Exploring the Differences Between Designing and Describing Designing

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Abstract
This paper presents a study investigating the differences between what designers and design managers say about designing and what designers do. Five datasets are analysed, labelled Samsung, Philips, Design Centre Pharmaceutical, Design Seminar, (interview designers and managers when they talk about designing) and DTRS7 (design session about designers designing). Differences between describing designing and designing are identified using a combined method of protocol analysis, word frequency count and sentiment analysis. There is significantly more Function (F) and less Structure (S) issues mentioned during describing designing than when designing. Sentiment is more positive when describing designing than when designing. Results also show that protocol analysis methods and the FBS ontology-based coding scheme can be applied to design management and descriptions of the design process as well as to designing.

1. Introduction

As global competition becomes more intense, companies are making various efforts including physical capital investment and R&D investment in order to enhance their design competitiveness. Particularly, design is recognized as an important means to improve the competitiveness of products by differentiating them and adding increased value to products while spending relatively little cost (Schwab, 2015). On the demand side, consumers' preference for products with sophisticated designs is increasing along with the increase in the demand for high-end products owing to the increase in income levels.

Design is in the vision of the western world seen as one of the main drivers in industry. Europe is a traditional design powerhouse and has defined design innovation as a key for future growth. In 2011, Europe established the 'The European Design Leadership Board' and has actively supported the design industry of Europe (European Commission, 2013). The strength of European design as a design powerhouse is that it combines the technical merits with the cultural traditions of each country. In the case of South Korea, the range of design application was narrow since most companies tried to utilize design to improve the styling of products in the past.

As stated above, design is dealt with and processed differently in South Korea and western countries. Moreover, they differ greatly in the methods of expressing the design. In the context of organizing engineering design knowledge, Hubka and Eder (1996) observed a difference between European and US English language counterparts in terms of the situation and the perception of the design process. In their

Preface they stated that "Continental Europeans tend to being outward looking and transnational, but also more formal and systematic; English-speakers tend to be more insular and isolationist, with any "foreign" language as a perceived cultural barrier, but also more intuitive and casual, and less formal". In the Asian scene, Li and Shu (2010) reported neuro-imaging studies that showed different areas of activation in the brain when nouns and verbs were presented to Chinese versus English speakers. Kan (2015) suggested that Chinese designers will be more conscious and are less free in presenting their design ideas.

Recently, the importance of design is increasing in South Korea as well. The design competitiveness of South Korea has yet to match that of advanced design countries including Europe. South Korea has abundant design manpower and the strong industrial base, which are strengths. However, South Korea has not been able to train enough creative designers. Established Korean conglomerates such as Samsung, LG and Hyundai, have been encountering the challenges of modern globalization. Previously Korea's design approach has tended towards a "style driven" direction, but now there is a perceived need to redirect the design approach towards being "knowledge driven" where design plays strategic roles. Towards that end it becomes critical to understand how Korean companies are 'thinking design' and what role designers play now and in the future.

This study explores the difference between designing and describing designing by using a combined method of protocol analysis, word frequency count and sentiment analysis. Five datasets are used, four datasets (Samsung, Philips, Design Center Pharmaceutical, and Design Seminar) from DTRS 12 and one dataset from DTRS7. In the data obtained from DTRS 12, South Korean managers and designers describe and explain the design issues and the general design processes through interviews and workshops. The DTRS12 datasets are about Korean managers or designers describing designing. DTRS7 involved Western professional designers (engineers and ergonomists) designing as a 7-person team in situ.

This study proposes a method of comparing 'designing' and 'describing designing' quantitatively. The novelty of the research is to compare designing by studying what designers do with describing designing by studying what designers and design managers say about designing by using the same methods. Protocol analysis helps to gain a rich understanding of different aspect of designing by eliciting verbal reports of thought sequences as a valid source of data on thinking (Ericsson, 2002). In this study designing is empirically examined through protocol analysis using a coding scheme based on the function-behavior-structure (FBS) ontology. There are many design researches that capture semantic information from design protocols including many using codes based the FBS ontology. However, there is a lack of work on studying describing designing. We intend to show that protocol analysis can be used to capture the cognitive activations of the design issues when Korean managers and designers describe designing. Word frequency analysis is a good way to see the distribution of words used in the respective datasets. Differences in word frequency would imply that there are differences in the distributions of cognitive effort between designing and describing designing. Furthermore, Sentiment analysis can be used to investigate the positive, negative, or neutral sentiment of designing and describing designing. The current research has suggested the combined method of protocol analysis, word frequency count and sentiment analysis is a promising method that is appropriate to research differences between describing designing and designing. If this approach can produce results that distinguish between designing and describing designing it can also be applied to studying the difference between Korean design and western design.

