Towards Simulating the Complex Nature of Asymmetric Operations in Tactical Immersive Environments

Presented by: Paul Cummings
Linda Lewandowski
ICF International

Problems in Simulating Irregular Warfare and Realistic Cultural Settings

- Tactical level artificial intelligence tends to be “shoot don’t shoot” style of interaction rather than negotiation, strategies, and IW concepts.
- Sense making in collaborative settings does not consider how the crowd may be influenced by behaviors
- Cultural interaction models tend to be static in nature and do not consider the more complex varying set of conditions on the ground

Immersive IW Tactical Training Environments

In urban terrain environments, virtual training scenarios often look like this:

Immersive Tactical Training Environments (cont)

When in fact real scenarios look like this:

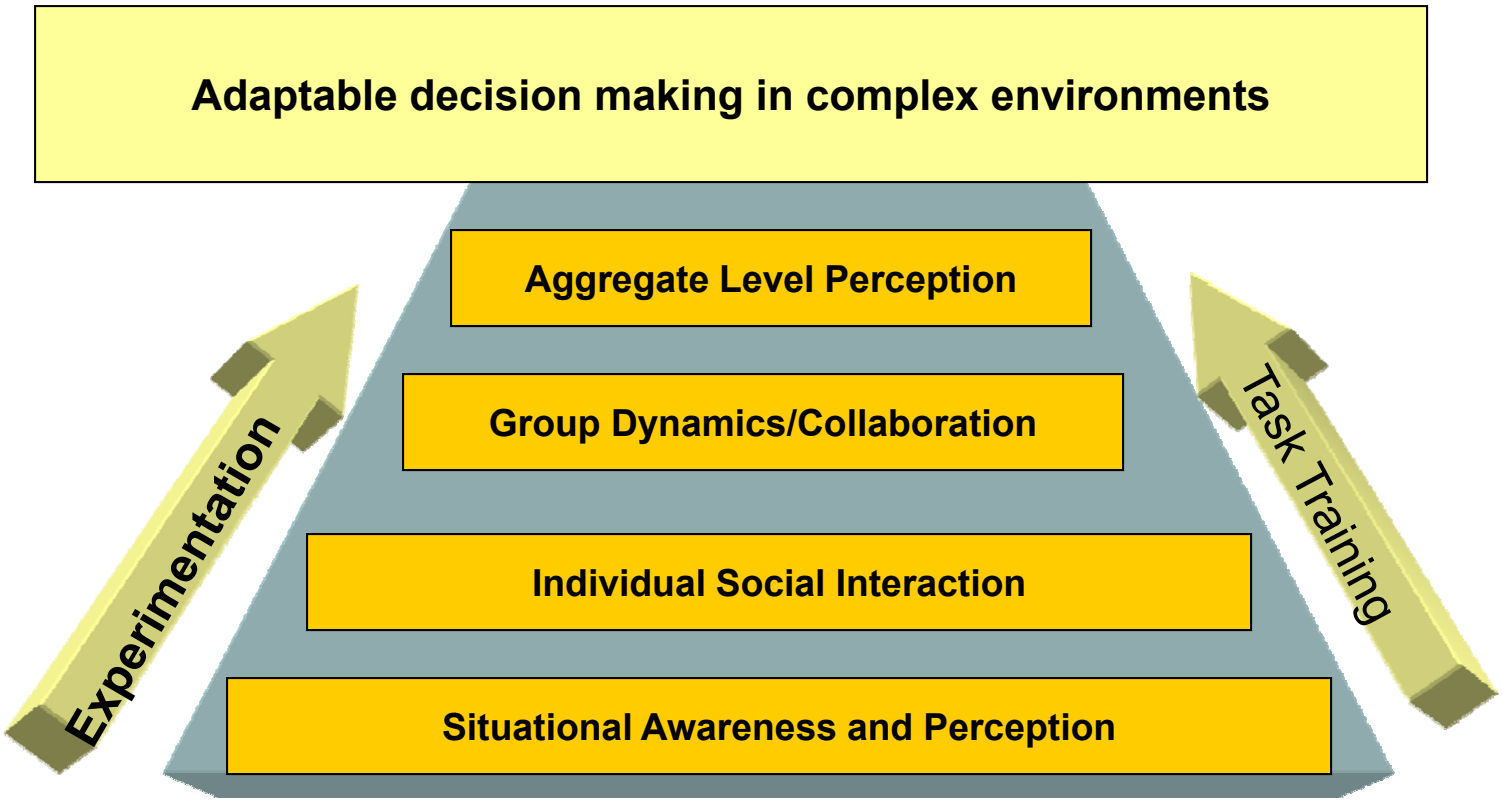
Look for novel ways of describing complex human interaction and how social awareness can be trained

