



Cognitive Models of Human (Inter-)action

Image adapted from <https://www.flickr.com/photos/falequin/8443342362> by Freddie Alequin & <https://www.flickr.com/photos/pzado/16950126282> by Erik Araújo

Learning Goals

- Model Human Processor
- Multiple Resource Theory

Model Human Processor

- Very simple “model” of a human interacting with a computer
- The model describes the human as three sub-systems
 - Perceptual system (input: from the real world)
 - Motor system (output: manipulate the real world)
 - Cognitive system (connection between input and output, basic processing and memory)

Card, S.K; Moran, T. P; and Newell, A. *The Model Human Processor: An Engineering Model of Human Performance*. In K. R. Boff, L. Kaufman, & J. P. Thomas (Eds.), **Handbook of Perception and Human Performance**. Vol. 2: Cognitive Processes and Performance, 1986, pages 1–35.

Model Human Processor

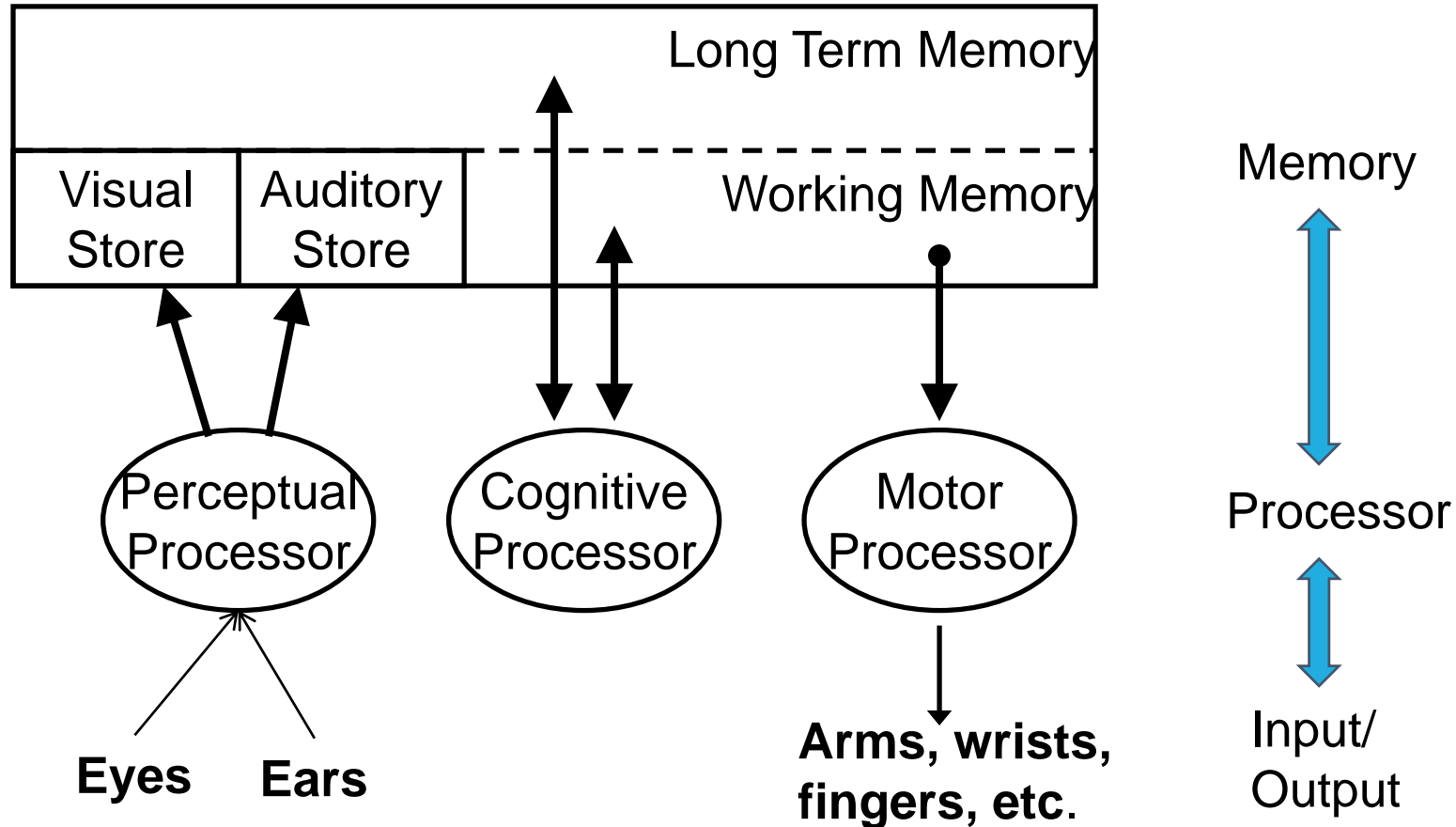


Image from Brian P. Bailey, Computer Science 498bpb, Psychology of HCI
<http://www-faculty.cs.uiuc.edu/~bpbailey/teaching/2004-Fall/cs498/>

