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

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► **To cite this version:**

Cédric T. Albinet, C. de Faria, B. Valéry, M. Causse. Inhibitory control and cardiac pre-ejection period in young and middle-aged adults. 21st World Congress of Psychophysiology, Jun 2023, Geneva, Switzerland. International Journal of Psychophysiology, 188, pp.108, 2023, 10.1016/j.ijpsycho.2023.05.277 . hal-04146942

HAL Id: hal-04146942

<https://hal.science/hal-04146942>

Submitted on 30 Jun 2023

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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)

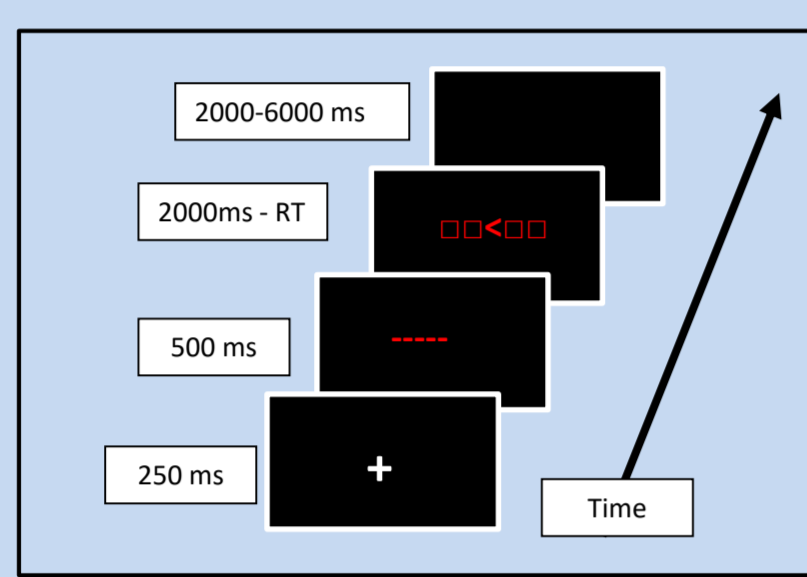
Richter et al. (2008); Kelsey (2012)

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)

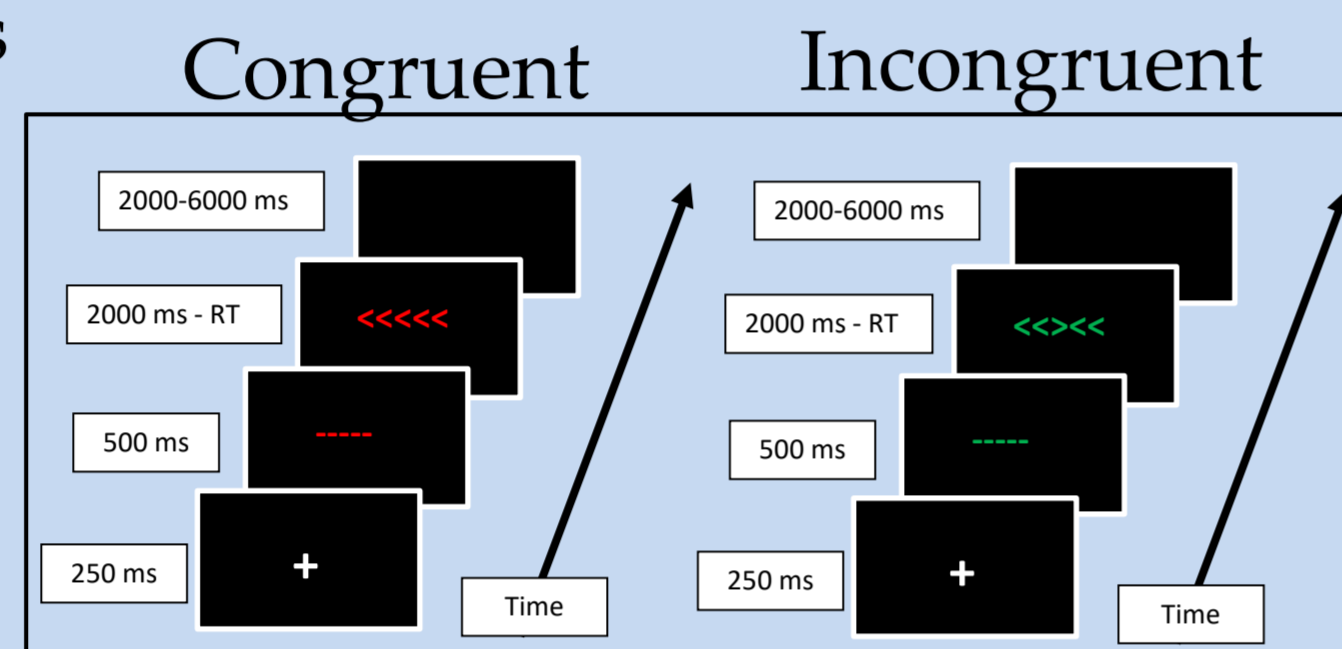
27 middle-aged adults (55-65 years)



