The Role of Aesthetics and Design: Wearables in Situ

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Abstract
Wearable technologies are increasingly popular, but often abandoned. Given their highly personal nature, aesthetics and form factor play a key role in adoption and continued use, but thus far little work has focused on this. This paper presents a three-part study to better understand the role of aesthetics and personalisation within wearables. We provided 15 participants with customised, low-fidelity, non-functional "activity trackers", based on their own designs, for in the wild evaluation. Our participants' use of these prototypes provided us with insights into their feelings towards their existing commercial devices and their own designs alike. We found that aesthetics plays an important, and currently underappreciated, role in use and continued engagement, particularly when the context of use is considered. We suggest that manufacturers should embrace adaptability and DIY cultures, allowing end-users to customise their wearables and support them in appropriately choosing, and creating their own designs.

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Introduction
Sales of wearable devices are predicted to double by 2021 [9], and in attempts to satisfy users' preferences, manufacturers are producing them in many forms: e.g. wristbands, watches, clips, and smartphone apps. However, despite their growing popularity, these devices are often only used for short time-periods, with users' often citing issues with wearability and aesthetics as reasons for abandonment [5, 8].

Figure 1: Participatory design workshop

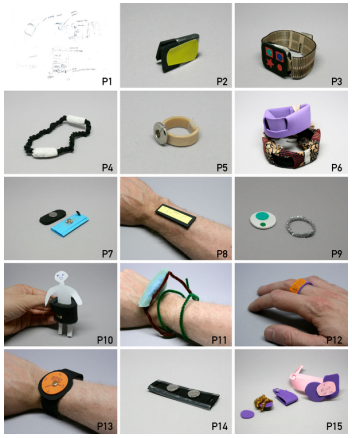

Figure 2: Participants' models

Many wearables, such as activity trackers, clad with functional plastic and rubber, appear to focus on sports use-cases. Some manufacturers have already started to better consider aesthetics and personalisation, allowing devices to better fit users' preferences and different social contexts. With the increasing availability of "just in time" manufacturing and 3D-printers for the home, one can imagine a future where users can much more easily order and create highly-customized wearables.

To better understand the challenges users face, both when choosing and designing their tracker, and to gain insights into their wants and desires, we provided 15 activity tracker users with the opportunity to design their own wearable. We then created a bespoke, non-functional, model for each participant to test. Participants were then asked to wear their prototype for five days, to gain insight into the lived experience. From these insights we present recommendations for end-user customisation of wearables, and recommend a combination of methods researchers can use to explore and evaluate people's lived experience of wearables.

Background

Interest and adoption of wearables has grown rapidly over the past five years, with devices from wearable cameras and smartwatches [4], to personal informatics (PI) systems that allow users to collect and reflect on data such as physical activity and heart rate [11]. Studies have focused on how people incorporate these systems into their everyday lives [8, 21] and have identified challenges to adoption, ranging from technical issues such as reliability and poor battery life, to design issues such as wearability and aesthetics [6, 18].

Most wearables are designed to be worn permanently, for long periods of time, and in a variety of situations, so understanding the situated and lived experiences of wearing them can be challenging. Some studies have focused on use within a specific context [16, 19] and Kelly suggests a framework [10] to evaluate the wearability of products. However, this work does not consider changing contexts in which devices are worn, and little has been done to explore use throughout the different contexts and situations of daily life.

Other HCI research on wearables has approached aesthetics and customisability from various angles. Research through design [21] sees the designer generating a variety of prototypes and evaluating them individually, while other HCI studies [16, 18] follow an iterative cycle between research, prototyping and evaluation. Building on approaches in [1, 15], our participants took part in the design process for a personalized wearable, these were then prototyped and given to the users for in the wild testing.

Method

Fifteen participants (9 female) aged between 18 and 65 years (M=34.8, SD=11.5) took part in the study. All participants were tracking their activity with one or more devices or apps: seven used a wearable tracker, four used a smartphone app and four used multiple devices and apps. All had already tracked for at least six months. Three participants had previously abandoned other devices for a variety of reasons.

