Safeguarding Pakistan's Nuclear Arsenal: The Threat of Nuclear Theft in Pakistan

An honors thesis for the Tufts International Relations Program

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Abstract

Safeguarding Pakistan's Nuclear Arsenal: The Threat of Nuclear Theft in Pakistan

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Relative to other nuclear-armed states, Pakistan's nuclear weapons are viewed as highly insecure and vulnerable to nuclear theft. There are terrorist organizations in Pakistan that have expressed their desire for nuclear material. If one of these organizations successfully stole from the Pakistani nuclear arsenal, the consequences would be catastrophic. It is critical that Pakistan's nuclear weapons (and all nuclear weapons) are protected from nuclear theft attempts.

A terrorist organization has never stolen from a country's nuclear arsenal. Therefore, evaluating the effectiveness of a country's nuclear security architecture is challenging, because scholars have no case studies and lack direct intelligence about terrorist organizations' leadership and decision-making.

In this thesis, I analyze the relationship between Pakistan's nuclear security architecture and the threat of nuclear theft by one of three major terrorist organizations. I use a variation of the Delphi Method to find scholarly consensus about Pakistan's nuclear security and terrorist organizations' decision-making calculus. By comparing Pakistani policies to terrorists' ambitions, I find that Pakistan has made great progress in its nuclear security, but there are outstanding vulnerabilities facing its arsenal (mostly from changes in its nuclear force posture) that will likely remain unresolved until the Indo-Pakistani conflict ends.

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Acknowledgments

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I must express my sincerest appreciation for my friends Alice Hickson, Bennett Fleming-Wood, Caleb Martin-Rosenthal, Jerry Zhang, and Will Kendall for acting as my sounding board during critical moments.

Thank you to my parents, housemates, and Tufts friends for their constant encouragement. I appreciate your enthusiasm about my research and treasure your kin/friendship, but you are under no obligation to read this thesis, as it is rather long.

Appendix A: List of Databases

- Columbia International Affairs Online (CIAO)
- Google Scholar (First 200 results)
- Harvard Kennedy School Think Tank Search
- IHS Jane's
- ProQuest Databases:
    - ABI/INFORM Collection
    - Alt-PressWatch
    - Boston Globe
    - Digital National Security Archive
    - Dissertations & Theses @ Tufts University
    - Ebook Central
    - EconLit
    - Ethnic NewsWatch
    - GeoRef
    - Index Islamicus
    - Military Database
    - NTIS Database (National Technical Information Service)
    - Policy File Index
    - ProQuest Dissertations & Theses Global
    - ProQuest Historical Newspapers: The New York Times with Index (1851 - 2017)
    - ProQuest Recent Newspapers: The Boston Globe
    - ProQuest Recent Newspapers: The New York Times
    - Publicly Available Content Database
    - SciTech Premium Collection
        - Natural Science Collection
        - Technology Collection
        - Science Database
    - Social Science Premium Collection
        - Criminology Collection
        - Education Collection
        - International Bibliography of the Social Sciences (IBSS)
        - Politics Collection
        - Social Science Database
        - Sociology Collection
- Middle East and Africa Database

Appendix B: Search Coding

Nuclear Force Posture	
Database	**Search Completed**
Columbia International Affairs Online (CIAO)	(Pakistan OR Pakistani) AND "nuclear security"
Google Scholar (First 200 results)	allintext: (Pakistan OR Pakistani) ("force structure" OR posture OR strategy) "nuclear security"
Harvard Kennedy School Think Tank Search	allintext: (Pakistan OR Pakistani) ("force structure" OR posture OR strategy) "nuclear security"
IHS Jane’s	[Pakistan OR Pakistani]<and>["nuclear security"]<and>["force structure" OR posture OR strategy]
ProQuest/Search #1	(ab(Pakistan OR Pakistani) AND ("nuclear security") AND ("force structure" OR posture OR strategy)) AND (pd(20160101-20211231) AND PEER(yes))
ProQuest/Search #2	((Pakistan OR Pakistani) AND ab("nuclear security") AND ("force structure" OR posture OR strategy)) AND (pd(20160101-20211231) AND PEER(yes))
Middle East and North Africa	(All Fields:Pakistan OR Pakistani AND All Fields:"nuclear security" AND All Fields:"force structure" OR posture OR strategy)

Nuclear Security Environment/Institutions	
Database	**Search Completed**
Columbia International Affairs Online (CIAO)	(Pakistan OR Pakistani) AND "nuclear security"
Google Scholar (First 200 results)	allintext: (Pakistan OR Pakistani) (institution OR commitment OR environment) "nuclear security"
Harvard Kennedy School Think Tank Search	allintext: (Pakistan OR Pakistani) (institution OR commitment OR environment) "nuclear security"
IHS Jane’s	[Pakistan OR Pakistani]<and>["nuclear security"]<and>[institution OR commitment OR environment]
ProQuest/Search #1	ab(Pakistan OR Pakistani) AND "nuclear security" AND (institution OR commitment OR environment) AND (pd(20160101-20211231) AND PEER(yes))
ProQuest/Search #2	((Pakistan OR Pakistani) AND ab("nuclear security") AND (institution OR commitment OR environment)) AND (pd(20160101-20211231) AND PEER(yes))
Middle East and North Africa	All Fields:Pakistan OR Pakistani AND All Fields:"nuclear security" AND All Fields:institution OR commitment OR environment"

On-Site Physical Protections	
Database	**Search Completed**
Columbia International Affairs Online (CIAO)	(Pakistan OR Pakistani) AND "nuclear security"
Google Scholar (First 200 results)	allintext: (Pakistan OR Pakistani) (arsenal OR stockpile OR base OR storage) "nuclear security"
Harvard Kennedy School Think Tank Search	allintext: (Pakistan OR Pakistani) (arsenal OR stockpile OR base OR storage) "nuclear security"
IHS Jane's	[Pakistan OR Pakistani]<and>["nuclear security"]<and>[arsenal OR stockpile OR base OR storage]
ProQuest/Search #1	((ab(Pakistan OR Pakistani) AND ("nuclear security") AND (arsenal OR stockpile OR base OR storage)) AND (pd(20160101-20211231) AND PEER(yes))
ProQuest/Search #2	((Pakistan OR Pakistani) AND ab("nuclear security") AND (arsenal OR stockpile OR base OR storage)) AND (pd(20160101-20211231) AND PEER(yes))
Middle East and North Africa	(All Fields:Pakistan OR Pakistani AND All Fields:"nuclear security" AND All Fields:arsenal OR stockpile OR base OR storage)

Capabilities	
Database	**Search Completed**
Columbia International Affairs Online (CIAO)	Pakistan AND “nuclear weapons” AND terrorism
Google Scholar (First 200 results)	allintext: (Pakistan OR Pakistani) (ISIL OR ISIS OR "Islamic State" OR Taliban OR al-Qaeda OR al-Qaida OR al-Qa'ida) "nuclear terrorism"
Harvard Kennedy School Think Tank Search	allintext: (Pakistan OR Pakistani) (ISIL OR ISIS OR "Islamic State" OR Taliban OR al-Qaeda OR al-Qaida OR al-Qa'ida) "nuclear terrorism"
IHS Jane’s	[Pakistan OR Pakistani] <and> ["nuclear terrorism"]
ProQuest	(Pakistan OR Pakistani) AND (ISIL OR ISIS OR "Islamic State" OR Taliban OR al-Qaeda OR al-Qaida OR al-Qa'ida) AND ("nuclear weapon" OR "nuclear material") AND (theft OR steal OR buy OR procure) AND (capabilities OR capability OR ability OR abilities OR potential OR capacity) AND (pd(20160101-20211231) AND PEER(yes))
Middle East and North Africa	(All Fields:Pakistan OR Pakistani AND All Fields:ISIL OR ISIS OR Islamic State OR Taliban OR al-Qaeda OR al-Qaida OR al-Qa'ida AND All Fields:”nuclear weapons” OR “nuclear material”)

Objectives	
Database	**Search Completed**
Columbia International Affairs Online (CIAO)	Pakistan AND “nuclear weapons” AND terrorism
Google Scholar (First 200 results)	allintext: (Pakistan OR Pakistani) (ISIL OR ISIS OR "Islamic State" OR Taliban OR al-Qaeda OR al-Qaida OR al-Qa'ida) "nuclear terrorism"
Harvard Kennedy School Think Tank Search	allintext: (Pakistan OR Pakistani) (ISIL OR ISIS OR "Islamic State" OR Taliban OR al-Qaeda OR al-Qaida OR al-Qa'ida) "nuclear terrorism"
IHS Jane’s	[Pakistan OR Pakistani] <and> ["nuclear terrorism"]
ProQuest	(Pakistan OR Pakistani) AND (ISIL OR ISIS OR "Islamic State" OR Taliban OR al-Qaeda OR al-Qaida OR al-Qa'ida) AND ("nuclear weapon" OR "nuclear material") AND (theft OR steal OR buy OR procure) AND (aspiration OR goal OR objective OR aim OR intent OR desire) AND (pd(20160101-20211231) AND PEER(yes))
Middle East and North Africa	(All Fields:Pakistan OR Pakistani AND All Fields:ISIL OR ISIS OR Islamic State OR Taliban OR al-Qaeda OR al-Qaida OR al-Qa'ida AND All Fields:”nuclear weapons” OR “nuclear material”)

Appendix C: Complied Quotes & Ratings

Nuclear Force Posture		
Title/Author(s)	**Quote(s)**	**Rating**
Deterring Nuclear Terrorism/ Robert Litwak	"The upper bound of the program is unclear because Pakistan's worrying development of tactical nuclear weapons for battlefield use has been justified by the Islamabad regime as essential for maintaining a credible nuclear deterrent in the face of Indian conventional superiority." (105-106) & "The risk of nuclear theft is increasing as the number of warheads grows and Pakistan develops, and possibly deploys, tactical nuclear weapons for battlefield use." (112)	2
Nuclear doctrines and stable strategic relationships: the case of south Asia/Mahesh Shankar and T. V. Paul	"All such risks, of course, are magnified within a delegative and dispersed command and control structure, as exists in Pakistan, and naturally become more extreme in crisis situations when nuclear assets have to be rapidly dispersed, thereby further degrading centralized control." (15)	3
Nuclear Terrorism: Did We Beat the Odds or Change Them?/Graham Allison	"Pakistan's growing nuclear arsenal and development of tactical nukes." - listed under: "Factors and Actions That Have Increased the Risk of Nuclear Terrorism" (9) & "Nuclear security experts have rightfully sounded the alarm bells. Tactical nuclear weapons deployed to the frontlines pose a clear risk of theft by a rogue field commander or terrorist group." (15)	3
Preventing Nuclear Terrorism: Continuous Improvement or Dangerous Decline?/Matthew Bunn, Martin Malin, Nickolas Roth, and William Tobey	"Pakistan has the world's fastest-growing nuclear arsenal, and is shifting toward tactical nuclear weapons intended to be dispersed to front-line forces early in a crisis, increasing the risks of nuclear theft should such a crisis occur." (48) & "The trend seems to be toward increasing risk, as Pakistan's nuclear arsenal expands and shifts toward tactical nuclear weapons, while adversary capabilities remain extremely high." (49)	3
Revitalizing Nuclear Security in an Era of Uncertainty/Matthew Bunn, Nickolas Roth, and William Tobey	"Pakistan's shift toward tactical nuclear weapons increases the risks of theft." (98)	2
Safer at Sea? Pakistan's Sea-Based Deterrent and Nuclear Weapons Security/Christopher Clary and Ankit Panda	"It is likely Submarine launched nuclear weapons may increase the danger of theft or sabotage. It is likely to choose the latter of these options, leaving it no choice but to make compromises on nuclear weapons security that leave open an unacceptably large possibility of unauthorized weapons' use or theft." (163-164)	1
The Arihant-Class SSBN and the Advent of Sea-Based Nuclear Forces in India, China, and Pakistan/Nathan Powell	"The development of this SSBN force has already led to Pakistan's own highly insecure sea-based nuclear force of conventionally powered submarines and cruise missiles." (136)	3
The Idea of 'Limited Nuclear War': As Impractical and Dangerous Now, As It Was Then/Manpreet Sethi	"Another related danger would be a heightened possibility of nuclear terrorism by non-state actors. The availability of nuclear weapons, related material, and infrastructure in more states not only raises the risks of nuclear security but also raise the chances of terrorists also feeling liberated from the taboo against the use of nuclear weapons." (243)	2

The Safety and Security of the Pakistani Nuclear Arsenal/Christopher Clary	"Pakistan’s nuclear developments over the last fifteen years have involved an unequivocal and dramatic expansion of the arsenal, some hints of heightened readiness, clear improvements for security, and a worsening threat environment." (105)	3
Trends in International Security and Trade (Trade Experts’ Roundtable, 2017)/Elinor Sloane	"Because smaller, short-range weapons are easier to steal, a major U.S. and Western concern is that nuclear weapons could fall into the hands of radicals." (5)	2
What the Nuclear Security Summits mean for South Africa/ Waheguru Pal Singh Sidhu	"What is not in dispute, however, is that the danger posed by forward-deployed tactical nuclear weapons, particularly by Pakistan, Russia and the US, has not been addressed and needs to be remedied."	3

