Using online product reviews to assist design for emotion

Lauren Reader*, Chris McMahon**

University of Bath, UK, readerl.87@gmail.com
*** University of Bristol, UK, chris.mcmahon@bris.ac.uk*

Abstract: This paper describes a study exploring how designers can exploit online product reviews in design for emotion (DfE), in particular through provision of an automated tool for the faceted classification and browsing of reviews which allows relevant reviews to be identified quickly. After introducing DfE the paper first describes a study in which over 100 on-line reviews were investigated to identify terms suggesting the reviewers' emotions. The language processing issues in the investigation are noted. The automated review classification approach is then described. A web crawler was used to download reviews, which were then processed using text mining software to identify the most frequently used words and phrases. These were then mapped to a faceted classification scheme for emotions based on the Geneva Emotion Wheel. Software allows the classification scheme to be browsed rapidly. The classification scheme provides an effective method for designers to go directly to relevant reviews, thus saving search times, but the classification performance could be adversely affected by the use of slang and colloquial language in the reviews.

Key words: design for emotion, product reviews, faceted classification

1. Introduction

There is a wide array of research indicating that designing to meet functional requirements alone is not enough in today's competitive markets. Design for Emotion (DfE) is a design approach that investigates consumers' emotional responses to products and uses this information to create future products with which consumers connect emotionally with the aim of increasing desirability and product sales [1]. The information and understanding required to achieve this can be gathered through many research methods but designers often do not utilise the vast amount of information available online. This paper describes a study exploring how designers can exploit online product reviews (OPRs) in design for emotion, in particular through provision of an automated tool for the faceted classification and browsing of reviews which allows relevant reviews to be identified quickly. At present designers predominately use surveys and focus groups in controlled environments and OPRs are not often used due to the mass of reviews causing difficulties in processing them efficiently. However, with so much information available online the effectiveness to which designers DfE could be dramatically improved. After briefly introducing the subject of DfE, this paper addresses the following objectives:

- To explore the computational approaches available.
- To identify and investigate sources and structure of online reviews.
- To identify characteristic terms and phrases in OPRs that might be helpful in the designer identifying the emotional response to products.

- To explore methods for information extraction and mining from texts, leading to an approach for the automated faceted classification and browsing of OPRs

- To process reviews for sample products, identify knowledge that may be gained from their browsing and evaluate the usefulness of the approach.

2. Background

Design for Emotion is a design approach that investigates consumers' emotional response to products and uses this information for future designs in order to create products that evoke desirable emotions in consumers. Designers and companies research how their target audience reacts to and interacts with prototypes and products in the market to discover what emotions the product evokes and why these emotions are felt. This information is applied to future designs to create products that not only meet all functional specifications but also generate the right response from consumers in order to improve sales and add value [1][2]. Functionality always has and always will be an essential condition for product success but in today's culture there is evidence of the increasing importance of an emotional connection with a product as a driving force of purchasing [1][2][3]. In the past companies have focused on the functionality of the product but more and more appreciate the importance of understanding the consumer.

DfE does not relate just to the products themselves but also brand awareness, marketing and services. Value can be added to the entire company by portraying the right brand image with clever marketing campaigns and services that generate emotional responses. In addition to the product, attention can be paid to issues such as showrooms, packaging and brand identity.

2.1 Techniques for Designer Learning in Design for Emotion

Norman [2] identifies three levels of emotion processing within the human brain:

- Visceral - automatic processing mostly concerned with the physical features –the look, feel and sound of the product. Emotions generated on this level occur without thought, they are subconscious.

- Behavioural – concerning pleasure and effectiveness of use in everyday processes. Design on the behavioural level should emphasise function, ease of understanding and the joy of handling, touching, and hearing.

- Reflective - the contemplative level, where active decisions are made. Affected by self-image, personal satisfaction and memories, emotions generated on this level are often sentimental. Design on this level includes the role of branding, image and pride of ownership.

As described by Desmet and Overbeek, it is difficult for designers to discuss such emotional responses with consumers because they find it challenging to express how they feel and there appears to be a lack of common language between designers and users [4]. Nevertheless, a number of techniques are used to assist companies and designers to gather the information they require to support DfE. These include focus groups involving a group of target users holding relatively informal discussions on a product with the discussions being prompted by a moderator [4], surveys using open and closed questions and conducted in controlled environments, over the telephone, by post, e-mail or posted on-line and psychophysiology – the measurement of 'distinct bodily expressions' such as pupil movement, facial expressions, heart rate, body temperature, hand movements and more, to identify the strongest emotions [6]. A number of different techniques are also used to assist in reporting DfE

experience, including the PrEmo self report method that uses cartoon characters portraying dynamic facial, bodily and vocal expressions to assist users in reporting emotional responses and the Geneva Emotion Wheel (GEW), a self-report method in which participants choose the emotion they feel from a wheel shaped emotion scale [7]. The GEW can be used in controlled environments or conducted via computer networks. The advantages of the wheel are that it can be used to assess all three levels of emotional processing. Unlike the majority of other self-report methods it also puts more emphasis on trying to assess the visceral level.

