

Cognitive Science: All Fun and Games?

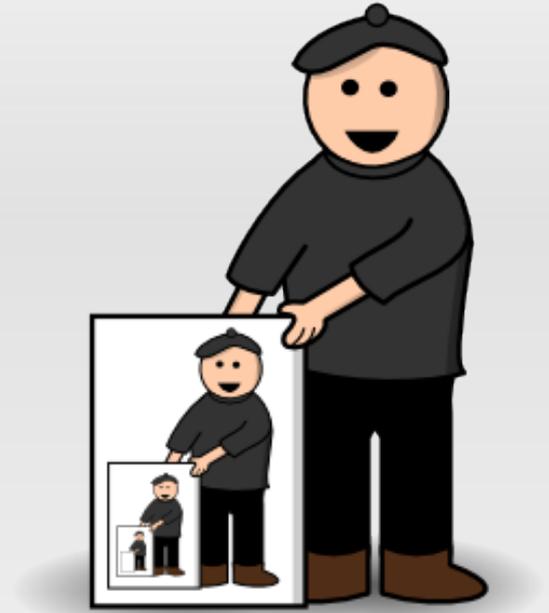
Michael Hansen
Rob Goldstone's Percepts and Concepts Lab
Indiana University 2009

Group Behavior

- Human behavior as a complex system
 - Emergent properties in group tasks
 - Decentralized computation
- Compare with "natural systems"
 - Plants, animals, minerals
- Compare with agent-based models
 - Formalize underlying strategies
 - Analyze efficiency
 - Apply models to dissimilar systems

Games

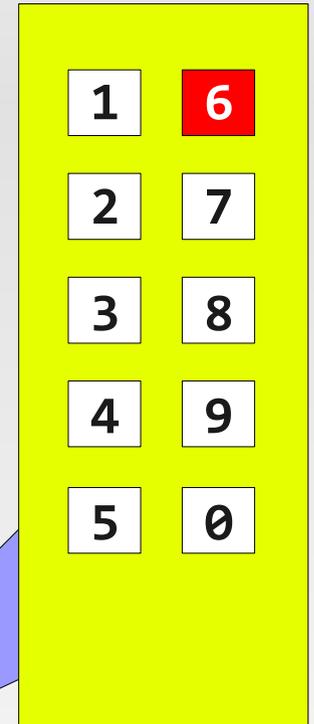
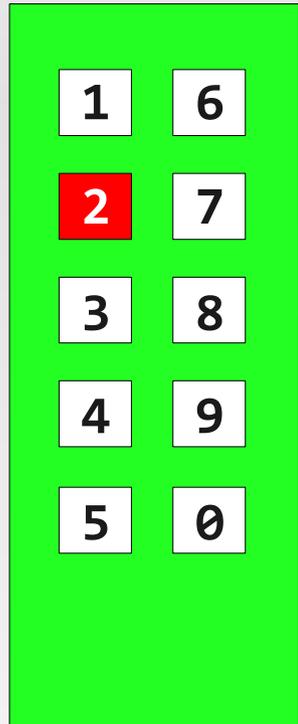
- **Pixel**
 - Collective digital art
- Group Sum
 - Collaborative binary search
- Forager
 - Resource mining competition
- Flatland
 - Grid world with optional constraints



Pixel Overview

- Conditions
 - Clustered, Diffuse, or Random layout
 - Simple or Disjunctive instructions
- Experimental questions
 - Influence on final picture (3rd party ratings)
 - Time to solution (TTS)
 - Overall group behavior

Pixel Game



Pixel Game

"Draw a Circle"

 1	 2	 5	 4	 1
 3	 6	 4	 3	 6
 3	 4	 7	 2	 5
 1	 5	 5	 2	 1
 2	 6	 6	 4	 3

Clustered

"Draw an Arrow"

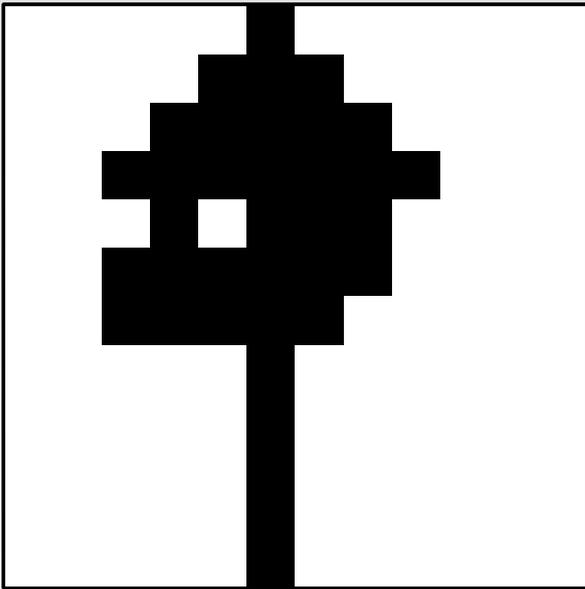
 1	 6	 5	 2	 4
 1	 3	 2	 1	 3
 3	 4	 3	 2	 4
 5	 5	 5	 6	 2
 6	 3	 6	 7	 6

