



Shared Information and Virtual Surfaces

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Objective

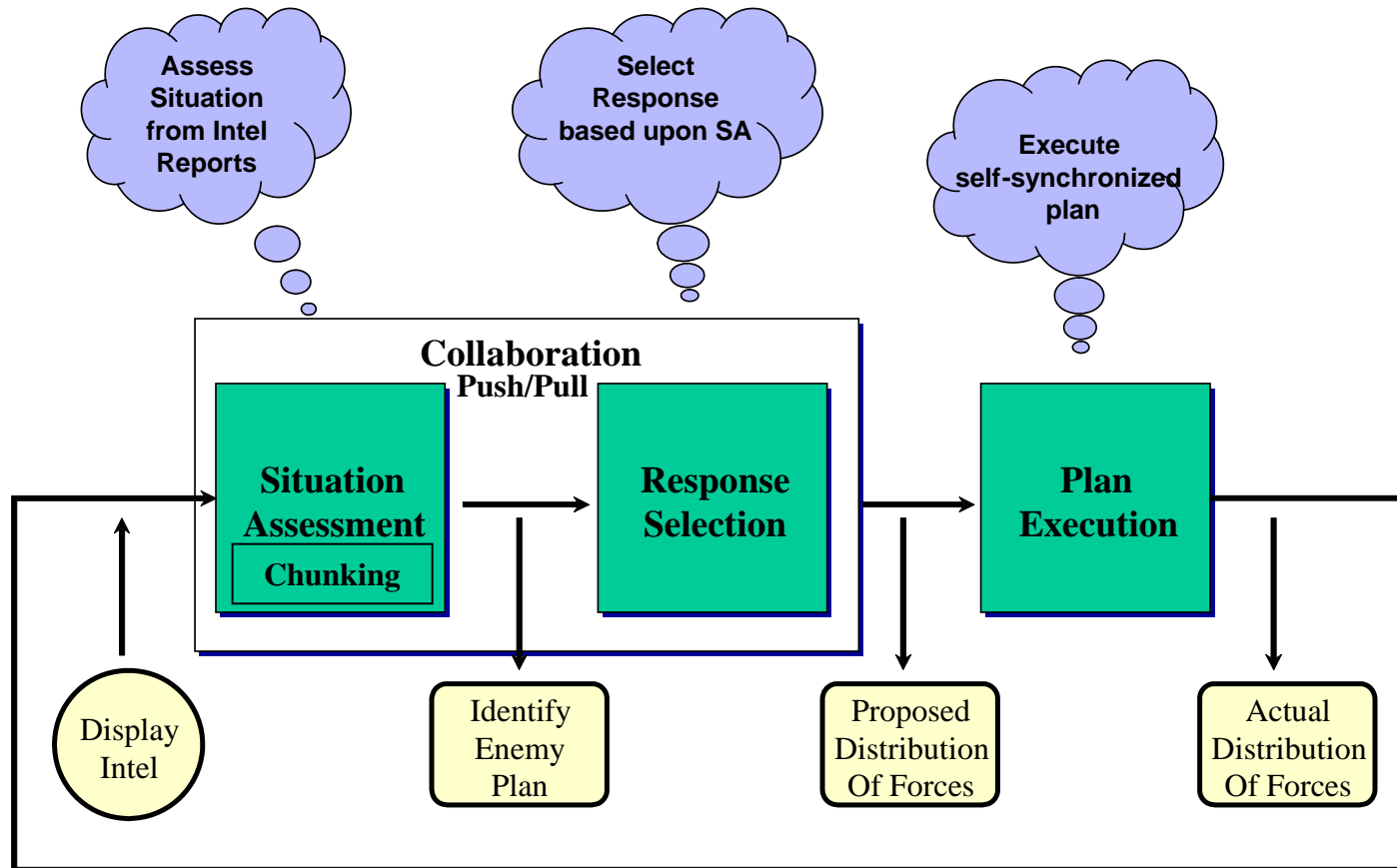
- Investigate performance of self-synchronizing teams
- Understand how teams collaborate in situations characterized by high stakes, time pressure and uncertainty

Research Vision

Problem: teams have difficulty coordinating their actions in real-time

Question: how can we support teams operating in rapidly changing environments?