2.2 Processing of Text Data

As an alternative to identifying user emotional response through the techniques listed above, this paper explores approaches to identifying emotional responses by processing what users have written about products, especially in on-line product reviews such as those available at Amazon's on-line stores[1] and at the Review Centre[2].   In this regard four broad classes of technique for the processing and interpretation of such texts were considered here:

- Data and Text Mining: data mining involves identifying and extracting patterns from data and text mining does the same from text.   Text mining tasks can include text categorization, text clustering, concept/entity extraction, sentiment analysis and document summarisation.

- Qualitative Data Analysis: qualitative data analysis software such as NVivo[3] is capable of analysing and organising unstructured (textual) information to aid in decision making for example through the use of techniques to interpret and code texts for example to identify themes, contexts and ideas.

- Natural Language Processing (NLP) is the computational analysis of texts at various linguistic levels with the aim of achieving human like language processing. Within NLP, sentiment analysis is used for purposes such as determining the attitude of the writer with respect to a topic or the overall tone of a piece of text and can determine the polarity of text, i.e. positive, negative or neutral. Very advanced sentiment classification attempts to go beyond this and assess emotional states to classify them by terms such as happy, sad or excited. However, the use of sentiment analysis for OPRs could offer poor accuracy because the writing in OPRs is typically informal and can contain many grammatical errors and terms that do not exist in dictionaries [8].

- Classification: classification is the process of finding a model that describes and distinguishes data classes and organizes information objects in such a way that similar objects are grouped together. Models can be based upon rules, decision trees, formulae or neural networks and there is no limit to what they are classified by, for example; topic, size, creation date, author and more.   Faceted classification is a special case of classification in which objects are classified into multiple hierarchically decomposed categories known as facets [9].

The present work has used text mining for word and phrase identification, qualitative data analysis to determine how texts may be interpreted to reveal emotional response and then automated faceted classification has been applied to a large cohort of OPRs to identify the benefits that might be obtained through browsing of such a classification.

---

[1] www.amazon.com
[2] www.reviewcentre.com
[3] www.qsrinternational.com/products_nvivo.aspx

3. Manual Analysis of On-Line Product Reviews

To aid in understanding how OPRs can be exploited, a manual investigation into their structure was carried out with the particular aim of examining issues that would be important in the automatic processing of reviews. The aim of the study was to investigate the structure of the reviews, identify any useful patterns and words that could be applied to an automated process and to identify any potential issues. It focused on three products – the iPod Touch, the Tom-Tom Europe Satellite Navigation and the Xbox 360 Console, gathering over 100 reviews of these and then using qualitative data analysis to identify key words and phrases indicating emotional responses while also observing the general structure of reviews.

The product reviews were manually read through with emotional words highlighted and annotations made on the general structure of the review or any important patterns observed. The key findings are:

- Words and phrases indicating positive emotional responses included such terms as "love, I fell in love, happy, could not be happier, impressed, amazing, enjoy", often preceded by 'really', 'extremely' and 'well' to emphasize the strength of the emotion.

- Words and phrases such as "looking forward to, could not believe, good experience, not hesitate, easy to use, recommend" suggested a positive emotional response while not themselves being words that describe emotions. Words such as 'brilliant' and 'great' occurred regularly and were typically used to describe particular features of the product or the general performance. Although these are not emotional words they could prove useful indicators as to which features customers appreciate the most.

- Negative emotional terms included "frustrating, disappointed, annoyed, regret, unreliable". These were used in a similar manner to positive ones, i.e. preceded by words to emphasize emotion.

