

Diagnosing Short-Term Memory Scanning Using Systems Factorial Technology: A Conceptual Replication

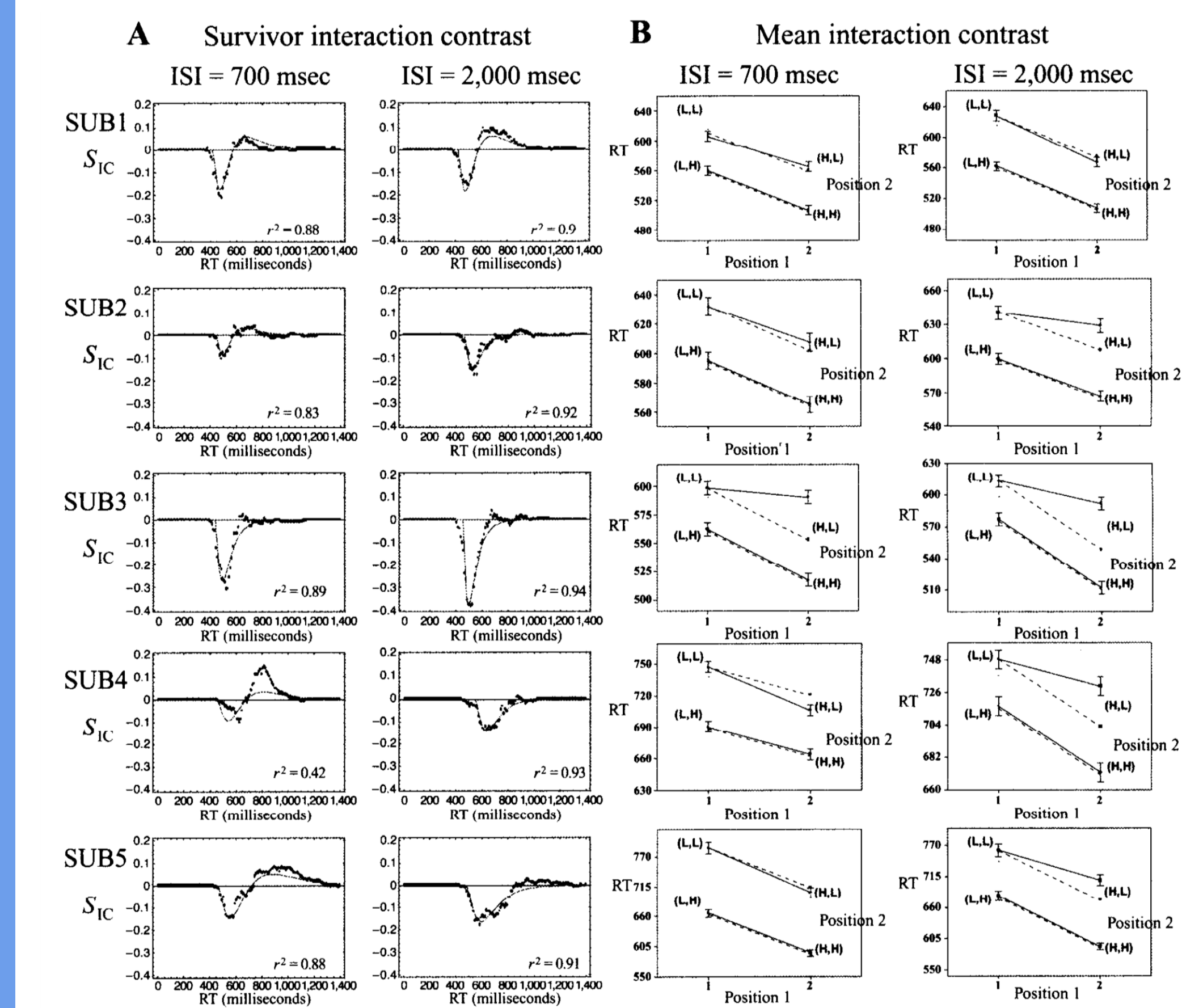
Monica Van Til, Tylor Kistler, and Mario Fifić

Overview

Townsend and Fifić (2004) published an influential short-term memory (STM) study in which they observed individual differences in serial and parallel STM scanning. The authors employed the systems factorial technology SFT – a novel methodology which provides strong diagnostic tests of cognitive architectures. Three variables were manipulated in this experiment: number of processing elements ($N=2$), phonemic dissimilarity of a target to the particular memorized item (high, low) and duration between the memorized set and a target (short, long). In the original study, 10 subjects participated in about 20 sessions each. In the current research, we conducted a conceptual replication of the original study: 261 subjects participated in 1 session each. The results added converging evidence in testing serial/parallel processing in short-term memory scanning.