Research Model



Empirical investigation of our model of
Team Recognition Primed Decision Making

Team Compensatory Aids

- **Perception Tools for**
 - *Pattern Recognition*
 - *Sharing of Intention*
- **Attention Tools for**
 - *Gesturing*
 - Alerting (negotiated)
 - Awareness
- **Memory Aids for**
 - Mitigating the Effects of Stress

Research Measures

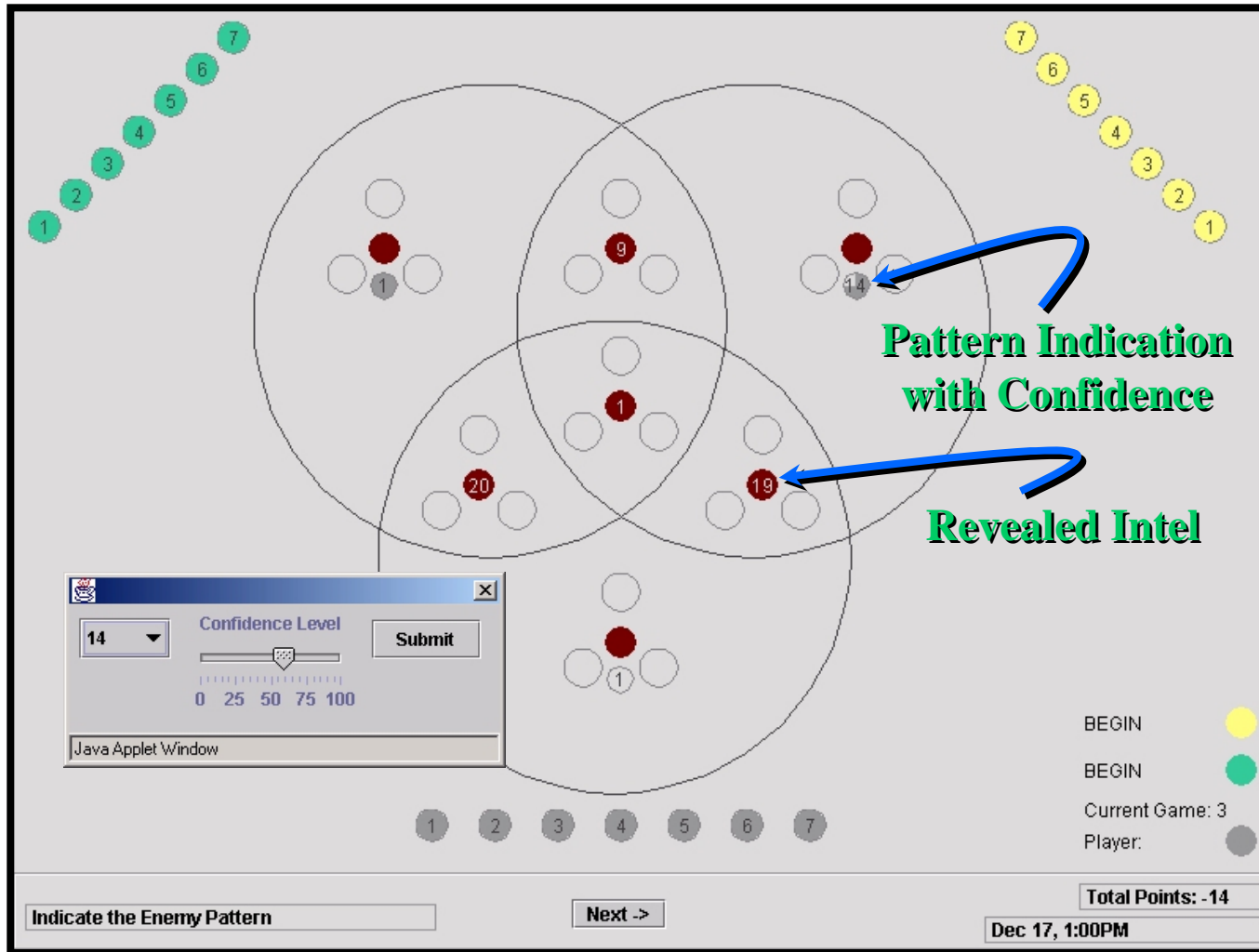
- Outcome Measures: *Quality, Speed*
- Process Measures:
 - *Pattern Recognition, Confidence*
 - *Information Sharing, Intention*
 - *Collaboration*
 - *Leadership*
- Mental Models: *Pathfinder C*