2. Protocol Analysis

2.1 Protocol Analysis

Verbal protocol analysis is a rigorous methodology for eliciting verbal reports of thought sequences as a valid source of data on thinking. It is a well-developed, validated method for the acquisition of empirical data on thinking (Crutcher, 1994; Ericsson and Simon, 1993; Van-Someren, et al., 1994). A design protocol is the record of behaviours exhibited by designers as captured in sketches, notes, and audio/video recordings (Akin, 1986). The strength of such an analysis for providing a detailed study of the design process in any given design environment has resulted in protocol analysis becoming the prevailing experimental technique used in exploring and understanding the process of design (Atman, et al., 2007). There are several common procedures for applying the protocol analysis method. According to Ericsson and Simon (1993), the general procedures include: proposing a hypothesis or direction of observation; experimental design and subject recruitment; conducting experiments; transcribing protocols and materials generated in the design process; devising a coding scheme; segmenting and encoding protocols; quantitative and qualitative comparison of encoded protocols; and proposing results. There are several alternative methods to segment data, such as dividing by a fixed time duration, on individual sentences or on the meanings. During the encoding process the current research segments the transcribed data based on the semantics of the utterance and then categorises each segment using an existing coding scheme. The generic process of protocol analysis results in a sequence of codes that represent the cognitive activations during thinking.

Protocol analysis is a widely used technique to study design processes and the cognitive activities involved in designing (Cross, 2001; Cross, et al., 1996; Kan and Gero, 2017). Protocol studies have been extensively used to explore problem formulation, solution generation, and process strategy in the design process (Cross, 2001). The design disciplines examined include architecture, industrial design, mechanical engineering, electronic engineering, and software design, amongst others. Only a few studies have applied the protocol analysis to explain generic design issues based on previous experiences.

2.2 Function-Behaviour-Structure (FBS) ontology

We claim that a coding scheme based on the FBS ontology can be used to capture the cognitive activations of the design issues when Korean managers and designers describe designing. The Function-Behavior-Structure (FBS) model of designing was initially developed to provide a conceptual foundation for designs and designing (Gero, 1990). The elements of the model have been extended to cover broader cognitive issues (Gero and Kannengiesser, 2004; Gero and Tang, 1999; Kan and Gero, 2005; Lammi, 2011; Song, 2014). The FBS model is one of the representative models that could be utilized in understanding the design process and can be used as an ontology. Up to 1995 the FBS ontology was a conceptual construct that had been used to develop conceptual and computational models. Empirical studies of designing based on verbal protocol analysis (Ericsson and Simon, 1993) had been introduced into design research some years earlier. These early studies and many of those continuing up to this day use project-specific schemes to code the protocol. It was unclear whether the terms used by one group of researchers mapped onto terms used by other researchers or whether they were describing different phenomena. Design appeared to present problems for scientific research in that the results of the acts of designing were always unique and therefore there would be no regularity (Gero and Kannengiesser,

2014). The effect of this is that the results are incommensurable, ie, they cannot be compared to each other since the dimensions of what is being measured vary across projects.

The FBS ontology offers a domain-independent, task-independent and designer-independent scheme to code protocols. At the same time the ability of the FBS ontology-based coding scheme to capture the design-related utterances of designers in a protocol provides evidence of its utility if not its validity. This is not to claim that other coding schemes that take a different view of designing are not useful. Using the FBS ontology as the basis of the coding scheme produces results that are commensurable across protocols independent of the designer, the design task, and all aspects of the design environment. The FBS codes represent the cognitive activations of the design issues that the designers are thinking about as they are designing. The FBS-based design processes are a consequence of the transformations of the design issues. This study applied the FBS ontology as its coding scheme in both designing and describing designing sessions.

