A Sentiment Analysis of Design Reflections from Design Projects

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Abstract

Little effort has been devoted to studying the emotional experience of designers over time. Using sentiment analysis, we explore a unique corpus of designers' written reflections on 15 different design processes. We investigate how positive and negative sentiment in the reflections change over the course of a three-month design project. Our findings indicate that change in sentiment is not attributable to time alone, but rather to different phases and methods employed by the design teams. Finally, we discuss implications and future avenues for both our results and for using sentiment analysis in HCI research.

Author Keywords

Design process; design experience; sentiment analysis.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous;

Introduction

While many have studied 'emotional design' in the context of users [6,10], we do not know much about the emotional experience of designers. In research of interaction design and creativity methods, designers are assumed to be rational and reflective practitioners, who make deliberate choices informed by their

experience and design knowledge [14]. There have been calls for more frequent and more intensive studies of interaction design practice that resonate with designers themselves [8]. These contributions highlight a strange discrepancy in HCI: on one hand, the importance of *user* experience is broadly acknowledged and even denotes a sub-field of research and practice, while this perspective has only sparingly been applied to understanding and studying designers. It is therefore pertinent to examine designers' experience, since their sentiments may influence the design process and its outcomes.

In this paper, we follow this line of inquiry to answer the research question: *How do designers' reflective sentiment change throughout a design process?* Using a unique corpus of thorough documentation of design projects from 15 groups of design students over the course of three months, this paper uses sentiment analysis to investigate whether the designers use a predominantly positive or negative vocabulary to describe their activities through the different stages. The corpus includes 196 entries with reflections on and descriptions of various design events (workshops, field studies etc.). Our contribution is twofold: as well as investigating the experience of design practice over time, we also propose to add sentiment analysis to the repertoire of analysis methods used in HCI.

Related Work
Moggridge's model of the design process contains ten phases of a circular process, including ideation, envisioning, selection and prototyping [12]. Similar models are presented by e.g. Rogers et al. [13] and Löwgren & Stolterman [11]. Common for the descriptions of the design process is that the process is

iteratively moving between phases, and that certain activities mutually characterize the different phases. This movement is often described with the terms convergence and divergence [3]. Divergence has been defined as "the process of expanding or opening up the design space, of identifying new options and alternatives beyond the immediate design space" and convergence as "narrowing down the list of potential options, on zooming in or focusing on particularly salient aspects of the design process" [2].

The Designer as an Emotional Being
Studies of emotions or attitudes of designers in design practice have previously primarily focused on isolated moments of conflict or resolution. For instance, the moment of creative insight has been widely described in terms of emotional qualities, e.g. as 'highly emotional' [7], 'a sense of something sacred', and even as highly addictive [5]. In the other end of the spectrum previous research has devoted attention to moments of breakdowns during the design process, for example of the collaboration [9], and design fixation during the early stages of design [11]. Some research has considered the designer as a user and thus performed user experience analysis of for instance the designer's attitude towards methods [1] or tools [16]. Based on knowledge about the design process, we might have an expectation of how experience might unfold in different phases. Siegel & Stolterman [15] discovered that design students under education move through intellectual, practical, psychological and social barriers. Rather than progression along a smooth continuum, this development seemed to happen in steps, as the students overcame different challenges.

First level of analysis:

1) All entries shorter than 150 words are excluded, as we observed how longer entries were more invariable to high fluctuation in sentiments. Furthermore, entries containing only tables/images were excluded.
2) The main text of each entry was then translated to English using Google Translate, and analyzed for document level sentiment through IBM's *Watson Natural Language Understanding* API [17].
3) We conducted a close qualitative investigation of the dataset to examine the tentative results.

Coding Guidelines:

Activities rated primarily divergent: brainstorming, extreme characters, field studies, cultural probes. Activities rated primarily convergent: scenarios, prototyping, mock-ups, vision. Neutral: workshops and entries describing both divergent and convergent activities.

Method

This research proposes sentiment analysis as a way to explore a large corpus of design reflections in the form of textual entries. The approach uses natural language processing to systematically identify affective states of a written corpus. Sentiment analysis has grown from a theoretical linguistic concept to a production grade real world approach, used by businesses in many languages worldwide. However, it requires local, domain specific data to operate well. In this research, we have combined sentiment analysis with close contextual reading of the written entries.