The level of use of the most common words is shown graphically in Figure 1.
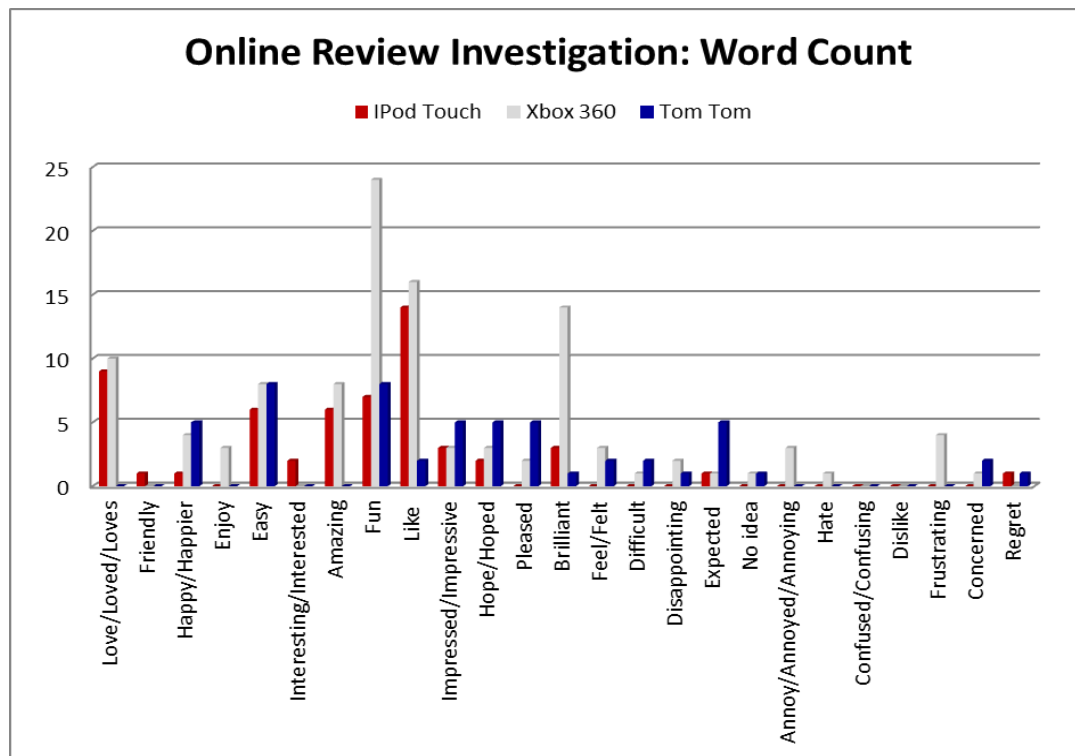

Figure 1. Word count from manual processing of OPRs

The level of positive, negative and neutral (discussed both good and bad and with no clear conclusion) reviews was then investigated. It was found that of the selection there were clearly more positive reviews than negative but still a relatively high number of negative reviews, higher than expected from the level of use of negative emotional words. This suggests perhaps that when a consumer negatively reviews a product they do not tend to portray their emotions but rather simply to explain why the product is bad in terms of performance and features.

When investigating emotive words and phrases it was crucial to look at the sentences in which they appear. The words alone are not enough as they are often not used for their true meaning or are contradictive. The emotional and descriptive words are typically surrounded by descriptions of features or aspects of the product that cause this feeling and that justify the emotion to readers. The way in which emotive phrases were used was grouped according to whether Function/Feature, Product or Other was being described. 'Other' refers to cases where an emotional word is used for a product or service that is not part of the product being reviewed. It was also used when emotional words are not used in an emotive context; mainly the use of like as an adjective to show similarity. Words relating to a particular aspect of a product were grouped into 'Function/Feature' and words relating to the product as a whole are grouped into 'Product'.

The use of words varies with the products but it was clear there was quite a high percentage in the 'other' category. This shows that information collected from the reviews could be misleading if the context is not properly taken into account. Words used in relation to features rather than the product as whole could prove more useful to designers as they directly show what it is about the product consumers have an emotional response to and how this can be developed or adapted for other products.

3.1 Difficulties Experienced

Difficulties experience in interpreting reviews, especially in an automated context, included:

Contradictions - reviewers commonly would state things they had hoped for, expected or worried about and then follow this up with what they actually felt and experienced with contradicting emotions. In electronic data mining this would bring up conflicting emotions and the true and relevant information would have to be deciphered, this may be difficult or reduce efficiency. An example of such a review is as follows: "*I was very excited when receiving the product but not happy when it was taking me long routes when it clearly said fastest route not happy really*". Also, negative words were used to display positive emotions, such as "I was not disappointed" or "I have never had a bad experience" which quite sophisticated natural language processing would be needed to interpret.

