

# Modeling an Interactive Dynamic Task: Argus Prime

ACT-R 1999 Workshop

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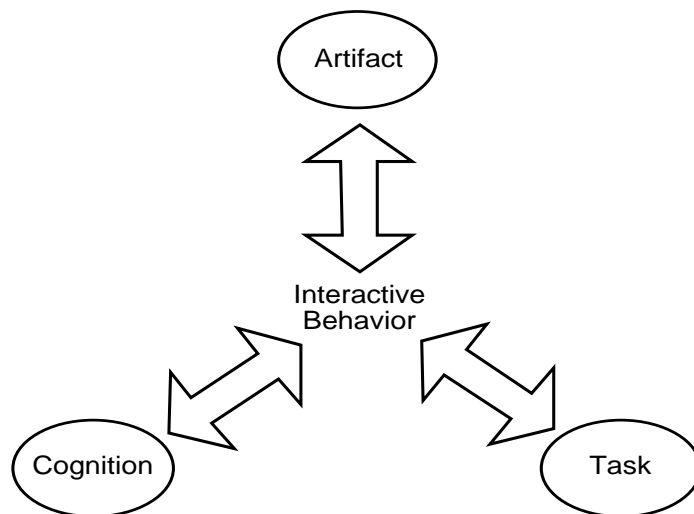


Project Argus:  
Eye to the Future

# ARGUS Project

- Argus project tasked with:
  - Studying cognitive workload
  - Providing qualitative and quantitative measures of workload and their impact on HCI
  - Single subject and team versions
- Develop a cognitive model that has a cognitive and perceptual-motor component to examine workload effects on Human Computer Interactions

# Cognition-Artifact-Task



# Overview

- Argus task - interactive, dynamic, complex
- Strategies at the Interaction Level
- Argus Models
  - What we have done
  - What we are working on
  - What is next

0% 4/3 Start time: 11:53:21 Elapsed time: 154 Scenario: High 1

Speed	Range	Bearing	Altitude	Course	AppDist
750	98	21	27000	239	71

1	2	3	4	5	6	7
0 - 1	2 - 3	4 - 5	6 - 7	8 - 9	10 - 11	12 - 13

Track Number: 2

## Target Classification Example

Let Range = 125, Altitude = 27500, IFF = .11

Raw to cue value mappings:

Range	> 150	100 -150	50-100	0 - 50
Altitude	500 - 13500	15000-37000	>37000	
IFF	.2 - .6	.7- .8	.9 - 1.6	
Cue value	0	1	2	3

Weights: Range = 2 Altitude = 1 IFF = 2

Target Score =  $2 * 1 + 1*1 + 2*2 = 7$

Threat value = 4

## Target Classification Example

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## Questions Raised

1. What strategies do people use to
  - manage the targets?
  - classify each target?
  - process feedback?
2. How do strategies change as a function of workload?
3. How do all of the above apply to 3 people doing the task as a team?

# Strategies Involving Interaction

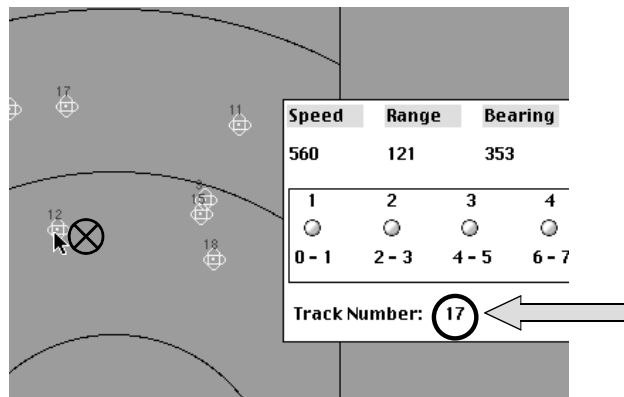
- Focusing on strategies that have a perceptual/motor (PM) component and a cognitive component
  - heavily perceptual/motor <----> heavily cognitive
- As workload increases, do the strategies employed :  
Take advantage of the parallel processing of cognition and the PM components?  
Reflect an optimal division of labor between cognition, perception, and motor components?