Social Complexity Immersive Environment Training System (SCIEnTS)

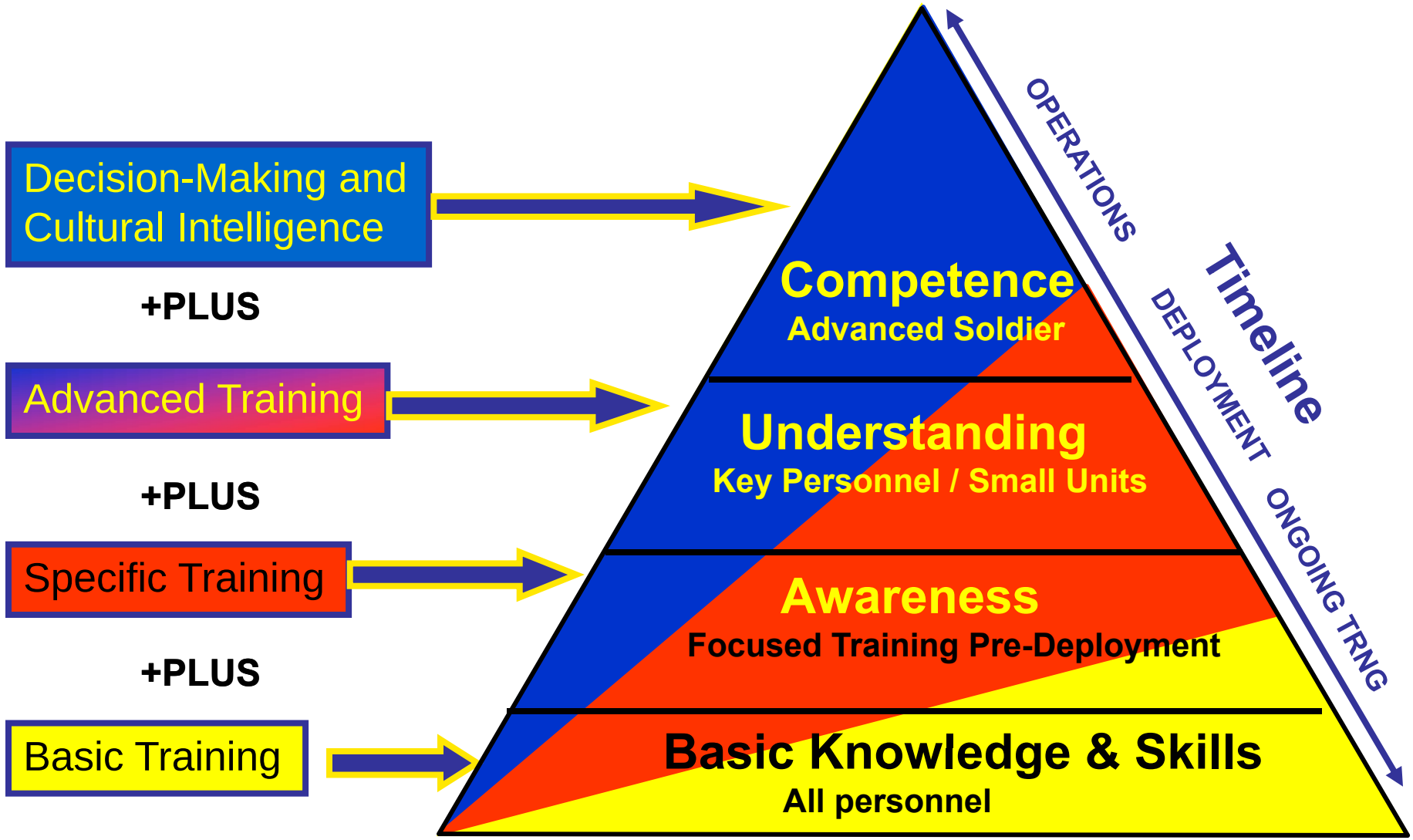
- Combination of theoretical, technical, and practical on-the-ground experience to accurately model the population effects in a computer simulated immersive training environment
- Dynamic simulated scenarios that feature a level of realism necessary for effective training in complex operations
- Open Source (No License)
- Web Deployable, SCORM 2004 Conformant SCOs
- Full tool suite to support building everything from dynamic environments to simulated human behavior models