Incorrect spelling – throughout the reviews there were spelling errors, colloquialisms, slang and general typing errors were rife. Often words such as 'brilliant' would be written as 'brill' and in other cases words were lengthened for emphasis. An example of such a review is "*IT'S BLOODY AWESSOOOMMMEEE. Except for the sucky still camera. But it is still the best mp3 player on the market! It is useful, fun, functional, good quality and everything! Everyone should have one of these! It's a sin to not like this thing, its absolutely, positively AMAZING*". It is clearly a good review with positive descriptive words but 'awesome' has been stretched out for effect and slang such as 'sucky' are not typically used in everyday language.

Reviewing other products – consumers regularly compared the product in question to past products or others on the market to highlight positives and negatives. This is useful information for companies; it makes it clear to them

what customers are looking for or how the competitors are doing. However, if searching for key words then these words may be give the wrong impression of the product being investigated.

It was found that many reviews started with a general statement of opinion, such as 'I am very pleased with'. This was then followed by a justification of the feelings. The main body of the review was typically where consumers would discuss the positive and negative features and their discoveries after purchase. As new features were introduced so were opinions but emotional words were more common near the start of the review with a few words scattered through. The majority of reviews end with a concluding paragraph or sentence to summarize the opinion of the product as a whole.

Very often emotions were not shown through one standard emotional word but a whole sentence and it was through understanding the English language that the underlying emotion could be discerned. For example, consider "*I bought this for my daughter for Christmas. I haven't used it myself but my daughter has rarely been seen without it in her hand ever since. Even when it needs charging, she plugs it into her laptop and continues using it. This leads me to believe that this is a very good product. I hope to see my daughter later in the year when her birthday comes around and she wants something else, until then I'm afraid I have lost her to her IPod Touch*". From this review it is clear the person described is extremely attached to the product but there are no obvious emotional words to portray this, it is through the overall understanding that it is understood. This level of interpretation is very challenging to computational techniques.

In some cases there was no evidence of emotion at all. Many of these reviews were very structured and listed good and bad points with headers regarding the functional performance and were more common on Amazon. This makes it very clear to see what the consumer thought was good and bad but these points rarely included any emotional references.

In almost every case where emotions were expressed they were supported by a reason relating to the functionality of the product. This is the consumer talking about the design on a behavioural and reflective level. OPRs are mainly written by consumers to help others before purchasing and this is a reason for the justification. It is helpful for the reader and also for designers to identify features that were perhaps thought to be insignificant but are actually unique selling points.

3.2 Discussion

OPRs are written after the consumer has had the opportunity to interact with the product and reflect on its use. This leads to reviews mainly focusing on the behavioural and reflective levels of emotion and design. Emotions can be detected through emotional words (many of which have been identified in this investigation) but also through understanding the review as whole. There are many phrases that show emotion without using any specific emotional words and the emotion is detected through understanding of the language used. The investigation shows the potential of using data mining software to extract emotive words but also issues and how potentially useful information could be missed. However, if emotive words are identified then the information around these words is manually read it could minimize the amount of information overlooked. Other issues with ORs were also found through this investigation including; spelling errors, contradictory statements and use of slang. If data mining software is to be used on the reviews it could require many rules to ensure a wide range of correct and useful information is obtained.

4. Automated Classification

The next stage in the work was to explore the usefulness of a classification system for the automated classification of OPRs. The purpose of the classification scheme is not to interpret the reviews but to take the user directly to reviews that are relevant to the emotions in their emotion plan without having to read through numerous irrelevant reviews. An experiment was carried out using the Waypoint classification software [9].

The experiment was carried out in 7 stages:

1. A web crawler was built to gather text from review websites and to write it to XML files. The crawler can easily be tailored to any product or source.

2. The ExtMiner software[4] was used to extract words and phrases used in the documents and to rank them by frequency of use.

3. The regularly used terms which were not product specific were mapped onto a categorisation of emotions using the 20 emotion groups of the Geneva Emotional Wheel (introduced in section 2.1). Figure 2 shows an example of the allocation of terms to the emotion groups. The words in black were those found in the body of the review and those in blue are words identified in the title.

