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Cosmetic Wear and Affective Responses in Digital Products: Towards an understanding of what types of cosmetic wear cause what types of attitudinal responses from smartphone users.

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Abstract: The manufacture of electronic consumer goods involves the consumption of a variety of materials. The outer skins of electronic goods are commonly manufactured using materials such as metal, plastic and glass. These types of materials, however, are being disposed of in landfill and are not being recycled, despite the introduction of the WEEE directive in 2012 (Waste Electrical and Electronic Equipment (DIRECTIVE 2012/19/EU, 2012)). Calculations by the Industry Council for Electronic Equipment Recycling (ICER), estimate that the amount of electronic products that are making their way into landfill is around 1 million tonnes a year in England alone (ICER, 2005).

These skin materials and the attitudinal responses that users have when they reflect on cosmetic change, is the focus for the study that is detailed within this paper. The study is part of wider doctoral research where the aim is to identify if cosmetic changes in digital products alter replacement behaviours and product attachment. This is the first study to look at the affective material changes that occur on electronic devices and it is the first to elucidate a taxonomy of damage (TOD) which describes the variety of damage that occurs during the use phase of an electronic device. The second part of the study is an analysis of how these material changes affect the attitudinal responses of users and as such is retrospective.

Introduction

Cosmetic obsolescence has been seen to take place in textiles (worn in jeans (Burns, 2010)), ceramics (stain ceramics (Wood, 2008) and furniture (patina accumulating on wooden furniture (van Nes et al., 1999)). Chapman identifies this when considering patina and states that: "*patina is a necessary design consideration to assist the extension of product life spans in graceful and socially acceptable ways.*" (2014, pp.141).

Chapman uses an example in digital products, where he states that they "*tend to occupy a synthetic and scratch-free world of slick polymers…*" (2014, pp.141). If the concept of scratch-free materials is synonymous with digital products, there is an implication that the materials that are used in analogue products are, given societal and semantic norms, more accepting of wear. The classic examples of leather and wooden goods are often used to illustrate this (Wooley, 2003; Rognoli & Karana, 2014). It is interesting to note here that the distinction between analogue and digital products and between natural and man-made materials may provide us with a link between the product type and the material; i.e. analogue products age well because they are made of natural materials – digital products age badly because they are made of man-made materials. In the case of digital products, this is argued within the literature (Fisher; 2004, Odom & Pierce; 2009) as it is posited that wear has a detrimental effect on the appreciation of the materials when they are used in the outer casings of digital products. In terms of analogue products, this is also advocated by a disparate selection of literature that suggests that the properties of ceramics, leather and wood, for example, lend themselves to being imbued with meaning, personal stories and a preferential cosmetic look and feel (Rognoli & Karana, 2014). There are far fewer examples of digital products being considered in terms of wear and material changes but the examples that do exist suggest that digital products that are skinned

with man-made materials are less likely to acquire a meaningful patina. This is shown in Odom and Pierce (2009) and Odom, Pierce, Stolterman and Blevis (2009) who found that accumulation of wear had a negative effect on the user perceptions of products. It can be seen that the '*wear*' that accumulates on an electronic product has a detrimental effect to the overall appearance and that the concept of '*clean*' and '*new*' is a material state that is deemed as advantageous to have (van Nes et al., 1999; Fisher, 2008; Burns, 2010).

If '*newness*' and '*cleanliness*' of an object is regarded as an important material characteristic, it follows that it must be an important factor outside that of practical function, therefore falling within the remit of cosmetic obsolescence (cosmetic obsolescence here being distinguished apart from aesthetic obsolescence as it is only concerned with the visual and physical characteristics of an object and not associated trends of fashion (van Nes et al., 1999).)

Methods

The data collection consisted of two separate but linked studies. Study 1 was a cataloguing of the types of material change (MC) that has occurred on a set of 50 mobile phones, which belonged to undergraduate students between the ages of 18 and 25. The cataloguing consisted of a photographic record being taken of the participants devices with the MC being recorded during the photography process and also through retrospective image analysis. This ensured that all of the MC's had been recorded and documented. The MC's were documented by the identification of the following tribology (the science of interacting surfaces and resultant wear) descriptors: *Abrasion* (the rubbing or scratching of a surface), *Ablation* (the removal or chipping away of material from a surface) and *Impact* (the deformation or change in form of a material due to physical contact with another material). *Accumulated Dirt* was also included as a measure of wear due to it being present in a significant number of product appraisals. These tribology indicators make up the taxonomy of damage (TOD) for this product family.