Diffuse

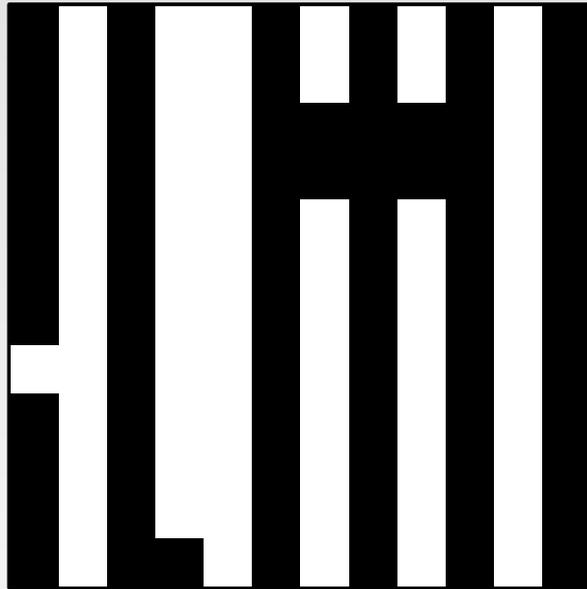
Pixel Results

Should be...

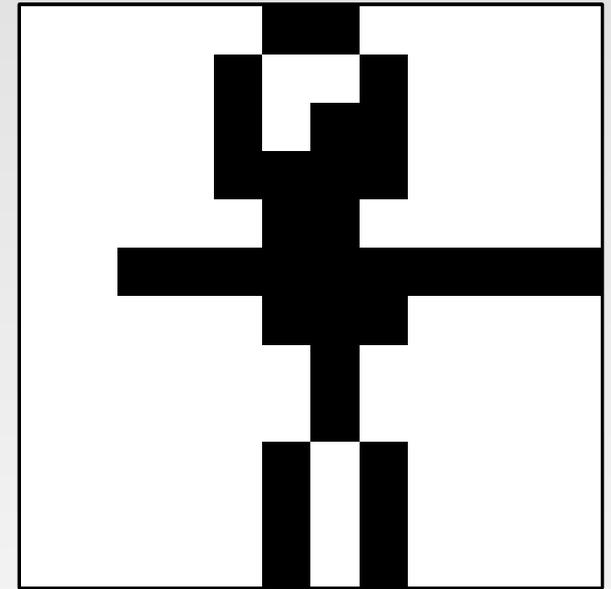
Arrow



Stripes



Stick Figure



Birdhouse?

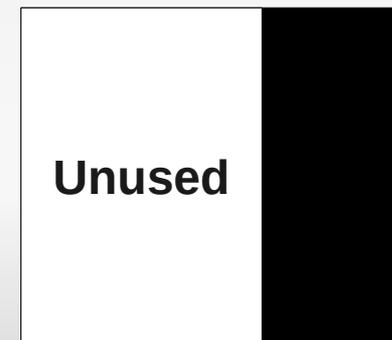
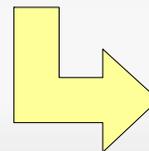
Labryinth?

xkcd?

Looks like...