1. Involvement, Interest	2. Amusement, Laughter	3.Pride, Elation	4.Happiness, Joy	5.Enjoyment, Pleasure	6.Tenderness, Feeling Love	7. Wonderment, Feeling Awe	8.Feeling Disburdened, Relief	9.Astonishment, Surprise	10.Longing, Nostalgia
was able to	very happy with	cool	happy with my	to play with	i love this	is a great	easier	expected	wish
being able to	excited	favorite	happy with the	enjoy	i love the	is the best	is easy to	impressive	hope
to be able	fun	a great device	very pleased with	and easy to	and i love	amazed	helpful	expecting	hoping
put it down	happy	of the best	happy with this	nice	i love my	beautiful	worth	surprised	favorite
i use it	enjoyed	pleased	excited	easy	i love	wonderful	ease	impressed	a great device
and easy to	fun	all the time	glad	thrilled	gorgeous	impressive	easily	immediately	recommend
allows me to	awesome	was the best	nice	enjoying	beautiful	amazing	durable	expect	i would recomme
is easy to	of fun	dedicated	happy	enjoyed	loved	awesome	appreciate	despite	improvement
easy	excited	quality of the	am very happy	very pleased with	i absolutely love	impressed	friendly	believe	dedicated
able to use		cool	enjoyed	easily	love	incredibly	is very good	immediately	remember
experience		awesome	thrilled	fantastic	loves	thrilled	advantage	expectations	improved
very easy to		a great little	pleased	friendly	love my ipod	excellent	satisfied	better than i	improvements
i can use		a nice little	i like the	a very nice	and she loves	perfectly	easy	than i expected	i wanted to
use it for		excellent produ	pretty	average	likes	fantastic	easily	impressive	i would have
been able to		best gift	please	enjoyed	i like the	realize	simply	incredibly	i would like
easily			happy	enjoying	perfectly	awesome	helpful	expected	it would be
easy to use			very happy with	a nice	i really like	amazed	personal		i want to
feel			happy with this	very nice	friendly	impressed	worth the wait		needs to be
to say that			happy with	nice little	liked	better than i	well worth		hope
designed			very happy	is great	perfect	excellent product	exactly what		wish
design			extremely happy	excited	i like it	the best of	dedicated		missing
i have found			extremely happy with	is awesome	i love it	the best	understand		improvements

Figure 25. Manual Classification of Terms

4. The manual classification of terms was then used to create classification rules for Waypoint. The GEW emotion groups were used as emotion categories, and the associated terms and phrases were used to form sub-categories. OPRs are associated with sub-categories by rules of the form "IF <query = true> THEN <associate OPR with category X>". Queries could include any Boolean combination of words or phrases in the title or body of a review, but typically would just look for the presence of a word or phrase. Any emotion group category could have any number of sub-categories and in turn rules associated with it.

5. A further classification group of products was created to allow in principle classification of reviews by product.

6. The classification rules were used to associate OPRs with each category. Any OPR could be associated with multiple categories.

---

[4] extminer.sourceforge.net

7. A browsing system was used to allow a user to browse OPRs according by selecting categories from a browsable tree structure.   By selecting multiple categories the OPRs displayed are those associated with all of the categories selected.   The display is updated after each selection to show the number of OPRs associated with each category.   Figure 3 shows a typical display, with the OPR text on the left of the display, and the category tree on the right (showing also the number of reviews associated with each emotional groups).   As well as browsing of categories the user may also use free-text search (search box at top right) in combination with browsing.
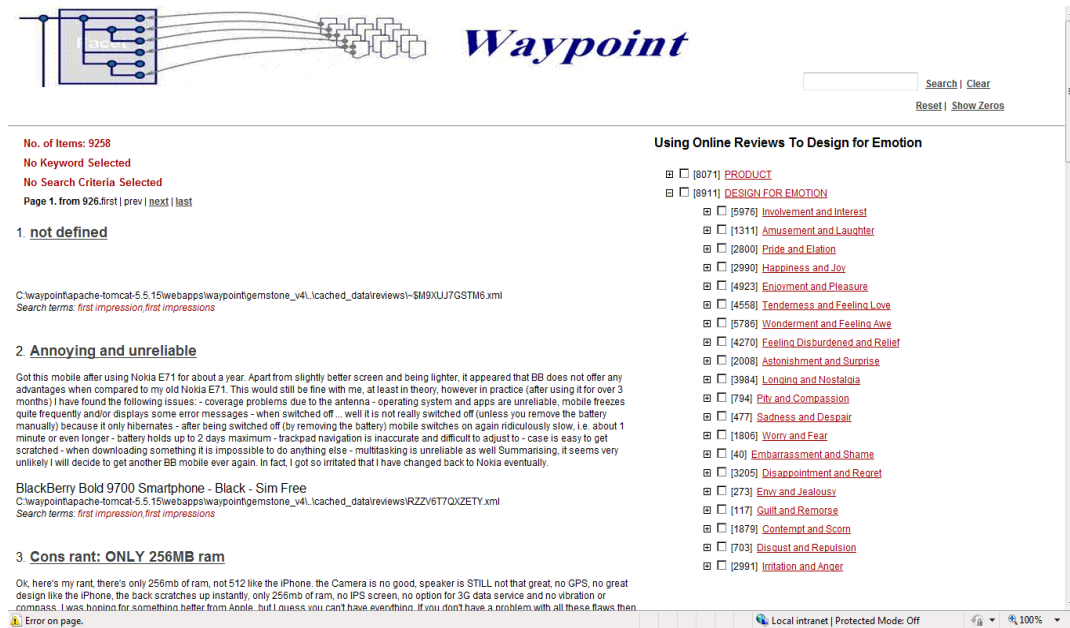