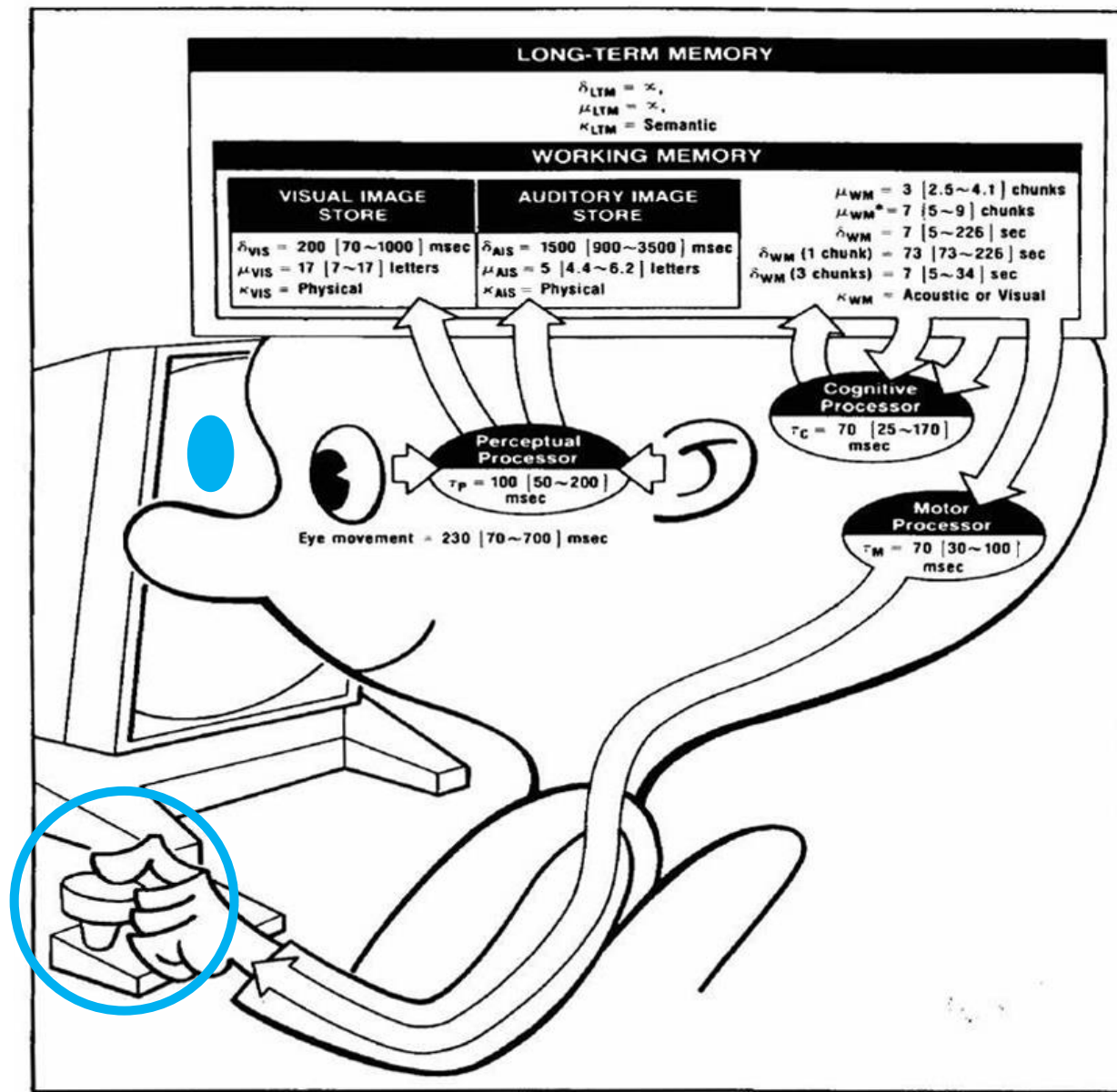


Image http://en.wikipedia.org/wiki/Human_processor_model

Model Human Processor

- Reaction/processing time, example:
 - Perception (stimulus); typical time: $TP \sim 100\text{ms}$
 - Simple decision; typical time: $TC \sim 70\text{ms}$
 - Minimal motion; typical time: $TM \sim 70\text{ms}$
(example for complex motor action see Fitts' law, KLM)
- Overall time for operation where there is a sequential processing
 - pressing a button when a light comes on is about 240ms
 $T = TP + TC + TM$
 - Matching a symbol and then pressing one of two buttons is about 310ms (2TC because there is comparison and decision)
 $T = TP + 2TC + TM$
- Processing can also be parallel
(e.g. phoning while writing, talking while driving, ...)