Study 2, which consisted of the interview, was split into three stages where the participants were asked to identify all the MC's that had occurred during their period of ownership, to recollect where and how the MC had occurred in each case and finally to compare how they would have felt if the MC had occurred closer to the beginning or later on in their period of ownership (comparing new and old damage dependent on what the MC was). The interviews were then transcribed verbatim by the researcher, coded and thematically analysed to elucidate the relationship between types of MC, attitudinal reaction and time of MC during product ownership.

The participants for the studies were selected using purposive sampling, which Robson describes as "*the principle of selection…is the researcher's judgment as to the typicality or interest*" (2011. p.274). The sample was selected from UK nationals between the ages of 18-25 as they represented the highest consumption rate of mobile phones (Smith, 2010).

Loughborough University students who were engaged in the first year undergraduate degree module 'Industrial Design Studies 1' (IDS1) were highlighted as a set of potential participants due to their availability and flexibility. Study 1 also required the participant number to be at least 50 (so that statistical significance could be achieved, (Robson, 2011)). The student body in IDS1 was in excess of 120 students which allowed a good opportunity to recruit the minimum 50 required participants.

The participants took part in a seminar group on a Friday afternoon between 13:00 and 15:00. This enabled Study 1 to engage with the whole group rather than attempt to invite them to take part outside of class and on an individual basis, which may have proved logistically more difficult and time consuming.

After Study 1, participants were asked to sign up in principle for the follow up interview in Study 2. Of the 37 participants that signed up, 12 respondents were available for the second part of the study, thus making the cohort for Study 2, self-selecting. The 12 participants that took part in the second stage of the study also represented a homogenised population (Guest et al, 2006) and as such represented a numerically significant cohort for conclusions to be elucidated from.

Results

The results section will be split into Study 1 and Study 2, which reflect on the research aims of both studies.

Results Part A – Material Change Analysis

From the identification of the types of MC that have occurred on the 50 devices, it can be seen that Abrasion was the most common MC with it occurring in 68% of the participants devices. Impact was seen in 50% of the devices that were looked at. Accumulated Dirt occurred in 36% of the phones and Ablation occurred in 30% of the devices.

A selection of the typical images collected for each of the MC's can be seen in Figure 1.

The spread of the types of MC over self-reported periods of ownership indicated a correlation between the gradual increase of MC and length of ownership, which was as expected with devices that were being owned for longer periods of time (see Figure 2). It was interesting to note, however, that the 8% of devices that had no damage recorded were also used *without* any protective products such as cases or screen protectors.

During Study 1 it was found that there were a significant proportion of devices that were being used that had an instance of wear on them (92%). Impact damage predominantly occurred (or originated from) on the corners of the phone and resulted in cracks, separation of material and splits in the screen component.

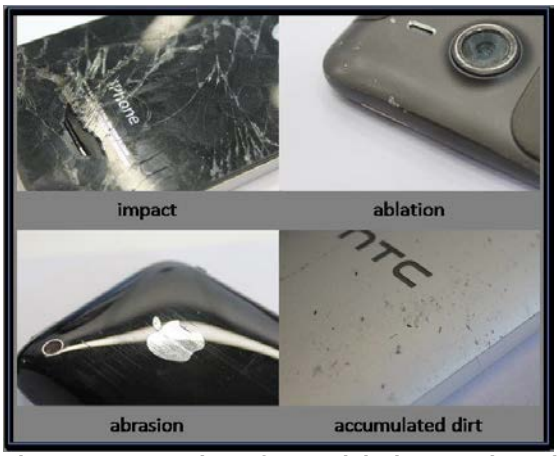

Figure 1: Examples of material changes based on tribology indicators (Authors own images)

The same location on the device across the sample (the corners) saw the majority of instances of ablation where material had been chipped from the surface and material had been deformed or removed. Abrasion occurred on most parts of the phone but due to the definition of Abrasion including scratching and rubbing, there were significant instances of scratching on the flat areas on the back and front of the phones, and rubbing which mainly occurred on the edges and corners. Accumulated Dirt was found to be common on the phones that had been kept in cases and where there were indentations or ridges in the exterior of the phone into which dirt could accumulate and be prevented from being removed during regular use; i.e. physical switches, recesses and joins in the material components.

