Talking to Whom?:
Changing Audiences of North Korean Nuclear Tests

Taehee Whang
Yonsei University

Michael Lammbrau
Ridge College

Hyung-min Joo
Korea University

Abstract

Objectives. We develop a model based on a big data analysis in order to find patterns in North Korean nuclear provocations. Methods. Using automated text analysis classification through supervised machine learning techniques, we analyze the North Korean Central News Agency (KCNA) from 1997 to 2014. Results. We find an interesting difference between the Kim Jong-il era and the Kim and Jong-un period, implying a major shift in Pyongyang regarding its nuclear provocations. While Kim Jong-il with a firm grip on power focused on international audience before conducting nuclear tests, Kim Jong-un in midst of succession targets at domestic audience prior to nuclear tests, probably in an attempt to consolidate his precarious power. Conclusion. Machine learning technique allows us to analyze the effect of political communication even in authoritarian governments.
Previous studies on the North Korean nuclear crisis have revolved around two questions. First, what does Pyongyang wants to achieve by pursuing a nuclear program? Second, is denuclearization of North Korea possible and if so, at what price? In both questions, it is assumed that figuring out the intention of the North Korean regime is critical. According to Robert Gallucci who orchestrated the first North Korean nuclear deal in 1994, however, they are wrong questions to ask because “American policy should be geared to U.S. objectives, not North Korean objectives” (Wit et al. 2004, 383). In other words, Washington should pursue its goal regardless of what Pyongyang prefers. It is a valid point, yet with one critical condition; that is, all options including a military solution must be on the table to deal with the North Korea nuclear crisis. In dealing with Iraq, the U.S. was able to force its policy on Hussein because it had the option of invading Iraq. In the North Korean case, however, even a minor military operation such as a surgical strike is hardly a practical option due to many reasons, such as strong opposition from China, South Korea, and so on. The “default policy” is then diplomacy and bargaining based on an accurate diagnosis of what North Korea wants in return for denuclearization (Cha & Kang 2003, 4).

Unfortunately, deciphering what Pyongyang wants is easier said than done. From the viewpoint of the outside world, “North Korea could have been on Mars... It was a faraway land of unknowns and unknowables explored mostly by space probes, in this case, spy satellites” (Sigal 1998, 10). Despite touted technological advances, even best spy satellites proved insufficient to monitor what was going on inside this mysterious country. On December 11, 2012, for instance, North Korea surprised the world by launching a long-range missile. It was all the more surprising in that just few hours earlier, government officials both in Seoul and Washington were busy briefing reporters that Pyongyang would not be able to conduct a missile test, supporting their judgment with satellite images showing “technical problems” at the launch site (Chosun Ilbo 12/12/2012; New York Times 12/11/2012). It goes without saying that officials at both capitals had a tough time to explain their misleading briefings shortly afterwards.

To a large degree, the hidden, mysterious, and opaque nature of North Korea is its...
own making. Since the early 1990s, the North Korean government has elaborated a “mosquito net” theory and applied it meticulously to the daily lives of its people. According to the theory, the North Korean government should drape the entire country with a mosquito net, so to speak, so that dangerous, alien, and harmful influences from the outside (“mosquitoes”) could be blocked from entering the country (KCNA 10/9/2009; 5/16/2011). The incapability of the outside world under such circumstances to observe what is going on inside “a mosquito net” has led to a blurry understanding of the country, thus creating the mysterious aura of uncertainty around the country. As a result, North Korea has often been regarded as “the blackest of black holes” or “the longest running intelligence failure” (Litwak 2007, 289).

Given the opaque nature of North Korea, it has become a popular practice among scholars to rely on a deductive logic in order to analyze the main motive of Pyongyang in its nuclear program (Cha 2002, 212). A conventional wisdom had been that countries pursue a nuclear program mainly due to security concerns (Davis & Frankel 1993; Deutsch 1992; Thayer 1995). Based on a careful analysis of nuclear proliferation attempts, however, Sagan points out that countries pursue a nuclear program with multiple goals in mind, such as a security guarantee, a bureaucratic logrolling, and a symbolic importance in international settings (Sagan 1996/1997, 55). North Korea does not seem to be exceptional in this respect. While employing a deductive logic, most scholars have argued that Pyongyang is pursuing a nuclear program for a combination of reasons, including a security guarantee, a bargaining leverage for economic gains, a symbolic prestige internationally, a domestic legitimacy in midst of otherwise a failing system, a bureaucratic logrolling, an ideological necessity of Juche (self-reliance), and so on (Ahn 2010; Cha 2002; Hecker 2010; Heo & Woo 2008; Mack 1993; Mansourov 1995; McEachern 2010).

Among those assumed goals, what is the prime motive of North Korea to pursue a nuclear program? On this question, there has been a fierce debate between two schools of thought: an armament theory vs. a bargaining theory. First, according to an armament theory, Pyongyang is irreversibly determined to manufacture nuclear weapons as its “security guarantor,” “existential deterrent,” or “ultimate equalizer” (Cha & Kang 2003; Clemens 2010; Hayes & Bruce 2011; Jung et al. 2015; Kim 1982; Kim 2010; Lankov 2009; Narang 2015; Park 2010). Although it has come to a bargaining table occasionally, such conciliatory gestures are carefully calculated schemes to secretly build nuclear weapons behind its back. An armament theory explains many aspects of the North Korean nuclear program, such as its long history dating from the 1950s and the clandestine Uranium Enrichment Program (UEP) in violation of the 1994 Agreed
Framework (Cha & Kang 2003; Clemens 2010; Hymans 2008; Mack 1993; Mansourov 1995; Park 2010). At the same time, there is a puzzling counter-evidence: namely, the Light Water Reactor (LWR) proposal of Pyongyang. As well known, a LWR is regarded as a “safer” nuclear program because it is much “harder to divert to that [bomb-making] purpose and more easily safeguarded” (Wit, et al. 2004, 54). As a result, both the United States and the Soviet Union had provided LWRs to their allies interested in a peaceful nuclear program during the Cold War. In the early 1990s, however, it was Pyongyang that first proposed the LWR option. In other words, the North Korean government proposed to replace its weapon-friendly graphite-moderated nuclear program with a LWR, first to the IAEA in 1991 and then to the U.S. in 1993. If Pyongyang was indeed hell-bent on acquiring nuclear weapons, why would it forego a proliferation-prone nuclear program already in operation for a weapon-resistant LWR? For an armament theory, the LWR proposal by Pyongyang remains a perplexing puzzle.

