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## Inhibitory control and cardiac pre-ejection period in young and middle-aged adults

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## INTRODUCTION

Cognitive aging leads to declines in inhibition. Inhibition deficits can lead to decision-making errors in complex work contexts. Cardiac reactivity may be a relevant marker of inhibition control, but little is known on its dynamics and age-related effects.

Performing a cognitive task with different levels of **Inhibition**:

- Interference control
- Response inhibition

Elicits different levels of:

- Mental effort
- Inhibitory control

Cardiac reactivity as an autonomic marker of such mental activities, with:

**Sympathetic nervous system activity:**  
 cardiac pre-ejection period (PEP)

Dynamics of PEP reactivity ?  
 Effects of chronological age ?

Nigg (2000); Friedman & Miyake (2004)

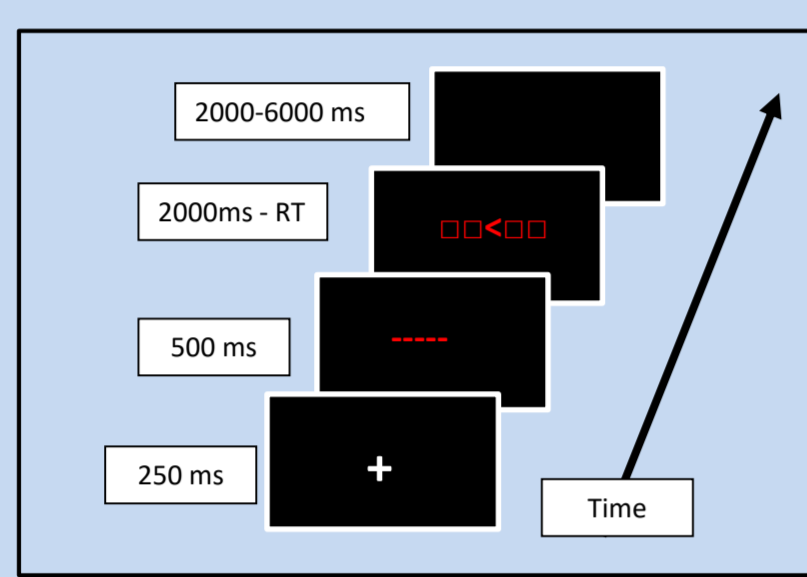
Richter et al. (2008); Kelsey (2012)

**Objectives:** To examine whether PEP reactivity dynamically adapts to different levels of inhibition control in young and middle-aged adults, using a mixed within-between-subjects experimental design.

## Participants

29 students (14 males; 18-27 years)

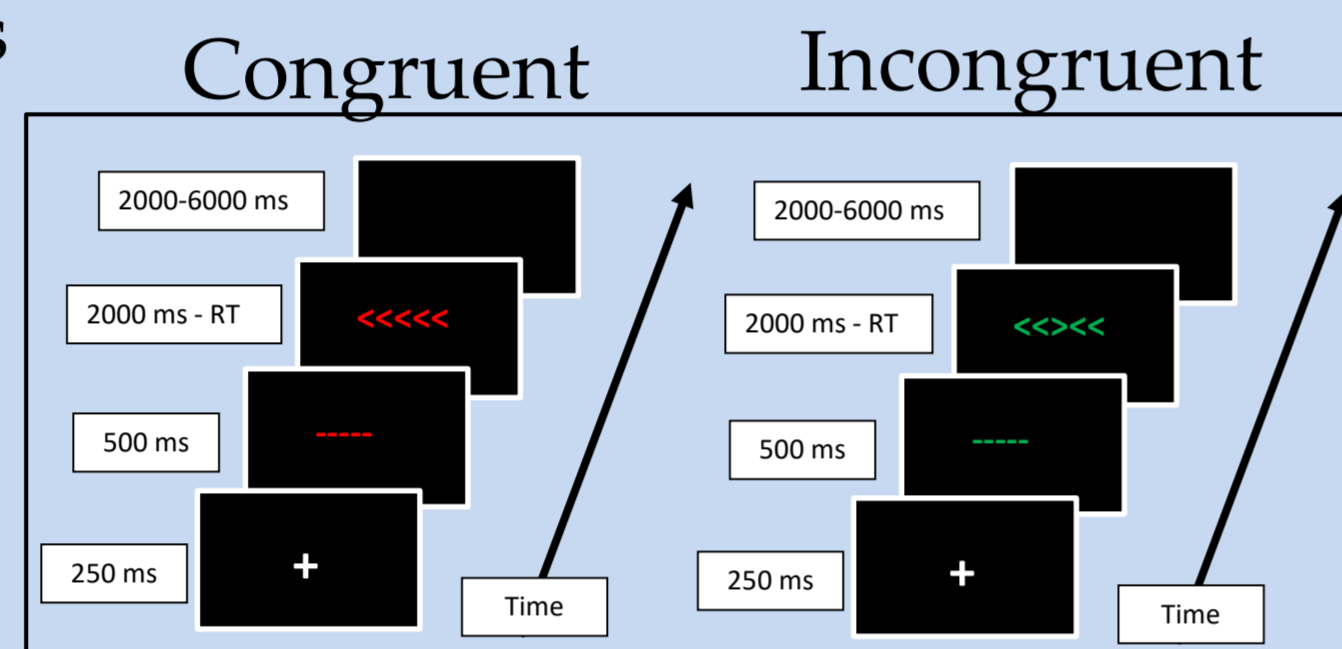
27 middle-aged adults (55-65 years)



