IoT Product Pleasurability - Investigating the Pleasurable User Experiences Between Conventional Products and IoT Products Through Watches

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Abstract. The arrival of Internet of Things (IoT) overcomes limitations of time and space by providing ubiquitous accessibility of its products. Design and HCI research are challenged by an increasingly complex network of diverse types of interaction. To design pleasurable user experiences (UXs), new models need to be developed for emerging IoT products as previous models for conventional products might not be applicable anymore. From a human-centred perspective, this project investigates how the pleasurable UXs will change after a product develops into an IoT product. The project aims at understanding the attributes of IoT products that might contribute to understand the future relationship between users and IoT objects. The project applies UX theories by Jordan (a hierarchy of consumer needs, 2003) and Hassenzahl (top-ten psychological needs, 2010) as theoretical guidelines. These theories classified the contribution of human factors to design pleasurable products and agreed that the enjoyments from the psychological level are at the top of UX. The project uses two online questionnaires to collect data on 1) the UX of Smartwatches and 2) conventional Wristwatches (digital and analogue), in order to reflect on the influence of IoT products on the pleasurable UXs. The results show that the UXs of IoT Watches and conventional watches were not significantly different in terms of the four kinds of pleasure as proposed by Jordan; however, IoT products and conventional products did appear to influence some items in top-ten psychological needs differently.

Keywords: IoT · User experience · Smartwatch

1 Emerging of IoT Products

The *Internet of Things (IoT)* appeared with the development of ubiquitous computing [1] and pervasive computing [2]. In the system of the Internet of Things, the Internet connects products to form a relationship network that is more complex than ever, including *human-to-human (H2H)*, *human-to-thing (H2T)* and *thing-to-thing (T2T)* interaction [3]. A multitude of goods have been developed that are connected to the Internet, and

have powerful and complicated functions for improving our lives and enhancing our abilities. The physical objects people interact with everyday are now different from the things (objects) humans previously encountered in their history. In his design fic-tion, Bruce Sterling catalogued the development of objects into six types [4]: artefacts, machines, products, gizmos, SPIMEs and Biots. He defined SPIMEs as, "manufactured objects whose informational support is so overwhelmingly extensive and rich that they are regarded as material instantiations of an immaterial system", and biots as, "the logical intermeshing, the blurring of the boundary" between human beings and SPIMEs. Some existing IoT objects are already close to his notion of Spimes, such as smart home appliances are interconnected in a complex network and exchange large amounts of data with each other. It could be speculated that Biot will be the future form of IoT products. Redström and Wiltse named the new type of object, one that is unfolding, assembled and dynamic, "fluid assemblages" [5]. "Assemblages", because they are made out of a diverse range of material and immaterial resources, both contained within the object as it appears in front of us and located elsewhere in the network; "fluid", because their precise forms are assembled dynamically and thus change continuously. Redström and Wiltse summarised five attributes of fluid assemblages that make them different from traditional objects: present-as-particular, multi-instability, multi-intentionality, tuning formations and the aesthetics of immanence, which reveal why and how IoT prod-ucts are unique and make the design methods for IoT products different from that of conventional products.

The increasingly complex interactions between users and products brought challenges to designers to deliver stable and instrumental user experiences. HCI researchers had two main orientations to consider products in IoT systems, 1) looking at their rela-tionship to human activity, or 2) look at looking at the things in themselves [6]. Studies explored the implications of IoT products from an object-oriented ontological perspec-tive and revealed that IoT products have more agency and are found to influence human's behaviours more easy than ever before [7–9].

Marenko and van Allen used an animistic design method to make IoT objects anthro-pomorphic and reimagine digital interactions between the human and the networked object [7]. The project of Larrisa et al. used a coffee machine "Bitbarista" to explore users' perceptions of data processes in the Internet of Things [8]. Taylln et al. designed a chatbot called 'Ethnobot' to do an ethnographic study which revealed benefits and draw-backs using IoT devices to collect data regarding the UX [9]. However, none of these projects reflects how UXs of IoT products differentiate from conventional products.

