The Language of Nuclear Security - New Case Studies

Zenobia S. Homan (King's College London, presenting author), Yara Sha'ban (Middle East Scientific Institute for Security), Shraddha Rane (Purdue University) & Fadime Özge Özkan (Istanbul Technical University)

Introduction

This paper is part of a project which connects nuclear security, open source information, and linguistics. Since nuclear security communication occurs in limited organisational contexts – through specialised language with professional standards, phrases, jargon and acronyms – information availability is relatively limited. We mapped the information landscape in three different countries, covering different continents, scripts, cultures, and, significantly, different levels of engagement with nuclear materials. Conducting open source internet searches, we paid particular attention to publicly available information. We looked at categories (e.g. government, industry, media), themes (e.g. energy, economy), and source quality (conceptual accuracy). Overarching, we considered how this information is affected by the language in which it is presented – building on an exploratory study presented at the INMM Annual Meeting in 2019.[1]

The case studies illustrate how someone may struggle to acquire useful information on nuclear security – for example, students or new professionals, but also journalists and policymakers. Accordingly, we examined the significance of gaps in information as well as any miscommunication.[2] It is important to map limitations in national-level information availability because concepts do not necessarily translate across languages, countries or cultures. Translation may simply not be possible (there is no direct equivalent of a word or concept) or confusing (the word or concept does not have the same connotations in the translated context). In particular, automated online translation does not always hit the mark. These discrepancies can cause misunderstandings and misperceptions, leading to failures in engagement and response.

Specifically, language-use in the nuclear community has become functionally stratified: in many situations, two or more languages are used under different conditions (for example, organisation as a whole versus a specific team within it; or work versus home). Despite this, nuclear language has not yet been thoroughly charted or defined; not as an international concept by itself, nor the variety between different national languages. Ultimately, it is our aim to 1) encourage the nuclear community to look beyond internationally dominant languages; both in acquiring information, and in publishing information in the first place, and 2) to contribute to clarifying the language of nuclear security and enhance global nuclear security practices. In this paper, we will specifically be examining these aims in the context of nuclear security training and education, forging practical steps forward for curriculum design.

Learning Nuclear Language

To start with, it might be useful to introduce some common scenarios. Many countries use more than one official language. In Morocco, it is common to have knowledge of both Arabic and French as well as a minority language such as Berber. South Africa maintains 11 official languages - although at least 35 are commonly spoken. Many people will have knowledge of at least 3 or 4 languages, used in different social contexts (including different work contexts, such as team versus manager). It could also be the case that someone grew up with German,

but then adopted English at work. More specifically, they may have grown up with German, speak German with their direct colleagues, but then use English in broader meetings and documentation. Alternatively, someone may use variations of one and the same language: for example, they speak Hiberno-English at home, but 'nuclear English' at work.

In order to think about this practically, there are some lessons we can take from second language learning. In the beginning, learners are often prone to making errors because of skill transfer stemming from knowledge of their native language, or another language they know. If these mistakes are not adequately addressed, they can lead to the development of habits that run contrary to target language expectations, and potentially cause mutual misunderstanding.[3] Useful in this context is the idea of 'tacit knowledge' – information someone acquires throughout their career, often in the process of working with others, which ensures that colleagues amongst each other know exactly what they mean. It has been argued in the past that if this type of nuclear knowledge is not documented then specific processes could be lost.[4] Therefore, it may be possible to address the nuclear learning curve, and initial errors in communication, by recording mutual understanding and agreement. Consequently, more advanced 'speakers' will find that the language has become more meaningful – and they develop the ability to work within that framework irrespective of any other language they know.[5]

At this micro level, it is important to acknowledge culture in relation to language learning. Ability to communicate in the appropriate (type of) language and awareness of specific meanings and connotations in that language can not only make a difference when it comes to respect and trust but also clarity and significance.[6] Upon surveying the the meaning of 'security' and 'safety' in various languages we were told that in Bengali both ideas often correlate with a sense of avoiding physical harm; in Bulgarian we were told there is a distinct difference between national security, guarding, and personal safety such as personal protective equipment; and in Japanese feeling safe or secure was linked to peace of mind, ranging from mental health to food safety. (N.b. these examples represent a collection of personal representations and not understanding in whole countries or societies.)

