

## DESIGN FOR PHYSICAL ACTIVITY: DESIGN ASPECTS OF WEARABLE ACTIVITY TRACKERS

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### Abstract

Many people use wearable activity trackers to gather personal behavioral data, make better decisions, and make changes to their behavior. While the proliferation of new products on the market makes collecting personal data easier, what people expect from these products remains an open question. To uncover which features of these products lead people keep using, a one-week user study was conducted with people who use these products to support or track their behavior. Baseline interviews were conducted and participants were asked to interact with a typical wearable activity tracking product.

The study reveals that people are open to use and accept these kinds of products. Still, resistance to keep using the system can be a major common point of the people, even though they can be volunteer and enthusiastic to use these products. This research also reveals the product qualities that people expect from these products to keep using the system. At the end, design implications for future products are offered.

**Keywords:** Service design, Human behaviour in design, User centred design

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## **1 INTRODUCTION**

Wearable activity trackers are new type of technology that have developed into a growing number of consumer products. These products can potentially help people improve the quality of their lives and their general well-being. In hopes of improving the use experience, Human Computer Interaction (HCI) researchers have explored the ways in which people interact with these products and how these products persuade people to change their behaviour positively. As the field evolves, new areas of research emerge and demand further exploration. These products are different from other technological products as they require a portable device to be carried on-body every day while they try to persuade people for a lifestyle change. We think that, these make the wearable activity tracker experience unique. In this paper, we explore people's experience of these products in order to put forward the strategies for designing acceptable and sustainable product use. To achieve this, after exploring relevant literature, we conducted a user study in which we seek the details of users' expectations that can lead to strategies for designing these products as a part of physical activity information systems.

## **2 WEARABLE ACTIVITY TRACKERS**

Personal informatics systems are a set of systems that serve as persuasive tools, aiming at helping people to "collect and reflect personal information" (Li, Dey, & Forlizzi, 2010). Mainly, these systems focus on making people aware of themselves, by giving personal information (i.e., their physical activity level) and motivate them to have better behaviour (i.e, to get active). They may be helpful in setting tangible goals and relaying a process towards that goal. These systems have traditionally been designed by considering the functional, social, interactive and personal needs of the people who will use them. Wearable activity trackers are within these systems that mainly focus on collecting personal physical activity data. It is well known that these products should foster curiosity, be interactive and take into account the social and cultural values of the people who will use them (Ahtinen, Ramiah, Blom, & Isomursu, 2008). We think that these products are different from health care products as health care products make more complicated and accurate measurements and calculations by taking all the parameters of the users into account, while wearable activity trackers make calculations in relation to basic user parameter such as age and gender and make estimations (Authors, 2013). Therefore, these types of products are "trackers" rather than fully dependable health care systems.

The research of these products either focuses on the problems of system use, methods for developing effective physical activity monitoring systems, or studies of the effectiveness of using such products as interventions (Maitland & Siek, 2009). However, HCI and design research also need to focus on how users experience these products and how people can be persuaded to keep using the product so as to overcome the barriers of and sustaining physical activity habits through technology (Maitland & Siek, 2009). Uncovering the user needs will help researchers and designers to gain an understanding of when users choose to use the product, in what ways the product can help the individual user and how users wish to use the system.

The companies do not produce a single product only, but a holistic system that the user experiences. In order to provide the experience holistically, including ways to motivate people, it is noteworthy to understand that the experience of a persuasive technology, in regard to wearable activity trackers. Without understanding how the form, the information content and interactive nature of these products are best to be designed, physical activity informatics systems will likely be abandoned soon after purchase, and will never realize the goal of long-term personal desired behaviour change. Thus, the persuasiveness of these products needs to be explored in relation to the people's hands-on experience, in order to understand the factors that can sustain long term usage for supplying motivation.

In the light of the literature, we define sustained user experience as the ability to inspire and motivate people, fostering repeated interaction with an object over time. In product and interaction design, this has translated into the consideration of functional, aesthetic, social, and emotional needs of people during the design process (Forlizzi, 2007; Rafaeli & Vilnai-Yavetz, 2004). Focusing on the user experience will help designers to understand how to design systems that motivate people to understand, change and sustain their behaviour for their own well-being.

