

## A Study on public opinion for possessing nuclear weapons: using Semantic Network Analysis

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### 1. Introduction

A nuclear weapon is a weapon with great destructive power by utilizing the energy released during nuclear fusion and fission. Nuclear weapons have a specific purpose: 'national security'. Nuclear weapons prevent large-scale warfare by nuclear powers, and have a positive effect in that nation which have nuclear weapons can conduct offensive diplomacy during a global crisis. For these reasons, besides the official nuclear weapons states (the United States, Russia, the United Kingdom, China, and France), many countries have made efforts to acquire nuclear weapons with the goal of increasing their national power. Even in Republic of Korea (ROK), there is a continuous debate on the pros and cons of possessing nuclear weapons. In this paper, we used text-data analysis methods to investigate social perceptions regarding nuclear weapons in ROK.

### 2. Research Methods

The purpose of analyzing text is diverse spanning from identifying the main concepts and sub-topics contained in the documents, reading the trends through its temporal changes. In this section, some of the Methods used to analyze web news articles and public opinion text data about possessing nuclear weapons are described. To analyze Korean social perception about possessing nuclear weapons, Korea's representative domestic web platform www.naver.com. was selected as the data collection scope. For the keywords 'possessing nuclear weapons', we obtained search results from NAVER News. From the search results, we extracted 36,400 articles, 1,047,149 comments and 158,851 reply to comments for the last 10 years (2012.01.01~2022.02.28). The analysis methods include Term Frequency, Term Frequency-Inverse Document Frequency (TF-IDF) and Semantic Network Analysis (SNA).

#### 2.1 Term Frequency (TF)

Term frequency (TF) often used in Text Mining is how frequently a term occurs in a document. Term frequency is the measurement of how frequently a term occurs within a document. Term frequency covers that aspect by capturing the number of times each word occurs in the

text. The easiest calculation is simply counting the number of times a word appears.

#### 2.2 Term Frequency-Inverse Document Frequency (TF-IDF)

The problem with using Term Frequency is that relevance does not increase proportionally with usage. For instance, there are lots of pronoun, definite and indefinite articles that are meaningless in text. To downgrade the relative importance of words that occur all too frequently, an inverse weighting is introduced to scale down the words that occur too frequently. This inverse weighting is referred to as Inverse Document Frequency. Together, TF-IDF captures the relative importance of words in a set of documents or a collection of texts. (equation. 1.)

$$w_{i,j} = tf_{i,j} \times \log\left(\frac{N}{df_i}\right) \quad (1)$$

$tf_{i,j}$  = number of occurrences of  $i$  in  $j$   
 $df_i$  = number of documents containing  $i$   
 $N$  = total number of documents

#### 2.3 Semantic Network Analysis (SNA)

Semantic Network is a network of words that is organized to the proximity of words that are extracted from unstructured text through morphological analysis. Semantic Network Analysis (SNA) allows you to import unstructured text data to automatically extract words in documents, paragraphs, and sentences, and to organize interword networks based on adjacency between words. Therefore, nodes in a semantic network are words, and links are adjacent relations between words. The size of the nodes of the important words that were extracted beforehand are bigger.

### 3. Results

#### 3.1 Articles

We collected a total 36,400 articles from 2012 to 2022. Table. 1. shows TF/TF-IDF results the noun words that appeared most from 2012 to 2022. As a result of TF analysis, the keyword "DPRK" was used most frequently

in news articles, and then "U.S.", "President", "China", and "Missile" were derived in that order. In other words, news articles on DPRK's possession of nuclear weapons indicate that there were the most reports on North Korea's nuclear weapons, and it shows that it focused on the reactions of neighboring countries ("U.S." and "China") and presidential countermeasures. Among the types of nuclear weapons, it can be seen that 'missiles' were mentioned the most.

As a result of TF-IDF analysis, new words such as 'denuclearization', 'Korean Peninsula', and 'economy' were derived. This means the media's interest in denuclearization. In addition, it can be seen that they are also concerned about the impact of possessing nuclear weapons on the Korean Peninsula and the international economy.

As a result of the SNA analysis, words such as "DPRK", "U.S.," "China," and "Iran" are located around the "nuclear" node (Fig.1.). In addition, various issues related to the nuclear issue are mentioned around it. In the lower right corner of the figure, reports on the Korea-U.S. summit and on the left side of the figure, reports on DPRK's "missile launch" can be seen. At the top of the graph, it implies that the media is discussing the possibility of "denuclearization" of the Kim Jong-Un regime.

Table. 1. Top 5 keywords for TF/TF-IDF results of articles

Rank	TF	TF-IDF
1	DPRK	denuclearization
2	US	China
3	President	DPRK
4	China	Korean peninsula
5	Missile	Economy

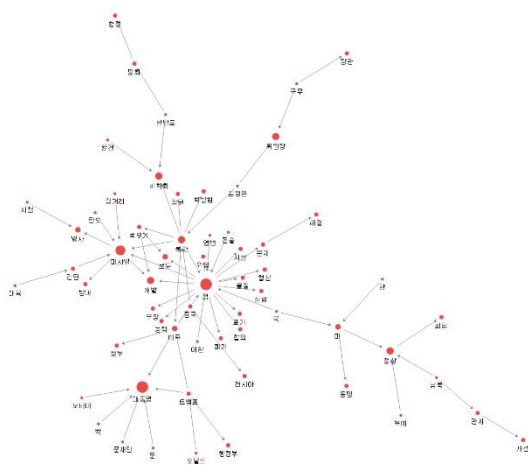


Fig. 1. Semantic Network Analysis of Naver articles, related to 'Possessing Nuclear weapons' (2012-2022)  
3.2 Comments/ Reply to comments

