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ENGINEERING

# Measuring Situational Awareness Through Analysis of Communications: A Preliminary Exercise

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C-171

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  - Aptima
- Our experimental participants

# EXPEDITIONARY STRIKE GROUP

## 22d Marine Expeditionary Unit



Command Element



Battalion Landing Team  
1st Battalion, 2d Marines



Marine Medium Helicopter Squadron 162  
(Reinforced)



## Amphibious Squadron Eight



USS *Saipan* (LHA-2)



USS *Philippine Sea* (CG-58)



USS *Ponce* (LPD-15)



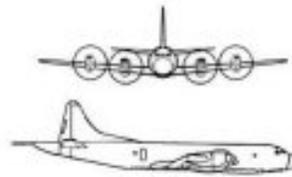
USS *Gonzalez* (DDG-66)



USS *Gunston Hall* (LSD-44)



USS *Nicholas* (FFG-47)



USS *Miami* (SSN-775)







ADAN MCNEESE

ADAM TARUM  
13

BEACH  
FIELD



“...FORCEnet will provide a comprehensive network of sensors, analysis tools, and decision aids to support the full array of naval activities... The focused, timely, and accurate data delivered by FORCEnet will help leaders at every level by allowing them to draw on vast amounts of information and share the resultant understanding.”

(Vice Admiral Richard W. Mayo, U.S. Navy, and Vice Admiral John Nathman, U.S. Navy -  
Proceedings, February 2003 )  
(<http://forcenet.navy.mil/index.htm>)

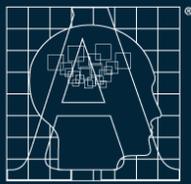


# What is the problem?

## ■ FORCEnet

- Flattened command hierarchy
- Increased number of Decision Makers (DM)
- Vast amounts of information → Information overload
- Need for accurate information exchange and distribution
- Potential for serious miscommunication





# How to avoid these pitfalls?

- All Decision Makers must have a consistent situational awareness



- Critical to making the most informed decisions
- Vital for understanding the actions of others
- Inconsistencies among the DMs' SA must be identified and remedied



We need to...

- ***Measure***
- ***Monitor***
- ***Manage***

***Situational  
Awareness***



# IMAGES Approach

1. Analyze streams of text and meta-data from DMs
2. Using modular tools, process that text. For example, use AutoMap to create **Semantic Networks** for DMs and the aggregate groups, as proxy representations for mental models
3. Measure the relationships among the various semantic networks: overlaps, disparities, and relative position of nodes
4. Visualize these similarities and differences
5. Translate these measures to provide human-understandable decision support
  - Alerting DMs to inconsistencies
  - Identifying disambiguating information sources



# Session I: NEO Scenario

- Noncombatant Evacuation Operation
- Red Cross workers in dangerous environment
- Participants develop COA
- Joint Forces resources
- Three experts
  - Environment
  - Intelligence
  - Weapons
- One common brief
- Three expert briefs

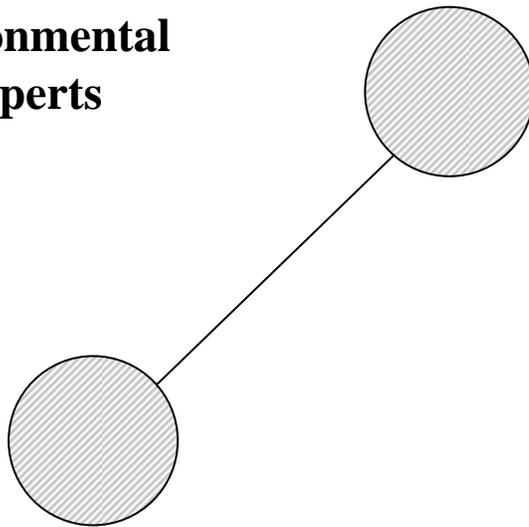


(Warner & Wroblewski, 2003)