Data

Our analysis is based on a large corpus of textual data from the Process Reflection Tool (PRT) developed by Dalsgaard & Halskov [4]. The tool is organized around ongoing reflection on events occurring in a design process. It contains blog-like features enabling designers to create entries called events, sub-events and notes, and to comment and add reflections on these. All entries are made by 4th semester bachelor students, with similar backgrounds, as part of a 20 ECTS design course. The students worked in groups of approximately four people and the course lasted three months. Consequently, this provides us with a rare, valuable corpus of designers' reflections on different processes based on the same design brief with the same extrinsic constraints and resources, and a similar repertoire of design methods. Furthermore, the students received the same instructions regarding the use of PRT and both the practical aspect of the design work as well as the academic were assessed equally. The students were not graded on their reflections.

Analysis

Our approach can be described as a two-levelled analysis, where each level is comprised of a set of consecutive steps. The first level is characterized by the three steps presented in the sidebar. The second level of analysis is characterized by a deeper engagement with the text, including an exploration of possible interesting topics and insights from the material. We qualitatively coded all entries included in the corpus as describing either *divergent*, *neutral* (not clear or both divergent and convergent), or *convergent* activities. We initially conducted a pilot coding without any formal guidance/definitions of the codes, where the entries of two groups were coded individually and then compared, yielding a Cohen's kappa of .19, which can only be considered slight agreement. Therefore, we developed the formal coding guidelines presented in the sidebar and a retest revealed almost complete agreement (k=0.85). We then proceeded to code the whole corpus. The entries with the highest and lowest sentiment were closely read for common tendencies and themes to be summarized and compared.

Results

Representation of the corpus where the vertical axis is time and horizontal axis is sentiment rating, reveals that there are clusters of entries around day 10, 25, 40, and 60. This is a result of deliverables in the course i.e. specifying a first vision or presenting a prototype.

No Average Change in Sentiment over Time

The sentiment in the entries is generally positive with a mean of 0.28 (SD=0.28). The mean of the sentiment is indicated on figure 1 by the dotted line. If we summarize all 15 groups, there is no significant
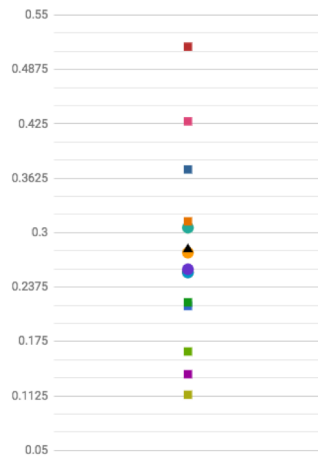
Figure 2: Average sentiment of each individual group. Black Triangle indicates average across all. Squares indicate significance at P<0.05.
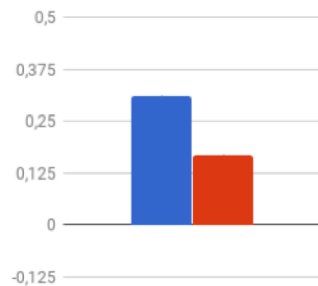

Figure 3: Average sentiment between convergent (0.31, *blue*) and divergent (0.17, *red*)
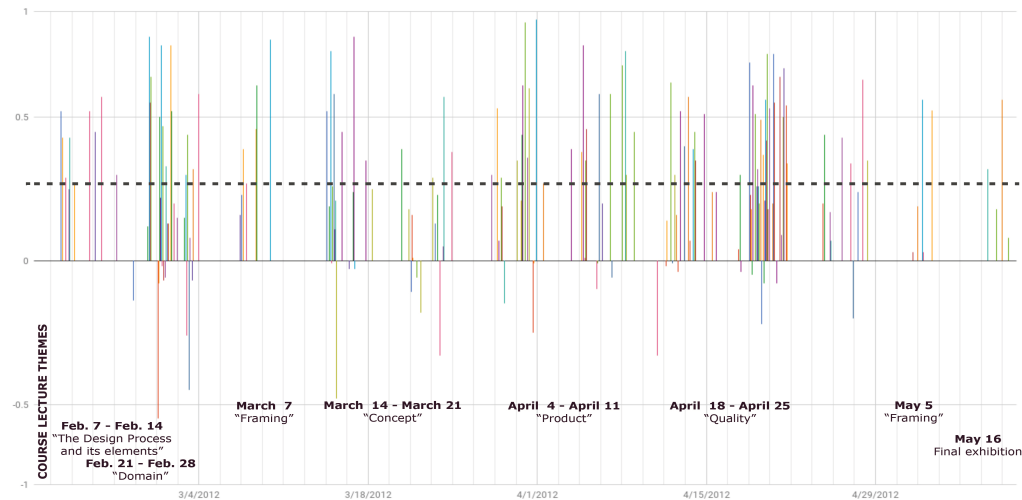