Nuclear Security Environment/Institutions		
Title/Author(s)	**Quote(s)**	**Rating**
A Review of the Performance of the International Atomic Energy Agency Regarding Pakistan's Nuclear Activities/Hossein Moein Abadi Bidgoli and Mohammad Davand	"Under their protection and support, Pakistan not only has expanded its illegal nuclear activities but has also downplayed the NPT." (249)	2
Assessing Detecting and Deterring the Threat of Maritime Nuclear and Radiological Smuggling in the Western Indian Ocean Region/ M Umer Khan	"Thus, the data shown in Figure 12 indicates that there is ample room for improvement in fostering a robust nuclear security culture in many states of the world, including in South Asia, where the emerging Centers of Excellence could make the region's states leaders and examples of the concept." (42)	2
Comparative Analysis of India-Pakistan Proliferation Contours/Zafar Nawaz Jaspal	"Pakistan assigned great importance to the safety and security of nuclear materials, nuclear facilities and nuclear weapons. Islamabad has not only indigenously institutionalized safety and security system but also has continuously been upgrading it with the assistance of neutral international institutions." (22) & "Today, its export controls are consistent with those being implemented by the NSG, MTCR, and the Australia Group. Moreover, the international community has acclaimed its Export Control Act of 2004." (22)	0
Fallacious Deterrence Theory of Waltz in the Context of Indo-Pak Conflict Over Kashmir/Rameez Raja	"Pakistan lacks a civilian control over nuclear weapons and jihadi leaders like Hafiz Saeed is willing to nuke India if they get access to deadly nuclear weapons. There might be sympathizers of jihadi organizations in Pakistan military and the ISI." (44)	2
Influence of Media on Public Perceptions: Case Study of Pakistan's Nuclear Program/Nida Shahid	"While the government of Pakistan is already very forth coming on matters related to its nuclear program by being part of a number of international treaties and norms dealing with the nuclear issues, there is a need for the US government to reciprocate as well." (89)	0
International Nuclear Law: A Case Study of Pakistan/Noreen Iftakhar	"Pakistan has well established nuclear security regime. The essentials of nuclear security in Pakistan include an effective command and control system under the NCA, rigorous regulatory regime, comprehensive export controls and extensive physical protection measures." (80-81)	0
NSG Membership for Non-NPT NWS: Criteria and Prospects/Muhammad Nasrullah Mirza and Syed Adnan Athar Bukhari	"Second, Pakistan has been acting as a responsible nuclear state." (83)	0
Nuclear Alarmism: Proliferation and Terrorism/John Mueller	"Pakistan, for example, maintains a strict watch on many of its nuclear scientists even after retirement." & "The government of Pakistan, which has been repeatedly threatened by terrorists, has a similar interest in controlling its nuclear weapons and material — and scientists."	0
Nuclear Security and Diplomacy in South Asia: Future Prospects for the Nuclear Pakistan/Asghar Khan,	"Yet over years Pakistan successfully proved that its nuclear security is as better as of any other nuclear power in our world. Critical analysis of her nuclear security gives Pakistan	0

Amjad Ali Dadda, and Syed Ali Shah	all positives as she managing well while being in all strains, pressures, and threats related her nuclear arms." (190)	
Nuclear Security Education and Training in Pakistan/Noreen Iftakhar and Sitara Noor	"This paper emphasizes the importance of nuclear security education and training in Pakistan, demonstrates that Pakistan has laid great importance on a safe and secure nuclear program, and expresses Pakistan's vigorous investment in its safety and security." (2) & "Pakistan has always emphasized the importance of nuclear security education and training in global efforts to deal with emerging security challenges. This paper highlighted the initiatives taken by Pakistan for nuclear security education and training programs, especially the establishment of its Center of Excellence and its role in the provision and growth of professional knowledge in the country." (8)	0
Nuclear security in the digital age/The Brookings Institution	"According to some experts at the discussion, the threat from Pakistan in the form of nuclear terrorism is overrated because the nuclear warheads in Pakistan are well guarded by its military establishment. A caveat to this scenario would be the ascension of radicals in the military command in Pakistan which would be jihadist in orientation and in possession of nuclear weapons. A nuclear programme that is entirely in the hands of the military and a military that is ideologically hostile to India is therefore a serious concern." & "Therefore, the threat from Pakistan's civil nuclear facilities is real and more imminent than the threat of nuclear weapons."	1
Nuclear terrorism – Threat or not?/ Miles Pomper and Gabrielle Tarini	"Moreover, the divide within the Pakistan's military, particularly the fact that senior military officials have been found to have proven ties to religious extremists, make safeguarding its nuclear weapons much more difficult." (8)	3
Pakistan and the Nuclear Security Summit Process/Muhammad Faisal	"Guarding its nuclear facilities, weapons and materials is the supreme national interest of Pakistan. The security of these weapons and associated infrastructure has, therefore, been the top priority of the government."	0
Pakistan: Challenges for U.S. Interests/Toby Dalton	"The prominence given to nuclear weapons in Pakistan's national security strategy means that the government has a very strong interest to protect them."	0
Pakistan's Nuclear Weapons/Paul Kerr and Mary Beth Nitikin	"A number of important initiatives, such as strengthened export control laws, improved personnel security, and international nuclear security cooperation programs, have improved Pakistan's nuclear security. However, instability in Pakistan has called the extent and durability of these reforms into question." & "Islamabad has taken a number of steps to improve its nuclear security and to prevent further proliferation of nuclear-related technologies and materials."	2
Pakistan's Nuclear Weapons Programme: Criticism, Propaganda and Response/ Qasim Mustafa Malik	"Pakistan also highlighted that it will fulfill its responsibilities of being a nuclear weapon state. However, Pakistan refused to seek any help from the US for the protection and security of its nuclear installations." (55)	1
Paradoxes of South Asian Security/Rajiv Nayan and Ravi Shekhar	"Quite interestingly, India and Pakistan have been showing understanding regarding management of the risks associated with nuclear weapons." (340) & "Like India, Pakistan too	1

	considers nuclear security a continuing process. Some appropriate practices to ensure and enforce nuclear security are necessary, yet the adoption of these practices should not lead to complacency." (340)	
PREFACE/Journal of Security and Strategic Analyses	"Pakistan was invited in NSS and it played a very active role as evidenced by the multiple steps it took to secure its nuclear materials and nuclear installations. Pakistan has been very conscious about nuclear security of its weapons from the very beginning and has taken numerous steps in this regard." (2-3)	0
Prospects of Internationalizing Nuclear Security: An Appraisal/Ahmed Saeed Minhas, Farhat Konain Shujahi, and Ghulam Qumber	"Security consciousness has remained an integral part of Pakistan's nuclear program, since its inception. Complacency has been rejected at all tiers and continuous evaluation of different threat scenarios both from insider and outsider elements have been the hallmark of Pakistan's nuclear security contingency planning." (404)	0
Revitalizing Nuclear Security in an Era of Uncertainty/Matthew Bunn, Nickolas Roth, and William Tobey	"Pakistan has an extensive nuclear security training program, based on the Pakistan Nuclear Security Center of Excellence, established in 2012." (95-96) & "Pakistan's deep and endemic corruption heightens the insider threat problem and may weaken nuclear security measures in some cases." (98)	2
The Nuclear Security Summit Process: Future and Impact on Pakistan's Nuclear Security/Sonia Naz and Rizwan Naseer	"Pakistan has been the most improved country on nuclear security index – a fact that international community admits. It has taken a numerous legislative and institutional measures to strengthen nuclear security regime in the country. By all means, it has achieved many milestones in peaceful nuclear energy as well. Pakistan has been very actively participating in all the programs of the International Atomic Energy Agency (IAEA)." (82) & "It has strengthened its nuclear export control structure, monitoring system and nuclear regulatory provisions in the form of strict laws and principles." (84)	1
The Strategic Chain Linking Pakistan, India, China, and the United States/Waheguru Pal Singh Sidhu and Robert Einhorn	"Pakistan strictly adheres to the ideals of equitable arms control and non-proliferation and actively engages with the international community to promote nuclear security and improve international best practices. Pakistan firmly adheres to global non-proliferation principles and supports a criteria-based approach towards the further expansion of multilateral strategic export control regime and considers exceptionalism as discriminatory, dangerous, and destabilizing." (9)	0

On-Site Physical Protections		
Title/Author(s)	**Quote(s)**	**Rating**
Deterring Nuclear Terrorism/Robert Litwak	"This shift could exacerbate an existing vulnerability—Pakistan's reliance on ground transportation to move warheads from site to site, which it does as a precaution against preemptive attack and seizure." (110)	1
Global Governance Monitor/Council on Foreign Relations	"In particular, the security of Pakistan's arsenal is a grave concern, especially for the United States. Nuclear weapons components are at times transported on normal roads with little to no protection."	3
Influence of Media on Public Perceptions/Nida Shahid	"Pakistan also has an impeccable record of safety and security with regards to its nuclear facilities as there have been no incident of a nuclear accident, theft or sabotage to any of it nuclear establishments." (87)	0
Non-state actors & WMD: Does ISIS have a pathway to a nuclear weapon?/Nada Eweiss	"Most nuclear weapons have Permissive Action Links (PALs), codes privy to a few and extremely challenging to unlock, but some do not." (5)	1
Nuclear Powers and Terrorism: Challenges for Indo-Pak Strategic Stability/Tahir Mahmood Azad	"Vulnerabilities can be identified in all states possessing nuclear weapons that might lead to falling of nuclear weapons into the hands of terrorists, but in case of India and Pakistan, this is least possible." (66)	0
Nuclear Terrorism: Hype, Risks and Reality-A Case of Pakistan/Rizwan Naseer and Musarat Amin	"Even though it might be correct that no state other than Pakistan is more likely to be affected by nuclear terrorism but it is also true that no state other than Pakistan has done more to secure its nuclear infrastructure." (391) & "The Pakistan's military has devised security mechanism for nuclear weapons that are not only hard but almost impossible to breach for individual or terrorist groups because they do not have cutting edge technology. An electronic safety mechanism and a personnel reliability program - a sensibly framed outline - is already working. Pakistan's nuclear arsenal is spread over various sites in disassembled form and is fully secured which makes it difficult for the terrorists to acquire it. Pakistan's nuclear arsenal is believed to be effectively safe and protected." (393)	0
Pakistan and the Nuclear Security Summit Process/Muhammad Faisal	"In parallel, Pakistan has also invested in a rigorous nuclear security regime to ensure maximum security of its nuclear installations and materials."	0
Pakistan: Challenges for U.S. Interests/Toby Dalton	"By most indicators, its security is probably quite good, but not foolproof."	1
Preventing Nuclear Terrorism: Continuous Improvement or Dangerous Decline?/Matthew Bunn, Martin Malin, Nickolas Roth, and William Tobey	"Pakistan has substantially strengthened its nuclear security in the past two decades." (47)	1
Prospects of Internationalizing Nuclear Security: An Appraisal/Ahmed Saeed Minhas, Farhat Konain Shujahi, and Ghulam Qumber	"It was the Pakistani nuclear security robustness that protected its nuclear sites from any act of terrorism amid GWOT. Thus, Pakistan's nuclear security measures could be a model for nuclear aspirant states that primarily rests on the principle of sovereignty." (406-407)	0

Revitalizing Nuclear Security in an Era of Uncertainty/Matthew Bunn, Nickolas Roth, and William Tobey	"Virtually all of Pakistan's HEU and separated plutonium is in Pakistan's military program, and it is heavily guarded. The SPD reportedly has some 25,000 troops in its security and intelligence sections, including a 1,000- person Special Response Force for tactical response to attacks on nuclear facilities.198 Pakistan reportedly stores nuclear weapons in disassembled form, with parts in different buildings, to make theft more difficult." (95)	1
The Nuclear Security Summit Process: Future and Impact on Pakistan's Nuclear Security/Sonia Naz and Rizwan Naseer	"Pakistan proved that it has secured nuclear, fissile and radioactive material from misuse and terrorist by its nuclear security efforts." (84) & "Pakistan's encouraging response towards NSS improved its nuclear security, placed Pakistan higher than India in NTI ranking and made international community realize that Pakistan's nuclear materials are safe and secure from any theft or misuse." (85)	0
The Safety and Security of the Pakistani Nuclear Arsenal/Christopher Clary	"Information suggesting physical separation of warhead components or separation of warheads and delivery vehicles is abundant, but increasingly dated. The passage of time does not necessarily imply change, but it does decrease our confidence amid all of the other changes in the Pakistani arsenal." (106) & "In recent years, the number of assurances of physical separation of components has decreased, while there have been inklings of greater readiness in peacetime storage." (107)	2
The Strategic Chain Linking Pakistan, India, China, and the United States/Waheguru Pal Singh Sidhu and Robert Einhorn	"Pakistan's nuclear arsenal is probably one of the most well-guarded, and is constantly secured by one of the world's largest nuclear security apparatuses, consisting of a highly trained, motivated, and specialized force, deployed in accordance with an elaborate, multi-layered, defense in depth concept." (40)	0