# Experiments

- Argus Prime
  - Ran 2 experiments
  - 9 or 18 targets
  - eyetracking data
  - 96 subjects
- Team Argus
  - Ran 2 experiments
  - 7-9 teams of 3 people per team
  - 6 weeks; one session per week
  - Two interfaces

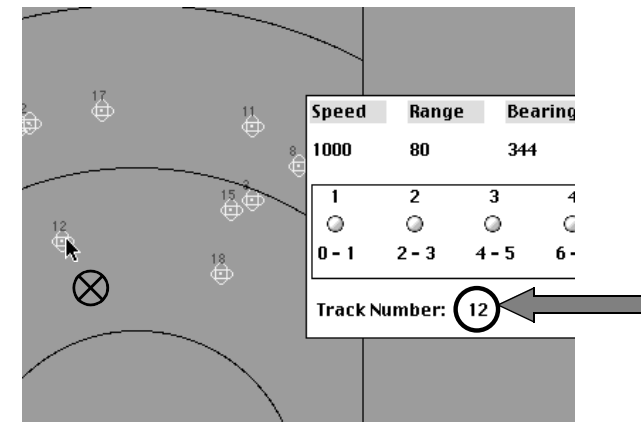
## Expected Strategy: Look After

Move eye and cursor to target



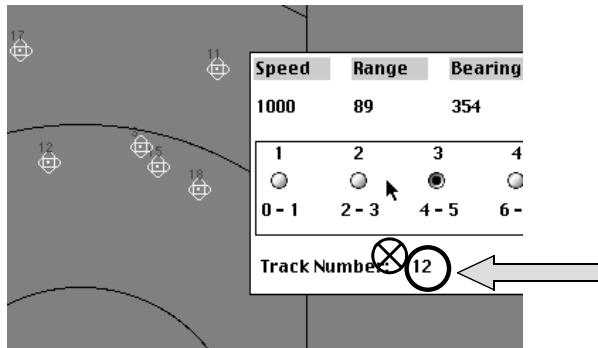
## Expected Strategy: Look After

Click on target



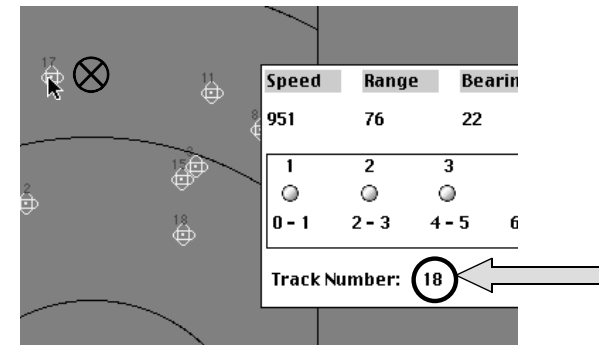
# Expected Strategy: Look After

Gaze at Information Window



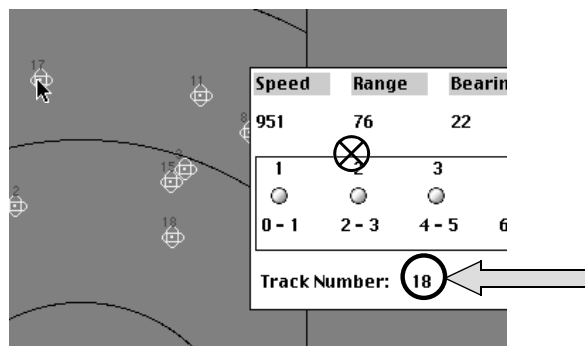
# Found Strategy: Look Before

Move gaze and cursor to target



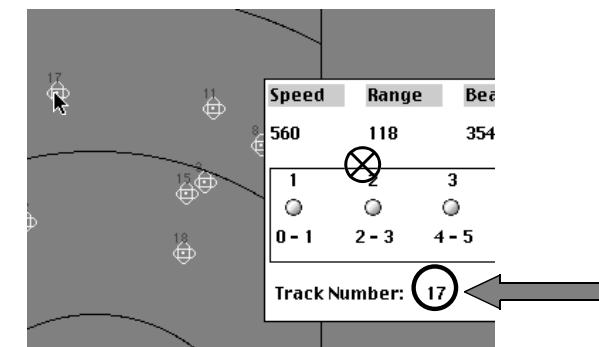
# Found Strategy: Look Before

Gaze at Information Window

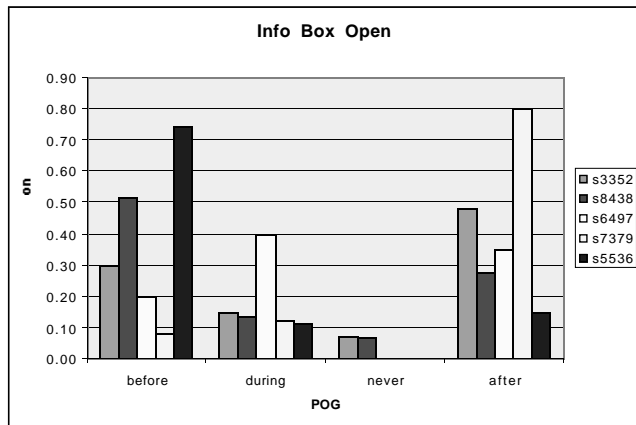


# Found Strategy: Look Before

Click



## When Does POG go to Information Box?

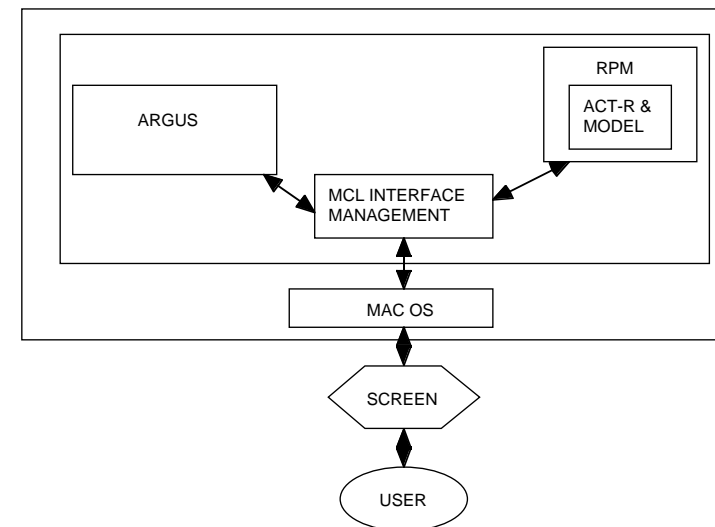


## What we've done

- Ran 2 experiments
  - Identified some of the interaction strategies
- Built a baseline model
  - Determine resource and timing requirements
