A Study on Nuclear News Frames Through Sentiment Analysis: Focused on Synonyms

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1. Introduction

Nuclear power is Korea's representative energy source and is responsible for about 30% of electricity generation higher economy and efficiency than other power sources such as fossil, hydro, and wind power. However, various issues such as the Fukushima nuclear accident deteriorated public acceptance of nuclear power generation and amplified doubts about the safety of nuclear power.

Considering these social issues, discussions on energy policy widely spread, and the Moon Jae-in government proposed preparing a roadmap for nuclear power plants as a policy pledge [1]. After the election, public debate prevailed on the suspension of Shin-Kori Units 5 and 6 to fulfill Moon's promise. Social conflicts such as public criticism of policies and implementation methods occurred, and public disputes over nuclear power plant policies emerged sharply.

The media greatly influenced the public when recognizing social issues involving such conflicts. In addition, since how the press treats nuclear power generation can influence public sentiment, the media should be made according to objective facts from a proper perspective. However, the current media has been reporting the from a biased perspective, deepening public conflict [2]. For this reason, the nuclear power generation industry and related academia are responding sensitively to the use of keywords in the media. Avoid the words '핵발전소 (nuclear power plant)' and '탈핵 (nuclear power phase-out)' encourage the use of the words '원전 (nuclear power plant)' and '탈원전 (nuclear power phase-out)'. This is because '핵 (nuclear)' is a negative term reminiscent of '핵무기 (nuclear weapons)' or '핵폭탄 (nuclear bombs)' and gives people a sense of rejection.

Understanding the meaning of the media's message is essential to determine what keywords are used and how they are used together [4] since the semantic relationship between the words used in the article eventually forms a specific 'frame'. When reading an article for the first time, the reader tries to understand it through subjective thoughts or prior knowledge, even if words with a specific purpose are presented. However, the continuous exposure of words with that particular intention greatly influences the reader's understanding. Therefore, understanding the keywords of the media and its direction are focuses to be noted in the nuclear power industry. In this study, we analyzed the direction of the article focusing on the keywords that use 'different forms but the same meaning(synonyms)' among the articles surrounding nuclear power phase-out.

2. Theoretical Background and Previous Research

2.1. Importance of Article Titles

The article title summarizes the contents of the text and delivers them to the reader. In addition, it attracts the reader's attention and induces the reader to select an article or affects their attitudes and opinion. Therefore, the average time to read news gradually decreases, and the number of 'Headline Shoppers' who impulsively select articles based on titles increases [6,7].

According to previous studies, it is analyzed that audiences perceive issues with titles indicating specific directions (positive or negative) more important than titles that neutrally and well imply the contents of articles [8]. The media takes a negative article title because they value unusual and dramatic events and accidents such as murders, wars, coups, landslides, droughts, typhoons, etc. [9]. Therefore, readers are more exposed to the titles of negative articles and are more affected by them.

The above studies reveal that the article's title plays a vital role in determining the reader's issue. Readers' perceptions are mainly considered in the article's title in this study.

2.2. The Nuclear Power in the Media

Nuclear issues are very complex involving various stakeholders, so they are often treated as conflict issues [10]. In particular, articles related to nuclear power are more likely to be determined by various interests than facts based on scientific foundations.

Previous studies pointed out that domestic media reports on nuclear power-related issues reveal bias according to the political factionalism that each media aims for [11]. Conservative media highlights advantages such as nuclear safety and economy. In contrast, progressive media highlights harmful content, such as the dangers of nuclear power and the effects of radiation. Therefore, the general public, who lacks expertise in nuclear power, is bound to be significantly influenced by how the media defines it [12]. Due to this background, related industries are also sensitive to the use of words in the media. Against this backdrop, associated sectors are sensitive to the use of words in the press. Many times, it has been reported that environmental, civic groups, development industries, and related academia have commented that each stakeholder likes or dislikes.

3. Data Extraction

This study focuses on the 'Synonyms' in the article's title related to nuclear power. It aims to analyze and compare the use of the synonyms through sentiment analysis to see if the use of certain words is related to the article's direction (positive or negative). The attitude of uncritically accepted terms is wary, and the correct receptive attitude is proposed.

3.1. Article Collection

72% of readers rely primarily on search engines and newsgathering services while reading digital news [13]. Therefore, we used 'Naver', Korea's most popular search engine. We collected seven keywords using a web crawling technique and grouped them as shown in Table I. Each classification is a word with the same meaning, although the pronunciation is different in Korean.