Second, according to a bargaining theory, Pyongyang is not irrevocably committed to acquire nuclear bombs. Rather, it has used a nuclear program mainly as a “bargaining chip” to induce political and economic concessions from the U.S. (Cha & Kang 2003; Chinoy 2008; Harrison 2002; Oberdorfer 2001; Sigal 1998; T’ongilyŏn’guwon 2013; Wit, et al. 2004). As a result, it is possible to denuclearize North Korea as long as the U.S. is willing to pay “the right price.” Several evidences provide support to a bargaining theory, such as the two successful denuclearization agreements (1994 and 2007), the similarity between the two agreements, and repeated North Korean demands for weapon-resistant LWRs. At the same time, there is also a troubling counter-evidence, especially the UEP which Pyongyang secretly sought from Pakistan in 1998 in violation of the 1994 agreement. If the real intention of Pyongyang had been to strike a deal with Washington, why did it pursue a clandestine UEP even though it was receiving economic aids, heavy fuel-oils, and two LWRs in accordance with the 1994 Agreed Framework? For a bargaining theory, the secret UEP remains a major enigma.

As shown thus far, scholars have relied on a deductive logic to analyze the intention of North Korean in its nuclear program, whether it was assumed to be security-driven or bargaining-oriented. Given the black-box nature of North Korea, it is natural to utilize a deductive logic in order to decipher the mysterious intention of Pyongyang. It becomes problematic, however, to rely on a deductive logic exclusively when there is another method available: namely, induction. Since the early 1990s when the North Korean nuclear crisis first surfaced, Pyongyang has published numerous articles in its official media outlet, the North Korean Central News Agency (KCNA), clarifying its positions.
on various issues related to the nuclear crisis. As a result, the main goal of this paper is to employ an inductive approach in order to understand North Korean nuclear provocations. In particular, we employ a supervised machine-learning (SML) based on an automated text analysis classification, while using KCNA articles published from 1997 to 2014 as our data. In doing so, we seek an answer to several key questions. Why does the North Korean leadership decide to conduct a controversial nuclear test occasionally? What are patterns, signs, or indicators from Pyongyang regarding its nuclear test? Is it possible to detect such patterns, signs, or indicators? By answering these questions, we seek to make mysterious behavior of North Korea less enigmatic in the end.²

I. Logistics: Data and Methodology

1. Data: Korean Central News Agency

   The official media outlet of North Korea is the Korean Central News Agency (KCNA hereafter). It provides radio broadcasts (i.e., Korean Central Broadcasting System), television broadcasts (i.e., Korean Central Television), and daily reports of major North Korean newspapers, such as Rodong Sinmun which is the official mouthpiece of the ruling Workers’ Party of Korea (WPK) and Minju Chosun which is the newspaper of the North Korean cabinet. Since 1996 when it established a server connection in Japan (www.kcna.co.jp), the KCNA has published daily newspaper articles on the internet both in English and in Korean. Typically the KCNA publishes 20-40 articles per day on various topics, such as reports on recent activities of top North Korean ruling elites (e.g., Kim Jong-un’s visit to a local factory), official announcements of the North Korea regime on critical issues (e.g., an official statement of the Ministry of Foreign Affairs on a nuclear issue), a few articles selected from major North Korean newspapers, various reports on North Korean society, news from other countries around the world, and so on.

   Over the years, scholars working on North Korea have relied on two news outlets:

² Importantly, it is not our contention to argue that previous works on the North Korean nuclear crisis are fundamentally mistaken due to its deductive approach. Instead, it is our intention to fill some holes and gaps in the existing literature, by incorporating an inductive approach. In other words, our motive is to offer a new possibility in addition to, not instead of, those already provided in the existing literature. It is our belief that adding an inductive approach is important to “understand this internal mechanism” of Pyongyang in the on-going nuclear crisis (McEachern 2010, 227).
Rodong Sinmun and the KCNA. As the newspaper of the ruling party, Rodong Sinmun is regarded as the official mouthpiece of the North Korean regime. As a result, many scholars (especially in South Korea) have conducted a content analysis of Rodong Sinmun so as to detect a policy trend or its shift on various issues (Koh, 2013). From our viewpoint, however, Rodong Sinmun does not provide an appropriate dataset due to its lack of coverage and availability. Although the North Korean government has recently made Rodong Sinmun available on internet (www.kcna.co.jp/today-rodong/rodong.htm), it covers only those articles published after 2002. Even for the articles published after 2001, the contents of few selected articles per day are available, whereas only titles are provided for the rest of Rodong Sinmun published after 2002. By contrast, all the articles in the KCNA from 1997 are available on its website, thus providing a better and more complete dataset for our machine-based text classification analysis. As a result, the KCNA is chosen as our main data.

