SAND2019-2520C

PROJECT ON NUCLEAR GAMING

Gaming Methods for Studying Deterrence in Hypothetical Escalation Scenarios

PRESENTED BY

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Sandia National Laboratories

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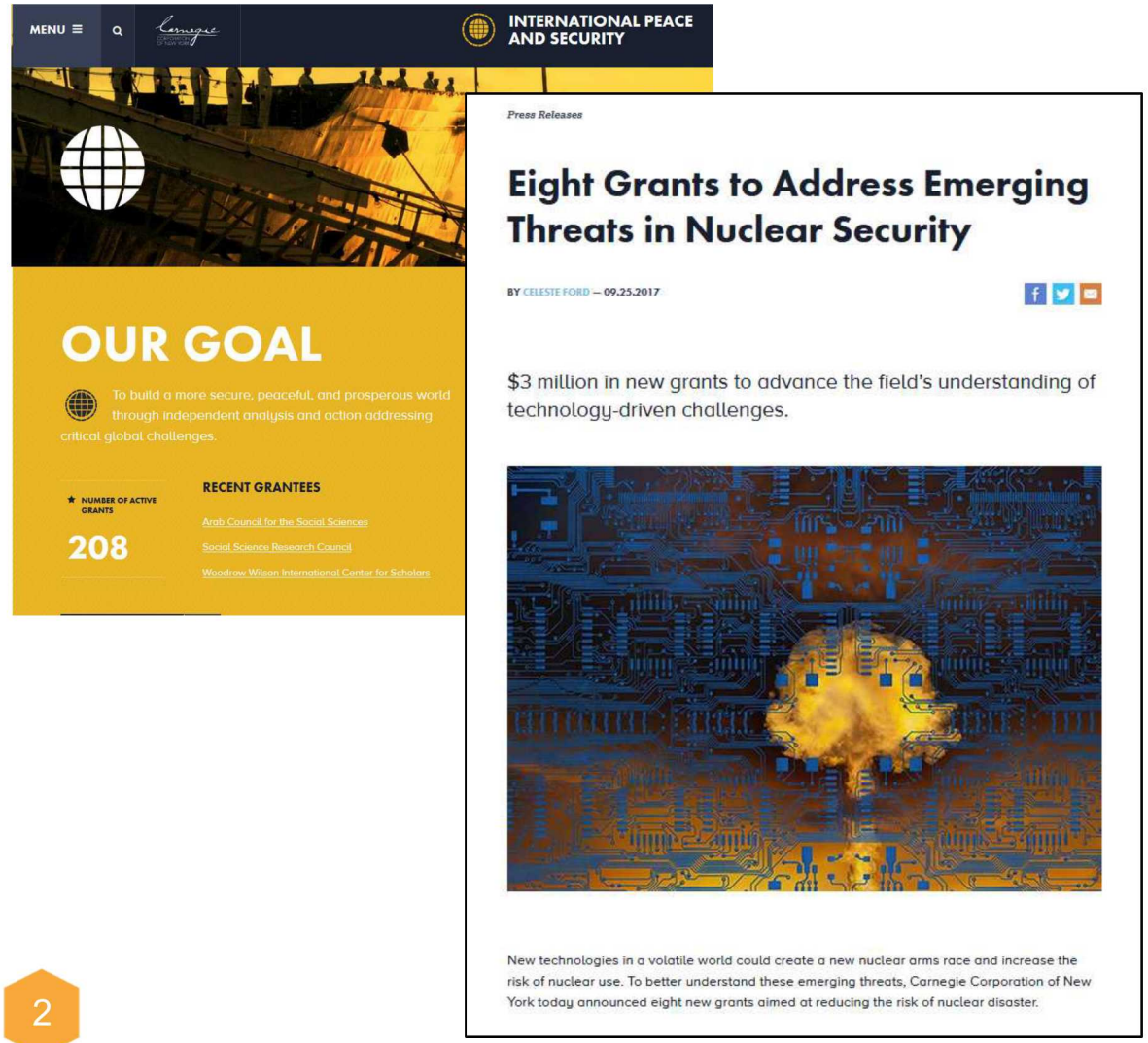
The Project on Nuclear Gaming is supported by the CCNY International Peace and Security Program.



Carnegie Corporation of New York

$500K funding over two years

"…assess the implications for global strategic stability of advances in technologies…"

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Australian National University
Australian National University, Canberra, Australia: $450,000 to evaluate how advances in networked sensing, data processing, and artificial intelligence are changing anti-submarine warfare and nuclear deterrence, with a focus on nuclear risks in the Asia-Pacific region.

Carnegie Endowment for International Peace
Carnegie Endowment for International Peace, Washington, D.C.: $450,000 to explore technical and policy steps in the United States and China to reduce the risk posed by cyber threats to nuclear command and control systems.

Center for Strategic and International Studies, Inc.
Center for Strategic and International Studies, Inc., Washington, D.C.:$402,000 to bring current and rising nuclear experts together to examine how recent advances in computer platforms, sensors and networks could affect situational awareness of decision-makers during crises between nuclear-armed states.

Royal United Services Institute for Defence and Security Studies|Center for Nonproliferation Studies
Royal United Services Institute for Defence and Security Studies, London, U.K., in partnership with the Center for Nonproliferation Studies: $430,000 to understand how the capability of non-nuclear states, such as South Korea, to conduct precision strikes with conventional weapons could affect strategic stability. Such capabilities could affect U.S and North Korean nuclear decision-making in important ways.