Decision Game

- Cooperative 3-Player Game
- 7 Tokens, numbered 1-7
- Opponent has asymmetric force
 - Patterns: Definitive, Equivocal, Uncertain
- Team places tokens so total \geq opponent

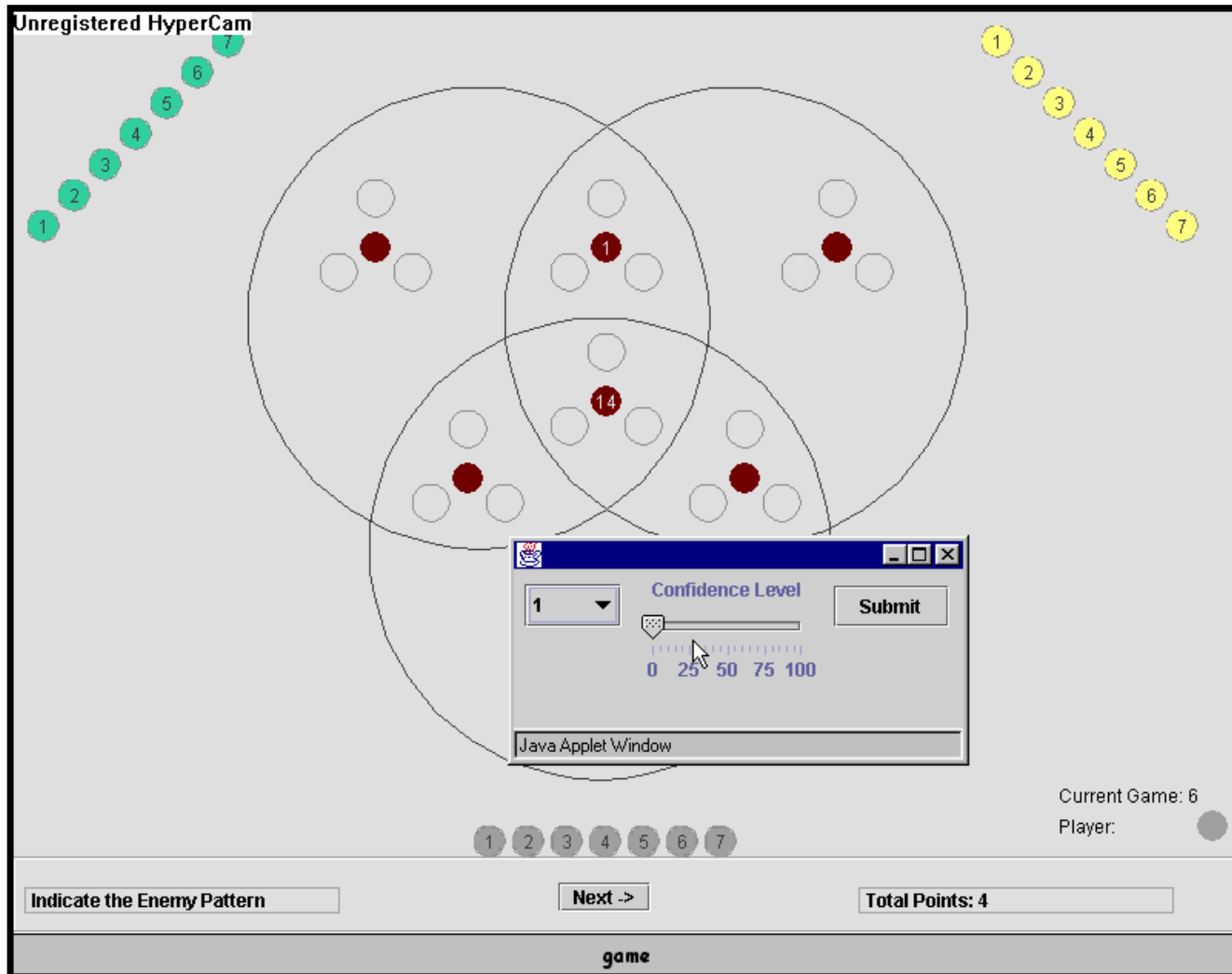
- Play is interactive

Game Screen



The screenshot displays a game interface for pattern recognition. At the top, there are two curved sequences of numbered circles: a green sequence (1-7) on the left and a yellow sequence (7-1) on the right. The main area features three overlapping circles, each containing a 3x3 grid of smaller circles. Some of these smaller circles are filled with red, representing a pattern. The numbers 1, 9, 14, 19, and 20 are placed within these grids. A blue arrow points from the text "Pattern Indication with Confidence" to the number 14, and another blue arrow points from "Revealed Intel" to the number 19. A "Confidence Level" slider is visible, set to 14, with a "Submit" button. The slider has markers at 0, 25, 50, 75, and 100. At the bottom, there is a "Next ->" button, a "Total Points: -14" display, and a timestamp "Dec 17, 1:00PM". A legend on the right side identifies the colors: yellow for "BEGIN", green for "BEGIN", and grey for "Player".