2. Methodology: Supervised Machine Learning

We use a supervised machine learning (SML) technology in this paper. There are four steps in SML: (1) data collection, (2) document labeling, (3) preprocessing, and (4) model building and analysis. First, we collected all the KCNA articles published between 1997 and 2014 from its website (www.kcna.e). Second, for SML to work, it is necessary to label KCNA article as either threat or non-threat. What is the criterion of this labeling process? As shown in Figure 2, all those KCNA articles published within a week prior to the three North Korean nuclear tests are labeled as “threat” articles. By contrast, all those KCNA articles published during a 10-day period at least two months before or after the three North Korean nuclear tests are labeled as “non-threat” or “peace” articles.
Third, since original KCNA articles were not ready for automated text analysis, a cleaning process called “preprocessing” was conducted to prepare the articles for a machine-learning technology. In particular, we followed a standard procedure of SML by removing the so-called “stopwords.” Stopwords were those terms which appeared for grammatical reasons but were meaningless from the viewpoint of a machine. For instance, words like ‘a, the, on, at, to, and’ were good examples of stopwords. Once stopwords were removed, preprocessed KCNA articles were then turned into a document term matrix form, made up of rows of news articles followed by columns of terms, which was finally ready for a machine-learning process.

Figure 2: Labelling Threat and Non-threat Articles

Figure 3: Training and Test Data Sets
Finally, in order to develop our model using a document matrix form of preprocessed KCNA articles, we divided the entire data into two subsets: a training dataset (randomly chosen 70% of the whole data) and a test dataset (the remaining 30%). As shown in Figure 3, the labels of “threat” and “non-threat” were provided for each article in the training dataset. The training dataset was then used by a machine-learning process to develop a model that could differentiate between “threat” articles and “non-threat” articles in the test dataset. The model developed from the training dataset was then applied to the test dataset in order to check its accuracy. Importantly, for all the KCNA articles in the test dataset, we removed labels of “threat” and “non-threat.” By doing so, our goal was to challenge the model to use what it had learned about significant features of North Korean nuclear tests in the train dataset and then to accurately classify KCNA articles in the test dataset without labels whether they were “threat” or “non-threat” articles.

II. Models: Single-platform vs. Double-platform

Before we proceed to analyze our model, it is necessary to discuss one critical issue. Should we proceed with a single-platform with one model covering the entire period from 1997 to 2014 or a double-platform composed of two separate models, one covering for the Kim Jong-il era (1997-2011) and the other for the Kim Jong-un period (2012-2014)? The question is important because it relates to a critical assumption regarding a consistency or a major policy shift in Pyongyang regarding its nuclear policy. Whereas a single-platform assumes that the North Korean regime has been quite consistent in its nuclear policy (thus, one model should suffice for the whole period), a different assumption is implicitly built in a double-platform that there has been a major policy shift from Kim Jong-il to Kim Jong-un as far as their nuclear policies are concerned (thus, one should employ two separate models).

Most existing works on the North Korean nuclear crisis, whether an armament theory or a bargaining theory, have implicitly assumed that there is consistency in the motive of Pyongyang in its nuclear program. Despite a leadership change in 2012, a typical argument would go, the North Korean regime has pursued a nuclear program for the same reason as before whether it is for an “armament” or for a “bargaining.” If such is indeed the case, a single-platform which covers the entire period (1997-2014) should perform better than a double-platform with two separate models. Unless there is a huge performance difference, a single-platform is preferred in general due to its simplicity. In addition, we have shown in a separate article that a single-platform actually performs much better than a double-platform in the case of conventional North Korean military
provocations (Joo, Lamm, and Whang 2016). As a result, despite a leadership change, it does not seem that there has been a major policy shift in Pyongyang as far as its conventional military provocations are concerned.

For two reasons, however, we suspect that Pyongyang is having a second thought about its nuclear program. In particular, the nascent Kim Jong-un regime may be pursuing a nuclear program for reasons other than those of its predecessor. First, the sudden death of Kim Jong-il in 2011 has made it urgent for Kim Jong-un to deal with a succession crisis. After graduating from a college, Kim Jong-il joined the Organization-Guidance Bureau which was considered the core of the ruling WPK in the early 1960s. Ten years later, Kim Jong-il became a permanent member of the Political Committee, the highest ruling organ of the WPK. For the next two decades until the death of Kim Il-sung in 1994, Kim Jong-il had a plenty of time to consolidate his position as the next leader of North Korea. By contrast, Kim Jong-un, who was barely 30 years old when succeeded his father, did not have such a luxury. When the sudden collapse of Kim Jong-il in 2009 gave an impression that his days were numbered, the North Korean regime had to hurry a succession process. On September 28, 2010, Kim Jong-Un was thus appointed to vice-chair of the Central Military Committee of the WPK, a new post created for him while his dying father held its chair position (Rodong Sinmun 9/29/2010). Within a year or so, Kim Jong-un took the official title of “Dear Respected Leader” after the death of Kim Jong-il on December 17, 2011.