The examples illustrate that meaning is complex, and difficult to copy from dictionaries or glossaries. Instead, in learning nuclear language, it is important not to work on the assumption that one system is right (e.g. the more experienced 'speaker') and that others need to adapt. Nuclear security culture should be examined from all perspectives, meaning all languages, in order to reach a common understanding in support of the ultimate goal: the security of both people and materials. Particularly in Western education, it has been shown that there can otherwise be 'colonising influence' i.e. bias towards 'dominant' cultural value systems embodied in teaching methods and materials.[7]

This dominance takes centre stage in the case studies which we will present below. We found that most countries, whether nuclear newcomers or veterans, have a mostly English-language nuclear security information landscape. There are both advantages and disadvantages to this, when it comes to developing 'nuclear language' - locally as well as globally. By studying Turkey, India and Jordan, we will identify common themes and gaps in openly available sources, and discuss the significance of these for each country-context.

Information Availability Case Studies

To sketch out the internet information landscape for each country, we adapted a method used in an open source study of military medical systems.[8] In essence, this can be utilised by

individuals with no prior knowledge or training in either search techniques or the subject in question, avoiding specific coding, programming, software, or other tools – and it should be applicable to any other country search as well. We conducted searches for 'nuclear security' in English, and then the equivalent in other languages – dividing the results into categories (for example, 'nuclear energy', 'nonproliferation' and 'regulation'). Notably, in Hindi the same word is used for both safety and security (*suraksha*), in Turkey the concepts are exchanged in certain contexts (*emniyet* and *güvenlik*) and in Arabic there are multiple concepts that relate to each (*al'amn, 'amn, al'aman, salama*, and more). We compared which language resulted in a higher quantity or quality of results, and examined gaps in information.

Turkey is a 'nuclear newcomer'.[9] It has a TRIGA Mark II research reactor at Istanbul Technical University (ITU) which has been under operation since 1979. At the time of writing Turkey is also in the process of completing its first nuclear power plant in Mersin province.[10] Turkey has a population of around 82 million whose primary language is Turkish. Despite the relative popularity of English as a language of education and tourism, overall national proficiency in English remains "very low".[11] With that said, Turkey came out on top from our three case study countries when it came to information availability on nuclear security, both in Turkish and in English.

In the English search for 'nuclear security' in Turkey we got 74 results (2020-2021). The biggest category overall was 'nuclear energy' – it was the primary category for 20% of results. In shared second place, with 13.5% of results each, were 'Nuclear Security Summit', 'international relations' and 'nuclear security' itself. While nuclear security was mentioned in many of the outputs, it was rarely the primary topic of a web-page or article. The oldest result dated to 2006 (a US case study on Turkey), with most outputs falling in the 2014-2016 Nuclear Security Summit period. News media were responsible for the largest number of results, while academic articles were notably absent (despite the fact that they do exist). In comparison, the Turkish language search yielded 87 results. The biggest category overall was 'nuclear energy' again (36%), the second largest category was 'Nuclear Security Summit' (18%). 'Nuclear security' itself was now the eighth largest category (5%) after others such as 'nuclear science' 'regulation', and also 'nuclear safety'. The oldest output was a set of regulation documents from 1983, and overall, in Turkish, more results related to nuclear regulation. There were also more results linked to the government, and more media articles.

India on the other hand currently has 23 operable nuclear reactors, both for research and for energy, with several more planned and under construction. It also has a nuclear weapon programme, having tested its first nuclear device in 1974. India has a population of more than 1.3 billion, with 121 languages recorded in the 2011 census. Almost half the country indicated Hindi as a first language, and English is the most widely spoken language (whether it is a second, third, etc. language) after this.