Past Research

- Townsend and Fifić (2004) utilized Systems Factorial Technology (SFT) to determine the following:
 - Processing order (serial vs. parallel)
 - Stopping Rule (exhaustive vs. self-terminating)
 - Capacity
 - Process Dependency
- They demonstrated striking differences between individuals and across different interstimulus intervals (700ms. vs. 2000ms.)



Fifić, M., Little, D. R., & Nosofsky, R. M. (2010).

Conceptual Replication

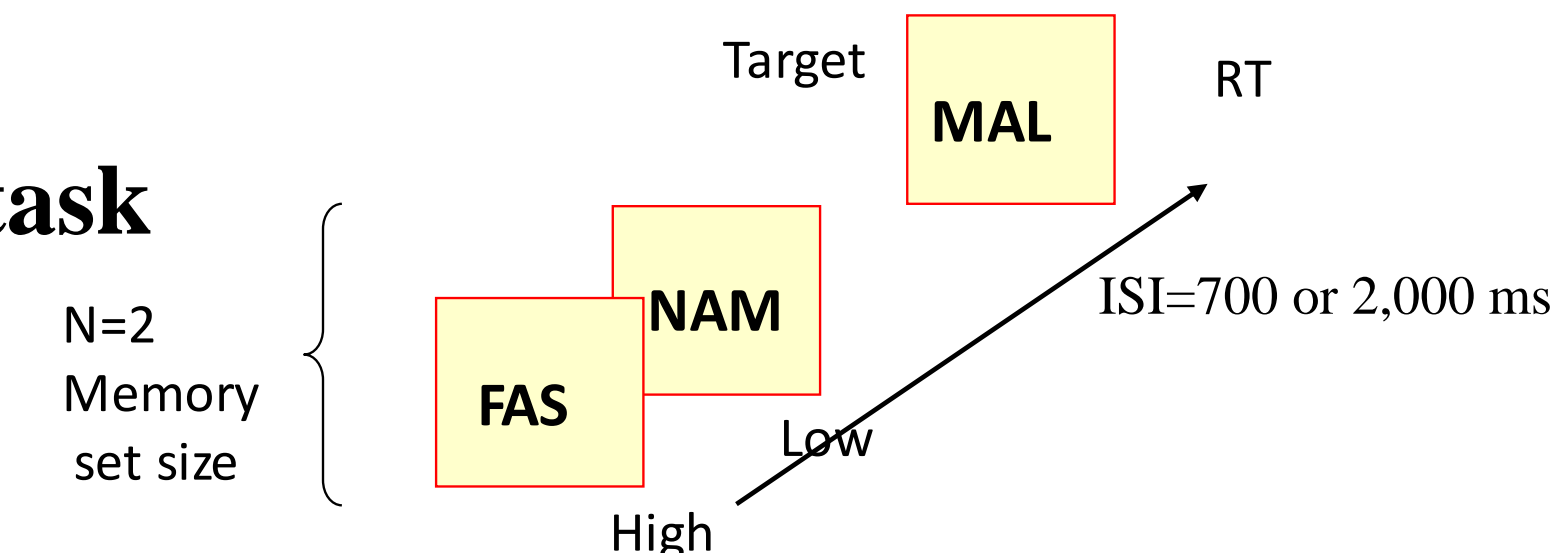
Main motivations:

- Replicated the original study with U.S. population.
- Reduced the number of trials to only one session per participant.
- Extended the original SFT design to include more diagnostic conditions.
- Added a novel phonemic category to introduce more stimulus variability.
- Assess the capacity measures *
- Hierarchical Bayesian modelling on the SFT*

