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A Proposal for a System for Extracting Factors Behind Service Recipient Dissatisfaction

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Abstract

In recent years, the proliferation of social networking services has enabled customers to freely express their opinions and complaints. For companies, such review information is important vis-à-vis the evaluation of products and services and establishment of points for improvement. However, systematically extracting useful information from the huge amount of data is challenging, and the current situation entails its subjective interpretation by individual analysts.

Herein, using the cosmetics industry as a case study, the objective was to identify customer interests and dissatisfaction quickly and accurately. Specifically, based on review information data, a specialized dictionary for cosmetics was constructed, incorporating vocabulary specific to the cosmetics industry. It was further developed into a generic dictionary for cosmetics that classified negative emotions into "complaints" and "requests." This made it possible to extract what customers were feeling and complaining about more quantitatively and objectively. While the contents extracted as requests were factors to be improved, it was suggested that information on complaints could also be used to extract factors for improvement. However, it became clear that expressions related to the usability of cosmetics were diverse, and further action is required for review information that includes pictograms and subtle nuances.

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1. Introduction

The spread of social networking services (SNSs) such as Facebook and X has enabled many people to widely disseminate their own ideas. Companies have also been focusing on mechanisms to not only collect customer opinions and requests but also build their own communities and disseminate information therewithin.

In these times, review information from customers is a valuable resource for companies. For example, it is a means for companies to comprehend their own products and services are evaluated, and the voices of dissatisfaction can directly lead to improvements in products and services. In recent years, with the development of text mining technology, the quantitative analysis of customer opinions has become more important. However, extracting useful information from the vast amount of review information data and analyzing it systematically are demanding, and the current situation relies on the interpretation of individual analysts.

This study aims to discover customer interests and dissatisfaction. It also identify their needs quickly and accurately, using the cosmetics industry as a case study, where Japanese companies are often ranked among the topmost worldwide and where there is likely to be a language unique to female customers. Specifically, a tool will be developed to quantitatively analyze review information, encompassing the voices (words) that customers transmit. Accordingly, the aim is to determine what customers resonate with and what they are dissatisfied with. In the language transmitted by customers, there are industry terms and words used only among customers. To accurately grasp these words, it is essential to not only create knowledge that includes the meaning of the words as well as their sensitivity information but also compile this knowledge into a dictionary that can be used with linguistic analysis tools.

If what customers want can be extracted from review information, it can lead to further improvement activities. Therefore, extracting information on "requests" from eager customers who are familiar with the product or service will help to understand what is required from the customer's perspective.

2. Research on cosmetics and customer reviews

2.1. Japanese cosmetics industry

The global cosmetics market size is approximately 46.5 trillion yen (approximately US$ 426.3 billion) in 2019, while the Japanese cosmetics market is approximately 3.8 trillion yen (approximately US$ 35 billion), making Japan the third largest cosmetics market in the world after the United States (approximately 8.5 trillion yen) and China (approximately 6.2 trillion yen). Japanese cosmetics are highly valued overseas for their high functionality, quality, safety, and security, and inbound demand from foreign tourists is increasing, with shipments exceeding 1.7 trillion yen in 2019 and reaching a record high in 2019 [1]. The COVID-19 pandemic caused inbound demand to disappear and domestic demand to decline, as people refrained from going out, creating a difficult situation for the cosmetics industry. However, there is an ongoing recovery in inbound demand in Japan, and according to a corresponding survey [2], the domestic cosmetics market is clearly on a recovery track, especially with growth in the makeup and fragrance markets. The size of the domestic cosmetics market in 2023 was 2,478.0 billion yen, representing a 104.6% increase relative to the previous year's level.

One of the structural characteristics of the Japanese cosmetics industry is that the market is formed by a few large companies and many small and medium-sized companies. Based on 2019 sales, the Shiseido Group has 13.2% of the market share of the domestic cosmetics market, followed by the Kao Group (12.1%), Kose Group (7.3 %), P&G (3.7%), and POLA ORBIS (3.0%), with the top 5 (10) companies accounting for approximately 40% (50%) of the market. The remaining 50% of the market is constituted of 2,990 companies (estimate) [1]. Japanese consumers are increasingly turning to review sites, such as @cosme, and SNSs as sources of information. Notably, SNSs are used by people in their 20s and 30s in particular as a way to reduce information [3]. At Cosme (@cosme), they have launched measures to encourage people to write reviews, such as publicizing the number of daily reviews (21,933,168 as of March 31, 2025) and giving points for using reviews on their site [3].

