

Does a single bout of Rock Steady Boxing improve procedural memory?

Karthik B. Kamath, OMS-II, Vyshnavi P. Kodali, OMS-II, Courteney E. Olenyk, OMS-II, Christina M. Roselli, OMS-II, Atif Ghaffar, OMS-III, Rosemary Gallagher, DPT PhD, Adena N. Leder, DO FAAN



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Research Question/Hypothesis

Procedural memory, a type of implicit learning, involves the acquisition of sequence-specific knowledge and is important for daily function, for example, driving a car or riding a bike (Jackson *et al.*, 1995). It can be tested using the Serial Reaction Time Task (SRTT) (Robertson, 2007). Rock Steady Boxing (RSB) is a program specifically designed to address motor and non-motor symptoms of people with Parkinson's disease (PD). It engages short and long-term memory, sequencing, and recall of punch combinations and therefore may impact procedural learning. However, the effect of RSB on procedural learning has not been investigated. This study examined the effect of an acute bout of RSB compared to no exercise on procedural learning using the SRTT. We hypothesized that procedural learning would be improved after RSB.

Significance

- Nearly 1 million people in the United States will be diagnosed with PD by the year 2020 (Marras *et al.*, 2018).
 - Both motor and non-motor symptoms are common, including deficits in cognition and memory (Jankovic, 2008).
- Procedural memory, a form of implicit learning, is presumed to involve the basal ganglia (Packard & Knowlton, 2002) and therefore is particularly affected in people with PD due to the degeneration of dopaminergic neurons.
 - While acute high-intensity aerobic exercise shows a positive effect on procedural learning in people with PD (Roig *et al.*, 2012), current literature does not address whether these effects extend to Rock Steady Boxing (RSB), a popular form of exercise for people with PD.
- Osteopathic philosophy states that each person is a unit of body, mind, and spirit.
- Rock Steady Boxing addresses these domains by incorporating exercise (body), engagement of cognitive processes (mind), and social interaction (spirit). This study focused on potential improvements in memory (mind) with RSB as a means to improve the lives of people with PD.



Rock Steady Boxing
Video (Please click to
play)



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Subject Criteria

Inclusion Criteria: diagnosis of PD, ages 40-85, stage I-IV (Hoehn and Yahr scale) (Hoehn & Yahr, 1967)

Exclusion Criteria: Montreal Cognitive Assessment Score (MoCA) <20 (Dalrymple-Alford, 2010), prior head injury, stroke, atypical PD

Descriptors: The Unified Parkinson Disease Rating Scale (UPDRS) Part III Motor subscale (Goetz et al., 2008), the Patient Health Questionnaire (PHQ-9) (Chagas et al., 2013) for measurement of depression, and the 9 Hole Peg Test (Earhart et al., 2011) for upper extremity motor dexterity