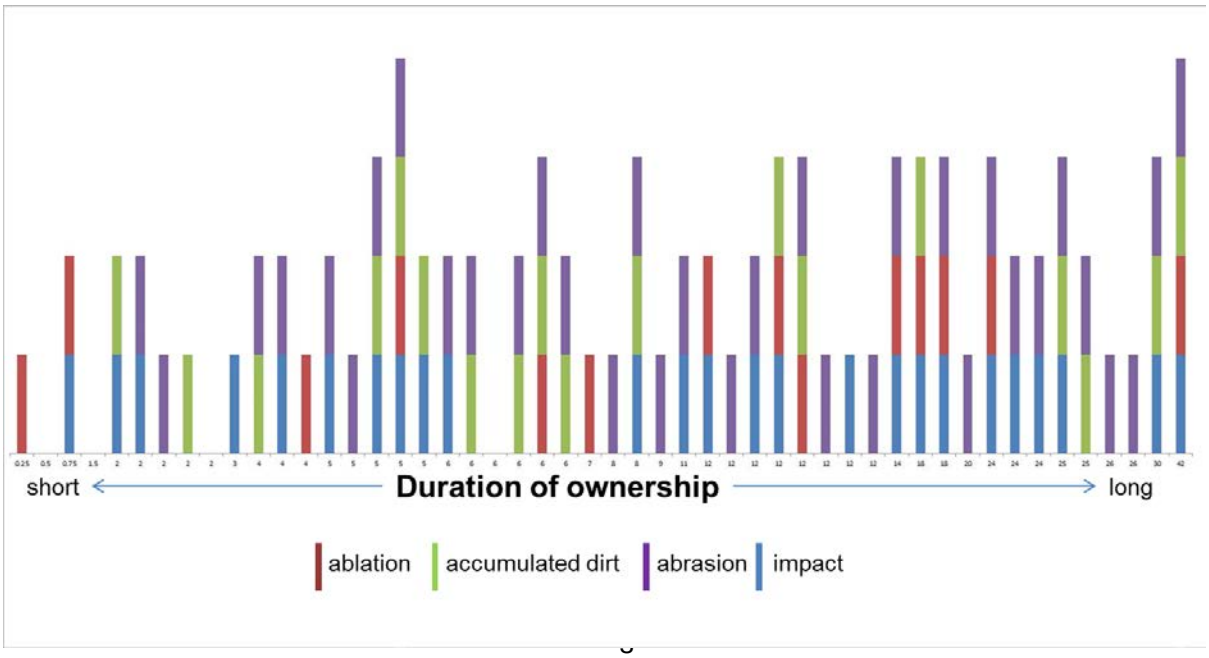

Figure 2: Accumulation of wear across participants (n=50).

Each phone was attributed with a Cumulative Damage Score (CDS) which corresponded with an overall assessment of the wear. If a phone had only one instance of Ablation, for example, it scored 1 on the CDS. If it had Ablation and Abrasion, it scored 2; and so on until the maximum CDS score achievable was 4, given that the phone exhibited all types of wear. Figure 3 illustrates the instances of CDS scores across the cohort number.

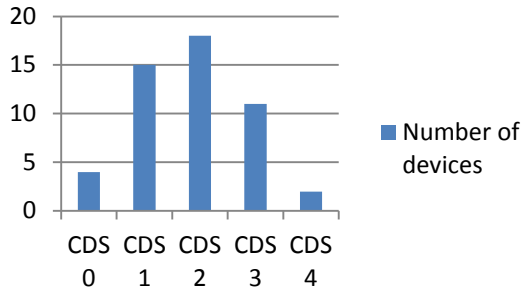

Figure 3: Cumulative Damage Score across devices

The CDS did not include an assessment of the severity or variability of the wear. For example, if a phone had one scratch or many, it was given 1 mark on the CDS. This is an issue that needs to be addressed in further iterations of the study. There was also seen to be a relationship between the uptake of protective devices and the damage that was occurring on the phones (see Figure 4). There was an interesting difference between the start, middle and end stages of use and when the protective devices were being adopted, indicating that the protective devices were being used less in the initial and end stages of use and the uptake of their use was in reaction to damage occurring at the preliminary stages of ownership.