Capabilities		
Title/Author(s)	**Quote(s)**	**Rating**
A.Q. Khan Nuclear Smuggling Network/Molly MacCalman	"Furthermore, it illustrates on a broader level the complexities of illicit supply chains and how violent non-state actors engaging in complex engineering tasks may be able to procure the expertise and equipment needed to succeed in their unlawful endeavors." (104) & "As a result, this case highlights the real danger posed by sophisticated transnational smuggling networks in terms of facilitating the efforts of violent non-state actors who endeavor to complete complex engineering tasks." (116)	2
Assessing Detecting and Deterring the Threat of Maritime Nuclear and Radiological Smuggling in the Western Indian Ocean Region/M Umer Khan	"The Mumbai attack was not an isolated incident." (19) & "The transfer of knowledge and expertise is also a worrying issue." (35)	1
Horror or Hype: The Challenge of Chemical, Biological, Radiological, and Nuclear Terrorism/Lasha Giorgidze and James K. Wither	"Although the media has hyped CBRN events, terrorists face significant difficulties in acquiring, weaponizing, and delivering weapons of truly mass effect." (17)	1
Intergovernmental Nuclear Fuel Banks: Re-examined/Gabriella Gricius	"However, with the rise of non-state actors such as the Islamic State, which obtain their funding from underground support, it is a very real possibility that a terrorist group may obtain nuclear weapons." (309)	2
Islamic State and Technology – A Literature Review/Truls Hallberg Tønnesson	"An article published in Islamic State's magazine Dabiq alluded to the fact that IS might be able to use its unprecedented access to financial resources to obtain a nuclear device from Pakistan and smuggle it to the United States and detonate it there. The author of the article admits that this might be a far-fetched scenario, but that the scenario nevertheless would be the 'sum of all fears of Western intelligence agencies'. In addition, the possibility that a state in possession of nuclear weapons, like, for instance, Pakistan, should willingly sell a nuclear device to a non-state actor has been discredited." (103)	2
Non-state Actors & WMD: Does ISIS Have a Pathway to a Nuclear Weapon?/Nada Eweiss	"There are many factors that could facilitate ISIS having access to materials for weapons of mass destruction, or fully assembled weapons." (6)	2
Nuclear Alarmism: Proliferation and Terrorism/John Mueller	"That lack of action may be because, after a brief exploration of the possible routes, they — unlike generations of alarmists — have discovered that the tremendous effort required is scarcely likely to be successful." & "In addition, almost no one would trust al Qaeda. As one observer has pointed out, the terrorist group's explicit enemies list includes not only Christians and Jews but also all Middle Eastern regimes; Muslims who don't share its views; most Western countries; the governments of Afghanistan, India, Pakistan, and Russia; most news organizations; the United Nations; and international nongovernmental organizations."	0

Nuclear Terrorism - Threat or Not?/Miles Pomper and Gabrielle Tarini	"Moreover, the divide within the Pakistan's military, particularly the fact that senior military officials have been found to have proven ties to religious extremists, make safeguarding its nuclear weapons much more difficult." (8) & "Other experts note that the Pakistani authorities have a dismal record thwarting insider threats – the AQ Khan network operated under the noses of the Pakistani establishment for years – and that the greatest risk of a loose nuke stems from insiders in the Pakistani nuclear establishment working with outside Islamist militants." (8)	1
Nuclear Terrorism: A Potential Threat to World's Peace and Security/Muhammad Wajeeh	"On the other hand, the acquisition of nuclear weapon is not so easy and thus far has remained out of the reach of terrorist organizations. It involves a great degree of hurdles such as the security structure of nuclear weapons' storage facilities and the inbuilt device code systems of nuclear weapons, which is not easy to break and hence lowers the probability of such an attack by terrorists." (154)	0
Nuclear Terrorism: Hype, Risks and Reality-A Case of Pakistan/Rizwan Naseer and Musarat Amin	"The most hazardous but least likely to occur nuclear terror scenario involves the theft or trafficking nuclear weapons by the terrorist organizations such as Al-Qaeda or IS." (388)	3
Prospects of Internationalizing Nuclear Security: An Appraisal/Ahmed Saeed Minhas, Farhat Konain Shujahi, and Ghulam Qumber	"It is argued that since the elimination of OBL, Al-Qaeda has almost been strategically defeated (Bumiller, 2011) and hence the risk of nuclear terrorism has been reduced.While internationally coordinated blows to al Qaeda must be appreciated; however, the international community should not lower its guard." (399)	2
Revitalizing Nuclear Security in an Era of Uncertainty/Matthew Bunn, Nickolas Roth, and William Tobey	"Incidents, test results, and other information that suggests that nuclear security systems still have important weaknesses that adversaries might be able to exploit;" (159)	2
Safer at Sea? Pakistan's Sea-Based Deterrent and Nuclear Weapons Security/Christopher Clary and Ankit Panda	"This is especially worrisome because Pakistan Navy facilities have been targets of terrorist attacks, and have demonstrated some vulnerability to such attacks." (159)	1
The Safety and Security of the Pakistani Nuclear Arsenal/Christopher Clary	"A violent nonstate actor seeking to acquire or detonate a Pakistani nuclear weapon would have tremendous challenges." (119)	2

Objectives		
Title/Author(s)	**Quote(s)**	**Rating**
A.Q. Khan Nuclear Smuggling Network/Molly MacCalman	"However, very few of the network's members have been successfully prosecuted and the demand for nuclear material by both state and non-state actors continues." (104)	2
Assessing Detecting and Deterring the Threat of Maritime Nuclear and Radiological Smuggling in the Western Indian Ocean Region/M Umer Khan	"Among these groups, ISIS and Al-Qaeda have shown considerable interest in acquiring nuclear or radiological material." (33) & "There have been serious apprehensions voiced by international security experts and politicians that there is an emerging threat that ISIS would like to employ nuclear and radiological weapons to inflict maximum financial and collateral damage." (35)	3
Horror or Hype: The Challenge of Chemical, Biological, Radiological, and Nuclear Terrorism/Lasha Giorgidze and James K. Wither	"Al Qaeda had the most ambitious and persistent program to develop CBRN weapons. The group tried to obtain highly enriched uranium on several occasions and considered the sabotage of vulnerable nuclear power plants." (7) & "IS has also voiced an interest in radiological and nuclear weapons." (6)	2
How terrorist actors in Pakistan use nuclear weapons for political influence/Sharad Joshi	"Contemporary terrorist groups rooted in extremist religious ideology, including global jihadist groups such as Al Qaeda, and Islamic State, are less susceptible to nuclear constraints and likelier to pursue CBRN attacks because of their unlimited, apocalyptic goals and unrestrained targeting strategies, which disregard bargaining for their objectives (bargaining could oblige them to eschew brutal, mass casualty attacks)." (2)	2
Islamic State and Technology – A Literature Review/Truls Hallberg Tønnesson	"However, an incident in Belgium illustrates the typical 'low-tech' and asymmetrical threat that IS, and other terrorist organizations, may represent." (103)	2
Managing Nuclear Risks/Robert Litwak	"The stark reality is that terrorist groups like Al Qaeda and ISIL remain intent on acquiring a nuclear weapon—and would have no compunction about using it." (73)	3
Non-state Actors & WMD: Does ISIS Have a Pathway to a Nuclear Weapon?/Nada Eweiss	"Given the motivation, were nuclear weapons within the reach of ISIS, they would be likely to use or threaten use of them." (2)	2
Nuclear Alarmism: Proliferation and Terrorism/John Mueller	"However, thus far, terrorist groups seem to have exhibited only limited desire and even less progress in going atomic."	1
Nuclear Terrorism: Hype, Risks and Reality-A Case of Pakistan/Rizwan Naseer and Musarat Amin	"As exposed in the memoir by the former Director of CIA, George Tenet, it was valid that the most senior leaders of Al-Qaeda are still individually focused on acquiring weapons of mass destruction, while the foremost threat is the nuclear one." (390)	3
Nuclear terrorism – Threat or not?/Miles Pomper and Gabrielle Tarini	"The Islamic State of Iraq and Syria (ISIS), a global jihadist group which rose to prominence in 2014, has not been as outspoken or as clear about their intentions with regards to nuclear weapons as Al Qaeda. Only one article in the group's English-language magazine, Dabiq, mentions a hypothetical scenario in which ISIS acquires a nuclear weapon and smuggles it into the US for detonation." (11)	1

Nuclear Terrorism: A Potential Threat to World's Peace and Security/Muhammad Wajeeh	"The demonstration of efforts to acquire nuclear weapons by terrorist organizations like Al-Qaeda, ISIS and its affiliated groups, and their willingness and ambitions to use them against their enemies (especially the US and Europe) further creates the hype." (154) & "Other terrorist organizations include the Japanese cult group Aum Shinrikyo, Al-Qaeda and its associates - notably the Islamic State of Iraq and Syria (ISIS)-who intended, and actively sought to acquire weapons of mass destruction." (142)	2
Remotely Piloted Innovation: Terrorism, Drones and Supportive Technology/Don Rassler	"Thus, even if they are initially interested, most terror groups soon find out that they do not possess the resources or the level of expertise required to make the investment in WMDs worth it."	0
Revitalizing Nuclear Security in an Era of Uncertainty/Matthew Bunn, Nickolas Roth, and William Tobey	"In recent years, for example, even some senior U.S. government officials focused heavily on the nuclear terrorism threat were unaware that al Qaeda's nuclear weapons effort had progressed as far as carrying out crude but sensible (for their level of resources) tests of conventional explosives for the bomb program in the Afghan desert." (159)	2
The Nuclear Security Summit Process: Future and Impact on Pakistan's Nuclear Security/Sonia Naz and Rizwan Naseer	"Al-Qaeda and other terrorist groups are trying to get nuclear weapons with which they will threaten the world if they obtain them." (70) & "Japanese terror group, Aum Shinrikyo has made serious efforts to get nuclear material and Al-Qaeda has attempted many times to acquire nuclear material." (72-73)	2
Understanding Nuclear Weapon Risks: Non-State Actors and Nuclear Weapons/Elena Sokova	"Al-Qaida, as revealed by documents seized in Afghanistan, actively sought nuclear weapons and clearly expressed desire to use them were it able to acquire them." (83) & "On the one hand, we face new terrorist actors such as Islamic State in Iraq and the Levant (ISIL) and the spread of Al-Qaida-type organizations to new regions in Africa, Asia, and the Middle East, yet it is difficult to assess their capabilities, motivations, and intentions. There are some indications of their interest in nuclear sites." (84)	2

Chapter 1: Introduction

The 2020 Nuclear Security Index from the Nuclear Threat Initiative (NTI) reported that Pakistan had the highest risk environment of the world's nine nuclear-armed countries.[1] This is unsurprising; Pakistan experiences high levels of terrorist activity and insider threats to its arsenal. The Islamic State of Iraq and the Levant (ISIL), al-Qaeda, and the Pakistani Taliban are present in Pakistan and have expressed interest in controlling the Pakistani nuclear arsenal.[2] Fortunately, Pakistan's Nuclear Command Authority (NCA) – a group of civilian and military experts with control over Pakistan's nuclear weapons policy[3] – has improved the security of the weapons in recent years. In fact, the Nuclear Threat Initiative (NTI) gave Pakistan the title of "most-improved" country for nuclear security in 2020. Although nuclear security in Pakistan has improved, the country is still ranked 19th out of 22 countries in NTI's "Theft: Secure Materials" category, a category that shows how protected different countries (with weapons usable nuclear material) are against nuclear theft. [4] Therefore, Pakistan's ranking indicates its nuclear materials are relatively vulnerable to theft. In my thesis, I assess if Pakistan's nuclear security architecture effectively protects its nuclear weapons arsenal from theft by three major terrorist organizations operating in Pakistan.

My research follows three questions. In my first research question, I answer: how vulnerable is Pakistan's nuclear security architecture? By detailing the weaknesses in Pakistan's nuclear security architecture, I am able to determine its impact on the likelihood of nuclear theft

[1] "NTI Nuclear Security Index: Losing Focus in a Disordered World." Nuclear Threat Initiative (NTI), July 2020. 204.
[2] Joshi, Sharad. "How Terrorist Actors in Pakistan Use Nuclear Weapons for Political Influence." *Asian Security*, March 14, 2019, 1.
[3] "Pakistan Nuclear Weapons Program | Pakistan Nuclear Technology | NTI." Accessed October 2, 2020.
[4] "NTI Nuclear Security Index: Losing Focus in a Disordered World." Nuclear Threat Initiative (NTI), July 2020. 14.

by a terrorist organization. My second research question is: what capabilities and objectives do terrorist organizations have to steal components of the nuclear arsenal? My answer to this question illustrates the likelihood of either al-Qaeda, ISIL, or the Pakistani Taliban carrying out nuclear theft. Finally, my third question is: does Pakistan's nuclear security architecture protect its nuclear weapons arsenal from theft by terrorist organizations? To answer this question, I use the answers to my first and second research questions to compare the relationship between Pakistan's nuclear security architecture and terrorist organizations' decision-making calculus, thereby determining the likelihood of nuclear theft by a terrorist organization in Pakistan.

In this chapter, I outline the literature surrounding Pakistan's nuclear security and the capabilities and ambitions of terrorist organizations. I also provide an overview of my methodological approach and theory. In chapter 2, I analyze my first research question: how vulnerable is Pakistan's nuclear security architecture? In chapter 3, I evaluate my second research question: what capabilities and objectives do terrorist organizations have to steal components of the nuclear arsenal? In chapter 4, I determine whether Pakistan's nuclear security architecture protects against theft by terrorist organizations. I conclude this thesis in chapter 5, providing a summary of my findings and policy recommendations.

Literature Review

There is substantial debate over whether the threat of nuclear terrorism is overblown. At the time of writing, no terrorist organization has acquired enough weapons-usable nuclear material for a weapon. I begin this review by summarizing perspectives on Pakistani non-state actor objectives and capabilities. I then discuss each component of Pakistani nuclear security separately, starting with nuclear force posture, moving to Pakistan's nuclear security environment[5] and institutions, and ending with on-site physical protection of the nuclear arsenal. The literature review ends by outlining how my research adds to the scholarly conversation.