### 3 USER STUDY

In this study, we explored design aspects of wearable activity trackers based on users' experience. In the study, we mainly explored, what people expect from wearable activity trackers based on their experience and how user needs and expectations make people be motivated to sustain usage of these products.

#### 3.1 Selection of Product

We selected the product based on the following criteria: ways of carrying the device, working principles of the product and ways of accessing personal data. We made comparisons between the systems that were on market at the time of this study. We found that the Body Media system combines different types of data collection tools such as accelerometers and pedometers. It was also speculated to be the most accurate ([www.bodymedia.com](http://www.bodymedia.com)). Therefore, Body Media system was selected as the product of the study.

The Body Media (BM) system features a wearable set of sensors on an armband that tracks activities, calories burnt and sleep quality. The product is worn on upper arm and around 60grams with the strap (Figure 1). A web and mobile app are used to synchronize and access data, and to track additional data such as calories consumed. The BodyMedia (BM) system features a wearable set of sensors on an armband that tracks activities, calories burnt and sleep quality. A web and mobile app are used to synchronize and access data, and to track additional data such as calories consumed. Once the user syncs the device with the online system, he or she can readily access a visualization of their personal data. At the time of the study, there were three versions of the product armband only, armband with a display, and armband with Bluetooth Technology. The Bluetooth-enabled device can also be synced with the smart phone to access some of the data. The Bluetooth connection creates the possibility to access data instantly the device still needs to be plugged in the computer to see the related progress graphs. Still, it ensures an additional technology for people to reach their data. Thus, Bluetooth enabled version was selected to increase the availability of reaching data.

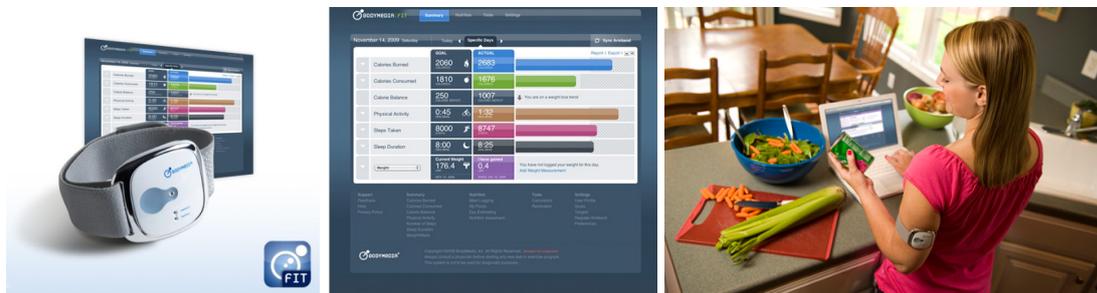


Figure 1. BodyMedia System

#### 3.2 Selection of Participants

For the study, we interviewed 20 people with ages ranging from 20 to 55, and with a mean value of  $M= 36.20$ . Participants were equally distributed over age and gender, so that one group of people would not dominate the results. All participants were unaware of the system and all encountered the product for the first time. The Snow Ball sampling method was applied to select participants (Biernacki & Waldorf, 1981). At the beginning of the study, a short recruitment text was sent to potential participants. The motivation behind being a participant of the study was important for us. Therefore, we selected participants who were in the process of losing weight, wanted to lose weight or were curious about their physical activity levels and wanted to learn about self.

##### 3.2.1 Procedure

The participants were first contacted by email or phone in order to explain the aim of the study. We conducted initial and final interviews. During the first interview, we asked the participants about their motivations and goals behind using such a system. Then we asked the participant to use the system for one week. The initial interviews took between 20–30 minutes. When the first interview was

conducted, another appointment was set for the final interview. At the end of the study, the participants were interviewed and asked their ideas about the product and usage, whether the system motivated them and whether they would like to keep using the system for an extended time period. The final interview took between 25–35 minutes. All of the interviews were voice recorded with the permission of the participants.