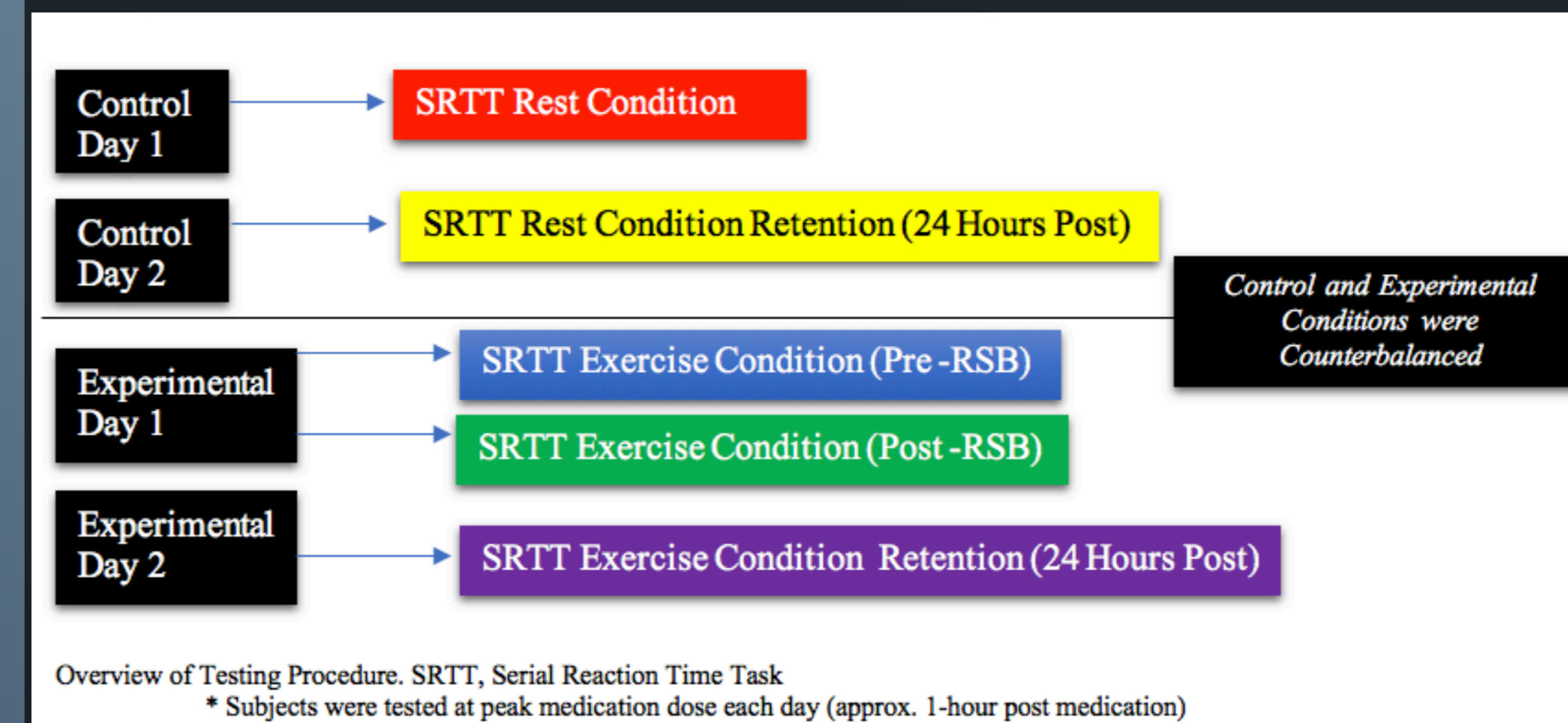
Statistical Analysis

- > The outcome of interest was to determine if an acute bout of exercise resulted in a faster reaction time compared to no exercise, and secondly, to determine if an acute bout of exercise improved reaction time for the exercise retention test compared to the no exercise retention test.
- > The mean of the median reaction times in milliseconds while performing the SRTT task was the primary outcome.
- > A one-way repeated measures ANOVA with planned t-tests was conducted to determine a difference in reaction time between trials. Means and standard deviations were calculated for reaction time with an alpha level of 0.05.
- > Results were processed by the Millisecond Software © Inquisit 5 Lab, a computer-based psychological testing program. Statistical analysis was performed using IBM © SPSS Version 23.

SRTT and Experimental Procedure

SRTT

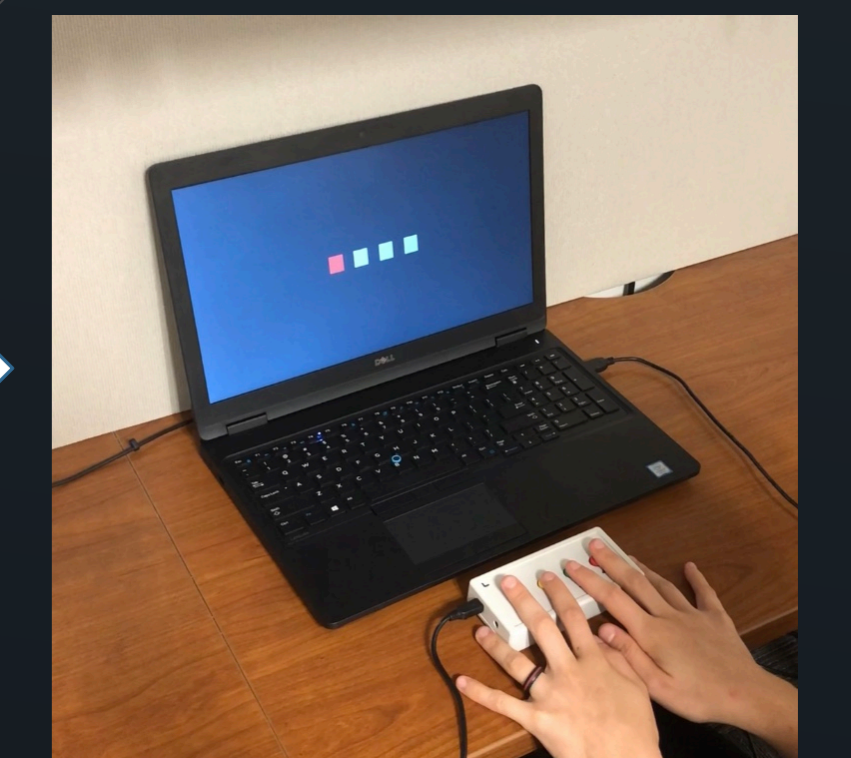
- > A visual stimulus repeatedly appearing in one of four locations was displayed on a computer screen
- > Seven blocks of sequences with a 30-second interval between each block were displayed
 - > Block One (Familiarization Sequence), Block Two-Five (Learning Sequence), Block Six (Transfer Sequence), Block Seven (Post-Transfer Sequence)
- > Participants indicated the location of the visual stimulus by pressing one of several buttons on a response board.