As the theories above revealed, the relationship between human and non-human became increasingly blurry after the emerging of IoT products, it is vital to understand how this change can influence users gaining pleasurability when they use these products. Thus, this research is focusing on pleasurable user experiences which are especially rele-vant in the context of human-centred design. By knowing how "pleasurable" IoT products can be developed, designers will be able to create positively-connotated UXs for users and design more pleasurable interactions. From a human-centred design perspective, this publication presents a study investigating differences in UX's pleasurability between an IoT product and its original (non-IoT) product.

2 User Experience Theory of Designing Products

There is a variety of frameworks discussing the user experiences of products. Jordan introduced a framework of three levels of consumer needs indicating how to design pleasurable products [10]. Norman proposed a framework for positive emotional design with three corresponding levels of design: visceral, behavioural and reflective based on human brain processing [11]. Desmet and Hekkert created a general framework for prod-uct experience that applies to all affective responses that can be experienced in human-product interaction [12]. McCarthy and Wright presented a framework considering the emotional, intellectual, and sensual aspects of human experience with technology [13]. Hassenzahl illustrated a holistic goal-directed system with a hierarchy which includes three levels; 'motor-goals', 'do-goals' and 'be-goals' (from low to high level) [14]. This study uses UX Theories by Jordan (a hierarchy of consumer needs) [10] and Hassenzahl (top-ten psychological needs) [14] as theoretical guidelines as both of these theories emphasised designing pleasurable products.

In Jordan's hierarchy, the three levels of consumer needs (from low to high) are functionality, usability and pleasure (Fig. 1). Following Maslow's Hierarchy of Needs [15], in Jordan's model, the lower level needs must also be met before the fulfilment of higher-level needs. For Jordan, functionality indicates the application area of a product, as well as the context and environment in which the product will be used. Usability represents the extent to which a product is easy to use. Pleasure means the emotional benefits provided by a product, regarding pleasure as a factor that provides users with emotional benefits, in addition to the functional ones. Jordan borrowed four types of pleasure – physical, social, psychological and ideological – from the framework in Lionel Tiger's book "The Pursuit of Pleasure" [16], which might be relevant in the context of products. Table 1 shows their descriptions. Jordan believed that designers could design pleasurable products by following the three levels in his framework to fulfil consumer needs. Hassenzahl proposed top-ten psychological needs to identify the most important phycological needs for satisfying UXs based on Sheldon et al.'s work [17]. The descriptions of Hassenzahl's top-ten psychological needs are shown in Table 2. These psychological needs can be seen as components that influence psycho-pleasure in Jordan's model.

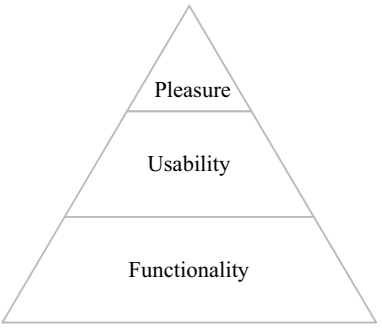

Fig. 1. A hierarchy of consumer needs redrawn based on Jordan [10]

Table 1. Four types of pleasure by Jordan [10]

Pleasures	Description
Physio-pleasure	Relates to the body and pleasures derived from the sensory organs. They include pleasures connected with touch, taste and smell, as well as feelings of sensual pleasure
Socio-pleasure	Enjoyment derived from relationships with others, e.g. relationships with friends and loved ones, with colleagues or with like-minded people
Psycho-pleasure	Psycho-pleasure pertains to people's cognitive and emotional reactions
Ideo-pleasure	Ideo-pleasure pertains to people's values

Table 2. Top-ten psychological needs by Hassenzahl [14]

Items	Description
Relatedness	Feeling that you have regular intimate contact with people who care about you rather than feeling lonely and uncared of
Meaning	Feeling that you are developing your best potentials and making life meaningful rather than feeling stagnant and that life does not have much meaning
Stimulation	Feeling that you get plenty of novelty and stimulation rather than feeling bored and under-stimulated by life
Competence	Feeling that you are capable and effective in your actions rather than feeling incompetent or ineffective
Security	Feeling safe and in control of your life rather than feeling uncertain and threatened by your circumstances
Popularity	Feeling that you are liked, respected, and have influence over others rather than feeling like a person whose advice or opinion nobody is interested in
Luxury	Feeling that you have plenty of money to buy most of what you want rather than feeling like a poor person who has no satisfying possessions
Bodily	Feeling like your body is healthy and well-taken care of rather than feeling out of shape and unhealthy
Independence	Feeling like you are the cause of your own actions rather than feeling that external forces or pressure are the cause of your action
Self-respect	Feeling like you are a worthy person who is as good as anyone else rather than feeling like a "loser"