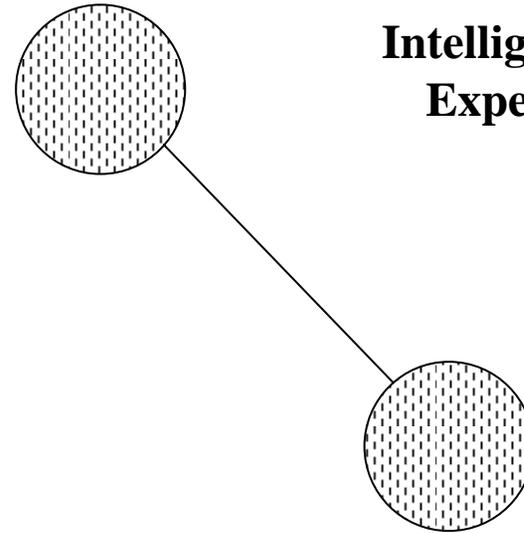


# IMAGES Exercise Session 1

**Environmental  
Experts**



**Intelligence  
Experts**



**Weapons  
Experts**

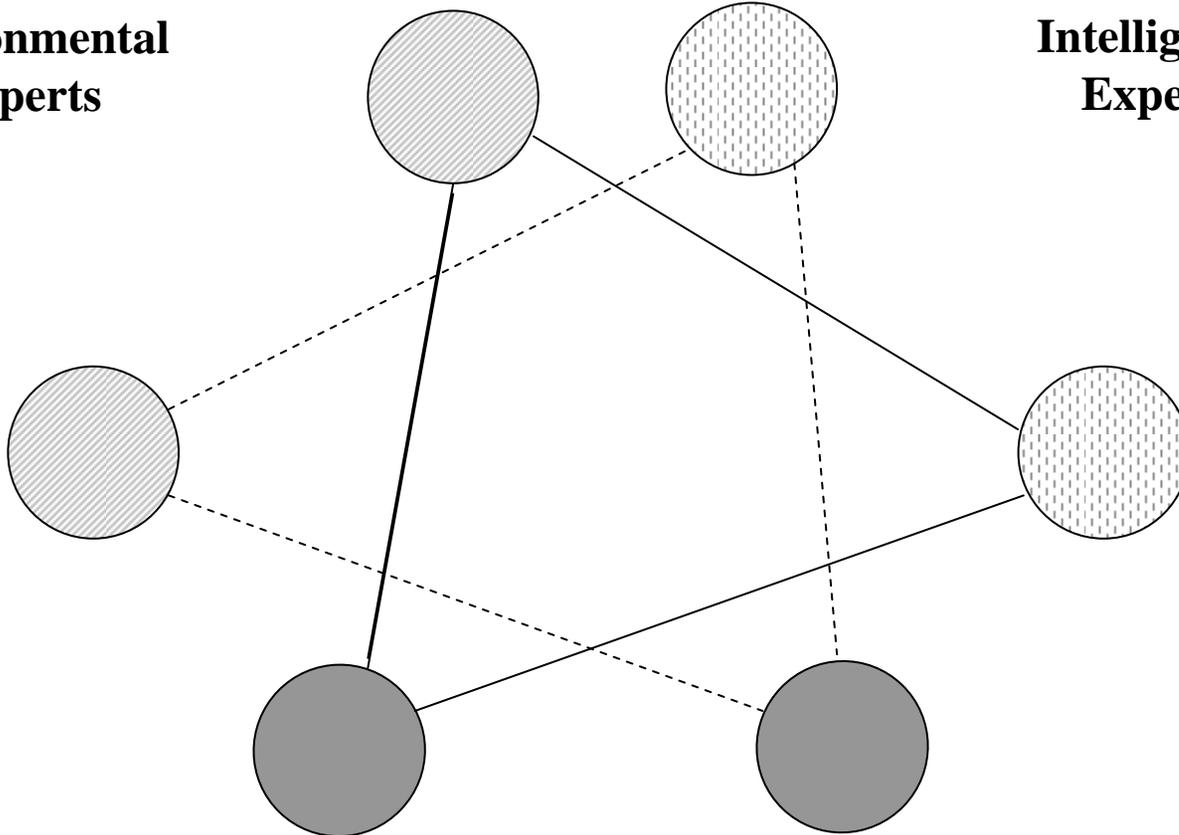