Table I: Categorization of analyzed keywords

Case 1	Nuclear power plant	원자력발전소 원전 핵발전소
Case 2	Nuclear phase-out	탈원전 탈핵
Case 3	Radioactive waste	방사성폐기물 핵폐기물

The analysis period is from January 1, 2018, to March 10, 2022. That period is after the date the Moon Jae In government's declaration of nuclear power phase-out policy. As Moon announced his plan to promote the public debate on the Shin-Kori 5 and 6 at the event to commemorate the permanent suspension of Kori Unit 1, the nuclear power plant policy became a critical issue. Immediately after the announcement, it is expected that there will be many articles on the declaration, so the analysis period is limited to six months after the expected media evaluation of the policy is sufficiently conducted. This period is when positive or negative opinions related to nuclear power are sharply opposed. Thus, it is a period when the article's sentiment analysis on nuclear power can be clarified.

3.2. Data Preprocessing and Sentiment Analysis

We removed the information from the collected data through preprocessing that does not contain the words we want to analyze. Since the article's title often uses Chinese characters and abbreviations with meanings, we replaced them with Korean and proceeded with a refining process that unifies words with the same meaning. Since the tags of the emotional dictionary to be used in this study are based on Sejong Corpus, we use the KKMA analysis package to analyze morpheme. To improve morpheme analysis performance, we added words including foreign words such as political parties, companies, people's names, Bitcoin, and drones to the user dictionary.

Sentiment analysis is classifying terms by analyzing the words expressed in the text. This study is conducted using the Polarity dictionary provided by the Korean Sentiment Analysis Corpus (KOSAC). The dictionary expresses the rate of a positive and negative morpheme as one of the attributes of COMP, NEG, NEUT, NONE, and POS. Although it is not in the existing sentiment dictionary, we added new words to the sentiment dictionary, focusing on words frequently used in nuclear-related articles such as cracks, pollution, and eco-friendliness. As shown in Fig. 1, the frequency of appearance of each sentiment is calculated, and the Sentiment score is calculated.

	title	pos_count	neg_count	comp_count	none_count	neut_count
0	[원자력/NNG, 발전소/NNG, 건설/NNG, 로/JKM, 인하/VV, 이/ECS...	4	1	0	0	0
1	[노후/NNG, 원자력/NNG, 발전소/NNG, 늘어나/VV, 자/ECE, 뜨/VV...	2	1	1	0	0
2	[인도/NNG, 원자력/NNG, 발전소/NNG, 공격/NNG, 북한/NNG, 해킹/...	1	2	0	0	1
3	[강석호/NNG, 의원/NNG, 원자력/NNG, 발전소/NNG, 건설/NNG, 취소...	1	3	0	0	0
4	[월성/NNG, 원자력/NNG, 발전소/NNG, 어찌하/VV, ㄹ/ETD, 것/NN...	0	2	0	1	0

Fig. 1. Frequency of appearance of each sentiment

4. Result

After calculating the frequency of appearance of each headline, the sentiment score is calculated by Equation (1) to determine whether it is positive or negative. A polarity value greater than zero is positive, less than zero is negative, and zero is neutral. We calculate the positive, negative, and neutral percentage for each keyword.

$$\text{polarity} = \frac{POS - NEG}{POS + NEG} \quad (1)$$

4.1. Case 1: Nuclear Power Plant

The sentiment score for the word in case 1 is shown in Fig. 2. According to the results, the negative ratio of '원자력발전소' and '원전' is about 40%, because the safety issues of the power plants such as voids, shutdowns, and decommissioning have been raised actively during the data collection period. On the other hand, articles classified as positive have titles about power plant exports and technical excellence.

Among the keywords, '핵발전소' has the highest negative rate and the lowest positive rate. There is a difference of 24.6% between '원자력발전소' and '핵발전소'. We can judge that the word '핵발전소' is related to the news frame and its direction is negative.
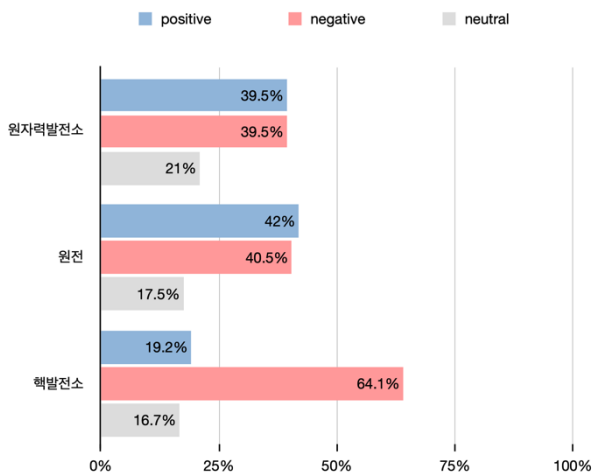
Fig. 2. Sentiment polarity ratio of nuclear power plant.