Figure 3. Classification tree and review results

4.1 System Testing

Several test scenarios have been generated with the aim of considering applications of the approach, to consider how it would be used, to assess its usefulness and also attempt to find areas of further improvement. Appropriate reviews have been gathered for each scenario.

Scenario 1: a designer has a plan of emotions for a new product.   A designer has a concept for a games console but wants to consider emotional design to develop the idea to make it more profitable straight from launch. A plan had been created as to what emotions the product should create. Aimed at adult men, the designer wants them to feel proud to use it but also a sense of enjoyment and to find it easy to use without frustration.

The system can be used to explore reviews of a range of existing games consoles. Reviews of successful products can be gathered then the categories 'pride and elation' and 'enjoyment and pleasure' selected from the classification tree. It is then possible to read the reviews and be drawn to the key word to read around it and understand the causes of the emotion. An alternative use would be to look at reviews of failed products to identify mistakes to avoid or to go against the problem areas and find a solution to what it is really desired. Figure 4 shows examples of reviews corresponding to fun and pride of ownership with the words used for classification highlighted.   Free text search allows reviews corresponding to ease of use to be identified also.
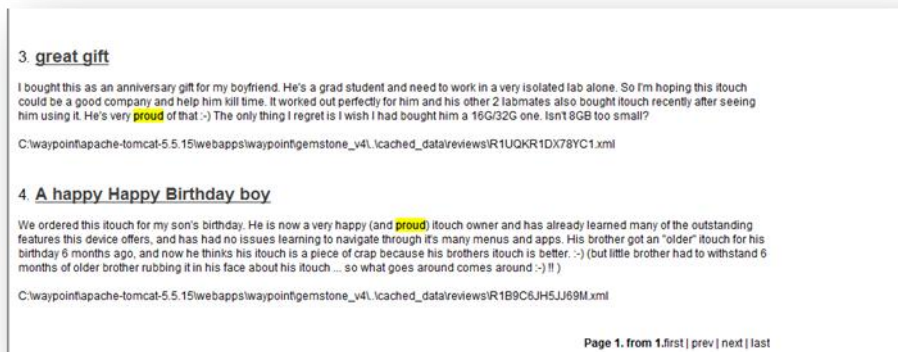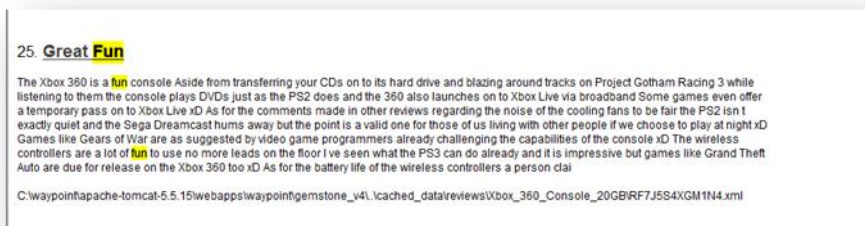
Figure 4. Reviews showing fun and pride.

Scenario 2. Development of a product is needed for a re-launch. A mobile phone's sales have dipped but competitors' sales are improving despite similarity in technical functionality. The research team want to look at online reviews to see why and what differentiates the products to then improve their own for a re-launch.