  - Emphasis on perceptual-motor interaction
    - 43 productions -- 20 send commands to RPM
  - Performs the basic task as a “baseline” subject (i.e., executes a single strategy, not adaptive)

## What we've done - Baseline Model

- Incomplete cognition
  - Simple target selection
    - based on scanning four quadrants
    - alternative strategies for target classification
      - goes to another target if classified
      - always re-computes threat value
  - Raw -> cue value done by partial matching
  - No learning
    - uses help always or not at all (for each target attribute)



## What we've done -Implications so far

- # of chunks generated for 15 minute scenario
  - visual-locations, visual-objects, numbers for dynamic attributes (15,000 - 20,000)

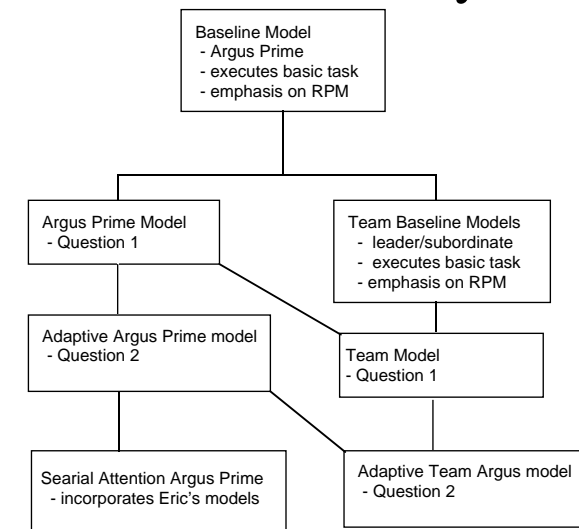
## What were working on

- What is the subject thinking while RPM is executing mouse movements, focus of attention, etc.?
  - In current model - Nothing
  - Chunk rehearsal
- Data analysis is ongoing
  - Analysis of eyetracking data - where to move attention