A total 1,047,149 comments and 158,851 Reply to comments were analyzed. In the case of TF/TF-IDF analysis, similar words appeared overall, and there was no significant change in TF and TF-IDF rankings (Table.2.). TF/TF-IDF 's 1st, 2nd, and 3rd places were 'U.S.', 'war', and 'ROK', respectively, and the keyword appearance rankings were consistent. However, while TF's fourth and fifth places were "DPRK" and "Kim Jong-un", TF-IDF's "Kim Jong-un" and "Peace" appeared. This indicates that the people are seriously concerned about 'war' and ultimately desire 'peace'. It shows that the public is also paying attention to the political response attitudes of U.S. and ROK.

In SNA analysis results of the comments, the number of nodes in the graph is very diverse (Fig.2.). On the right side of the graph, keywords that seem to guess the positions of governments around nuclear weapons appear. At the top of the graph, words are connected around the keywords 'unification' and 'peace'. It can be seen that exchanges of opinions on peace and unification on the Korean Peninsula are active. On the left side of the graph, words such as "Kim Jong-un," "pig," "removal," "beheading," "government," "pro-North," and "commie." It indicates that netizens are strongly criticizing the regime and system of DPRK.

Table. 2. Top 5 keywords for TF/TF-IDF results of comments

Rank	TF	TF-IDF
1	US	US
2	War	War
3	ROK	ROK
4	DPRK	Kim Jong-un
5	Kim Jong-un	peace

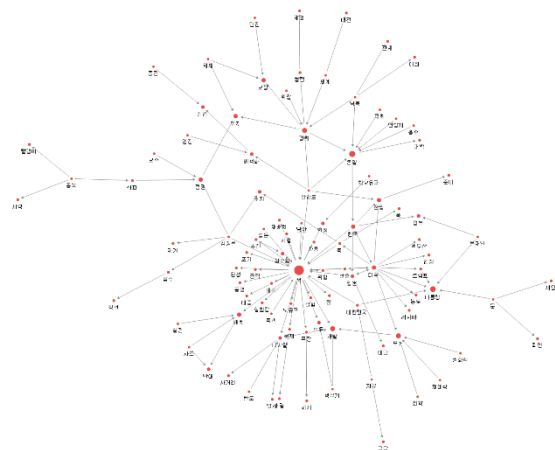


Fig. 2. Semantic Network Analysis of comments, related to 'Possessing Nuclear weapons' (2012-2022)

Table. 3. and Fig.3. are results of an analysis of 158,851 Reply to comments posted on the articles of possessing nuclear weapons. In Table. 3., the analysis results of the Reply to comments are generally similar to the results of the comments, but the keyword 'Japan' was newly derived. In addition to the 'U.S.', 'ROK', and 'DPRK' mentioned in the comments, it implies that people are also interested in the 'Japan' response.

As a result of the SNA analysis, interest in 'nuclear', 'U.S.', 'war', and 'unification' seems to be high (Fig. 3.). As a result of TF/TF-IDF/SNA analysis, it was derived similar to the previous results of the comment analysis. In other words, it means that most of Replies to comments are agreed with the comment's contents.

Table. 3. Top 5 keywords for TF/TF-IDF results of Reply to comment

Rank	TF	TF-IDF
1	US	US
2	war	war
3	Japan	Japan
4	ROK	ROK
5	DPRK	DPRK

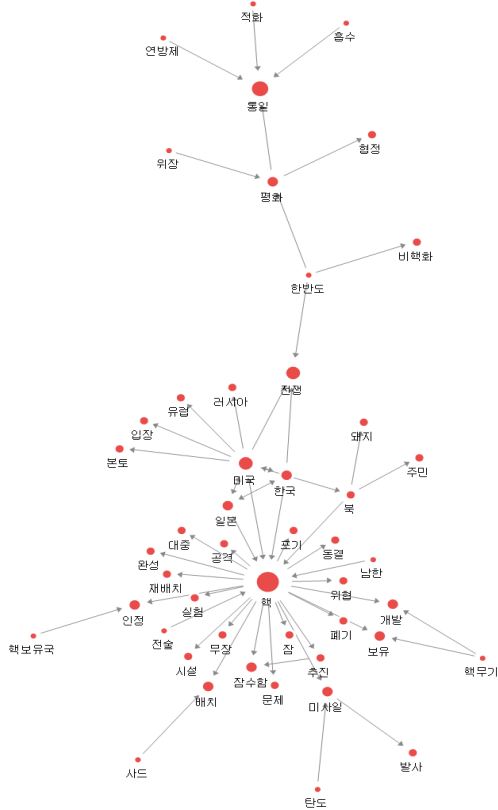


Fig. 3. Semantic Network Analysis of reply to comment, related to 'Possessing Nuclear weapons' (2012-2022)

#### 4. Conclusions

From this study, we confirmed that the public opinion on possessing nuclear weapons in ROK. The following facts were found through the analysis results. The most prominent feature of the analysis results is that people were praying for peace. Regardless of whether the nation has nuclear weapons, the people were praying for peace and were most concerned about North Korea's missile tests. In addition, it was confirmed that cases of other countries related to the possession of nuclear weapons were mentioned a lot in the media and the public. This implies that the possession of nuclear weapons is not limited to the field of science and technology, but a diplomatic matter.

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