Video



Unregistered HyperCam

1 2 3 4 5 6 7

1 2 3 4 5 6 7

1

14

Confidence Level

1

Submit

0 25 50 75 100

Java Applet Window

Current Game: 6
Player: ●

Indicate the Enemy Pattern

Next ->

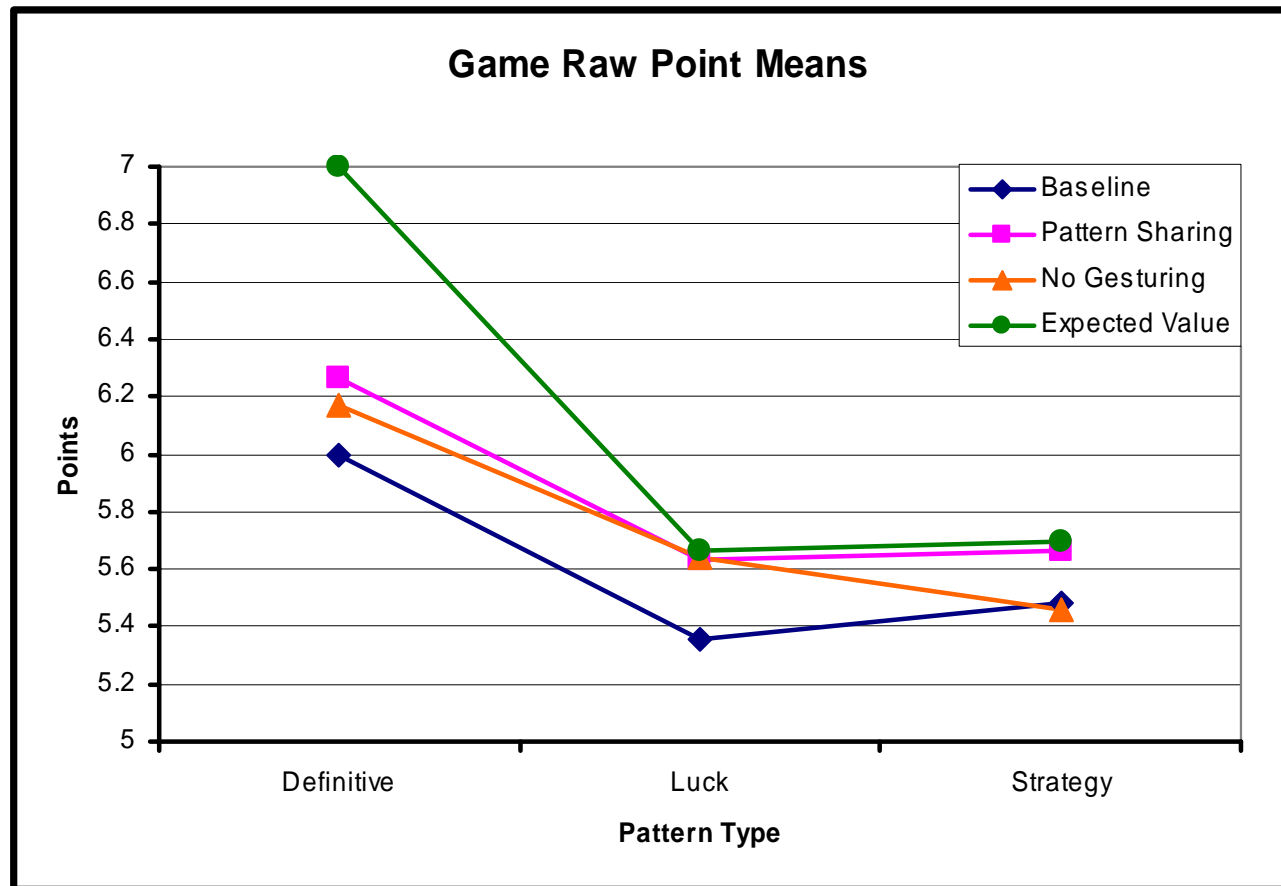