What Does SCIEnTS Do?

Provides a free world to train soldiers in irregular warfare through increasingly difficult vignettes and adapting environments

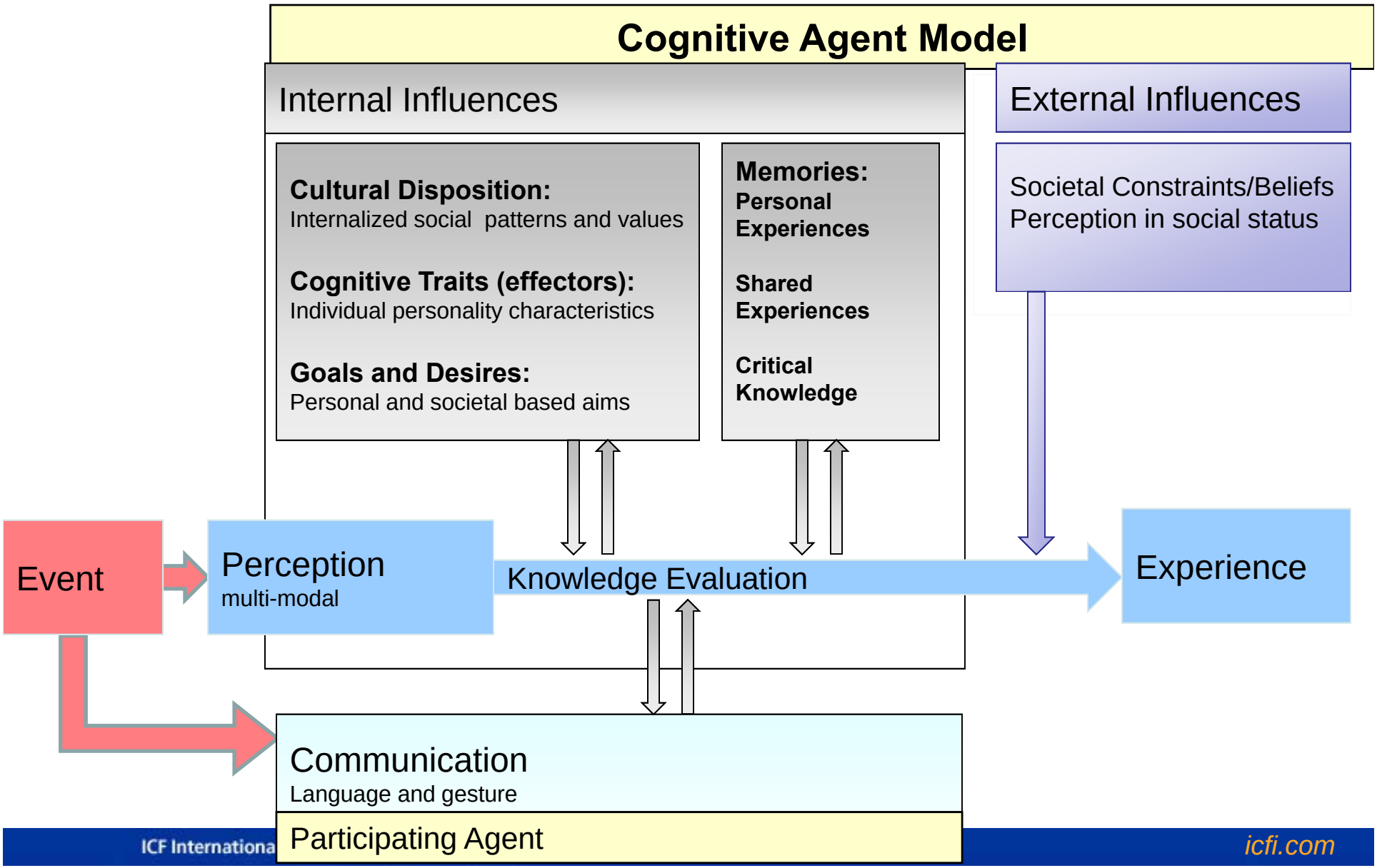


Mapping SCIEnTS to Advanced Decision Making Skills



Creating Realistic Complex Scenarios

The Brains: SCIEnTS Cognitive Agent Models