Results Part B – Qualitative Interviews

From the qualitative interviews, which followed the visual inspection of the devices in Study 1, the participants reflected on incidents of MC that had occurred on their devices since the beginning of ownership. In the majority, participants reflected that if the MC that was being discussed (which was conducted for each example of MC on their device) had occurred in the early period of ownership, their attitudinal reaction would have been more negative. For example Participant (P)1 stated that on reflecting whether an impact MC which was evident on the back of their phone had occurred within the first month of ownership, "[I would have been] *more annoyed, I would have probably got it fixed.*" This is supported by a comment by P2, "*that would annoy me, yeah you kind of expect things to be tougher than that*". This was a common occurring response to any MC that had occurred on the participants devices. Annoyance of the expected build quality of the device at an early stage seems to be an overriding factor.

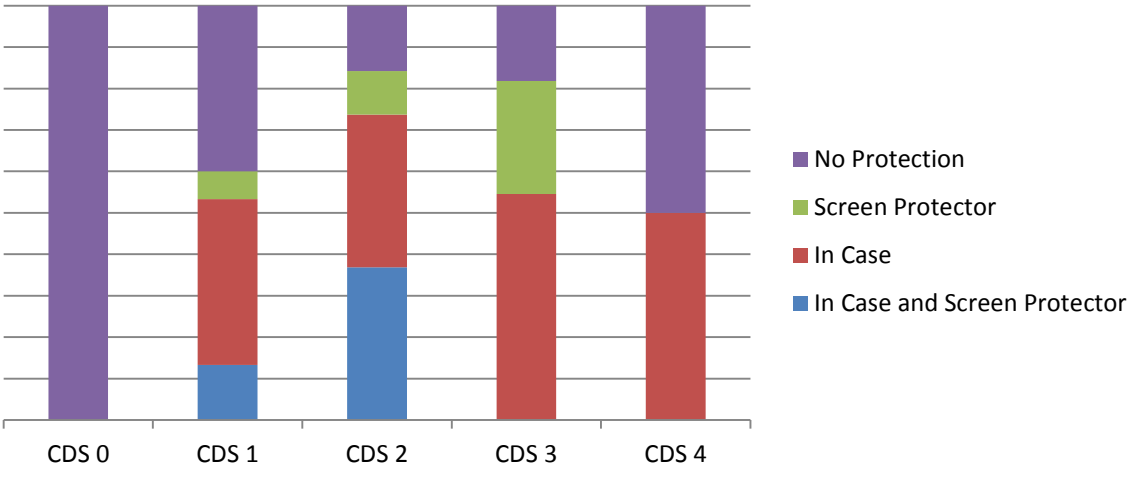

Figure 4: Cumulative Damage Score and uptake of protective products.

Reflections on the physical changes

The participant's attitude towards the types of damage on their devices ranged from '*non-*

plus' to '*annoyance*'. Responses were often influenced by the working condition of their phones; if the device still functioned as desired then the damage was not seen to be as bad. However, there were some differences in response to when and where wear occurred on the phones.

Damage occurring earlier on in ownership is seen as more annoying and elicits more attitudinal reaction. The point at which the first instance of damage occurs, the level of tolerance increases towards the subsequent instances of damage that occur. The results indicate that there was a moment of relief in being able to use the product without restraint after the first significant piece of wear had occurred. P2 stated *"...I'm pretty protective over it for the first couple of weeks and then after that you don't really notice damage so much.*" which is supported by P6 who stated "*when it's new you're like it's fresh and stuff but if you've had it six months, it becomes just part of the furniture.*" There was a noticeable difference between responses depending on whether the phone was new or not new. As P7 stated "*Obviously when you first get it* [wear occurring] *you're really sad, because you're like 'oh my god it's new' but now it's just like 'what else is new?"*". This tipping point of '*care*' was seen to occur either after a significant first instance of wear or after a period of time when the novelty of a new device had worn off. The duration for the period of novelty are different for each participant but a '*few months*' was a common response when prompted by the interviewer.