3. Methods

3.1 Datasets

3.1.1 DTRS12

Unlike some previous DTRS data, the data sources for DTRS12 are highly heterogeneous ranging from form filling, partially structured interviews to workshops. There is no representational commensurability across the data sources. Data is sparse and not suitable for a detailed quantitative analysis and a detailed semantic analysis. The characteristics of the given data were that managers or designers were asked to describe the processes, experiences, and views about the design, not to design something for a given design task. The data sources contain no temporal information that is available when studying designing as an activity. The DTRS12 datasets represent Korean managers or designers describing designing.

Interview

We have two interviews with head of SADI, Samsung Art & Design Institute in South Korea and with a recently retired manager of Philips Singapore who knows both the Asian and European situations. Interview data includes personal views on issues related to South Korean design. The following are major issues that are addressed: 1) Working / Company culture, 2) Company / Design team organization, 3) Perception of the importance of the use of design, 4) Korean design education, Culture and future situation of Korean, 5) Identification of the drivers and enablers of design used by the firm, innovation driven by design, and 6) Company / government / designer role

Workshop

We have a workshop session with a Korean pharmaceutical company. And we have a design seminar with four Korean companies, from a conglomerate to medium-sized companies. In the case of workshop datasets, at the start participants received a card set with various aspects of the design process represented. They were asked to explain individually their own design process with the help of the cards. The results show the different design process between the companies and designers.

3.1.2 DTRS7

The DTRS7 dataset is a series of videotaped design meetings obtained from a range of design disciplines. The DTRS7 dataset selected involved professional designers (engineers and ergonomists) working in situ.

The DTRS7 dataset was analyzed by using the FBS-based coding scheme after transcribing the design utterances of the design team designing.

3.2 Methodology

3.2.1 Word frequency analysis

We conducted a word frequency analysis to see which words were used most dominantly in the five datasets. We assume that word usage describing designing would be different to designing. NVivo is used to find the list the most frequently occurring words or concepts in given datasets. We extracted the words spoken by each participant from the transcripts, removed common English stop-words and used NVivo to obtain root words. Based on the word lists extracted by the word frequency analysis, a correspondence analysis and sentiment analysis were performed. Then, we conducted correspondence analysis to see the categorical differences between designing session (DTRS7) and describing designing session (DTRS12). We assume that designing session will appear in a different quadrant to the other four datasets in the graphical representation of the result.

3.2.2 Sentiment analysis

We conducted a sentiment analysis using two methods, SentiWordNet (SWN) and Syuzhet, to investigate the sentiment of each of the sessions; each segment in each session is computationally identified with a positive, negative, or neutral sentiment. We assume that the designing session (DTRS7) will exhibit a different sentiment to the other four datasets.

For the SentiWordNet method, a simple, free, dictionary-based python tool available through github (https://github.com/anelachan/sentimentanalysis/blob/master/ReadMe.md) for sentiment scoring a sentence based on SentiWordNet 3.0 (Baccianella, et al., 2010) was used. SentiWordNet is a lexical resource in which each entry is a set of lemma-PoS pairs sharing the same meaning, called “synset”. Each synset s is associated with the numerical scores Pos(s) and Neg(s), which range from 0 to 1. In SentiWordNet each pair can have more than one sense. The rationale behind this choice is based on the assumption that more frequent synsets should bear more “affective weight” than rare synsets when computing the prior polarity of a word. The python tool can handle negations and multiword expressions. The weighting being used was 'geometric' (Guerini, et al., 2013).

The Syuzhet method being used is an R package based on a custom sentiment dictionary developed in the Nebraska Literary Lab. It iterates over the vector of segments (strings) and returns sentiment values based on a default dictionary whose entries were extracted from a collection of 165,000 human coded sentences taken from a small corpus of contemporary novels (https://github.com/mjockers/syuzhet).

3.2.3 FBS analysis

The interviews and workshops from DTRS12 and design session from DTRS7 are treated as protocol data and using the FBS ontology based coding scheme will be segmented, coded and characterized through FBS distributions. These characterizations will be used to compare this data with results from characterizing designers designing. We assume that we can see the different distributions, particularly for Function (F) and Structure (S). When talking about designing, people are likely to talk much more about what it is for (F), when designing, people are likely talk much more about what it is (S)

Coding Segments

The protocol is segmented strictly according to the ontology—each segment contains only one of the FBS codes. The segmenting and coding are done simultaneously by discerning whether an action or utterance expresses which FBS aspect of designing. If an utterance needs more than one code it will be further divided.