Methods

- Sample: $N=261$ undergraduate GVSU students
- Phonemes used:
 - Fricatives:** FAS, SAF, SAV, VAS, FAV, VAF
 - Nasals:** MAL, LAM, NAL, LAN, MAN, NAM
 - Plosives:** PAK, KAP, KAD, DAK, PAD, DAP

STM task



- We used a computerized task to administer trials where two items were presented (three-letter pseudo words), then an interstimulus interval of either 700 or 2,000 milliseconds, followed by a target item. Participants had to decide whether the target item was presented in the original set or not.
- Factors include item-to-target dissimilarity of the two items: high dissimilarity of items was expected to be associated with slower reaction times.

SFT tools

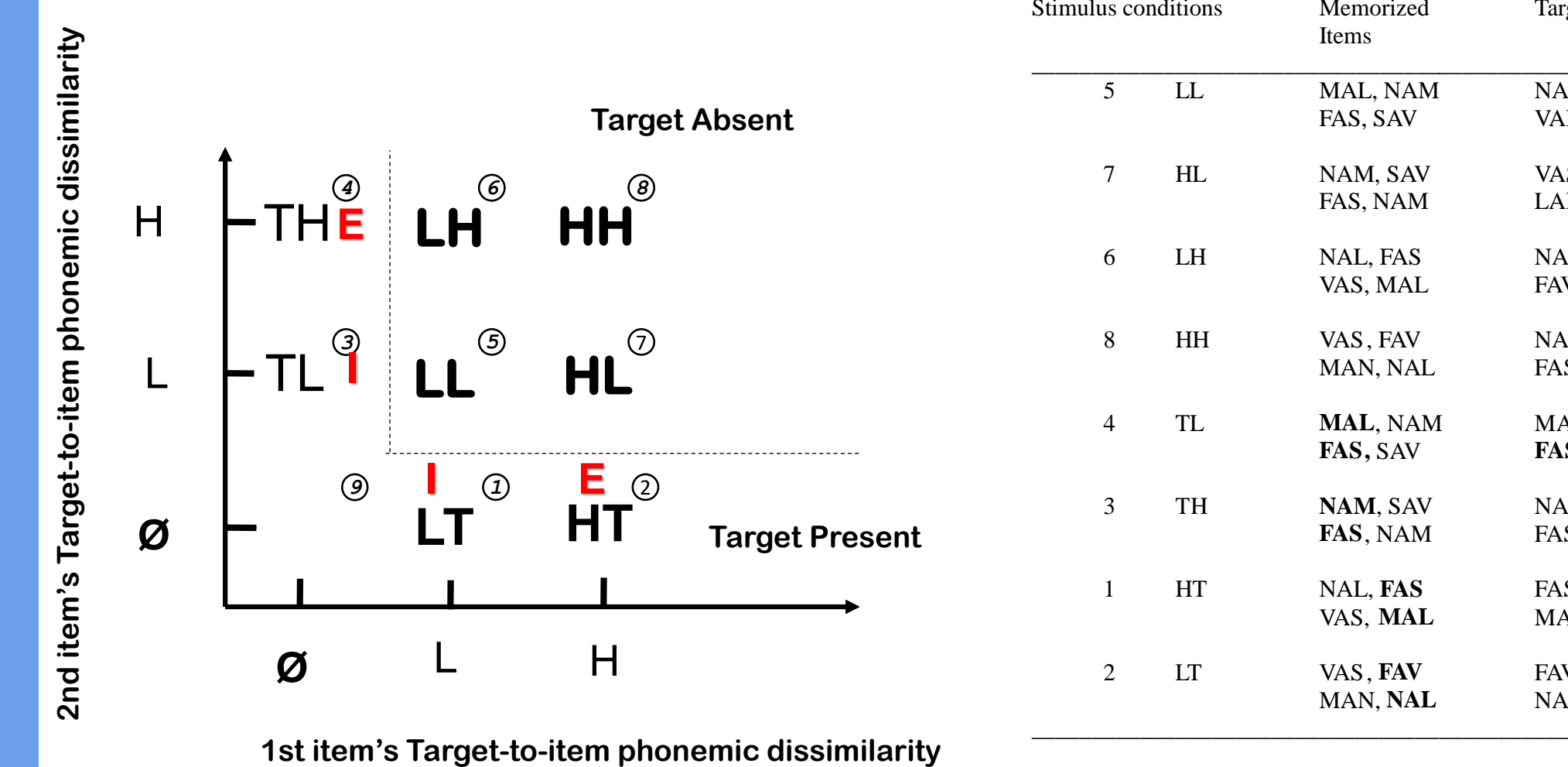
THE MEAN INTERACTION CONTRAST

$$M_{IC} = RT_{ll} - RT_{lh} - RT_{hl} + RT_{hh}$$

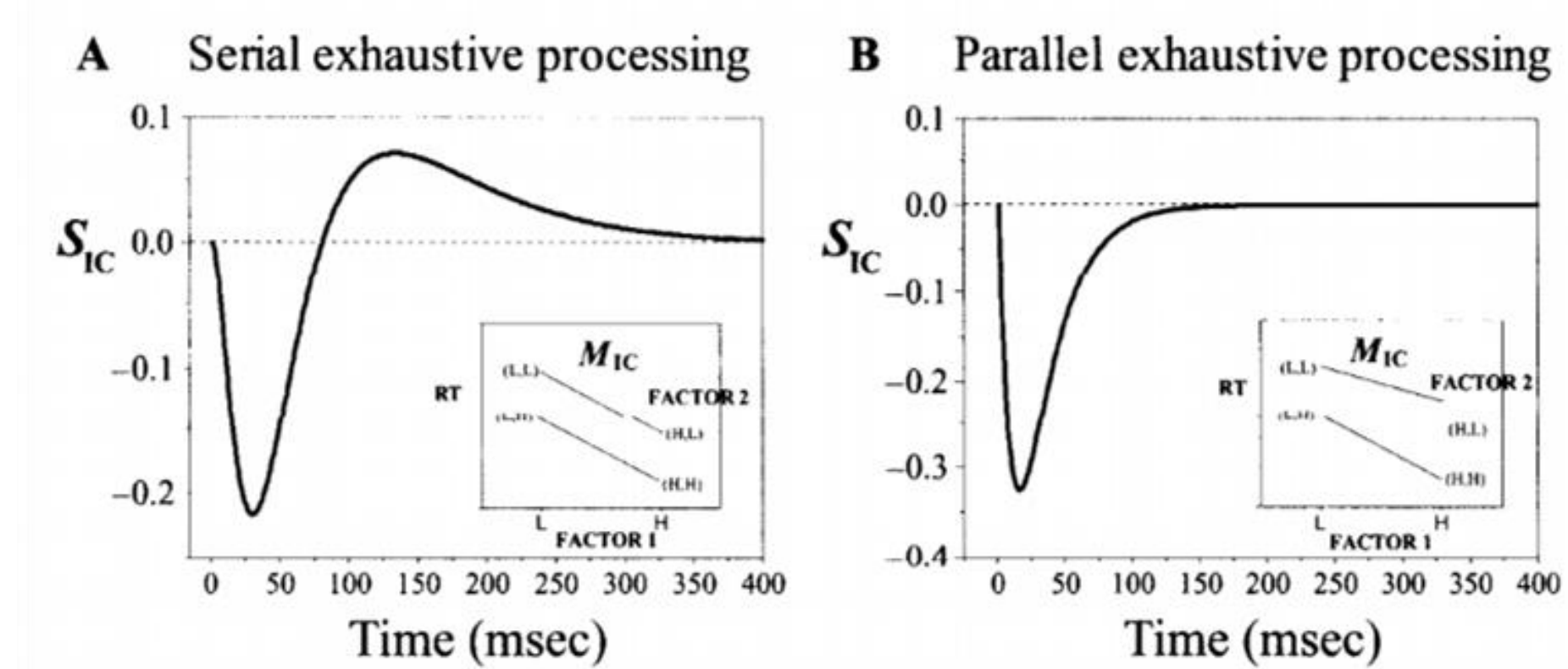
THE SURVIVOR INTERACTION CONTRAST FUNCTION