Neutral trials

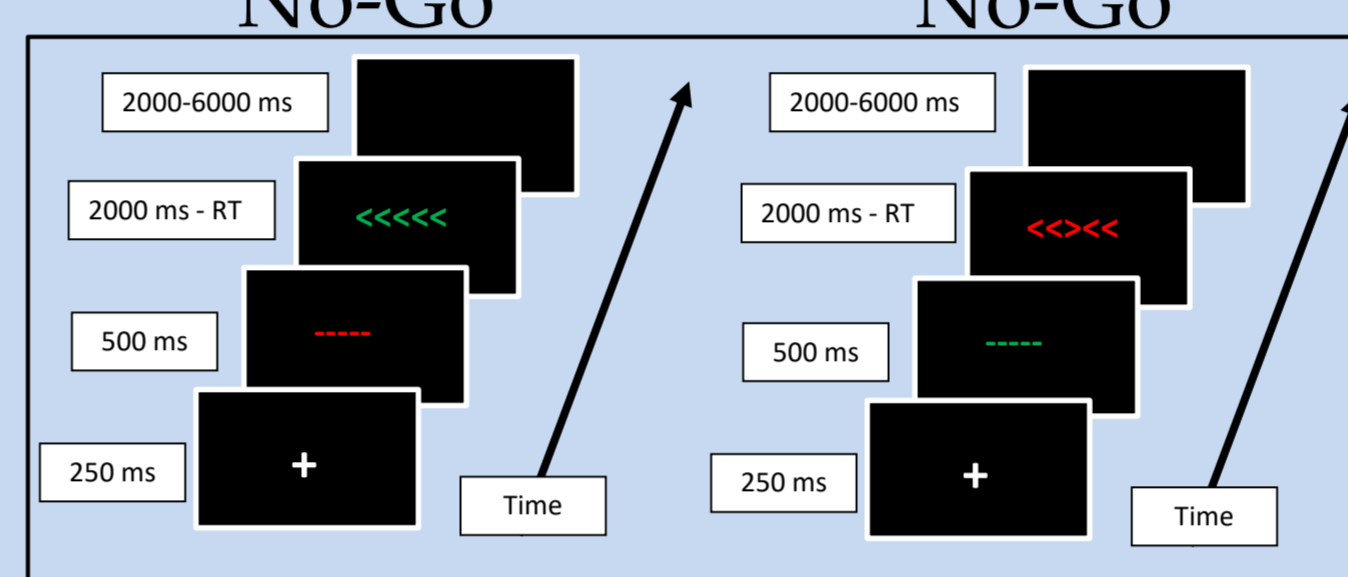
## Modified Flanker task

2 blocks of 40 trials per condition.