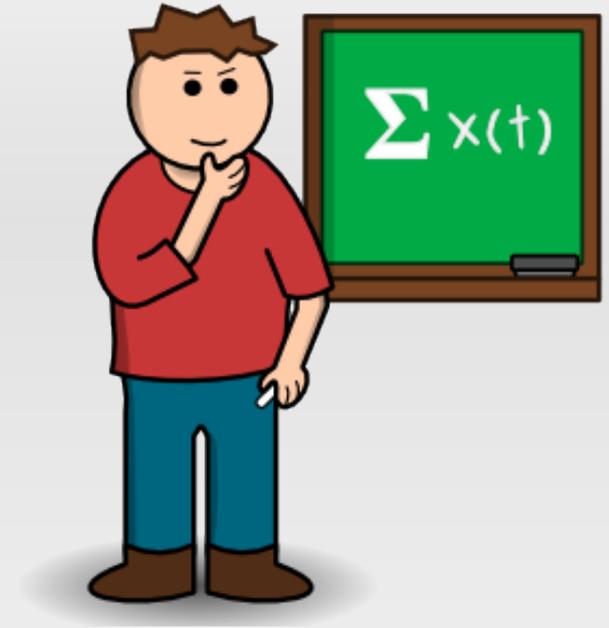
Pixel Results

- Too few experiments
 - Undergrads are fickle in Spring
- Clustered → Poor rating 
- Disjunctive or clustered → Quicker TTS
 - Odd given choice involved (H or E, C or U)
- Any condition →
 - Linear decrease in average click rate
 - ~ 60% of pixels not changed



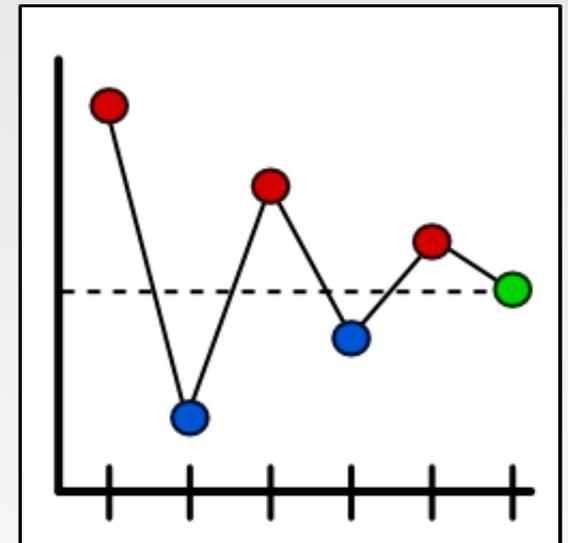
Games

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Group Sum Overview

- High / low number game
 - "Collaborative binary search" sounds fancier
 - All guesses are summed
 - No communication allowed
- Feedback after each round
 - Numeric: "High by 10"
 - Non-numeric: "Too Low"
- History of guesses available
 - Color-coded line plot



Group Sum Overview

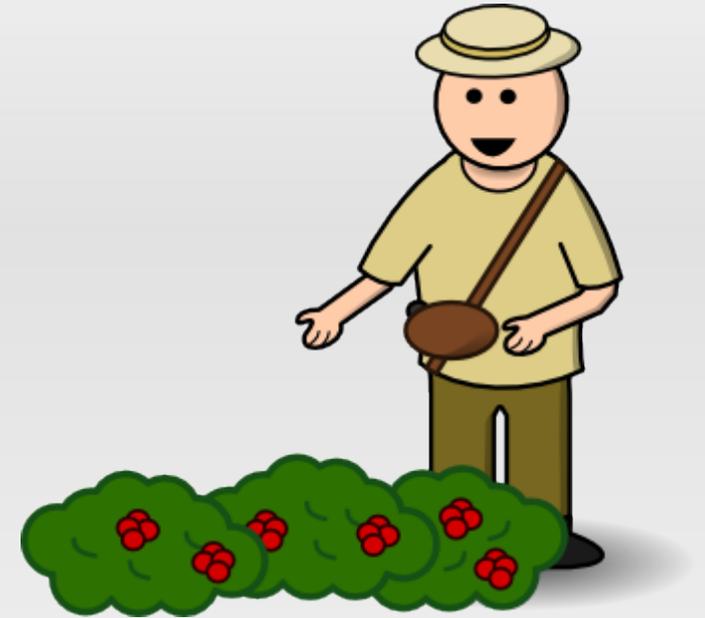
- Goldstone and Roberts 2009
- Experiment hypotheses
 - Members will compensate for each other
 - Feedback will influence coordination
 - Larger groups (10+) will have more difficulty
 - Variability will change over time:
 - Decreased within-participant
 - Increased between-participant

Group Sum Results

- Numeric feedback → Quicker TTS (~2 rounds)
- Small vs. Large groups (~7 vs. 12 rounds)
- Individual reactivity proportional to feedback
 - Not optimal if everyone does this, but flexible
- Role differentiation in large groups
 - Some individuals are inactive, very active, etc.
 - Diffusion of responsibility
- Homogeneous roles in small groups
 - Between-participant variance decreases

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Forager Overview

- Individuals compete for resources ()
- World is divided into plots
 - Different resource probabilities
 - Probabilities can vary through time
 - Resources are randomly distributed
- Players are free to move
 - Travel time penalty
 - Others may follow suit