In the English search for 'nuclear security' in India we got 58 results (2020-2021) – notably fewer than Turkey. However, this time the largest category overall was actually 'nuclear security'. Other common themes were the Nuclear Security Summits, nuclear energy and nuclear policy. Nuclear weapons and terrorism occurred more often as themes than in our other country case studies. The biggest media category was 'news', contributing 43% of results, followed by academia, government and policy. None of the English-language results were linked to the nuclear or radiological industry. This more limited information landscape can be

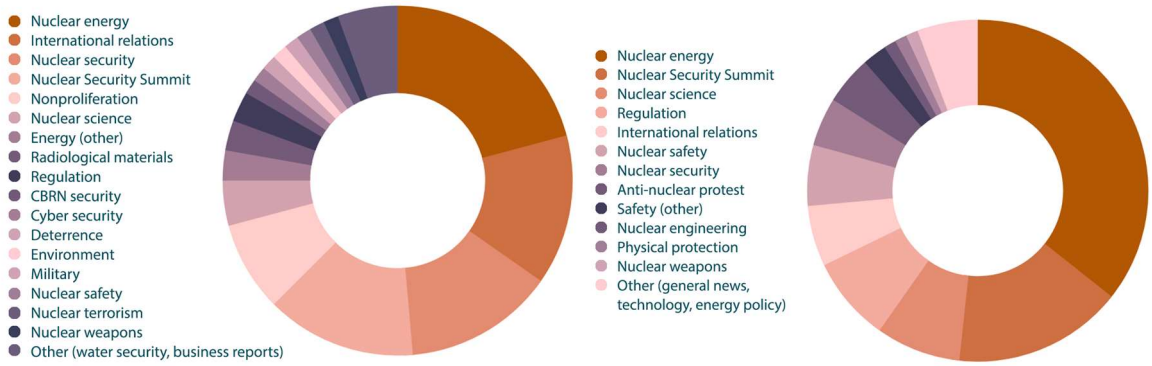

Figure 1a: Open Source Internet Search for 'Nuclear Security' in Turkey – English. Figure 1b: Open Source Internet Search for 'Nuclear Security' in Turkey – Turkish.

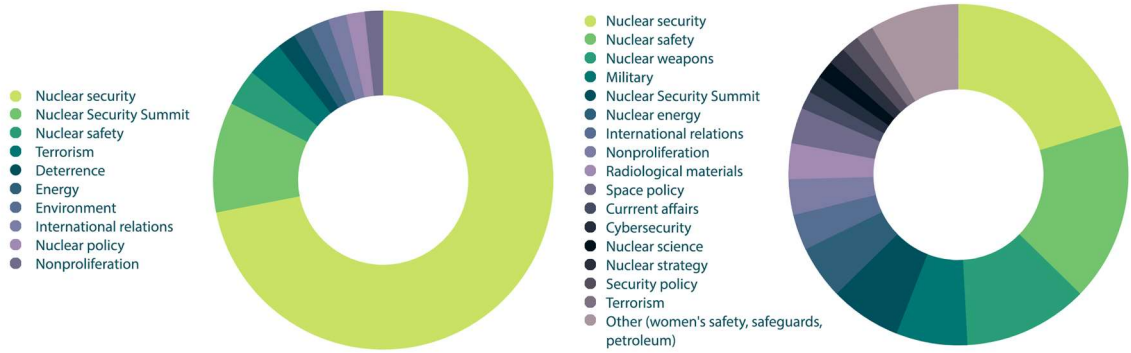

Figure 2a: Open Source Internet Search for 'Nuclear Security' in India – English. Figure 2b: Open Source Internet Search for 'safety/security' in India – Hindi.

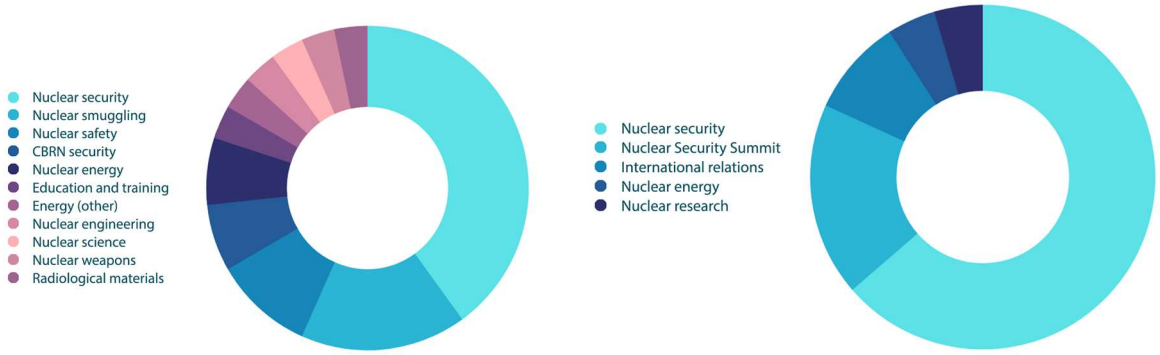

Figure 3a: Open Source Internet Search for 'Nuclear Security' in Jordan – English. Figure 3b: Open Source Internet Search for 'Nuclear Security' in Jordan – Arabic.