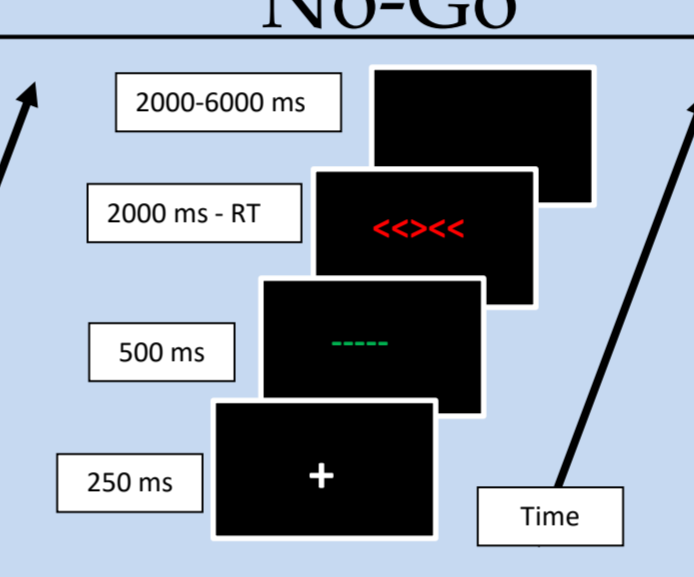


## METHODS

### Congruent No-Go



### Incongruent No-Go

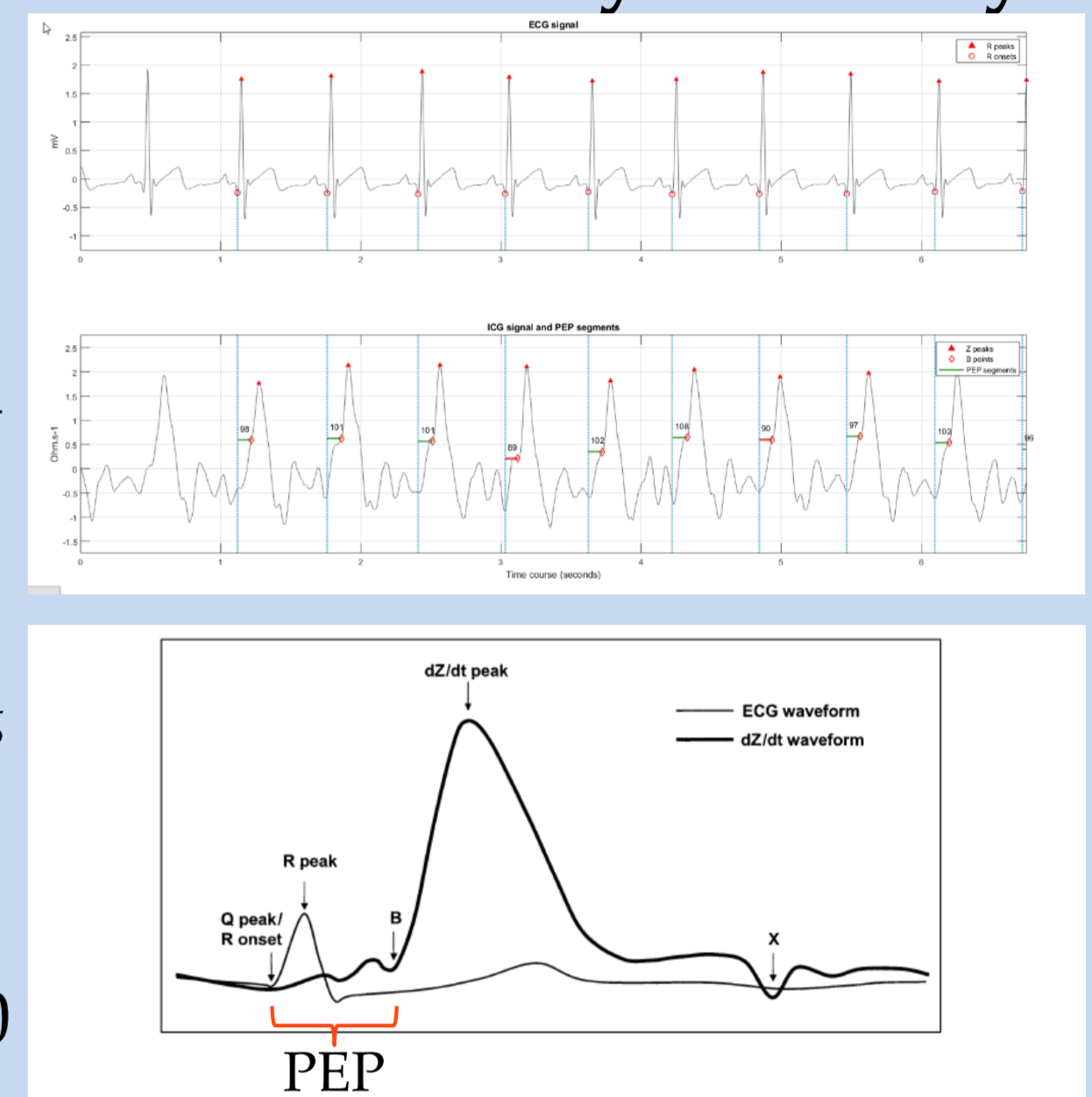


## Cardiac activity/reactivity

ECG / ICG at rest