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The look of rough: visual and tactile perceptions of cosmetically aged materials

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Keywords

Material selection
Ageing
Cosmetic obsolescence
Product lifetime extension
Emotionally durable design

Abstract

The aesthetics of material performance within design is typically only considered up to the point of sale, a false end state in which the ‘newness’ of the product is protected by the hermetic packaging in which it is sold. Beyond this, the ‘ageing’ of a material is thought of only in terms of utility or easily measured technical parameters such as durability or toughness, and rarely reflects upon, or accounts for, the user’s experiential relationship with the material. Here, we explore changes in tactile and visual perceptions when sample materials have been artificially aged through the application of a taxonomy of damage observed from real world products. This paper argues that to expand our current knowledge in material culture and to assist in providing a more nuanced understanding of the user’s long-term relationship with materials, we, as designers, need to observe, record and reflect upon attitudinal reactions to aged and used materials.

Introduction

The relationship that we have with materials and their associated meaning is constructed from tangible interactions combined with the tacit semantic baggage of meanings that are defined by our collective material culture (Demirbilek & Sener, 2003; Dunne, 2005; Sudjic, 2008; Chapman, 2015). Current understanding of how material wear and damage fits into our lexicon of material meaning is anecdotal and not always “...a necessary design consideration to assist the extension of product life spans in graceful and socially acceptable ways.” (Chapman, 2014, pp.141). In addition, if the concept of a “scratch-free world of slick polymers” (ibid) 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, for example the leather strap of an heirloom watch or the working surface of an old oak butchers block. In the case of electronic products wear has a detrimental effect on the appreciation of the materials when they are used in the outer casings of digital products (Fisher, 2004; Odom and Pierce, 2009) but again conclusions in the majority of current literature are primarily drawn from tacit and anecdotal evidence, not backed up with the rigour of an empirical study. There are some notable exceptions with Lilley et al., (2016) being the best case so far for assessments of material affect using repeatable scientific methods.

The current semantic language that is linked to user’s perceptions of materials has been codified through a set of studies that explore, mainly, the tactile and visual

characteristics of new, rather than aged, material samples (Pedgley, 2009; Karana and Hekkert, 2010; Rognoli and Karana, 2014, Zuo et al., 2001), omitting consideration of the use phase of a product, where the material will inevitably suffer wear and tear from everyday use. This illustrates a large gap in knowledge where the meanings of materials and the products that are manufactured from these materials are understood only until the point of purchase. The majority of the life of the product is in use and it is during this period that significant changes to the meanings of materials and products take place. This paper explores this shortcoming drawing on the findings of a study which identified, and provided a taxonomy for wear occurring on real world products during their use phase, (Manley, 2015) which was completed in partial fulfillment of a PhD research project (Manley, forthcoming).

For the purposes of this paper, and within the interests of brevity, this paper will report on the results of user evaluation of three materials: Plastic Gloss, Metal and Wood Matte. The Plastic Gloss and Metal were chosen as they represent two of the most commonly used materials in the manufacture of portable electronic products. Wood Matte was chosen to test a central hypothesis of the PhD that worn natural materials are more favourably judged than their man-made counterparts.

The full analyses, findings and conclusions of the entire study can be found in Manley, (forthcoming).

Methods

This paper utilises the tried and tested Semantic Differential Method (Osgood, 1964), to elicit attitudinal responses to the material samples used during the study (See Figure 1 for material samples used). Firstly, a series of seven word pairs¹ were used to assess the material samples that were presented in each of the five material states (No Wear [control samples], Abrasion, Ablation, Impact and Accumulated Dirt), to a group of 18-25 year-old participants (n=35) engaged in study at XXXX University. From this, and the subsequent quantitative analysis (Wilcoxon Signed-Rank Test) of the participant responses, affective responses to certain types of wear and damage were identified [Study Part A].