Communicating Agents:

Constantly sharing knowledge with each other and human participants

Agents use strategies to create optimal environment for themselves, friends, faction, families

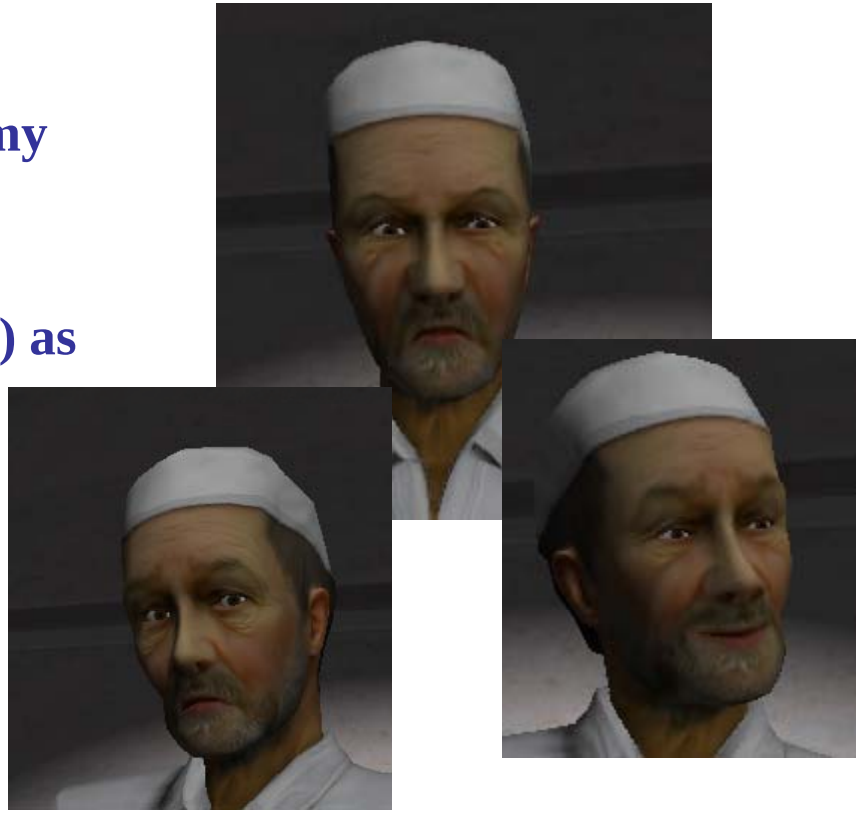
Negotiation protocols, game theory

(Lying, sharing partial knowledge, misrepresenting situations)