SRTT Block Sequences

- 1) Familiarization Block: 1,2,3,2,3,4,2,1,1,4
- 2) Learning Block #1: 1,2,1,3,4,2,3,1,4,3
- 3) Learning Block #2: 1,2,1,3,4,2,3,1,4,3
- 4) Learning Block #3: 1,2,1,3,4,2,3,1,4,3
- 5) Learning Block #4: 1,2,1,3,4,2,3,1,4,3
- 6) Transfer Block: 1,2,3,4,1,3,2,1,4,2
- 7) Post-Transfer Block: 1,2,1,3,4,2,3,1,4,3

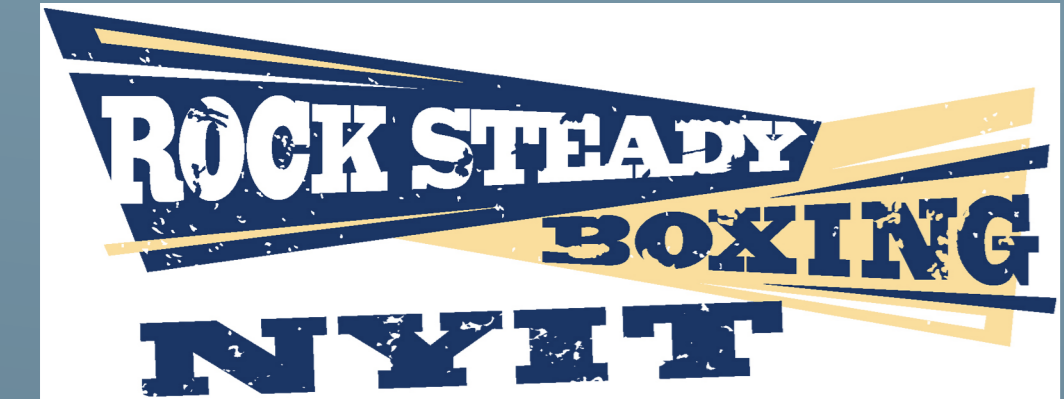
SRTT Block Video



Please Click on Images to Enlarge

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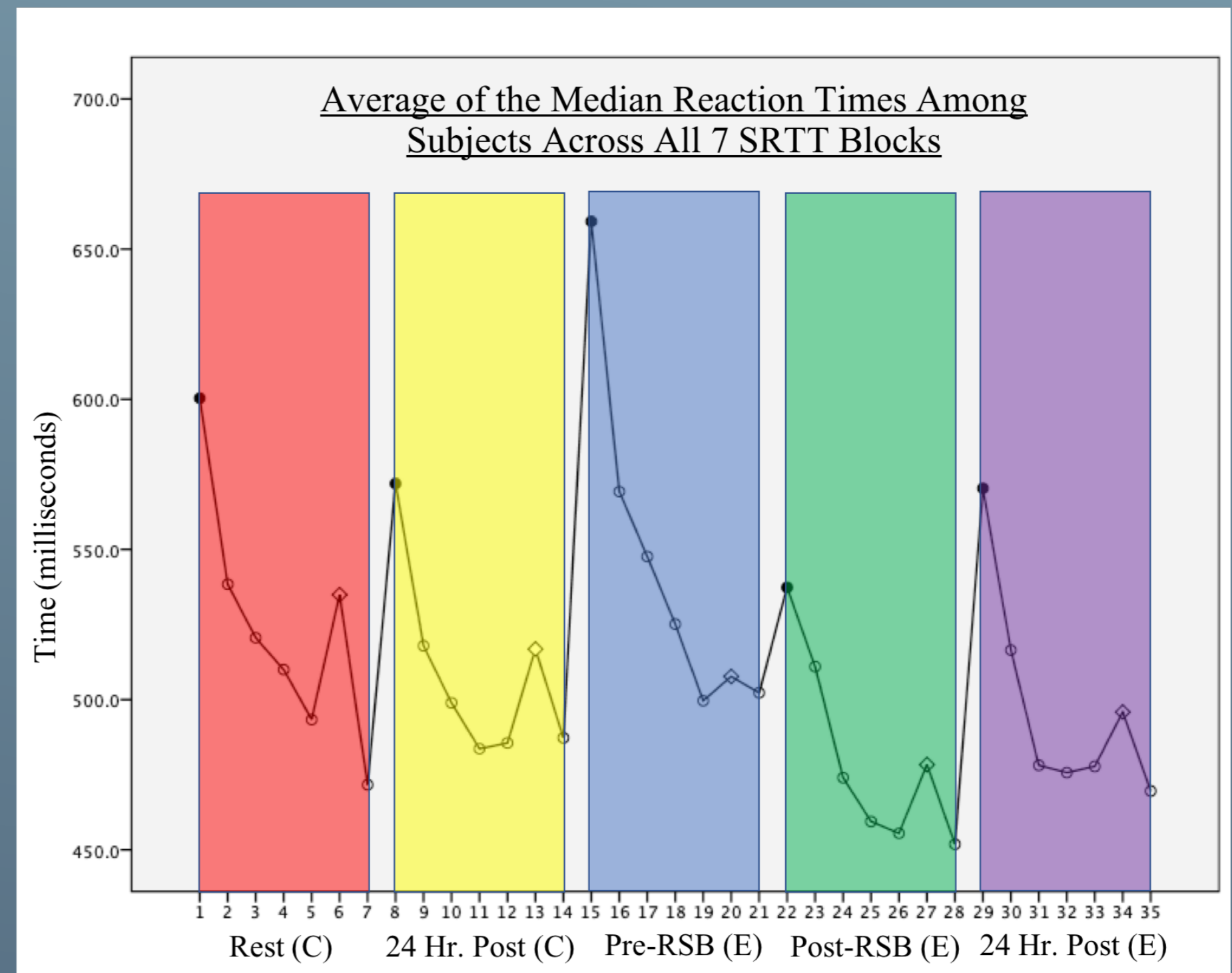