2.2. Research on analysis of customer reviews

Research on extracting not only customer emotions from all kinds of review information but also information on customer dissatisfaction from custom review information and using this information for improvement is being conducted in various industries. For example, reference [4] conducted a study on customer emotion from word-of-mouth information of companies and products on the Internet, finding that positive (negative) emotion increased (decreased) reputation. Owing to the unavailability of quantitative measures, they attempt to quantify online criticism by analyzing quantitative and qualitative changes for five years of customer review information about companies and products.

Reference [5] proposed a method for extracting dissatisfaction information from reviews and matching the dissatisfaction with a service provider who can resolve it, as reviews submitted by users sometimes contained dissatisfaction information. In the study, using a dataset on beauty salons, the authors verify that the recommendation is made to stylists corresponding to the dissatisfaction information in the review text. Moreover, research to extend the evaluation polarity dictionaries that have been studied so far to fit the industry, among others, is underway; words in the evaluation polarity dictionary may not match the text in a particular domain [6]. The study utilizes customer review data from a travel information website; however, the authors state that approximately 60% or more of the 13,625 words in the evaluation polarity dictionary are not included in the data vocabulary, making it difficult to say that the dictionary contains words that are adapted to the domain. Furthermore, the report states not only that some words registered as negative in the polarity dictionary are used with positive connotations in the actual review information data but also that if domain-specific dictionaries are to be used, it is necessary to expand the dictionaries at low cost according to the domain.

2.3. Emotional analysis and evaluative expression

Sensitivity analysis algorithms for extracting sensitivity information from various free descriptions have been studied for many years [7][8][9][10], and their accuracy has gradually improved. The study of extracting opinions from comments in the open-ended sections of a questionnaire or data containing people's opinions is called reputation or sentiment analysis [11][12]. Reference [13] defined "reputation expressions" as those indicating favorable and unfavorable emotions extracted from comments, while Reference [14] suggested that we could effectively extract reputational expressions by focusing on expressions that constituted modifying phrases, such as adjectives and adjectival verbs, and sentence patterns, such as auxiliary verbs. In particular, Reference [20] proposed a simple algorithm for acquiring sensitivity information using a Japanese polarity dictionary. The method entails building a polarity dictionary, which is a set of words that have sensitivity information, and then matching it with words in the document to be analyzed to obtain the sensitivity information of the document [16].

2.4. Summary

Competition in the cosmetics industry is intense, and improving customer satisfaction is one factor that increases a company's competitive advantage. There are several ways to improve customer satisfaction, and research has been conducted from a variety of perspectives, including improving cosmetics themselves, review information for unique products, and word-of-mouth and sales. However, customer dissatisfaction varies widely, and conducting a comprehensive analysis of the factors behind such dissatisfaction is taxing.

Herein, focusing on the cosmetics industry, the objective was to accurately obtain emotional information about dissatisfaction and its contents from review information. However, as review information is freely written, it is expected that its analysis will reveal unexpected customer thoughts.

Specifically, the research will adapt text mining techniques to review information on cosmetics complaints, extract not only negative emotions but also words specific to the cosmetics industry, and develop a dictionary dedicated to the cosmetics-related industry. In addition, an attempt will be made to classify negative review information into "complaints" and "requests." The cosmetics industry is complex in terms of complaints and requests, and by selecting it as a case study for classifying the two, we aim to identify matters that can be improved.

3. Methods

3.1. Data used in the study

In the present study, review information from the "Dissatisfaction Survey Dataset," provided by Insight Tech, Inc. (Former company name: Dissatisfaction Buying Center, Inc.) and made available to researchers by the National Institute of Informatics, will be used. The "Dissatisfaction Survey Dataset" comprises approximately 5.25 million data items submitted by general users to the "Dissatisfaction Buying Center," a web service operated by Insight Tech, Inc. from March 18, 2015, to March 12, 2017.