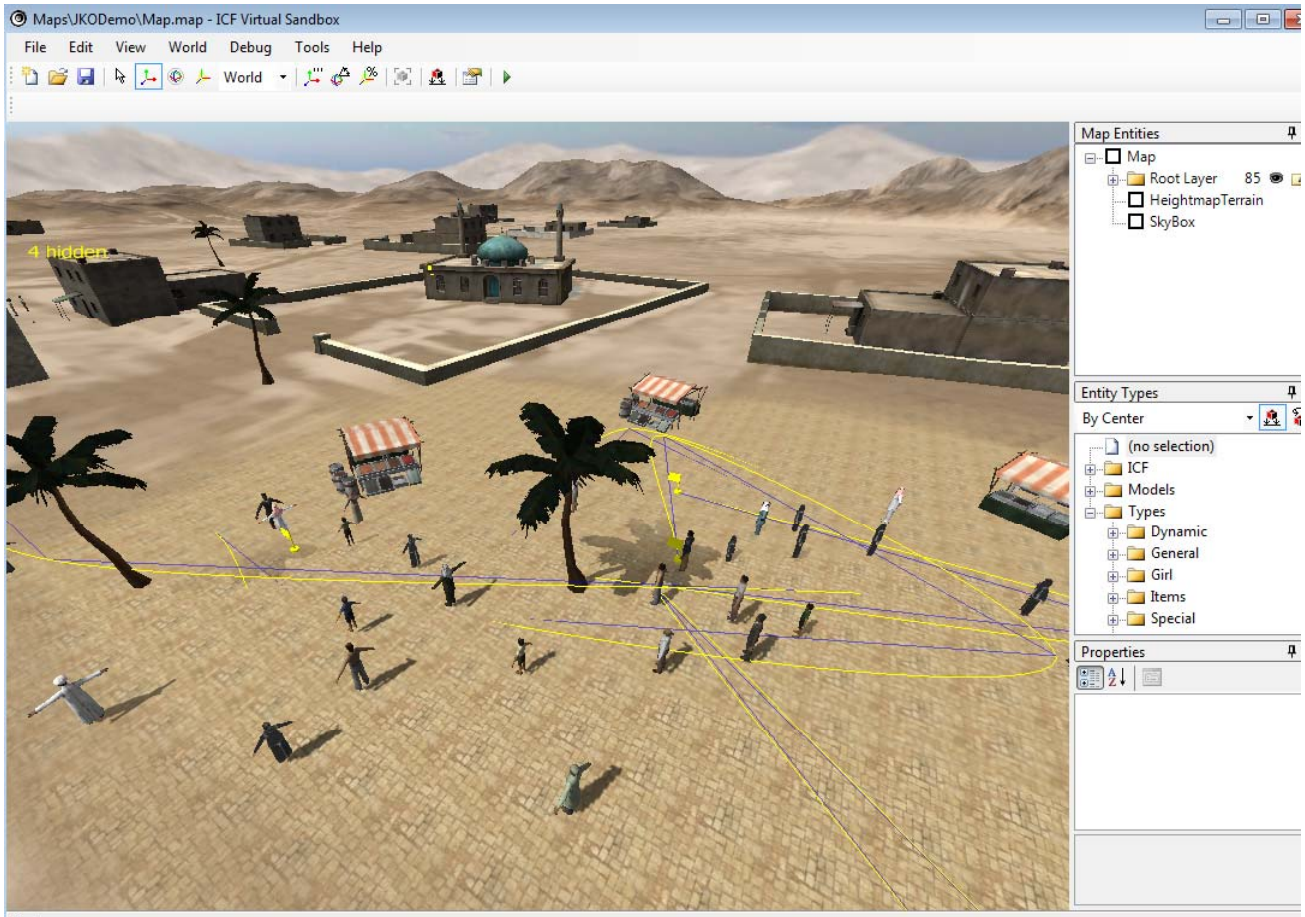
Use Strategies to gain utility ("Get what they want")

