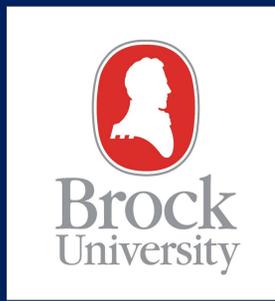


# CARDIAC AUTONOMIC REGULATION AND COGNITIVE CONTROL IN OLDER AND YOUNGER ADULTS

Lesley J. Capuana, Jane Dywan, Raechelle M. Gibson, Sidney J. Segalowitz  
Department of Psychology, Brock University, St. Catharines, Ontario, Canada



## BACKGROUND

- Respiratory sinus arrhythmia (RSA) is an index of cardiac autonomic control and should be advantageous for cognitive control performance.<sup>1</sup>
- Older adults demonstrate declines in both cognitive and cardiac autonomic control, but little is known about the link between them.
- Data has shown that RSA does not relate to cognitive control for all tasks<sup>2</sup> and can be opposite of the direction expected.<sup>3</sup>
- We proposed that relations between RSA and cognitive control would be more evident when the task depended on the more metabolically-costly *proactive* rather than *reactive* cognitive control strategies.<sup>4</sup>

## PRESENT STUDY

We recorded pre-task RSA in older and younger adults and examined its relationship with accuracy on a Stroop paradigm that involved responding to lures designed to elicit either a “proactive” or “reactive” response strategy.

- Basic Task:** “accept” congruents; “reject” incongruent lures (e.g. **red/RED**)
- Memory Task:** “accept” congruents; “reject” incongruent lures and memory contingency lures, i.e., a predefined congruent item (e.g. **green/GREEN**)
- Super Memory Task:** “accept” congruents; “reject” incongruent lures and super memory contingency lures, i.e., a predefined congruent of a particular case-size (e.g. **GREEN** but not **green**)

### Incongruent Lures

- Cannot anticipate by maintaining cue
- Should elicit a **reactive strategy** based on *late correction*

### Memory & Super Memory Contingency Lures

- Can anticipate by maintaining cue
- Should elicit a **proactive strategy** based on *early selection*

### Specific Hypotheses:

- Proactive control will lead to faster and more accurate responses for memory and super memory contingency lures.
- Higher pre-task RSA will relate to better performance on proactive control trials (i.e., memory & super memory contingency lures), especially among older adults

## METHODS

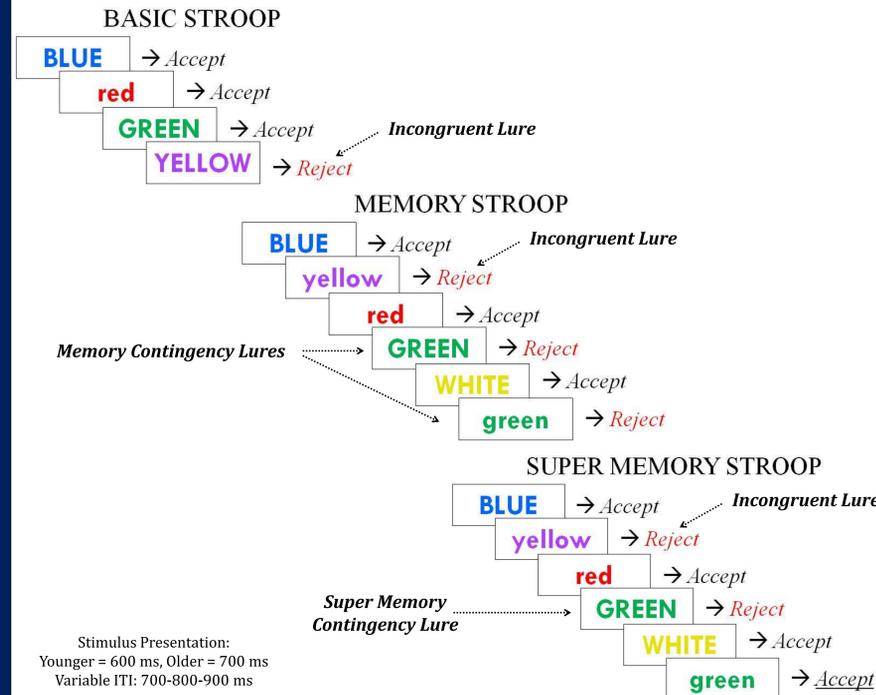
### Participants

- 23 younger adults (18 women,  $M = 20.0$  years)
- 22 older adults (17 women,  $M = 68.8$  years)

