

Interplay of Declarative and Procedural Memory Systems: Role of Cardiovascular Exercise in Consolidation

Jing Chen, Division of Health Professions, Texas A&M University-Texarkana, Texarkana, Texas, 75503, USA

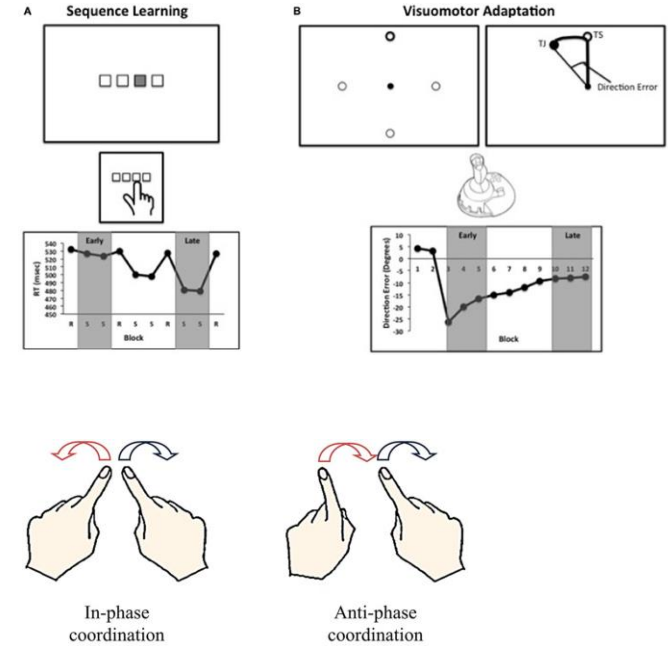
Yiming Chen, College of Natural Sciences, University of Texas, Austin, Texas, Austin, Texas, 78712, USA

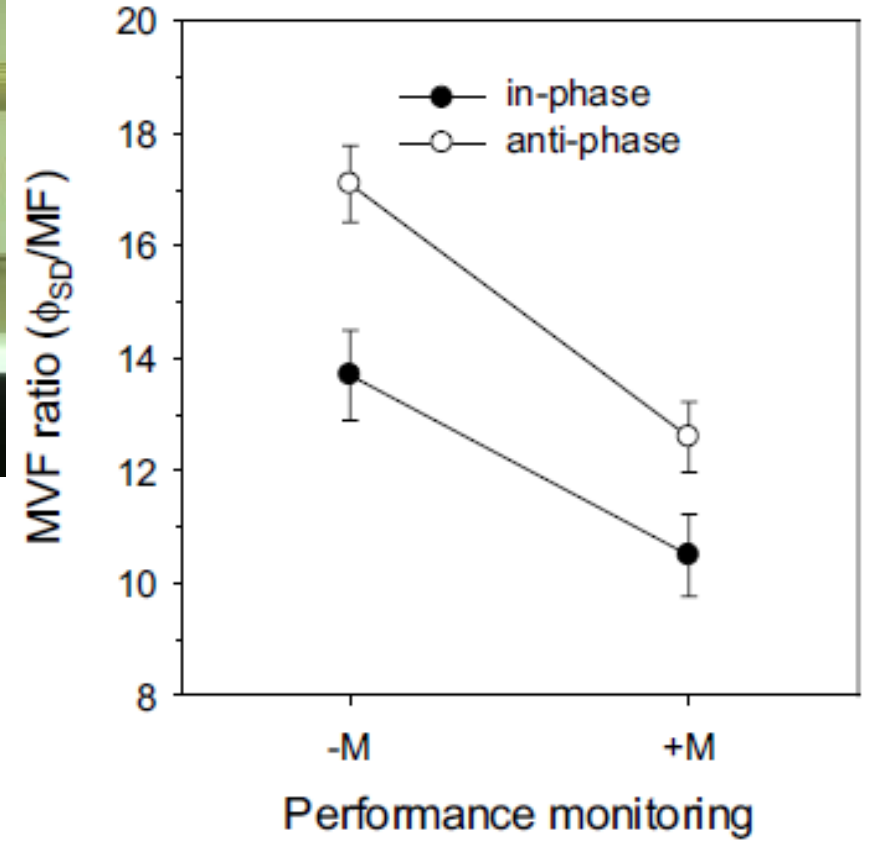
David L. Wright, Department of Kinesiology & Sport Management, Texas A&M University, College Station, Texas, 77843, USA

