that of other people and the perceived norm: P11: “I would like to compare the way they had a marked difference in their data and see what items of clothing prompted it, to see if it matches up with my tastes, to see if it also prompts the same type of responses in me... Just to see how normal or abnormal my responses would be”. This highlights that participants view their data in a social space, for sharing and exchanging information. Physiological information was also seen as a way to compensate for the lack of tactile sensation.

Participants mentioned that meaningful interpretation of physiological data is key to its usefulness. Eight mentioned they would have preferred to see their physiological data represented in a more scientific form, particularly a graph. These sentiments are in contrast to the theory by Gaver et al. [14] that ambiguous representations are best suited for ambiguous data. It remains to be seen that, if presented with a graph of physiological data, laypeople could interpret that data any better than an abstract visualisation.

Physiological information also raised ethical concerns. Many participants believed anonymity to be a key factor in their acceptance of a physiological crowdsourcing website. This suggests that site contributors should remain anonymous for the site to be a success. In contrast to this, some participants expressed an interest in specific groups of peoples’ physiological data. Of particular interest was physiological data of acquaintances, for example: P6: “It would be interesting to see friends, but it would be more useful, for instance your colleague or your boss”. It seems that participants did not want to expose their identities in relation to physiological data, but did wish to see the identities of other people in relation to physiological data. This apparent conflict could be resolved by allowing users to selectively share their information from the collective wardrobe with specific people, revealing their identities in the process.

Decision making
During discussions of the utility of the information on the website, participants were broadly split into two roles; “contributors” who would actively add garments to the collective wardrobe and “consumers” who would passively use the information on the website. Some participants expressed an interest in both contributing content for the site and consuming content from the site as keen clothing enthusiasts.

Motivations for using the site primarily fell into two categories: deciding what to buy and deciding what to
wear. Participants repeatedly mentioned that the information on the website would aid shopping, while Weddings were the most frequently mentioned significant event for which people desire opinions from others regarding what to wear. P6 referred to wearing a Scottish kilt at events: "It would be fantastic to know before I went to a wedding or ball what everyone else liked because sometimes, one can get slightly self-conscious being the only guy in a skirt". This desire for a way to quickly ascertain opinions regarding choice of outfit may prove to be another valuable incentive for user participation.

Discussion
A website such as wardrobemalfunction.org.uk may be a useful surrogate experience for touching garments. It may help communicate remotely and across languages as a sensorial experiential emphasis is employed. Participants of this study were willing to share their physiological data: six (30%) were willing to share with anyone, and twelve (60%) were willing to share with caveats such as "only with friends". Hook et al. [15] discuss the importance of empowering users in relation to their own physiological and emotional data, a finding which also emerged as a theme in this research. The website hypothetically tries to sense physiological changes automatically, so the only control users have is a choice not to wear the biosensor.

Modes of use
Participants revealed a theme of decision making when thinking about uses of the site. They wanted to use the emotional and physiological information on the site to help make informed decisions about what to wear or what to buy. Two types of participants were identified. The ‘Contributors’, who wanted to decide what to wear, wished to add information to the site and then share this with specific friends or family in order to get feedback. This sharing would not only create a use for the website and increase loyalty, it would also spread word of the site and hopefully associate new users. The ‘Consumer’ users prefer to use information on the site to help them make informed decisions about what to buy. This information would be best sourced within an existing e-commerce site where people are already making buying decisions.

As Rode [10] suggested, technologies should be used to complement existing social encounters. Participants in this study explained that they already remotely communicate with friends and family regarding clothing via social networks and phone conversations and that these experiences are somewhat lacking. To improve the chances of a large and diverse user group, the crowdsourced emotional wardrobe may be best situated within an established digital space such as a social network or e-commerce site. This would exploit the existing loyal user base and easily fit in with users' social habits.

Ambiguity vs. clarity
A tension between ambiguity and clarity of the multimodal message also emerged. Whereas the fuzziness let people speculate on how others may have felt, the need for clarity especially in relation to the representation of physiological responses emerged. This could be partially due to the novelty of the information as most people are not yet familiar with the use of such sensors. Perhaps using the scientific term "physiological data" with participants biased them into wanting a scientific graph. Purposefully minimal
sparkline graphs with no labels, axes or scales, may be a useful compromise between ambiguity and clarity.

The wardrobemalfunction.org.uk site compelled some participants to dig deep regarding the ambiguous aspects of design. Those participants responded positively towards the texture images: using the selection of an image to creatively think about their experiences of a garment, and using other peoples’ choice of texture image to infer the experiences of the other person. Clothing described in terms of emotion is a novel interaction which forced participants to view their clothing in a new light.

How do people feel about crowdsourcing such data? The success of any crowdsourcing system relies on an abundance of valuable content. Such content is provided by the crowd, and results of this project indicated that only 35% of participants would be motivated to contribute content to the site. However, 65% would be interested in using the content on the site to help make decisions. This combination of contributors and consumers makes wardrobemalfunction.org.uk a promising prospect for success. Tomasic et al. [17] note that information for the crowd is generated by the crowd, so crowdsourcing requires a minimum level of activity to be self-perpetuating. They highlight the problem of incentivising use of crowdsourcing sites. Perhaps participants in the qualitative research for this study were enthusiastic due to the monetary incentive offered for participation. Tomasic et al. suggest that an exchange incentive may be a solution, whereby users are not allowed access to content until they have provided content themselves.

Conclusions
This study aimed to understand if and how consumers could produce, share and use multi-modal descriptions of perceptual and objective qualities of garments. Most participants (70%) responded positively to the wardrobemalfunction.org.uk site and expressed a view of it being useful for them as it compensates for a lack of sensorial experience. The results of the interviews showed that a combination of modalities provide consumers with a greater understanding of, and engagement with, clothing on-line. These forms of language provide complementary perspectives on the perceptual experience that clothing may provide. The use of physiological changes highlighted the need or desire of consumers to better understand themselves and others in relation to their appreciation for clothes. A strong social theme emerged through participants’ engagement with others’ data, seeing it as a useful tool for selecting clothing online and aiding self-awareness. Such engaging experiences could incentivise use of the website and lead to successful crowdsourcing of clothing data for the public and designers alike, as a way to facilitate design conversations between consumers and brands/manufacturers, which could be a precursor to new digital co-design tools. The website is now open and we are continuously collecting data to better understand the use of multi-modal lexicons by a larger audience. This should help refine the set of texture images used on the site, as well as the emotion taxonomy to improve the articulation of garments and hence textile perceptions. This data can be browsed (see top banner in Figure 2) by following the links ‘Browse’, to see descriptions of garments, and ‘Analyse’, to see emerging relationships between fibre

1 The physiological option is deactivated as under development.
materials, emotions and hand feel words. In our future work we aim to improve the quality of the website interface to make it more engaging and fun and to allow people to use the multi-modal language to comment on others’ descriptions. One more question that we aim to address is if crowdsourcing is the best way to collect such information. Various forms of human computing are emerging as discussed in [18] and there may be more appropriate frameworks for this kind of information.

Acknowledgements
We thank the EPSRC Digital Economy Programme for funding Digital Sensoria: grant no. EP/H007083/1.

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