In this case reviews of competitor products can be gathered and positive emotive terms selected from the classification tree to gain an understanding of responses to the products. Negative terms can be explored to understand where competitor or existing products are failing. Even just seeing what group has the highest number of reviews can give a clue as to consumers' emotional responses. An example here, shown in Figure 5, is the browsing of multiple terms – in this case 'wanting' and 'uselessness', to find issues with a competitor's product, where consumers are disappointed combined with what it is consumers want from the product.
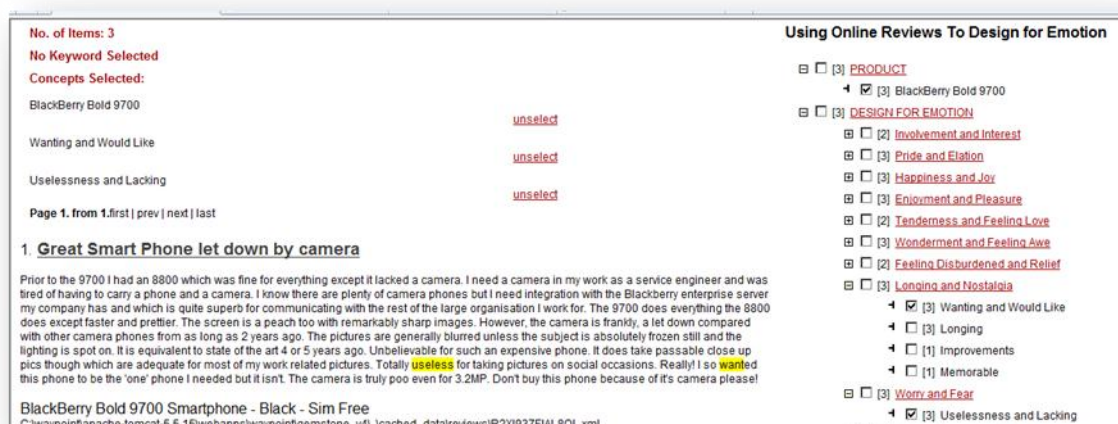

Figure 5. Reviews showing combination of selected categories

4.2 Comments

The model created is a generic model that can be applied to all products which could make it very useful and versatile. To make it more effective for different products the model can be tailored as descriptive words will vary across product ranges. The scheme allows designers to select multiple emotional groups, which can help to refine searches and help make search of a large number of reviews straightforward. By highlighting the search term in the presented OPR the user is drawn to the relevant part of the review.

There are however some difficulties with the methodology. Reviews are classified by words they contain but these words are occasionally used in an unexpected manner that misleads the classification and the review does not actually portray the emotion against which it has been classified. This is a problem for designers as it could lead to them reading through unnecessary information and wasting time. Issues identified in the manual investigation were also found in the automated approach, including spelling errors; both mistakes and deliberate slang. When using reviews from eCommerce sites it was also found that some emotional words were used to describe the site's service rather than the product that had actually been purchased. There are some rules that can be put in place in an attempt to minimise these errors but it will be extremely difficult to eliminate them completely.

Nevertheless, the generic method of information retrieval and classification established proves to be a useful and efficient method of gathering information for use in the process of emotional design. It allows designers to work from their emotion plan and select the emotions they want to evoke from the classification tree in the Waypoint software and view the relevant reviews. It is not a perfect method and there is still scope for refinement but it does show the information held within OPRs is useful and benefits outweigh the costs.

5. Overall Discussion and Conclusions

When designing for emotion, designers typically consider what emotions they want their product to evoke before they begin designing, sometimes creating an emotion plan to apply to designs. The significance of this is that designers know precisely what emotions they want consumers to feel when they interact with their product and they research around these emotions. In this regard the Geneva Emotion Wheel has been well researched and tested, is widely used in industry and is an accepted method of recording emotional responses. It is for these reasons that the Waypoint classification system created in this paper has been modelled on its 20 groups of emotions. The words by which the reviews are classified were manually assigned to the 20 emotion groups, leaving room for bias, but the titles of the sub-divisions provide clear guidance on the words the user is searching for so even if they are not in exact agreement, users are aware of which node to select. The classification scheme (Figure 3) is comprehensive yet simple to use and can be applied to any product with the option of tailoring the system for specific products.

The main advantage with the use of the automated classification approach is that browsing can quickly narrow hundreds of reviews to those relevant to the designer. Much of the information held in OPRs is irrelevant and as discovered in the manual investigation; does not relate to emotional responses. To manually read through hundreds of reviews, with the risk of not even finding anything useful is not time efficient. However, the use of the classification scheme as demonstrated in the scenario testing shows that OPRs hold valuable information and can be used efficiently. The classification tree has been designed to work with the designer's emotional plan.

Designers understand how they want the consumer to feel and can directly go to reviews that relate to the emotions they want to research. Highlighting of the search term draws the user to the relevant part of the text.

There are some issues with searching for words due to spelling errors and slang. The classification scheme helps to tackle this issue by including common slang words in the search process. Uncommon ones were ignored as by including many search words, the initial issue of an abundance of information is not improved. Too many search words could gather too many irrelevant reviews and ones that contain slang tend not to hold information that a designer can solidly build upon. As well as choosing the most popular words to include in the classification scheme, a balance between one, two and three word phrases was also considered. Three word phrases could improve precision of classification but have a negative effect on recall, vice versa for key single words. The classification scheme aims to strike a balance between the two by using a combination of phrase lengths with the phrases being carefully considered. The manual investigation helped in understanding the likely phrases and structure of reviews in order to effectively select which phrases to use.