and during cognitive activity

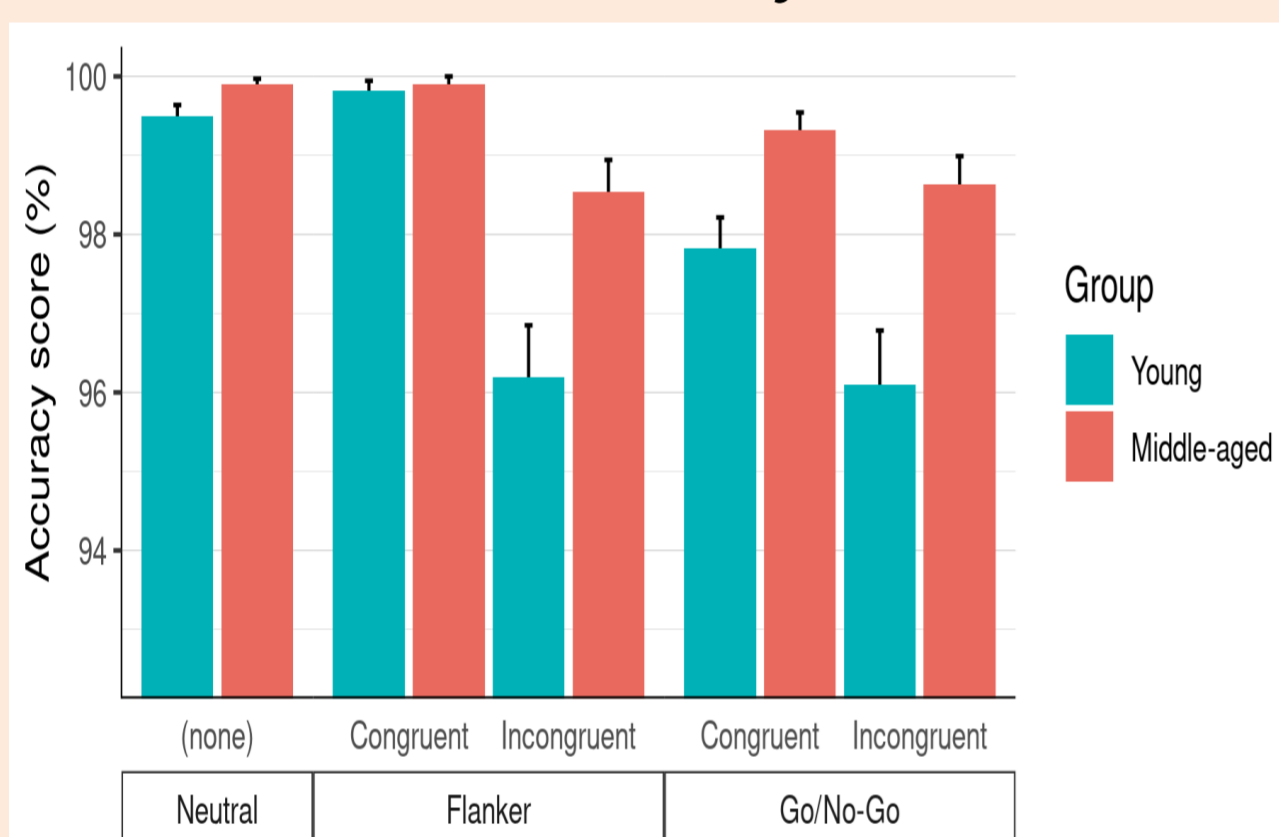
PEP reactivity = PEP<sub>task</sub> - PEP<sub>resting</sub>  
 1-min epoch

Rest period = 3'  
 Task period = 4'30"