explained by a general information opacity in India when it comes to topics such as nuclear security, including nuclear weapons and nuclear energy. In comparison, the Hindi language search yielded 59 pages – so while *suraksha* encompasses the broader idea of both safety and security, this did not result in additional outputs. The biggest category overall remained 'nuclear security' (19%) (and also 'nuclear safety' – 12%). However, there was more variation in results and themes than in English. Most results came from news media, and again very little could be linked to industry or government. The volume of reports from the United States on India's nuclear security was higher than the reports from India itself. Although English is clearly the language of nuclear security in India, open source information diversity in English is more limited than in Hindi.

Finally, we considered Jordan. It began operating a research reactor as recently as 2017, and while nuclear energy has been discussed there are currently no plans being taken forward. Jordan has a population of around 10 million, and the main language spoken is Arabic – although it is important to remember there are significant differences between Modern Standard Arabic and colloquial variations. We adapted our search multiple times to include different grammatical compositions and spellings, each resulting in slightly different outputs. In universities, a mix of English and Arabic is used (e.g. English text-books, Arabic lectures).[12]

In the English search for 'nuclear security' in Jordan we got 37 results (2020-2021), of which the majority was published after 2010. The biggest category overall was 'nuclear security' (30%), followed by 'nuclear smuggling' (13.5%) – a topic which had not come up in the other countries' case studies. Notably, the majority of results this time were government web pages (38%), followed by career-related content (such as profiles, CVs and job listings) (24%) and academia (11%). There were not many news media outputs. This indicates very different information priorities than in India, and even Turkey. In comparison, the Arabic language search yielded only 20 pages. The biggest category was 'nuclear security' (60%), followed by 'Nuclear Security Summit' (20%) – and these mostly dated to 2016 and beyond. However, the Arabic results included significantly more news media outputs. It is clear that nuclear security is a much newer topic in Jordan than in the other case study countries. Overall, the main open sources of information on nuclear security in Jordan are news articles – but it should be noted that many of these were copied from one site to the other. If in Arabic, they were sometimes translated from English into Arabic (rather than vice versa). There were hardly any academic or industry results: the only industry-related result linked to the Middle East Scientific Institute for Security (primarily in English rather than Arabic).

In conclusion, the three case studies suggest that it makes sense to match education and training to the specific informational needs of a country's nuclear program. In India, most nuclear-related discourse available on the internet is centred on English-language based media and newspaper articles, and working documentation is produced or translated into English. Turkey, on the other hand, has a lower English proficiency in the nuclear industry and also faces a unique challenge of regulator-operator information asymmetry. Turkey's energy agreement with the Russian Federation comes at the cost of foregoing opportunities for domestic workforce development – and confusion may arise during technical discussions between Russian and Turkish speaking personnel when they lack a common language. In the case of Jordan, the challenge is to make sure that the version of Arabic being used to translate technical documents is equivalent to the language and writing used in a particular region. The IAEA's documents are mostly translated in Modern Standard Arabic which do not reflect information and knowledge from different dialects.[13]

With that said, many people working with nuclear materials in these countries will be required to use English – e.g. those working at the power plants, universities, and research labs. This is a much smaller step to make for bilinguals from India, where English is commonly used in the security field, than from those from Jordan and Turkey, where English plays a much less prominent role. Even so, the results from each case study country showed a much larger volume of English language than local language outputs, with significant differences in topics and themes between them. While there is something to be said for encouraging organisations such as the IAEA to promote 'nuclear English', it may also be useful to focus on improving the availability of materials in different languages.