Stockholm International Peace Research Institute (SIPRI)
Stockholm International Peace Research Institute (SIPRI) Solna, Sweden: $400,000 to spotlight ways that machine learning and autonomy could lead to a new type of arms race that will affect nuclear operations. The project will develop recommendations for proactive crisis management.

University of California, Berkeley | Sandia National Laboratories | Lawrence Livermore National Laboratory
University of California, Berkeley, Berkeley, California, in partnership with Sandia National Laboratories and Lawrence Livermore National Laboratory: $500,000 to explore and analyze the implications for strategic stability of tailored effects and low-yield, high precision nuclear weapons through serious games that force national experts and university students to confront escalation dilemmas.

Center for Strategic and Budgetary Assessments
Center for Strategic and Budgetary Assessments, Washington, D.C.: $250,000 to evaluate the poorly understood effects of hypersonic technology on strategic nuclear stability and on current assumptions about deterrence and nuclear operations.

Atlantic Council of the United States, Inc.
Atlantic Council of the United States, Inc., Washington, D.C: $250,000 to assess the impact of computer, space, and missile defense developments on the global power balance and on nuclear stability, and to identify ways that new technologies could reinforce rather than weaken the existing international order.

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The Project on Nuclear Gaming is a consortium.

Berkeley
UNIVERSITY OF CALIFORNIA

- UC Berkeley Goldman School of Public Policy
- Nuclear Science and Security Consortium, an NNSA-sponsored program to develop new generation of laboratory-integrated nuclear experts

Sandia National Laboratories

- Systems Analysis and Engineering experience
- Support application of Sandia experimental and serious game technology & subject matter expertise
- Mentoring and hosting of student interns

Lawrence Livermore National Laboratory

- Center for Global Security Research
- Providing expertise in weapons effects and international security
- Mentoring and hosting of student interns
- Organizing and hosting project workshops

PROJECT ON NUCLEAR GAMING

The Project on Nuclear Gaming has many goals.

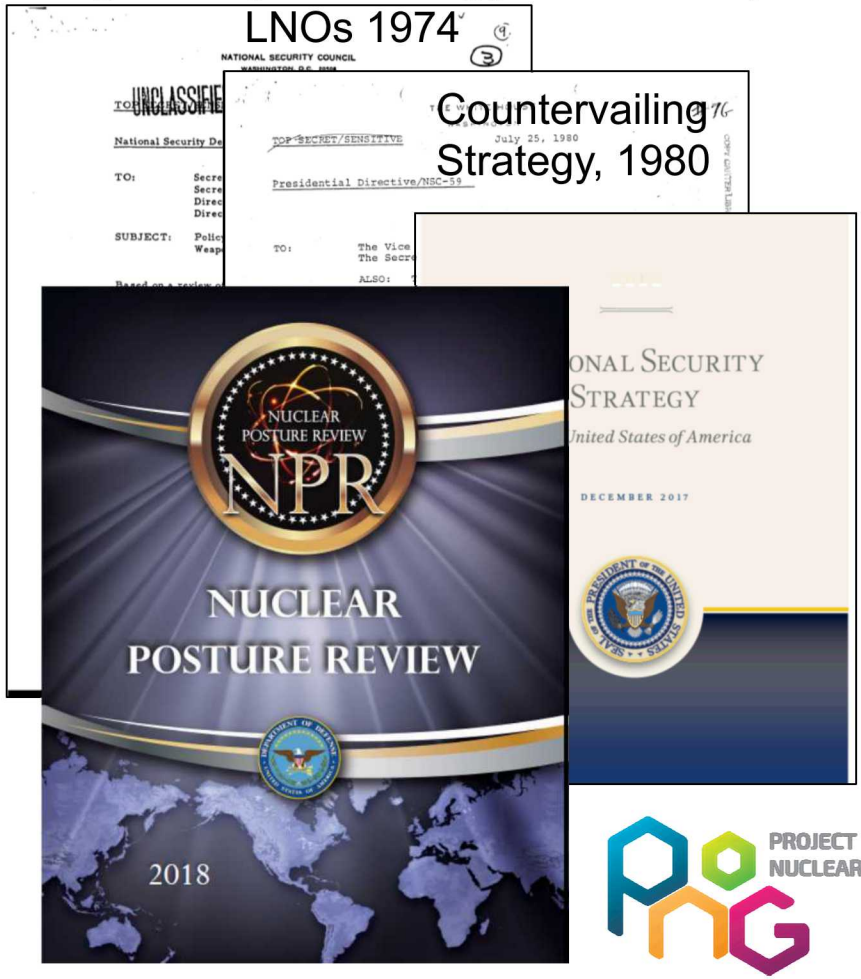
Research Questions:

- How can experimental games be constructed and executed to place players in abstract and hypothetical situations to model escalation challenges, including threats of nuclear use?
- What impact might nuclear weapons with different or tailored effects and capabilities have on deterrence and strategic stability?
  - Electromagnetic pulse
  - High-precision, low-yield systems

Partnering and Mentoring Objectives:

- Strengthen and leverage existing partnerships between National Labs and Universities
- Engage the next generation of scientists, analysts, and researchers on nuclear matters

PoNG is NOT making an assessment of any specific national policy or conflict scenario, but is informed by a long history of strategy and concepts.