# IMAGES Exercise Session 2

**Environmental  
Experts**

**Intelligence  
Experts**

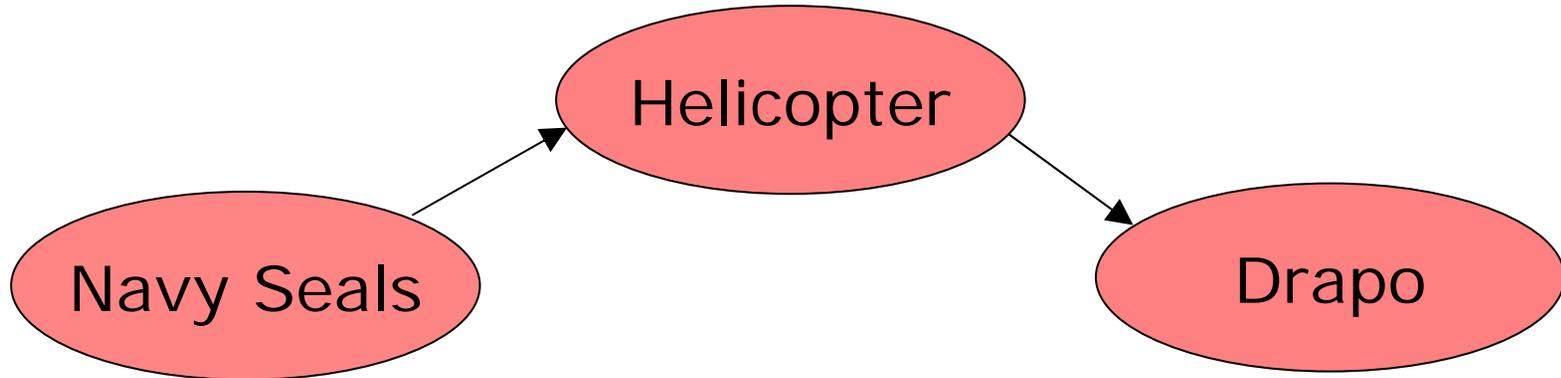


**Weapons  
Experts**



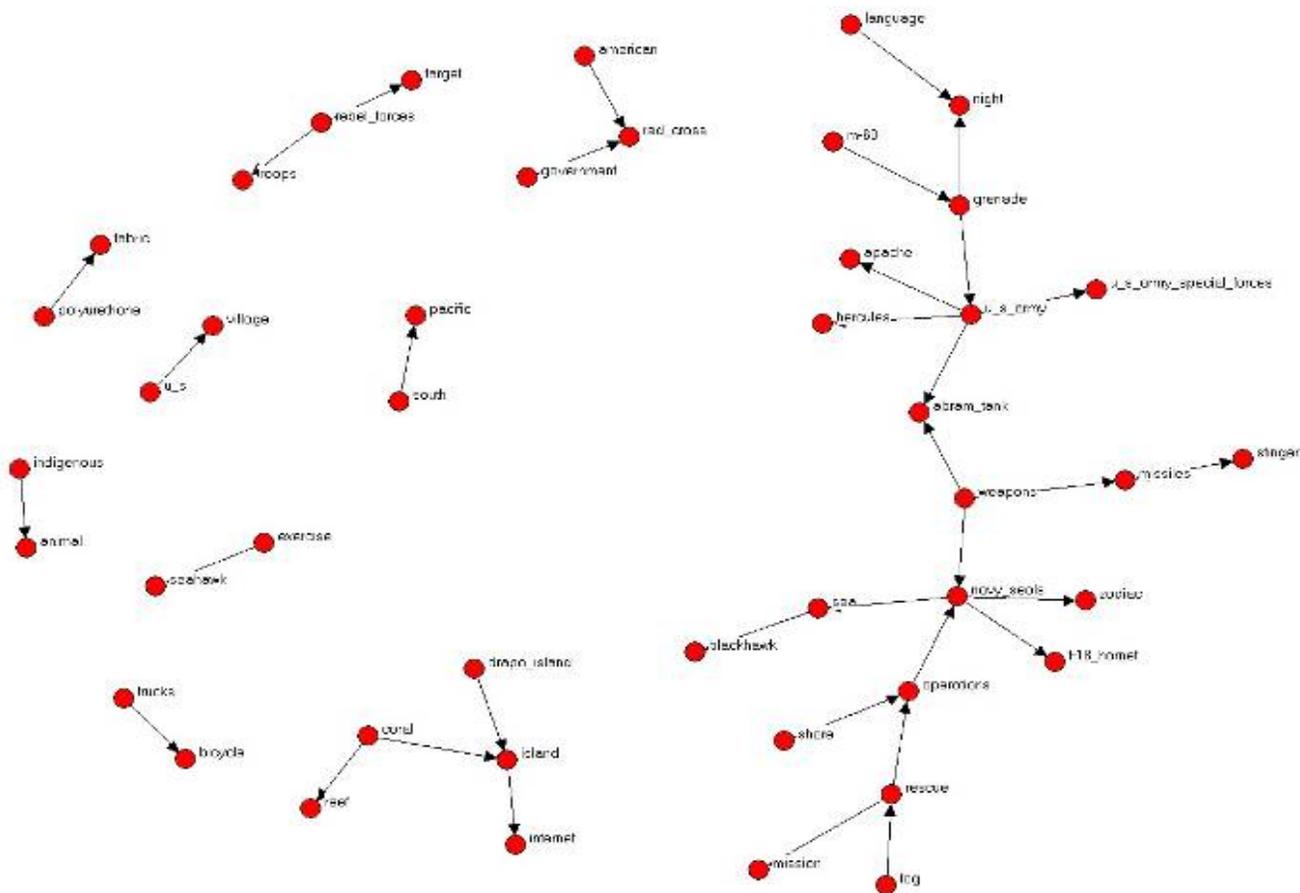
# Network Text Analysis (NTA)

- Participants coordinating via Groove Virtual Office
- Communication captured
- Text pre-processed in CMU's AutoMap
- Semantic Maps created using AutoMap
- Representations of aggregate 'Mental Models'
  - "Navy seals use helicopter to land on Drapo."