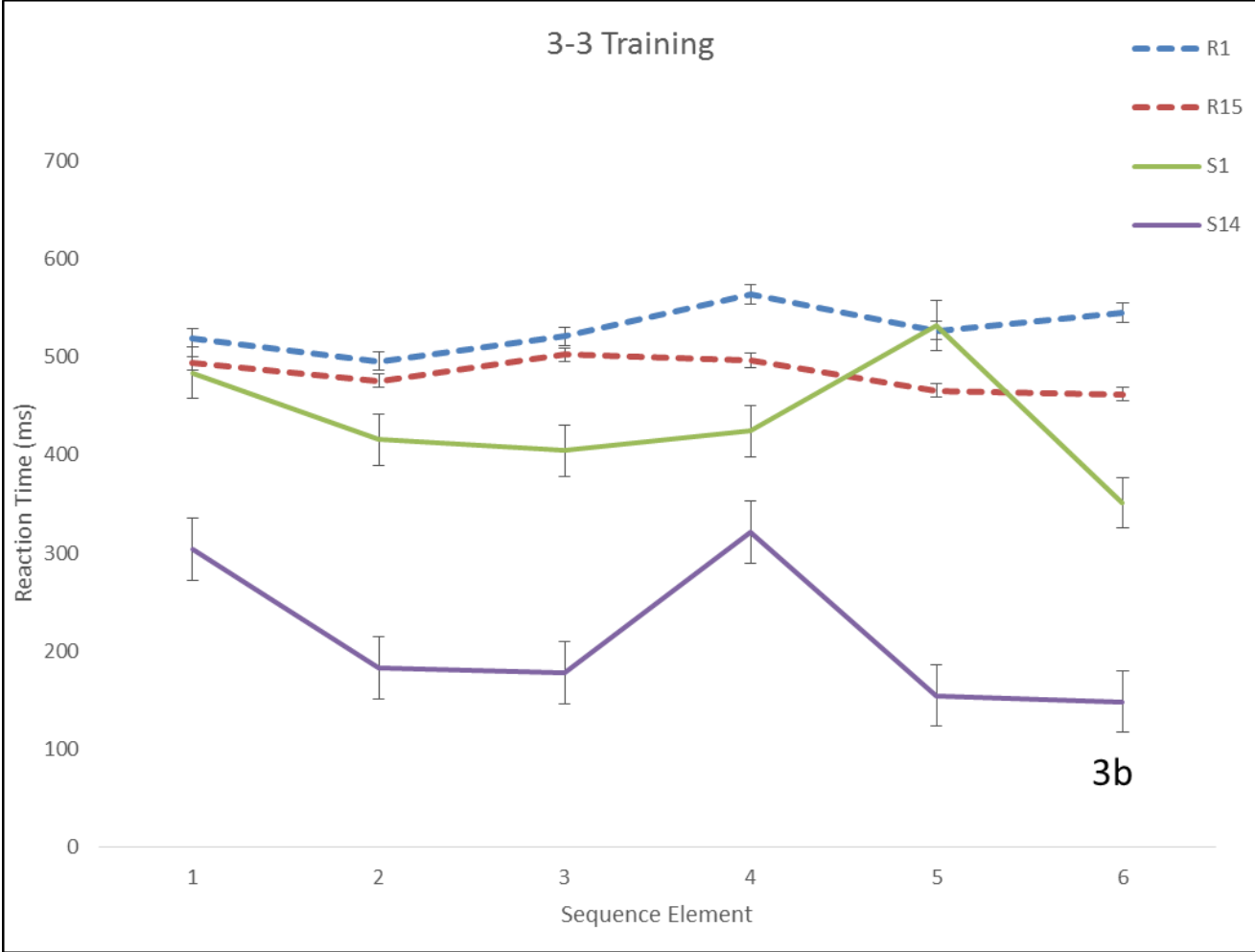
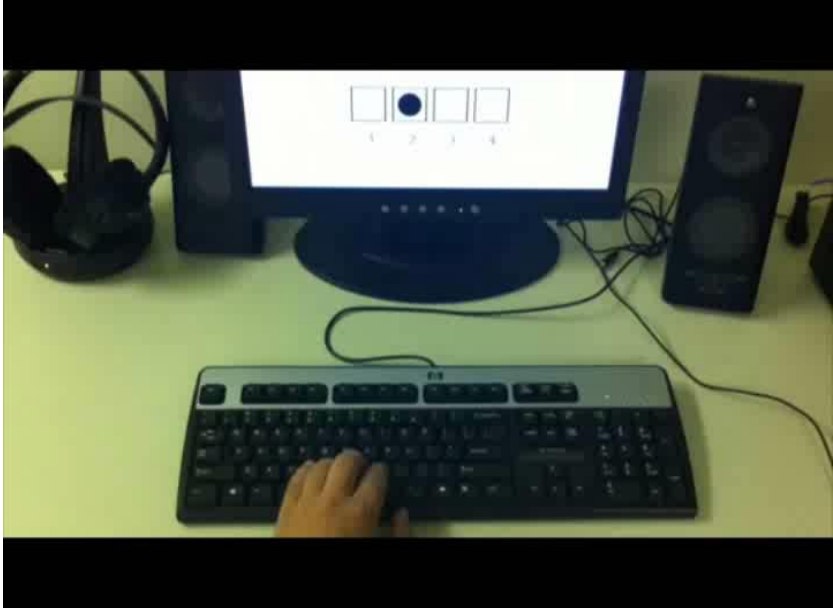