There are 222 total categories. Of these, there are 8 beauty and health categories, whereof there are 52,237 reviews about categories of cosmetics. In this study, we use 15,090 reviews that clearly specify the willingness to purchase in the future (hereafter referred to as "dissatisfaction information"). For reference, the three types of future purchase intentions are "1: no longer purchase," "2: purchase frequency decreased," and "3: no impact." Other data are information besides specified input or not yet input.

3.2. Research methods

This study aims to extract emotional information from review information to identify whether customers are interested or dissatisfied with the information.

First, we will evaluate review information using a general-purpose polarity dictionary. If words specific to the cosmetics industry are discovered, we will attempt to register them as a new dictionary so that we can ascertain more accurate and precise information.

The research steps are stated as follows:
1) Using a text mining tool, extract emotions using the polarity dictionary
2) Evaluate review information
3) Compare the results of the polarity dictionary in (1) with those in (2)
4) Analyze negative words that can be newly registered and create a new dictionary for negative words ("Cosmetics Special Dictionary Ver1")
5) Evaluate the Cosmetics Special Dictionary Ver1

Furthermore, if it is possible to extract what customers, among others, want from review information, further improvement activities can be realized. Therefore, we attempt to classify negative expressions in the dictionary into two categories: "complaints," which are negative expressions that point out dissatisfaction or problems with a service or product, and "requests," which are constructive expressions that seek improvements or additions to a service or product.

6) Classify negatives in review information into two categories: "complaints" and "requests"
7) Update the Cosmetics Special Dictionary Ver1 and create the "Cosmetics Special Dictionary Ver2"
8) Evaluate the Cosmetics Special Dictionary Ver2

Through research, it will be possible to quantitatively extract customer needs from review information. By creating a new cosmetics-related industry-specific dictionary, we believe we can improve the accuracy of our analysis. In addition, we aim to extract what customers are looking for.

3.3. Japanese evaluation polarity dictionary

This section describes the Japanese evaluation polarity dictionary used in this study. It was created at Inui Laboratory, Tohoku University, comprising a terminology section and a noun section. The term version is a list of about 5,000 evaluation expressions collected mainly from terms [17], which was reorganized and manually assigned positive and negative evaluation polarity information [19]. The noun section is a manually checked dataset of approximately 80,000 nouns with evaluation polarity (compound), whereto evaluation polarity information is assigned [18][19].

Table 1 summarizes the content of words registered in the Japanese evaluation polarity dictionary. In the term section and noun section, 5,460 positive words and 8,129 negative words were registered, about 1.5 times more than

the number of negative words. Additionally, there was the label "e" as a headword that could not be determined, as well as other words that could be input errors.

This study will analyze only the 8,129 words registered as negative. This is because the data used in subsection 3.1 are related to dissatisfaction. Hereafter, the Japanese evaluation polarity dictionary will be referred to as the "polarity dictionary."

Table 1. Number of sensible words registered in the polarity dictionary.

	Positive word	Negative word	e	Other	Total
Number of words	5,460	8,129	4,954	50	18,593

4. Methods of extracting sensitivity information

4.1. Validation with a generic dictionary

In this section, we attempt to analyze the dissatisfaction information in subsection 3.1 using the polarity dictionary in subsection 3.3 and extract information on sensibility.

Table 2. Result of matching dissatisfaction information with negative words in the polarity dictionary (number of matches).

Number of collations per sentence	Number of sentences	Number of collations
0	4,984	0
1	5058	5,058
2	2,874	5,748
3	1,219	3,657
4	542	2,168
6	236	1,180
7	111	666
8	31	217
9	11	88
10	14	126
11	6	60
12	3	33
13	1	13
Total	15,090	19,014

Table 3. Result of matching dissatisfaction information with negative words in the polarity dictionary (number of words).

	Number of words	Number of negative words
Dissatisfaction information	754,441	1,046

Table 2 shows the results of matching the dissatisfaction information against the negative words in the polarity dictionary. 4,984 of the 15,090 sentences had no negative words that could be matched against the negative words in the polarity dictionary, or about 33% of the total number of documents. The sentences that were matched to the most negative words were matched to 10 or more words. The total number of negative words in the polarity dictionary matched against all dissatisfaction information was 19,014, which means that on average, one negative word was matched per sentence. Table 3 shows the results of matching against words registered in the polarity dictionary. The

number of matches is 1,046, which was one word is matched with a word registered in the polarity dictionary every 720 characters.