To find these articles, I found the predominant scholars on nuclear security and looked at their recent works and by whom they were cited. I focused on articles from the last five years, as al-Qaeda and ISIL have experienced significant losses since 2016.

Scholarly Views of Terrorist Organizations in Pakistan

Objectives of terrorist organizations in Pakistan

Scholars agree that three major terrorist organizations with a presence in Pakistan want to acquire a nuclear weapon: ISIL, the Pakistani Taliban, and al-Qaeda. Some, like Matthew Bunn, Nickolas Roth, William Tobey, Michael Dempsey, and popular media outlets, highlight these three organizations with their focused objectives and relatively advanced capabilities as the main threat to the Pakistani arsenal. Others, like Sharad Joshi, contextualize the threat to Pakistani nuclear weapons by explaining their national significance and terrorist organizations' perceived guardianship of the arsenal.

Bunn, Roth, and Tobey see al-Qaeda and ISIL as significant threats to Pakistan's nuclear weapons. They cite both groups' political ambitions, saying they each want to defeat international superpowers by using powerful weaponry, like nuclear bombs.[6] This assertion is not thoroughly supported; it is a forced connection between ISIL and al-Qaeda's ambitions against the US and the power of nuclear weaponry. Bunn, Roth, and Tobey outline statements

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[5] Throughout this thesis, I define "nuclear security environment" as Pakistan's demonstrated commitment to nuclear security through its adherence to international norms/treaties and strengthening its security architecture. Unlike other scholarly literature, it does not refer to the distribution of capabilities between Pakistan and its adversaries.
[6] Bunn, Matthew, Nickolas Roth, & William H. Tobey. "Revitalizing Nuclear Security in an Era of Uncertainty," 2019.

made by al-Qaeda leadership, like Osama bin Laden declaring it was al-Qaeda's "religious duty" to acquire nuclear weapons in 1999, to support the idea of terrorists' nuclear ambitions.[7] These statements are worrisome, but both al-Qaeda and ISIL have since suffered critical setbacks. Both look different today compared to 1999. However, these scholars do raise an important point: large terrorist threats can arise quickly, and this possibility should not be discounted.[8]

Unsurprisingly, some popular media outlets, such as *The Independent* and *Newsweek*, quickly reported on ISIL theorizing about buying a nuclear weapon from a corrupt Pakistani official. In their propaganda magazine (formerly *Dabiq*, now *Rumiyah*), ISIL published a hypothetical story about the group taking over a large bank and using its funds to buy a nuclear weapon from a sympathetic Pakistani official.[9] This is a worrisome development, but the authors fail to mention the significance of ISIL's psychological war. Generating public fear may be the end goal of such an article. If this was the case, the article does demonstrate ISIL's potential interest in Pakistani nuclear weapons.

Terrorist organizations with a presence in Pakistan have a unique relationship towards its arsenal. Sharad Joshi shows that al-Qaeda, ISIL, and the Taliban all seek to overthrow the Pakistani government and seize the nuclear arsenal. He mentions the Islamic State in passing, primarily addressing the ambitions of al-Qaeda and the Pakistani Taliban. Joshi lists many instances of planned attacks on nuclear sites by both groups, and al-Qaeda specifically targeting

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[7] Bunn, et al. "Revitalizing Nuclear Security." 33.
[8] Ibid. 206.
[9] Saul, Heather. "Isis Claims It Could Buy Its First Nuclear Weapon from Pakistan Within A Year." The Independent, May 22, 2015. https://www.independent.co.uk/news/world/middle-east/isis-claims-it-could-buy-its-first-nuclear-weapon-pakistan-within-12-months-10270525.html.

Pakistani nuclear scientists.[10] He contextualizes these incidents with the Jihadist messaging surrounding the Pakistani arsenal. Joshi explains that the Pakistani Taliban, al-Qaeda, and ISIL see the Pakistani government and army as "slave[s] of America."[11] When the first weapon was detonated in 1998, many saw the arsenal as a means to protect the global Islamic community.[12] Pakistan's reputation as the world's only Muslim-majority, nuclear-armed country was a source of national pride. Terrorist organizations capitalized on this sentiment, insinuating that it did not matter who controlled the arsenal if it was used to protect the global Muslim population from non-believers. Terrorist organizations advance reports that the United States wants to seize Pakistani nuclear weapons and argue that terrorist organizations are the true protectors of the arsenal. They attempt to gain political influence by convincing Pakistanis that their seizure of the arsenal would be in the country's best interest.[13] Joshi does an excellent job of detailing terrorist groups' objectives regarding nuclear weapons. However, terrorist organizations have not made any significant attempts to seize these nuclear weapons; they seemingly never move past the planning stages. Joshi does not explain what is stopping these organizations from attempting nuclear theft. It is also difficult to determine if aspirational talk about acquiring nuclear weapons in public online forums, speeches, and propaganda materials has led to terrorist organizations entering the planning stages of a nuclear theft attempt. Unfortunately, Joshi does not have a source within Pakistani terror groups, so must rely on speculation.

Capabilities of terrorist organizations in Pakistan

[10] Joshi, Sharad. "How Terrorist Actors in Pakistan Use Nuclear Weapons for Political Influence." *Asian Security*, March 14, 2019, 1–22. 5-6.
[11] Joshi, "How Terrorist Actors." 5-6.
[12] Ibid. 15.
[13] Ibid. 10.

No one knows exactly how a terrorist organization would try to seize a nuclear weapon; scholars rely on details of terrorists' capabilities to make predictions. Bunn, Roth, and Tobey list several resources that Pakistani terrorists could use to steal a weapon. They argue terrorists could exploit a combination of modern drone technology, cyber warfare, insider sympathies, and well-armed militias to mount an attack against the Pakistani army and seize a nuclear weapon. This is particularly striking prediction, considering terrorist organizations have successfully attacked Pakistani military establishments with apparent insider help.[14] Yet, these scholars state that nuclear security mechanisms could effectively protect against militias and a few low-ranked, corrupt officials. Apart from this recount of historical events, Bunn, Roth, and Tobey do not provide sufficient detail about the resources of terrorist organizations. Of course, there is a lack of information about terrorist capabilities, but if Bunn, Roth, and Tobey claim that "well-designed" nuclear security systems effectively protect against terrorist threats,[15] they need specific supporting evidence.

Some scholars have an idea of ISIL's available weaponry. Truls Hallberg Tønnessen outlines the extent of ISIL's drone program and how the group uses their size and consumer-available goods to advance their technological capabilities. Of all terrorist groups with a presence in Pakistan, ISIL is the most technologically advanced.[16] It took ISIL one year from when they had a stated interest in drones to use one on the battlefield.[17] ISIL relies on commercially available drones, which they modify to release explosives over a target. Their efforts to deploy operational drone technology led them to announce a separate drone unit in January of 2017.[18]

[14] Bunn, et al. "Revitalizing Nuclear Security." 20.
[15] Ibid. 99.
[16] Tønnessen, Truls Hallberg. "Islamic State and Technology – A Literature Review." *Perspectives on Terrorism* 11, no. 6 (December 18, 2017). http://www.terrorismanalysts.com/pt/index.php/pot/article/view/659. 101.
[17] Tønnessen. "Islamic State and Technology." 103.
[18] Ibid. 104.

Tønnessen details ISIL's online network of technical experts who advise experiments with new technologies, like drones. Additionally, ISIL followers with advanced degrees have helped the group with cyber warfare tactics, armored vehicle design, and driverless car bombs.[19] Tønnessen does not address the possibility of these technologies enabling a nuclear theft, but provides an extensive look at ISIL's new, less-conventional technology, which could aid an attack on the Pakistani arsenal.

Scholarly Views of Pakistan's Nuclear Security Architecture

The following sections focus on Pakistan's nuclear force posture, nuclear security environment and institutions, and the on-site physical protection of the arsenal from a scholarly perspective.

Nuclear force posture

Pakistan is one of four countries that are increasing their quantities of weapons-usable nuclear material.[20] Pakistan is rapidly expanding its nuclear stockpile,[21] and is on track to have the world's fifth largest nuclear arsenal by 2025 (all else equal).[22] Currently, Pakistan is estimated to have 140 to 150 nuclear warheads.[23] In the 2020 Nuclear Security Index, the NTI gives Pakistan a 38 out of 100 for "Quantities of Nuclear Materials," and a 0 out of 100 for "Material Production/Elimination Trends."[24] Both are very low scores, indicating that Pakistan's quantities and production of nuclear material is of paramount concern.

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[19] Tønnessen. "Islamic State and Technology." 105-6
[20] "NTI Nuclear Security Index." 39.
[21] Bunn, et al. "Revitalizing Nuclear Security." 95.
[22] Kristensen. "Pakistani Nuclear Forces." 348.
[23] Ibid. 348.
[24] "NTI Nuclear Security Index." 117.

This growing nuclear stockpile necessitates the increase in the number of delivery vehicles and fissile material bulk processing facilities, which are vulnerable to nuclear theft.[25] Bunn, Roth, and Tobey note that fissile material processing facilities do not have the necessary equipment to detect small amounts of nuclear material. Therefore, an insider could smuggle limited amounts of fissile material out of the facility and to a terrorist organization. Likewise, if a non-state actor infiltrated the facility, they could steal a small amount of fissile material and not be detected.[26] This is an unlikely scenario, considering Pakistan's extensive screening process and protection of processing facilities. However, all human screening processes are flawed, as is discussed later. Theft or diversion of fissile material from these facilities is possible. As the number of facilities grows, the likelihood of such an event increases.[27]

Additionally, Pakistan has recently developed tactical nuclear weapons, or Nasr missiles.[28] These lower-yield weapons have relatively compact warheads and are intended for battlefield use. Nuclear security scholars are worried about this move towards tactical nuclear weaponry. Many claim tactical weapons are at increased risk of theft because of their compact warheads and method of employment.[29] For use on the battlefield, these missiles must travel on Nasr transporter-launch vehicles that carry two to four missiles each.[30] Many believe missiles outside secured military bases can be intercepted by motivated non-state actors. Scholars worried

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[25] "NTI Nuclear Security Index." 348., Bunn, et al. "Revitalizing Nuclear Security." 96., and Litwak. "Deterring Nuclear Terrorism." 13.
[26] Bunn, et al. "Revitalizing Nuclear Security." 41.
[27] Ibid. 41.
[28] Kristensen. "Pakistani Nuclear Forces." 348.
[29] Bunn, et al. "Revitalizing Nuclear Security." 32., and Kristensen. "Pakistani Nuclear Forces." 353.
[30] Clary, Christopher. "The Safety and Security of the Pakistani Nuclear Arsenal." In *Pakistan's Enduring Challenges*, edited by C. Christine Fair and Sarah J. Watson. Philadephia: University of Pennsylvania Press, 2015. 118.

about this possibility include: Matthew Bunn, William Tobey, Nickolas Roth, Robert Litwak, Hans Kristensen, and Matt Korda, among others.

Pakistani officials do not believe tactical weapons are less secure. They argue that tactical weapons that are changing locations are harder to pinpoint than nuclear weapons stored at established military bases. Litwak refutes this claim, arguing that terrorists could access transportation routes from an inside source.[31] Fortunately, the NTI Index gives Pakistani nuclear weapons' "Physical Security During Transport" a perfect score,[32] showing that Pakistan incorporated IAEA guidelines for transporting nuclear materials into its regulatory regime.[33] Although the NTI score is promising, nuclear theft during transport is still a possibility. There is no way to ensure that Pakistan follows the IAEA guidelines, as it does not allow for peer review of its nuclear security apparatus.[34]

In addition to tactical weapons, Pakistan is developing submarine-launched cruise missiles (SLCMs). Submarines are harder to detect than land-based missiles and could survive a disarming first strike from an adversary seeking to destroy all of Pakistan's nuclear weapons.[35] Kristensen says these SLCMs, called Babur-3 missiles, are not yet operational, but are cause for concern.[36] The Pakistani navy has approximately thirteen submarines that could carry these missiles. The submarines will be held at one to two sites.[37] Naval sites are relatively easy to locate using commercially available satellite imagery. Therefore, the location of these Babur-3

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[31] Litwak. "Deterring Nuclear Threats." 110.
[32] "NTI Nuclear Security Index." 117.
[33] "EIU Methodology: Theft and Sabotage." NTI Nuclear Security Index: The Economist Intelligence Unit. https://www.ntiindex.org/wp-content/uploads/2020/07/2020_NTI-Index_EIU-Methodology_Final.pdf. 61.
[34] Bunn, et al. "Revitalizing Nuclear Security." 98.
[35] Kristensen. "Pakistani Nuclear Forces." 348.
[36] Ibid. 355.
[37] Clary, Christopher, and Ankit Panda. "Safer at Sea? Pakistan's Sea-Based Deterrent and Nuclear Weapons Security." *The Washington Quarterly* 40, no. 3 (July 3, 2017): 149–68. 159.

missiles is less secret than missiles stored on land.[38] Not only are these weapons easier to locate than land-based missiles, Clary and Ankit Panda note that Pakistan's ships and naval bases are vulnerable to attacks from non-state actors.[39] Additionally, nuclear armed submarines from the United Kingdom and Russia have been attacked by non-state actors with varying levels of success.[40] No Pakistani submarine has been infiltrated by a non-state actor, but their less secret location and historical cases of non-state actors targeting submarines is worrisome. When Babur-3 missiles are developed and attached to submarines, they could be vulnerable.