Limitations of a "single-resource" theory of attention

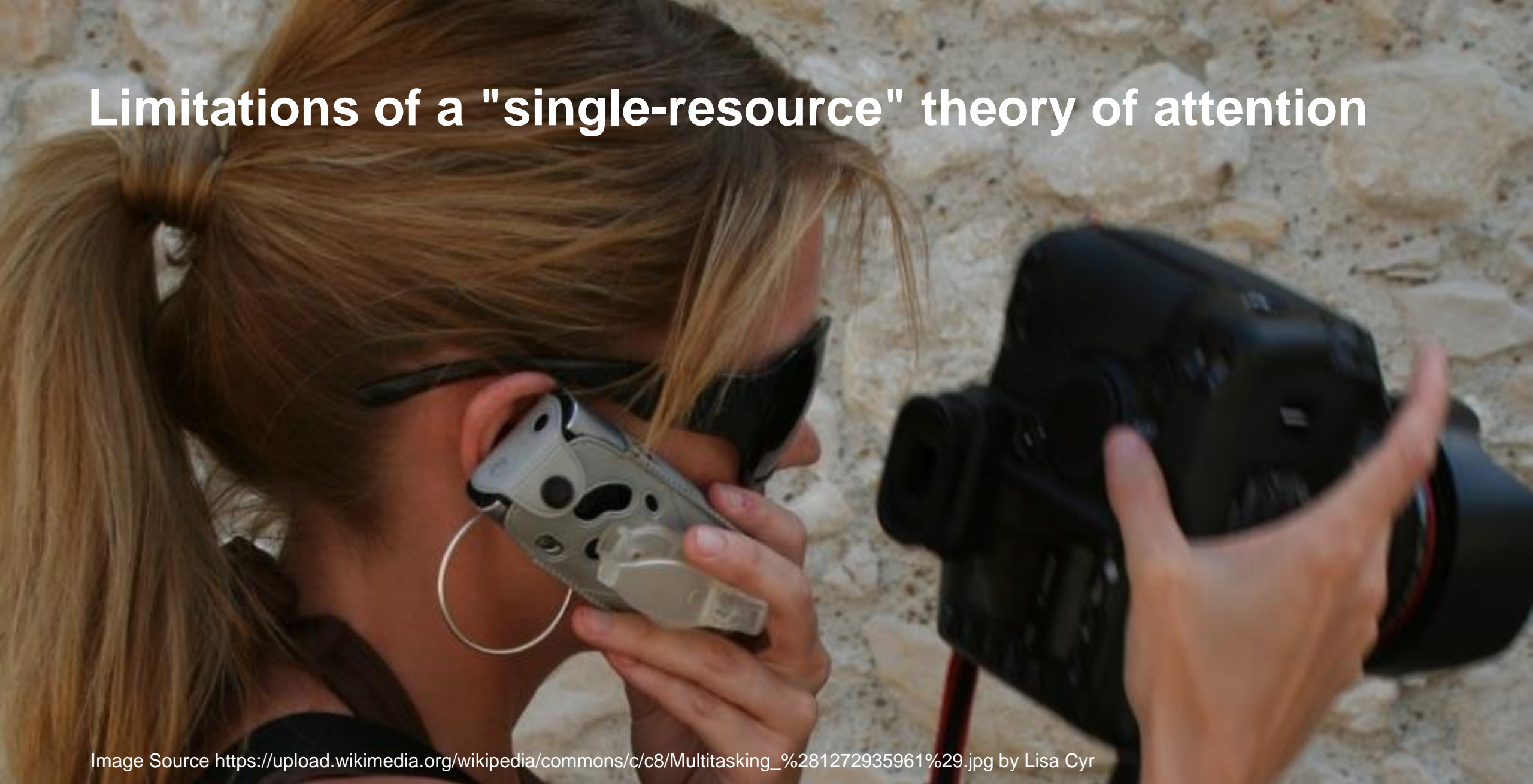


Image Source https://upload.wikimedia.org/wikipedia/commons/c/c8/Multitasking_%281272935961%29.jpg by Lisa Cyr

Multiple Resource Theory

- Instead of one “pool” of resources, there are several different capacities of resources:
 - Modalities: visual or auditory
 - Information type: spatial or verbal
 - Responses: manual, spatial, vocal, verbal
 - Stages of processing: early (perception/cognition) or late (responding)
- Tasks using same resources interfere each other
- Tasks using different resources can be done “simultaneously”

Wickens, C. D.: Multiple resources and performance prediction. Theoretical Issues in Ergonomics Science. S.159–177, 2002.

Multiple Resource Theory

- Conversation (**ears**-cognition-mouth) and using the navigation assistant (**ears**-hand) interfere