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The Project on Nuclear Gaming has a two year arc.

FY2018

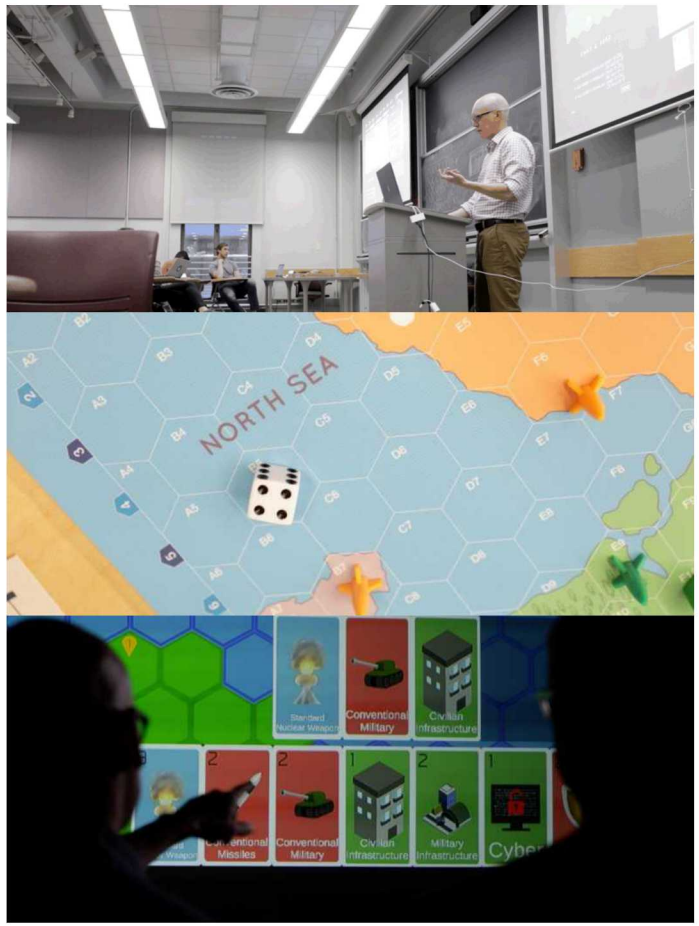
- Develop background research and analytic frame
- Seminar wargaming
- Build experimental board and online games

FY2019

- Collect data from playthroughs via workshops and online events
- Analyze data to identify trends and outcomes
- Collect lessons learned for future versions
- Publish results in conflict and wargaming literature

FY2020 and Beyond (TBD)

- Extend scenarios, methods, and tools



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There are important distinctions in nuclear weapons effects.

A ***traditional nuclear weapon*** detonation creates:

- Blast
- Thermal pulse
- Neutrons
- Radiation
- Electromagnetic Pulse (EMP)
- Potential fallout

Nuclear weapons can also be designed to provide specific enhanced outputs, e.g.,

- Enhanced radiation weapons with higher neutron output (neutron bomb)
- *EMP weapons optimized for energy output and height of burst*
- *Precision-delivered low-yield weapons to provide lethality to targets that otherwise would require higher yields*

These may be called ***tailored effect nuclear weapons***.

Ranger Easy – 1951, 1 kt

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What do scholars and practitioners think about tailored effect nuclear weapons?

Potential Costs:

- Breaking the nuclear taboo/Lowering threshold of nuclear use (Tannenwald 1999, Rovere and Robertson 2013, Doyle 2017)
- Lack of utility (Nelson 2010)
- Crisis instability
  - Blurring the distinction between conventional and nuclear weapons
  - Risk of inadvertent escalation if the adversary cannot discriminate between low- and high-yield attack (Sagan 1992, Posen 2013)
  - Inability to control escalation (Work 2015)
- Proliferation risk: Encouraging other countries to develop their own low-yield nuclear deterrent (Coyle and McKeon 2017, Gerstein 2018)

Potential Benefits:

- Tailored effect weapons less likely to lead to civilian deaths (Carpenter 2016)
- Increased probability of damage/kill for a given yield (Gen. Schwartz 2014)
- Providing a more credible nuclear deterrent for certain regional scenarios (Lieber and Press 2009)
- Raising the threshold for nuclear use (Williams and Lowther 2017)

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Our Approach to the Research Questions

How can experimental games be constructed and executed to place players in situations to model escalation challenges, including threats of nuclear use?

- Build it and see!
- Rigorous, multi-dimensional war-gaming that provides an experimental setting for analyzing behavior (Wack 1985; Kupers and Mangalagiu 2013; Barma et al. 2015; Lytwyn 2017)

What impact might nuclear weapons with different or tailored effects and capabilities have on deterrence and strategic stability?

- IV (Player Capability) → DV (Nuclear Use)

		Nuclear Player 2 Capability	
		Traditional (T)	Tailored (A)
Nuclear Player 1 Capability	Traditional (T)	T, T	T, A
	Tailored (A)	A, T	A, A

Player 3 is a non-nuclear state

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Experimental games have attractive features.

Replicability

- Strengthen our conclusions and address human variability by replicating a set of initial conditions and capturing significant quantities of data.

Controllability

- Allow for variable manipulation in initial conditions set.

Clear instrumentation

- Capture clear data about when a player chooses to take certain actions.

Neutrality

- Remain uninvolved with the actual data gathering, reducing the bias of the experiment team.