Nuclear security environment/institutions

The Pakistani government is adamant about keeping the nuclear arsenal under centralized control.[41] The country's nuclear program is organized under the National Command Authority (NCA), which is chaired by the Pakistani Prime Minister. The nuclear security branch of the NCA is the Strategic Plans Division, or SPD.[42] The SPD created a Nuclear Material Protection, Control, and Accounting regime (MPC&A) to audit strategic organizations and monitor their nuclear security architecture.[43] The SPD takes nuclear security seriously,[44] although the NTI Index gives Pakistan a modest score of 50 out of 100 for "Security Culture."[45] Within the SPD, there is a dedicated Inter-services Intelligence Unit that works to provide regular threat assessments.[46] Scholars note that this intelligence unit has a history of employing sympathizers

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38 Clary and Panda. "Safer at Sea?" 158.
39 Ibid. 159.
40 Ibid. 161-2.
41 Ibid. 155.
42 Bunn, et al. "Revitalizing Nuclear Security." 95.
43 Clary. "The Safety and Security." 105.
44 Ibid. 96.
45 "NTI Nuclear Security Index." 117.
46 Clary. "The Safety and Security." 111.

of terrorist organizations.[47] In response, the Pakistani government strengthened their vetting system to protect against insider threats.

Pakistan is home to the Centre of Excellence for Nuclear Security, where future nuclear officials study nuclear security and train to effectively protect the arsenal.[48] It is the biggest nuclear security center worldwide. Additionally, the SPD implemented new cybersecurity measures in 2016 to prevent hackers from sabotaging security systems at nuclear sites.[49] Scholars concede that there is work to be done; the NTI rates Pakistan's cybersecurity 38 out of 100 and its overall nuclear security legislation a 67 out of 100.[50] Pakistan has improved since 1998, but serious concerns remain.

Scholars suggest that terrorist organizations would need some insider knowledge or assistance to steal nuclear material. To prevent against insider threats, Pakistan has an extensive screening program, similar to the United States' Personnel Reliability Program.[51] For employment at a site storing weapons-usable nuclear material, applicants must fill out seventy-page questionnaire. The applicant and their questionnaire are then scrutinized by the Inter-Services Intelligence Directorate, Pakistani Military Intelligence, and the Civilian Intelligence Bureau. This process can last up to one year and is followed by a probationary period. New employees cannot access sensitive nuclear sites until this period is over.[52] There are follow-up screenings every two years and employees are subject to random "spot checks."[53] Clary notes that no human processing system is infallible; the United States' screening system had

[47] Litwak. "Deterring Nuclear Terrorism." 107.
[48] Bunn, et al. "Revitalizing Nuclear Security." 96.
[49] "NTI Nuclear Security Index." 38.
[50] Ibid. 117.
[51] Bunn, et al. "Revitalizing Nuclear Security." 96., and Clary. "The Safety and Security." 105.
[52] Clary. "The Safety and Security." 111.
[53] Ibid. 111.

shortcomings.[54] This is concerning, but Clary does not propose any policies to strengthen this system. It is impossible to completely eradicate insider threats.

All considered, the NTI Index gives Pakistan a low score for "Insider Threat Prevention," a 27 out of 100. This is an improvement from 2018; Pakistan has since subscribed to the IAEA insider threat prevention guidelines listed in INFCIRC/899.[55]

Litwak pays particular attention to Pakistan's international nuclear security commitments and partnerships. Pakistan never signed the Nuclear Non-Proliferation Treaty (NPT), the foundational treaty of the global movement towards non-proliferation and disarmament.[56] Pakistan's nuclear strategy is linked to that of India, whose government has not signed the NPT. It is unlikely that Pakistan will join the NPT while it is embroiled in conflict with India.

While Pakistan is not a signatory of the NPT, it does cooperate with the United States on nuclear security.[57] The United States has spent a cumulative 100 million USD on Pakistani nuclear security under the Bush and Obama administrations.[58] Representatives from the United States Department of Energy met with the SPD,[59] and President Obama publicly stated that the Pakistani army understands the consequences of nuclear theft and takes the security of its nuclear weapons seriously.[60] The cooperation between the United States and Pakistan was limited. US officials were never granted access to Pakistani nuclear sites. Pakistani officials said that allowing the US government into these sites was a "red line" they would not cross.[61] Privately,

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[54] Clary. "The Safety and Security." 112.
[55] "NTI Nuclear Threat Index." 117.
[56] Litwak. "Deterring Nuclear Threats." 12., and "Treaty on the Non-Proliferation of Nuclear Weapons (NPT) – UNODA." https://www.un.org/disarmament/wmd/nuclear/npt/.
[57] Litwak. "Deterring Nuclear Terrorism." 109., and Clary. "The Safety and Security." 105.
[58] Litwak. "Deterring Nuclear Terrorism." 110.
[59] Ibid. 109.
[60] Ibid. 44.
[61] Ibid. 110.

US intelligence officials reportedly noted that their lack of information about Pakistani nuclear security was a concerning blind spot.[62] Overall, Pakistan has not adhered to international norms of nuclear security, and the Nuclear Threat Initiative gives Pakistan a rating of 45 out of 100 in the "Global Norms" category.[63] Scholars should pinpoint the consequences of this lack of cooperation on nuclear security and the threat of theft.

On-site physical protections

Virtually all nuclear material in Pakistan is stored at heavily guarded military bases.[64] These bases are secured by a 20,000-member force and a 1,000-person special response force.[65] They have modern surveillance equipment and an inventory system to track their nuclear components.[66] The specific location of Pakistani nuclear weapons is a state secret, but scholars do have limited information about policies and technologies that protect the arsenal from theft.

Pakistani officials proudly note that Pakistani nuclear weapons components are disassembled and stored in different locations.[67] Specifically, most weapons have three to four components that are housed in three to four locations.[68] The Sargodha Weapons Storage Complex Mushaf Air Force Base reportedly stores nuclear warheads that will be driven and attached to missiles held at the Mushaf Air Force Base ten kilometers away.[69] Although these warheads will be transported on roads like tactical weaponry, scholars have not expressed similar concern for their security. Moreover, Clary argues that disassembled weapons may be easier to

[62] Litwak. "Deterring Nuclear Terrorism." 110.
[63] "NTI Nuclear Security Index." 117.
[64] Bunn, et al. "Revitalizing Nuclear Security." 95.
[65] Litwak. "Deterring Nuclear Terrorism." 109., and Bunn, et al. "Revitalizing Nuclear Security." 95.
[66] Litwak. "Deterring Nuclear Terrorism." 109.
[67] Ibid. 109.
[68] Kristensen. "Pakistani Nuclear Forces." 350.
[69] Ibid. 352.

steal, because it is comparatively easy to remove a warhead's fissile material core when it is not attached to a missile.[70]

Pakistani nuclear weapons are equipped with a system similar to Permissive Action Links (PALs).[71] To deploy a weapon, two to three Pakistani officials would need to communicate with the NCA and receive a twelve-digit alphanumeric code.[72] Scholars agree that requiring two or three people to deploy a weapon effectively prevents against unauthorized use. This policy is called "the 2-to-3-man rule."[73] The Pakistani government is confident in this system. The head of Pakistan's nuclear program from 1994 to 2007, Samar Mubarakmand, asserted that a Pakistani nuclear weapon left on the side of the road for 10 months would not be detonated.[74] This is an astonishing level of confidence, but there has not been a peer review of these PAL equivalents. Their level of tamper-resistance is unknown to scholars.[75] While scholars describe the extensive actions needed to deploy a weapon, they do not discuss the effect of this system on the strategic calculus of a terrorist organization.

Scholars have limited information about terrorist organization's objectives and capabilities and Pakistani nuclear security. In this thesis, I examine specific variables to determine how the Pakistani nuclear security architecture affects the threat of a nuclear theft by a terrorist organization. It provides a clear explanation of how nuclear security affects a terrorist organizations calculus and partially explains why a nuclear theft has not yet occurred in Pakistan, despite substantial concerns.

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70 Clary. "The Safety and Security." 105.
71 Bunn, et al. "Revitalizing Nuclear Security." 95., and Litwak. "Deterring Nuclear Terrorism." 109.
72 Clary. "The Safety and Security." 105.
73 Litwak. "Deterring Nuclear Terrorism." 109., and Clary and Panda. "Safer at Sea?" 154.
74 Clary. "The Safety and Security." 108.
75 Ibid. 108.

Theory

To evaluate the effectiveness of Pakistan's nuclear security architecture against the threat of potential theft, I first provide two formulas: one to describe the components of Pakistan's nuclear security architecture, and another to determine the likelihood of nuclear theft by a terrorist organization. I split these concepts into separate variables to provide focused analysis and determine outstanding strengths and weaknesses. These formulas act as the operational definitions that guide my initial research questions.

My first research question is: how vulnerable is Pakistan's nuclear security architecture? I define nuclear security architecture by the following function:

$$\text{Nuclear Security Architecture} = f\,(\text{Nuclear Force Posture, Nuclear Security Environment and Institutions, On-Site Physical Protections})$$

During my preliminary research, I found that Pakistan's nuclear security policies could be divided into these three categories. On-site physical protections are "traditional" security measures, such as locks. The nuclear security environment and institutions are normative security measures, like Pakistan's Centre of Excellence for Nuclear Security. Finally, the nuclear force posture of Pakistan is the impact of Pakistan's military strategy on the security of their nuclear weapons.

My second research question is: what capabilities and objectives do terrorist groups in Pakistan have to steal components of the nuclear arsenal? This question is based off the following function:

$$P\,(\text{Nuclear Theft}) = f\,(\text{Objectives, Costs, Opportunities, Capabilities})$$

This probability function is inspired by Stephen M. Meyer's research on the choice of states to pursue nuclear weapons.[76] Meyer noted that a state's choice to build a weapon was based on its strategic objectives, a calculation of costs and benefits, and whether a state had the opportunity and capabilities necessary to build a nuclear weapon. Since the costs imposed on and opportunities for a non-state actor are contingent on Pakistani nuclear security architecture, they are not evaluated in my second research question.

I evaluate my research questions using a variation of the Delphi Method. The Delphi Method was created by the RAND Corporation in the 1950s.[77] It was used to reach expert consensus on certain topics. Experts would answer a questionnaire, their answers corresponding to a numerical score which could be analyzed statistically. Given the time constraints I face in writing a senior thesis, I do not contact nuclear experts directly. Instead, I identify experts' answers to my research questions by analyzing their recent papers/reports on Pakistani nuclear security and/or terrorist organizations. The Delphi Method is suited to my research, because I am detailing the likelihood of future events. There has never been a successful instance of a terrorist organization stealing a nuclear weapon. Therefore, I cannot analyze case studies. Additionally, I chose this variation of the Delphi Method because I do not have access to detailed information about Pakistani nuclear security and terrorist organizations. I rely on secondary source material. The Delphi Method allows me to pinpoint expert consensus and find the most accurate values for my variables, given my reliance on secondary sources.

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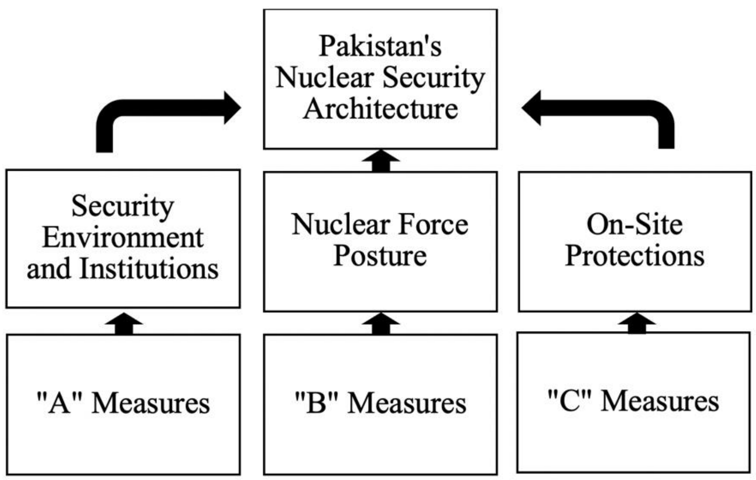
[76] This probability function was suggested to me by Professor Richard Eichenberg based off Stephen M. Meyer's book, *The Dynamics of Nuclear Proliferation*.
[77] RAND Corporation. "Delphi Method," n.d. https://www.rand.org/topics/delphi-method.html.

Methods

Pakistan's nuclear security architecture is defined by the tools, policies, and procedures the Pakistani government uses to secure its nuclear arsenal. These tools, policies, and procedures fall into three different categories: Pakistan's nuclear security environment and institutions, Pakistan's nuclear force posture, and on-site protections. I use these categories as the variables that define Pakistan's nuclear security architecture. The individual tools, policies, and procedures serve as the measures that define each variable.



"A" measures are tools, policies, and procedures that strengthen the Pakistani government's commitment to nuclear security or work to secure the arsenal but are not necessarily "on-site," or physically on/near weapons components. For example, this may include international treaties signed by Pakistani leadership, institutions that educate on nuclear security, and/or hiring procedures that prevent insider threats. These are the measures that inform the value of the variable "Pakistan's security environment and institutions."