There is a lack of evidence that these frameworks of conventional product design can be used to assess the pleasurability of new emerging IoT products. Therefore, this study investigated how the pleasurable user experiences (UXs) will change after a product develops into an Internet of Things (IoT) product. The research aims and methodology are discussed in the following sections.

3 Research Aims

The long term aims of this research are to understand the attributes of IoT products and generating a new framework for IoT products that contributes to the future relationship between human beings and IoT objects. The specific aim of the research is comparing user response for a specific non-IoT and an IoT product to facilitate generating new insights for pleasurable user experiences of IoT products. More specifically, this research aims to reflect the differences regarding pleasures delivered by IoT and non-IoT products to users by conducting a survey related to conventional watches and Smartwatches.

According to Collins English Dictionary, a *Smartwatch* is defined as [18]:
"A Smartwatch is an electronic Wristwatch that is able to perform many of the functions of a smartphone or tablet computer."

Based on this definition of a Smartwatch, we are using the following definition for an *IoT Watch* (short for IoT Smartwatch) in the context of this work:

"An IoT Watch is a Smartwatch which provides Internet-connected functionality."
And for *Wristwatches*, we are using the extended definition based on Collins English Dictionary [19]:

"A traditional watch worn strapped around the wrist including analogue or digital quartz watches which neither belong to Smartwatches or IoT Watches."

Smartwatches and Wristwatches were selected as the product to investigate for the following reasons:

- The Smartwatch is a typical product that, in recent years, has evolved into a networked object.
- Smartwatches are popular so it is easier to find sample users than for most other IoT objects.
- The development of Smartwatches represents market demands and customer needs.
- The significant differences in functions might result in different experiences.

4 Methodology

The study chose a questionnaire as the research method because this survey is a prelim-inary study to identify areas that need further investigation, where other data collection methods will be employed at a later stage. As a method used in the early stage of research projects, questionnaires are quick to administer; they can be sent out to a large number of participants at relatively low time and monetary costs [20]. Compared to interviews, questionnaires are more convenient for respondents to answer and formulate their responses and are not influenced by the interviewer's bias [21]. Online question-naires changed the ways how researchers undertake their research and they are used commonly by manufacturers on their websites to collect feedback from customers [22]. To effectively collect feedback from users of a conventional product and an IoT product, we designed questionnaires in digital form and distributed them online to collect data.

5 The Questionnaires

Each questionnaire was separated into four sections based on Jordan's hierarchy model. At the beginning of each questionnaire, there was a consent letter to introduce the research background and inform the participants' that their information would be kept confiden-tial. The participants needed to answer the first question of each questionnaire (asking if they had a Smartwatch or a Wristwatch) to check whether their questionnaire would be valid. The study also secured Ethics Approval from the Research Ethics Committee of the Royal College of Art.

In the first part, users were asked to provide basic information about themselves and their product (including their age, gender, nationality, country of residence, product model, etc.), as this might influence their perceptions of their UXs. The questions in Sect. 1 were closed questions. The second section asked questions concerning their watches' functionality, including the used functions, the frequency of functional usage, as well as the environments they used their watches in. The third section contained questions related to usability and ease of use. In the fourth section, users were asked to evaluate the four types of pleasure in Jordan's theory in relation to the UX their watches provided. The participants were also asked about the six specific items selected from Hassenzahl's top-ten psychological needs that are relevant to watches. The six items selected in the context of this work were relatedness, meaning, stimulation, competence, security and popularity (descriptions see Table 2).