Fidelity

- Create an appropriate abstraction of scenarios of interest that focus on research questions and experimental design considerations.

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The games include critical aspects of deterrence, escalation, and decision making.

Important elements and action

- Military
- Economic
- Political/diplomatic

Important dynamics and mechanics

- Bargaining
- Signaling
- Uncertainty

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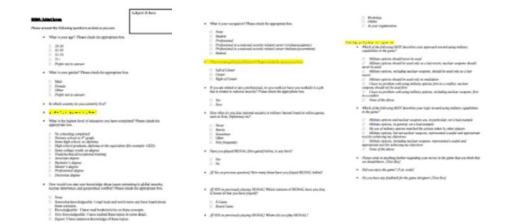
PoNG is investigating four experimental approaches to explore the research questions.



Seminar Games (Elite Players)

- Fluid exploration of scenario features, player concerns, and boundaries for outcomes, control team adjudication, qualitative and narrative data collection

Board Games (Knowledgeable and Expert Players)

- Highly structured scenarios, rules based adjudication, fluid conversation and over-the-table player dynamics, improved quantitative data collection

Online Games (Any Players)

- Highly structured scenarios, rules based adjudication, more structured player dynamics, high quantitative data collection

Survey Experiments (Targeted Responders)

- Questionnaires focused on evaluating subject responses to specific situations, no dynamic interaction, serves as a control set

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The approach varies initial conditions in the game to explore alternate scenarios.

Vary military capabilities of players

- Tailored & Traditional NW
- Traditional NW
- Conventional Forces Only
- Cyber
- Defensive

Vary existing economic/political ties

Execute of series of rounds, each with three phases:

- *Signaling Phase* for Diplomacy/Threats
- *Action Phase* for Making Moves
- *Upkeep Phase* for Accounting of Results

Gather data

- What signals do players send to each other?
- What actions and reactions do players take?

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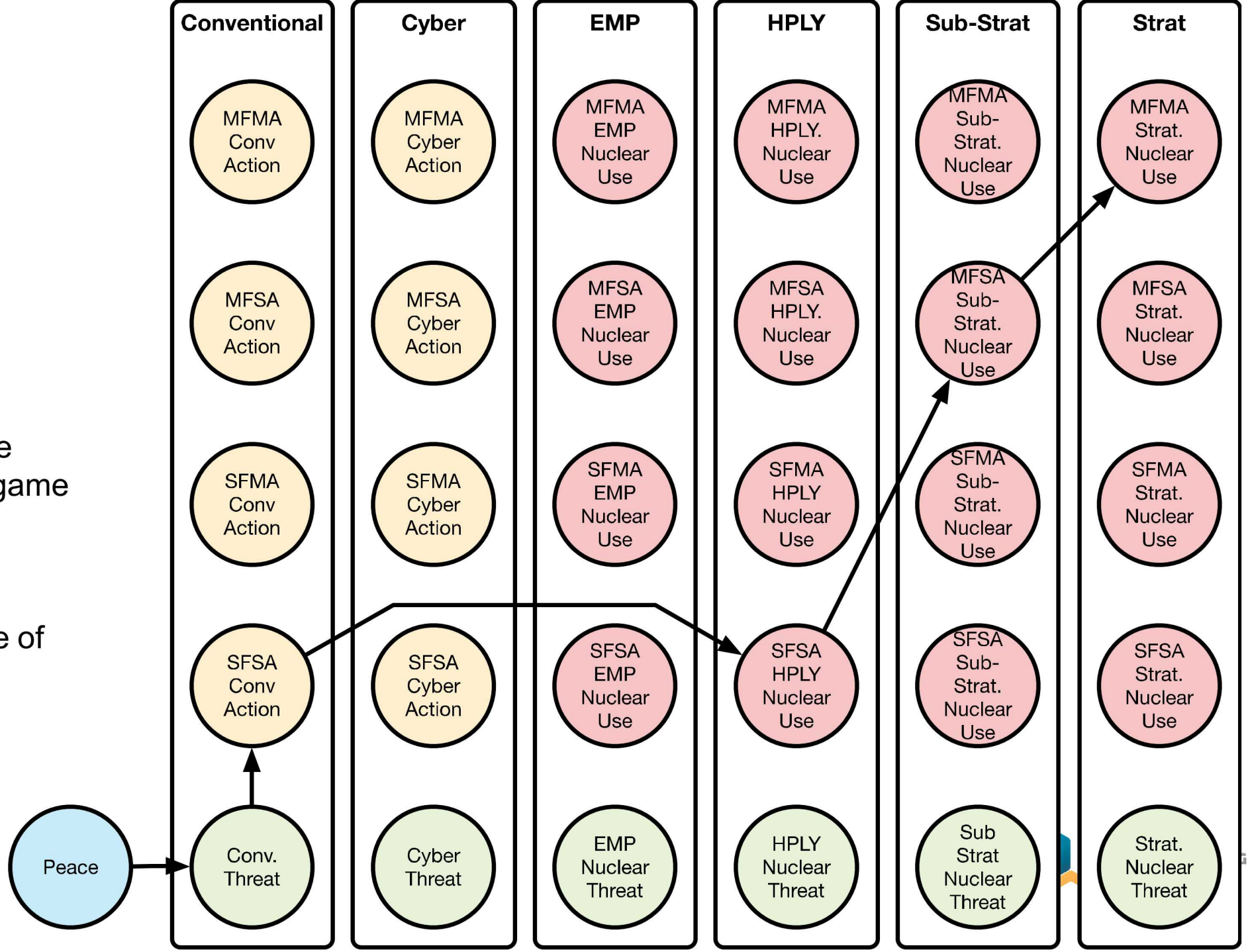
Round 4 of 4
Phase Diplomatic
68 (+15)
0/0
1/1
3/3
1/1
7/12 (+5)
B tutorialplayer
NATIONS
A 0/12
B 0/12
C 0/12
Rank: 2nd
TRADE PROPOSALS
Time left: 00:48
G14
Currently owned by C
Part of C's starting territory
CHAT & FEED
Diplomatic, Round 3
Game has transitioned to Phase Resolution, Round 3
A passed
B passed
Game has transitioned to Phase Upkeep, Round 3
Game has transitioned to Phase Diplomatic, Round 4
ALL
Enter text...
SEND
M
M
M
I
I
M
I
Cyber