Total Points: 4

game

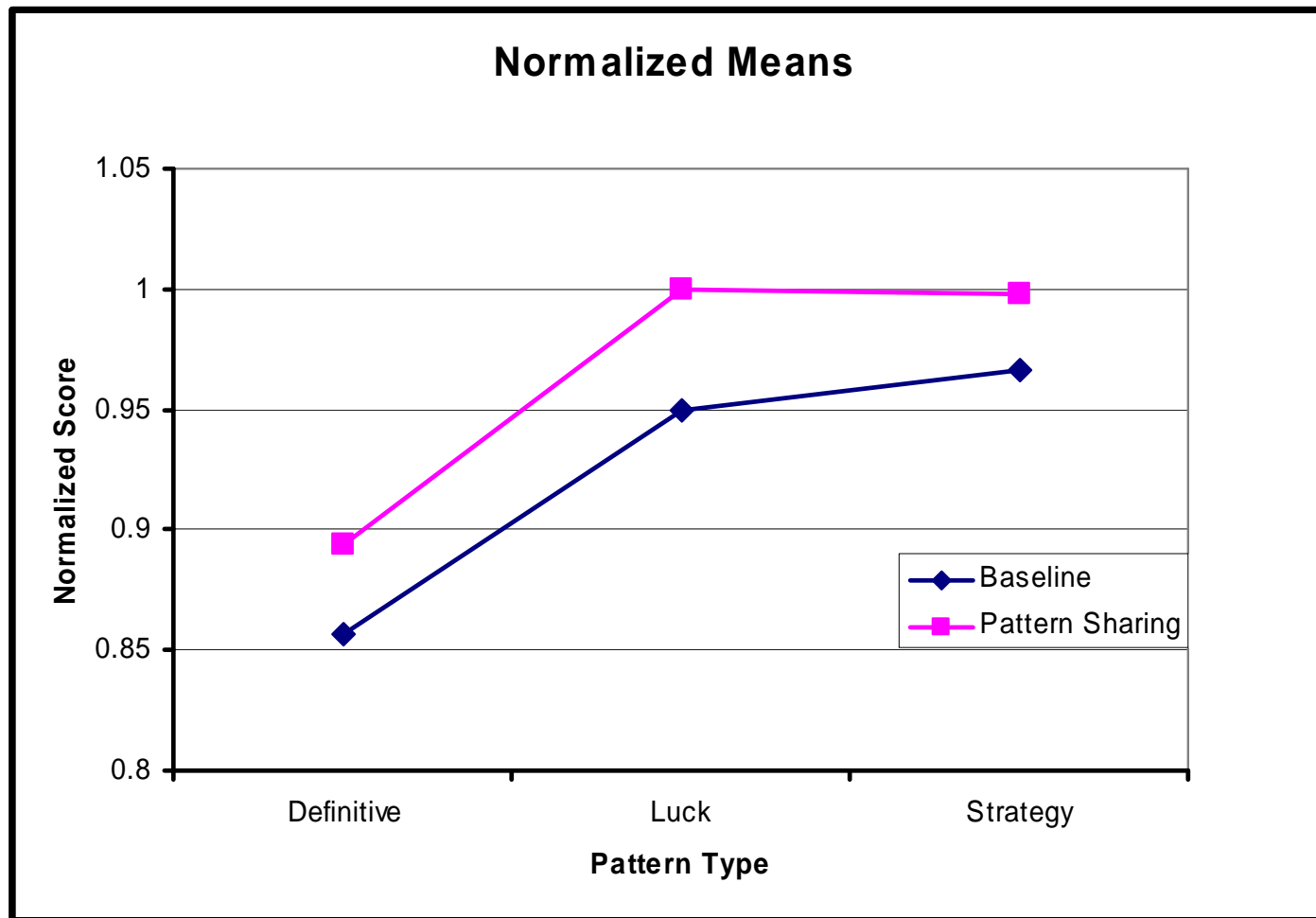
Current Progress

- Model and Software Developed
- Data Collected:
 - 144 Participants, 3 Treatments
- Analysis Performed
- Findings Reported

