



Modeling Human Perception of Situation Awareness During Constructive Experimentation

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Outline

- Motivation
- Situation Awareness and Human-in-the-Loop (HITL)
Situation Awareness Objects (SAOs)
- Synthetic SAOs (SSAOs)
- SAO Case Study
- Concluding Remarks

Motivation

Human-In-the-Loop Experiment

- Lots of:
 - Data Points
 - Variables
 - Time develop and run
 - \$\$\$\$\$\$ to conduct

• Human Interpretation and behavior affect results

Engineering /
Physics
level
assessment
Sensor Systems
Performance

Monte Carlo Constructive Experiment

- Faster to:
 - Put together
 - Execute
- Controlled Environment
- NO Human Interpretation and behavior affect results

Goal: To Bring Together the Best Elements of Each Experiment Type

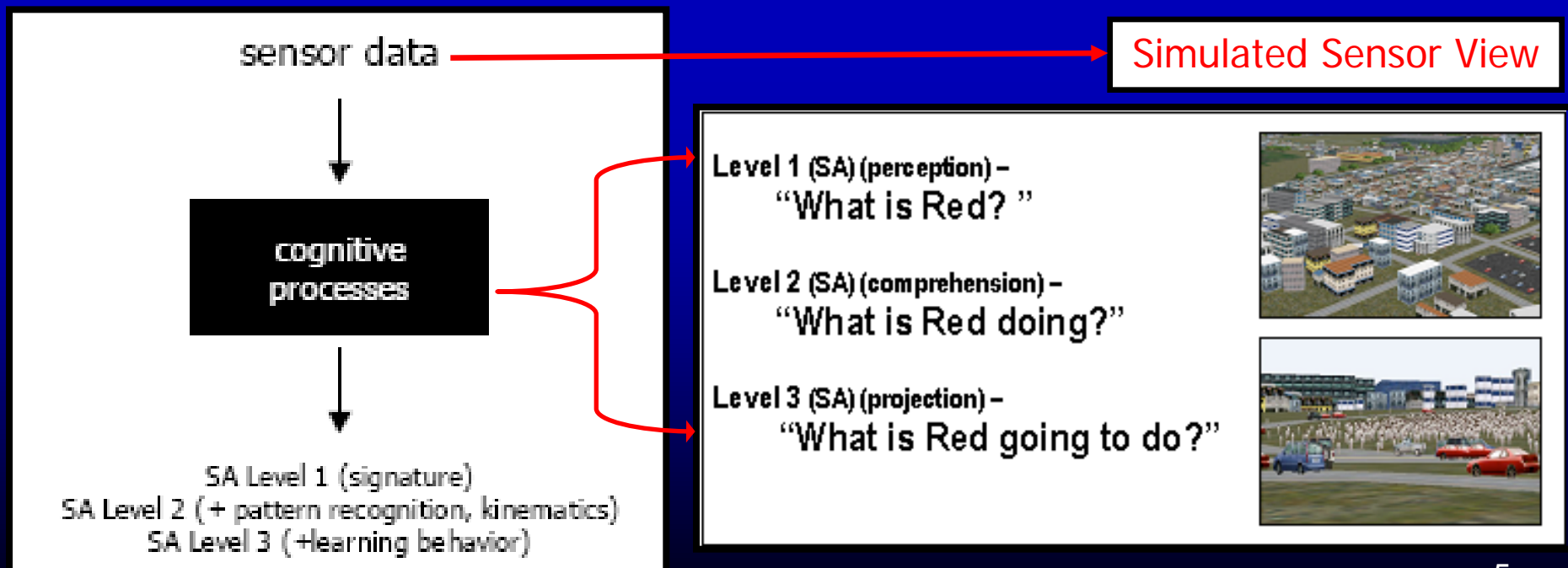
Motivation

- Cost and time limits frequency of HITL experiments
- MCC experiments sacrifice human interactions
- Human interactions are very useful in sensor deployment and tasking
- Both approaches provide engineering level insight into sensor performance but ...
- ...currently only HITL experiments lend insight into usability and performance issues from the user's perspective.