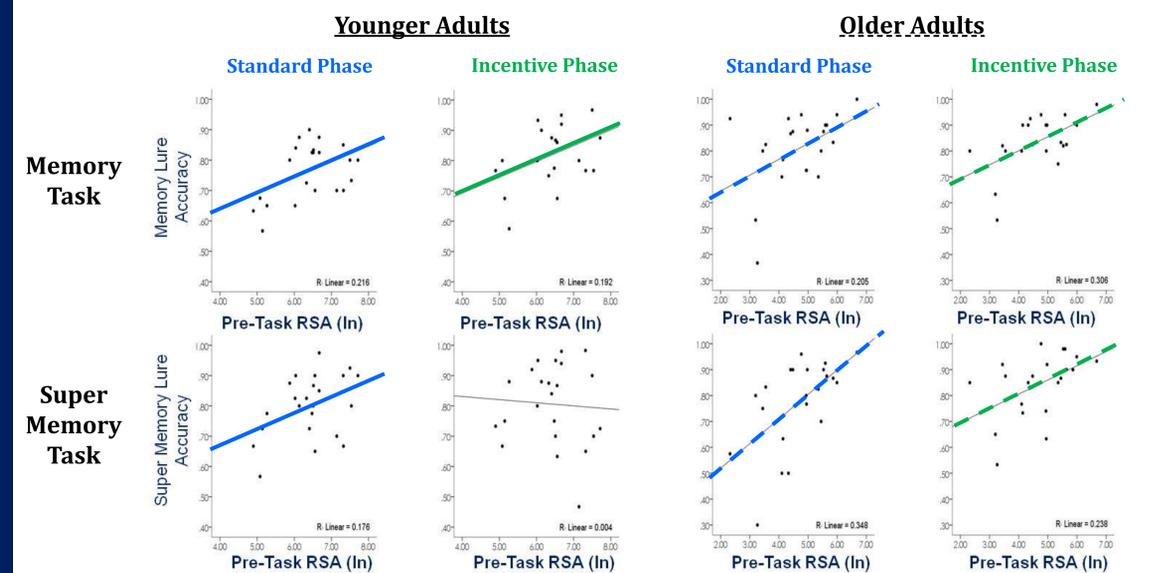
### Procedure

- Participants completed the 3 Stroop tasks (Basic, Memory, Super Memory)
- Each version was completed twice
  - Standard Phase
  - Incentive Phase
    - Received 30 points for correct responses
    - Lost 120 points for errors and lost points for responding too slowly
    - Points converted to money (\$5 - \$15) on completion of task
- Participants completed Stroop tasks in identical order (Basic, Memory, Super Memory), with incentive phase always following standard phase.

## TASKS



## CORRELATIONS

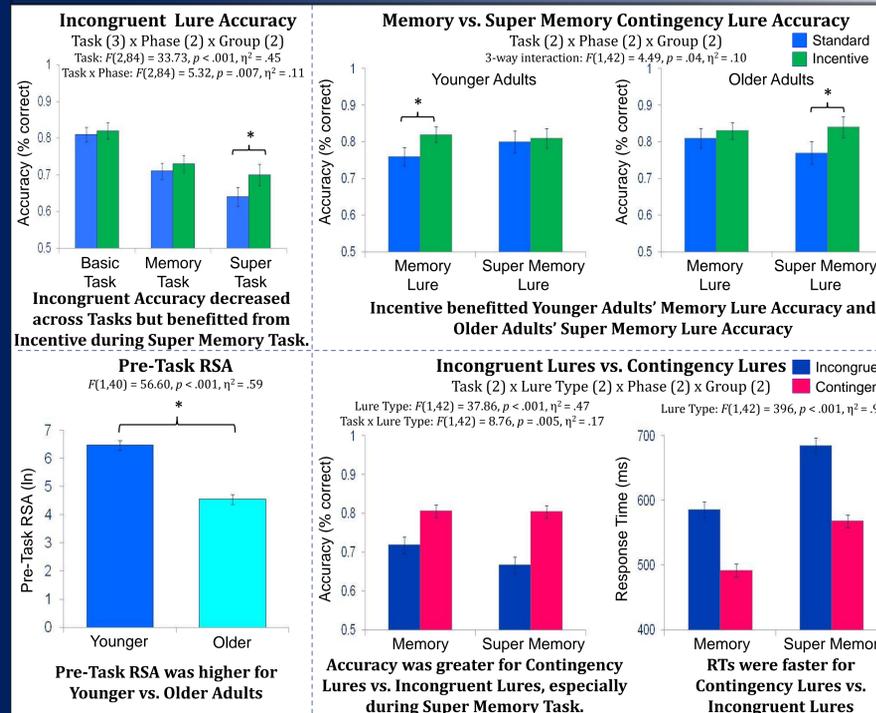


**Younger Adults:** Higher Pre-Task RSA was associated with better accuracy for Memory Lures during both Standard and Incentive Phases and Super Memory Lures during the Standard Phase.

**Older Adults:** Higher Pre-Task RSA was associated with better accuracy for Memory Lures during both Standard and Incentive Phases and Super Memory Lures during both Standard and Incentive Phases.

Pre-Task RSA did not relate to Incongruent Accuracy for either group during any of the task-phase combinations (all  $ps > .08$ ).

## RESULTS



## CONCLUSIONS

- Lures that could benefit from the use of a *proactive strategy* (i.e., memory & super memory contingency lures) elicited faster and more accurate responses than those more dependent on a *reactive strategy* (i.e., incongruent lures).
- Higher levels of pre-task RSA were most strongly and consistently associated with responses involving proactive control (i.e., memory & super-memory contingency lures), especially for older adults.
- These findings support a model of neurovisceral integration that links cardiac autonomic control and cognitive performance.<sup>1</sup>
- They also indicate that cardiac autonomic control is most relevant when performance relies on the use of proactive control, i.e., a cognitive control strategy that involves the sustained, active maintenance of goal representations over time and, as a result, represents a more resource-demanding and metabolically-costly operation.<sup>5</sup>

## References

- Thayer et al. (2009). *Annals of Behavioral Medicine*, 37, 141-153.
- Mathewson et al. (2011). *Biological Psychology*, 88, 20-27.
- Capuana et al. (2012). *Biological Psychology*, 90, 60-70.
- Braver et al. (2009). *PNAS*, 106, 7351-7356.
- Czernochowski et al. (2010). *Psychophysiology*, 4, 637-646.

### Acknowledgements

Thanks to James Desjardins and Allison Flynn for their invaluable assistance.