



PROJECT ON
NUCLEAR GAMING

MORS: Experimental Gaming Methods for Studying Deterrence and Escalation Scenarios

PRESENTED BY

Dr. Bethany L. Goldblum, *University of California, Berkeley*

Andrew W. Reddie, *University of California, Berkeley*



BLUF:

- War gaming has traditionally been described as “an art rather than a science” (Perla 1990)
- Today, new tools—both technological and experimental—have the potential to provide a science-based approach to wargaming
- “Wargames as experiments” offer a tool with which to test existing theories in social science research



The Project on Nuclear Gaming (PoNG):



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



- Advanced Systems Studies and Exploratory Engineering
- Providing expertise related to experimental design, game build, and data analysis
- Mentoring and hosting of student interns



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



Wargames as an Art

Scenario-based Discussions

- Designing around identified policy challenges
- Useful for “process-oriented” inquiry (depth)
- “Open-ended” design
 - Blue, Red, and White Cell games
- Large game staffs and in-depth preparation (briefing books, opening presentations)
- Engaging high-level policy-makers
 - Training, education, and strategy
- Ex. Apex Gold Exercises; Deterrence and Escalation Game and Review (DEGRE)

Structured Exercises

- Using a more restrictive ruleset that allows for repeated playthroughs
- Increased ability to “Plug and Play”
- Ex. RAND Baltic Sea Scenario (Mueller 2016)

“Wargames as Experiments”

Existing wargaming methods do not provide for outcome-oriented inference:

- Generalizable insights require data to perform large- n analysis.
- Experiments also have standards with regard to *replication* and *reproducibility*
 - Often, existing games vary on the basis of how they are presented, the identity of the players, and actions taken within the adjudication cell.
 - Few games split their player populations into *treatment* and *control* groups to test a variable of interest.
 - There are also concerns surrounding sponsor bias that can be overcome using experimental approaches.

One of the responses of researchers to these challenges is to look for existing data...

The Advantages of Experimental Gaming for Inquiry

Replicable and Reproducible

- 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 as well as in-game manipulation.

Clear instrumentation

- Capture clear data about when a player chooses to perform actions in the game.

Neutrality

- Researchers uninvolved with the actual data gathering, reducing bias.

Fidelity/Complexity

- Creating a simulation that captures the key features of the world surrounding the research question.

The Search for Data: Archived Wargames

There are a number of researchers attempting to find that data using existing archives:

- Pauly (2018):
 - Uses MIT archival material from the 1960s to examine nuclear restraint among policy-making elites
- Schneider (2016):
 - Uses Naval War College cyber wargames for longitudinal analysis of cyber deterrence strategies
- The Wargaming Repository (Office of the Secretary of Defense)

The Search for Data: Leveraging Commercial Games

Scholars have also looked to commercial gaming platforms for data...

Data from “regular” gameplay

- World of Warcraft (Keegan et al. 2011; Yee et al. 2011)
- Eve Online
 - Battle of R-R5RB

Data from “mods”

- Starcraft; Warcraft
- Second Life (Castronova et al. 2009)
- Game X (Epifinovskaya et al. 2018)
- “Collaborotaries”
 - Ex. NetLab



The Search for Data: Building Experimental Environments

Rather than sourcing data from existing archival material, researchers can also attempt to manufacture experimental data...

- In analog settings...
 - Erik Lin-Greenberg (2018): UAVs in wargames
 - Jackie Schneider and the Naval War College (2018): Cyber Escalation
 - Andrew Reddie and Heather Williams (2019): Social Media Strategic Comms
- And in digital settings...
 - The Project on Nuclear Gaming's SIGNAL architecture (2018)

The Value Proposition

Contributing to contemporary international security research...

- Addressing the limits of existing wargaming methods related to inference, generalizability, and replicability
- Providing an additional data generating process
 - Particularly for policy issues where observational data is unavailable
- Providing a new type of experimental tool for social science research
 - Existing reliance on survey experiments
- Addressing the complexity of contemporary security environments
 - Cross-domain capabilities
 - Cross-regional threats
 - New types of actors