Next, five phrase² pairings were used to enable participants to evaluate the full range of material samples with all four wear types present at the same time [Study Part B] (the No Wear control samples were not used at this time as the phrase pairings were focused on the accumulation of wear and damage and the assumption that the materials had been 'used'). The participants were explicitly instructed



Figure 1. Material sample discs used in study [From left to right; Plastic Gloss, Wood Gloss, Metal, Plastic Matte, Wood Matte and CLEVER material. From top to bottom; Abrasion, Ablation, Impact and Accumulated Dirt.] (Authors own image)

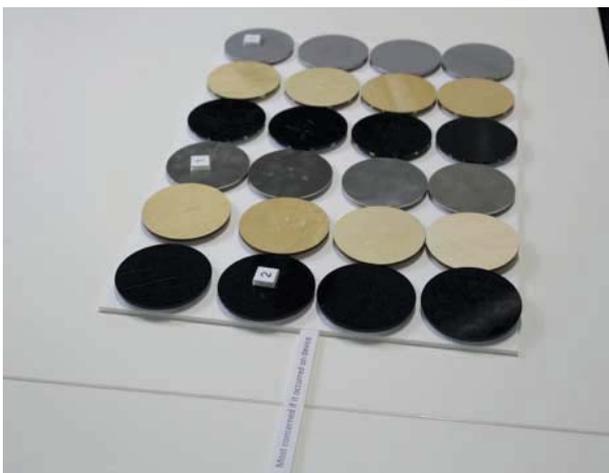


Figure 2: Material sample discs being selected using rank phrases for Part B. (Authors own image)

¹ Aged Badly-Aged Well, Boring-Interesting, Dislike-Like, Hard-Soft, Old-New, Rough-Smooth, Ugly-Attractive

² Dislike/like, indicates a device getting old/does not indicate, most/least concerned if occurred on a device, looks worse/better after more of the same wear, most/least likely to encourage product replacement.

to consider the material samples within the context of portable electronic products. This differentiated the research from prior studies in which material swatches devoid of a product context were considered (Karana and Hekkert, 2010; Rognoli, Karana, 2014, Zuo et al., 2001). Participants were asked to identify and rank, with three numbered tokens, their top three materials based on the five phrase pairs (see figure 2).

For Part B the samples included the CLEVER material.

Findings

Part A

Table 1 indicates the p-value scores (used to statistically identify significance) for each of the samples being compared based on median scores. As a result, the p-value can indicate (if $p < 0.05$ and highlighted in green) that the median scores for two samples that differ in their wear type, have elicited significantly different reactions based on the semantic differential scale being used. It can be seen that the assessments of the material samples are indeed affected by the introduction of wear. It is interesting to note that wear had an influence on all the materials depending on the semantic scales being used to assess them. There is evidence also, by observing the lack of a difference in assessment ($p\text{-value} > 0.05$), that certain semantic associations do not change. For example, it was seen, without exception that the perceptions of hard-soft were not affected by a change in the wear on the samples.

Findings Highlights

It was seen that the comparison between No Wear and Impact drew fewer significant differences with only Plastic Gloss being seen to be less old, rougher and uglier when Impact was present. It also made Wood Matte uglier.

The findings also identified that the presence of Accumulated Dirt was seen to have a greater negative influence than the other wear types which was not anticipated. To visualise the effect that differing wear types had on the assessments of the samples, the median scores have been plotted with each material sample being shown on the semantic differential scales used in the study. [red arrows identify $p\text{-value} < 0.05$, green arrows identify $p\text{-value} > 0.05$, see table 1.

Plastic Gloss

It can be seen the Accumulated Dirt sample for Plastic Gloss scored significantly lower on all but the boring-interesting scale (see figure 4). Abrasion was also often seen to be assessed lower than the other wear types with it being disliked, rougher, uglier and looking to have aged worse than both Ablation and Impact. There was little difference in the assessment of Ablation and Impact which

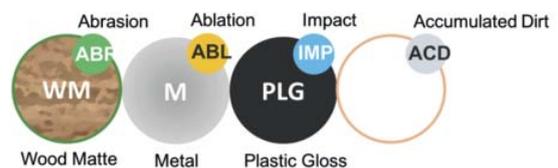


Figure 4. Legend for material samples with wear.