1	2
3	4



Forager Game

01:49

Time left in round

Missed resources

1



2

Traveling players

3



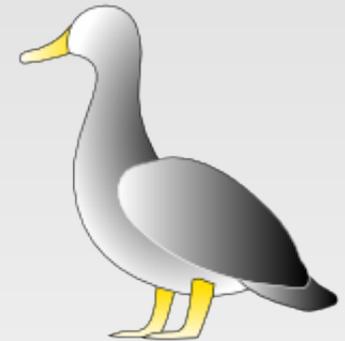
Active players

4



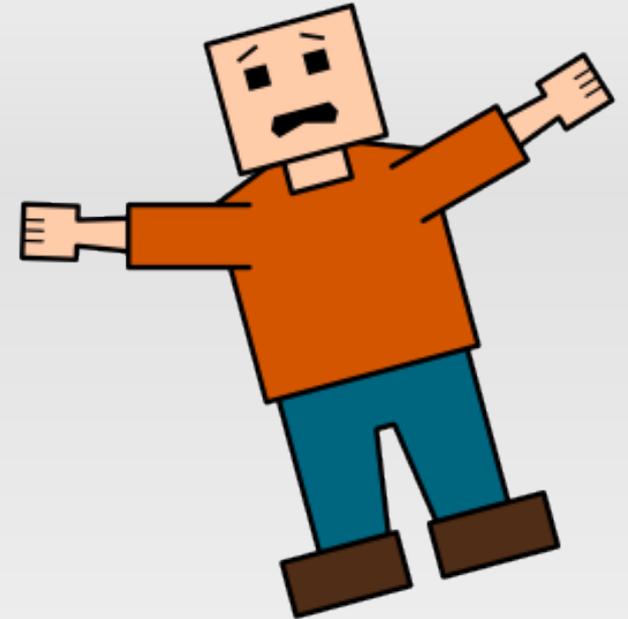
Forager Results

- None yet!
- Similar to Goldstone and Ashpole 2004
 - **Visible** or invisible peers, resources
 - Consistent undermatching
- Experiment differences
 - Coarser grid and resource distribution
 - Individual score is hidden
- Second Life
 - Two resource pools
 - Real money, sort of...



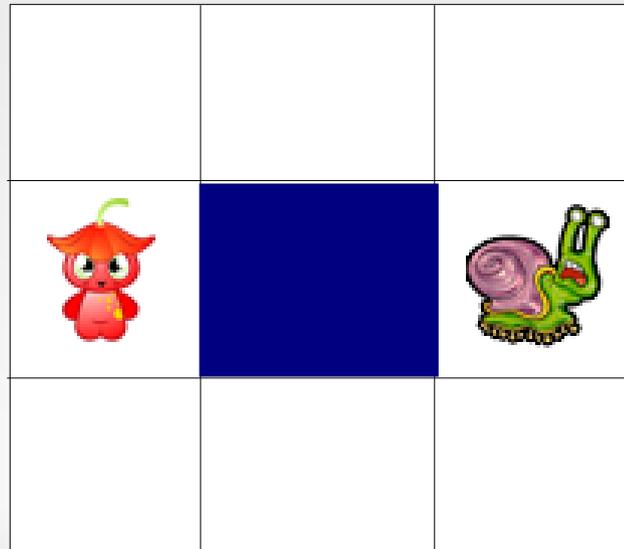
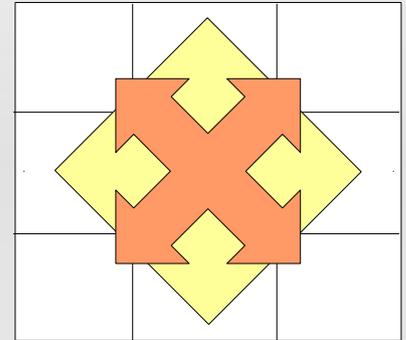
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Flatland Overview