### 3.3 Data Analysis

We employed Content Analysis (Krippendorff, 2004) to analyse the data. Interviews were transcribed into Excel sheets. Then, open coding was applied where system characteristics, features and participants’ interaction, needs and expectations were identified (Strauss & Corbin, 1990). While talking about the product’s characteristics, participants also talked about their expectations from future products, or what they expected the system should have done. Therefore, expectations were also indicated during the coding process and were separated from overall positive and negative comments. Each sentence of participants was combinations of several sentences; thus they were divided into meaningful utterances.

During the coding process, to maintain consistency, the first coding was done only by the interviewer. For assessing the reliability of the coding (Krippendorff, 2004), two different researchers went through the codes and both played an active role in reaching an agreement upon codes (Figure 2) . An iterative process was carried out until an agreement was reached. In the study, using the exemplified analysis technique, 2472 utterances were listed.

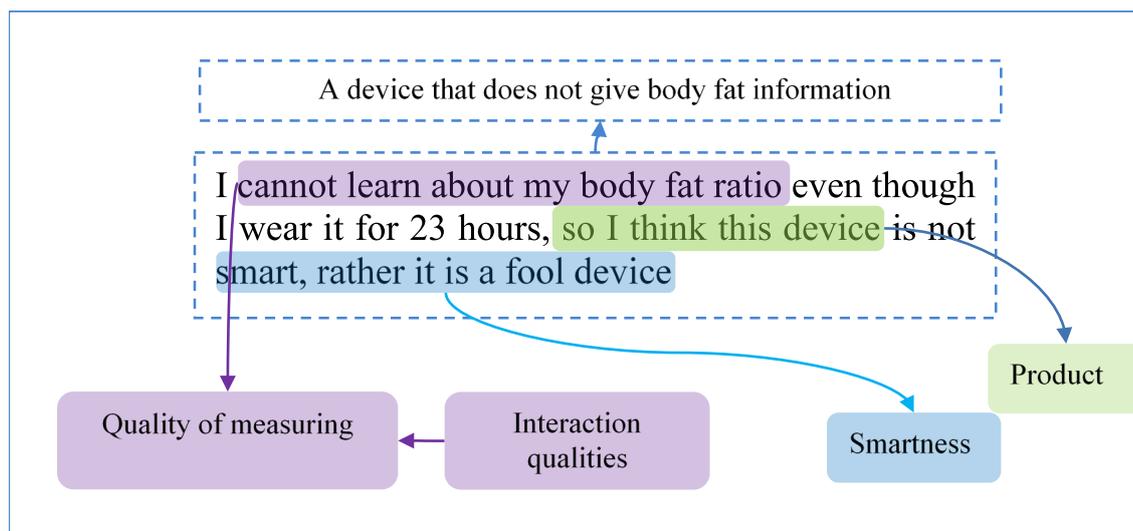


Figure 2. Example Coding

Comments were counted to determine the frequency with which factors were mentioned. However, we observed that some of the participants were more talkative and were talking more about some of the qualities. Then, it was decided that summing up all number of comments might distort data. In order to overcome this, percentages of mention times for each participant were calculated. The mean values of all qualities were then summed up to have the overall mention frequency of the code.

### 3.4 Results

In this section, we explain the product qualities that people cared and expected. We applied to the coded data in which we found that participants discussed basically about information-related and product-related features and they discussed the information-related features (53.15%) slightly more than product-related features (%46,85) (Table 1).

It was observed that participants cared about interactivity and understandability of data as well as appropriateness of size and portability/comfort of device. These dimensions give idea about what participants expect from these products: These products should be interactive especially in terms of

data, diversify mobility of the potential portable device and have good aesthetical characteristics to satisfy users. While ensuring these, it should be noted as the major issue that, once participants start getting results of their activities, their expectations from the system in terms of usage and interaction changes, because after a while, they become aware of their daily routine. We also got clues about the connectivity and personalization of data which gave an idea about through what these systems can sustain usage.

It was evident that participants who have a concrete goal or an expectation (ie. losing weight vs knowing about self) to use such a system, would get more benefit when they keep using, in comparison to participants who don't. It is because, two participants dropped out the study during the initial days. When participants started using the system with initial goals, they are more willing to keep using the system. Initial personal goals and motivations can also be regarded as the indicators of willingness to use.