SD SCALE	Material Sample	No Wear-Abrasion	No Wear-Ablation	No Wear-Impact	No Wear-Acc. Dirt	Abrasion-Ablation	Abrasion-Impact	Abrasion-Acc. Dirt	Ablation-Impact	Ablation-Acc. Dirt	Impact-Acc. Dirt	
Aged Badly-Aged Well	Plastic Gloss					.013	.000	.000	.123	.000	.000	
	Wood Matte	NO DATA					.005	.000	.065	.000	.534	.000
	Metal					.234	.000	.283	.000	.106	.000	
Boring-Interesting	Plastic Gloss	.023	.334	.287	.056	.341	.340	.520	.765	.073	.102	
	Wood Matte	.433	.016	.002	.016	.034	.026	.052	.400	.889	.446	
	Metal	.047	.006	.689	.031	.332	.125	.816	.007	.368	.126	
Dislike-Like	Plastic Gloss	.000	.020	.188	.000	.005	.002	.000	.475	.000	.000	
	Wood Matte	.001	.017	.745	.006	.027	.001	.149	.025	.316	.007	
	Metal	.006	.004	.185	.002	.798	.056	.347	.056	.545	.007	
Hard-Soft	Plastic Gloss	.945	.528	.452	.334	.395	.689	.259	.627	.080	.057	
	Wood Matte	.991	.464	.688	.908	.533	.691	.983	.270	.330	.624	
	Metal	.075	.168	.712	.051	.673	.130	.691	.296	.459	.092	
Old-New	Plastic Gloss	.000	.000	.000	.000	.119	.013	.000	.370	.000	.000	
	Wood Matte	.004	.118	.117	.001	.071	.000	.730	.029	.004	.000	
	Metal	.049	.021	.967	.006	.587	.026	.232	.010	.785	.002	
Rough-Smooth	Plastic Gloss	.000	.000	.000	.000	.708	.013	.000	.022	.000	.000	
	Wood Matte	.043	.686	.695	.228	.030	.022	.480	.390	.249	.110	
	Metal	.589	.490	.060	.077	.936	.155	.016	.073	.007	.001	
Ugly-Attractive	Plastic Gloss	.000	.001	.002	.000	.039	.034	.000	.697	.000	.000	
	Wood Matte	.852	.984	.001	.472	.511	.000	.736	.001	.802	.000	
	Metal	.010	.008	.845	.059	.238	.004	.898	.001	.461	.008	

Table 1. P-Values calculated using Wilcoxon-Signed Rank test. Green=study hypothesis has been confirmed [no difference in assessment], Red=study hypothesis being violated [significant difference in assessment].