What if...reflections

It was identified that if participant devices had received the same damage at the beginning of ownership then the reactions would have been more extreme. When asked if the most prominent type of damage on their phone had occurred at the start of their ownership, P4 stated "*I think I would have been more annoyed.*". P9 supported this by stating that "[I] *think I'd be more annoyed about it, if it had happened straight away*". The reaction to the fictional scenario of the wear occurring at the start of ownership also elicited disappointment in the construction of the devices; P2 explained "*that would annoy me, yeah you kind of expect things to be tougher than that.*". This scenario also prompted respondents to talk about services in which phones are covered for damage. The safety net of insurance, warranties, and new phones with upgrades meant that some damage was excused or ignored, especially if it occurred at the end of a contract. P8 was '*due*' a new phone on their contract and therefore responded with "*oh well, I'll change it in two months' time*"; identifying the influence of the contract system of upgrades and new devices. This apathy for the wear that was occurring was reiterated by the fact that some of the devices were not bought by the participants, as P11 confirmed "*I'm not in the least bit bothered, because I didn't buy the phone*". This indicated a detachment to the condition of the phone, illustrating a symptom of the purchasing structure that accompanies phones and the lack of an upfront monetary commitment.

It was seen that a certain severity of damage is expected nearer to the end of contracts thus attitudinal responses to wear was less with promise of a new device in the near future. Overall, there was an indication that damage occurring at the start of a contract was deemed worse than damage at the end. The assessment of the damage was often justified by the opportunity to upgrade in the near future or the fact that the phone still functioned despite the cosmetic damage and therefore was not an issue, however this was often stated with the caveat that they did "*need a new phone*" or a "*new device would be nice*" (stated by P7).

The importance of performance

A significant amount of respondents' reaction to the types of cosmetic damage that was occurring was justified by the disclaimer that "*as long as it doesn't affect how the phone works it doesn't bother me*" (P11). Given the access that a smartphone provides to the user, the requirement to make calls, send texts, access social networks, capture and share images of everyday life; the necessity of functioning software seems to increase user tolerance for cosmetic damage.

Practical function of the software was also seen as important as the necessity to have an electronic product that retains battery life, maintains processing speed and can be upgraded to compare with contemporary models; are all contributing factors to the users ongoing assessment of a digital product like a smartphone.

Discussion

The study provides evidence that there is a relationship between material changes and the user's attitudinal response to them depending on when they occur during a period of ownership and where they appear on the device itself.

The link between these attitudinal responses and the impact these have in the replacement behaviours of users' needs to be addressed and elucidated in further studies, however, even with this preliminary and exploratory study it can be seen that it could be a contributory element in replacement behaviour. A proposal for the relationship between the necessity of a digital product to function, the appreciation of newness and the tolerance of wear can be seen in Figure 5. This hypothesis will be tested in a further longitudinal study that will track ageing of digital devices and the extension of study 1 and study 2 with three other product categories (over-ear headphones, tablet pc and fitness tracker bands).

From these two exploratory studies it could be hypothesised that there is a constant level of need for physical function. Responses from (i.e. '*as long as it still works, I don't mind how it looks*'). This reinforces Fisher (2004) and Odom & Pierce (2009) when they refer to the lack of appreciation of ageing plastics and the importance of content rather than product.

In the hypothesis, as length of ownership increased, tolerance of wear over time goes up. The rate at which this tolerance increases is subject to noticeable and significant wear occurring at different points along the length of ownership. If this happens earlier in ownership then the levels of tolerance of wear increases above that of the normal rate. Counter to this, there is an opposing reduction in the appreciation of the newness of a new device where a '*honeymoon*' period of ownership is observed, making wear less acceptable and less tolerated. This again can decline quicker with more rapid accumulation of wear on a device occurring earlier in a period of ownership. The rate of tolerance has not been investigated in the literature so far and would contribute to a new understanding of how cosmetic changes contribute to product replacement. It would also go towards explaining why and in what ways the wear that accumulates on digital devices is not appreciated.