PoNG: RQ and Research Methods

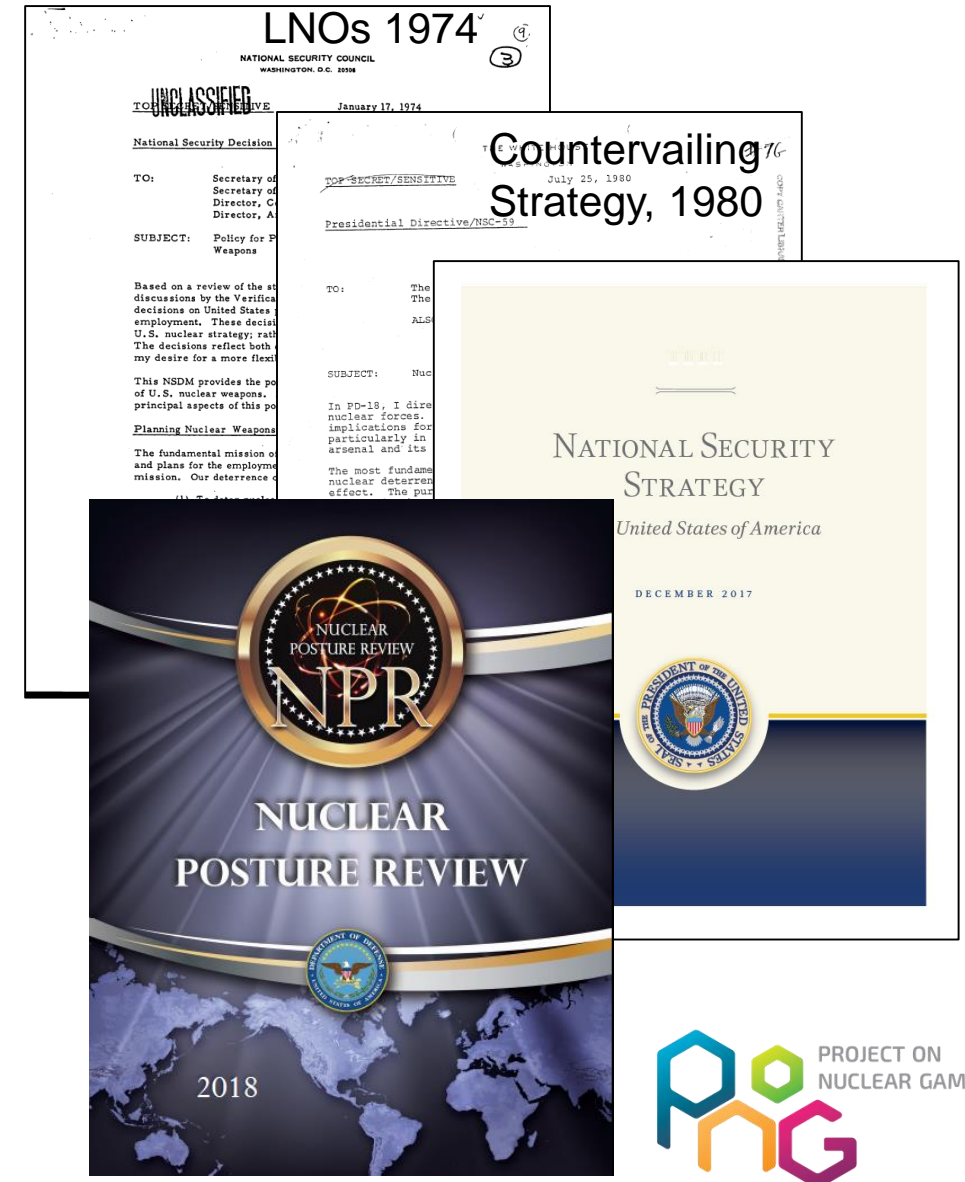


PoNG as a Proof of Concept

Research Questions:

- How can experimental games be constructed and executed to place players in situations to model escalation challenges, including threats of nuclear use?
- What impact do weapons capabilities have on deterrence and strategic stability?
 - Treatment variables:
 - Electromagnetic pulse
 - High-precision, low-yield systems

Note: PoNG is NOT making an assessment of any specific national policy or conflict scenario.



Substantive Research Questions

How do military capabilities change the threshold of nuclear use?

- IV (Player Capability) → DV (Nuclear Use)
- Measured dichotomously
- Measured temporally

How do military capabilities change conflict escalation dynamics?

- IV (Player Capability) → DV (Conflict Escalation)
- Measured by conflict class criteria

		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

Testing a Continuum of Capabilities

- Conventional Weapons
- Cyber Weapons
- High-Yield Nuclear Weapons
- High-Precision Low-Yield Nuclear Weapons (HPLY)*
- Electromagnetic Pulse Nuclear Weapons (EMP)*