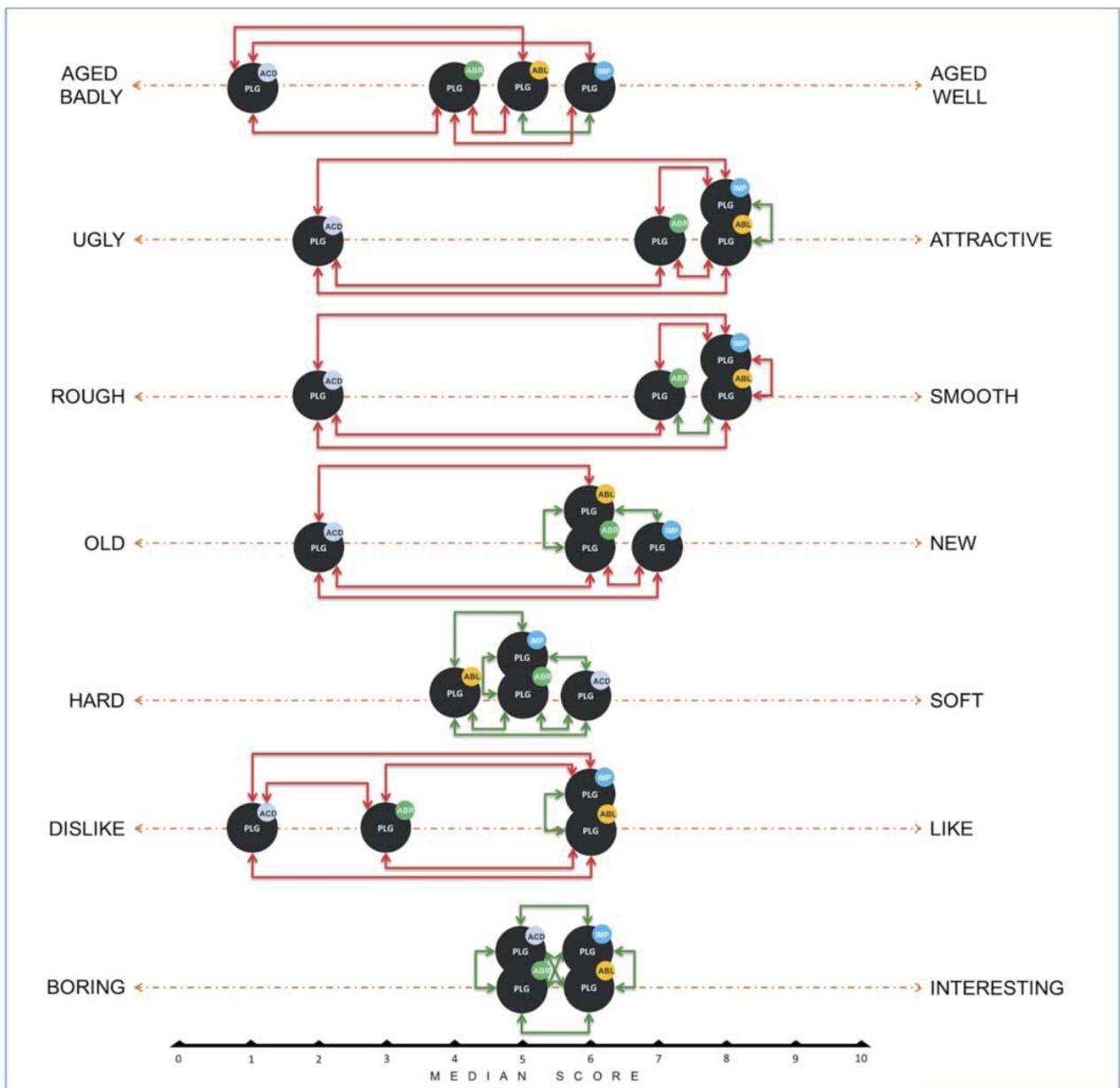


Figure 4. Sample comparisons across wear types within Plastic Gloss. [green lines indicate confirmed study hypothesis; no difference in assessment and red lines indicate contradiction of hypothesis; significant difference in assessment.] (Authors own image, 2017)

were seen to be assessed the same within the Plastic Gloss sample apart from when Ablation was seen to be rougher.

Metal

For the metal sample the assessments were all much closer between the four wear types but the common assessment being that Impact was not as bad as Abrasion, Ablation and Accumulated Dirt. Impact scored better for interest, likability, newness, attractiveness and ageing better in most cases. Again for the metal sample, the assessment of Hard-Soft was not affected by the introduction of wear.

Wood Matte

In opposition to the assessment of Impact being the better type of wear in most scales when occurring in metal; the reverse is true for the Wood Matte sample (see figure 6). Impact was seen to be more disliked, older, uglier and seeing to age worse over time. As with the other samples, hardness was not affected by the introduction of any of the wear types with it still being assessed as soft.

Part B

When all the discs were appraised together, the highest three ranked of the twenty-four samples were identified. This is rationalised by there being a ranking of the top/ bottom three by the participant's taking part and as such reflect the overall cohort in how the material samples were appraised. Table 2 shows the top ranked samples for each of the rank phrases.

It was interesting to note that there were some common samples that appeared to be least and most favourable given the semantic differential scales that were used. For example, the Wood Gloss and Matte with Abrasion samples were seen to look better after more of the same wear and least likely to encourage product replacement. The Metal sample with Impact was ranked the highest for being liked, not indicating a device would be getting old and causing least concern if occurring on a device. The Wood Matte with Abrasion also ranked in the top three for being of least concern if occurring on a device and not indicating that device was getting old.