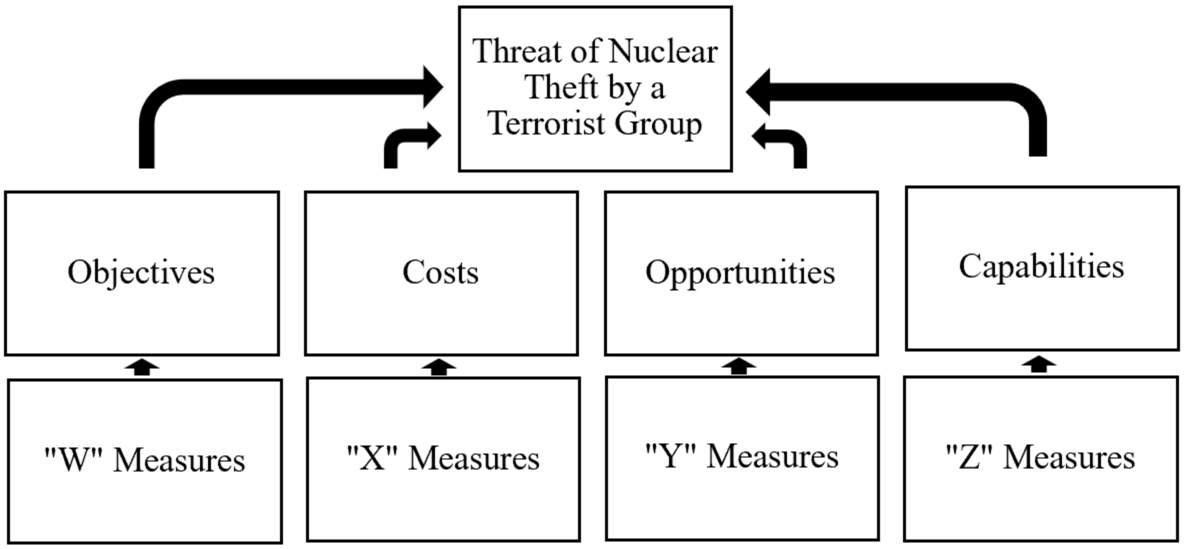
"B" measures are changes in Pakistan's nuclear weapons policy that affect the security of the arsenal. These changes may be strategic, meaning they were made by Pakistani officials to strengthen their position vis-à-vis an adversary (likely India). “B” measures could include the development of new weaponry and/or the relocation of existing weapons. These are the measures that define the variable “Pakistan’s nuclear force posture.”

“C” measures are tools, policies, and procedures that secure the arsenal and occur/are physically on-site. Examples of “C” measures may be physical locks, procedures for accessing weapons, physical structures protecting weaponry, or policies for the storage of weapons components. These are the measures that make up the variable “on-site protections.”

I define the threat of nuclear theft by a terrorist organization by the following probability function:

$$P\,(\text{Nuclear Theft}) = f\,(\text{Objectives, Costs, Opportunities, Capabilities})$$

As seen above, the probability of nuclear theft by a terrorist organization is a function of the terrorist organization’s capabilities, its objectives, the costs imposed by the theft attempt or its completion, and the opportunities for theft. These variables define the threat of nuclear theft by a terrorist organization. The variables themselves are defined by different, organizationally specific measures.



"W" measures are the assertions of the official objectives of the different terrorist organizations in Pakistan. These may be in writing or by public statements of an organization's leadership.

"X" measures are terrorist organizations' perception of the costs imposed by a successful nuclear theft and by an unsuccessful nuclear theft attempt. When deciding to take one course of action, a terrorist group likely performs a cost-benefit calculation. If the perceived costs of the action exceed the potential benefits, the group will change course. Notably, these are the *perceived* costs of an action. The cost-benefit calculation is performed by the terrorist organization. The organization's leaders are not omniscient; they have no way of knowing the *actual* costs of an action. Potential costs of attempting or succeeding at nuclear theft could be the number of casualties, financial costs, opportunity costs (the next best alternative action), and/or the costs associated with the potential backlash.

"Y" measures are the actions of the Pakistani government that create or lessen the opportunity for a terrorist organization to steal nuclear material or nuclear weapons components. Essentially, "Y" measures are vulnerabilities or strengths in the nuclear security architecture.

"Z" measures are the individual capabilities of terrorist organizations (with a presence in Pakistan) that would aid a nuclear theft. These could include the number of fighters in an organization, weaponry, vehicles, and money.

Methodology for Research Question #1

The first research question I answer is: how vulnerable is Pakistan's nuclear security architecture? I rely on secondary source materials, like scholarly journals, reports, and interviews with nuclear security experts to gather data. Following my operational definition of Pakistan's nuclear security architecture, these secondary source materials act as indicators of the outlined measures' vulnerability. For example, the scholarly consensus (indicator) of a physical lock's vulnerability (measure) informs the value of Pakistan's on-site protections (variable) which is a part of Pakistan's larger nuclear security architecture (concept).

I find the scholarly consensus surrounding each measure by first assigning each scholar's view of the measure a number 0 to 3. These scores are detailed below.

Not vulnerable = 0
Somewhat vulnerable = 1
Moderately vulnerable = 2
Extremely vulnerable = 3

If a scholar views a measure as perfect, without error, or infallible, the measure is given a score of 0. If a scholar sees a measure as imperfect and believes it could only be exploited in an unlikely "what-if" scenario, the measure is given a score of 1. If a scholar sees a measure as worrisome, but not easily exploitable, it is given a score of 2. If a scholar sees a measure as a pressing danger and as easily exploitable, it is given a score of 3.

I identify scholarly viewpoints in articles, papers, and reports by finding a clear statement of perspective. For example, “Pakistan’s nuclear arsenal does not have sufficient on-site protections. This is concerning.” Citations of other reports (e.g., the NTI Index) in another work do not represent a separate scholarly viewpoint.

After compiling the scores of several scholarly viewpoints, I calculate the average score given to each measure. This average score represents the scholarly consensus surrounding a measure. The following table is used to analyze these averages.

Not vulnerable = 0
Somewhat vulnerable = (0 - 1.5]
Moderately vulnerable = (1.5 - 2.5]
Extremely vulnerable = (2.5 - 3]

To find the vulnerability score of each variable within Pakistan’s nuclear security architecture (e.g., the vulnerability of Pakistan’s on-site protections) I take the average of all the relevant measure’s average scores. I find the overall vulnerability score of Pakistan’s nuclear architecture by calculating the average of each variable’s vulnerability score. Critically, I do *not* compare the numerical scores of these variables. These scores are supposed to serve as estimators of vulnerability. A score of 1.75 and 1.9 are not viewed as notably different; both variables would be seen as moderately vulnerable.

Throughout this discussion, I note gaps in information, other limitations, and cross-reference these scores with the Nuclear Threat Initiative’s Index scores. The Nuclear Threat Initiative (NTI) is the first attempt to give countries a nuclear security “score.” They provide scores in different sub-categories. The NTI has a full-time staff and larger budget than I, so their assessment of certain measures and variables may strengthen my findings. If our scores are strikingly different, I study their methodology and attempt to find an explanation for the discrepancy.

Methodology for Research Question #2

My second research question is: what capabilities and objectives do terrorist groups in Pakistan have to steal components of the nuclear arsenal? Both "capabilities" and "objectives" are variables for the threat of nuclear theft. I do not analyze "costs" or "opportunities," because those variables are directly affected by Pakistan's nuclear security architecture. I analyze the relationship between Pakistan's nuclear security architecture and the costs and opportunities of a terrorist organization in my analysis of question #3.

Terrorist organizations try to keep information about their specific capabilities and strategic objectives secret. Therefore, there is a significant gap in the knowledge scholars have about terrorist organizations. Most scholars get information about terrorist organizations through sources (e.g., defectors, insiders), official government reports, and statements made by terrorist leadership. In the case of the Islamic State, some of their propaganda magazines and posters hint at their objectives. I use both secondary sources, like scholarly journals and reports, and primary sources, like interviews, official group publications, and speeches, to conduct my analysis.

Given the time and financial constraints of my research, I focus on three major terrorist organizations with a presence in Pakistan: al-Qaeda, the Islamic State (ISIL), and the Pakistani Taliban. These are the largest terrorist organizations in Pakistan, with the most followers and capabilities. Moreover, most smaller terrorist groups in Pakistan pledge allegiance to one of these three organizations.

Like in my first research question, I try to find the scholarly consensus for terrorist organization's capabilities and objectives. The measures for these capabilities and objectives are the separate capabilities and objectives of the three terrorist organizations (e.g., ISIL's capabilities). I assign a score between 0 and 3 to each scholarly viewpoint I find (as seen below). Some scholars use primary source material to support their viewpoints, so I do not assign a score to primary sources. I use them to contextualize my findings.

No capabilities/objectives = 0
Limited capabilities/objectives = 1
Moderate capabilities/objectives = 2
Significant capabilities/objectives = 3

For each capabilities score, if a scholar finds that the terrorist organization in question has none of the necessary resources to steal nuclear weapons components, they are given a score of 0. If a scholar finds that a terrorist organization has limited, rudimentary capabilities to carry out nuclear theft, they are given a score of 1. If a scholar finds that a terrorist organization has some worrisome capabilities that could aid a nuclear theft, they are given a score of 2. If a scholar finds a terrorist organization has advanced capabilities that could easily aid a nuclear theft, they are given a score of 3. In most cases, scholars analyze a terrorist group's capabilities in the context of vulnerabilities in the Pakistan nuclear security architecture. I also look for scholars who focus on terrorist groups' capabilities but not on nuclear security. I take their assessment of terrorist groups' capabilities into account, if it is known that the capabilities they detail would assist a nuclear theft. For example, if a nuclear security scholar writes that ISIL could hack into an army base's security system, I look for scholars who assess ISIL's cybersecurity capabilities to provide further support for the nuclear security scholar's assertion.

For each objectives score, if a scholar shows that a terrorist organization has no interest in nuclear theft, they are given a score of 0. If a scholar shows that a terrorist organization has mentioned acquiring nuclear weapons components hypothetically or only a couple of times, they are given a score of 1. If a scholar shows that a terrorist organization has expressed a keen interest in nuclear theft, detailing why and how they would steal weapons components, but it is not a main objective, they are given a score of 2. If a scholar shows that stealing nuclear weapons components is one of the main objectives of a terrorist organization, they are given a score of 3.

I calculate the average score of the variables to find the overall capabilities and objectives scores. Each of the three groups have the same weight in the overall capabilities and objectives scores. They each represent the same number of inputs. I identify the organization with the highest score, to find the terrorist organization most likely to attempt nuclear theft. The following table is used to analyze the overall scores:

No capabilities/objectives = 0
Limited capabilities/objectives = (0 - 1.5]
Moderate capabilities/objectives = (1.5 – 2.5]
Significant capabilities/objectives = (2.5 – 3)

Just as with question #2, I do not compare the numerical scores of these variables.

Methodology for Research Question #3

My third research question, or my guiding question for my research, is: does Pakistan's nuclear security architecture effectively decrease the threat of nuclear theft by a terrorist organization? I analyze this question by testing two different hypotheses:

Hypothesis A: Pakistan's nuclear security architecture *does* effectively decrease the threat of nuclear theft by a terrorist organization.

Hypothesis B: Pakistan's nuclear security architecture *does not* effectively decrease the threat of nuclear theft by a terrorist organization.

To test these hypotheses, I analyze the relationship between the "costs" and "opportunities" variables of the probability function and the variables within Pakistan's nuclear security architecture. I follow the below formulas:

Opportunity = Y_A (Nuclear Security Environment/Institutions) + Y_B (Nuclear Force Structure) + Y_C (On-Site Protections) +…

Costs = X_A (Nuclear Security Environment/Institutions) + X_B (Nuclear Force Structure) + X_C (On-Site Protections) +…

Using these formulas, I find the directions of each coefficient (i.e., whether the relationship is positive or negative) and identify their relative magnitude (e.g., *extremely* positive/negative). This shows the effect of each variable within Pakistan's nuclear security architecture on the threat of nuclear theft. Drawing from the findings of question #1, each coefficient corresponds to its variable's vulnerability score. The following tables are used:

For the opportunity function:

Not vulnerable score → Extremely negative relationship
Somewhat vulnerable score → Moderately negative relationship
Moderately vulnerable → Somewhat negative relationship
Extremely vulnerable → No relationship OR a positive relationship

For the costs function:

Not vulnerable score → Extremely positive relationship
Somewhat vulnerable score → Moderately positive relationship
Moderately vulnerable → Somewhat positive relationship
Extremely vulnerable → No relationship OR a negative relationship

I confirm, disconfirm, or partially confirm hypotheses A and B using this analysis. If hypothesis A is confirmed, I find that *either* Pakistan's nuclear security architecture causes costs to clearly exceed benefits (each coefficient describes an extremely positive relationship) or all opportunities for nuclear theft are eradicated (each coefficient describes an extremely negative relationship), *or* that Pakistan's nuclear security architecture leaves little opportunity for nuclear theft. I know that there is little opportunity for nuclear theft if each coefficient in the opportunity function shows a moderately negative relationship or an extremely negative relationship and none show a somewhat negative relationship, no relationship, or a positive relationship.

If hypothesis B is confirmed, at least one of the coefficients in the opportunity function shows a *somewhat* negative relationship, no relationship, or a positive relationship *or* at least one of the coefficients in the costs function shows a *somewhat* positive relationship, no relationship, or a negative relationship. There is a clear difference between the three relationships described for each function. This is noted. However, the consequences of a terrorist organization stealing components of a nuclear weapon are catastrophic. Each of the three relationships outlined show ineffective protection and the need for the Pakistani government to improve its nuclear security architecture.

