

Modeling Dynamic Tasks: Implications for ACT-R/PM

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ACT-R/PM: What is it?

- ACT-R/PM (Byrne & Anderson, 1998) is an extension to ACT-R that endows it with the ability to model precise perceptual and motor processes.
- ACT-R/PM is a hybrid of the ACT-R Visual Interface (Anderson, Matessa, & Lebiere, 1998) and EPIC (Meyer & Kieras, 1997).

ACT-R/PM: Why is it important?

- Addresses the criticism of “disembodied cognition” (Meyer & Kieras, 1997) and thus “experimentally grounds” ACT-R.
- Additionally, with the finer resolution provided with ACT-R, it is important to account for the time taken by the perceptual and processes underlying the model.

Strengths of ACT-R/PM

- Allows parallelism across cognitive, perceptual, and motor processes
- Allows fine grained control over perceptual and motor processes
- Provides simple and consistent visual representation

ACT-R/PM is great, but why can't I...

- Find an empty hold level fast?
- Point to an empty space?
- Search through a list of planes again?
- See that the runway has cleared?

Limitations of ACT-R/PM

- Difficulties with recognizing, representing, and targeting empty regions on the task screen
- Unrealistic management of memory for what has not been attended
- Insensitive to visual onsets and offsets
- Unclear relationship between eye movements and attention

Why can't I find an empty hold level fast?

FLT#	TYPE	FUEL	POS.	
342	DC10	5	3 n	Score : 380
148	727	6	3 s	Landing Pts: 400 Penalty Pts: -20
-> 692	747	4	3 e	Runways : DRY
			3 w	Wind : 0 - 20 knots from SOUTH
			2 n	Flts in Queue:
			2 s	<F1> to accept
428	prop	* 3	2 e	
			2 w	
259	727	4	1 n	
			1 s	
840	prop	4	1 e	
190	DC10	5	1 w	
n	=====			s #1
n	=====			s #2
w				e #3
w				e #4

Empty Spaces: An example task

Your task: Find the missing square!



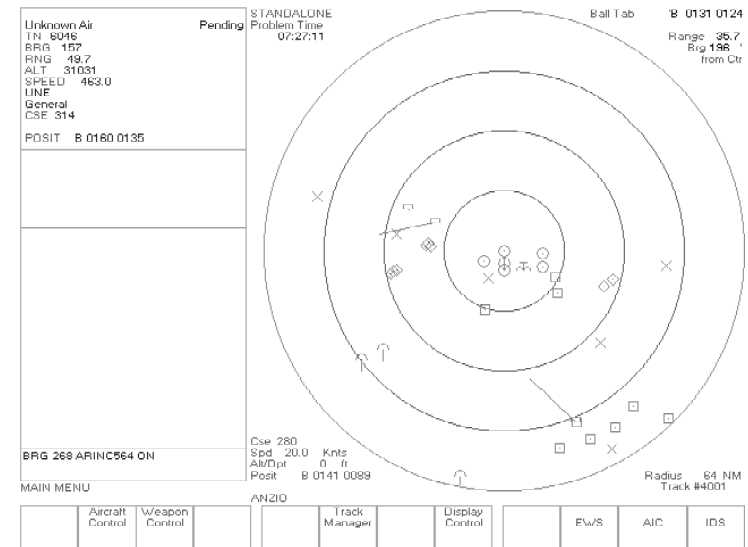
Issues

- How is the empty space recognized and represented?
- How does one target that empty space?

Visual onsets and offsets: A proposal

- Solution:
 - Augment the current T/Nil representation for attended slots to include a third, e.g. New, flag.
 - Onsets would get New flags while offsets would generate empty-space with New flag.
- Issues:
 - How long is something New?
 - Should they decay? If so, what is the decay function?

Eye movements = Attention shifts???



Eye movements versus attention shifts

- The mapping between eye movements and visual attention isn't clean
- Additionally, eye-tracker provides information about saccades and fixations, but ACT-R/PM produces a sequence of attention shifts
- Issue:
 - How should the timing be mapped?

Summary

- Clearly, ACT-R/PM is a significant and even necessary addition to ACT-R architecture
- However, there are still some pragmatic and theoretical issues that we need to address
- For some issues, e.g. empty-space, it seems to address the current problem directly with little overhead
- But with others, e.g. attention markers, it is not clear what is the right solution.
- However, ACT-R/PM is a work in progress, and it is by far superior to anything that currently exists for ACT-R.