Second, the rhetoric of the KCNA on nuclear issues has changed in recent years. Previous studies show that Pyongyang had sent two consistent messages from 1991 to 2011; that is, denuclearization of North Korea was possible but three conditions should be satisfied beforehand (i.e., no U.S. hostility, no U.S. nuclear threat, and a peace treaty) (Joo 2014). After Kim Jong-un rose to power, however, the North Korean regime has announced that its denuclearization is no more possible. On January 22, 2013, Pyongyang made a shocking statement that its denuclearization was “no more possible” due to “intensifying U.S. hostility.” Instead, “we will strengthen self-defense military measures including a nuclear deterrence, quantitatively and qualitatively” (KCNA 1/23/2013). Three weeks later, the Kim Jong-un regime escalated the crisis further by conducting a third nuclear test. Since then, Pyongyang has been adamant that any negotiation over its denuclearization would be “meaningless” (KCNA 10/4/2014). Instead, it is time to treat North Korea as “a nuclear weapons state” (KCNA 11/15/2014). For these two reasons (i.e., the succession crisis and the harsher rhetoric in recent years), we employ a double-platform in this paper, with an implicit assumption that the main motive of Pyongyang in its nuclear program has changed under Kim Jong-
As we expected, a double-platform performs much better than a single-platform (Table 1). A single-platform, which assumes that there is consistency in the North Korean nuclear provocations from Kim Jong-il to Kim Jong-un, has an overall accuracy of 75.5%. Although it is quite effective in identifying “noises” (i.e., harsh North Korean rhetoric which does not result in an actual nuclear test) from Pyongyang (82.3%), a single-platform has a significantly low accuracy rate with respect to a nuclear test (55.5%). Put differently, a single-platform functions like a coin toss when it comes to a successful detection of a pattern in the KCNA that a North Korean nuclear test is around corner. The low nuclear threat accuracy of a single-platform is particularly disappointing from our viewpoint because, after all, our goal is to develop a SML model for North Korean nuclear tests, not peaceful days.

In comparison, a double-platform performs much better in every category. In the case of the Kim-Jong-il-era model (KJI), its overall accuracy is 83.3%. Specifically, its nuclear threat pattern accuracy is 75% whereas its non-threat accuracy is 88.3%. A similar result is found for the Kim-Jong-un-era model (KJU) with its 84.3% overall accuracy, 73.2% nuclear threat accuracy, and 83.3% non-threat accuracy. What is particularly encouraging to us is the observation that a double-platform has a strong threat accuracy: that is, 75% for the KJI model and 73.2% for the KJU model. Simply put, a double-platform with two separate models for KJI and KJU detects three out of four North Korean nuclear tests successfully, based on its automated analysis of KCNA articles. As a result, we adopt a double-platform in this paper.

It is necessary to emphasize two points before we proceed further. First, the superior performance of a double-platform framework observed above was not a foregone conclusion. As mentioned previously, a single-platform model has a higher accuracy in every category in the case of conventional North Korean military provocations (Joo, Lamm, and Whang 2016). To our surprise, however, it was the double-platform that
performed better in the case of nuclear provocations. Second, an implicit assumption is built in a double-platform that the main motive of Pyongyang in its nuclear program has changed from Kim Jong-il to Kim Jong-un. Indeed, the next section will demonstrate that there is a clearly demarked pattern differentiating the Kim Jong-un regime from its predecessor as far as nuclear provocations are concerned. Whereas Kim Jong-il with a firm domestic control had aimed at international audience in the first two nuclear tests (2006 and 2009), Kim Jong-un in midst of a succession crisis targeted at domestic audience when he conducted the third North Korean nuclear test in 2013. Our finding indicates that the father and the son have different reasons, motives, and intentions in their nuclear provocations.

IV. Results of Double-platform Models: KJI vs. KJU

1. KJI Model: Targeting “International” Audience

According to our SML model in which the training dataset (i.e., a random selection of 70% from the KCNA articles) is used, the key words which show a certain pattern in the pages of KCNA immediately before a North Korean nuclear test during the Kim Jong-il era include “suppression,” “DWI (down-with-imperialism),” “delegation,” “foreign,” “greeting” and “cooperation.” Under certain conditions (to be explained below), the appearance of these key words in KCNA articles indicate that a nuclear test by the North Korean regime is about to occur within a week or so. In other words, they represent the patterns, signs, or indicators that Pyongyang is about to conduct a nuclear test in near future. As will be shown below, most of these terms (i.e., suppression, delegation, foreign, and cooperation) are targeted at an international audience. It seems that Pyongyang wants to consolidate its ties to those parts of the world which are sympathetic to North Korea before it conducts a nuclear test, probably in anticipation that its nuclear test would further isolate the country.

According to our SML model, the best indicator of an imminent North Korean nuclear test during the Kim Jong-il era is the word “suppression.” In the training dataset, 17 out of 21 KCNA articles which contained the term “suppression” appeared within a week from North Korean nuclear tests. How should we interpret such a result? A careful analysis of those 17 KCNA articles reveals that the term “suppression” is targeted at the “progressive forces” in South Korea which have long been known for its sympathetic stance toward Pyongyang. A typical pattern is that the North Korean government criticizes a “suppression” of progressive forces in South Korea. Or, Pyongyang urges the South Korean regime to stop persecuting progressive forces. For instance, “the [South Korean] authorities … benumb the independent awareness of the people while
kicking up a row of suppression of patriotic people … The south Korean judicial authorities should … immediately set free the detained patriotic people and democratic figures” (KCNA 10/5/2006. Italics added). Or, “the Lee Myung Bak group is frantically resorting to the fascist suppression of the progressive organizations for the reunification movement” (KCNA 5/20/2009. Italics added). As these examples illustrate, the most distinctive sign of an imminent North Korean nuclear test is a sudden increase in the use of the term “suppression” in KCNA articles. Our SML analysis indicates that an increasing reference to and criticism of the “suppression” of progressive forces in South Korea precedes a North Korean nuclear test with a short time lapse. Pyongyang tries to strengthen its ties to those sections of South Korea whom it sees as being sympathetic to North Korea immediately before it conducts a nuclear test.