## Behavioral data

### Accuracy

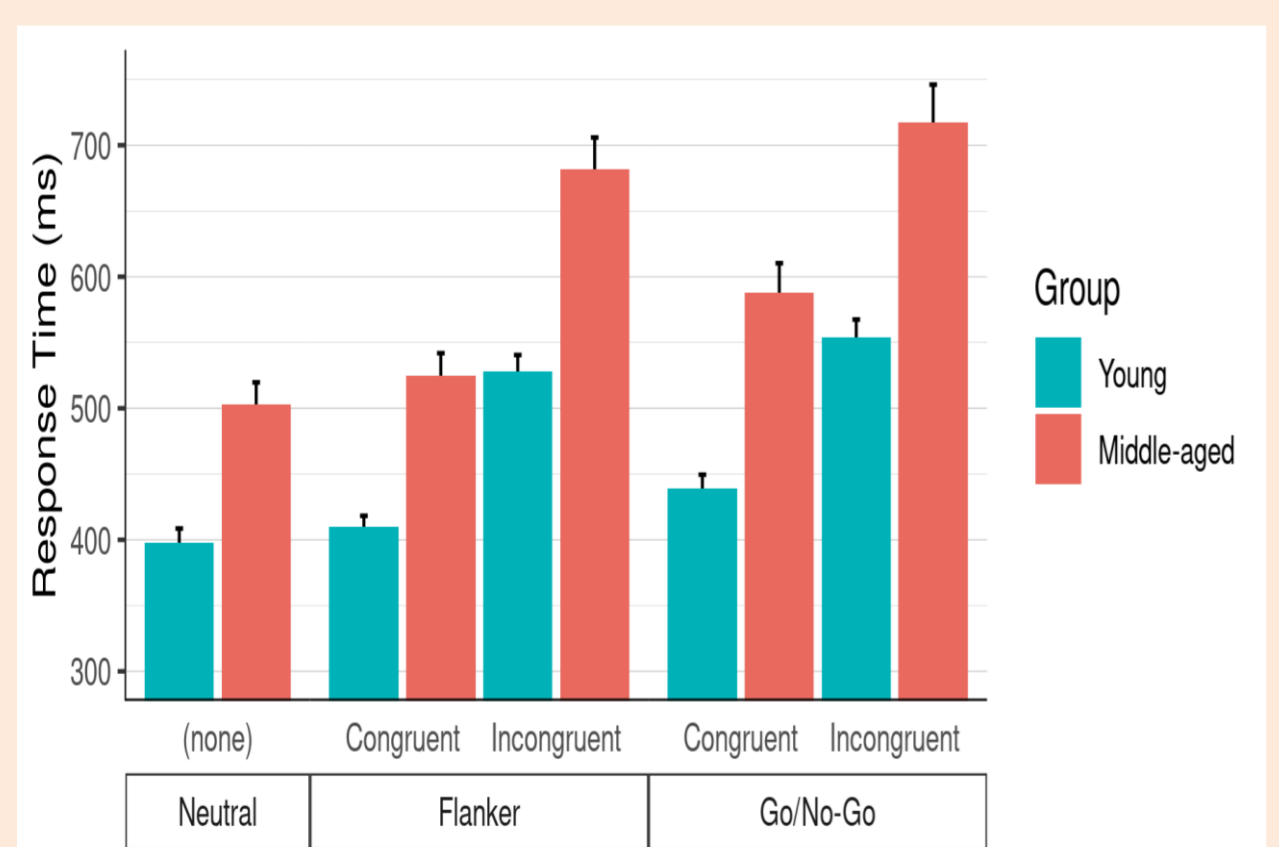


Accuracy was greater for Neutral block than Flanker block and Go/No-Go block ( $p < .001$ ;  $\eta^2_p = .33$ ).

Greater for Congruent trials than for Incongruent trials ( $p < .001$ ;  $\eta^2_p = .34$ ).

Greater for Middle-aged than Young ( $p < .001$ ;  $\eta^2_p = .35$ ).

### Reaction Time



RT increased from Neutral to Flanker to Go/No-Go block ( $p < .001$ ;  $\eta^2_p = .72$ ).

Shorter for Congruent trials than Incongruent trials ( $p < .001$ ;  $\eta^2_p = .72$ ).