4.2. Case 2: Nuclear Power Phase-Out

Fig. 3 shows the sentiment scores of case 2. '탈원전' and '탈핵' have a difference of 36.1% in the negative rate. In the collected articles, '탈핵' is mainly used in the name of civic groups, and they use negative words such as accidents, shutdowns, and dangers of nuclear power plants. Judging from this, '탈핵' is used negatively compared to '탈원전'.
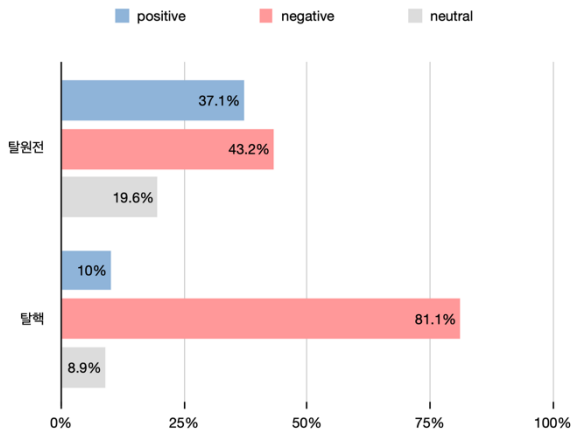

Fig. 3. Sentiment polarity ratio of nuclear phase-out.

4.3. Case 3: Radioactive Waste

Fig. 4 shows the sentiment score for case 3. Both keywords are used negatively rather than positively because radioactive waste is an issue that does not have a straightforward solution to the site selection and disposal, and problems are constantly being raised.

There is no significant difference between the negative ratio of '방사성폐기물' and '핵폐기물'. We can determine that case 3 is not related to the news frame.

Nuclear operators and related societies mainly use the word '방사성폐기물', but '핵폐기물' is already included in the dictionary in the same meaning as

'방사성폐기물' and is generally used for information transmission in the article. In this way, '핵폐기물' appears to be used interchangeably with the word '방사성폐기물'.
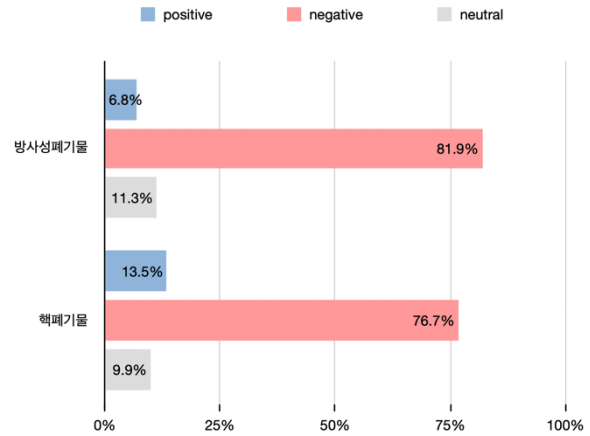

Fig. 4. Sentiment polarity ratio of radioactive waste.

5. Conclusion

The media has a significant impact on public perception on issues that are very conflicting in Korea, such as nuclear power. Therefore, in this study, we analyze the direction of the article according to the synonyms through sentiment analysis of the collected article titles. Except for case 3, we judged that the use of the word containing '핵' is related to the direction of the article. In other words, the media uses the article's title in the words '핵발전소' and '탈핵' when trying to write in a negative direction as expected. These results derive the following results and implications.

In the case of peaceful purposes, the media usually uses the word '원자력' and in the case of non-peace, the word '핵'. Although this cannot be distinguished, we can infer that it has a peaceful meaning given that the government uses the term '원자력' more often than '핵'. In addition, terms related to '핵' stipulated in Korea's nuclear law are generally used only for academic terms or definitions [14]. It is not common to use the word '핵'. According to this study; media chooses the words '핵발전소' and '탈핵' when trying to write articles in a negative direction. Now that trust in the nuclear power industry has declined, critical awareness of nuclear power is inevitable. However, using non-neutral words can instill unnecessary worries and fears about nuclear power in the people.

As nuclear power is a pending issue with various interests, the media should make more balanced articles based on objectivity and fairness, not biased articles. This requires an attitude of using the right word and a responsible media report rather than intentionally using a word that gives a negative impression. In addition,

readers must take a critical perspective and look at these words from a more objective and fair view.

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