Results showed that the BM product was sufficient in regulating participants' daily routines. However, participants' expectations in using the product were not met, and this resulted in resistance to keep using the system. This was the major common point of the participants, even though all of them were volunteer and enthusiastic to be a participant. In relation to the results, we found that participants' resistance to sustain use over time resulted largely from lack of satisfaction with the product related and interaction related aspects of the system.

*Table 1. Main and Sub Qualities Mentioned*

Main-Quality	Sub-Quality	TOTAL
Product Related	Appropriateness of Product Size	27,84
	Portability/ Comfort	19,01
	Total	46,85
Interaction Related	Interactivity of Data	17,53
	Understandability of Data	14,16
	Connectivity of Data	13,37
	Personalization of Data	8,09
	Total	53,15

### **3.4.1 Product Related Aspects**

The two main product-related concerns were product size and portability/comfort of the product and these are interconnected. Almost all participants mentioned about the negative effects of product size and comfort of the product. The main concerns of the participants were in the way that the product needed to be worn and its size. Actually, the device was said to cause problems when worn on body. For instance, users reported that the size of the device caused a social stigma because of the way is supposed to be worn. Therefore, if it is intended to be a mobile device to be worn on the body as part of the system, it should be designed so as to avoid unexpected social experience.

### **3.4.2 Appropriateness of Product Size**

It was expected that the size of the device should not catch other people's eyes and disturb its user. This affected the participants in two ways: It affected wearability of the device negatively, and it attracted attention of other people. This was indicated to create negative implications for the participants. Likewise, some of the participants tried to hide the device with mid-sleeve t-shirts. It was even harder to hide it as the study was held in summer. Male participants were more successful in hiding it; however female participants were unable to do that, and were disturbed by the attention of others. As an expectation, female participants wanted the device to offer flexibility in mobility in order to be able to hide it whenever they want. As an expectation related to the size, participants wanted the device to look like other wearable products, such as wrist watches in order to be able to hide it better. This way, the device would not also be eye-catcher. If the portable part of the system is in convenient size and gives the flexibility in mobility, then people will have positive impressions about it. Because of the size of the device, it was stated to be not appropriate for business life. For four of the participants, visual language of the device is neutral and appropriate for usage of wide variety of

people. Visual analogies strongly affect perception of expressive qualities and visual similarities evoke unexpected social status, while it actually should be associated with a positive change.

### **3.4.3 Portability/Comfort**

Participants were concerned about portability of the device which affects habits and lifestyle of people. People have to think about what they wear in order not to catch eyes which can cause serious problems of usage over time. However, the aim of those kinds of products should be creating awareness by being part of people's life without changing their lifestyle. In this case, people's attention moves from being motivated by its functions to being frustrated by its aesthetics. While most of the participants were positive about it, the location of the device was stated to restrict doing some of the activities. Those were also stated to be inconvenient for long term usage and not easy to use every day. It also created sliding problems as it was mentioned to slide down when the user sweats. When the strap is tightened, it creates marks of the metal sensors. In addition, the device covers a large area on the arm, and during summer days, that area is not exposed to sun, resulting in a big "device mark" on the arm. As a precaution of visibility, some of the participants had to shift the location of the device which caused some of the participants to take extra effort to straighten the location of the device.

## **3.5 Information Related Aspects**

Information-related concerns were slightly more dominant than product related ones and requires a detailed understanding.

### **3.5.1 Interactivity of Data**

Main concern of the participants about interactivity of the system was the method of interaction concerning their personal data. They were mostly positive about the quality of the data interacted presented through the online system. Detailed activity and calorie reports had positively affected their motivation to continue to be active. It has different graphics that enabled the participants to easily draw conclusions. They stated that the lack of interactive features diluted their perception of usefulness and getting the most benefit from the system. The device was also expected to measure all body functions, including blood sugar and weight. Participants also desired features such as suggestions for good eating habit. As stated, getting direct and instant feedback has special importance for participants, they wanted to know immediately how many calories they burn or how many steps they take, but they couldn't achieve this, because of disabilities of the system. These were stated to be major motivation breakers.

### **3.5.2 Understandability of Data**

Understandable data was stated to have increased participants' awareness of the data. The more awareness they gained, the more they became curious about learning how to use the system. However, participants desired more simplicity in accessing and interpreting data through the online system. For instance, one of the participants stated that once she checked her data and she realized that she was often sedentary, so she walked around the house to increase her level of physical activity. Understandability of the data was effective in gaining awareness and increasing motivation. Therefore, the simplicity in reaching and interpreting data through online system were expected to be reached whenever people were curious about it.