Longer for Middle-aged than Young ( $p < .001$ ;  $\eta^2_p = .42$ ).

### Inhibition cost of Composite Score (Accuracy/RT\*100)

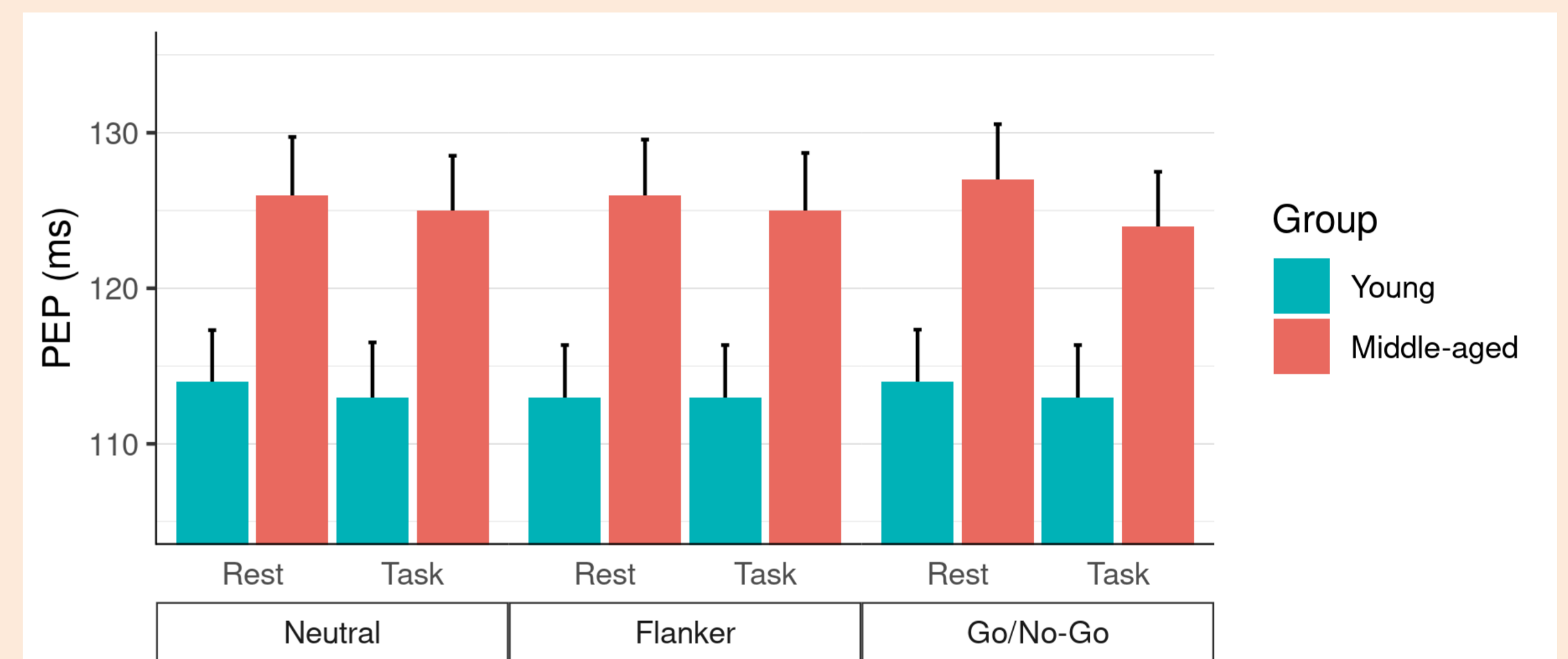
Block	Young	Middle-aged
Inhibition cost Flanker	24.8 % (4.8)	23.7% (6.9)
Inhibition cost Flanker Go/No-Go	21.9% (6.4)	17.9% (8.9)

Relative inhibition cost decreased from Flanker to Go/No-Go block ( $p < .001$ ;  $\eta^2_p = .45$ ).