Using a combination of methods, we aimed to better understand how activity tracker wearers might respond to device aesthetics and physical properties *in situ*. Our approach had three stages:

Figure 3: P6's design and the making of the prototype using sewed materials, 3d printed elements and jewellery making components.

1. Reflecting on Current Use (Diary Study A)
Initially, participants completed a one week diary study to help sensitize them to contextual factors in their lives (cf. [27]). Via email, we prompted participants with up to ten questions about their use of their tracker(s) each day. The diary also encouraged them to reflect on properties of their tracker such as comfort, shape and materials. It was important for us to identify their lived experience [19], including the challenges and barriers participants had faced [8].

2. Co-Design and Prototyping (Workshop)
Participants then took part in a two-hour co-design workshop to design their ideal tracker (Fig. 1 & 2) (cf. [20]). Following the workshops, a designer created low-fidelity prototypes for each participant, inspired by participants' designs and ideas, and based on the individual themes expressed during the session. Components were 3D-printed and customized to the participants' designs with jewellery fastenings, beads, hand-crafted fabric pouches and leather straps (Fig. 3). The weight of prototypes was also considered.

3. In the Wild Evaluation (Diary Study B)
Participants were given their prototype and asked to use and interact with it, as if it were functional, for a maximum of 5 days. Participants documented these interactions and were asked questions via email, similarly to *Diary Study A*. This method was inspired by Jeff Hawkins and the Palm Pilot prototype [2, 14], and recalls methods such as Body Storming [13] and Experience Prototyping [3]. We later followed up with semi-structured interviews with each participant (average 20 min.), which took place in person or via Skype, focusing on their experience with the prototype, views on aesthetics, form and wearability.

Workshops and interviews were recorded and transcribed. Transcripts and diary entries were thematically analysed and emerging themes and patterns were extracted. As part of an iterative process, analysis of the first diary study and initial findings from the workshops informed the questions for the second diary study and final interviews.

Findings

A total of 96 diary entries were produced (67 in Diary A, 29 in Diary B). Fifteen prototypes were created (Fig. 4), and worn for a total of 30 days (average: 2 days per participant). Here we focus on the elements that influence aesthetics, personalisation and wearability.

Motivations for use
In line with previous work [18], participants motivations for tracking PI (table 1) influenced their choice of tracker. For example, those who tracked socially wanted a similar tracker to their peers. However, they also wanted something to fit in with their personal taste, and this influenced their choice. For example, P10 was considering a new tracker, but she did not like the aesthetics of it, which prevented her purchase: *"They said they use metal but the design looks quite cheap* […] *and the price is not cheap. I think they didn't properly design it"* (P10, Interview).

Physical Properties
Participants often compared their prototypes to their existing commercial trackers, sometimes unfavourably - despite them being produced to their own designs. As P9 described, "*to actually see something that you designed and went through to prototyping - that was great. To actually wear that and realise actually the idea is not so great after all - so enlightening*".

Figure 4: Finished prototypes


Figure 5: P15's design and prototype

Materiality. Sensory qualities, such as the materials used and the weight of the device, were important aspects of the design that affected participants interactions. P9 found his prototype to be *"heavier than expected"* and that it *"flapped around too much"* on some clothing (P9, Interview) (Fig. 6). Embedding these characteristics in the low-fidelity prototypes was challenging, as using production materials is at odds to the methods used in rapid prototyping.

Aesthetics. Almost half (7) of our participants designed prototypes resembling jewellery, integrating technology into existing, socially acceptable objects thus making them "invisible". For example, both P1 and P5 described their tracking devices as "sporty" and "bulky", and then went on to design elegant, attractive and small prototypes that they considered more suitable as eveningwear.

Form Factor. Some of our participants, such as P6 and P7, designed prototypes with non-traditional form factors. Both of these trackers allowed their arms to be device-free when participating in sports: P6's tracker was worn on her ankle, and P7 designed a modular device with a separate tracker and screen. Similarly, P15's design could also be worn in a variety of ways, but with a focus on being context-appropriate, such as for evening occasions where a wrist-tracker might not be suitable. Others also desired less obtrusive trackers: P8 designed a plaster-prototype and P10 a prototype to attach to clothing.