### **3.5.3 Connectivity of Data**

The system requires regular connectivity, such as having internet connection to sync data; however people may not be able to have constant internet connection. It is users' responsibility to connect the device to the computer to check data; however, people expect the system to offer better interaction media to reach it. Thus, connectivity arouse as a major expectation of the participants. Reaching data instantly affects both usefulness and interactivity positively. As an example, two participants were able to reach their data with the iPhone application and those stated that it was "extremely easy and useful" to sync the device with the phone and see personal data instantly.

Participants wanted the system to offer more easy and versatile ways of accessing the online data. Problems in connecting to data were stated to greatly contribute to an unwillingness to use the system.

Over time, novelty wears off and the system does not show any new information. This led users to be burdened when using the system and in turn get bored of using it. They expected the data to be accessed easily and the system to be interconnected in any condition, but it was not possible in the current system. These show that, even though the system seems to solve connectivity problem by offering different media, instant data was only available for smartphone users, and thus other people expect it too. The main concern of people is seeing every detail of data immediately when they need to see. Success in doing this, a personal informatics system can convince people that it is useful and helpful.

#### **3.5.4 Personalization of Data**

Participants stated that after a few days, they learn, more or less, the average number of steps they take or calories they burn in an average day. However, this information does not inspire them to be more active. For instance, most of the participants expected the system to suggest activities to change their daily routine and motivate the user to be active from time to time, but without interrupting their daily routine. However, the system was only measuring the activity level and this information was only made known when the user wants to learn it. In relation to the above expectations, the most important part of those suggestions was “personalized” feedback. It was stated they wanted it to be more tailored to the user. Five of the participants stated that even though the device is collecting a lot of data about the user, it does not analyse the data, and thus does not make any suggestions in relation to users’ data. Two of these participants defined a “personal coach”, which is defined like a personal assistant which should give advice to the user, by looking at user’s data. Another expectation from the device was that it could be able to collect all kinds of personal data, such as pulse and blood sugar. This was defined as a way to get as much benefit as possible. In summary, people expect these devices to be able to collect all kinds of personal data, analyse it and make suggestions throughout the day.

#### **3.5.5 Sustained Motivation**

When we asked the participants whether using the tracker had motivated them or not, 9 of the participants stated that the tracker had, at least limited number of, positive effects on regulating their daily routines. However, as the tracker lacked the qualities they expected, 11 of them indicated that they were not motivated at all. Even, the participants, who stated indications of motivation, expected the tracker to be changed, in order them to be much more motivated. Thus, all participants require the whole system to be redesigned. When we asked about the qualities that are related to sustained motivation, 21.07% of the comments were on the qualities that are related to the usefulness of the system. 13.64% were on awareness, 7.44% were on wearability, and 5.79 of them were on interactivity. This means that, sustained motivation is closely related to how useful the system is, how it makes people aware of their activities, how suitable the device is for carrying all the time and how interactive the system is.

While talking about the effect of usefulness of the system to their motivation, participants actually emphasized on the “usefulness of the data”. Data quality, such as detailed activity and calorie reports, had positive effect on motivation of the participants. For instance, one of the participants stated that realizing that she was sedentary; she walked around the house to increase her activity. In relation to this, participants made positive comments about usefulness of the product in increasing their awareness as a motivational factor. The system stated to have increased their awareness, and the more awareness they gained, the more they became curious. Again the quality of data was effective in gaining awareness and increasing their motivation.

Portability of the device indirectly affects motivation. For instance, while one of the participants believed that the system supports people’s motivation, the portability issues of the device is a negative influential of motivations, and should be redesigned. It was revealed that the system has little effect on motivation as the system was not designed to motivate the user: it only collects information and the user can only get it if wondered. In other words, the system is passive in terms of interaction, usefulness and thus motivation. Using such a system was valued for its usefulness, which users believed resulted in awareness and thus motivation. However, users reported that the system caused social stigma because of its portability and size issues. Moreover, lack of expected interactivity

qualities dilute perception of usefulness, getting the most benefit from the system and thus voluntariness to keep using the product.