4.2. Making a dictionary of missing parts of a polarity dictionary

In this study, the authors verified whether there were any terms specific to the cosmetics-related industry or words that could be classified as negative and constructed a dictionary of such terms.

As can be seen from Table 3, there were few sentences that could be sensitized from review information in the cosmetics-related industry, even when matched with the polarity dictionary. As the polarity dictionary could not accurately extract what customers felt and what they were dissatisfied with, we decided to construct a dedicated dictionary. The verification of vocabulary for the construction of the dictionary was conducted by reading all sentences and discovering if there were any words that should be classified as negative words. For example, it was not possible to extract some or any emotions from the sentences shown in Table 4.

Table 4. Examples of reviews from which some or all of the emotions could not be extracted.

No	Example review comment
(1)	Cotton wipes sting when I use them. I want them to be gentler on my skin.
(2)	The product claims to keep my eyebrows in place for a week, but they fall out within a day. I won't buy it again!
(3)	It doesn't suit my skin. My skin tingled and I was disappointed.
(4)	It costs 1,000 yen but it doesn't moisturize my skin at all! I lost money. Never buy it again.
(5)	I have to spray enough to make it damp to make it manageable, but when I do, my hair feels sticky. It creaks when I wash my hair.

For each of the example sentences shown in Table 4, the unextracted emotions are explained.

Example review comment (1) indicates dissatisfaction with the sensation of "tingles," as well as the improvements that are of concern in the "want" part of the sentence.

Example review comment (2) indicates a decrease in willingness to buy (non-purchase) due to dissatisfaction with "it falls off" and dissatisfaction with "I won't buy it again!" after using the product.

Example review comment (3) shows dissatisfaction with the feeling of using the product, such as "It doesn't suit my skin" and "My skin tingled.

Example review comment (4) indicates dissatisfaction with the feeling of use, such as "it doesn't moisturize," and a decrease in willingness to purchase (non-purchase) due to dissatisfaction after using the product, such as "I lost money" and "Never buy it again."

Example review comment (5) indicates dissatisfaction with the feeling of "my hair feels sticky."

In particular, the case sentences reveal that things related to the actual feeling of use and the effects on the body used, such as skin and hair, can be registered in the dictionary as unique words; for example, expressions such as "sting," "tingling," and "sticky" indicate the feeling of using the product and are expressions that are specific to cosmetics.

4.3. Dictionary of omissions

In this section, the method of creating a dictionary from the dissatisfaction information is explained. Aggregating the case study sentences shown in Table 4 in 4.2, the emotions can be extracted as shown in Table 5.

For each of the case sentences in Table 5, the emotions to be extracted are explained. The underlined expressions in the case study sentences and their emotions, that is, negatives, are registered in the dictionary.

In example review comment (1), "I want XXX," "please," and "sting" can be registered.

In example review comment (2), "falls off" and related "falling off," "won't buy it again" and related "don't buy any more," "never buy it again" can be registered.

In example review comment (3), "doesn't suit my skin" and related "doesn't fit my skin," "tingling" can be registered. Note that "disappointment" has already been registered in the polarity dictionary, but "disappointment" is often written in katakana, so it is added to the registration. The Japanese language has hiragana, katakana, and kanji.

In example review comment (4), words related to "lost money" and related "wasted money" and "doesn't moisturize" can be registered. Moreover, "never buy it again" and those in example review comment (2) can be registered.

In example review comment (5), "sticky" and "creaks" can be registered.

As described above, there are many words that can be judged as negative in the cosmetics industry, and as a result of verification, we registered the words in Table 6 as negative in addition to those already registered in the polarity dictionary and created a new dictionary for negative expressions (hereinafter: "Cosmetics Special Dictionary Ver1"). Specifically, the words shown in Table 6 could be registered.

Table 5. New word examples for extracting emotions.