*denotes treatment variables

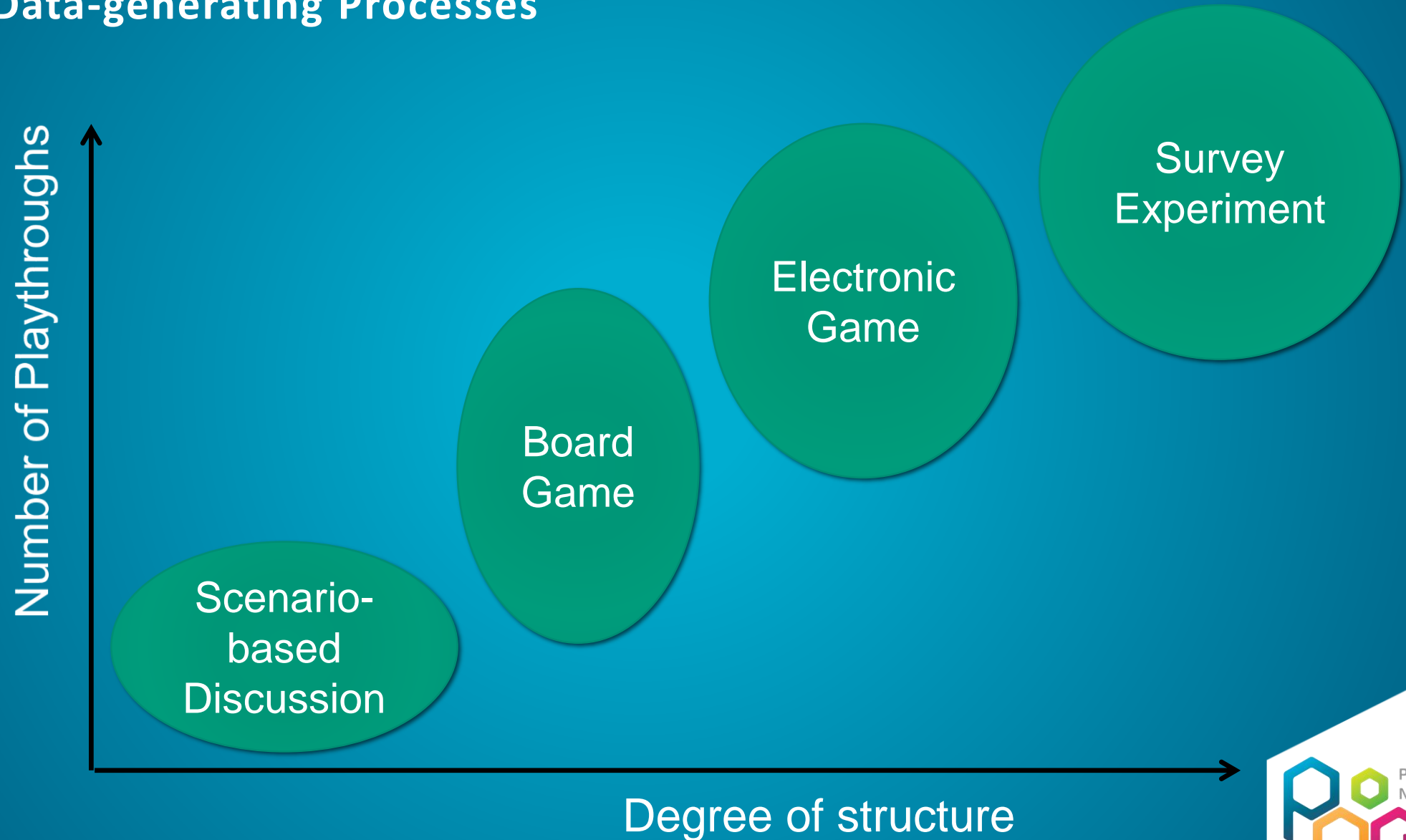
A 4-Method Framework: A Cross-Method Analysis

To examine the utility of experimental games in international security research...

- Survey Experiment
 - Testing weapon capability effects using both real-world and abstract scenarios
- Traditional Scenario-based Discussion
 - Orange, Green, Purple, and White cells
 - Expert participants
 - First Event: May 2018, LLNL
- Structured Ruleset: SIGNAL Board Game
- Online Game: SIGNAL E-game

The advantages of mixed-methods design...

PoNG's Data-generating Processes



SIGNAL Game Design

Abstract “states” (Orange, Purple, Green)