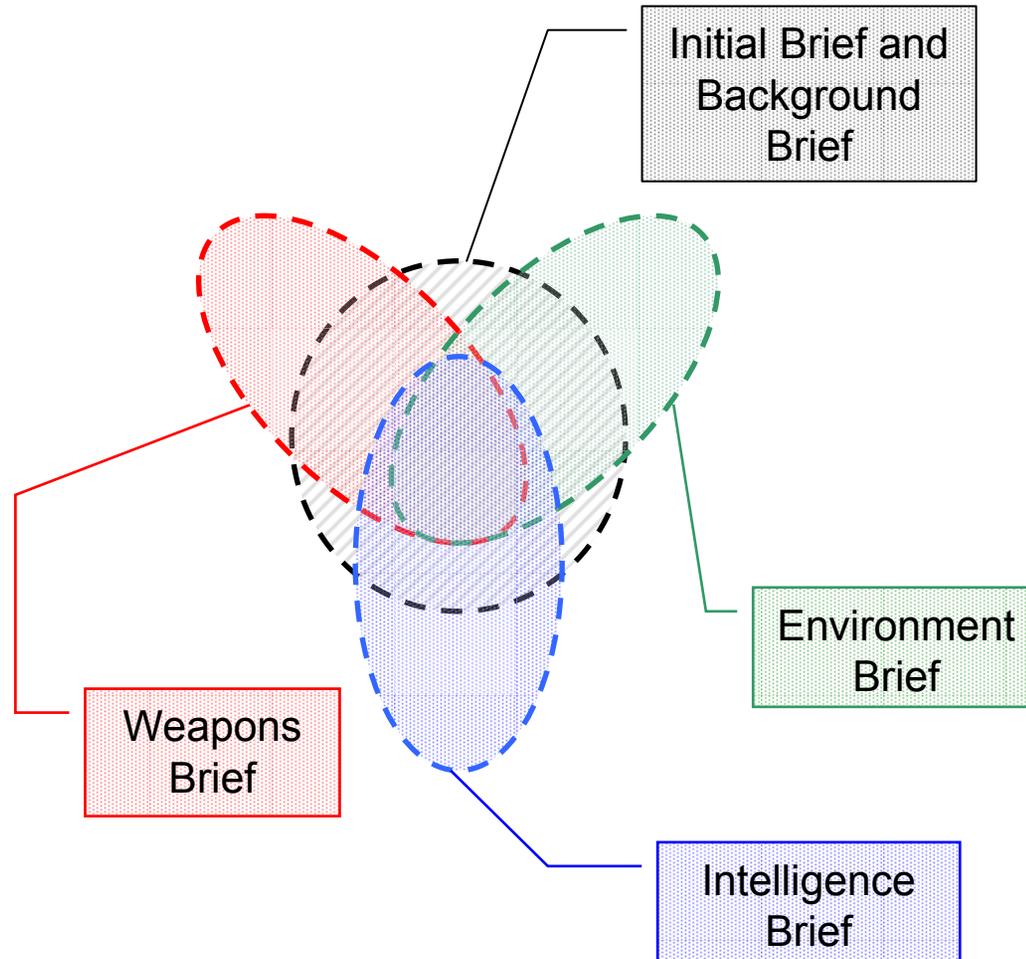


# Semantic Map based on NEO Materials



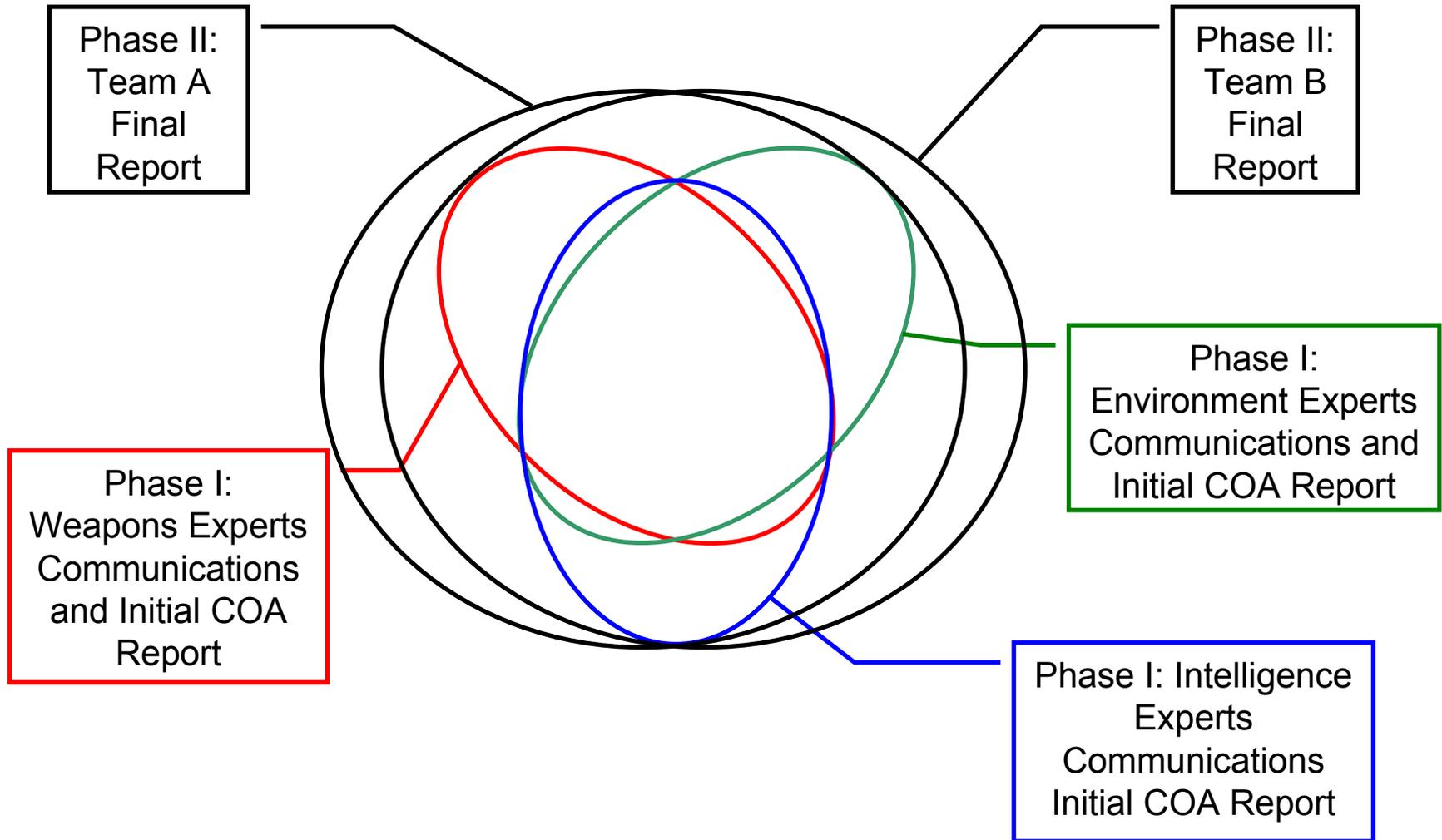


# Idealized Semantic Networks for Original NEO Materials



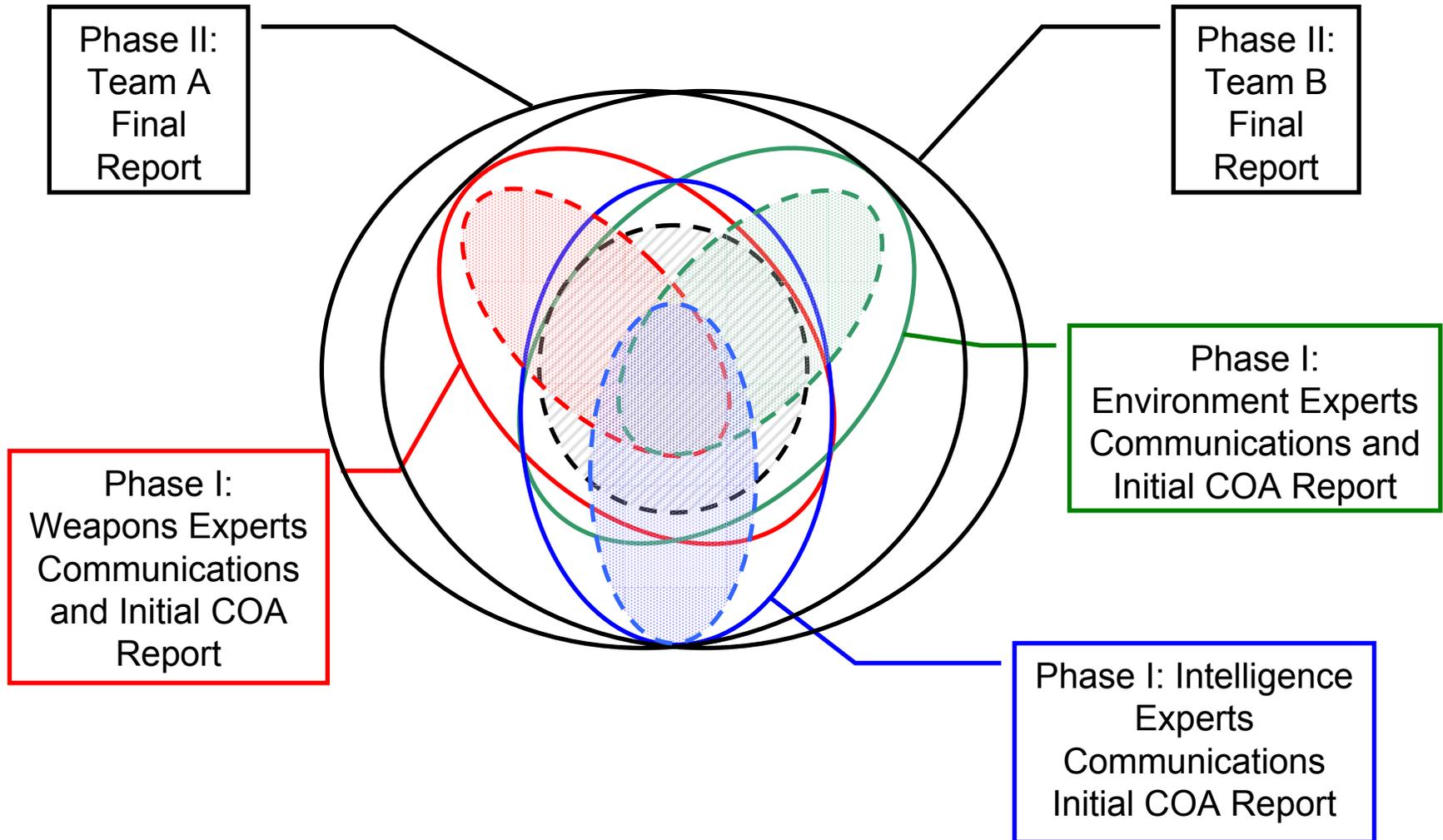


# Idealized Semantic Networks for Generated Materials



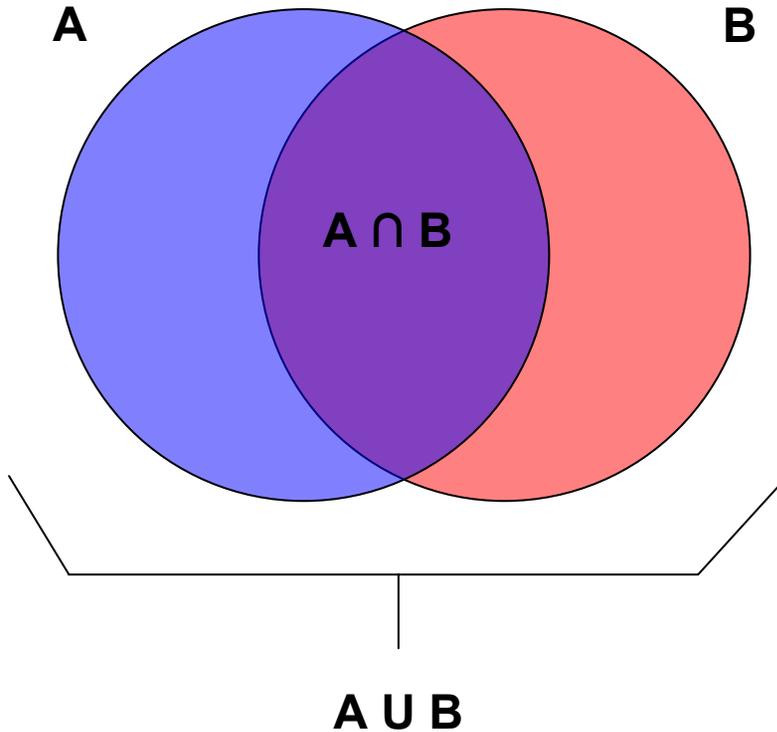


# Idealized Overlap in Original and Generated Semantic Networks





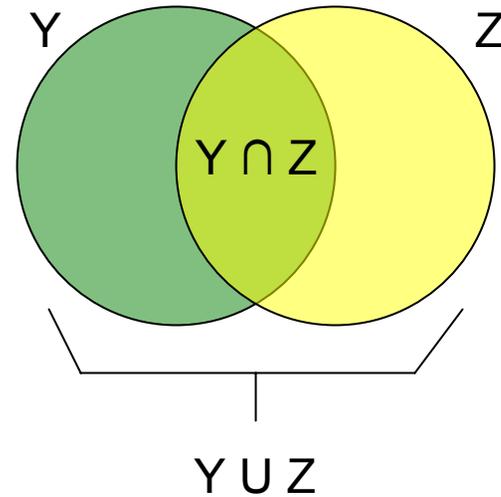
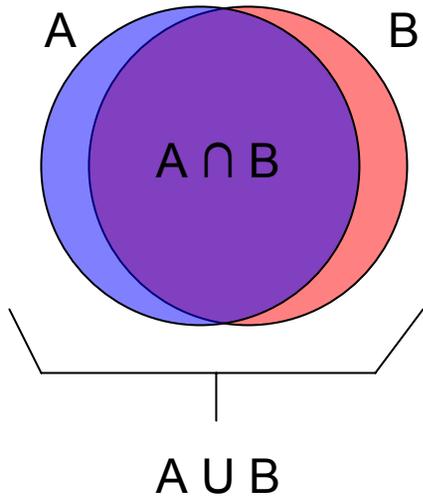
# IMAGES Metrics (1)



$$\frac{A \cap B}{A \cup B}$$



## IMAGES Metrics (2)



$$\frac{A \cap B}{A \cup B} - \frac{Y \cap Z}{Y \cup Z} > C$$