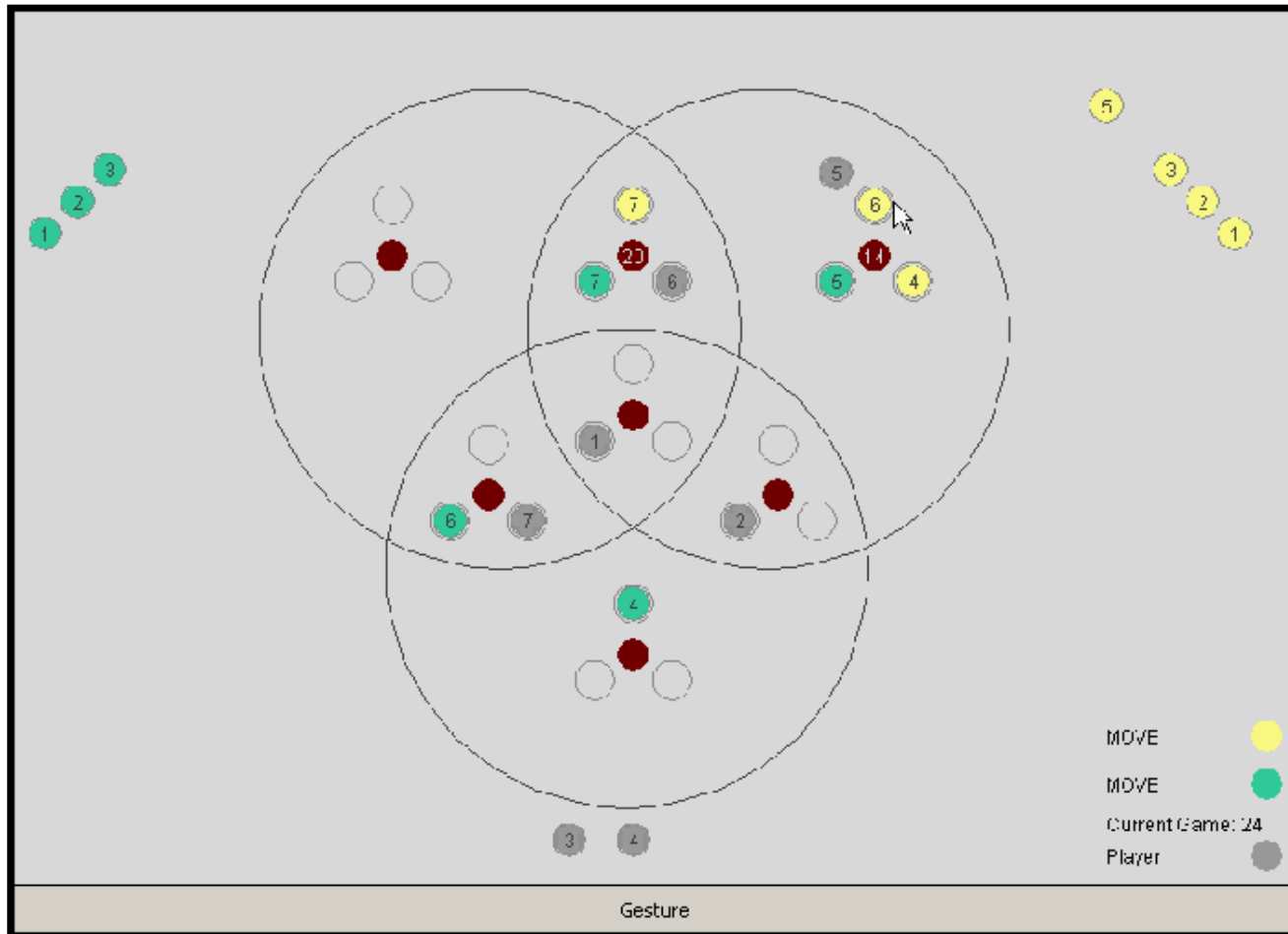
Raw Scores



Normalized Scores



Gesturing Example



Conclusions

- Team Recognition Primed Decision Making Model Validated
 - More time spent in situation assessment than in response selection
 - Pattern sharing reduces “extra” movement by 50%
 - Surprise finding wrt importance of real-time gesturing

Research Issues

- Shared Mental Models
 - Similar or compatible knowledge
Cannon-Bowers, J. E. & Salas, E. (2001)
“[Reflections on Shared Cognition](#)”, *Journal of Organizational Behavior*, 22(March):195-202
 - Consensus on who knows what
Kraut, R. E., Lerch, F. J., & Fussell, S. R. *The Development of Shared Mental Models and Group Performance* ([NSF IIS-9812123](#))

Research Issues

- Team Cognitive Chunks

- Slots and Templates

Gobet, F. & Simon, H. A. (in press)

“Five Seconds or Sixty? Presentation Time in Expert Memory”, Cognitive Science.

- Labels and Mnemonics

Staszewski, J. (1990). Exceptional memory: The influence of practice and knowledge on the development of elaborative encoding strategies. In F. E. Weinert & W. Schneider (Eds.), Interactions among aptitudes, strategies, and knowledge in cognitive performance, (pp. 252-285). New York: Springer.

Research Issues

- Attention Management

- Negotiated Alerts

Horvitz, E., Jacobs, A., & Hovel, D. (1999) “*Attention-Sensitive Alerting*”, In Proceedings of UAI '99, Conference on Uncertainty and Artificial Intelligence (pp. 305-313).

McFarlane, D. C. (1999) “*Coordinating the Interruption of People in Human-Computer Interaction, Human-Computer Interaction*”, INTERACT'99, Sasse, M. A. & Johnson, C. (Editors)

- Information Push and Pull