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Results

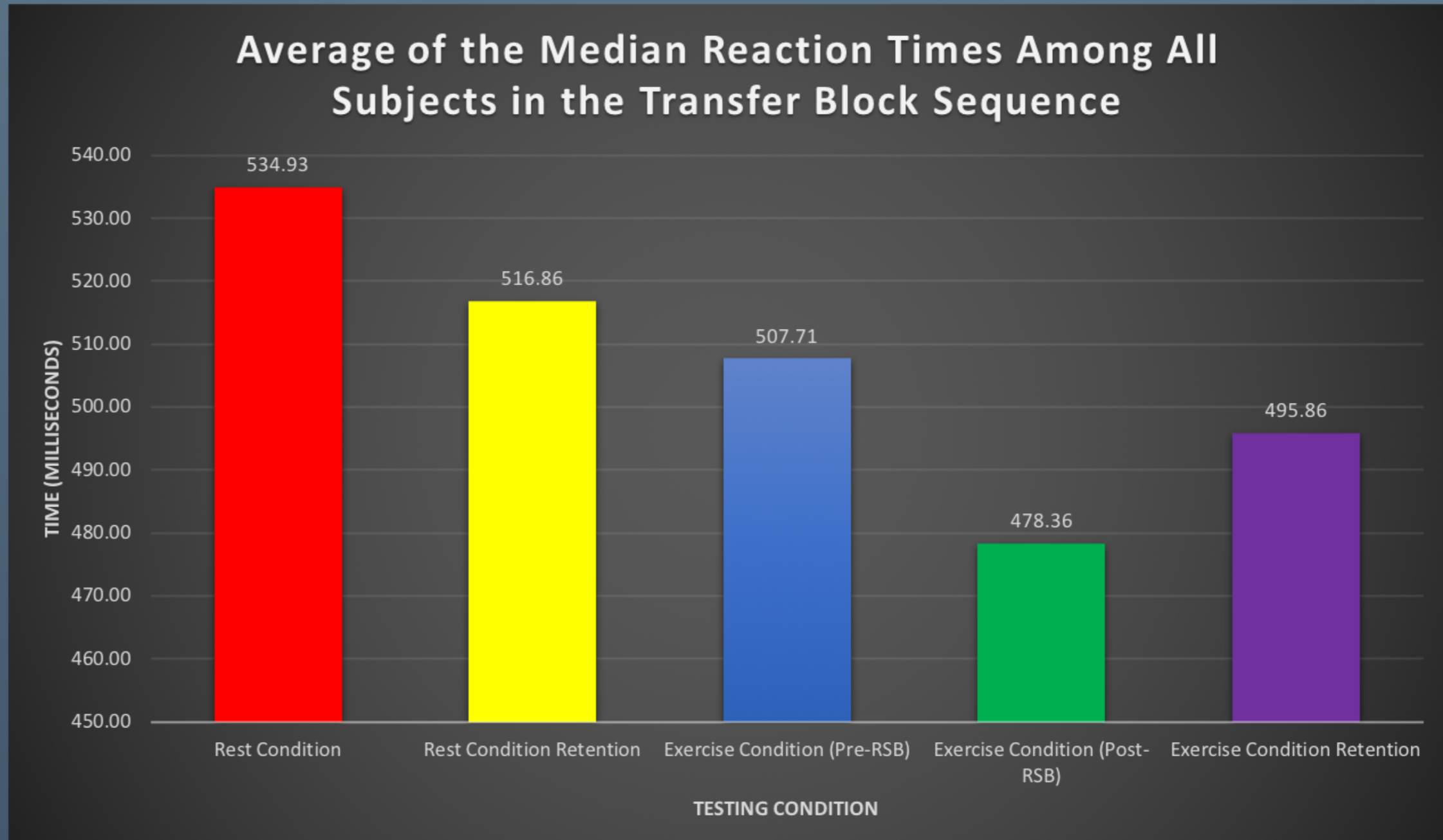
- 7 individuals with PD, 4 males (mean age 68.5) and 3 females (mean age 57.3), consented to participate in this study conducted at the New York Institute of Technology College of Osteopathic Medicine.
- The fastest reaction time occurred for the transfer sequence block under the immediate post exercise test condition.
- A significant decrease within ($F=5.989, p<0.000$) and between ($F= 307.078, p<0.000$) subjects was found when comparing reaction times for each trial.
- No significant difference was found in reaction time between the post exercise and rest conditions for immediate or retention tests.