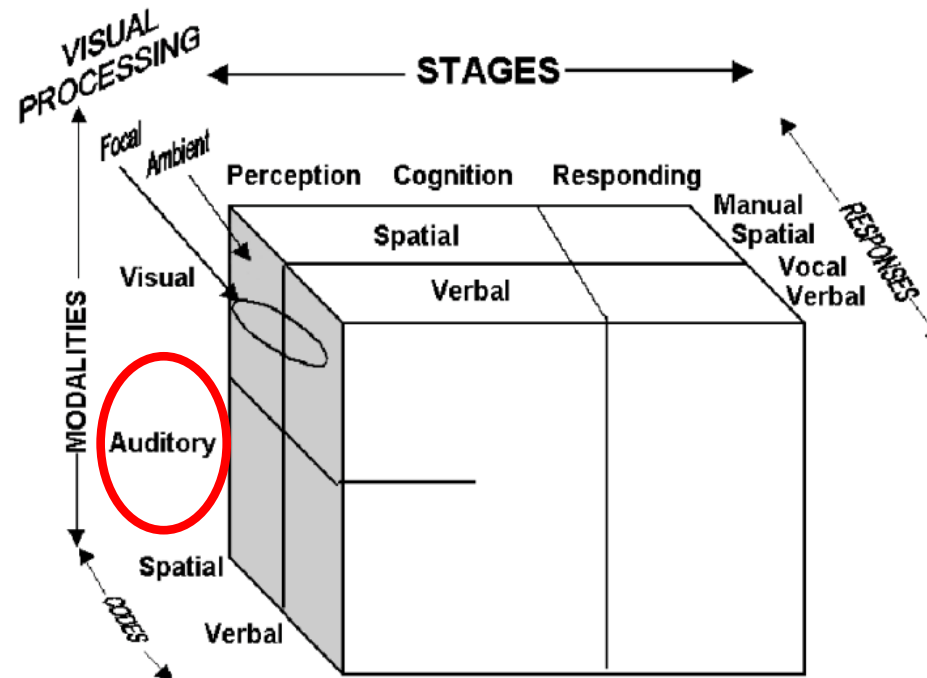


Image: Wickens, C. D.: Multiple resources and performance prediction. Theoretical Issues in Ergonomics Science. S.159–177, 2002. & <https://www.piqsels.com/en/public-domain-photo-jjmiz>

Multiple Resource Theory

- Deep conversation (ears-**cognition**-mouth) and complex driving maneuver, e.g. lane changes (eyes-**cognition**-hand) interfere