No	Example review comment	Word to register
(1)	Cotton wipes sting when I use them. I want them to be gentler on my skin.	sting I want XXX
(2)	The product claims to keep my eyebrows in place for a week, but they fall out within a day. I won't buy it again!	falls off won't buy it again
(3)	It doesn't suit my skin. My skin tingled and I was disappointed.	doesn't suit my skin tingling
(4)	It costs 1,000 yen but it doesn't moisturize my skin at all! I lost money. Never buy it again.	doesn't moisturize lost money never buy it again
(5)	I have to spray enough to make it damp to make it manageable, but when I do, my hair feels sticky. It creaks when I wash my hair.	sticky creaks

Table 6. Number of negative words to be newly registered as Cosmetics Special Dictionary Ver1.

	Number of words	Examples
Negative words	879	Can't use, difficult to do XXX, sticky, peeled off, difficult to understand, won't buy again/ don't buy any more /never buy again, too expensive, not enough, heavy, doesn't suit my skin, harsh, doesn't moisturize, I want XXX /please/I wish XXX (e.g., I wish they'd stop), stinging, falls off/falling, tingling, loss, creaks, squeaky, etc.

As Table 6 shows, 802 new negative words were registered. For example, "It was difficult to use" and "I want it to be better" were registered, as well as "It does not suit my skin" and "It was too tingly," which are words unique to the cosmetics industry.

4.4. Evaluation with Cosmetics Special Dictionary Ver1

In this section, we analyze the dissatisfaction information in subsection 3.1 and attempt to extract information on sensitivity using the Cosmetics Special Dictionary Ver1. The results are presented in Table 7.

Table 7. Results analyzed by the Cosmetics Special Dictionary Ver1.

	Number of collaterals
Negative word	11,861

In addition to Table 2, a new number of matches in Table 7 could be extracted. Combined with the results from the polarity dictionary, this brings the total number of negative words extracted in the dissatisfaction information to 30,875.

4.5. Dictionaryization by the reclassification of negatives

Reference [20] not only considers that customer opinions include complaints and requests but also examines the influence of word-of-mouth information, mainly complaints, on sales. In this study, we also attempt to find factors that contribute to improvement by classifying negatives into complaints and requests.

To validate the vocabulary for the construction of the dictionary, all sentences are read, and the sensitivity of the negatives in the complaint information is classified as "complaints" and "requests." For example, "I want XXX to be done," "Please," and "if XXX were done, it would XXX do it," which are classified as negatives, can be improved. By classifying these as "requests," it may be possible to derive the target items for improvement.

In Table 8, (1) is a case statement from Table 4, and (5) and (6) are new cases, which are used for the classification.

For each of the example sentences in Table 8, the emotions extracted as negative were classified into "complaints" and "requests."

Notably, "sting" in example review comment (1); "trouble," "not quite sure," and "difference" in example review comment (5); and "hassle," "dissatisfaction," and "if XXX it would be XXX" in example review comment (6) are categorized as "complaints."

"I want XXX" in example review comment (1), "please" in example review comment (5), and "if XXX it would be XXX" in example review comment (6) are classified as "requests."

The negative words in Table 6 were reclassified into "complaints" and "requests" as shown in Table 9 (hereafter referred to as "Cosmetic Special Dictionary Ver. 2"). Specifically, the words shown in Table 9 were registered.

Table 8. Case statement reclassifying negatives as complaints and requests.

No.	Example review comment	Cosmetics Special Dictionary Ver1 (Negative words)	Reclassification ("complaints" and "requests")
(1)	Cotton wipes sting when I use them. I want them to be gentler on my skin.	Sting	Complaints
		I want XXX	Requests
(5)	I have trouble with lotion and milky lotion because they are similar in shape. When I open both and try to close them later, I am not quite sure which is which. So, please make them distinguishable in either color or shape.	Trouble	Complaints
		not quite sure	Complaints
		difference	Complaints
		please	Requests
(6)	I like it very much, but it is a hassle to take it out with a spatula, and I am not satisfied with the sanitation. If they made it in a tube or pump type, it would be easier and more hygienic to use it until the end!	hassle	Complaints
		dissatisfaction	Complaints
		if XXX it would be XXX	Requests

Table 9. Number of words to reclassify negatives as complaints and requests.