Data analysis begins by establishing conflict classes.

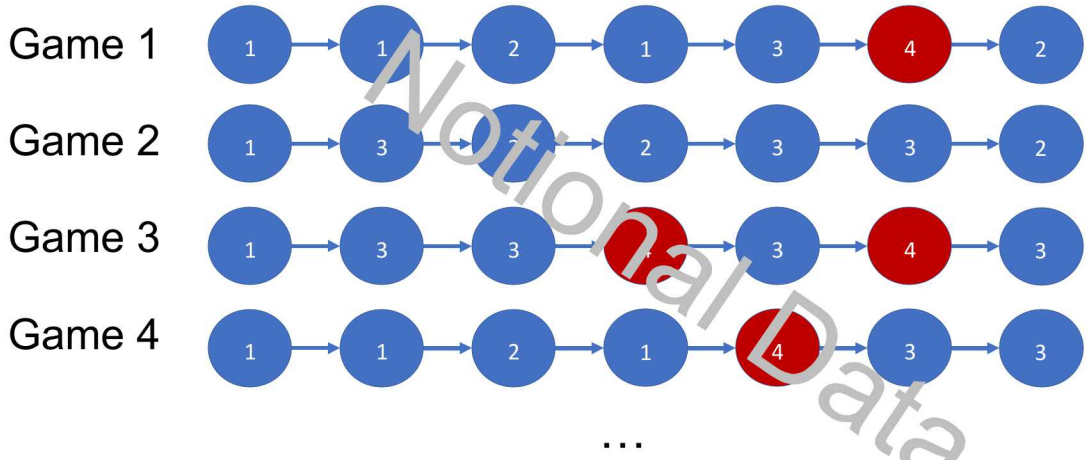
Measured through the reduction of the raw game data.

Can track escalation through the sequence of conflict classes.

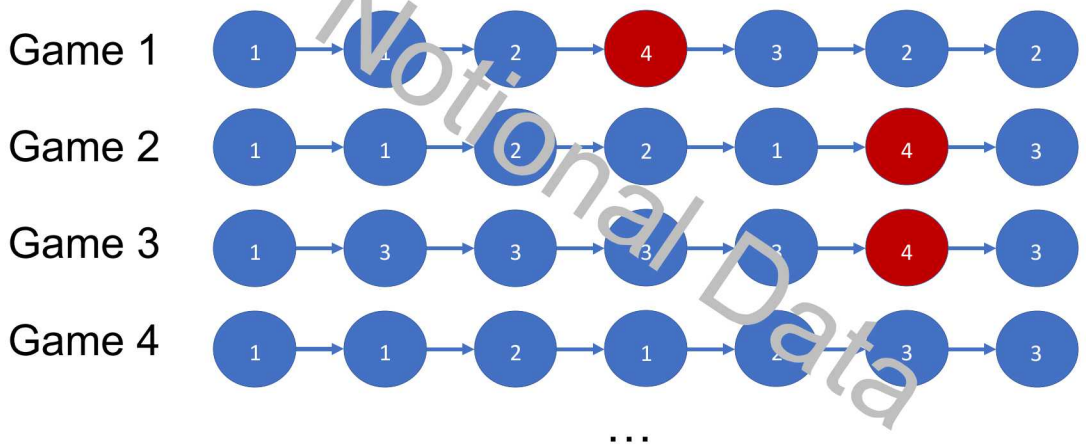


Data analysis in PNG is focused on a simple set of metrics…initially.