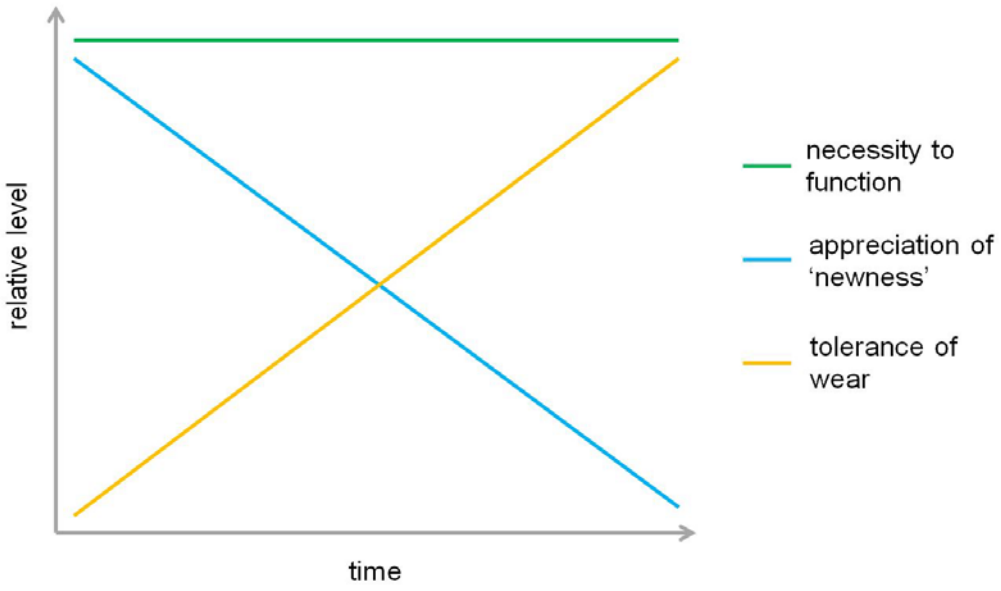

Figure 5: Hypothesis of the relationship between function, newness and wear.

Study 2 indicate this to be the case, and that functional obsolescence is a more important decision making factor than the negativity of wear occurring and cosmetic obsolescence

The amount to which material changes contribute to product replacement will be explored in further studies which repeat the

method outlined in this paper using different product families, in addition to conducting a third, longitudinal study which will seek to track the material changes and the attitudes towards those changes in real time to observe and to understand if they are contributing to an increased tendency towards replacement.

Conclusions

The user's tolerance of wear in smartphones is very low at the start of ownership due to products being '*new*' and wear being more easily identifiable. After the first instance of wear occurring, the tolerance level for wear increases and the accumulation of more instances of wear does not elicit as much of a negative attitudinal reaction. The findings show that Impact and Ablation are the least tolerated types of wear, due to the fact they are often the result of accidental damage, such as dropping the device. Accumulated Dirt is incremental and takes longer to accumulate on a device, hence not eliciting as much of a reaction. Abrasion was also seen as more tolerable as scratches were expected with use and again are more noticeable over longer periods of time.

There was no noticeable pattern with specific MC's occurring at particular times, although Accumulated Dirt was seen to increase over time. The MC's did occur on specific parts of the device with damage to the screen/front being seen as the most affective. This leads us to propose that even though there is not a predictable pattern of wear occurring on smartphones, the times at which they happen across a period of ownership, the likelihood of them appearing on prominent areas of the device and the type of wear that is occurring, can influence attitudes towards the appreciation of participants' devices.

Due to the social access granted by smartphone devices (social networking, calls, texts etc.), product performance and stability was dictated largely by the software. The internal hardware (such as battery life and processor speed) was also seen as an important factor in participants' appraisal of how the product was ageing. The external '*skin*' of the product was seen to be less of a concern.

In conclusion, the types of wear that presently accumulate on the outer-skin of a product are not desirable. Rarely was the accumulation of wear seen as beneficial or aesthetically pleasing, our results confirming the literature on the subject. Over time the tolerance for cosmetic wear increases and priority switches from aesthetics to function. Within the category of smartphones the necessity for stable functionality is paramount, wear and tear is expected, and access to networks is more important than the device that provides it.

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