Procedural Learning?

- Motor Adaptation
- **Sequence Learning**
- Bimanual Coordination







Taken from Chen et al., 2015

Taken from Wright et al., 2015

Online and Offline Environments

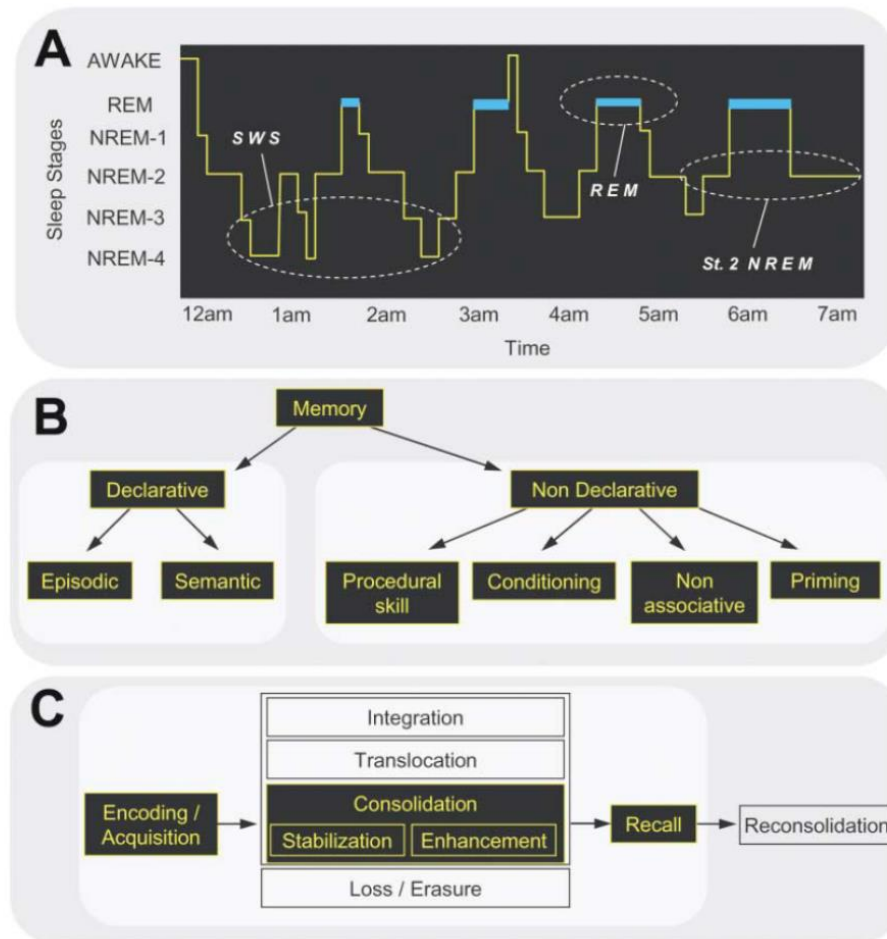


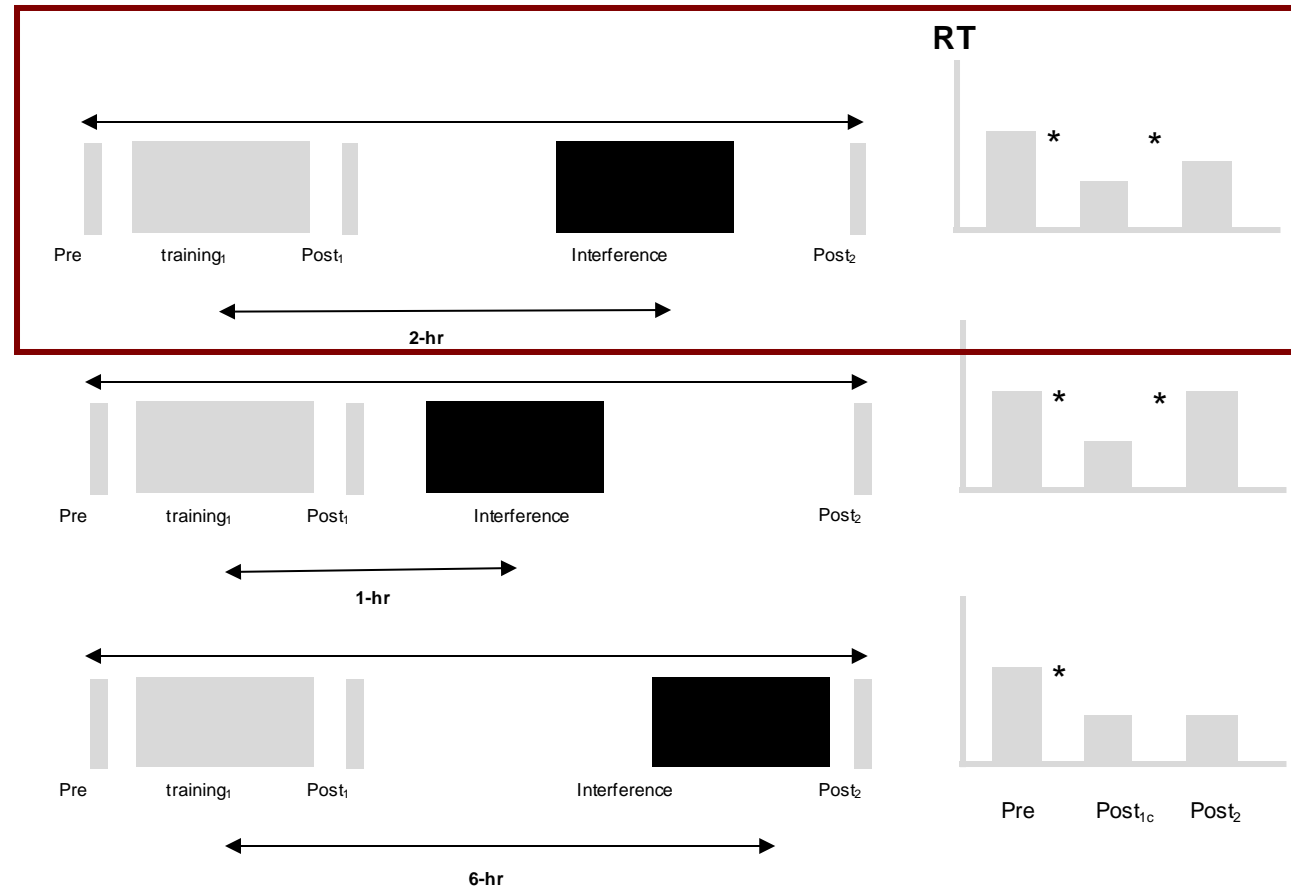
Figure 1. The Sleep Cycle, Memory Systems, and Memory Stages

(A) The human sleep cycle—across the night, NREM and REM sleep cycle every 90 min in an ultradian manner, while the ratio of NREM to REM sleep shifts. During the first half of the night, stages 3 and 4 NREM (SWS) dominate, while stage 2 NREM and REM sleep prevail in the latter half of the night. EEG patterns also differ significantly between sleep stages, with electrical oscillations such as K complexes and sleep spindles occurring during stage 2 NREM, slow (0.5–4Hz) delta waves developing in SWS, and theta waves seen during REM.