Three-player game design

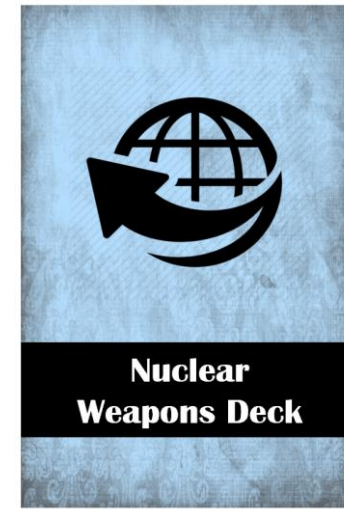
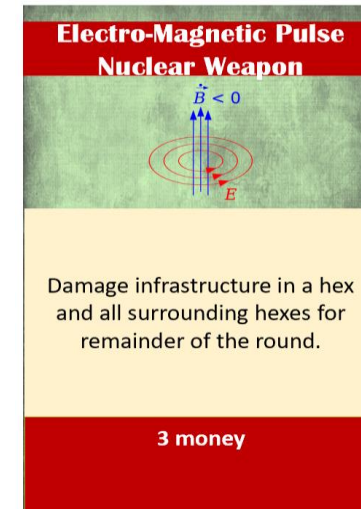
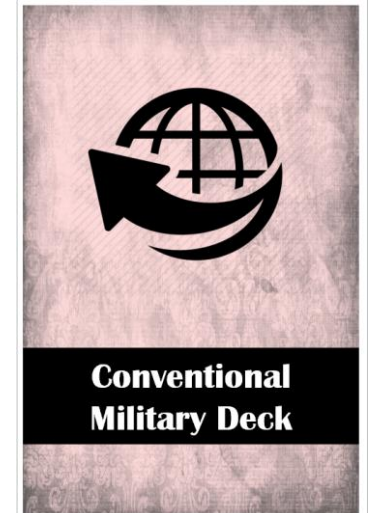
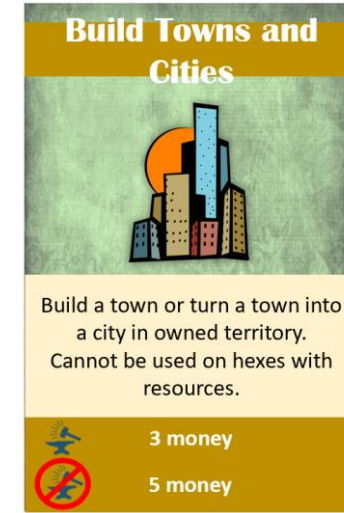
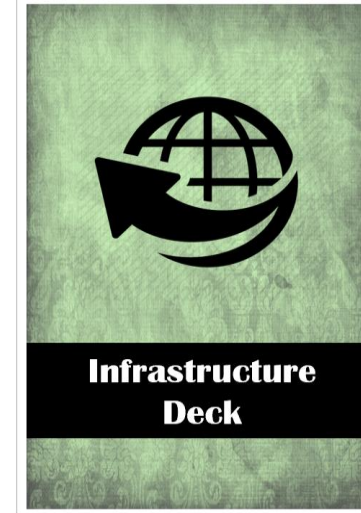
Win Conditions

- Economic
 - Resources
 - Infrastructure
- Security
 - Minimize loss of territory

n-round games

- Signaling phase *cost
- Action phase *cost
- Upkeep phase
 - *Player turns are randomized

Designed for data collection





SIGNAL: Online Game

Designed for data analysis

- Tracking player signaling and actions
- Chat features
- Automated data processing and validation
- Game Replay
- Pre- and Post-Survey Design
 - Testing elite vs. non-elite play
 - Interrogating causal stories
- Designed for expansion
 - Configuration files
 - Maps
 - Number of players
 - Varying capabilities available to players

Round
4 of 4

Phase
Diplomatic

 68
(+15)

 0/0

 1/1

 3/3

 1/1

 7/12
(+5)

 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

GAME HAS TRANSITIONED TO PHASE
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...