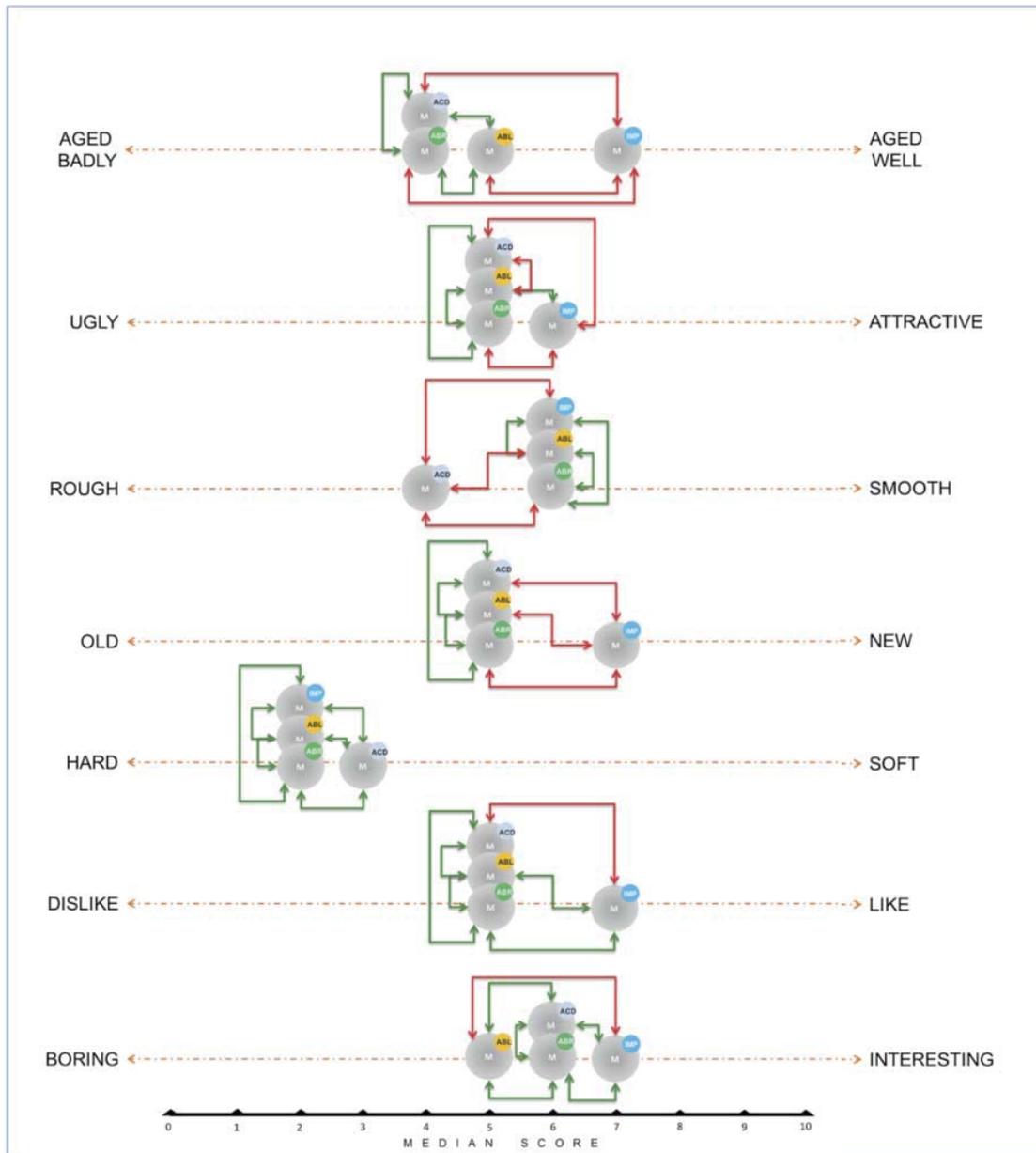


Figure 5. Sample comparisons across wear types within Metal. (Authors own image, 2017)