The questions in part 2 and 3 are mainly rating-scale questions. As the aim of this research is measuring and comparing the pleasurability of two kinds of watches, UX metrics which present some aspect of the UX in a numeric format naturally became the appropriate tool. UX metrics are an efficient, engaging and easy to use tool to be used, but they also need to use the same set of measurements each time to be comparable and produce results that are directly or indirectly observable and quantifiable [23]. The scale used for these questions in part 2 and part 3 was the semantic differential (SD) scale. Osgood developed the semantic differential scale to measure the affective and cognitive components of respondents' attributions to words or concepts [24]. The ques-tionnaires in this study used the original SD scale which is a seven-point scale (−3; 0;+3) between bipolar, contrasting adjectives (e.g., infrequent–frequent, unpleasurable–
pleasurable) and a neutral zero point. There were also some open-questions in part 2 and 3 which enable respondents to provide further opinions and feedback.

6 Data Analysis

6.1 Sample Size and Analyse Method

The questionnaires were posted on the online forum Reddit and also sent to students at the Royal College of Art through email by the college's School of Design Administration Office. The survey collected 171 responses in total. There were 87 individuals who answered the Wristwatch questionnaire and 84 individuals who answered the Smart-watch questionnaire. Of those, 80 participants of each questionnaire were deemed valid and selected as the final sample to analyse. Statistical analysis was applied to the sample

data; ANOVA tests and t-tests were conducted to determine if there is a significant difference between the means of two groups. In order to compare a conventional product and an IoT product in terms of their UXs, it needs to distinguish IoT Watches from Smartwatches in the context of this study. (In Sect. 3, it has been classified that not all Smartwatches belong to the class of IoT Watches.) We checked the models of participants' Smartwatches (they answered this question in part 1 of the questionnaire) and selected models with Internet functions as IoT Watch. After the selection, there were 67 IoT Watch users of 80 Smartwatch users.

6.2 Background of Participants

For both Smartwatches and Wristwatches, there were more male users than female users in the sample. There were 76% male users and 21% female users of Smartwatches, and 85% male users and 13% female users of conventional Wristwatches. In this survey, Wristwatch users were slightly younger than Smartwatch users: 38% of Wristwatch users were aged 18 to 24 and 40% of Wristwatch users were aged 25 to 39, compared to 23% of Smartwatch users aged 18 to 24 and 55% of Smartwatch users aged 25 to 39. The majority of the participants were living in the UK and the US (40% of users in the US and 20% of users in the UK for Wristwatches, 48% of users in the US and 18% of users in the UK for Smartwatches). For the Wristwatch users, the top three brands owned were Seiko (16%), Omega (11%) and Timex (9%). 83.75% of the Smartwatch users' models had an Internet feature (the remaining 16.25% had normal Smartwatch features like health tracker (usually track how many steps users walk and how many calories users burn in one day) and 68% of these were Apple brands. 50% Smartwatch users had used their models for between 1 and 3 years and only 3% Smartwatch users had been using their models over 3 years. 38% of the Wristwatch users had been using their models from 1 to 3 years, and 29% of Wristwatch users had been using their models over 3 years.

7 Findings

7.1 Functionality and Usability

Firstly, we looked at the functionality level and usability level in Jordan's theory. The function most often used by both groups of users was checking time. Obviously, Smart-watch users had more functions available to them than Wristwatch users; however, it was noticeable that 72% of the Smartwatch users believed the feature, "surfing Inter-net" to be unimportant (8% "slightly unimportant", 23% "very unimportant", 41% "ex-tremely unimportant") and 63% Smartwatch users believed the feature, "using social media" unimportant (13% "slightly unimportant, 16% "very unimportant, 34% "ex-tremely unimportant"). It seems that these Smartwatch users did not value the IoT fea-tures of their watches; however, they considered the health and sleep trackers more important as 84% participants believed "health tracker" and 72% participants believed "sleep tracker" to be important. Most of participants in both groups believed that their watches basic functions were easy to learn to use (92% for Wristwatches and 88% for

Smartwatches) and easy to use after they became familiar with them (97% for Wristwatches and 92% for Smartwatches). 48% of Smartwatch users claimed the, "surfing Internet" feature was difficult to use; 29% of Smartwatch users had a neutral attitude about it while only 24% of Smartwatch user found it easy to browse webpages with their devices. 32% of Smartwatch users thought "using social media" was difficult to use; 29%of Smartwatch users had a neutral attitude about it and 30% of Smartwatch users found this function easy to use. The data presented that all IoT features on Smartwatches got negative or neutral overall feedback in terms of their usability. After we have checked the participants' Smartwatch models, it might be that two reasons caused this result. 1) Some non-IoT Smartwatches lacked internet functionality. 2) A number of IoT Watch producers did not install a browser application on their products; although these IoT Watches are able to connect to the internet, users cannot use them to browse webpages and social media. The internet connection on these watches was mostly used to transfer data to servers or other devices.