DTRS7 Coding Scheme

In this section a brief summary of the FBS coding scheme with its relation to designing session is presented. The FBS ontology framework (Gero, 1990) models designing in terms of three basic classes of variables: function, behavior, and structure. In this view the goal of designing is to transform a set of requirements (R) into a set of functions (F). The function (F) of a designed object is defined as its purposes or teleology; the behavior (B) of that object is how it achieves its functions and is either derived (Bs) or expected (Be) from the structure, where structure (S) is the elements of an object and their relationships. Segments that are not related to designing are coded as "O". A design description is never transformed directly from the function but undergoes a series of processes among the FBS variables. Table 1 shows some examples from the protocol for each code.

Table1. DTRS7 Coding examples

FBS scheme	Examples
Requirements (R)	"quite important is its about the thermal-incli- inclis ( ) pen" "design a-a prototype"
Function (F)	"that's the standard plain thermal paper err and then it can draw"
Expected Behavior (Be)	"either atoms or line types" "we can print thermo-reactive dyes onto media substrates"
Derived Behavior (Bs)	"it'll be about fifty percent more expensive" "if you lift an optical mouse slightly off the page you'll see the pattern it creates"
Structure (S)	"…sledge" "show the size of the pen if you've got an example"
Others (O)	"yeah we'll come to that in a minute"

DTRS 12 Coding Scheme

In order to study describing designing there needs to be a shift in using the function-behavior-structure ontology from structure being the artefact of design to the design process being the artefact of design, ie, the design process becomes the structure (S). The behavior conducting a design process becomes (Bs), and it becomes a goal (F) through a design process. Function (F) includes goals to be achieved at a design level, a designer level, a company level. Derived behavior (Bs) includes a series of actions, activities, and evaluations that are performed to achieve a goal. Expected behavior (Be) includes actions required to produce better results. Table 2 shows some examples from the protocol for each code. The elements necessary for explaining designing (e.g., departments composing a company and positions) are included in (S). This is needed to understand the designers who design, the teams composed of designers, the organizational relationships made up of teams, and their roles for explaining design.

Table 2. DTRS12 Coding examples

FBS scheme	Examples
Requirements (R)	interview questions, workshop tasks
Function (F)	"design is the activity to solve various problems and to produce new value through analytic

	and creative thinking” (Samsung, 19)
Expected Behavior (Be)	“President Lee gun-hee advocated design management” (Samsung, 40) “they had high interest and deep insight in design” (Samsung, 41)
Derived Behavior (Bs)	“the Korean recognition of design has the tendency toward considering design as exterior styling” (Samsung, 46) “Korean design education tends to be slanted toward modelling” (Samsung, 51)
Structure (S)	“Innovation, Concept Development, Product Development, Trendy issues, Aesthetics” (Samsung, 21) “planning and proposal by design team” (Samsung, 70)
Others (O)	“yeah we'll come to that in a minute” (E1, 737)

4. Results

4.1 Word Analysis

4.1.1 Word Frequency Count

Word frequency analysis is a quick way to give an overview of what designers or managers are talking about, but is no replacement for deep qualitative analysis. We conducted word frequency analysis to see the frequency of utilized words between the designing and the describing designing sessions. Table 3 shows the word distribution of the given data. Since the given data each possess different characteristics, the numbers of words used vary widely. The first column of Table 3 is the total number of FBS segments, the column row is the total number of extracted words, excluding stop words, and the third column shows the type of words, excluding repeated words. The number of total FBS segments inevitably affects the distribution of words. In the Samsung data, 219 different types of words are extracted over 424 times. On the other hand, 976 different words are extracted over 3999 times in DTRS 7. For the DTRS 7, which has the largest FBS segments, it has about 16 times more FBS segments than Samsung, which has the least FBS segments, Table 3.