Teaching Nuclear Language

The field of learning sciences offers some evidence on how "cannon building is knowledge building". It demands awareness and vigilance on the ways we use language in training to shape our collective knowledge. Within this, views that science is a settled discipline, disconnected from its cultural, historical, and political underpinnings, have become outdated. Instead, many will now take an onto-epistemic heterogeneity approach to "craft a new language and tools for conceptualising problems and possibilities in disciplinary learning."[14] How this conversation and the results of this paper have implications in nuclear security training needs some unpacking, and we offer three guiding points.

First, our research indicates that there is indeed a multiplicity of knowing and understanding of nuclear security from the different terms people adapt and adopt from their language. How these meanings contribute to learning and participating in nuclear security training is restricted and often-times excluded when the language of instruction and content is in English. Meaning-making is layered, and language is an elasticised medium of continuous negotiation.[15] We can conclude that nuclear security education as a medium to advance nuclear safety and security practices will be enriched and expanded by the cultural and political histories of the participants' language.

Second, researchers have studied both everyday language and academic language in the context of science learning. For example, it has been shown that academic language distinctly differs from students' conversational language.[16] Teachers need to build on students' well-developed language to learn new forms of thinking such as theorising and categorisation that the academic language enables. It is possible to empirically argue for a "dialectical relationship between scientific and everyday concepts".[17] This means that these two concepts, communicated and manifested in language, activities, and tools, shape one another and pave the way for their development. We can conjecture that the same dynamics apply in nuclear security training and education. Therefore, understanding the use of language in concept formation in formal and informal registers used in training would inform educators and practitioners alike on advancing their fields.

Third, code-switching is the norm when conducting nuclear security training in emerging nuclear states such as Turkey and Jordan. The Middle East Scientific Institute for Security designed and delivered various training on topics related to nuclear security in Arabic. Both the trainers and the participants utilised Arabic to elaborate on ideas and concepts. At the same time, they often switched to English to encapsulate concepts such as 'Design Basis Threat', 'nuclear security', and 'half-life' of radioactive materials. This emergent third language, while the norm, is not well studied – if at all. This paper indicates how knowledge about nuclear

security topics in similar countries is publicly arranged in Arabic and English depending on the category, the audience, and the communicative goals of the sources. However, the impact of nuances of language and the nuances of interpretation as discussed and negotiated in training needs further investigation.

In summary, nuclear security education needs to be examined in-situ and the building of nuclear security terminology should not only factor the literal translation efforts from one language to another. Instead, the language of training and education must offer the flexibility to expand nuclear security terms and concepts that meet the needs of the participants, the state, and to accommodate the richness of the language. This process also entails engaging in solutions from experts and practitioners for the problems faced by emerging nuclear states – thereby allowing the emergence of new meanings facilitated by the language in use.

Going forward, a practical step would be to place emphasis on the ability to function in a language rather than on knowledge about the language. Some helpful suggestions from second language acquisition include minimising language interference by relying only on translation and transliteration; encouraging newcomers to engage in communication with more experienced 'speakers'; and accompanying verbal language by non-verbal messages as much as possible (situational learning).[18]

Conclusions

In this paper, we have summarised some of our case study results from Turkey, India and Jordan, and mapped out the open source nuclear security landscape for each country. Details on specific aspects of this, such as digital sociology (internet use in each country), the human factor in open source investigation (data collection), our methodology (which categories we used and what they mean), 'IAEA English', and the significance of multilingualism and different writing systems can be found in our other paper, referenced in the bibliography.[19] It is clear that openly available information on nuclear security in our case study countries is scarce; less information is available in the local languages; and mistranslation is a source of confusion. What is more, our online searches demonstrated limited usefulness. Therefore, we have tried to bring attention to pedagogy – providing observations on learning and teaching 'nuclear language', and exploring the significance of 'nuclear language' in nuclear security and nuclear security culture. We hope that this will help the nuclear community to see where there are gaps in information that can be filled, and why – in particular, nuclear newcomer countries, who can still shape rather than re-shape their information landscape now.

---

[1] Homan, Z. S. & Udum, S. (2019). 'The Influence of Language on Nuclear Security Education and Training' *Institute of Nuclear Materials Management Annual Meeting Proceedings*, Vol. 60. Mount Laurel: INMM.