Chapter 2: Analysis of Research Question #1

In this chapter, I evaluate my first research question: how vulnerable is Pakistan's nuclear security architecture? I divide this chapter into four sections, the first three corresponding to the x-variables in my nuclear security architecture function (i.e., nuclear security architecture = f (nuclear force posture, nuclear security environment/institutions, on-site physical protections)), and the final section summarizing the scholarly consensus surrounding Pakistan's nuclear security architecture.

I gathered articles for each variable by searching across fifty-five online databases, looking for specific words and phrases (e.g., "nuclear security" and "Pakistan OR Pakistani"). On some databases with more options, I performed two searches. In the first search for each variable, I specified that the term "Pakistan OR Pakistani" should be found in the articles' abstracts. In the second search, I specified that the phrase "nuclear security" should be in each abstract. All other specified terms could be found anywhere in the articles. On every database, I limited my search to peer reviewed articles from 2016 through 2021.

I chose to limit my research to articles from 2016 to 2021 for several reasons. The last Nuclear Security Summit was held in 2016, ending the most significant international effort to improve nuclear security. This affects the nuclear institutions and environment variable, as the Nuclear Security Summits streamlined US-Pakistani cooperation on nuclear security, which the Trump administration largely abandoned.[78] Additionally, Pakistan announced their development

[78] Bunn, et al. "Revitalizing Nuclear Security." 15.

of tactical nuclear weapons at the end of 2015, marking a major shift in their nuclear force posture.[79]

I compiled a list of well-known international security institutions and think tanks and searched their websites for reports and articles. It is difficult to find every article written about Pakistani nuclear security in the last five years, but this method ensures I find enough reputable, scholarly source material to find an acceptable average score. With a sufficient sample of source material, the average scores should not be significantly affected by new inputs.

After gathering articles and assigning scores, I compare my calculated scores to the scores assigned by the Nuclear Threat Initiative (NTI). The NTI scores countries in several areas relevant to securing nuclear materials. In the NTI, the higher the score, the better the country is doing in that category. A score of 0 to 33 is a low score, 34 to 66 is a medium score, and 67 to 100 is a high score. This reflects my method of scoring, where elements of nuclear security are either not vulnerable (an NTI score of 100), somewhat vulnerable (an NTI score of 67 to 99), moderately vulnerable (an NTI score of 34 to 66), or extremely vulnerable (an NTI score of 0 to 33). When comparing my scores to the NTI's, I will look for scores that are significantly different and offer an explanation for the discrepancy.

Analysis of Nuclear Force Posture

Pakistan's nuclear force posture refers to the nuclear weapons strategy of the Pakistani military. Pakistan's recent deployment of tactical nuclear weapons is an example of a strategic

[79] "Pakistan Nuclear Weapons Program | Pakistan Nuclear Technology | NTI." Accessed October 2, 2020. https://www.nti.org/learn/countries/pakistan/nuclear/.

decision that impacts Pakistani nuclear security and is a measure of the "nuclear force posture" variable.

My searches targeted peer-reviewed articles from the last five years including the terms "Pakistan OR Pakistani," "nuclear security," and "'force structure' OR posture OR strategy." These searches gathered fourteen potentially relevant articles. I supplemented these articles with reports and articles from scholarly institutions. I had eleven inputs for this variable.

The average score for Pakistan's nuclear force posture was 2.5. The scores are broken down in the below table:

Score	Number of Articles
Score of 0	0
Score of 1	1
Score of 2	4
Score of 3	6

This score means that Pakistan's nuclear force posture was *moderately vulnerable*, according to scholars. Scholars found Pakistan's transition to tactical weapons, use of submarine launched weapons, and increase in number of warheads/sites very concerning.

The NTI's assigned score for Pakistan's "Quantities and Sites" was 19, meaning the NTI believes Pakistan's choice to expand their arsenal leaves their weapons extremely vulnerable to theft. Their rationale for this low score argued that Pakistan increasing its stockpile of nuclear material increases management costs and the possibility of theft. They say that the increasing number of sites with nuclear materials and the increased transportation of nuclear materials increases the chances of a security breach.[80] Although my score does differ slightly from the NTI, our scores are not directly comparable. The NTI does not factor the Pakistani military's nuclear weapons strategy into their analysis. Recent strategic choices may be less concerning to scholars and my inclusion of strategy in this variable could account for the slight discrepancy between the NTI score and my own.

Analysis of Nuclear Security Environment/Institutions

The nuclear security environment/institutions of Pakistan are the normative aspects of nuclear security in Pakistan, such as the Pakistani government's expressed commitment to nuclear security, Pakistan's signatory status on international nuclear security agreements, and Pakistan's Centre of Excellence for Nuclear Security.

My searches highlighted peer-reviewed articles from the last five years including the terms "Pakistan OR Pakistani," "nuclear security," and "institution OR commitment OR environment." These searches found thirty-six potentially relevant articles. After supplementing with reports and articles from institutions and think tanks, I had twenty-three inputs for this variable.

The average score for Pakistan's nuclear security environment/institutions was 0.77. The scores are broken down in the below table:

[80] "EIU Methodology: Theft and Sabotage." NTI Nuclear Security Index: The Economist Intelligence Unit. Accessed November 1, 2020. https://www.ntiindex.org/wp-content/uploads/2020/07/2020_NTI-Index_EIU-Methodology_Final.pdf.

Score	Number of Articles
Score of 0	12
Score of 1	4
Score of 2	5
Score of 3	1

This score means that Pakistan's nuclear security environment and institutions were *somewhat vulnerable*, according to scholars. This is a good score, but there were a few areas for improvement. Scholars noted that Pakistan is not a signatory of the Nuclear Non-Proliferation Treaty, does not allow for peer review of its nuclear security architecture, and suffers from potential insider threats.

Three NTI scores are relevant to this category. The NTI gave Pakistan a score of 89 for Domestic Commitments, a score of 50 for Security Culture, and a score of 45 for Global Norms. I believe their scoring reflects my findings. None of these NTI scores are low. The two medium scores are in areas where I similarly found weaknesses.

Analysis of On-Site Physical Protections

On-site physical protections refer to the tangible aspects of nuclear security, often in close proximity to weapons or weapons components. Examples include permissive action locks (PALs), storing weapons in disassembled form, and two-to-three-man rule.

My searches found peer-reviewed articles from the last five years including the terms "Pakistan OR Pakistani," "nuclear security," and "arsenal OR stockpile OR base OR storage." These searches identified thirty-three potentially relevant articles. After adding other relevant scholarly articles, I had fourteen inputs for this variable.

The average score for Pakistan's on-site physical protections was 0.71. The scores are broken down in the below table:

Score	Number of Articles
Score of 0	7
Score of 1	5
Score of 2	1
Score of 3	1

This score means that Pakistan's on-site physical protections are *somewhat vulnerable*, according to scholars. Major areas of concern were Pakistan's reliance on ground transportation to move weapons components, the unreliability of available data, and Pakistan's recent move towards storing weapons at greater stages of readiness.

The NTI gave Pakistan a score of 60 for On-Site Physical Protections. They see this area as moderately vulnerable. This score is close to the next category (it would need seven more points to be a high score). The NTI does see this area as slightly more concerning than the scholars included in my analysis.

Conclusions

In my analysis, I gave nuclear force posture a score of 2.5, nuclear security environment/institutions a 0.77, and on-site physical protections a 0.71. The average score for Pakistan's nuclear security architecture is 1.3, making it *somewhat vulnerable*. The scholars included in my analysis see Pakistan's on-site physical protections as their greatest strength and recent strategic moves as their greatest area of weakness. These findings affect the probability of a terrorist organization attempting nuclear theft. The nuclear security of Pakistan affects two variables in my likelihood function: opportunity and costs. Weaknesses in this area increase the opportunity and lower the costs of nuclear theft. Furthermore, stored weapons are not the primary concern of scholars. A nuclear theft attempt is most likely to be successful if a terrorist organization were to target tactical weapons or nuclear-armed submarines. Additionally, Pakistan's choice to expand their arsenal and number of sites housing nuclear weapons components increases the number of opportunities for a terrorist organization to find insider sympathies or exploit a weakness in on-site physical protections. While the Pakistani government has made improvements in its nuclear security architecture, it remains somewhat vulnerable to theft. Considering the extreme consequences of a terrorist organization with access to nuclear weapons components, any vulnerability is cause for concern.

Chapter 3: Analysis of Research Question #2

In this chapter, I analyze my second research question: what capabilities and objectives do terrorist groups in Pakistan have to steal components of the nuclear arsenal? I start by analyzing the capabilities of my three terrorist organizations of interest: al-Qaeda, ISIL, and the Pakistani Taliban. I then analyze the nuclear objectives of these three groups. I hope to use my analysis of this question to evaluate the effectiveness of Pakistan's nuclear security architecture. I do not need to divide my scoring by each terrorist organization, because every article I cite focused primarily on the organization the author found to be the most likely to pursue nuclear theft. The average scores I give for capabilities and objectives reflect the scholarly consensus about the highest level of terrorists' capabilities and objectives found in Pakistan. Because I must rely on scholarly material, I have to assume that each scholar highlights the terrorist organization they see as the *most* concerning. This assumption allows me to compare the most significant threats to the vulnerability of Pakistan's nuclear security architecture, evaluating the effectiveness of Pakistani nuclear security.

Similar to my analysis of the first research question, I searched for relevant articles using fifty-five online databases. I limited my searches to peer-reviewed articles from 2016 to 2021. This time period allows these variables to be compared to the nuclear security architecture function, which followed these same time limits. Furthermore, ISIL's strategy changed in 2016, as the organization had lost much of their territory, continued to suffer major defeats into 2017, and lost their physical caliphate.[81]

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[81] Dempsey, Michael P. "How ISIS' Strategy Is Evolving," January 18, 2018. http://www.foreignaffairs.com/articles/syria/2018-01-18/how-isis-strategy-evolving.

I did one search per variable. I found that this provided a sufficient number of relevant articles. Both searches specified that the terms “Pakistan OR Pakistani,” “ISIL OR ISIS OR ‘Islamic State’ OR Taliban OR al-Qaeda OR al-Qaida OR al-Qa'ida,” “‘nuclear weapon’ OR ‘nuclear material,’” and “theft OR steal OR buy OR procure” had to be found in the text of the articles.

Analysis of Terrorist Organizations’ Capabilities

In this section, I evaluate the capabilities of al-Qaeda, ISIL, and the Taliban that would aid a nuclear theft. While many scholars discussed the difficulties of building a nuclear explosive device with stolen nuclear material, this did not factor into my analysis of terrorist organizations’ capabilities. My thesis looks at the threat of nuclear theft, not the threat of a terrorist group detonating a nuclear explosive device in an act of terrorism.

I searched for articles that contained either “capabilities OR capability OR ability OR abilities OR potential OR capacity,” in addition to my previously specified terms. While my searches found many articles, I limited my analysis to fourteen relevant articles, giving me fourteen inputs for the capabilities variable.

The average score for Pakistani terrorist organizations’ capabilities was 1.5. The scores are detailed in the below table:

Score	Number of Articles
Score of 0	2
Score of 1	4
Score of 2	7
Score of 3	1

This score indicates that terrorist organizations in Pakistan have *limited capabilities* that would enable them to steal from the Pakistani nuclear arsenal. This score indicates that scholars see the three terrorist organizations of interest as having some worrisome capabilities that could aid a nuclear theft. Scholars noted that each of the three terrorist organizations would likely rely on a sympathetic insider to transfer or sell them nuclear material. This possibility was most concerning. Scholars believe that all three terrorist organizations would have extreme difficulty stealing nuclear material without insider help. Several believed it would be impossible for any of these organizations to independently access a weapons stockpile. It is impossible to know which organization is most likely to have insider sympathy in the Pakistan Armed Forces, so I treat each of the organizations as having equally concerning capabilities in my analysis.

Analysis of Terrorist Organizations' Objectives

A terrorist organization's objectives are impossible to detail without insider knowledge. My analysis of al-Qaeda's, ISIL's, and the Taliban's objectives relies on scholarly analysis of their public statements or released information concerning their nuclear programs. I rely on scholars to discern whether public statements reflect the true mindset of terrorist organizations, instead of simply seeking to frighten. Moreover, my analysis is far removed from primary source data. I simply do not have access inside terrorist organizations or to advanced intelligence.

For the objectives variable, I searched for articles containing "aspiration OR goal OR objective OR aim OR intent OR desire" and my previously specified terms. I limited my analysis to the sixteen most relevant sources, translating to sixteen inputs for the objectives variable.

The average score for Pakistan's terrorist organizations' objectives was a 1.9. The scores are broken down in the below table:

Score	Number of Articles
Score of 0	1
Score of 1	2
Score of 2	9
Score of 3	3

This score shows that terrorist organizations in Pakistan have *moderate objectives*. The pursuit of nuclear weapons is not the primary goal of these organizations, but it remains an objective. To support this claim, scholars cite ISIL propaganda, the al-Qaeda nuclear program, emphatic (albeit older) statements from al-Qaeda leader Osama bin Laden, and recent actions by ISIL operatives in Belgium.