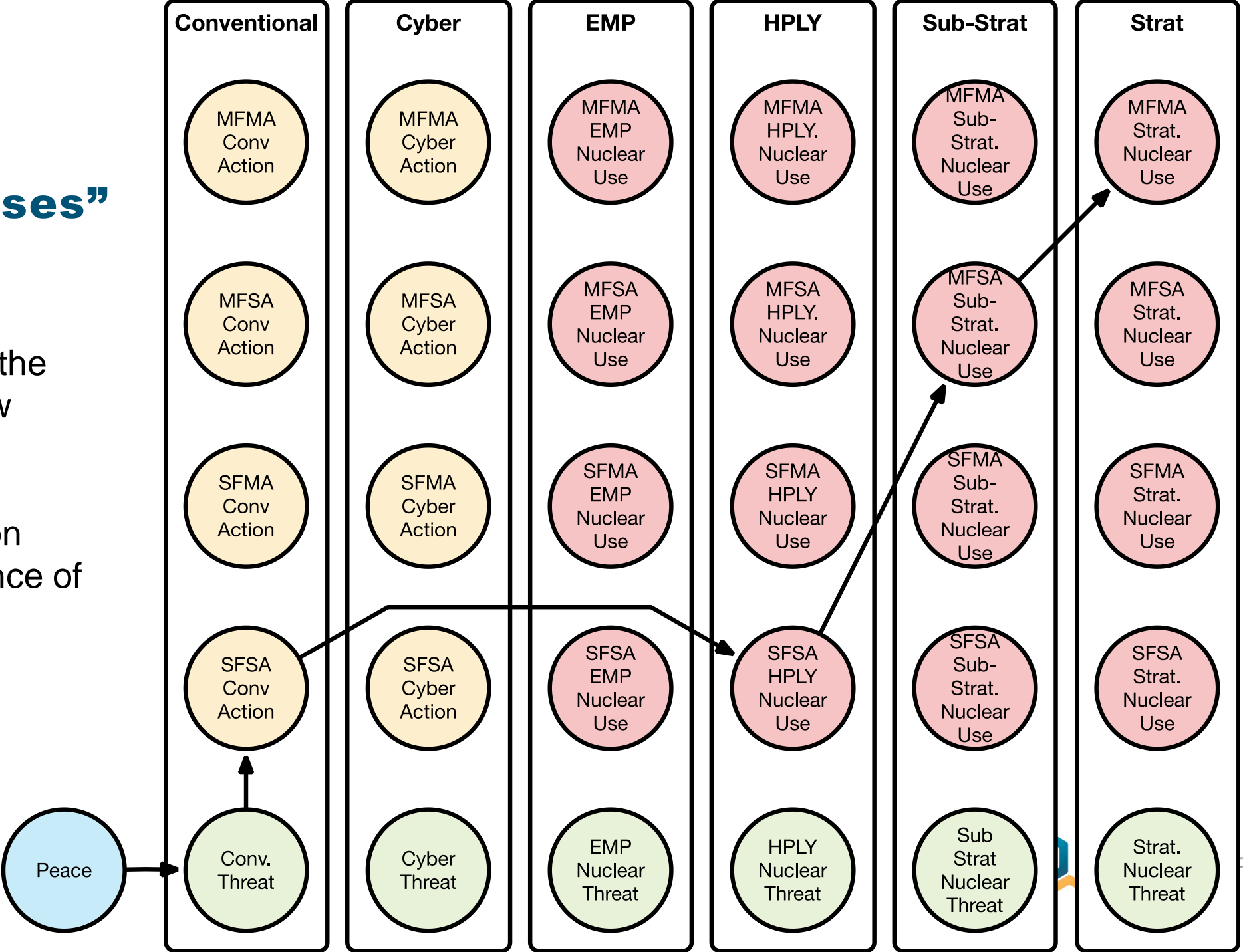
SEND

M	M	M	I	I	M	I
						
4	2	3	2	2	(2)	2
Standard Nuclear Weapon	Conventional Missiles	Conventional Military	Civilian Infrastructure	Military Infrastructure	Cyber	Military Defense

SIGNAL Data Analysis: “Conflict Classes”

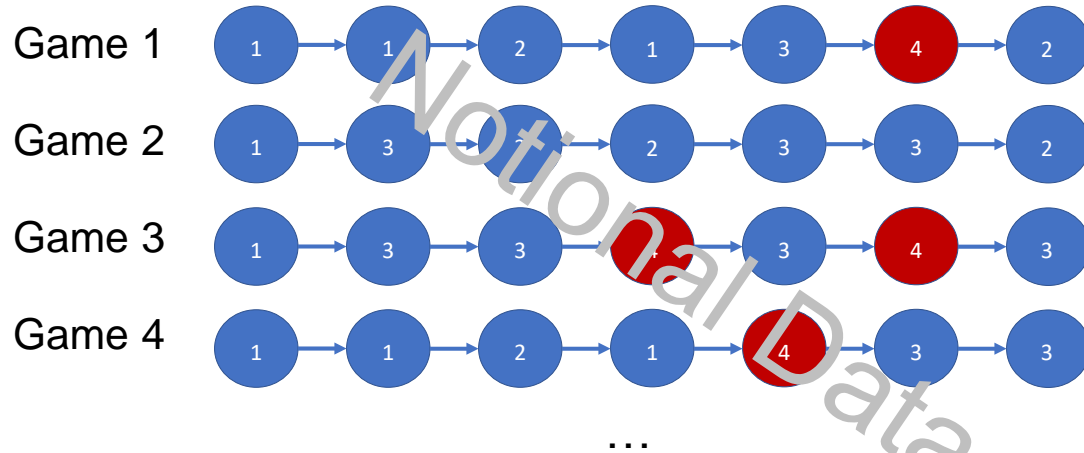
Measured through the reduction of the raw game data.

Can track escalation through the sequence of conflict classes.

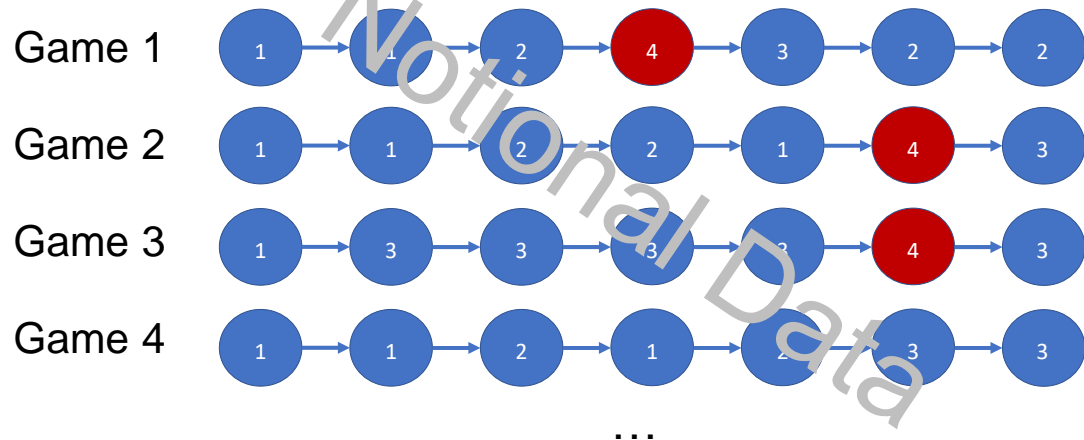


Data analysis in PoNG is focused on a simple set of metrics...initially.