[2] Full academic publication forthcoming (2021): Homan, Z. S., Sha'ban, Y., Rane, S., Özkan, F. Ö. & Yun, E., "Language Diversity in Open Source Internet Searches: Nuclear Security Case Studies," in *The International Journal for Intelligence and CounterIntelligence, Special Issue on Looking for Diversity in Intelligence – Organizations, Processes, and People.*

[3] Allard, D., Bourdeau, J. & Mizoguchi, R. (2011). 'Addressing Cultural and Native Language Interference in Second Language Acquisition,' *CALICO Journal*, Vol. 28, No. 3: p. 677.

[4] MacKenzie, D. & Spinardi, G. (1995). 'Tacit Knowledge, Weapons Design, and the Uninvention of Nuclear Weapons,' *American Journal of Sociology*, Vol. 101, No. 1: pp. 44-99.

[5] Taylor, B. P. (1975). 'Adult Language Learning Strategies and Their Pedagogical Implications,' *TESOL Quarterly*, Vol. 9, No. 4: p. 395.

[6] Lomicka, L. (2006). 'Understanding the other: Intercultural exchange and CMC,' L. Ducate & N. Arnold (Eds.), *Calling on CALL: From theory and research to new directions in foreign language teaching*. San Marcos, TX: CALICO.

[7] Allard, D., Bourdeau, J. & Mizoguchi, R. (2011). 'Addressing Cultural and Native Language Interference in Second Language Acquisition,' *CALICO Journal*, Vol. 28, No. 3: p. 677.

[8] Homan, Z. S., Bricknell, M. C. M., Leone, R. M., & Lelong, A. (2020). 'Analyzing International Military Medical Services: Developing a Methodology for Information Acquisition from Open Source Data,' *International Journal of Intelligence and CounterIntelligence*, Vol. 34: pp. 235-258.

[9] Homan, Z. S. & Udum, S. (forthcoming 2022). 'Nuclear security for nuclear newcomers,' in *Oxford University Press Handbook on Nuclear Security.*

[10] IAEA (2020). 'Country Nuclear Power Profiles: Turkey,' available online at https://cnpp.iaea.org/countryprofiles/Turkey/Turkey.htm.

[11] Savaşkan, I. (2016). 'Turkey's Place in the Rankings of The English Proficiency Index,' *Journal of Teacher Education and Educators*, Vol. 5, No. 2: pp. 192-208.

[12] Suleiman, Y. (2008). 'The Language Ecology of the Middle East: Jordan as a Case Study,' Hornberger N.H. (eds.) *Encyclopedia of Language and Education*. Springer, Boston, MA.

[13] Banks, J. Massy, K. & Ebinger, C. (2012). *Human Resource Development in New Nuclear Energy States: Case Studies from the Middle East*. Brooking Energy Security Initiative, Policy Brief.

[14] Warren, B., Vossoughi, S., Rosebery, A. S., Bang, M. & Taylor, E. V. (2020). Multiple Ways of Knowing: Re-Imagining Disciplinary Learning. Handbook of the Cultural Foundations of Learning, Routledge: p. 278.

[15] Bakhtin, M. M. (1981). *The dialogic imagination: Four essays*. Austin, TX: University of Texas Press.

[16] Gee, J. (2008). *What is academic language? Teaching science to English language learners: building on students' strengths.* Arlington VA: National Science Teachers Association Press.

[17] Gutierrez, K. D. (2014). 'Syncretic Approaches to Literacy Learning: Leveraging Horizontal Knowledge and Expertise,' *Integrative Research Review: Syncretic Approaches to Literacy Learning, Literacy Research Association Yearbook,* Vol. 63: pp. 48-60.

[18] K. H. (1995). 'Age Differences in Second Language Acquisition: An Educational Perspective,' *The Korean Language in America*, Vol. 1: p. 288.

[19] Homan, Z. S., Sha'ban, Y., Rane, S., Özkan, F. Ö. & Yun, E. (forthcoming). "Language Diversity in Open Source Internet Searches: Nuclear Security Case Studies," in *The International Journal for Intelligence and CounterIntelligence, Special Issue on Looking for Diversity in Intelligence – Organizations, Processes, and People.*