The Body: Physical Response Modeling

- **Physical states are procedural and not static**
- **Subject experts can develop a taxonomy of physical responses**
- **Mapped to emotional (cognitive states) as fuzzy sets that exist in the framework**
  - **example: Very Angry, Somewhat Nervous,**
- **Easy tools for generating physical states with verbal and gesture responses**

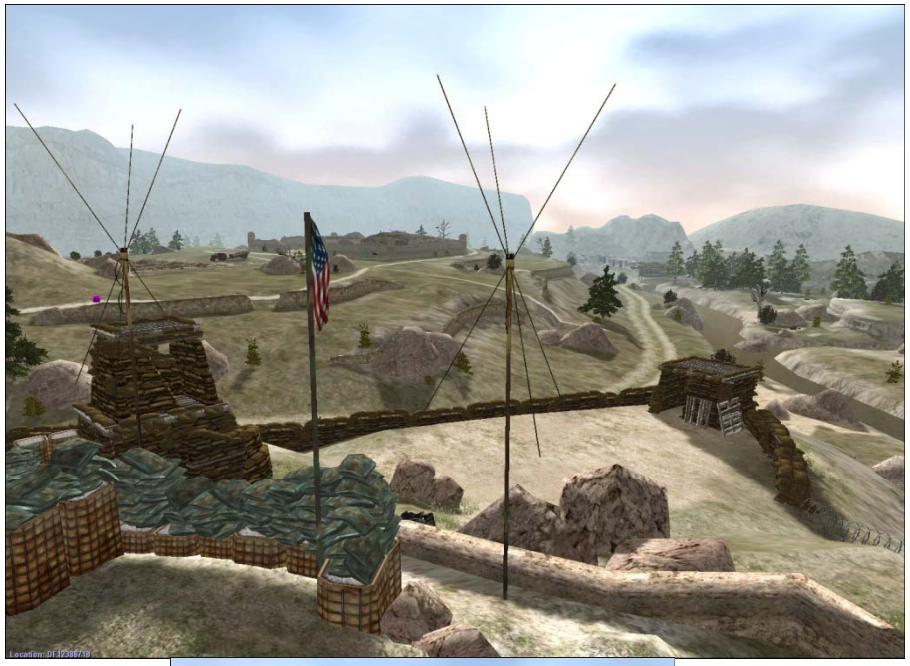


The Environment:
Rapid Scenario Development using ICF Sandbox Editor



Scenarios can be built by non-programmers with the goal of very rapid modifications to environments

Rapid Scenario Development
Afghanistan



Data Collection and Assessment

Multi-Tiered Approach

First Order Effects
How well did you achieve your objective?

Second Order Effects

How well did you influence others in your environment?
Were cultural norms followed?
Who saw what?
How was information shared?

SCIEnTs in Action

Center for Army Leadership Multi-Source Assessment and Feedback Online SCORM 2004 Conformant Training

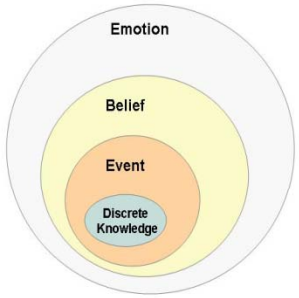
Level 4 simulations designed to teach influencing for Army leaders

- Continued work in human behavior modeling and encoding influence techniques

Leadership Competency Training:

- **Influencing Others**
- **Social/Cultural Competency**
- **Getting Results**
- **Leading Others**