### **3.5.6 Sustained Usage**

When we asked the participants whether they would like to keep using the system, 14 of the participants stated that they didn't want to keep using the tracker. 6 of them were neutral, but all admitted that in order for them to keep using the tracker, the system should be revised in relation to their expectations. In total, 53.85% of the comments were on the qualities that are related to the usefulness of the tracker. 15.94% were on motivation, 7.14% were on portability, and 5.49% of them were on social interaction. Participants who will keep using the system mentioned mostly about the useful characteristics of the product, such as helping the user to lose weight and showing useful data.

The reasons for resistance to use the tracker were mainly related to the long term usage. However, the product was only measuring the activity level and this information was only known when the user wants to know. Moreover, the product was problematic in terms of the interaction (as stated in interactivity section) and was one of the reasons of resistance.

Getting the data through only online system, participants expected the tracker to offer more easy and versatile ways of reaching and engaging the data. Additionally, visual qualities of the device were also stated to be the reason of resistance. The product seemed to be huge to be carried on the arm. Therefore, users stated that it should be small in size or even invisible in order not to catch attention and thus not creating constrained conversations. In addition to its size problem, carrying the device only at upper arm was indicated to be another reason to resistance to keep using the device, as it was restricting the user in action. It was expected to offer various modes of carrying in order user to will to use. Another reason of resistance to use the system was that after a while, novelty wears off and product tells nothing new for the user. This led users to feel burden about using the system and get bored of using it.

These indicate that people expect a wearable activity tracker to have qualities that they would like to keep using. They do not want to have interaction and visual problems, so that the product can keep them engaged with the product: otherwise, usage becomes a burden and results in boredom. In keeping people engaged, all listed product qualities should somehow integrated into the system to create sustained behaviour awareness and behaviour change over time.

## **4 DISCUSSIONS AND IMPLICATIONS**

The study revealed that people are open to use and accept wearable activity trackers. However, resistance to keep using the system was the major common point of the participants although all of them were volunteer and enthusiastic to be a participant. In relation to the previously listed qualities, it is possible to state that users have concerns which can further affect the usage of these systems:

People do not want to carry the product for long time, as the experience with the system becomes routine over time. People learn, more or less, the average number of steps they take or calories they burn in an average day. However, this information does not inspire them to be active. The device that requires to be connected to a computer to sync and see the data, become a burden for the people. Instead, it is expected for the device to give instant feedback. While people suppose that the product is useful for activity tracking, they may not want to carry the product at all the times. This unwillingness will lead to lack in realization of the effect of long term use of the product. These factors collectively point out how it might be difficult to understand the use of personal informatics tools over time.

In the early days of usage, people explore the possibilities of the product intensively, especially in terms of its functions. In this period, all product characteristics play vital role in exploration, as all product qualities and characteristics have strong relations with each other. To explain the dynamics of using a wearable activity tracker, from the evidences of the results of the study, we divided the experience of people into 3: before use, during use and after initial experience. The following discussions are also illustrated Fig. 2 to show the model of experience.

People’s initial goals affect the success of the system. People who have a concrete goal or an expectation (ie. knowing about self or losing weight) to use such a system, would get more benefit, in comparison to people who don’t. When people start using the system with initial goals, they will be more willing to keep using the system. Initial personal goals and motivations can also be regarded as the indicators of willingness to initial use. Also, having positive first impression is likely to affect the initial evaluation of system positively. In the early days of usage, people explore the possibilities of the product and system intensively, especially in terms of its functions. In this period, all product characteristics play vital role in exploration, as all product qualities and characteristics have strong relations with each other. In that sense, fluid interaction, mobility of device, understandability of data and invisibility of form are all expected.