# IMAGES Exercise Results

## **X** Three main predictions

- 1. Phase 1 teams will have greater overlap with associated expert briefs
- 2. Phase 2 teams will have greater overlap with source materials than the Phase 1 teams
- 3. Phase 2 teams will have greater overlap with each other than the pairings of Phase 1 teams

*Trends suggest NTA has potential to **measure** differences in SA*



# Caveats and Challenges

- Small amount of text = greater effect of noise
- Ceiling effect → Shared material
- Metrics need refinement
- Informal communication mediums
- Need to automate preprocessing when possible
- Non-text communication
- Combinatorial Explosion



- Exercise conducted using NEO scenario
- NTA used on subsets of original and generated materials
- Predictions made based on materials presented
- Trends were observed which supported predictions
- Suggest promise of NTA for ***Measuring*** gross SA

What about ***Monitoring*** and ***Management*** ?



# Future Directions

- Build on Phase I demonstration of concept
- Integrate pieces of application
- Enhance current tools
- Utilize converging approaches
  - ORA tool measures developed by Kathleen Carley and her lab
  - FAUCET measures developed by Nancy Cooke and her lab
- Develop Modular Application
- Create Intuitive Interface
- Demonstrate approach on suitable corpus



- IMAGES would have improved coordination
  - **Measure** the communications within the U.S. Naval and Marine forces, and between U.S. and non-U.S. organizations.
  - **Monitor** the communications patterns and topics of conversation, and how they change as tasking changes.
  - **Manage** likely problems in SA alignment by providing oversight.
- The result:

Increased Efficiency

Improved Mission Effectiveness

***IMAGES***



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# Thank You