Table 3. Distributions of utilized word in the five datasets

Dataset	Total FBS Segments	Total Words Count	Word Category
Samsung	73	424	219
Philips	326	2214	649
Pharmaceutical Company	297	1326	423
Seminar Video	282	1575	635
DTRS 7	1230	3999	976

This data is normalized through the use of percentages, Table 4. The word ‘Design’ is mentioned 11.0% of all words mentioned in Samsung, 6.3% in Philips, 7.1% in Pharmaceutical company, and 7.0% in the Seminar Video. ‘Design’ is dominant word in DTRS12 dataset. However, in the designing session (DTRS7), the word of design is mentioned only 0.2% of the time and is not in the top 10 list. The word 'design' occupies a large portion of describing designing. On the other hand, there is no dominant concept in designing. The word ‘thing’ occurs with the highest percentage of usage in the DTRS7 dataset and occurs 1.8% of the time, while it is hardly mentioned in the other four datasets (Samsung 0.2%, Philips 0.4%, Pharmaceutical 1.2%, Seminar 0.1%). In the other four datasets except for DTRS, the number of second dominant word, while a design was the most dominant word, decreased greatly. A graph of the normalized primary word dominance in all datasets in shown in Figure 1.

Table 4. The frequency of the top 10 words in the five datasets expressed as percentages

Samsung		Philips		Pharmaceutical		Seminar Video		DTRS 7	
Word	**%**	**Word**	**%**	**Word**	**%**	**Word**	**%**	**Word**	**%**
Design	11.0	Design	6.3	Design	7.1	Design	7.0	Thing	1.8
Product	2.3	Company	1.7	Idea	3.1	Line	1.4	Pen	1.6
Team	1.9	Team	1.5	Product	2.3	Process	1.4	Print	1.5
Business	1.5	Manage	1.5	Concept	2.0	Company	1.2	Think	1.3
Company	1.5	Innovation	1.4	Process	1.8	User	1.2	Head	1.3
Development	1.5	Need	1.4	Think	1.8	Product	1.1	Way	1.3
Process	1.3	Product	1.3	Work	1.5	Make	1.0	Draw	1.1
Case	1.3	Creative	1.1	Evaluation	1.4	Development	0.9	Switch	1.1
Management	1.3	New	1.0	People	1.3	Technology	0.9	Write	0.9
Role	1.3	Development	0.9	Need	1.2	Next	0.9	Angle	0.9

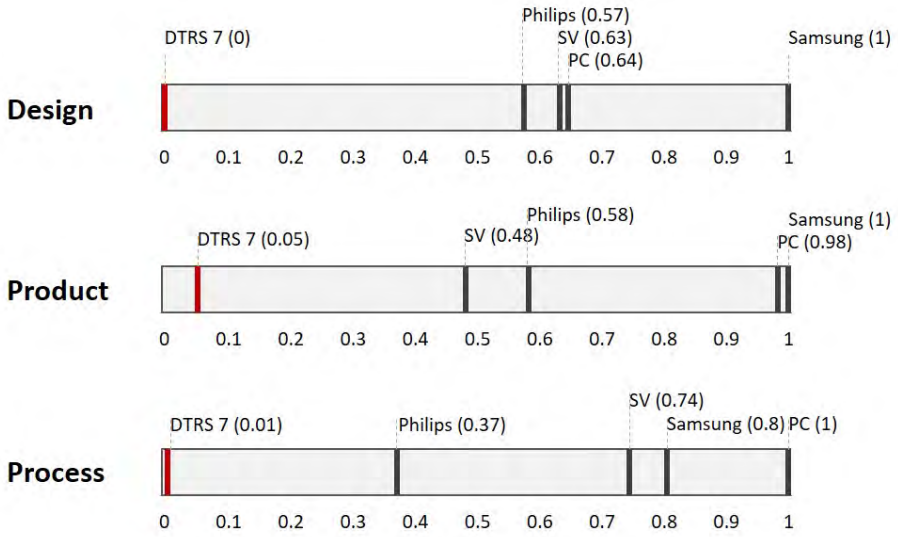

Figure 1. Normalized word dominance across all datasets.

However, in the case of DTRS7, the most dominant word and the next most dominant word occurred with a similar frequency. The frequency of the top 10 words does not differ much. In other words, there was no dominant concept in DTRS7. The most dominant word in the four datasets describing designing occurred with a frequency at two to five times as high as the next most dominant word. This implies that the cognitive effort spent is concentrated in a different way in designing and describing designing.