	BEFORE USE	USAGE		
<b>DETAILS OF USER EXPERIENCE</b>	<ul style="list-style-type: none"> <li>* <i>Losing weight</i></li> <li>* <i>Learning about self</i></li> </ul>	<ul style="list-style-type: none"> <li>* Impression of being beneficial</li> <li>* Explore possibilities</li> <li>* Engage with data frequently</li> <li>* Interpret data – make commitments</li> </ul>	<ul style="list-style-type: none"> <li>* Try to perform desired behavior in relation to data</li> <li>* Experience unexpected social interaction</li> <li>* Experience repetition in data</li> </ul>	 <i>Connectivity</i> <i>Personalization</i>
<b>DIMENSIONS TO BE CONSIDERED</b>	Perceived Usefulness	Fluid interaction Mobility of device	Understandable data Invisibility of form	
<b>BEHAVIORAL FACTORS</b>	WILLINGNESS	ENTHUSIASM		
<b>USER'S MOTIVE TO USE</b>		BEING CURIOUS BEING MOTIVATED		

Figure 3. Dynamics of Using Physical Activity informatics Systems

Sustainability of usage should be assured, by working on the experience of people in relation to the system characteristics as people tend to leave the system usage if they feel that the system has not effect on them. Once they learn about themselves, the data becomes a routine. Unless product gives user-specific feedback, it becomes a burden for the user to keep using the system. On the other hand, creating long term awareness is required to keep people performing a desired behavior. In terms of wearable activity trackers, this can be supplied by keeping people engaged with the system more, as people in the study lost their enthusiasm after 1-week of usage. Thus, finding ways to keep people be engaged with the system can maintain continuity of usage.

## 5 CONCLUSIONS

It was emerged that people didn’t feel enthusiasm to keep using the Body Media System. They wish to keep using the product only when the product is redesigned. The lack of enthusiasm is the indicator of interruption of awareness and motivation. In relation, when people stop using the system, it is likely that they revert to their early behaviour. Thus discovering product qualities to certify motivation to create awareness would give cues about the ways to make people enthusiastic in using the product. Even though the aim of this study is not to show whether wearable products are successful or not, this study demonstrates that wearable products still do not correspond to a real need. This study contributes to design of wearable activity trackers with listed findings:

Usefulness of the product reinforces sustainability of usage: It is fundamental that people need to get the most benefit from these products. Most of these products have similar functions, but the ways these functions are presented should fascinate the user to pull them into usage process. This fascination can be yielded with adaptability of the product qualities to the user needs, (such as

flexibility in wearability of device or fluid interaction with the data) through which users can also be suspended from boredom or anxiety in usage.

Quality of feedback boosts motivation: The feedback that the product gives on changes in physical activity should present motivating messages for the users. In addition, this feedback should be instantaneous in order to sustain motivation throughout the usage. Problems in interacting with the product leads to lack of maximum benefit from the system.

Good visual qualities ensure the motivation to use: It was proved that visual characteristics of the device are important as they should coincide with users' taste, and should not catch attention of other people. Visual qualities also have tight connections with wearability of the device: wearable related characteristics should be diversified to give people opportunity to be carried in different ways.

Make everything easy for people to make them familiar with the system: It was discovered that ease of interaction with the product and ease of carrying of the tracker are indirect underpinnings of increase in motivation. When the product withstands what the user wants to get from the product, it is obsolete that users' interest will be lost. This will lead to abandonment of the product. The major way of keeping people aware of their physical activity is keeping people use the product for long time. The tenets listed above show that, people should be engaged with the product with several system functions. Even though the study has evidences in finding the ways to sustain usage and motivation for longitudinal awareness, the role of system qualities of wearable activity trackers in user engagement of these systems requires better understanding.

## **6 LIMITATIONS AND FURTHER STUDY**

The study that was designed to gather data was designed as one-week study. It can be argued that the length of the study is short. However, when we asked participants whether they wanted to keep using the product or not, we understood that most of the participants didn't want to keep using the system after one week. We can say that one-week study helped us to understand people's expectations; however, a longer-term study can still help designers to uncover the relations between the qualities that we listed in this paper.

As already learned, motivation is an important factor in behavior change and designers should ensure it. It was realized that engaging users with the system over time can motivate people to keep using a product, leading to further motivation for its use. Further research on engaging user experience of personal informatics tools is required to construct knowledge about how they can motivate people and ensure awareness. It is also required to comprehend (1) whether lack of enthusiasm to further use the system is case specific or this is a common situation for different types of personal informatics systems and (2) whether this situation is time specific or this is a common situation for long term usage.

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