$$S_{IC}(t) = S_{ll}(t) - S_{lh}(t) - (S_{hl}(t) - S_{hh}(t)).$$

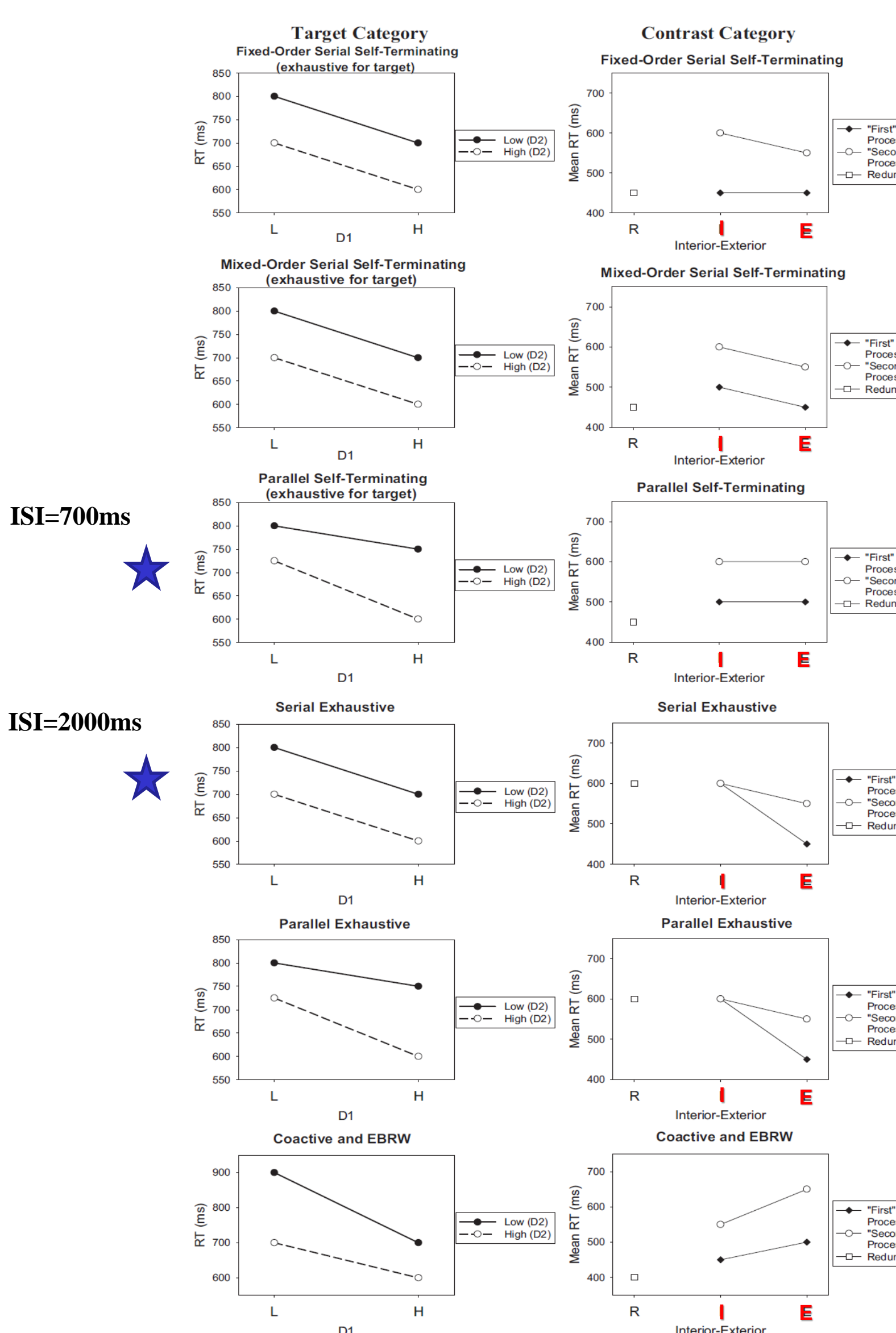
Integrative Space and SFT Predictions



SFT models predictions

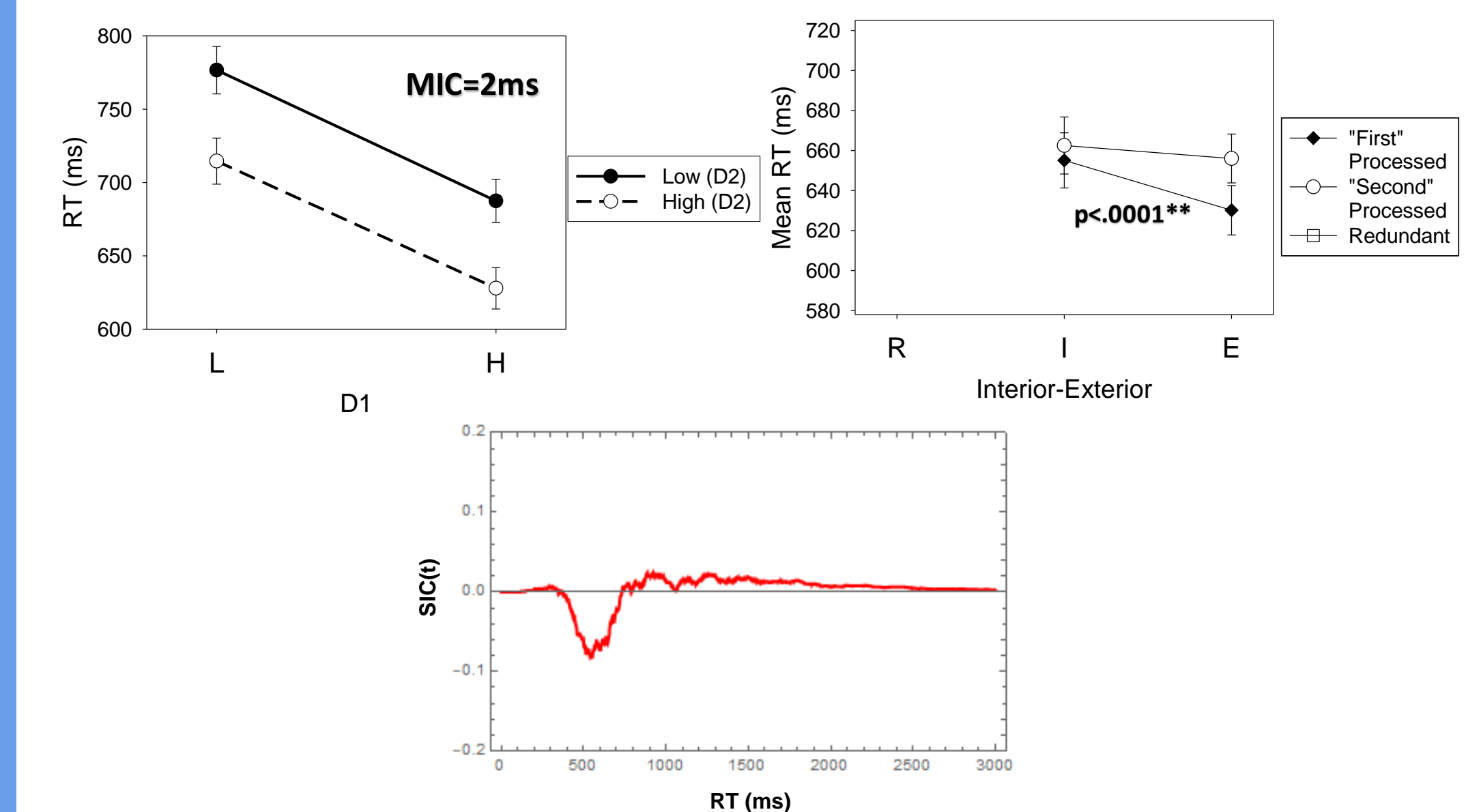


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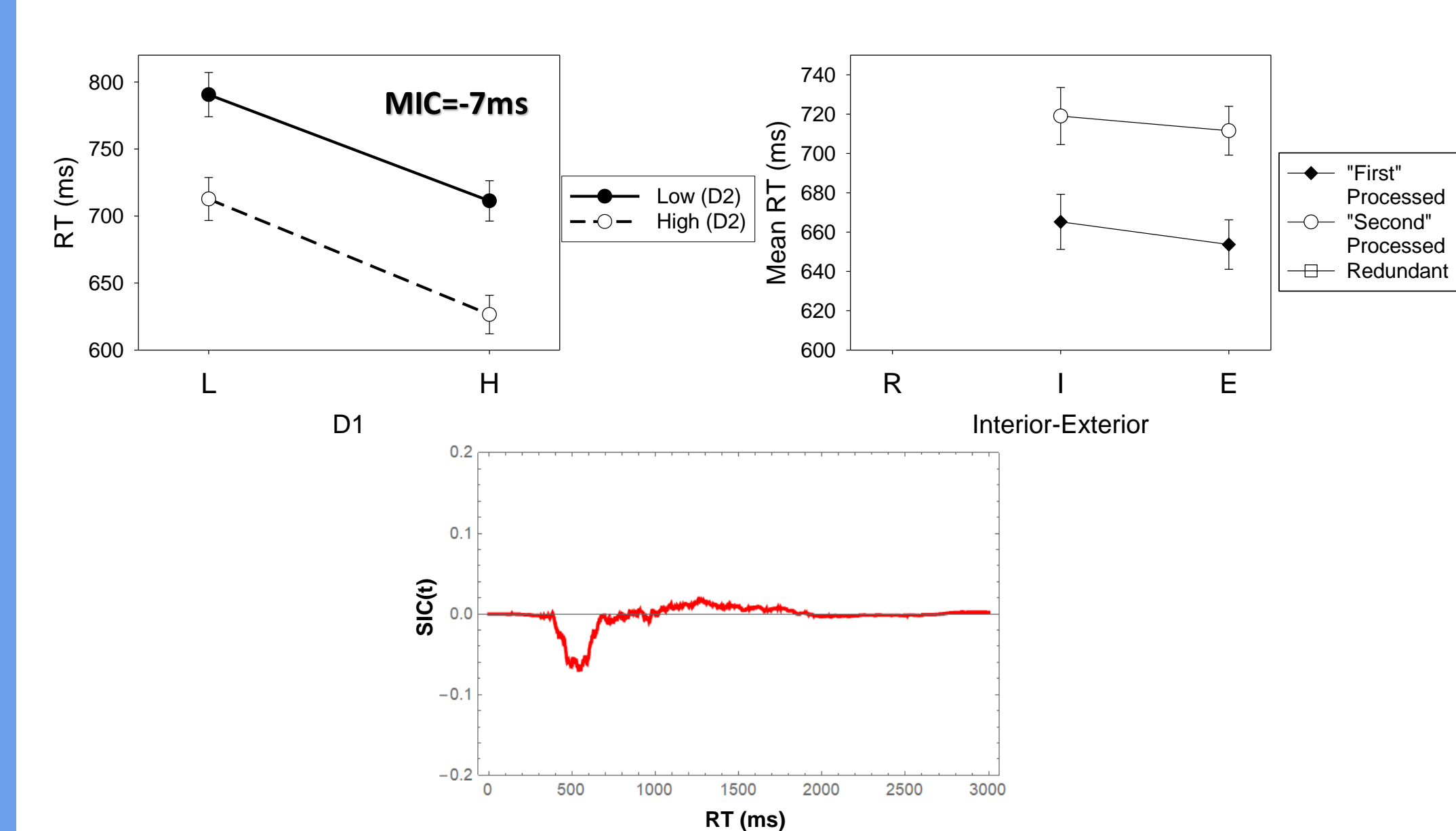


Results

ISI=700ms



ISI=2000ms



Discussion

- On average, the subjects showed evidence for Serial Exhaustive and Parallel Terminating/Exhaustive processing in the short and long ISI conditions, respectively.
- The results on average replicates the original 2004 study.
- The phonemic properties of pseudowords led to similar effects across Serbian and US populations.
- A single session per participant provided sufficient data for the analysis of STM retrieval.
- Possible issue: data were averaged across subjects.
- Next steps: Hierarchical Bayesian approach (Haupt & Fifić, 2017) and calculation of SFT capacity functions.

Contact

Email: fifcm@gvsu.edu
Research: <http://faculty.gvsu.edu/fifcm/index.html>