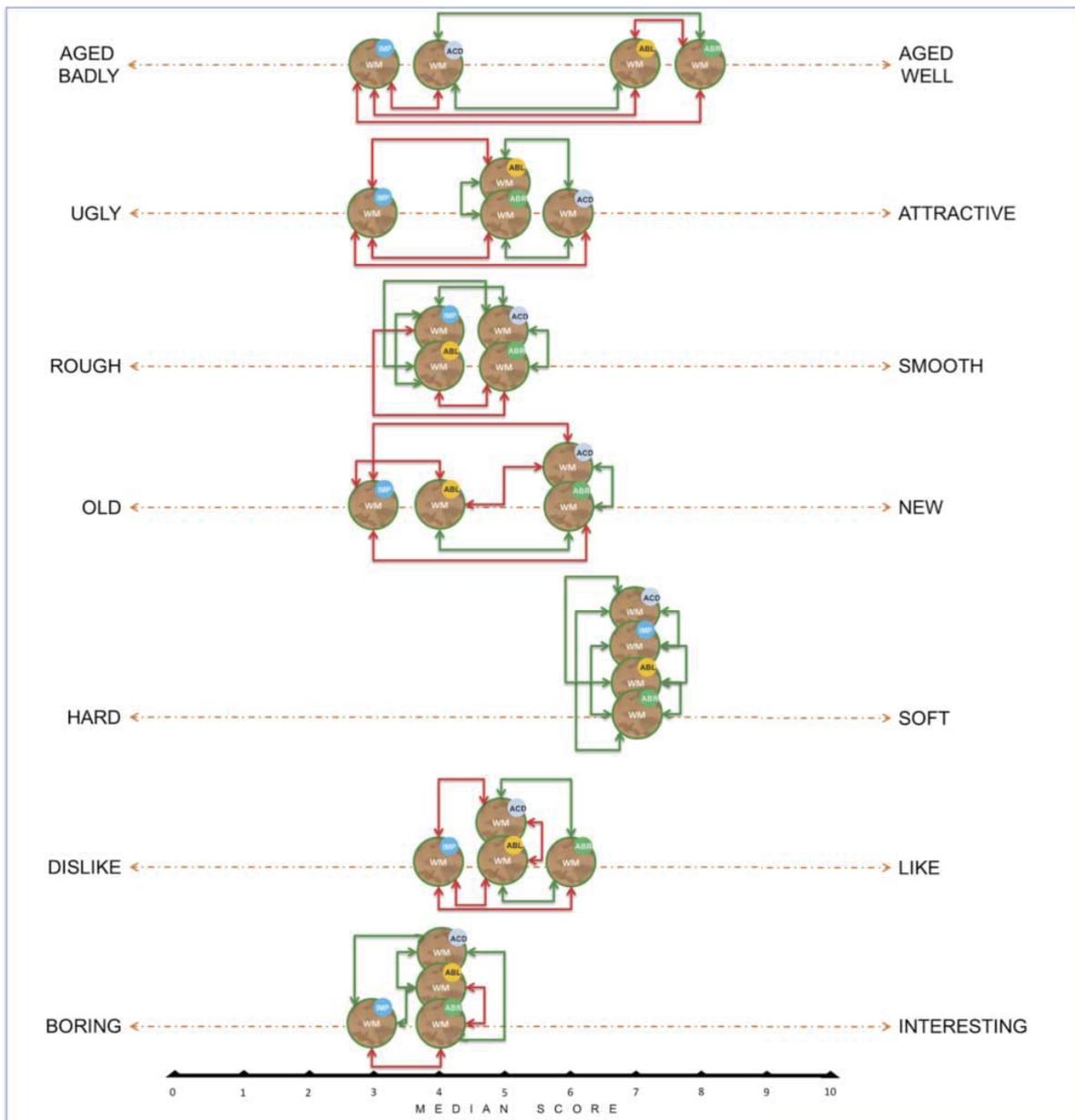


Figure 6. Sample comparisons across wear types within Wood Matte. (Authors own image, 2017)

