Enhancing ACT-R's Perceptual-Motor Abilities

Michael D. Byrne and **John R. Anderson**
Department of Psychology
Carnegie Mellon University
Pittsburgh, PA 15213-3890
byrne+@andrew.cmu.edu

The Problem

ACT-R (Anderson, 1993), while being rich in mechanisms for cognition, has a history of being somewhat weak in the perceptual-motor domain—a situation common in computational models of cognition. The "Visual Interface" was the first serious attempt to remedy the situation for ACT-R and was successful in many ways (Anderson, Matessa, & Douglass 1995). However, the Visual Interface raised many issues as well. One of the most central limitations of the Visual Interface is its serial nature. Perceptual and motor operations did not execute in parallel with cognition, which made it impossible for ACT-R to model a variety of high-performance and dual-task situations, such as PRP experiments (e.g. Kieras & Meyer, 1997). The Visual Interface also had a limited set of perceptual-motor operators and was technically cumbersome, making it difficult to extend.

ACT-R/PM

In order to address these issues and broaden the scope of ACT-R's application, a new architecture for perception and action has been constructed around ACT-R, called ACT-R/PM, which consists of ACT-R's procedural and declarative memories and mechanisms and a new Perceptual-Motor system. The Perceptual-Motor system is conceptualized as a layer between cognition and the external environment. That is, the environment does not directly provide inputs to cognition, nor can cognition directly influence the environment. Communication between cognition and the outside world is mediated by the perceptual-motor capabilities of the system. (See Figure 1.)

The Perceptual-Motor layer is made of several "Managers" which operate in simulated parallel with themselves and each other, which gives ACT-R/PM the ability to overlap cognitive and perceptual/motor processing. The Vision Manager in the current system is much like the visual attention system of Anderson, Matessa, and Douglass (1995) and the Motor Manager is based on the Motor Processor in EPIC (Kieras & Meyer, 1996). Speech and audition capabilities are still being added to the system.

These extended perceptual-motor capabilities, combined with ACT-R's strong theory of cognition, should produce one of the richest and broadest production-system theories to date. For example, research on cognitively demanding dual-task situations using ACT-R/PM is ongoing.

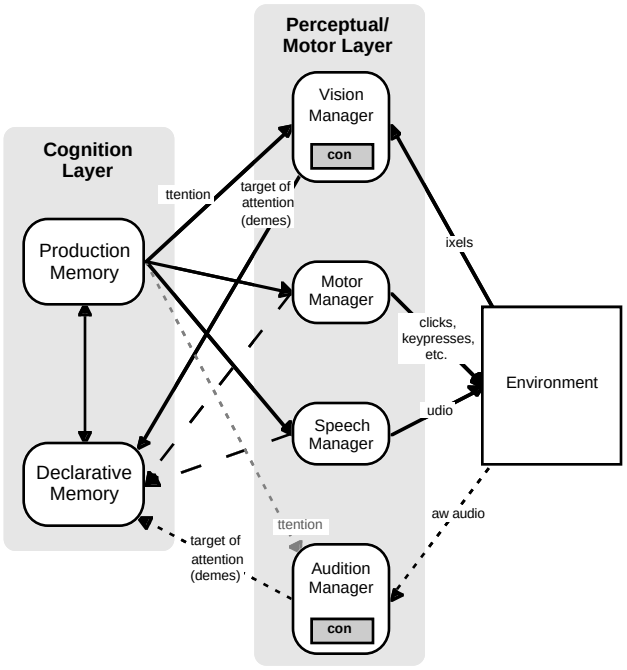

Figure 1. System Diagram

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