Human Dimension Modeling: The Experience



The Experience is a relationship between specific occurrences and the belief about what has happened. The experience is derived as

$$E = (0 - i)\sum Ii\ (Ei \mid Ai)$$

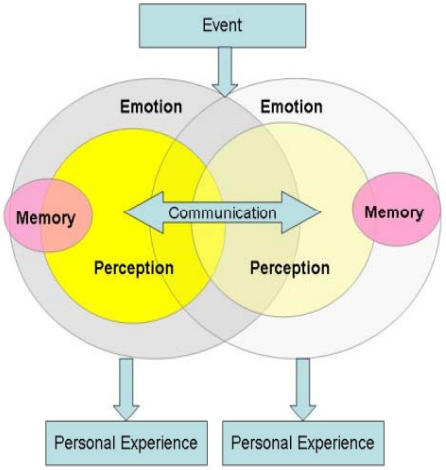
where E is the receiving agents interpretation of his experience plus the combined interpretations Ei of other agents' experience Ai.

Experience described as concentric circles where information at its center is discrete and non-interpretive.

As the circles extend outward, data become more abstract and open to interpretation and meaning. Each of the concentric circles are explained below as they relate to the building of the experience.

How Agents Share : Evolution of Information Towards **Agreement**

Experiences are agreed upon using several techniques:



- Perceptual (first hand) knowledge
- Cultural Convergence Models: Homophily vs. Ideal
- Social Impact Theory
  - Strength, Immediacy, Number of Sources; f = f(SIN)
  - Transmission (biased, unbiased, direct)
- Transfer of cultural information
- Cooperation and Negotiation Models
  - Equilibrium states, efficiency, self preservation
- Communication:
  - Language processing: Encoding information into language (speech acts, gestures, knowledge)
  - Physical responses and perceptual information
- Development of individualized cultural and social models
  - Methods to encode culture (under development)

How Agents Share : Evolution of Information

Cultural, social, cognitive, and anthropological subject matter expertise

Emergent behavior models (genetic algorithms, swarm behaviors)

Cultural adaptation methods (computational sociology):

- Well researched but not applied effectively in immersive training

Cooperation Models

- Game Theory

Cultural Convergence Models: Homophily vs. Ideal

Social Impact Theory

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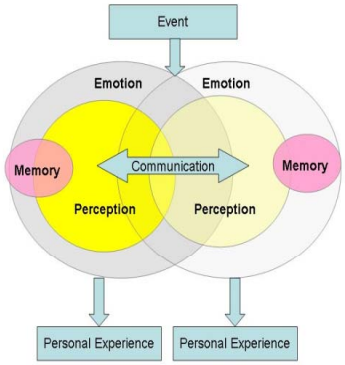

Memetics: Transfer of cultural information

Communication:

- Language processing: Encoding information into language (speech acts, gestures, knowledge)
- Physical responses and perceptual information

Development of individualized cultural and social models

Communication Model: Knowledge Encoded in Language and Gesture

- **Engagements:** Like-minded agents with similar predispositions interact in a continual state sharing mode.
  - A cooperation matrix function determines agents' levels of initial information sharing.
  - Mechanism Design for high order individual rationality, budget balance, and social welfare. Other variables (knowledge, personal relationships, personality, & cultural bias) also influence cooperation.
- **Communications:** Agents communicate both verbally (voice recognition) and non-verbally (gestures & actions). Language script tags encode knowledge (memes; Dawkins, 1989) that agents can store and share.
  - Discrete knowledge and evaluation mechanisms stored in language syntax
- **Agent and Man-in-the-Loop Communication:** Interactive between agents and between humans and agents

Knowledge and Mutation

Knowledge :

- Knowledge transferred between agents maintains a fitness value based on K= (α, μ, ν, τ)
- memory recall of the event α (integrity of information from perception) ,
- consensus of the event μ (transfer knowledge),
- influencing effectors (social learning models) ν ,
- and first-hand knowledge or perception of the event τ.

Knowledge Mutation:

- Unintentional Misperception—data that is not fully available to the agent, and Intentional Misperception—
- information that is available to the agent but is intentionally modified/obfuscated with the intention of spreading misinformation.

Intentional Misrepresentation can be used as a strategy (agent or subject) to shift or transmute knowledge as necessary.

Demonstration