	Number of collaterals	Example
Negative word (complaints)	802	Can't use, difficult to do XXX, sticky, difficult to understand, won't buy again/ don't buy any more /never buy again, too expensive, not enough, doesn't suit my skin, harsh, doesn't moisturize, etc.
Negative word (requests)	77	I want XXX /please/I wish XXX (e.g. I wish they'd stop), please, it should be XXX, XXX more XXX, give XXX, ask for XXX, etc.

As Table 9 shows, we are able to classify 802 negative words (complaints) and 77 negative words (requests). For example, "won't buy again" and "doesn't suit my skin" were categorized as complaints, while "I want XXX" and "please" were categorized as requests. In particular, requests are classified as constructive expressions requesting improvements or additions to a service or product.

4.6. Evaluation using the Cosmetics Special Dictionary Ver2

In this section, we reanalyze Table 7 and attempt to extract information on sensibility using the Cosmetics Special Dictionary Ver2. The results are shown in Table 10.

Table 10. Results analyzed by the Cosmetics Special Dictionary Ver2.

	Number of collaterals
Negative word (complaints)	8,092
Negative word (requests)	3,769

In addition to Table 2, it was possible to extract a new Table 10 number of sentiments. This resulted in a total of 8,092 negative words (complaints) and 3,769 negative words (requests) being extracted.

5. Discussion

Using the cosmetics industry as a case study, the objective of this study was to determine customers' interests and dissatisfaction to identify their needs more quickly and accurately. Specifically, we aim to discover what customers feel and what they are dissatisfied with by creating a tool that enables the quantitative analysis of the voices (words) transmitted by customers, that is, review information.

For the Cosmetics Special Dictionary Ver1, by analyzing customer review information, it became possible to extract more emotions from review information by adding words specific to the cosmetics industry to the generic Japanese evaluation polarity dictionary. This made it possible to extract information on customer dissatisfaction more accurately, an impossibility when using only the polarity dictionary. It also enables analysis that is independent of the analyst's interpretation. Using text mining technology, we find that it is possible to extract dissatisfaction with services, products, and detailed usage as perceived by customers, rather than setting up questions such as score evaluation.

For the new Cosmetics Special Dictionary Ver2, we were able to classify negative emotions into two types: "complaints," which were negative expressions that pointed out dissatisfaction or problems with a service or product and included dissatisfaction with the current usage experience, and "requests," which were constructive expressions requesting improvements or additions to the service or product and included specific suggestions for improvement and expectations for future experiences.

The results suggest that requests can be used directly for improvement and that there is a possibility of extracting requests from complaints. This made it possible to extract not only negatives (dissatisfaction) and consider improvement measures but also specific suggestions from customers and determine improvement factors based on expectations, which had been overlooked in the past. In other words, extracting more information on customer "requests" helps to deepen the understanding of what customers want.

In the cosmetics industry, there were many vocabulary words such as "sting" and "tingling," which can lead to skin-related problems, among others. These are likely to be matters that must be improved, suggesting the need for the close monitoring of products in which these terms are frequently detected. By closely examining the contents related to the body, there is a possibility that information that leads to better improvements can be drawn out.

6. Conclusion

In this study, we constructed knowledge for analyzing review information about the cosmetics industry, compiled this knowledge into a dictionary that could be used with linguistic analysis tools, and analyzed review information using this dictionary. This suggests the possibility of understanding what customers say about the feeling of use, usage, service, dissatisfaction, and so on, including problems with their bodies—what they feel and what they are dissatisfied with.

However, there are difficulties in analyzing cosmetics. There are a wide variety of expressions in connection to the feeling of use, and even with regard to "moisture," there is a vast range of requests, depending on the condition of the skin, for a refreshing or moist feeling. As many of the respondents were women, they mostly used pictograms to express their opinions. These cannot be determined via vocabulary alone.

In the future, information extracted in this study will be further scrutinized to clarify the characteristics of expressions specific to the cosmetics industry and women. Furthermore, as we were able to construct a system to define and classify negative words as "complaints" and "requests," both can be used for improvement. An attempt will be made to extract requests from complaints by means of semantic interpretation in subsequent studies.

Acknowledgements

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