When the term “suppression” is absent, the next best indictors of a nuclear test by the Kim Jong-il regime are “making” and “main.” A close reading of the KCNA articles which contain these two terms, however, shows quite clearly that they do not carry any specific meaning with respect to a nuclear test. When we exclude them as de facto stopwords, the second best sign that Pyongyang is about to carry out a nuclear test is the term “downwithimperialism” (in one word). Known as ‘ㅌ·ㄷ’ (acronym of “down with imperialism” in Korean), it refers to an illegal communist youth organization, which Kim Il-sung allegedly created to fight against Japanese colonialism in 1929 when he was only a middle school student. Although it is highly unlike that he was the leader of the group which included several college students, it is true that Kim Il-sung was expelled from a school and even imprisoned for his involvement in the “down-with-imperialism (DWI)” group, thus launching his long career as a communist. What is interesting is that the North Korean government increases its reference to the DWI immediately prior to a nuclear test. In the training dataset, 7 out of 10 KCNA articles which included the term DWI were published within a week from a nuclear test by Kim Jong-il. It seems that Pyongyang tries to send a nuanced message before its nuclear tests that it is entering a new era, an atomic one, just as the DWI opened a new era in North Korean history. Perhaps the North Korean regime tried to convey an image that as Kim Il-sung once struggled against imperialism (Japan then), Kim Jong-il was fighting against imperialism (America now), thus legitimizing his nuclear pursuit.

When we exclude “ago” as a de facto word, the next best indicator after “suppression” and “DWI” is a group of words such as “delegation,” “foreign,” “greetings,” and “cooperative.” In the training dataset, 14 out of 22 KCNA articles containing “delegation” and “foreign” were published within a week of a nuclear test. Likewise, 11 out of 14 KCNA articles containing “greetings” and “cooperative” were
published within a week from a nuclear test. It is not difficult to interpret these terms. Prior to a nuclear test which would further isolate the country, North Korea wants to boast that its relations to the outside world (especially, sympathetic countries, such as Russia, China, and some third world countries) remain solid. On October 4, 2006, for instance, “a delegation of the Russian International Charity Fund … arrived here Tuesday” and it “was greeted at the airport by Hong Son Ok … [who is] chairwoman of the Korea-Russia Friendship Association” (KCNA 10/3/2006. Italic added). Or, on May 21, 2009, “Kim Yong Nam, president of the Presidium of the DPRK Supreme People’s Assembly, sent a message of greetings to Ali Abdullah Saleh, President of Yemen, on the occasion of the 19th national holiday … [e]xpressing belief that the friendly and cooperative relations between the DPRK and Yemen would grow stronger” (KCNA 5/21/2006.Italic added). Or, on May 17, 2009, “Wu Donghe, chairman of the China-Korea Friendship Association, was interviewed by KCNA … [H]e recalled that President Kim Il Sung together with Chairman Mao Zedong, Premier Zhou Enlai and other Chinese revolutionaries of the elder generation provided the friendly relations between the two countries. The President is … a close friend of the Chinese people, he said, adding that the Sino-DPRK friendly and cooperative relations are growing stronger” (KCNA 5/17/2009. Italics added). As these examples illustrate, Pyongyang emphasizes its close ties to several sympathetic counties prior to a nuclear test, probably in an effort to counter an international backlash which its nuclear test would soon bring.

Finally, there remain 170 KCNA articles in the training dataset, which do not include any of the indicators discussed so far. Accordingly, our SML model identifies them as peace articles. In reality, however, about 30% of these KCNA articles (52 out of 170) were published within a week from the two nuclear tests by Kim Jong-il. As a result, our model based on an automatized text classification has a roughly 70% accuracy when none of the six indicators of a nuclear test (i.e., suppression, DWI, delegation, foreign, greetings, and cooperative) appears in the pages of the KCNA. On the one hand, it is encouraging to learn that our model has detected six critical signs or indicators during the Kim Jong-il era that its nuclear test is around a corner. When these key terms appear in the pages of KCNA under certain conditions, the SML model can correctly categorize about 70% of KCNA articles either as nuclear threat articles or peace items.

On the other hand, it is too early to be optimistic at this point. After all, the 70% accuracy is achieved in the training dataset from which our model is derived in the first place. To be amazed at the 70% accuracy of our SML model would be similar to a case study specialist who develops an elaborate theory from several cases and then applies it back to those original cases only to be amazed how “accurate” his theory is. The real
test, however, comes when the theory is applied to cases other than those from which it has been driven. In other words, it is necessary to apply our model to a dataset which is different from the training dataset. In fact, this is why we have divided the entire KCNA data into two subsets in the first place: that is, the training dataset (a random selection of 70% from the total KCNA data) and the test dataset (the remaining 30% of the KCNA data). It is time to apply our model to the test dataset in order to examine whether or not its 70% accuracy vis-à-vis the training dataset can be maintained against the test dataset.

<table>
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<th>Neg. Predictive Value</th>
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<td>0.86</td>
</tr>
<tr>
<td>Non-Nuclear Test</td>
<td>0.75</td>
<td>0.88</td>
</tr>
</tbody>
</table>

Table 2: KJI Model against the Test Dataset

Table 2 shows the result of the KJI model against the test dataset with its overall accuracy at 83%. To our surprise, the figure is even higher than the original model accuracy we have obtained from the training dataset (75.5%; See Table 1). As a result, although the KJI model is driven from the training dataset, it gains even more explanatory power vis-à-vis the test dataset. To be precise, out of 150 KCNA articles in the test dataset, the KJI model correctly categorizes 125 articles (83.3%) either as nuclear threats or as peace signs. It can accurately detect whether various messages of the Kim Jong-il regime represent real signs of an imminent nuclear test or mere noises in eight out of ten cases. In particular, the KJI model performs somewhat better in identifying “noises” from Pyongyang: namely, messages not resulting in a nuclear test. Out of 94 peace articles in the test dataset, the KJI model successfully classifies 83 articles as noises with only 11 misses (88.3% accuracy). By contrast, the accuracy of our model drops a little bit with respect to nuclear threats. Out of 56 nuclear threat articles in the test dataset, the KJI model accurately categorizes 42 items as a pattern of an imminent nuclear test, while misclassifying 14 items as peace signs even though they have actually led to a nuclear test (75% accuracy).