It is possible to deduce from Table 4 what contents are covered in the given data. Considering that words such as 'team', 'business', 'company', 'development', 'process', 'management', and 'role' are found in Samsung data, it is possible to imply that it emphasizes the company structure or the designer's role. Philips is unique that, unlike Samsung, it refers to words such as 'creativity' and 'innovation'. Additionally, the Pharmaceutical data mainly mentions words describing a design process such as 'idea', 'concept', 'people', 'need', 'evaluation'. Seminar Video data, on the other hand, is characterized by mentioning words closely related to technology such as 'make', 'development' and 'technology'. Conversely, structure equivalent words appear in the FBS codes of DTRS7.

Since ‘design’, ‘product’, ‘company’, ‘process’ are ranked high in the rest of four data excluding the designing session, it seems to the dominant concept, but specific words are not dominant in the designing session (DTRS 7), Figure 1, which is a potentially important difference.

4.1.2 Correspondence Analysis

The results of the correspondence analysis of the word frequency in the DTRS7, Philips, Seminar, Samsung and Pharmaceutical datasets is shown in Figure 2. Correspondence analysis describes the similarities of the data qualitatively and is used to explore the relationships between categorical variables. Correspondence analysis suggests how similar the variables are at the categorical level, which is an effective method for exploring relationships between variables (Greenacre, 2007). From Figure 2, we can see that DTRS7 data is in the first quadrant while the other four datasets appear in the second quadrant. This suggests that at categorical level when designers are designing their word usage is different to the other four interview datasets when they describe designing. While, at the same time the word usage in the other four datasets is similar to each other. This may because the words they use for designing and describe designing are very different categorically. Moreover, all five datasets are similar in dimension 1, which means they have similarities in certain dimensions. This may due to the fact all five datasets are design related content.

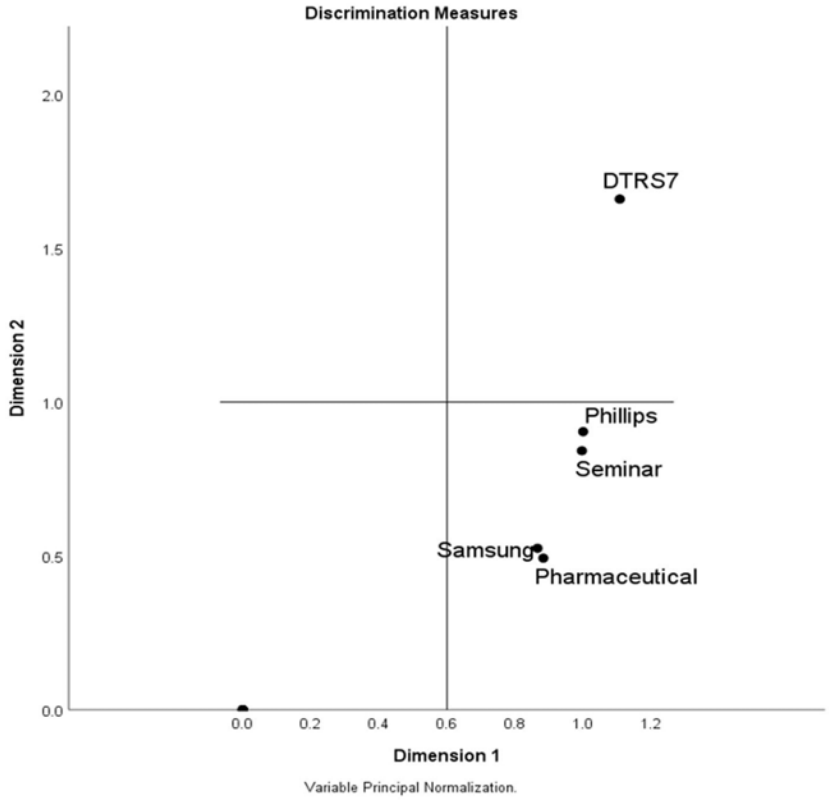

Figure 2. Results of correspondence analysis of the five datasets.