Situation Awareness

- Endsley's 3-Level Model of SA

- Level 1: Perception involves detection, recognition and identification of basic situation elements
- Level 2: Comprehension involves understanding current enemy activity
- Level 3: Prediction involves inferring enemy intent



Situation Awareness Objects

The HITL approach to understanding the Player decision making process using SAOs

The screenshot shows the JSAP Station software interface. The main map area displays a terrain with several red location markers labeled "Associated Track(s)". One marker is specifically labeled "ADWCHDFoot" with a red diamond icon and the number "1". A callout box points to these markers with the text: "Players may associate tracks and other SAOs with SAOs".

An information box on the right side of the screen displays detailed data for a selected track (Track #: 412465). The data includes: CIP call sign, Classification: AD, ID: 30 23, Speed: 8 knots, Heading: 90.0 degrees, Location: 09+11 04 54° 104+39 13. 0, Track Quality: 0.883, and various system settings like Target Priority and Decoy Effect.

At the bottom of the screen, the JSAP Editor window is open, showing a "Tracks/Comments" panel. It includes a list of tracks (411350, 412465) and a "Comments" section with a text area containing the following text: "Intermittent Radar Tracking. Trucks brought large crates of equipment this morning. Likely the facility is not fully operational yet". A callout box points to this text with the text: "Add free-text comments".

Another callout box points to the information box with the text: "Inspect info related to associated tracks/SAOs and center on them".

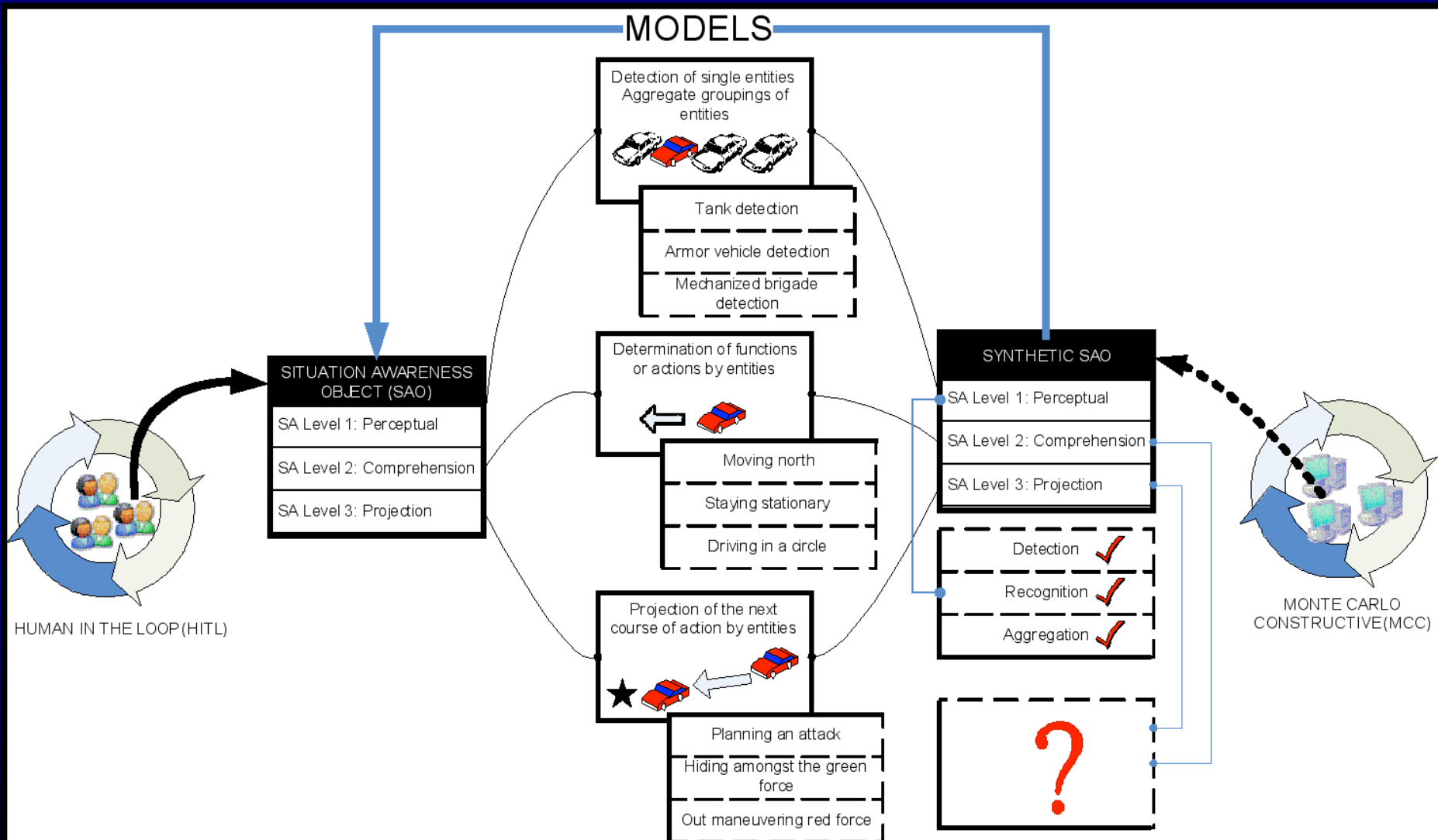
A third callout box points to the "Attach to Track" section of the JSAP Editor with the text: "Attach SAO objects to tracks, so they move with the tracks".