Figure 1: All entries represented on a timeline. Each group is indicated by a specific colour. X-axis = date, Y-axis = sentiment. Each course theme was followed by a deliverable, which explains clusters of entries around the end of each theme.

correlation (P=0.361) between the sentiment and time, meaning that the overall slight increase in sentiment over the course of the design projects might be random. We also found no obvious correlation between sentiment and length of the entries, which were on average 418 words (SD=224).

Groups Have Different Average Sentiments
The average sentiment of the individual groups varies from 0.11 to 0.51 perhaps indicating that some groups had very dissimilar experiences of their design processes. This could be due to factors apart from the design work, e.g. team composition. The sentiment of the different groups is illustrated in figure 2, where the groups that were significantly different (P<0.05) from the sample are distinguished by a square.

Convergence and Divergence Yield Different Sentiments
From the corpus, we coded 44 entries as describing divergent activities and 42 as describing converging activities. On average, we saw that the sentiment was more positive in entries that were coded as convergent (0.31) compared to the entries coded as divergent (0.17), see figure 3 in the sidebar.

The Design Vision Is Primarily Positive
If we look at the five entries rated highest and lowest, positive and negative respectively, we see that those with positive sentiment are shorter than average (243.4, average length 418 words). The five entries with most negative sentiment are longer than average (453.2). This still holds true if we include the top ten most positive and negative entries: 250.3 and 373.2.

□

Ethical statement

All participants in the course gave informed consent to their blog entries in the PRT being used for research purposes. The participants were able to opt out of this consent at any point during the course without any consequences to their final grade.

The study setup and the treatment of the data is in line with national regulation.

words respectively. The five entries with most positive sentiment are characterized by describing the future; either the design vision itself, or plans for following workshops.

Field Studies May Emphasize Negative Aspects
When we look closer at the entries with most negative sentiment, we find that several of them are about ethnographic field studies. The students were posed with the task of defining a problem domain, and conducting field studies in that domain. Thus, it is to be expected that their descriptions would focus on identifying problematic situations. We also speculate that this may reflect a sense of frustration in the early part of the students' project.

Discussion: Limitations and Future Work

The graphical representations allow for novel interpretations of data (e.g. clusters or tendency lines). The numerical representations allow us to explore research questions (e.g. cross-referencing between convergent/divergent phases and sentiment). We see indications of interesting tendencies in this corpus, such as the correlation between positive sentiment and describing design visions. An inclination to use a primarily positive vocabulary about the future may reveal a risk of emphasizing the positive aspects of the design and its consequences, while not addressing potential problematic outcomes. Additionally, negative sentiment in descriptions of field studies may indicate that design students overlook (or fail to describe) positive aspects of the existing design domain.

Limitations
Our study is based on studying the design processes of interaction design students, rather than professionals, and for this reason we cannot directly generalize from

the study to design practice at large. Studying design students comes with a number of caveats, including the fact that their experiences and sentiments may be influenced by factors such as time and evaluation pressure and organisational structure within the student groups. We know from many years of studying design documentation in industry, that it is very hard to obtain a similar corpus of textual descriptions of the design process and designers' reflections from professional designers. Studying design students thus provided us with access to empirical data that would otherwise likely be unavailable.

Future Work
We see several potential directions for future work, including comparison of sentiment before and after important landmarks in a project, e.g. the formation of the first concept, or the moment when the most important user needs become apparent. It would also be interesting to compare the sentiment of a team of designers with the final result of the design project (e.g. assessed by experienced peers) or to triangulate the data in this methodology with an ecological momentary assessment method such as the Experience Sampling Method.

Conclusion

We employed textual sentiment analysis on a large and unique corpus of design documentation and reflection to understand how designers' reflective sentiment changes throughout a design process. Our findings showed that average sentiment did not change in relation to time, but varied across different design teams and activities. We found indications of a relation between divergent activities and less positive sentiment and between convergent activities and more positive

sentiment. The topmost positive sentiments were often related to describing the futures and defining visions for projects, and the most negative sentiments were describing field studies. In addition, we introduced sentiment analysis as a new method to studying design processes.

Acknowledgements

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