Social Context and Wearability

When wearing their prototypes, participants highlighted contextual factors they did not consider during the workshop. While most participants were happy for their wearable to be visible to others, they did prefer to hide them in some situations where they made them feel awkward or self-conscious. For example, neither P3 or P5 wanted their wearable to be visible in a professional environment: *"I had a formal meeting, and I didn't wear* [the prototype.] *It may draw some unexpected attention"* (P5, Diary B, prototype tracker).

After using their prototypes, participants seemed to become more aware of social situations when they might not wear their commercial device, for fashion and style reasons. P15 commented, *"I don't mind if other people see it. It is just, for example, if I was going to go out for an evening I would not necessarily want to wear my current tracker* [if it] *didn't match my outfit"* (P15, Interview, commercial tracker). Her prototype design included accessories to make the device more discreet (ankle, bracelet, pin) (Fig. 5). However, after using it she found the accessories did not work, *"at times it was difficult wearing trousers and socks,* [...] *because my trousers were quite tight at the bottom* [and the prototype kept] *catching"* (Interview, prototype tracker), once more showing the utility of testing prototypes.

Discussion and conclusions

Wearables are intended to be integrated into all aspects of one's daily life, as such, evaluating something as subjective as aesthetics can be a challenging task. A person's perception of a device's wearability is dependent on several factors relating to physical materiality, form-factor and aesthetics, as well as personal preference and the context of use.

At the highest level, our findings show the importance for designers and manufacturers of wearables to not

Figure 6: P9's design and prototype

Motivations	N
Improving health and performance	5
Social engagement and competition	4
Collecting data	3
Interest in new technology	2

Table 1: Motivations for use

only focus on the functional properties of devices, but also their sensory qualities. These include not only the visual appearance, but also the intangible qualities of materials and associations that come with them. Importantly, we found that our participants' requirements changed with context of use: in some day-to-day situations, they were satisfied with a device which they would otherwise find unacceptable to wear in more social contexts. Similarly, a device designed for evening dress might not be suitable for use in an exercise class. This suggests an opportunity for multiple, modular, or customisable devices which could be easily adapted for different occasions. Frequently, participants simply desired for their wearable technology to be *less visible* – either through designing it to look like an everyday piece of jewellery, or by literally hiding it beneath other items of clothing.

Our findings can be extended to the design of other types of smart wearables, such as smartwatches or smart-jewellery. As a result of the growing availability of 3D printers, end users are increasingly taking the role of a designer and it is easy to see how customised accessories for commercial devices could be created by any user with access to a 3D printer. However, when considering end-user customisation, it is important to recognise that users are generally not trained designers, and whist "one size fits all" wearables may not be appropriate, users do need support when choosing, customising or designing their own solutions. Initial steps are already being taken in this direction (e.g. DIY personal healthcare systems like managing diabetes [12]), but future research should further invest in creating adequate support for end-user customisation of smart-wearables. We found that involving users in co-design sessions and self-evaluation of their designs *in situ,* using their custom prototype, was key for them to better understand their own needs and desires: after using their prototypes in the wild participants often discovered their original designs did not meet their requirements as well as expected. This instead solicited further feedback and ideas for future developments, or acceptance of their current solutions. However, the non-functional nature and durability of the prototypes meant engagement levels for the Diary Study B were not as high as expected. Therefore, a higher prototype fidelity or even use of the Wizard of Oz technique is recommended.

Our three-staged study aimed to evaluate the importance of aesthetics on wearable activity trackers. We identified how both aesthetics and personalisation have impact on the social contexts and wearability of a device and that this may currently be underestimated by manufacturers. Thus, we argue that involving users in better understanding their own needs within a situated study is vital to improving the device aesthetics, and that this can ultimately improve engagement. Aesthetics are an important aspect of wearable technology, but they must be properly considered in context.

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