4.2 Sentiment Analysis of the Sessions

Here we test if the designing session (DTRS7) exhibits a different sentiment to the describing designing sessions and whether the sentiment of the describing designing sessions exhibit similar sentiments. As described inearlier, we used two methods, SentiWordNet (SWN) and Syuzhet, to investigate the sentiment of

each session. Each segment in each of the sessions are computationally identified with a positive, negative, or neutral sentiment. The results are shown in Table 5, where "Total" is the overall sentiment value by adding the sentiment value of each segment. %+ve is the percentage of segments with positive values, %-ve is the percentage of segments with negative values, and %=0 is the percentage of segments with neutral values.

Table 5. Results of sentiment analysis using SentiWordNet (SWN) and Syuzhet

	DTRS7		Samsung		Philips		Pharmaceutical		Seminar	
	SWN	Syuzhet	SWN	Syuzhet	SWN	Syuzhet	SWN	Syuzhet	SWN	Syuzhet
Total	17.9	247.6	2.4	65.2	8.57	265.1	8.9	127.5	6.3	101.4
Ave.	0.014	0.193	0.0250	0.679	0.026	0.789	0.025	0.352	0.022	0.345
%+ve	55.6	37.4	76.0	70.8	77.8	71.5	67.7	51.7	68.3	50.3
%-ve	27.5	12.3	19.8	3.1	18.8	4.8	23.8	5.0	27.9	11.7
%=0	16.9	50.2	4.2	26.0	3.4	23.7	8.6	43.4	3.8	37.9

These result suggest that the average sentiment value per segment of the DTRS7 dataset is much lower than the other four datasets; also the DTRS7 sentiment has a much lower percentage of positive sentiment segments than the others in both measurement methods. Using the Syuzhet method, the DTRS7 session (12.3%) has a much higher percentage of negative sentiment segments than the Samsung (3.1%), Philips (4.8%) and Pharmaceutical (5.0%) datasets with the Seminar session (11.7%) as an outlier. The probable reason for the overall results is that the DTRS7 is a designing session which involved evaluation and analysis process, which contains both positive and negative comments while when talking about design and the function of design is much more positive. Further investigation is required to examine the outlier. Also, with the SWN method, the DTRS session has a higher percentage of neutral sentiment than the others (16.9%, 4.2%, 3.4%, 8.6% and 3.8%).

4.3 FBS Analysis

An FBS coding was carried out with multiple coders who arbitrated to produce a final coding. The distributions of the FBS design issues for the five datasets in shown in Table 6.

Table 6. Distributions of FBS design issues in the five datasets expressed as %

	DTRS 7	Samsung	Philips	Pharmaceutical	Seminar
F	3.9	19.1	17.7	13.5	21.9
Be	22.8	19.1	22.7	26.3	25.8
Bs	30.6	41.0	34.7	30.4	26.9
S	42.5	20.5	24.6	29.7	25.1

Figure 3 shows the same FBS distribution for DTRS, Samsung, Philips, Pharmaceutical and Seminar graphically.