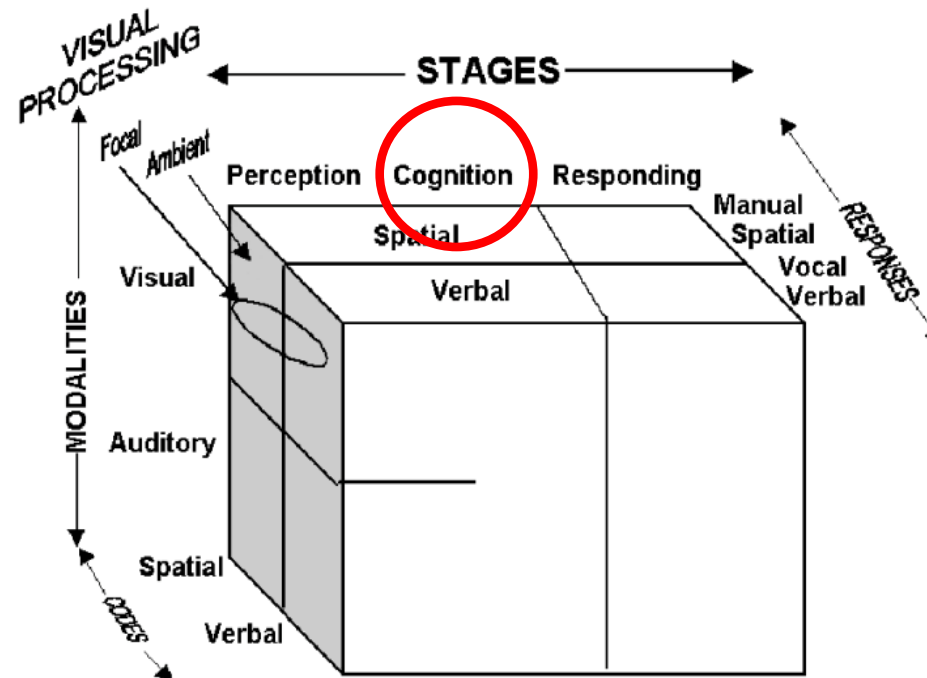


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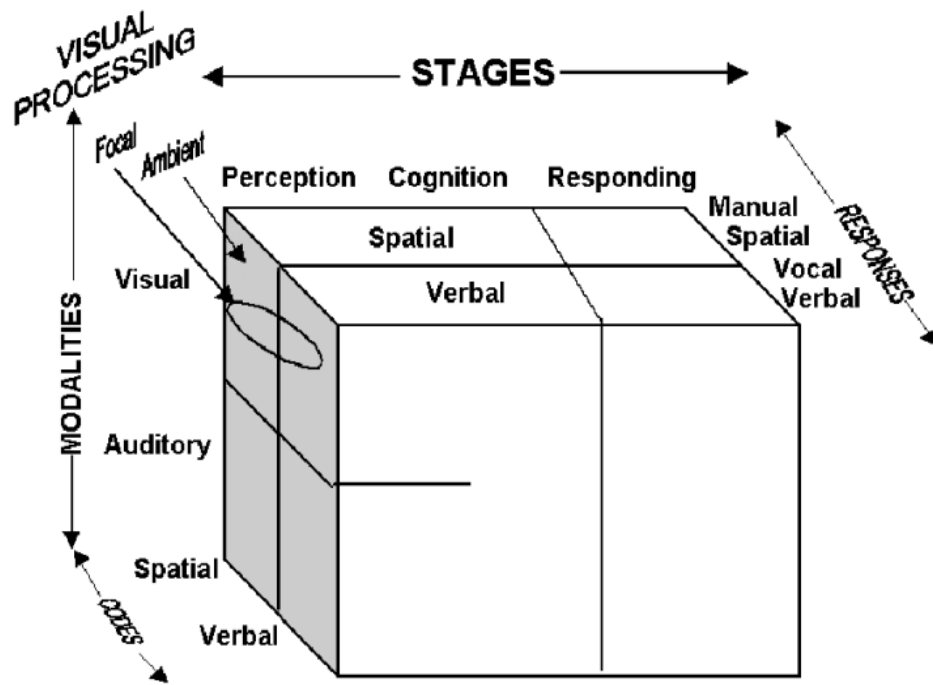
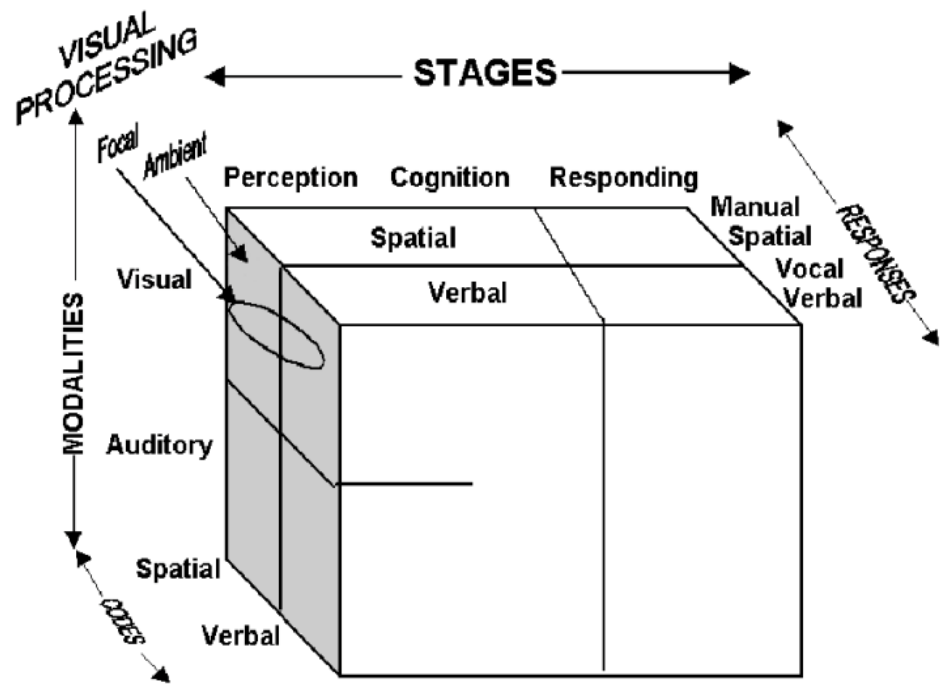




Image: Wickens, C. D.: Multiple resources and performance prediction. Theoretical Issues in Ergonomics Science. S.159–177, 2002. & <https://pxhere.com/en/photo/796351>



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