7.2 Pleasure

By comparing the means of four types of pleasure (Table 3), it can be seen that watches were experienced as most pleasurable in terms of their physical aspects no matter what kind of watches the participants were using. By comparing the mean of four types of pleasure, it can be seen that ideo-pleasure was associated with minimal gain, regardless of the sort of watch they used. The differences between the means of the same type of pleasure were all below 0.15, which means the means of different kinds of watch in the same type of pleasure were close. Figure 2 represents the means of four types of pleasure in a bar chart; it shows that the four types of emotional experience that users gained from IoT watches, Smartwatches and Wristwatches were approximately at the level of "slightly pleasurable".

Table 3. The means of four types of pleasures of wristwatches, smartwatches and IoT watches

	Physio-pleasure (touch)	Socio-pleasure	Psycho-pleasure	Ideo-pleasure
Wristwatch (n = 80)	1.613	1.238	1.113	0.850
Smartwatch (n = 80)	1.613	1.100	0.938	0.888
IoT Watch (n = 67)	1.761	1.149	1.000	0.955
Non-IoT Smartwatch (n = 7)	0.429	0.143	0.714	0.286

By applying ANOVA tests (Table 4) and t-test (Table 5) between IoT Watches and Wristwatches, we can see that the p-values are all above the threshold (0.05) chosen for statistical significance, suggesting there is no statistical significance between the four types of pleasures from using Wristwatches and IoT Watches.

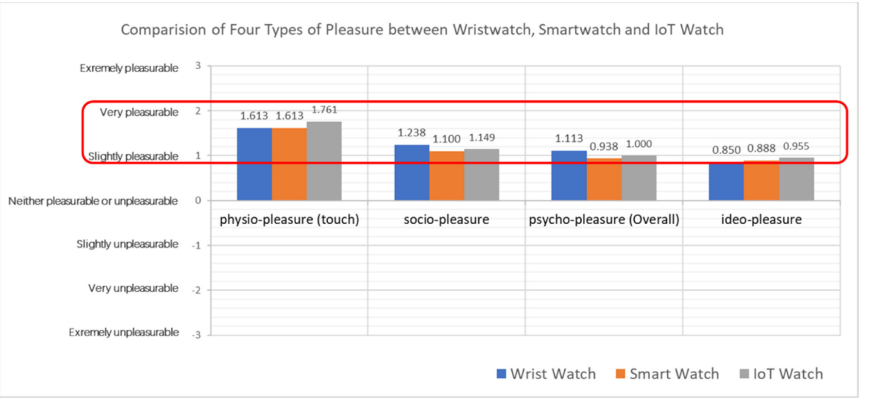

Fig. 2. Comparison of four types of pleasure between Wristwatch, Smartwatch and IoT Watch

Table 4. ANOVA of four types of pleasure between wristwatches (n = 80) and IoT watches (n = 67)

	Physio-pleasure (touch)	Socio-pleasure	Psycho-pleasure	Ideo-pleasure
F	0.570	0.175	0.360	0.316
P-value	0.452	0.676	0.550	0.575

Table 5. T-test of four types of pleasure between wristwatches (n = 80) and IoT watches (n = 67)

	Physio-pleasure (touch)	Socio-pleasure	Psycho-pleasure	Ideo-pleasure
P-value	0.447	0.674	0.543	0.571

Looking at the means of the six items in psycho-pleasure (Table 6), popularity was the item that had much more obvious influence on the psycho-pleasure of Wristwatches than that of Smartwatches and IoT Watches, while stimulation the item influencing the psycho-pleasure of Smartwatches and IoT Watches more obvious than the psycho-pleasure of Wristwatches. Interestingly, the user experience of non-IoT Smartwatches was always the most unsatisfying in the six psychological needs comparing to Smartwatches, Wristwatches and IoT Watches.