To summarize, the KJI model identifies a certain pattern in the pages of KCNA immediately before the North Korean regime under Kim Jong-il conducts a nuclear test. To be specific, there is a strong tendency in the KCNA that key terms like “suppression,” “DWI,” “delegation,” “foreign,” “greetings,” and “cooperative” appear
more frequently prior to a nuclear test. Our qualitative analysis of those KCNA articles containing the six attack words reveals that the Kim Jong-il regime was especially focusing on international audience (i.e., those foreign countries and groups sympathetic to North Korea) before it conducts a nuclear test, probably in an attempt to consolidate its ties to the outside world when its upcoming nuclear test is all the more likely to cause a further isolation of the country. Based on these six key terms, the KJI model can categorize with a roughly 80% accuracy whether various messages from Pyongyang during the Kim Jong-il era are critical signs of a nuclear test or not.

2. KJU Model: Targeting “Domestic” Audience

According to the KJU model, by contrast, the key words which separate nuclear threat articles from peace items during the Kim Jong-un period are “star,” “satellite,” “respected,” “service,” “sovereignty,” and “defending.” As will be shown below, the most interesting characteristics of the Kim Jong-un era is that unlike his father who focused on international audience, Kim Jong-un has mainly aimed at domestic audience prior to a nuclear test. Whereas the father with a firm domestic control had been able to aim at international audience before his two nuclear tests, the young son in midst of a succession crisis had to target domestic audience when he conducted the third North Korean nuclear test immediately after his rise to power.

The first and strongest pattern-detector of a nuclear test by Kim Jong-un is the term “star.” In the training dataset, all the KCNA articles which contained the word “star” (36 articles in total) are published within a week from the third North Korean nuclear test. What does the term “star” mean and why does it play such a significant role? A careful examination of those 36 articles in question reveals that the term “star” refers to the deceased leader Kim Jong-il. In fact, “the shining star (kwangmyŏngsŏng)” is a euphemism which is regularly used by the North Korean media to refer to “Dear Leader Kim Jong-il” (KCNA February 4, 2014). As a result, it turns out that the most distinctive pattern of KCNA articles immediately prior to a nuclear test by the Kim Jong-un regime is a sudden increase of a symbolic reference to Kim Jong-il. Hurried to power and barely 30 years old, Kim Jong-un may be trying to connect an incoming nuclear test to the symbol of his father in an apparent attempt to highlight continuity between his father (who had first conducted a nuclear test) and himself, thus smoothing out a succession process. As Kim Jong-il used to incur his father’s symbol (i.e., “DWI [down-with-imperialism]”) before he conducted a nuclear test, Kim Jong-un is now resorting to his father’s symbol (i.e., “shining star”) prior to a nuclear test.

When “star” is absent, the second best pattern-detector of a nuclear test by the Kim
Jong-un regime is the word “satellite.” To be specific, the term “satellite” successfully categorizes about 83.3% of the KCNA articles containing it (35 out of 42) as nuclear threats. As a result, a sudden increase in the frequency of the word “satellite” in KCNA articles indicates that a nuclear test is around corner. How should we interpret such an outcome? A careful analysis of those KCNA articles containing the term “satellite” shows that a direct reference to a successful missile launch (i.e., “satellite”) tends to precede a nuclear test with a temporal lapse of a week or so. In other words, Pyongyang tends to boast a successful missile launch right before it conducts a nuclear test. On February 4, 2013, for instance, “the dear respected Marshal Kim Jong Un invited Pyongyang scientists, technicians, workers and officials who contributed to successfully launching satellite … [and] showed the greatest privilege and deepest loving care to be always remembered by them throughout their lives” (KCNA 2/4/2013). Obviously, Pyongyang tries to emphasize a successful missile launch as an important achievement by Kim Jong-un whose “deepest loving care” should be remembered “throughout their lives.” As a result, it is “the greatest privilege” of North Koreans to live under Kim Jong-un. Clearly, the second indicator “satellite” is aimed at domestic audience, trying to consolidate the rule of Kim Jong-un.

The third distinctive pattern that Kim Jong-un was inching toward a nuclear test is the increasing appearance of the word “respected” in the pages of the KCNA. In the training dataset, the term “respected” correctly identified with about 60% accuracy whether or not those KCNA articles containing the term is associated with an imminent nuclear test. In particular, 15 out of 25 KCNA articles with the word “respected” (but without “star” and “satellite”) are published within a week from a nuclear test by Kim Jong-un. How should we interpret the significant role of the term “respected”? Consider the following quote from a KCNA article; “A pledge-taking meeting of exemplary primary information workers of the Kim Il Sung Socialist Youth League across the country … vowed to accomplish generation after generation the revolutionary cause of Juche which started on Mt. Paektu, under the Songun leadership of the dear respected Marshal Kim Jong Un, true to the noble intention of Kim Jong Il” (KCNA 2/5/2013. Italics added). Or, “the slogan whose justice and might have been clearly proved in army building and military activities is being successfully carried out under the Songun leadership of the dear respected Supreme Commander Kim Jong Un. He underscored the need to make the hot wind of intensive training sweep the army just as the anti-Japanese guerrillas did on Mt. Paektu, so as to prepare all the soldiers to be a-match-for-a-hundred combatants who have acquired Kim Il Sung-Kim Jong II’s strategy” (KCNA 2/5/2013). As these examples illustrate, the term “respected” is used in KCNA articles in
reference to Kim Jong-un with various titles, such as “dear respected leader,” “dear respected marshal,” “dear respected Supreme Commander,” and so on. Pyongyang seems to have dramatically increased the visibility of its young leader prior to a nuclear test, as a preparatory measure to claim the upcoming nuclear test as his achievement. Again, the third indicator “respected” is targeted at domestic audience, trying to build up credentials of the young inexperienced leader.