A fourth callout box points to the "Standard Awareness" buttons (Done, Revert, Abort, Next) with the text: "All SAOs are shared instantaneously with other players and analysts".

A fifth callout box points to the bottom of the JSAP Editor with the text: "SAOs are captured and archived in a common database, and used to assess progress during play and later, for after-action reviews and analysis".

Human Cognition in MCC Experiments

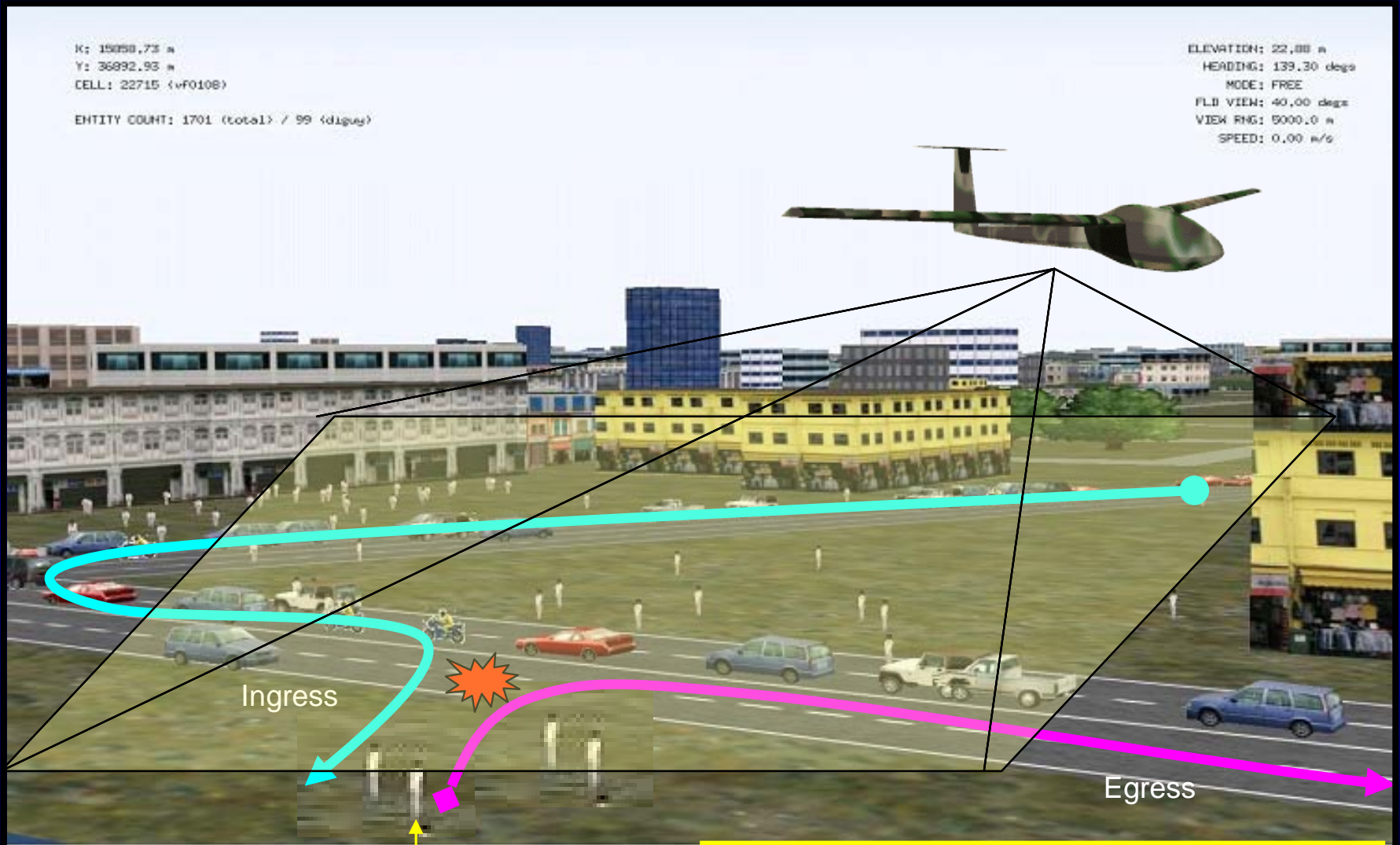
Synthetic Situation Awareness Objects (SSAOs) methodology Defined