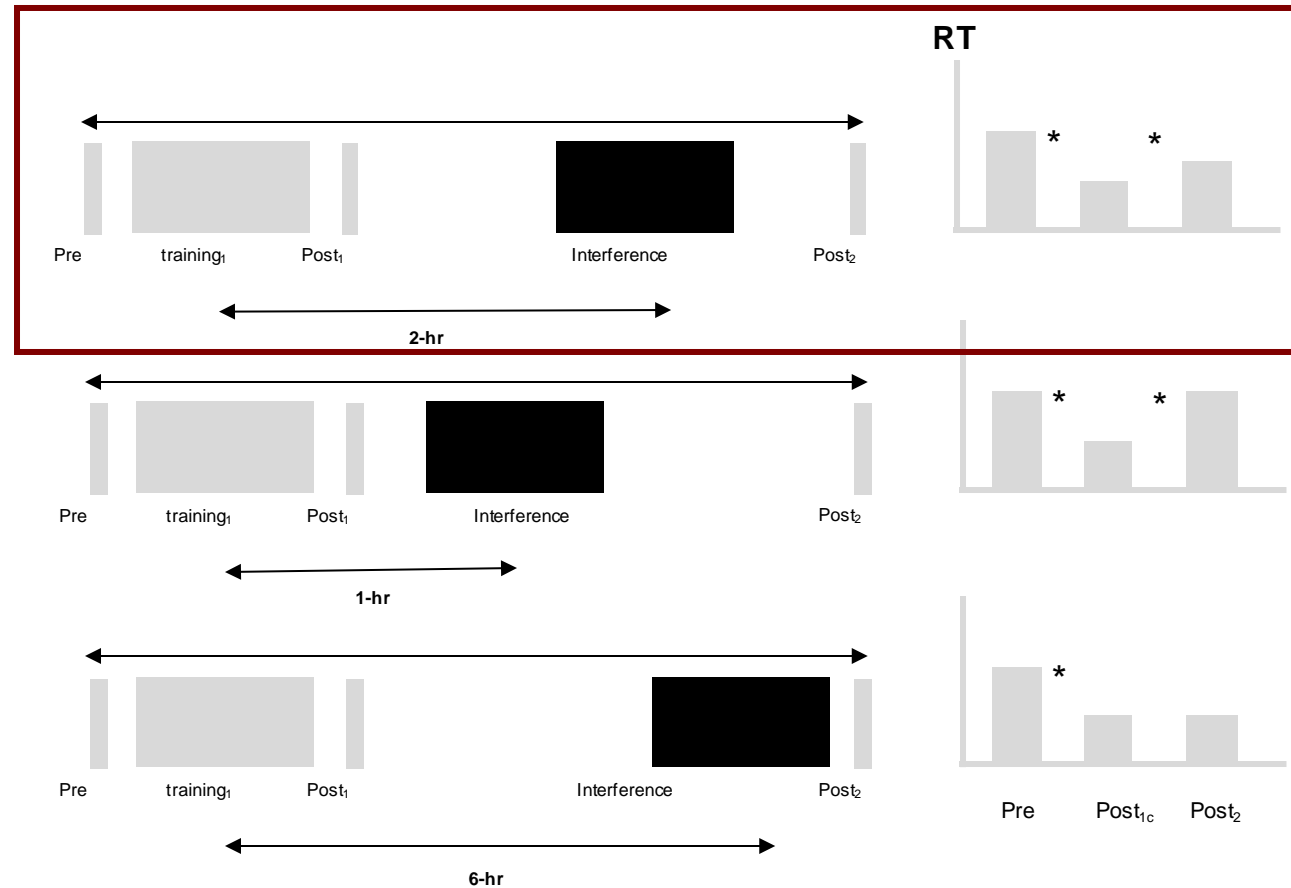
(B) Memory systems—human memory is most commonly divided into declarative forms, with further subdivisions into episodic and semantic; and nondeclarative forms, subdivided into an array of different types including procedural skill memory

(C) Developing stages of memory—following the initial encoding of a memory, several ensuing stages are proposed, beginning with consolidation, as well as integration of the memory representation, translocation of the representation, or erasure of the memory. Also, following later recall, the memory representation is believed to become unstable once again, requiring periods of reconsolidation.

Retroactive Interference and Consolidation



Retroactive Interference and Consolidation



Many factors have influence on offline learning

- Non-Invasive Brain Stimulation (NIBS)
 - **Transcranial Direct Current Stimulation** (tDCS)
 - Transcranial Magnetic Stimulation (TMS)
- **Exercise**
- **Sleep**

Acute Exercise and Consolidation