Figure 3 demonstrates that the psycho-pleasure influenced by six items gained by using Wristwatches was rated by participants as being below the slightly pleasurable level. For Smartwatches, only psycho-pleasure influenced by stimulation was higher than the “slightly pleasurable” level, while for IoT Watches, psycho-pleasures influenced by stimulation, competence, meaning and security were all above or at the slightly pleasurable level. It is noticeable that in this survey for all of the six phycological needs except popularity, the means of the pleasurable level of IoT Watches were higher

Table 6. The means of six items in psycho-pleasure of wristwatches, smartwatches and IoT watches

	Relatedness	Stimulation	Popularity	Competence	Meaning	Security
Wristwatch (n = 80)	0.563	0.738	0.625	0.838	0.738	0.938
Smartwatch (n = 80)	0.763	1.150	0.263	0.975	0.875	0.938
IoT Watch (n = 67)	0.851	1.224	0.269	1.060	1.000	1.000
Non-IoT Smartwatch (n = 7)	0.000	0.429	0.429	0.286	0.429	0.429

than those of Smartwatches, which were, in turn, higher than those of Wristwatches. It reveals that IoT Watches might provide more pleasurable user experience in terms of psychological aspects than Wristwatches.

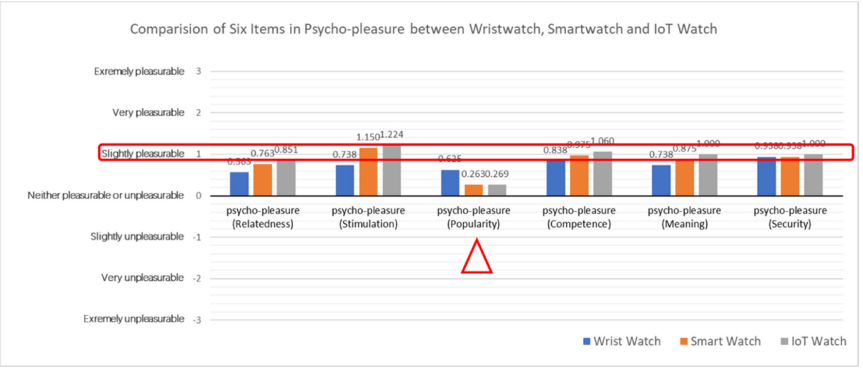

Fig. 3. Comparison of six items in psycho-pleasure between Wristwatch, Smartwatch and IoT Watch

By applying ANOVA tests (Table 7) and t-tests (Table 8) for IoT Watches and Wrist-watches, it showed that the p-values of stimulation were below the threshold (0.05) chosen for statistical significance. Thus, it can be seen that stimulation had signifi-cantly different influence on psycho-pleasure of Wristwatches and that of IoT Watches, and also significantly differed from that of IoT Watches. It also emerged that the p-values of popularity were close to the threshold (0.05) chosen for statistical significance which means that popularity also had obviously different influence on psycho-pleasure of Wristwatches and that of IoT Watches. Calculating the average means of six items influ-encing psycho-pleasure enabled a comparison with means of overall psycho-pleasures in order to find out how these components influenced the psycho-pleasure overall (Table

9). For Wristwatches, Smartwatches and IoT Watches, the average means of six items influencing psycho-pleasure were all lower than the means of overall psycho-pleasure.

Table 7. ANOVA of six items in psycho-pleasure between wristwatches (n = 80) and smartwatches (n = 80)

	Relatedness	Stimulation	Popularity	Competence	Meaning	Security
F	2.286	6.097	3.260	0.994	1.521	0.085
P-value	0.133	0.015	0.073	0.320	0.219	0.771

Table 8. T-test of six items in psycho-pleasure between wristwatches (n = 80) and IoT watches (n = 67)

	Relatedness	Stimulation	Popularity	Competence	Meaning	Security
P-value	0.132	0.014	0.073	0.332	0.217	0.771

Table 9. Comparison of means of overall psycho-pleasure and average mean of six items in psycho-pleasure