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Subject Demographics

Age	Sex	Race	Hoehn and Yahr	MOCA	PHQ-9	UPDRS Part III	Side affected	Dominant hand	Dominant 9 Hole Peg (sec)	Non-Dominant 9 Hole Peg (sec)
76	M	White	II	24	0	24	L	R	27	51
53	M	White	II	28	12	32	R	R	27	27
61	F	White	II	27	2	40	R	R	33	35
73	M	White	II	26	4	42	R	R	32	37
65	F	White	II	25	3	7	R	R	20.22	22.89
46	F	White	II	28	6	17	L	R	21.31	28.23
72	M	White	I	24	2	16	L	L	30.72	28.91



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- A significant decrease in reaction time was found trial-to-trial within and between subjects in this preliminary pilot study
- A difference in reaction time with an acute bout of aerobic exercise during an RSB class compared to the no exercise condition was not found, demonstrating no residual effect of RSB on procedural memory (Small sample size and large variability in reaction times found in these subjects)
- Osteopathic philosophy was applied to people with PD who participated in the RSB program, thus cultivating a sense of community (spirit) with other people with PD, which together with the physical (body) and cognitive aspects of the class has the potential to have a positive effect on memory (mind).
- Future studies should include a larger sample size to determine if there are indeed positive effects on procedural learning with RSB.



References



Acknowledgements

We thank the New York Institute of Technology College of Osteopathic Medicine for use of the facilities in the Wellness Gym and W. Kenneth Riland Academic Health Care Center. We would also like to thank Rock Steady Boxing head coach, David Patton and Wellness Center Coordinator, Amanda Braadt for their assistance with this study. Lastly, we would like to thank Christopher K. McLeod, OMS III, for launching the procedural memory pilot study at NYITCOM in 2018 of which this study is based on.