World with Tailored NW



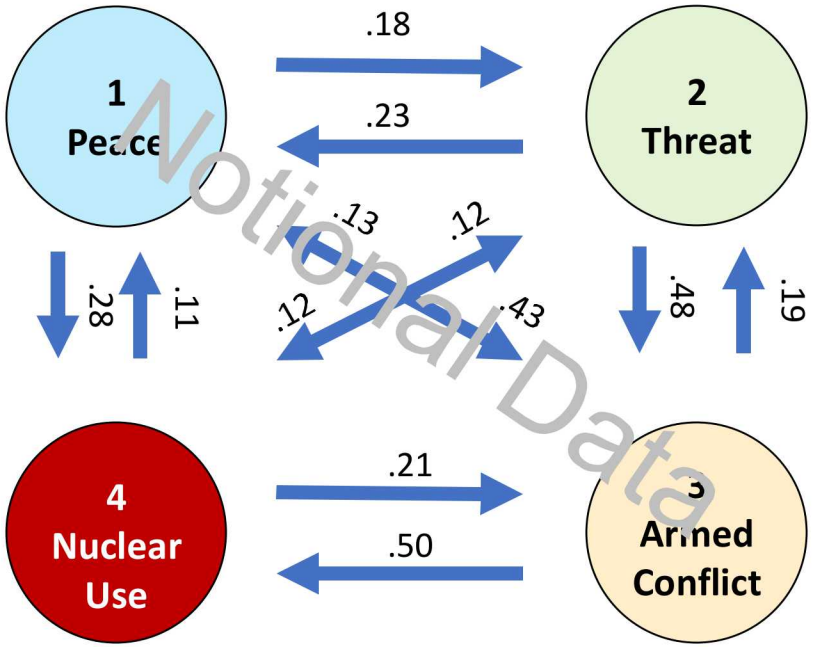
World without Tailored NW



Metrics of Interest:

1. Fraction of games with nuclear use
2. Distribution nuclear use over turns
3. Class transition frequencies

World with Tailored NW



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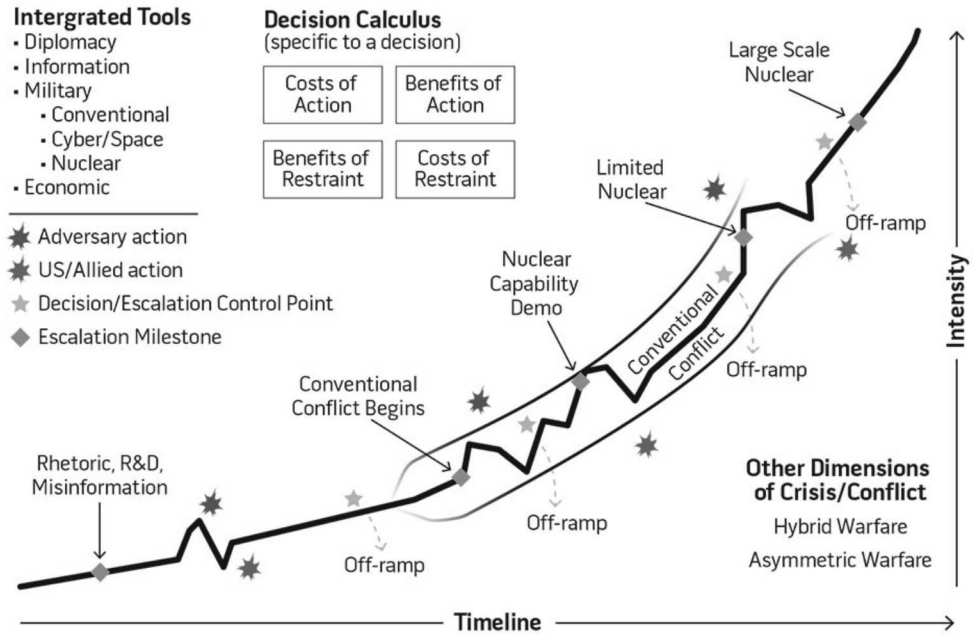
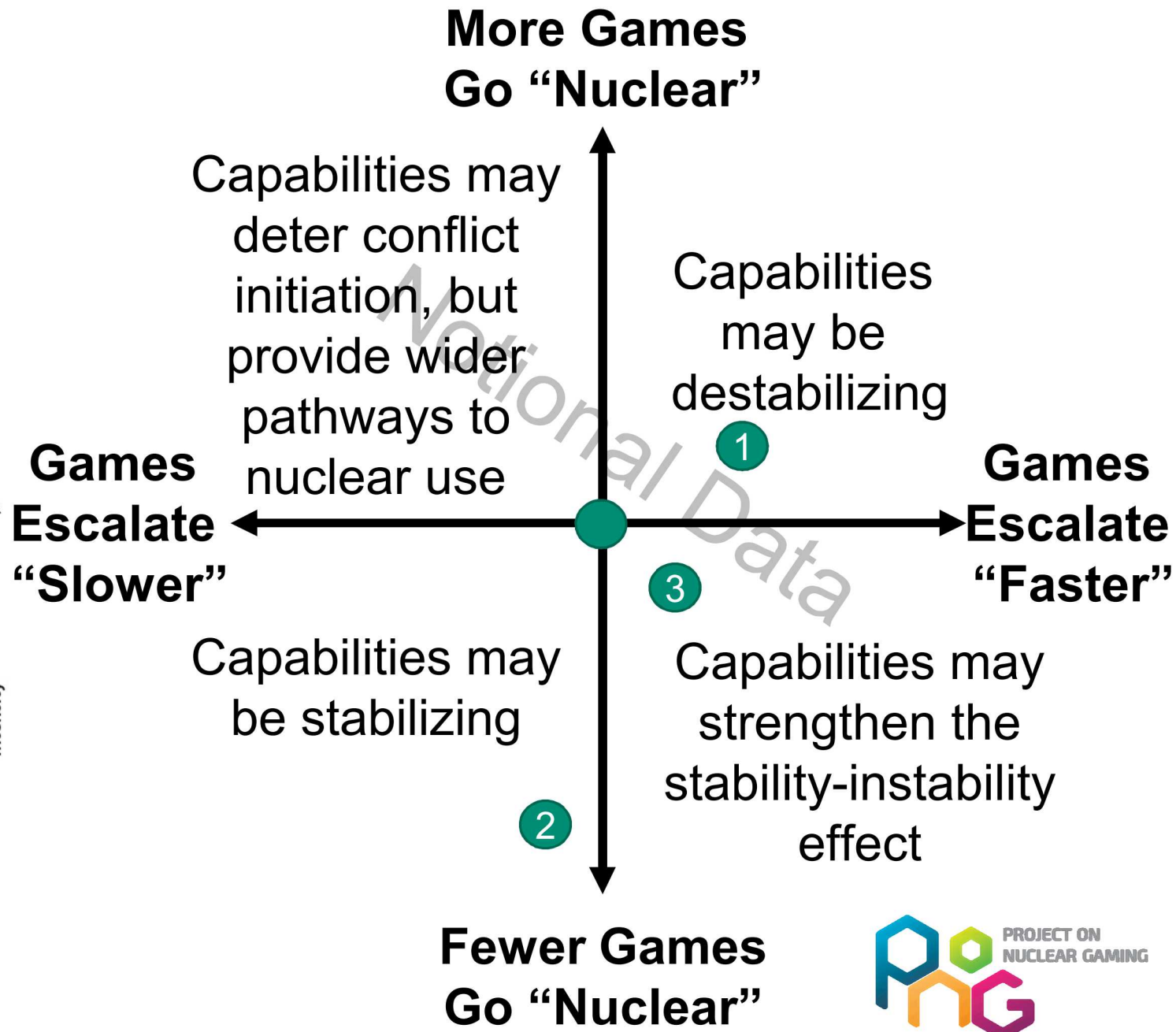
A Notional Result