## What's next

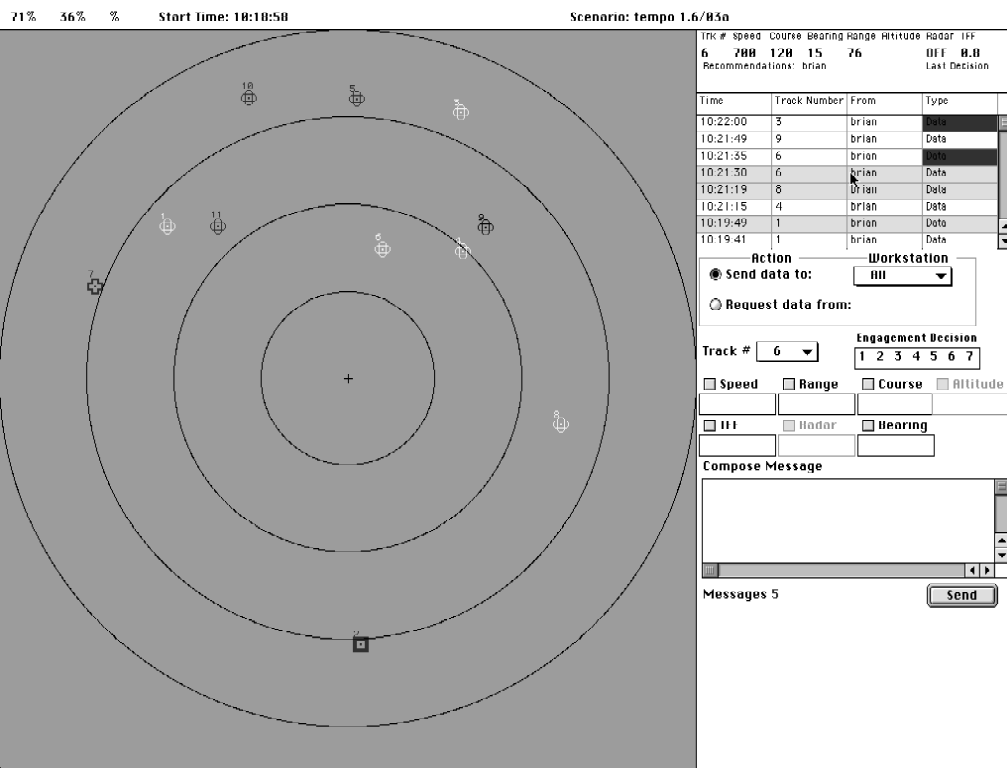
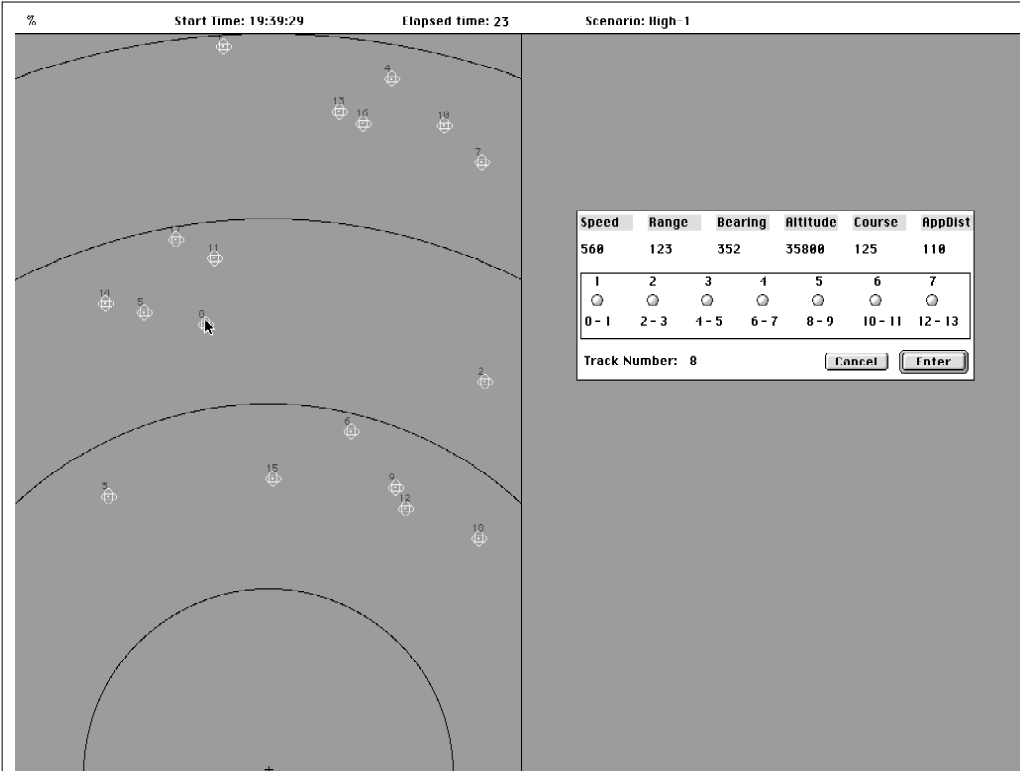
- Complete baseline model
- Complete data analysis in order to model classes of subjects
- Design and conduct experiments
  - memory vs. memoryless strategies
  - to extend serial attention studies to scaled world level of complexity
- Extend models to Team Argus

## Model Family



# RPM in a Complex Dynamic Environment

- Extendibility of screen objects (model defined features and visual objects)
- Multiple windows (screen = device)
- User controlled iconic (feature) memory for device
- Rectangle as constraint for visual locations
- Move cursor to an object



## Argus Basic Task

- Determine target score of each target in a specified zone
  - target-score = linear combination of cue values
  - cue value =  $f(\text{real-valued attributes of target})$
  - $f$  = table of ranges of the real values
- Map target score to a 1 - 7 scale (decision)
- Subject score =  $7 - |\text{truth} - \text{decision}| / 7$

# Argus Examples

- Point of Gaze/Target selection interaction to bring up target data
- Spatial vs. textual strategy for encoding of the target range attribute
- Target prioritization
  - change with number of targets on screen
- Decision verification