The Waypoint system assists in making OPRs useful in DfE but their usefulness is limited by their content. As previously mentioned there are three levels of emotional processing and a limitation of OPRs is they mainly provide information on behavioural and reflective levels. OPRs are written some time after the initial interaction, the user has had time to think about how they use they product and why they feel the way they do. Behavioural and reflective responses are extremely useful in emotional design; they can help designers improve the usability of features, simplicity of use and inclusion of desired features, however they lack the information to make a product naturally beautiful and appealing. In some reviews consumers state how they felt when they first purchased the product which is very useful as it reveals some visceral emotions but often important reactions occur on the subconscious level making them impossible to report in an OPR. Words have been included in the concept map that relate to all levels to improve the extent to which online reviews can be exploited and become useful in DfE. Words such as 'proud' and 'embarrassed' relate mainly to the reflective level and 'irritating' and 'frustrating', for example, can be used for detecting behavioural interaction with the product. During the testing, a useful phrase discovered was "first impressions". Although this is not an emotional word it can lead the designer to the consumers visceral emotion; how they felt when they very first saw the product. The inclusion of this phrase in the concept map helps to make the Waypoint system and online reviews more useful on the visceral level. The use of an 'Appearance' category involving searches for words such as 'look' and 'feel' which typically relate to emotions on the visceral level again reveals useful information but the information is not as accurate or in depth as other review techniques such as psychophysiological techniques including as eye tracking to reveal what aspects of the design consumers are most drawn to. If a company has the option of using these more in depth techniques to research visceral emotions as well as ORs they have the potential to gain very powerful knowledge.

A disadvantage of the system is that, apart from showing the number of results per node, it does not provide quantitative results unlike other methods such as the coding of surveys and focus groups. However emotions are a complex area that are difficult to quantify and for a designer to understand the reasoning behind them and read responses it is likely to provide them with thorough well rounded understanding of consumer reactions. Other emotional review techniques use scales to quantify but the nature of emotional reviews means emotions are not scaled as consumers can discuss any area, to any extent they wish.

The research reported in this paper is evidence of the usefulness of OPRs in the process of DfE but it also shows their limitations. Some limitations will be difficult to overcome; mainly the extraction of information

regarding visceral emotions and other limitations such as the accuracy to which emotions are accurately classified is something that will improve as technologies in natural language processing and machine learning develop.

References

[1] Boatwright, P and Cagan, J. (2010) *Built to Love*. Berrett-Koehler Publishers Inc., San Francisco.

[2] Norman, D. A. (2004) *Emotional Design*. Basic Books, New York

[3] The Design and Emotion Society, (2006) *Society, Design and Emotion*. [Online] Available at <http://www.designandemotion.org/> [Accessed 10 February 2011.]

[4] Desmet, P.M.A, Overbeeke, C.J and Tax, S.J.E. (2001) *Designing products with added emotional value: development and application*. The Design Journal, volume 4, number 1, pp.32-47

[5] Conner, P (2010) *John Nolte on Conducting Psychodramas for Emotional Consumer Research. Emotive Analytics - Revealing Consumer Feeling*. [Online] EmoBlog, 20 04 2010. [Cited: 21 03 2013.] http://www.emotiveanalytics.com/emoblog/?tag=emotional-marketing.

[6] Cacioppo, J T, et al. The Psycophysiology of Emotion. Biological and Neurophysiological Approaches, Chapter 11, http://psychology.uchicago.edu/people/faculty/cacioppo/jtcreprints/cblpi00.pdf

[7] Scherer, K R, (2005). *What are emotions? And how can they be measured?* Social Science Information December, volume 44, number 4, pp.695-729

[8] Yang, C. C., Tang, X, Wong, Y.C., and Wei, C-P (2010), *Understanding Online Consumer Review Opinions with Sentiment Analysis using Machine Learning*, Pacific Asia Journal of the Association for Information Systems, volume 2, issue 3.

[9] McMahon, C.A., Lowe, A., Culley, S.J., Corderoy, M., Crossland, R., Shah, T. and Stewart, D. (2004), *Waypoint: an integrated search and retrieval system for engineering documents*, ASME Journal of Computing and Information Science in Engineering, volume 4, number 4, pp.329-338