Conclusions

I found that my three terrorist organizations of interest had *limited capabilities* and *moderate objectives.* When analyzing the capabilities variable, no one terrorist organization was more worrisome than the others. The main concern was insider sympathies in the Pakistani Armed Forces for Islamist terror organizations. Al-Qaeda, ISIL, and the Taliban all fall under this category, and are all of equal concern. Al-Qaeda was generally the most concerning to scholars for the objectives variable, because of past statements made by the organization's leadership and their nuclear weapons program. These two variables affect the likelihood of theft function (i.e., P(theft) = f (capabilities, costs, objectives, opportunity)), which details terrorist organizations' cost-benefit calculation when considering a nuclear theft attempt. As discussed in chapter 2, the costs and opportunity variable are affected by Pakistan's nuclear security architecture. Capabilities and objectives are solely affected by the actions of terrorist organizations. Overall, scholars do not see nuclear theft as the most pressing threat terrorist organizations pose in Pakistan. It is far more likely for one of these three organizations to use conventional weapons than to try and mount an extensive plot to seize a weapon or weapons components from the Pakistani Armed Forces. A major concern for scholars, however, is the possibility that a terrorist organization would exploit insider sympathy. If one of these three organizations had a sympathizer willing to help steal a weapon or weapons components, terrorist organizations would likely capitalize on the opportunity, since nuclear theft is still an objective.

Chapter 4: Analysis of Research Question #3

In this chapter, I analyze the relationship between the nuclear security architecture function and the likelihood of theft function. I begin by defining the relationship between Pakistan's nuclear security architecture and the opportunity and costs variables from the likelihood of theft function. I describe the direction and magnitude of these relationships (e.g., extremely positive). I then use my findings, along with my answers to my first and second research questions to answer my third research question: does Pakistan's nuclear security architecture protect its nuclear weapons arsenal from theft by terrorist organizations?

I define the opportunity and costs variables following functions:

Opportunity = Y_A (Nuclear Security Environment/Institutions) + Y_B (Nuclear Force Structure) + Y_C (On-Site Protections) +…

Costs = X_A (Nuclear Security Environment/Institutions) + X_B (Nuclear Force Structure) + X_C (On-Site Protections) +…

I can find the coefficients for each x-variable by using the results from chapter 2. The magnitude and direction of each variable is illustrated using arrow icons next to their coefficients. A negative relationship is depicted by a down arrow and a positive relationship by an up arrow.

Type of relationship	**Icon**
Extremely positive/negative relationship	⇑/⇓
Moderately positive/negative relationship	↑/↓
Somewhat positive/negative relationship	⇡/⇣
No relationship	Ø

In the first chapter, I detailed how the vulnerability scores of each nuclear security architecture variable would determine their effect on opportunity and costs.

For the opportunity function:

Not vulnerable score →	Extremely negative relationship
Somewhat vulnerable score →	Moderately negative relationship
Moderately vulnerable →	Somewhat negative relationship
Extremely vulnerable →	No relationship OR a positive relationship

For the costs function:

Not vulnerable score →	Extremely positive relationship
Somewhat vulnerable score →	Moderately positive relationship
Moderately vulnerable →	Somewhat positive relationship
Extremely vulnerable →	No relationship OR a negative relationship

Through analyzing scholarly views of Pakistani nuclear security architecture, I found that Pakistan's nuclear security environment/institutions are somewhat vulnerable, Pakistan's nuclear force posture is moderately vulnerable, and Pakistan's on-site physical protections are somewhat vulnerable. Using these findings, I detailed the following relationships in the opportunity and costs functions:

$$\text{Opportunity} = \downarrow Y_A \text{ (Nuclear Security Environment/Institutions)} + \downarrow Y_B \text{ (Nuclear Force Structure)} + \downarrow Y_C \text{ (On-Site Protections)} + \ldots$$

$$\text{Costs} = \uparrow X_A \text{ (Nuclear Security Environment/Institutions)} + \uparrow X_B \text{ (Nuclear Force Structure)} + \uparrow X_C \text{ (On-Site Protections)} + \ldots$$

Pakistan's nuclear security environment and institutions somewhat decrease the number of opportunities for theft and somewhat increase the costs of theft. There are a few areas for improvement. Pakistan does not allow for peer review of its nuclear security architecture. This is cause for concern; in a worst-case scenario there may be a weakness that presents an opportunity and lowers costs for successful nuclear theft. Additionally, Pakistan's screening program for personnel is substantial, but not infallible. This is difficult to avoid, but a potential radical Islamist insider still presents a grave threat. The presence of a sympathetic insider gives terrorist organizations an opportunity for nuclear theft with significantly lowered costs. Terrorist organizations would not have to spend resources on gathering information about the facilities or secure advanced weaponry to get past military protections. This scenario may be unlikely, but it does justify the relationships between opportunities, costs, and the Pakistani nuclear security environment and institutions.

Pakistan's nuclear force posture has a somewhat negative relationship with the opportunity variable and a somewhat positive relationship with the costs variable. These are the most concerning relationships found in the opportunity and costs functions. Pakistan's expansion of the arsenal increases the number of targets, the frequency of transporting weapons, and the likelihood of less protected weapons, creating more opportunities for theft. Further, Pakistan's deployment of nuclear-armed submarines and tactical weapons decreases the cost of theft. Submarine-launched cruise missiles (SLCMs) are clear targets for terrorist organizations, as naval bases are more easily located and other countries' submarines have been successfully intercepted by terrorist organizations in the past. SLCMs attached to submarines are at a greater stage of readiness than disassembled weapons at a land-based facility. Once the submarines are at-sea, terrorist organizations would face considerably less physical military security. Similarly, tactical nuclear weapons are smaller and easier to transport. When being transported to the battlefield, tactical nuclear weapons are assembled, easier to target, and have less physical protection than when inside a storage facility. Depending on their location and readiness level, both of these weapons systems can significantly decrease the costs associated with a nuclear theft. Pakistan's choice to deploy SLCMs and tactical weapons increases opportunities for nuclear theft and decreases the associated costs. Overall, Pakistan's nuclear force posture does more to decrease opportunities and increase costs, but there is substantial room for improvement.

The vulnerabilities in Pakistan's on-site physical protections have a moderately negative relationship to the opportunities variable and a moderately positive relationship to the costs variable. There are a few vulnerabilities. The information available to the scholarly community about the physical security measures of the arsenal is dated. In a worst-case scenario, there could be outdated protection systems, digital systems (i.e., non-analog) that are vulnerable to hacking, or other weaknesses in physical protections that present an opportunity for theft. Some on-site practices decrease the costs associated with theft, like relying on ground transportation to move weapons components and the storage of weapons at higher stages of readiness. Weapons are less heavily guarded during ground transport and assembled weapons are a more valuable target. Assembled weapons eradicate the need for the terrorist organization to build or buy other weapons components necessary to cause a nuclear explosion. Therefore, transporting nuclear weapons components on the ground and storing assembled nuclear weapons decreases the costs of nuclear theft for terrorist organizations.

Given the above relationships, I disconfirmed hypothesis A and confirmed hypothesis B: Pakistan's nuclear security architecture *does not* effectively decrease the threat of nuclear theft by a terrorist organization. The nuclear force structure of Pakistan has a *somewhat* negative relationship to opportunities and a *somewhat* positive relationship to costs. These relationships match the confirming criteria for hypothesis B outlined in chapter 1. The test of a successful nuclear security architecture is whether it protects its weapons from theft in a worst-case scenario. Pakistani nuclear security has several weaknesses that could be exploited. Although the prospects of an organization carrying out a successful nuclear theft are rather unlikely, they are not impossible. Since the potential ramifications of a terrorist organization having access to a nuclear weapon, detonating a weapon, or building a device to spread nuclear material are great, there cannot be any room for avoidable error.

Chapter 5: Conclusion

Pakistan's nuclear security architecture is only absolutely effective if it reduces the value of one or more of the variables in the likelihood of threat function to zero, not including the costs variable. Any outstanding vulnerability is concerning, given the potential ramifications of successful nuclear theft by a terrorist organization. It is also true that it is extremely difficult to eradicate any threat of theft in a nuclear-armed state where there is a terrorist organization that is somewhat capable of nuclear theft and wants nuclear weapons components.

Evaluating the Likelihood Function

In chapter 2, I evaluated the nuclear security architecture function and each variables' relationship to the opportunity and costs variables. In chapter 3, I found values for terrorist organizations' capabilities and objectives. The effectiveness of Pakistan's nuclear security architecture can be found by detailing the relationship between its components and variables in the likelihood function, as well as other variables in the likelihood function that are not directly affected by nuclear security measures.

Opportunity

Both the nuclear security environment/institutions and the on-site physical protections have a moderately negative relationship to the opportunity variable. There is room for improvement, as both variables are somewhat vulnerable. Within Pakistan's nuclear security environment and institutions, this relationship is accounted for by potential insider threats, no peer review of Pakistan's nuclear security, and Pakistan not signing the Nuclear Non-Proliferation Treaty. The vulnerability of on-site physical protections can be explained by some weapons stored at high levels of readiness, the unreliability of old data about these protections, and Pakistan's reliance on ground transportation to move weapons components. There are outstanding issues with both of these components of the nuclear security architecture function. Therefore, they have a moderately negative relationship, but not a relationship of the magnitude necessary to eradicate all opportunities for theft. Moreover, Pakistan's nuclear force posture only has a somewhat negative relationship to the opportunity variable. Recent developments, like moving towards tactical weapons, Submarine-Launched Ballistic Missiles, and an increase in the number of warheads and sites, present new opportunities for theft and represent clear areas for improvement. The value of the opportunity variable is non-zero.

Costs

Pakistan's nuclear security environment/institutions and on-site physical protections both moderately increased the costs associated with theft. Pakistan's nuclear force posture somewhat increased these costs. By making the nuclear security architecture more advanced, the Pakistani government increases the amount of time and resources a terrorist organization would have to devote to orchestrate a nuclear theft. The costs variable represents the cost-benefit analysis calculation of terrorist organizations. The nuclear security architecture of Pakistan imposes many costs, but the potential benefits of having a nuclear weapon or weapons components are great. The Pakistani government is unable to know terrorist organizations' exact calculus, but their best course of action is to impose all possible costs, considering the potential catastrophe of nuclear theft. Existing vulnerabilities represent opportunities for the government to impose more costs and help ensure that the costs of nuclear theft continue to outweigh benefits. The benefits a terrorist organization sees from acquiring nuclear weapons components can fluctuate and are not affected by Pakistan's nuclear security architecture. Pakistan's nuclear security architecture has outstanding vulnerabilities, which translate to a decrease in costs. Therefore, the value of the costs variable is not sufficiently high.

Capabilities

I found that scholars feel that terrorist organizations would be most capable of nuclear theft if there were a sympathetic insider. Additionally, terrorist organizations are historically more capable of attacking SLBMs and likely capable of stealing tactical weapons. This applies to all three organizations I study in this thesis. I evaluate these variables based off the worst-case scenario. This ensures that the nuclear arsenal is protected against all possible threats. Given Pakistan's move towards SLBMs and tactical weaponry, the value of capabilities is non-zero. In a worst-case scenario, there is a sympathetic insider, and the value of capabilities is even greater.

Objectives

Scholars researching terrorist propaganda, public statements/actions, and the old al-Qaeda nuclear program believe that terrorist organizations want nuclear weapons components. Nuclear theft remains a secondary objective for ISIL and al-Qaeda. If their cost-benefit calculations fluctuate based off changes to the Pakistani nuclear security architecture, there may be increased focus on attempting nuclear theft. In any case, the value of the objectives variable is non-zero.

Conclusions

Although it is imperfect, much of Pakistan nuclear security architecture decreases the threat of theft. There are only a few areas of concerning weaknesses. My findings suggest that Pakistan should recommit to international nuclear security cooperation outside of the Nuclear Security Summits which ended in 2016. Although unlikely, Pakistan could optimize its nuclear security by joining the Nuclear Non-Proliferation Treaty, allowing for peer review of its security systems, and rolling back its SLBM and tactical weapons programs. This highlights the challenge of pursuing both nuclear security and nuclear strategy during an active conflict. Pakistan's nuclear posture changed because of its conflict with India. Pakistan will likely continue to develop tactical weapons, SLBMs, and other (potentially less secure) technologies as long as this conflict continues. Weapons are also stored at higher stages of readiness during conflict. This means the likelihood of nuclear theft will be higher during an active conflict and can likely only be optimized once it ends.

In this thesis, I applied quantitative analysis to qualitative research done by scholars to provide a more accurate portrayal of the scholarly conversation surrounding Pakistan's nuclear security and the threat of nuclear theft it faces. During my data collection process, I read around two hundred articles and isolated their authors' statements of opinion, if there was one. Most articles simply cited the opinions of others in the field. The authors cited in this thesis clearly state their beliefs about the vulnerability of Pakistan's nuclear arsenal and/or the decision-making calculus of terrorist organizations.

The conversation surrounding Pakistani nuclear security is often divided into two camps: those authors who believe the arsenal is not secure and those who think the threat of nuclear theft is overblown. My research shows that Pakistani's changes in their force posture are the most concerning aspect of their nuclear security architecture. Pakistan's posture changes are inextricably linked to their assessment of India's capabilities, and are therefore subject to change while the Indo-Pakistani conflict continues. Nuclear force posture changes are directly related to the opportunities terrorist organizations have to steal nuclear material and the costs imposed on them when doing so. The Indo-Pakistani conflict is directly impacting the security of Pakistan's nuclear arsenal.

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