- Control Game (Conv., Conv.)
- 1 Asymmetric (Trad., Tailored.)
- 2 Symmetric (Trad., Trad.)
- 3 Symmetric (Tailored, Tailored)

Figure. Spectrum of Conflict with Nuclear Adversary





http://ndupress.ndu.edu/JFQ/Joint-Force-Quarterly-83/Article/979753/an-interview-with-cecil-d-haney/

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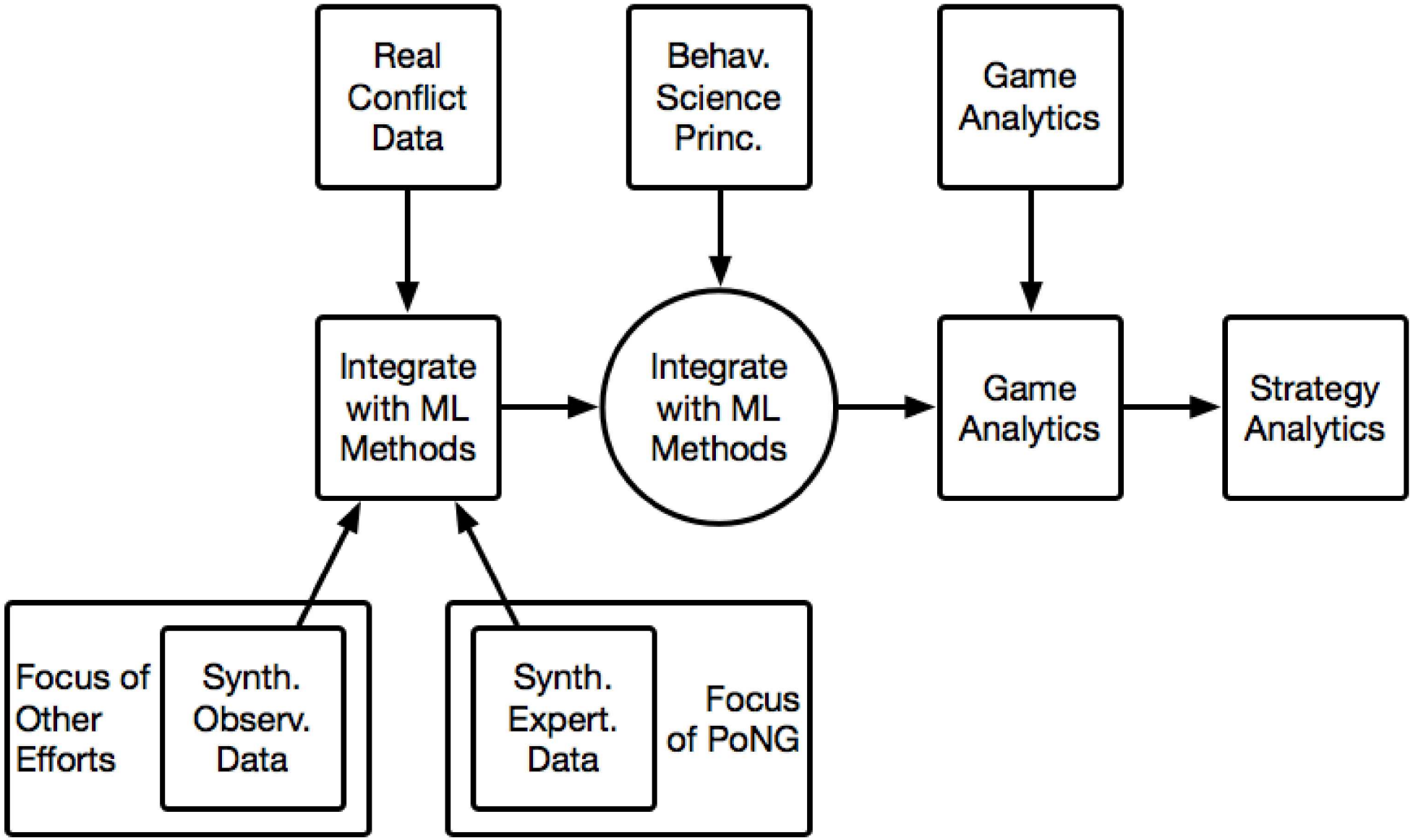
The Project on Nuclear Gaming is part of a bigger vision for enhancing the study of conflict.