	Psycho-pleasure (explicit overall)	Average mean of six items in psycho-pleasure
Wristwatch (n = 80)	1.113	0.827
Smartwatch (n = 80)	0.938	0.740
IoT Watch (n = 67)	1.000	0.921
Non-IoT Smartwatch (n = 7)	0.286	0.333

8 Discussion

8.1 Improved Functionality and Uncertain Usability of IoT Products

Functionality and usability are the bases of pleasurable user experience in Jordan's model. Obviously, IoT Watches have more functions than non-IoT Smartwatches and conventional watches. The findings (Sect. 7.1) showed that there are several functions, like using social media and surfing the Internet, which were only available on a smart device that is able to connect to the Internet. From this finding, we might speculate that users can only notice the value of functional extension of an IoT product when they use its internet feature and it can be seen that all the smart features of a product which make it more powerful than its conventional form benefit from IoT. Moreover, an increase of functions related to IoT does not mean they are all easy to use and this would influence

the pleasurability of an IoT product. In this study, respondents claimed that functions like using social media and surfing the Internet were more difficult to use than non-IoT features like health trackers and reminders, which are provided by all Smartwatches. This finding also reflected the multi-instability and the multi-intentionality in attributes of fluid assemblages [5] (mentioned in Sect. 1). The final question in the functionality part of the survey asked participants to fill in any special reason of using a Smartwatch. 13 (of 80) participants mentioned they felt convenient to receive notifications by Smartwatches in a scenario they cannot look at their mobile phone. This finding revealed that a new way of interaction generated by IoT products' thing-to-thing interactions that conventional products hardly ever had. Thus, the usability has high potential to be improved when a conventional product evolves into IoT form but this improvement strongly depends on the UX designer's ability to implement an appropriate user-device interaction. This result also reflected the features of Spime in Sterling's theory [4] – the Smartwatches are not only material products but also part of a notification system involving multiple devices. Comparing to the disappointing IoT functions like using social-media and surfing the Internet, notification received more positive feedback. The implication of IoT product might should emphasise how different devices work together in a social network rather than a single piece of product. Therefore, when UX designers design the functionality and usability of IoT, they should have a societal perspective to consider the devices network and the service holistically to shape pleasurable user experiences.

8.2 No Obvious Differences in Four Kinds of Pleasure Between Conventional & IoT Products from Data

Comparing the means (Table 3) and the p-values (Table 4, Table 5), the four types of pleasure did not reveal significant statistical differences between Smartwatch/IoT Watches and conventional watches (Sect. 7.2). This finding suggests that the extended functionality of IoT products do not enhance UXs on the level of pleasure. The four types of pleasure the user experienced from IoT, non-IoT Smartwatches and Wristwatches all reached a pleasure level of "slightly pleasurable" (Sect. 7.2, Fig. 2). As these watches were user-centred design-products and designed to be instrumental, the designers might have considered four types of pleasures when they designed these watches and their interventions were successfully reflected in the UXs. If, however, all IoT and non-IoT products all achieved the same UX pleasure-level, it could imply that the advantages of IoT in pleasurable UXs cannot be seen from Jordan's model (2003). It might be that a higher level of consumer needs (beyond the level of pleasure) could be delivered by IoT products or some kinds of pleasure are missing in Jordan's model, and this would be worth exploring in future studies.

However, the means of and the p-values from ANOVA and T-test only can represent statistical differences but not all of the differences in pleasurability can be presented by data. In the opening question at the end of the questionnaire which asked their additional opinion about watches, two Smartwatch users and seven Wristwatch users stated that a watch is only a tool for them and they cannot connect it to any emotional feelings. Even the results did not differentiate regarding the four terms of pleasure in Jordan's model but they showed differences in the six psychological needs (which are introduced

in the next section). Socio-pleasure and ideo-pleasure need a deeper investigation using different components that might influence them just like the psycho-pleasure.