DISLIKE:			LIKE:		
ACCUMULATED DIRT	PLASTIC GLOSS	1ST	IMPACT	METAL	1ST
ABRASION	CLEVER	2ND	IMPACT	PLASTIC GLOSS	2ND
ABLATION	CLEVER	3RD	IMPACT	PLASTIC MATTE	3RD
INDICATED THAT A DEVICE IS GETTING OLD:			DOES NOT INDICATE THAT A DEVICE IS GETTING OLD:		
ACCUMULATED DIRT	PLASTIC GLOSS	1ST	IMPACT	METAL	1ST
ABRASION	CLEVER	2ND	ABRASION	WOOD MATTE	2ND
ABLATION	CLEVER	3RD	IMPACT	PLASTIC GLOSS	3RD
MOST CONCERNED IF OCCURRED ON DEVICE:			LEAST CONCERNED IF OCCURRED ON DEVICE:		
ACCUMULATED DIRT	PLASTIC GLOSS	1ST	IMPACT	METAL	1ST
ABRASION	CLEVER	2ND	ABRASION	WOOD MATTE	2ND
ABLATION	CLEVER	3RD	IMPACT	PLASTIC MATTE	3RD
LOOKS WORST AFTER MORE OF THE SAME WEAR:			LOOKS BEST AFTER MORE OF THE SAME WEAR:		
ACCUMULATED DIRT	PLASTIC GLOSS	1ST	ABRASION	WOOD MATTE	1ST
ABRASION	CLEVER	2ND	ABRASION	WOOD GLOSS	2ND
ABLATION	CLEVER	3RD	ACCUMULATED DIRT	WOOD GLOSS	3RD
MOST LIKELY TO ENCOURAGE PRODUCT REPLACEMENT (Even if device was still working):			LEAST LIKELY TO ENCOURAGE PRODUCT REPLACEMENT (Even if device was still working):		
ABRASION	CLEVER	1ST	ABRASION	WOOD GLOSS	1ST
ACCUMULATED DIRT	PLASTIC GLOSS	2ND	ABRASION	WOOD MATTE	2ND
ABLATION	CLEVER	3RD	ACCUMULATED DIRT	WOOD GLOSS	3RD

Table 2. Ranking of materials based on Rank Phrases.

Conversely it was seen that the CLEVER material with both Abrasion and Ablation (which revealed layers of differing colour from the original top-coat) ranked amongst the least favourable responses.

The Plastic Gloss with Accumulated Dirt sample also ranked in the least liked, looked worse after more of the same wear, most likely to encourage product replacement, dislike, indicated the device getting old and most concerned if occurred on device.

Conclusions

Between Materials within Wear Types

When looking at the influence of materials it was seen that the type of material has notable effects on visual and tactile user perceptions. The most interesting finding highlighted the difference in the attitudinal reactions between plastic or metal and wood. The wooden samples engendered some positive reactions to some of the wear types. The plastic and metal samples all had attitudinal reactions that were more negative when the wear had been applied. The wooden samples were seen to look best after more of the same type of wear and were less likely to encourage product replacement, as confirmed in Part B. In Part A the wooden samples were also, unexpectedly, seen to be newer, more attractive and more liked in some cases with the wear applied. It was found that material types influenced the perception of a specific type of wear with the clearest example being the assessment of Abrasion which ranked the highest in negative Rank Phrases when it was applied to the CLEVER sample but drew the most positive rankings when applied to the wooden samples.

Between Wear Types within Materials

The influence of wear on participants' attitudinal responses was significant and it was seen that there were notable differences in the assessments of the differing types of wear on the different material samples that those differing types of wear occurred. The differences in the assessments, in some cases, were mirrored across the material types. For example, the assessment of Accumulated Dirt was seen to be assessed as less attractive and less liked across the majority of the material types. Impact was often the wear type that elicited the least difference from the control state of No Wear across the material types. This was confirmed in Part B where samples with Impact present were ranked in two of the top three samples selected for the positive rank phrases. If the wear types were to be ranked in terms of their influence on attitudinal reactions to the cosmetic condition of materials it could be said that Impact elicited the least reaction and Accumulated Dirt drew the biggest difference from the control samples. The material sample that drew different attitudinal responses was the wooden samples. These material samples were seen to, in some cases, age better, look and feel more attractive and be liked more when wear was present.