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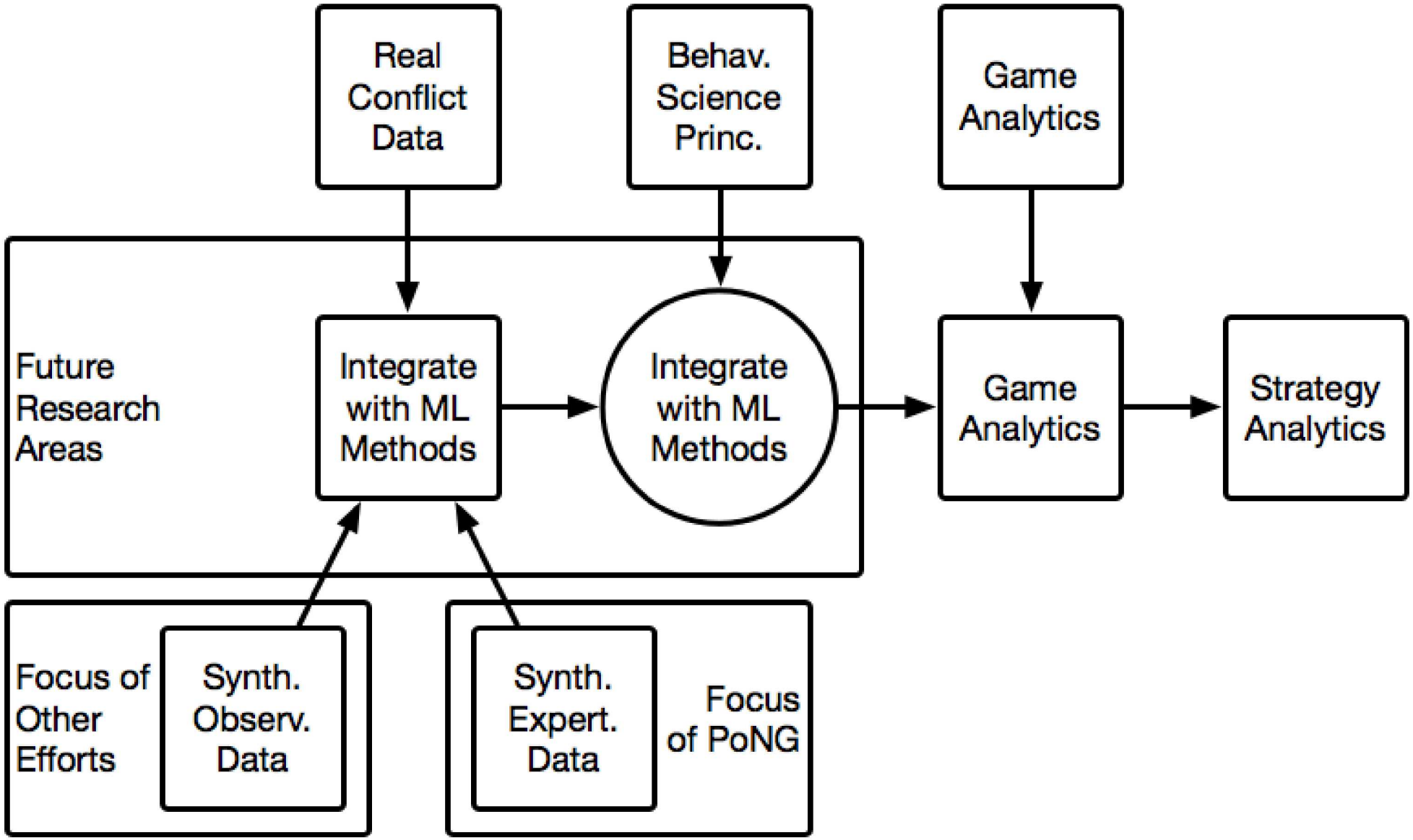

The Project on Nuclear Gaming is building experimental games that collect data to study deterrence and conflict.

Partnership between Carnegie Corporation of New York, UC Berkeley, Sandia National Laboratories, and Lawrence Livermore National Laboratory

Over halfway through a two-year research program, about to deploy board- and e-games

Focused on building new experimental game methodologies to enable new ways to study deterrence and conflict escalation

Initial scenarios and game mechanics center on traditional vs. tailored nuclear weapon capabilities and their impacts on escalation and nuclear use within the context of the abstract scenario

Data analytics focus on simple comparative metrics across scenarios…for now

Beginning to plan efforts beyond current cycle.

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What's Next?

Board Game Event TODAY!

- Logistics details go here

March 2019: E-game Launch

April 3, 2019: Board Game Collection at King's College London

Through July 2019: Multiple data collection events (e.g., NTI, UK PONI, Connections, MORS)

July – October 2019: Data analysis and results prep

October 2019: Results release

Visit pong.berkeley.edu to learn more!

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