8.3 The Different Psycho-Pleasures Between Conventional and IoT Products

From the exploration of the six items (Sect. 7.3) in psycho-pleasures (Table 6 and Table 9), the aspect that has the most significantly-different influence on psycho-pleasures between IoT Watches and Wristwatches is stimulation. The reason for this could be that IoT Watches allow users to set their goals through a health tracker, sleep tracker and reminders, and this stimulates users to achieve their goals (based on the opening ques-tions in the questionnaire). The aspect that has the second-most significantly-different influence on the psycho-pleasures between IoT Watches and Wristwatches is popularity. This might be due to the fact that watches tend to have a similar appearance, but Wrist-watches are often designed to users' status, 'identity' and tastes through their appearance (and marketing). This finding reflects the aesthetics of immanence in attributes of fluid assemblages (mentioned in Sect. 2). In this way, this study might also have revealed the high potential for traditional watch brands to enter the Smartwatch market, as well as to improve the design of existing Smartwatches. Comparison of means of overall psycho-pleasure and the average mean of the six items in psycho-pleasure (Table 9) showed that the selected six items influenced the psycho-pleasure of IoT Watches more than Wristwatches. There might be other elements that influence the psycho-pleasure of Wristwatches and IoT Watches that have not been explored in this study.

8.4 Limitations of the Study

The study had several limitations in terms of its development. Firstly, watches were chosen as the type of product to investigate, but watches may not represent all the features of a product that are relevant for the transformation of a traditional to an IoT product. IoT products vary enormously, so it is impossible for a single product to be representative for all IoT products. Some IoT products, like Wi-Fi routers, did not have a form before becoming an IoT product; they were invented as IoT products. Secondly, the sample size of each questionnaire was 80 and all the questionnaires were sent out online, meaning that the current group of study participants might not have been representative for all characteristics of the target group. Also, most of the participants were English-speakers, from or living in an English-speaking country, so their response may not be representative for other cultures, and UXs in HCI are highly culturally-determined. Thirdly, the data analysis used a quantitative method, and the figures may not fully represent the subjective opinions of each user. The closed questions did not give participants the opportunity to explain how they evaluated their pleasurable experience of using watches. For a more detailed and in-depth investigation of the pleasurability of IoT products; they should be investigated qualitatively, by observing and interviewing. In addition, the two questionnaires used in the context of this study ignored the experiences of users who are using Smartwatches and Wristwatches in parallel. We are currently undertaking a follow-up survey addressing this user group.

9 Conclusions

This research project compared and discussed the pleasurable UXs of IoT Watches and conventional Wristwatches using a quantifying UX method. The aim of this study with 160 participants was to reflect the differences in pleasures that IoT and non-IoT products provide to users, as well as to create a new pleasurable user experience framework in further studies. The three key findings are:

1. The functionality of IoT Watches is more advanced than non-IoT Watches, but unique features of IoT products are not always easy to use. Thing-to-thing interactions of IoT products could bring convenience and new ways of interactions to users. UX designers should consider how IoT Watches work with other devices in a network when they design their usability and functionality to enhance pleasurable user experiences.
2. In this study, IoT Watches and non-IoT Watches provides the same level of pleasurability to users did not show a statistical difference. Also, UXs of IoT Watches and non-IoT Watches did not show significant statistical differences in four kinds of pleasures in Jordan's framework.
3. In terms of the six items associated with IoT Watches in the top-ten psychologi-cal needs, stimulation and popularity showed significant differences in their influences on the psycho-pleasures of IoT Watches and conventional watches. There is a high potential for traditional Wristwatch brands to launch Smartwatches. Moreover, Smartwatch developers might also benefit from learning design languages from Wristwatches.
4. When investigating pleasurable UXs of two different product types, it might be more effective to collect feedback from users who used them in parallel.

The key contribution of this paper is to provide new insights for designing pleasurable UXs for IoT products. The testing of existing UX theories on Wristwatches and Smartwatches could help researchers to address the shortage of current UX frameworks and develop new ones for IoT products specifically. Designers could benefit from this research by better understanding the differences in UXs between IoT and conventional products and the shortages of existing IoT Watches in order to design more-instrumental IoT products. Traditional Wristwatch and Smartwatch companies might also benefit from this study by identifying new design opportunities for increasing the pleasurability of their products. Further work should gain feedback from users who have used both Smartwatches and Wristwatches. In the future, we are going to use experimental meth-ods to explore the specific reasons for the differences in the perception of pleasurability between IoT products and conventional products.

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