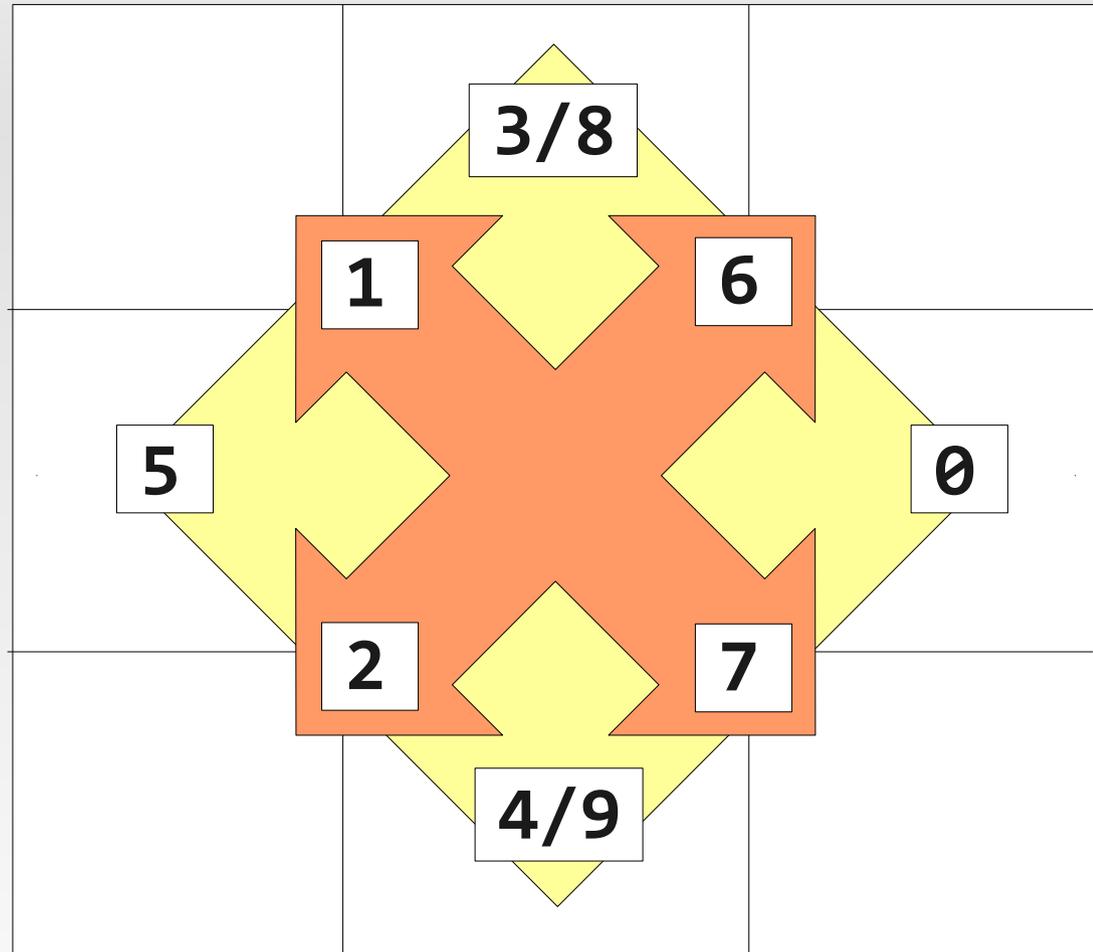
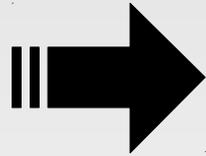
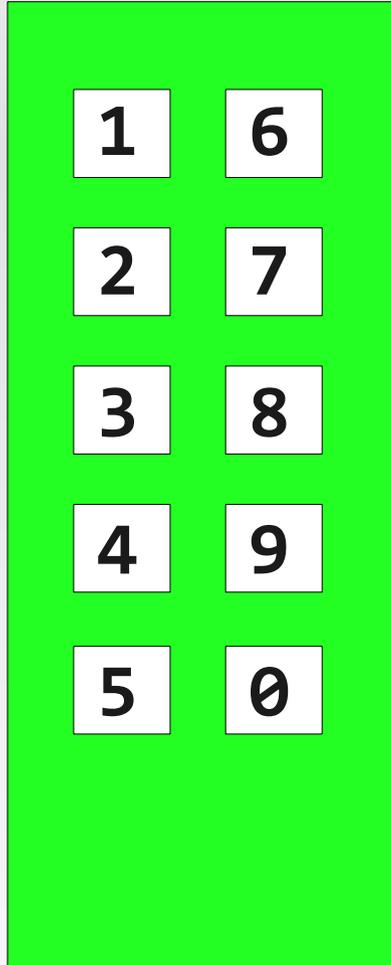
- 2D grid world
 - Players are free to move around
 - Collisions, obstacles
 - Synchronized team movement
- Game modes
 - Free form
 - Predator-prey
 - N-Queens



Flatland N-Queens Game



Flatland Game Controls



Future Work

- Pixel
 - More experiments, paper
 - Time-series analysis of data
- Forager
 - Same undermatching result?
 - Similar group migrations?
- Flatland
 - Predator-prey with obstacles
 - N-Queens – anyone but CS people?

Thank You - Questions?