When we remove “said” as a de facto stopword, the fourth pattern-detector of a nuclear test by Kim Jong-un is the term “service.” To be specific, the word “service” classifies with 64.3% accuracy whether the KCNA articles containing it indicate an upcoming nuclear test or not; that is, 9 out of 14 such articles are published within a week from the third North Korean nuclear test. What is the meaning of the term “service”? Turning back to the KCNA articles containing the term reveals that it refers the loyalty of the service personnel of the Korean People’s Army (KPA) to Kim Jong-un. On February 8, 2013, “Supreme Commander of the Korean People’s Army Kim Jong Un … called on the army to undertake the project and demonstrate its might as the army of the party and the people once again. KPA service personnel held a meeting on the spot on Thursday to vow to implement to the letter the order given by the supreme commander” (KCNA 2/8/2013. Italics added). Or, “service personnel, officials and people across the country achieved many successes in the land administration true to the patriotic intention of Marshal Kim Jong Un” (KCNA 2/4/2013). As these examples demonstrates, Pyongyang tends to boast before a nuclear test the loyalty of its army, the most important unit to maintain the Kim Jong-un regime, especially due to the so-called “Military-First Politics” introduced by Kim Jong-il in 1997. Once again, the fourth indicator “service” is aimed at domestic audience, conveying the message that the army is fully behind Kim Jong-un in midst of a succession process.

The least significant, yet related, two indicators of a nuclear test by Kim Jong-un are “sovereignty” and “defend.” Unlike other and stronger pattern-detectors (i.e., “star,” “satellite,” “respected,” and “service”), the classification accuracy of “sovereignty” and “defend” is meager at best. Only three out of 13 KCNA articles containing these two terms are published within a week from the third nuclear test. On the one hand, it is not difficult to interpret these two indicators; that is, Pyongyang is determined to defend its sovereignty. For instance, “Songun [Military-First] politics which fully embodies the Juche idea serves not only as a treasured sword for defending the DPRK’s sovereignty but also as the most powerful weapon for the anti-imperialist struggle” (KCNA 2/4/2013. Italics added). On the other hand, it is not easy to identify to whom such a message is addressed. The message of “defending sovereignty” is sometimes targeted at
domestic audience. For instance, “all servicepersons [of the KPA] are fully ready to risk their lives in an all-out action for defending the nation’s sovereignty” (KCNA 2/4/2013). At other times, however, the same message is aimed at international audience, especially the United States. For instance, “their [American] reckless military challenge only hardens the DPRK’s will to wage a final battle for defending its sovereignty” (KCNA 2/6/2013). As a result, we remain agnostic to the intended audience of the last two indicators, “sovereignty” and “defend.”

Finally, the training dataset has 237 KCNA articles that lack any of the indicators discussed above. Since they do not contain any signs or patterns of an upcoming North Korean nuclear test, the KJU model categorizes them as peace signs. It turns out that 178 out of 237 articles are, in fact, published during a period far from the third North Korean nuclear test in 2013. By contrast, about 25% of these KCNA articles (59 out of 237) are published within a week from the nuclear test by Kim Jong-un, thus wrongly classified by our model as peace signs. As a result, the KJU model based on a machine-learning of KCNA articles has a roughly 75% accuracy rate when none of the six indicators (i.e., “star,” “satellite,” “respected,” “service,” “sovereignty,” and “defending”) are present in the pages of KCNA.

It is encouraging to learn that the SML model has identified six key indicators, signs, or patterns from Pyongyang that its nuclear test is highly likely in near future. Even better, when these key terms are put together under certain conditions (as described above), they can successfully categorize about 75% of KCNA articles in the training dataset either as nuclear threats or as peace signs. As noted in the previous section, however, it is unwise to be optimistic at this stage because the reported 75% accuracy is achieved in the training dataset from which our model is driven in the first place. Instead, the real test comes when we apply the KJU model to the test dataset in order to find out whether or not its 75% accuracy vis-à-vis the training dataset can be maintained against the test dataset. The result is reported in the following table.

<table>
<thead>
<tr>
<th>Observation</th>
<th>Nuclear Test</th>
<th>Non-Nuclear Test</th>
<th>Pos. Predictive Value</th>
<th>Neg. Predictive Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear Test</td>
<td>41</td>
<td>7</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>Non-Nuclear Test</td>
<td>15</td>
<td>77</td>
<td>0.84</td>
<td></td>
</tr>
<tr>
<td>Sensitivity</td>
<td>0.73</td>
<td>0.92</td>
<td>0.84</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: KJU Model against the Test Dataset
As shown in Table 3, the KJU model performs even better when applied to the test dataset (an overall accuracy of 84%). It is surprising because when we used the machine-learning technology to analyze conventional North Korean military provocations in a separate paper (Joo, Lamm, Whang 2016), the accuracy of our model dropped a little bit against the test dataset. By contrast, the SML model on the North Korean nuclear tests remains robust (in fact, even more so) when it is applied to the test dataset. Out of 140 articles in the test dataset, the KJU model accurately categorizes 118 articles (84.3%) either as nuclear threats or as peace signs. It successfully tells us whether various messages from Pyongyang represent real signs of an upcoming nuclear test or mere noises in eight out of 10 cases. In particular, the KJU model is more effective in identifying noises from Pyongyang: namely, messages which do not lead to a nuclear test. Among 84 peace articles in the test dataset, our model successfully classifies 77 articles as noises with only seven misses: namely, 91.7% accuracy. By contrast, the accuracy of our model drops somewhat with respect to nuclear threats. Out of 56 nuclear threat articles in the test dataset, the KJU model categorizes 41 items accurately as significant indicators of a nuclear test: that is, 73.2% accuracy.