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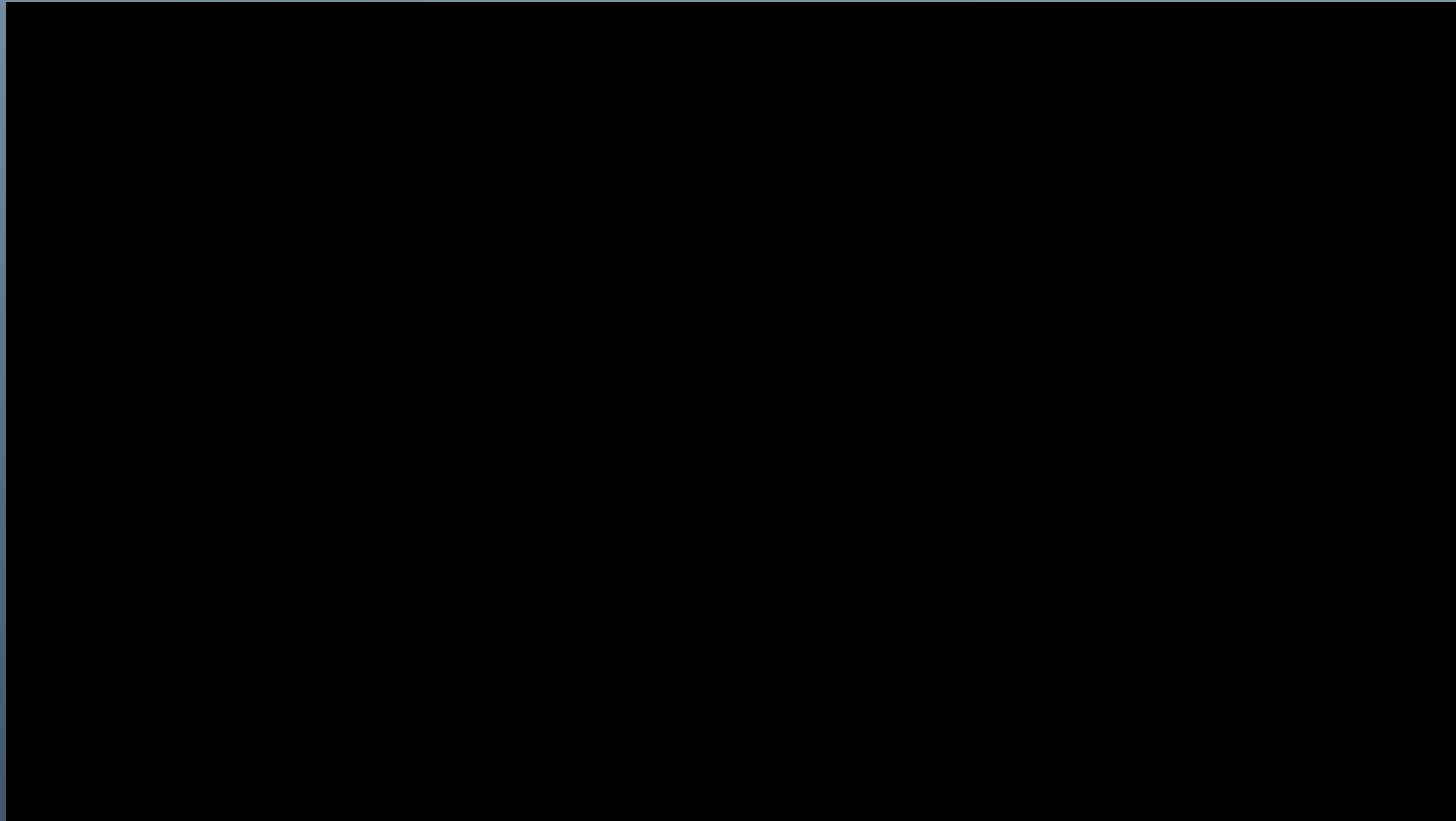
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ROCK STEADY BOXING VIDEO

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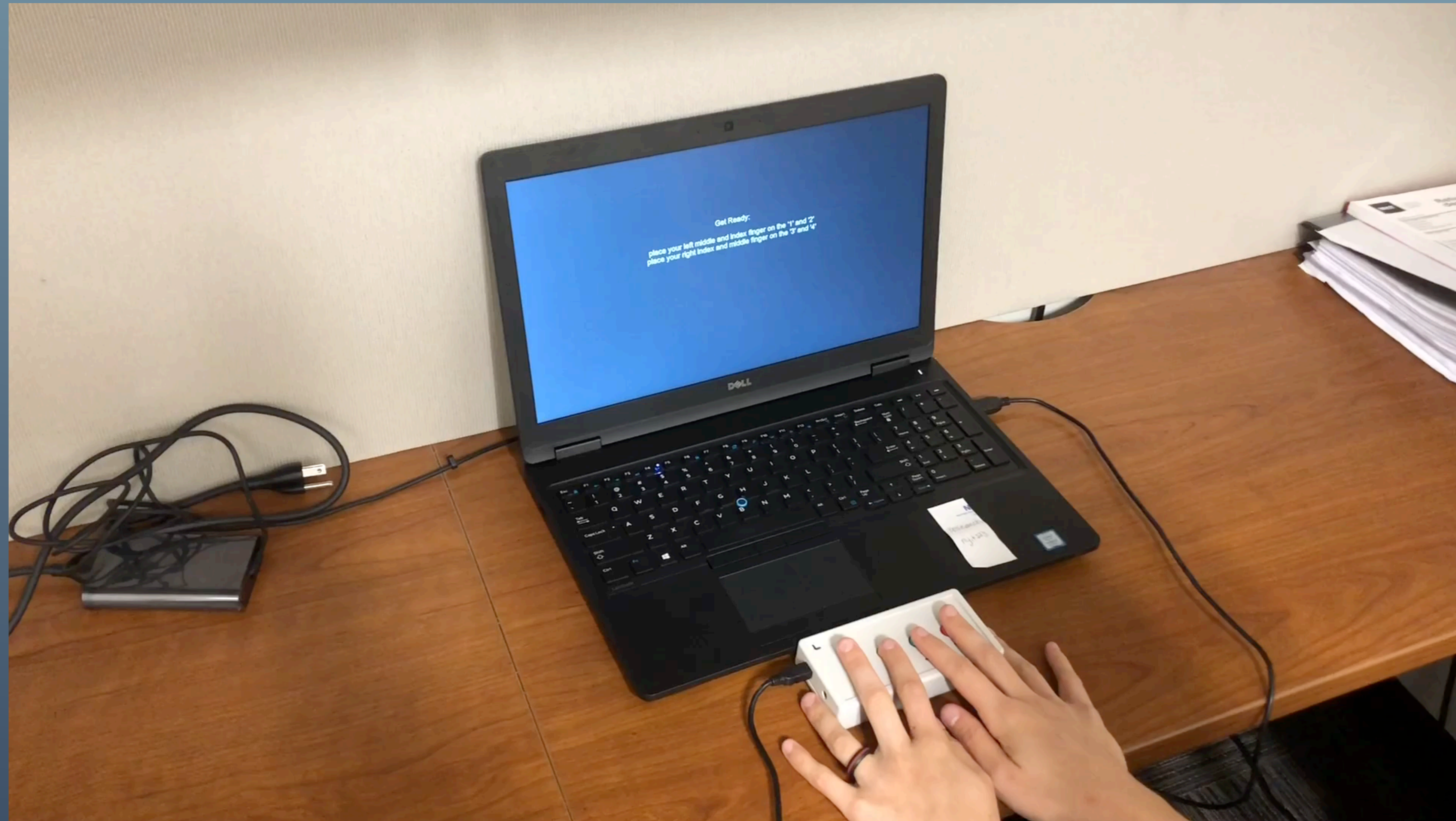
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SRTT VIDEO OF SAMPLE BLOCK