World with Tailored NW



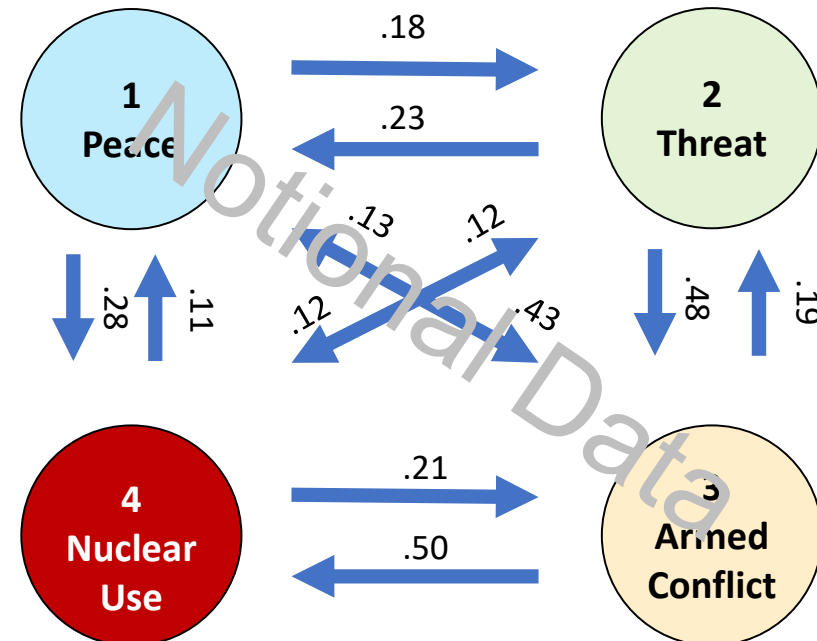
World without Tailored NW



Metrics of Interest:

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

World with Tailored NW



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

Escalation Ladder

Integrated Tools

- Diplomacy
- Information
- Military
 - Conventional
 - Cyber/Space
 - Nuclear
- Economic

Decision Calculus
(specific to a decision)

Costs of Action	Benefits of Action
Benefits of Restraint	Costs of Restraint

Legend:

- ★ Adversary action
- ★ US/Allied action
- ★ Decision/Escalation Control Point
- ◆ Escalation Milestone

Other Dimensions of Crisis/Conflict

- Hybrid Warfare
- Asymmetric Warfare

Timeline

Intensity

Escalation Ladder Stages:

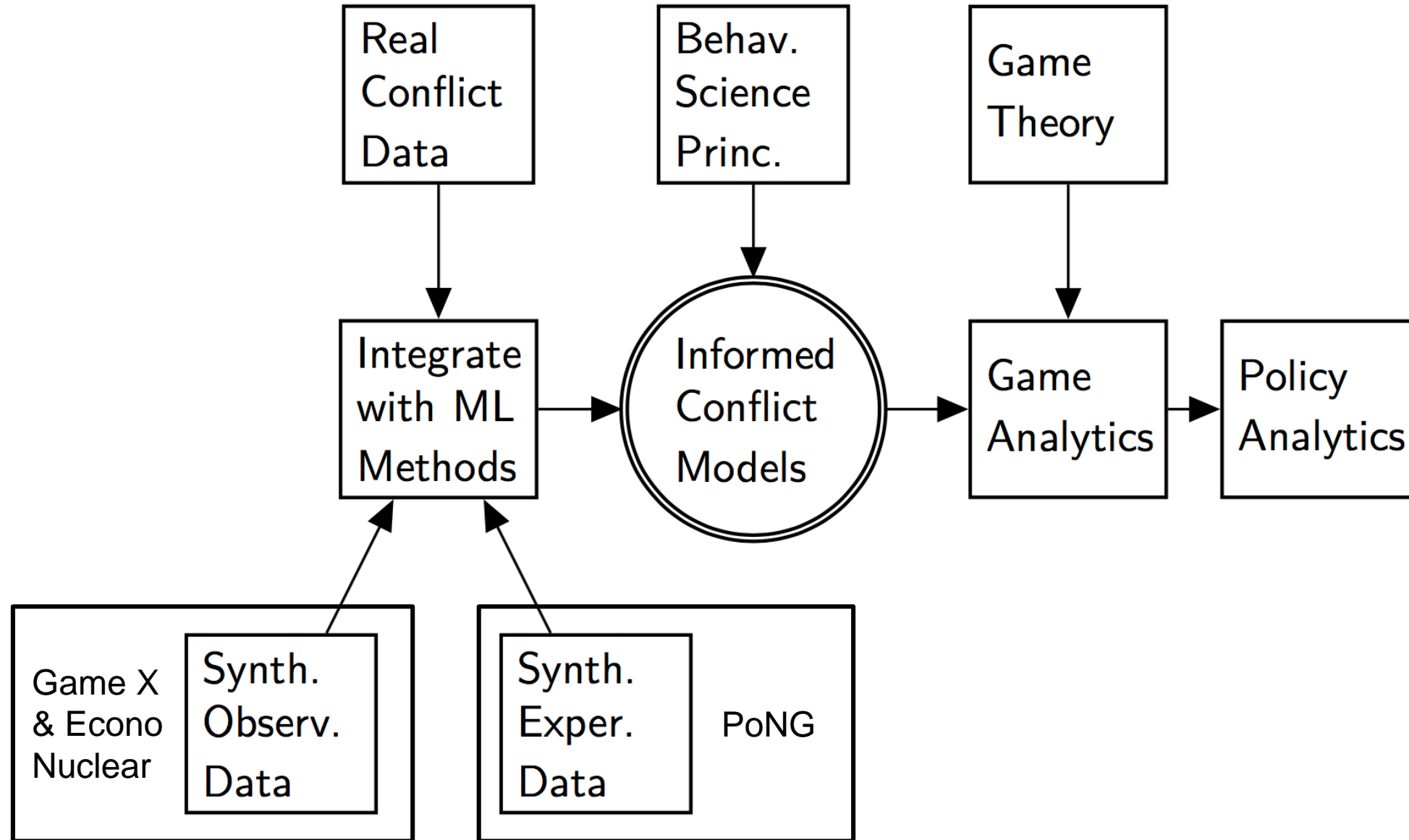
- Rhetoric, R&D, Misinformation
- Conventional Conflict Begins
- Nuclear Capability Demo
- Large Scale Nuclear

Off-ramp points:

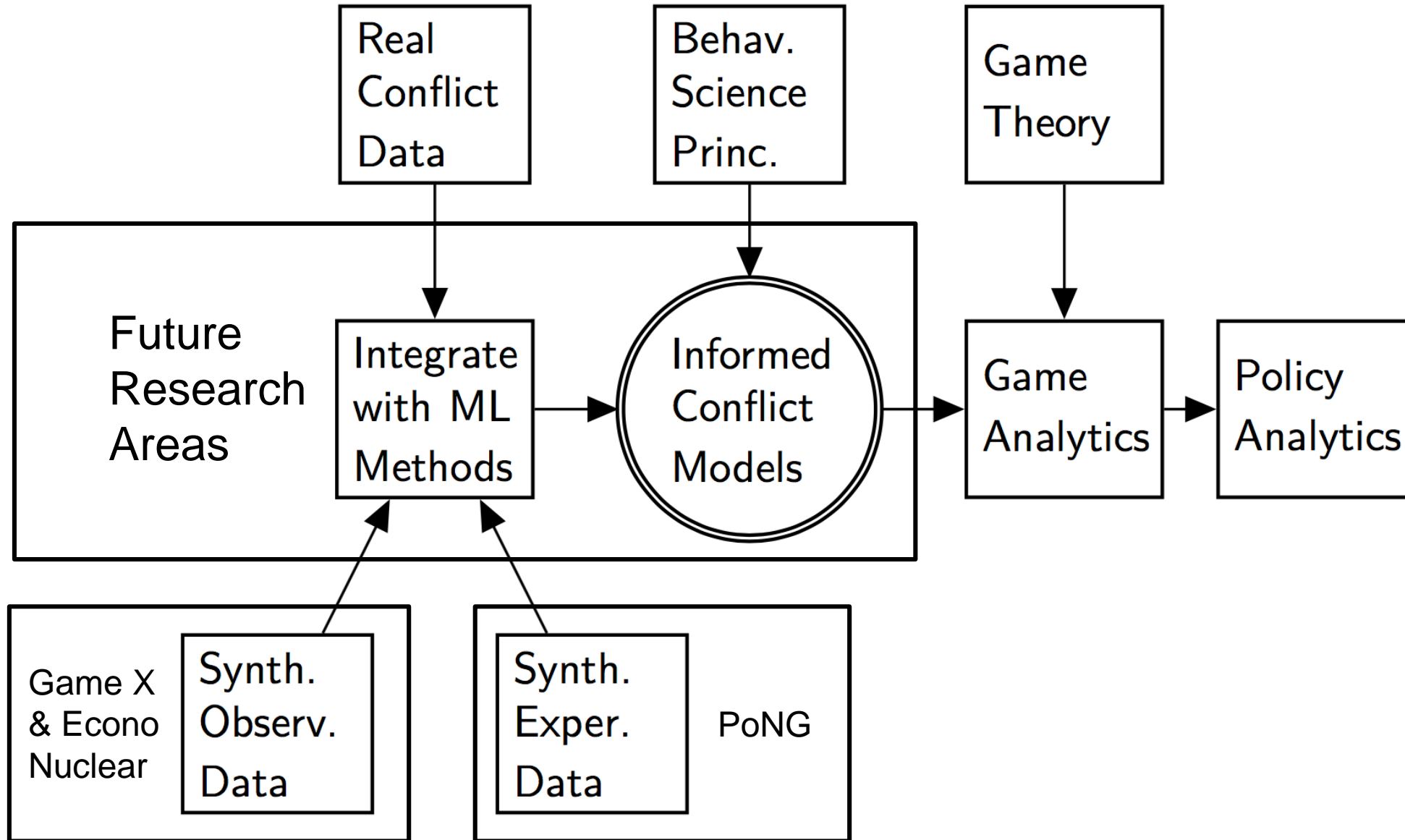
- Between Rhetoric and Conventional Conflict Begins
- Between Conventional Conflict Begins and Nuclear Capability Demo
- Between Nuclear Capability Demo and Large Scale Nuclear