Expanding the Semantic Lexicon

Before this study was conducted there was some evidence that non-homogenous surfaces and more 'natural' materials could elicit more positive reactions. This was (in the majority but with notable exceptions; Lilley et al., 2016, Sauerwein et al., 2017), tacit and anecdotal with little confirmation from quantitative methods. This study confirms this tacit understanding and quantifies to some extent the influence of more natural material finishes in the attitudinal assessments of material samples. The study also goes further and for the first time identifies the influence of wear and damage on these attitudinal perceptions within the context of electronic products. Further work is of course needed to confirm these findings, but there is a strong implication that in terms of the way that materials are assessed and selected during the design process, ageing is an important aesthetic factor. It also points to a newer and fuller understanding of our cosmetic perceptions of materials from not only a practical/technical perspective but also from an experiential stand-point where the visual and tactile characteristics of a material should be part of both our semantic understanding and an influencing factor in how we interact with products that inevitably age during use.

As such, if the start point for a designer were to be which material would be best if one was to expect a specific type of wear; it can be seen that there are preferences that could be concluded from the attitudinal responses.

Within the material selection process for product design, the physical state of a material past new is rarely considered. When considering the emergence of circular economy business models and the recent, yet small, upsurge in the concentration of academics and industrialists to consider products that last (Bakker et al., 2014; van Hinte, 1997); the influence of materials choices that are sympathetic to product's ageing is increasingly important. The traditional material choices, for electronics at least, are understandably myopic given their short use cycles. Materials can be chosen or developed that are appreciated in their visual and tactile appearance by considering their technical qualities to encourage longevity (durability for example), but by also selecting them on propensity to engender emotional durability which necessitates taking into consideration and building into the design process, a space for materials that age with grace.

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References

- Bakker, C., den Hollander, M., Van Hinte, E., & Zlijstra, Y. (2014). Products that last: product design for circular business models. TU Delft Library.
- Chapman, J., (2014). Meaningful stuff: Toward longer lasting products. *Materials experience: Fundamentals of materials and design*, pp.135-143.
- Chapman, J., (2015). Hadal or epipelagic? The depths, and shallows, of material experience. *Product Lifetimes and the Environment (PLATE) Conference 2015, 17th-19th June 2015, Nottingham Trent University*
- CLEVER Research. (2016). *Clever-research.com*. Retrieved 18 January 2017, from <http://www.clever-research.com>
- Demirbilek, O. and Sener, B., (2003). Product design, semantics and emotional response. *Ergonomics*, 46(13-14), pp.1346-1360.
- Dunne, A., (2008). *Hertzian tales: Electronic products, aesthetic experience, and critical design*.
- Fisher, T., (2004) *What We Touch Touches Us: Materials, Affects and Affordances*. *Design Issues: Volume 20, Number 4*.
- Karana, E. and Hekkert, P., (2010). User-material-product interrelationships in attributing meanings. *International Journal of Design*, 4(3).
- Layers on Vimeo. Retrieved from <https://vimeo.com/147843561>. Accessed on 18 January 2017.
- Lilley, D., Smalley, G., Bridgens, B., Wilson, G. T., & Balasundaram, K. (2016). Cosmetic obsolescence? User perceptions of new and artificially aged materials. *Materials & Design*, 101, 355-365.
- Manley, A.H.G., Lilley, D. and Hurn, K., (2015). 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. Presented at: *Product Lifetimes and the Environment (PLATE) Conference 2015, 17th-19th June 2015, Nottingham Trent University*
- Manley, A.H.G., (forthcoming). *Cosmetic Wear and Attitudinal Response: Determining how materials in digital products age during use and how that influences the user*. PhD Thesis
- Odom, W., Pierce, J., (2009), *Improving with Age: Designing Enduring Interactive Products*, CHI, April 4-9. Boston, MA, USA.
- Osgood, C. E. (1964). Semantic differential technique in the comparative study of cultures. *American Anthropologist*, 66(3), 171-200.
- Rognoli, V. and Karana, E., (2014). Towards a new materials aesthetic based on imperfection and graceful ageing. *Materials experience: Fundamentals of materials and design*, pp.145-154.
- Van Hinte, E. (1997). *Eternally Yours: visions on product endurance*. 010 Publishers.
- Zuo, H., Hope, T., Castle, P., & Jones, M. (2001). An investigation into the sensory properties of materials. In *Proceedings of the International Conference on Affective Human Factors Design* (pp. 500-507).