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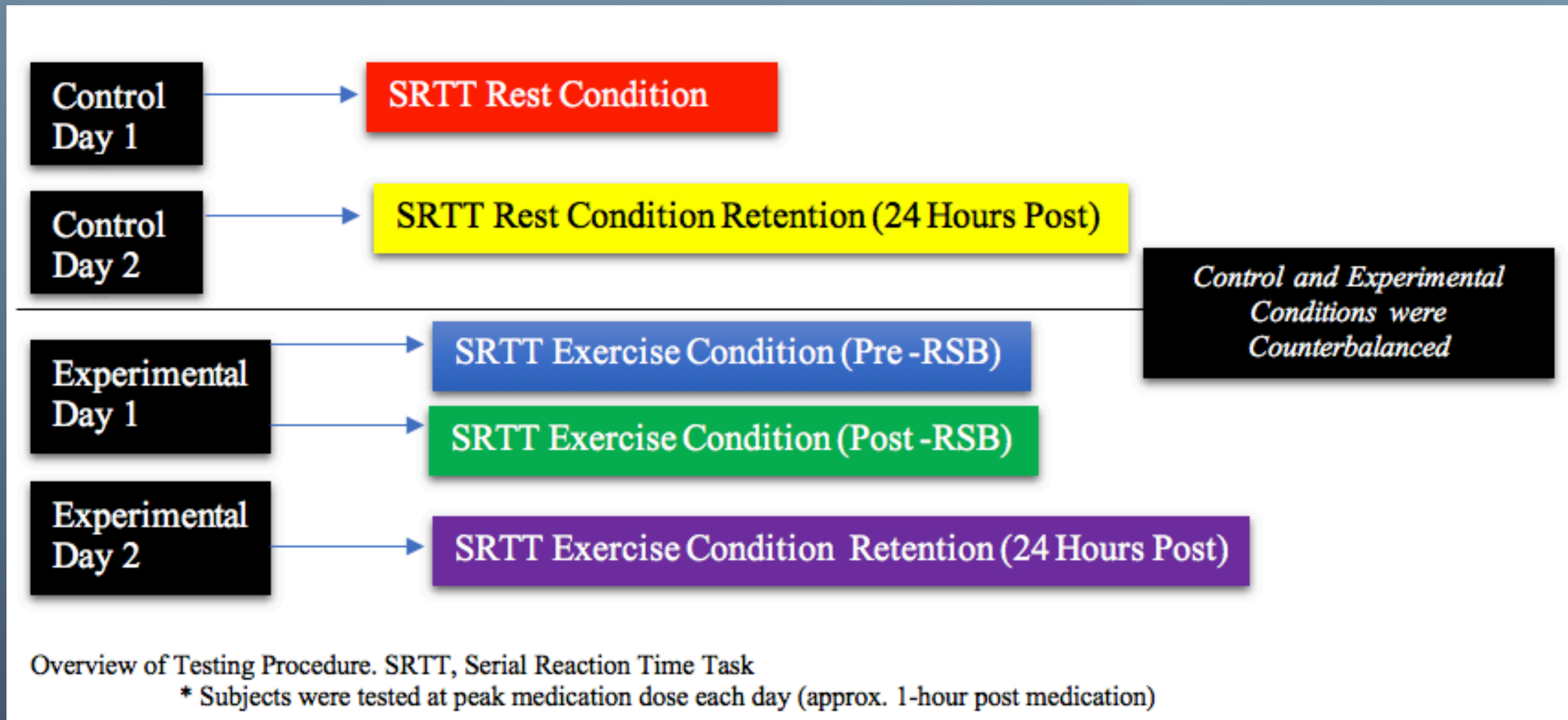
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TESTING PROCEDURE