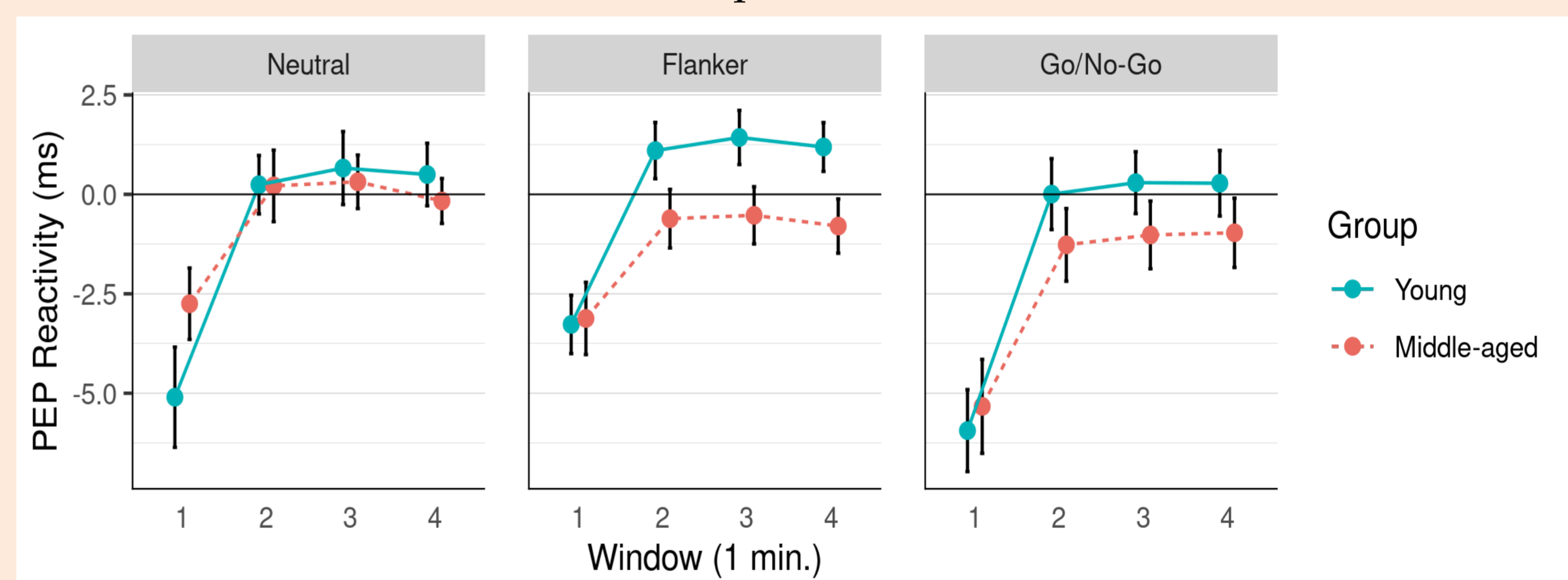
No difference between the 2 groups.

## RESULTS

## Cardiac activity/reactivity



Globally, PEP<sub>task</sub> was slightly shorter than PEP<sub>rest</sub> ( $p = .02$ ;  $\eta^2_p = .09$ ). PEP was longer for Middle-aged than Young ( $p = .01$ ;  $\eta^2_p = .10$ ). PEP was stable across rest periods.



PEP reactivity was significant only for the first 1-min window (w1). PEP reactivity was greater for Go/No-Go block than Neutral block and Flanker block ( $p = .002$ ;  $\eta^2_p = .11$ ). No difference between the 2 groups.

## DISCUSSION

Overall, participants were **less accurate and slower** during the **most challenging** task involving **interference control and response inhibition**. Middle-aged were more accurate but slower and their inhibition cost was comparable to the one of the younger participants.

**Absolute PEP** values were **higher** for the **middle-aged** but **PEP reactivity** was **comparable** between the **2 groups**. These results add to the current very limited but contradictory literature on this topic (Cybulski, 1996; Gurel et al., 2019).

Importantly, for both groups, **PEP reactivity** was significantly **lower than 0** only during the **first minute** of each experimental task, going back to baseline level afterward. Similar dynamics were recently reported but during a recovery period by Czarnek et al., (2021). **PEP reactivity** was also **more important** during the **flanker Go/No-Go** task comparatively to the flanker task and the neutral task.

**PEP reactivity** appears to be **sensitive to different levels of inhibitory control** requirement, but **does not increase linearly as a function of task demands**. It also appears to be a **short lasting phenomenon**, demonstrating a possible rapid dynamic adaptation of the cardiac activity to task constraints or a form of habituation. Additional within-subjects design studies are required to replicate these findings.

## REFERENCES