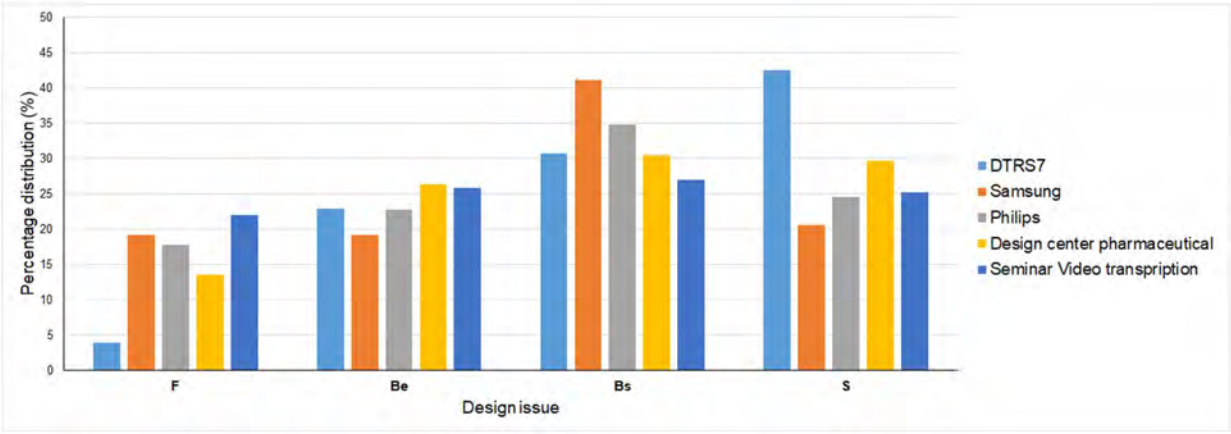

Figure 3. The FBS distributions in the five datasets

Results suggest that the distributions of Be and Bs are similar among the five datasets. This means, in terms of Behaviour, either the way to achieve goals or the examination of existing situation, is similar when describing designing and designing. However, there is significantly more structure (S) and less function (F) in DTRS7 dataset than the other four datasets. This suggests, as expected, that when designers design, they tend to focus on the actual design element, such as material, geometry and texture to complete the design. However, when describing designing, as expected, more design purpose and intention related issues are focused on. For example, managers tends to talked about functions and responsibilities of different design department. It is important for a manager to improve his or her awareness of design. It is necessary to cultivate design-oriented thinking and focus on design-centered management so that design can be utilized to the active stage that creates desires and needs beyond the pursuit of consumer's desires. The overall goal of the company is mentioned as function (F). It is necessary to create a design-centered organizational culture. For the innovation activity, a horizontal and flexible organizational culture is needed because it can communicate ideas smoothly.

5. Discussion and Conclusion

This paper presents the results from protocol studies of 5 datasets, Samsung, Philips, Design center pharmaceutical, design seminar, and DTRS7. Among those datasets, Samsung, Philips, Design center pharmaceutical and design seminar are the content of interviews of designers and design managers when they talk about design, while DTRS7 is the design session about designers designing. During interviews, statements regarding the differences between western design and Korean design were described. The main contribution of this research is that:

1. This may be the first time a design protocol analysis method has been applied to analyse when people describe designing. This implies that, at least, this protocol analysis method can be applied to a broader range of research areas. Furthermore, the FBS ontology is able to capture content that is related to design management and description of design process.
2. Differences were identified when describing designing and designing. For example, there were significant more Function (F) and less Structure (S) issues mentioned during describing designing, which is due to the nature of designing, where designers tends to work on the actual form when

designing. And when managers talk about design, they focus more on the design concept, different responsibilities of department, how the design process proceed.

3. From word frequency analysis, differences are identified between the four sets of interview/seminar data (Samsung, Philips, Design center Pharmaceutical and design seminar) and design protocol data (DTRS7): "Design", "Product", "Process" are not only the most frequently mentioned words in the interview/seminar data, the word "Design" dominated all other word occurrences by a large factor. However, in the DTRS7 data no single word dominated the word usage. Differences are also shown in the correspondence analysis of the word frequency, which indicates that DTRS7 is different from the other four datasets at the categorical level. This suggests that when describing design, there are common concept to refer to, while designing tends to be a linear process where less repetitive terms would appear.
4. Sentiment analysis results suggested that the average sentiment value per segment of the DTRS7 session is much lower than the others. Also the DTRS7 sentiment has a much lower percentage of positive sentiment segments than the others in both sentiment measurement methods. It indicates that designing contains a mixture of positive, negative and neutral sentiments while talking/managing design contains mainly positive sentiments. Another possible reason could be because of cultural differences; asian culture is prone to be more polite and hence using more positive words in the communication.

In summary, there are differences between describing design and designing identified from various of analysis including protocol analysis, word frequency count and sentiment analysis. This suggests that managers may not need to study designing because their concerns are different from those of designers. Furthermore, this research is a starting point for us to understand the differences between describing design and designing, as well as Korean design and western design. Since Korean design has unique characteristics, which is "style driven" rather than "knowledge driven". In a future study, it will be meaningful for us to distinguish Korean designing and Western designing, and when Koreans describe designing and Western people describe designing. The current research has suggested the combined method of protocol analysis, word frequency count and sentiment analysis is a promising method that is appropriate to be applied in such research. Therefore it is possible to apply this combined method for the future study in this area.

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https://github.com/anelachan/sentimentanalysis/blob/master/ReadMe.md

github.com/mjockers/syuzhet