SAO Case Study Example

- **Purpose:**
 - To identify pieces of evidence used in determining a suspected IED event.
 - To formulate sensor tasking and CONOPS to increase effectiveness
- **Scenario:**
 - IED Emplacement (refer to following slide)
 - Low fidelity Culture entities are modeled to populate environment
- **Sensor System:**
 - Fields of view and resolution video modes provide persistent surveillance of battlespace
 - Player responsible for monitoring video continuously
 - Medium and Narrow FOV looks require zooming at the expense of losing WFOV coverage
- **SAO Model:**
 - **Model for suspected Terror Acts were defined for the following events:**
 - Misc. Other, Meeting, Surveillance, Suspicious, Loitering, Fleeing, Generic Event
 - **Regardless of event, players could type free text to add additional information**

IED Emplacement Scenario

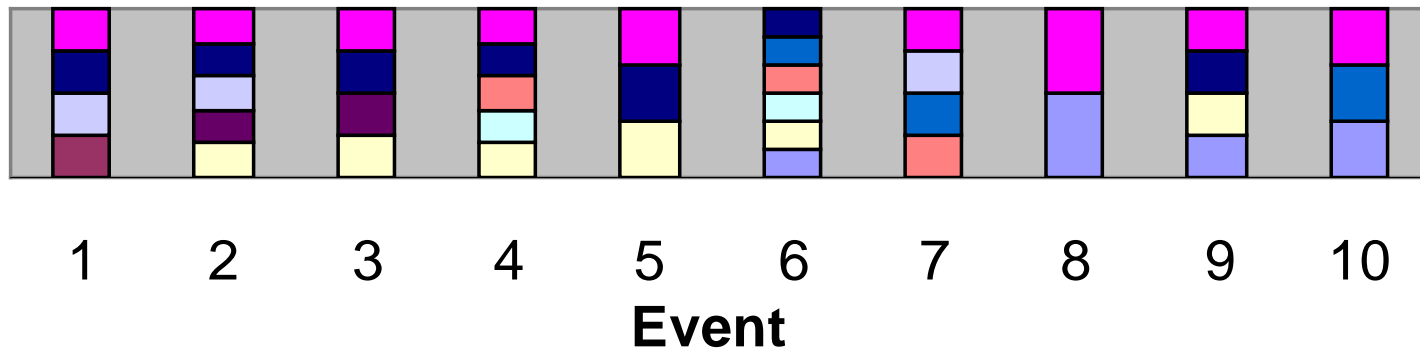


IED Emplacement /
Detonation

Observables: human kneeling, car near road,
shovel digging, IED object, loitering people

Case Study Remarks

Evidence Proportions for 10 IED Emplacement SAOs



Types of Evidence:

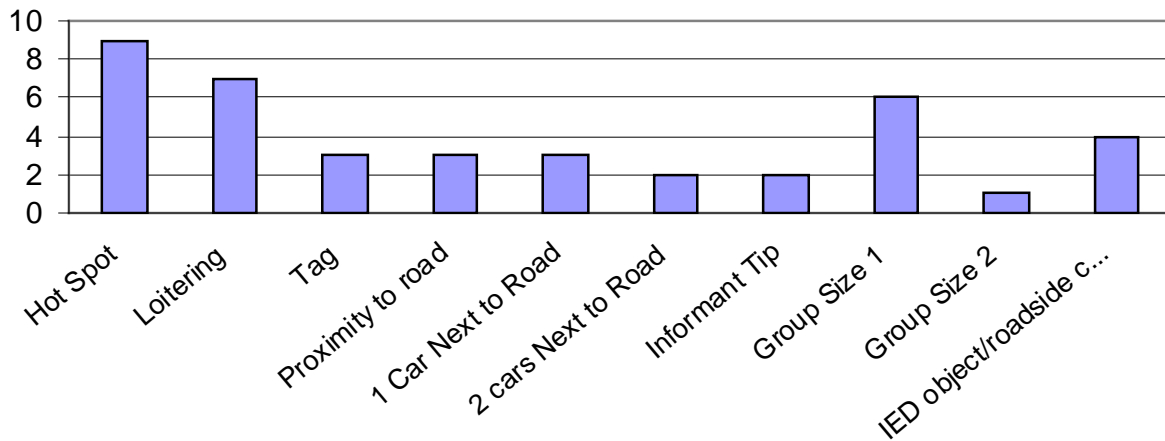
- IED object/roadside clutter
- Group Size 1
- 2 Cars Next to Road
- Proximity to road
- Loitering
- Group Size 2
- Informant Tip
- 1 Car Next to Road
- Tag
- Hot spot

Case Study Remarks

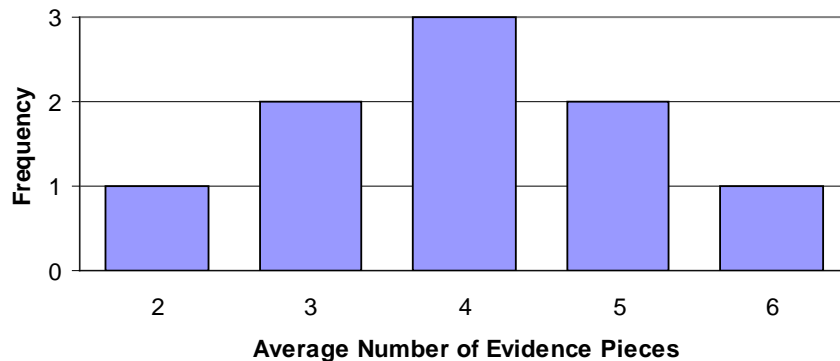
Categories	Type	Specific	Definition
Actions	Loitering	Loitering	Individual standing or kneeling in roughly same location for several minutes
	Proximity to Road	Proximity to Road	Any action, location, or information located at roadside
Counts		Group Size = 2	Observed individual is acting alone
		Group Size = 1	2 observed individuals close to one another
	Vehicle count parked at roadside	Vehicle Count = 1	Observed one vehicle parked along roadside
		Vehicle Count = 2	2 observed vehicles parked along roadside
Objects	Tag	Tag	A person or vehicle with any type of tag
	Object on Road	IED/Clutter Object	An observed object laying on the road (either a roadside clutter or IED)
Information	Location	Hot Spot	Action or object observed in known area of interest
	Tip	Informant Tip	White cell injection that suspicious activity is taking place

Case Study SSAO Generation

**Evidence Frequency for Determining IED
Emplacement**



Average SAO Evidence Counts for IED Emplacement



SSAO Data Feeds
MCC Simulation
Fusion and
Tracking Algorithms

CART
Algorithm
Training Set

Bayesian
apriori
Distribution

Concluding Remarks

- Resource limitations
- SSAO is new paradigm for combining human cognition and MCC experiments
- Applications:
 - SAOs and SSAOs as drivers for technology development
 - Value of sensor technologies under specific circumstances
 - Understand potential usage of sensor systems
 - Algorithmic approaches to higher level SA
 - Human cognitive limitations, e.g., timeliness of information.