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SRTT SCRIPT

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SRTT Block Sequences



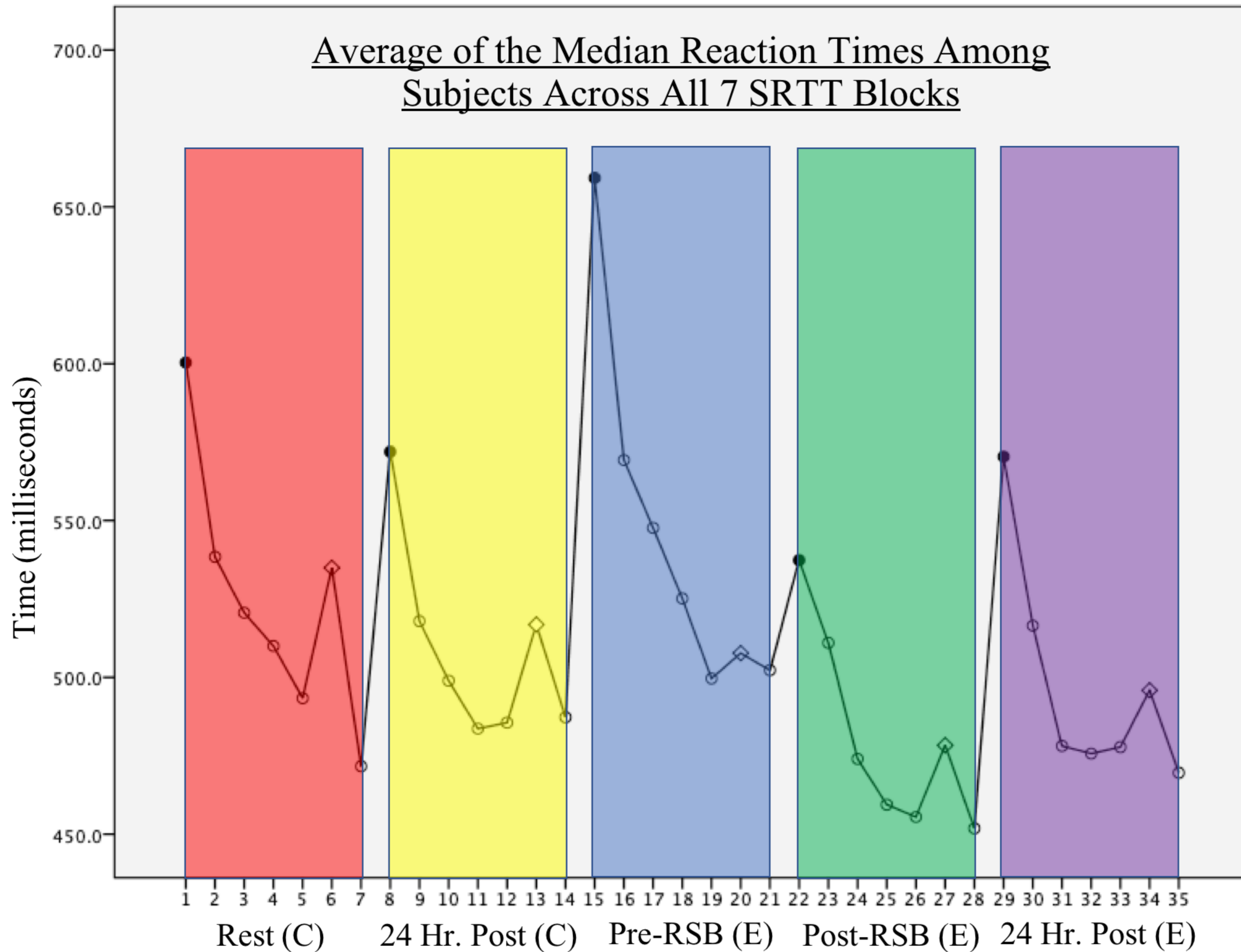
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Average of the Median Reaction Times Among Subjects Across All 7 SRTT Blocks



*Time is on the Y axis and the seven blocks for each condition for all participants are on the X axis; 35 blocks in total. Each filled circle represents a “new testing day” and each diamond represents the transfer blocks (block 6). Red is SRTT results on the rest condition. Yellow is SRTT results 24 hours after the rest condition. Blue is SRTT results before boxing on the exercise condition. Green is SRTT results immediately after boxing on the exercise condition. Purple is SRTT results 24 hours after the exercise condition.

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