To summarize, the KJU model identifies a certain pattern in the pages of KCNA immediately before the Kim Jong-un regime conducts a nuclear test. There is a strong tendency of the North Korean regime to increase the frequency of key terms, such as “star,” “satellite,” “respected,” “service,” “sovereignty” and “defending,” in the page of KCNA immediately prior to a nuclear test. A careful reading of these KCNA articles containing the six “attack words” (so to speak) reveals an interesting pattern that the Kim Jong-un regime was mainly targeting at domestic audience before it conducts a nuclear test, probably in an attempt to consolidate the power of the young inexperienced leader in midst of a succession process. In this respect, there is a stark contrast to Kim Jong-il with a firm grip on power, who was mostly focused on international audience before his two nuclear tests, probably in an effort to consolidate his ties to the outside world when upcoming nuclear tests were most likely to lead to an international isolation of the country already in a deep trouble.

V. Conclusion

We employed a supervised machine-learning (SML) technique based on automated text classification in order to elaborate an analytical model of the North Korean nuclear tests between 1997 and 2014, while using the KCNA as our main data. Specifically, our SML model investigated the frequency of all the words (except “stopword”) used in
KCNA articles right before the North Korean nuclear tests. The SML model then compared the frequency of those words appearing in the pages of the KCNA prior to the nuclear tests with the frequency of those terms appearing in KCNA articles during a peaceful period without the North Korean nuclear tests. In so doing, we were able to distil a number of pattern-detecting terms, the occurrence of which increased conspicuously in KCNA articles immediately before Pyongyang conducted a nuclear test. On the basis of those key terms, our SML model accurately categorized about eight out of 10 articles in the test dataset either as signs of an imminent North Korean nuclear threat or as signs of non-threat.

What is most interesting in our findings is that a double-platform has performed better than a single-platform in the case of the North Korean nuclear tests. It is all the more surprising because we have shown in a separate paper that a single-platform is, in fact, superior to a double-platform in the case of conventional North Korean military provocations during the same period. As a result, it seems that there has been consistency in the North Korean policy as far as its conventional military provocations are concerned. By contrast, Pyongyang seems to have a second thought about its nuclear program in recent years. As emphasize earlier, a double-platform has a built-in assumption of a policy shift; that is, it performs better than a single-platform only if the main motive of Pyongyang has changed from Kim Jong-il to Kim Jong-un. Indeed, our analysis shows that there is a unique pattern differentiating the Kim Jong-un regime from its predecessor as long as its nuclear tests are concerned. For the KJI model, the key pattern-detecting terms include “suppression,” “DWI,” “delegation,” “foreign,” “greetings,” and “cooperative.” A close look at the KCNA articles containing these six terms shows that Kim Jong-il was mainly focusing on international audience (especially, those countries or groups sympathetic to North Korea) before he conducted a nuclear test, probably in an effort to strengthen ties to the outside world when an imminent nuclear test would put the country in a more isolated position. For the KJU model, by contrast, the main terms of differentiation were “star,” “satellite,” “respected,” “service,” “sovereignty,” and “defending.” An analysis of the KCNA articles containing these six words reveals a unique pattern of the Kim Jong-un regime that it was mostly targeting at domestic audience before a nuclear test, probably in an attempt to consolidate the position of the young inexperienced leader in midst of a succession process. The stark contrast between the two different target audiences suggests that the father and the son have different reasons, motives, and intentions in their nuclear provocations.

As a final note, it is important not to over-interpret our SML model. In particular, we
do not contend that our SML model has detected intentional signals from the North Korean regime that its nuclear test is just around corner. If such were the case, the SML model should be able to “predict” a future North Korean nuclear test. For one simple reason, however, we are skeptical to a predictive potential of our model. If the North Korean regime has intentionally employed those key terms or “attack words” as deliberate signals to warn the outside world that it ran out of patience and is gearing up for a nuclear explosion, why would it transmit such a critical signal in an unreasonably arcane way which could be detected only through a complicated process of automated text classification? If Pyongyang intends to send an important message or warning to the outside world, there is a better, simpler, and more visible way, such as an “Official Announcement by the Ministry of Foreign Affairs” which the North Korean government has occasionally announced in the KCNA on critical issues, such as a nuclear crisis. For their arcane nature, the key terms or “attack words” in our SML model should not be regarded as a deliberate signal from Pyongyang that warns an imminent nuclear test.

To reject a “signalling” nature of the attack words (thus, questioning a “predictive” potential of our SML model), however, does not mean that none was intended by the North Korean regime in those KCNA articles published just prior to a nuclear test. As shown throughout the paper, something important was intended and that something has changed over the years. Whereas Kim Jong-il with a firm domestic control intended to appeal to international audience prior to a nuclear test, Kim Jong-un in midst of a succession crisis intended to appeal to domestic audience to consolidate his relatively precarious power. As far as nuclear provocations are concerned, the expression “Like Father, Like Son” does not apply to Pyongyang where the son is looking inside while the father used to gaze outside.
References