SIGNAL is one part of a larger vision for enhancing how we study conflict.



Areas of Future Research:



Project on Nuclear Gaming Timeline:

FY2018

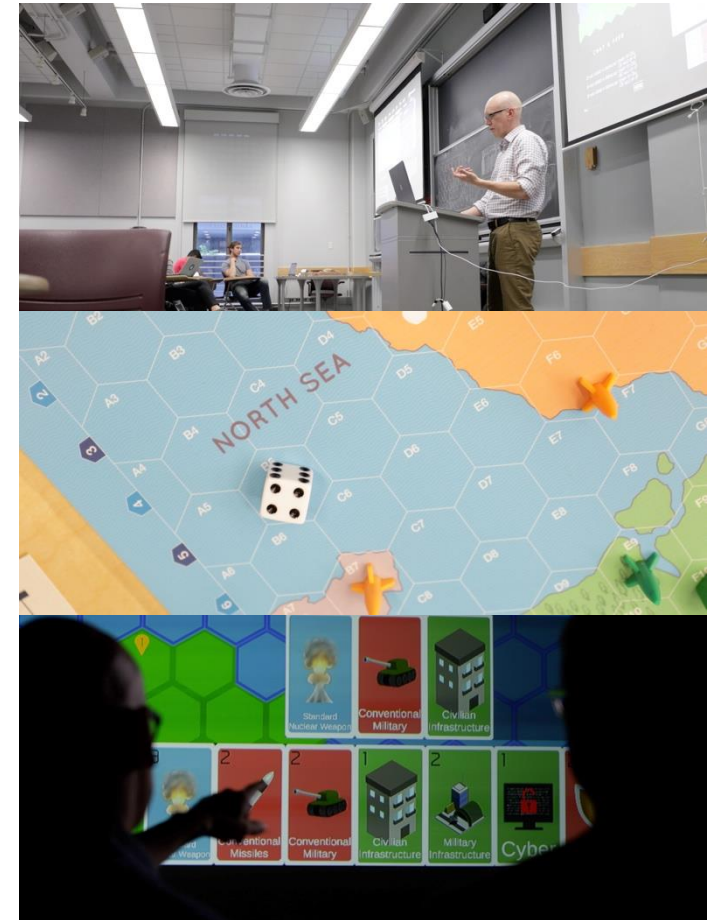
- Develop background research and analytic frame
- Seminar wargaming
- Build experimental board and online games

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



What's Next?

March 2019 – June 2019: Data Collection

- March 7, INDOPACOM Pacific Operational S&T Conference
- March 19, DARPA Brown Bag
- March 21, E-game Launch, Carnegie Corporation of NY
- March 26, ISA Conference
- April 2-3, King's College, London: Board Game Data Collection

June – Oct 2019, Data Analysis and Results Prep

October 2019, Results Release



The PoNG Team



- Michael Nacht (PI), Bethany Goldblum, Andrew Reddie, Manseok Lee, Camila Valenzuela, Soravis Prakkamakul, Roshan Kirshnan, Jake Tibbetts, Chris Zheng, Vamshi Balanaga, Roshni Iyer, Sarah Laderman, Janani Mohan



- Sheryl Hingorani (PI), Jason Reinhardt, Kiran Lakkaraju, Jonathan Whetzel, Laura Epifanovskaya, Joshua Letchford, Alexandra Valdez



- Wes Spain (PI), Craig Wuest, Andrew Reddie





Questions?

Contact Information:

- bethany@berkeley.edu
- areddie@berkeley.edu

Website:

- pong.berkeley.edu