Cybenko, G. and Brewington, B. “*The Foundations of Information Push and Pull*,” in The Mathematics of Information Coding, Extraction, and Distribution (G. Cybenko, D.P. O'Leary and J. Rissanen editors), Springer, IMA Volume 107, 1999.

Research Issues

- Team Memory
 - Targets and Distractors
Clark, S., Hori, A., Putnam, A., and Martin, P. (2000) “*Group Collaboration in Recognition Memory*”, *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 26(6):1578-1588.

Research Issues

- What You See Is What I See (WYSIWIS)
 - Strict and Relaxed

Stefik, M., Foster, G., Bobrow, D.G., Kahn, K., Lanning, S., and Suchman, L. (1987) “*Beyond the chalkboard: Computer support for collaboration and problem solving in meetings*”, Communications of the ACM, 30(1):32-47.
 - Mutual Orientations

Valin, S., Francu, A., Trefftz, H., Marsic, I. (2001). “[Sharing Viewpoints in Collaborative Virtual Environments](#),” In Proceedings of Hawaii International Conference on System Sciences, 3, 1-9.

Research Issues

- Information

- Common vs. Private

Stasser, G., Vaughan, S., and Stewart, D., (2000).

“Pooling Unshared Information: The Benefits of Knowing How Access to Information Is Distributed Among Group Members,”

Organization Behavior and Human Decision Processes, 82(1):102-116.

Research Issues

- Eye Tracking

- Pupil Dilation and Cognitive Load

Marshall, S. P., Morrison, J. G., Allred, L. E., Gillikin, S., & McAllister, J. A. (1997).

“Eye tracking in tactical decision-making environments: Implementation and analysis”, in Proceedings of the 1997 Command and Control Research and Technology Symposium (pp. 347-355).

FY '02 Research Plan

- Explore sharing of pattern chunks
 - Labels
 - Mnemonics
 - Templates (slots)
- Rewards for speed and accuracy