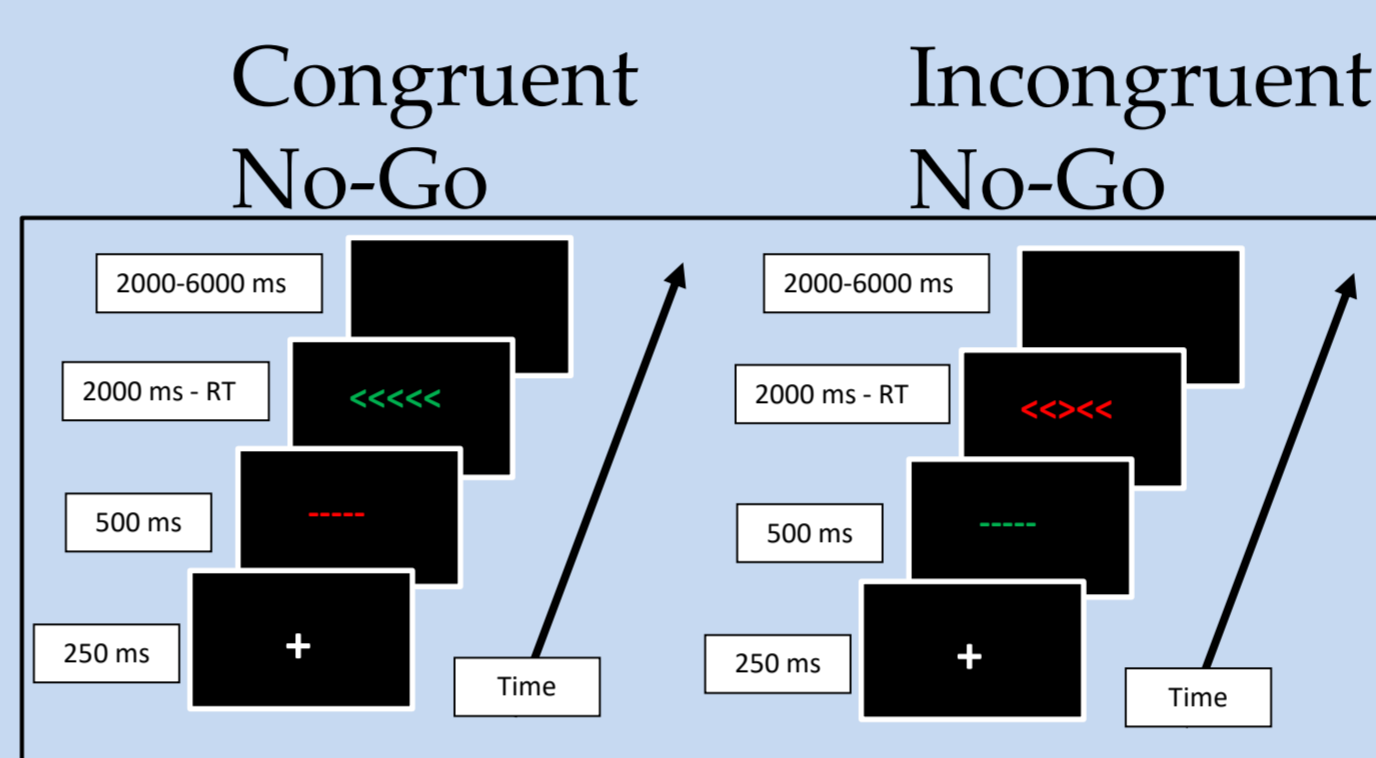
Neutral trials

Modified Flanker task

2 blocks of 40 trials per condition.



METHODS

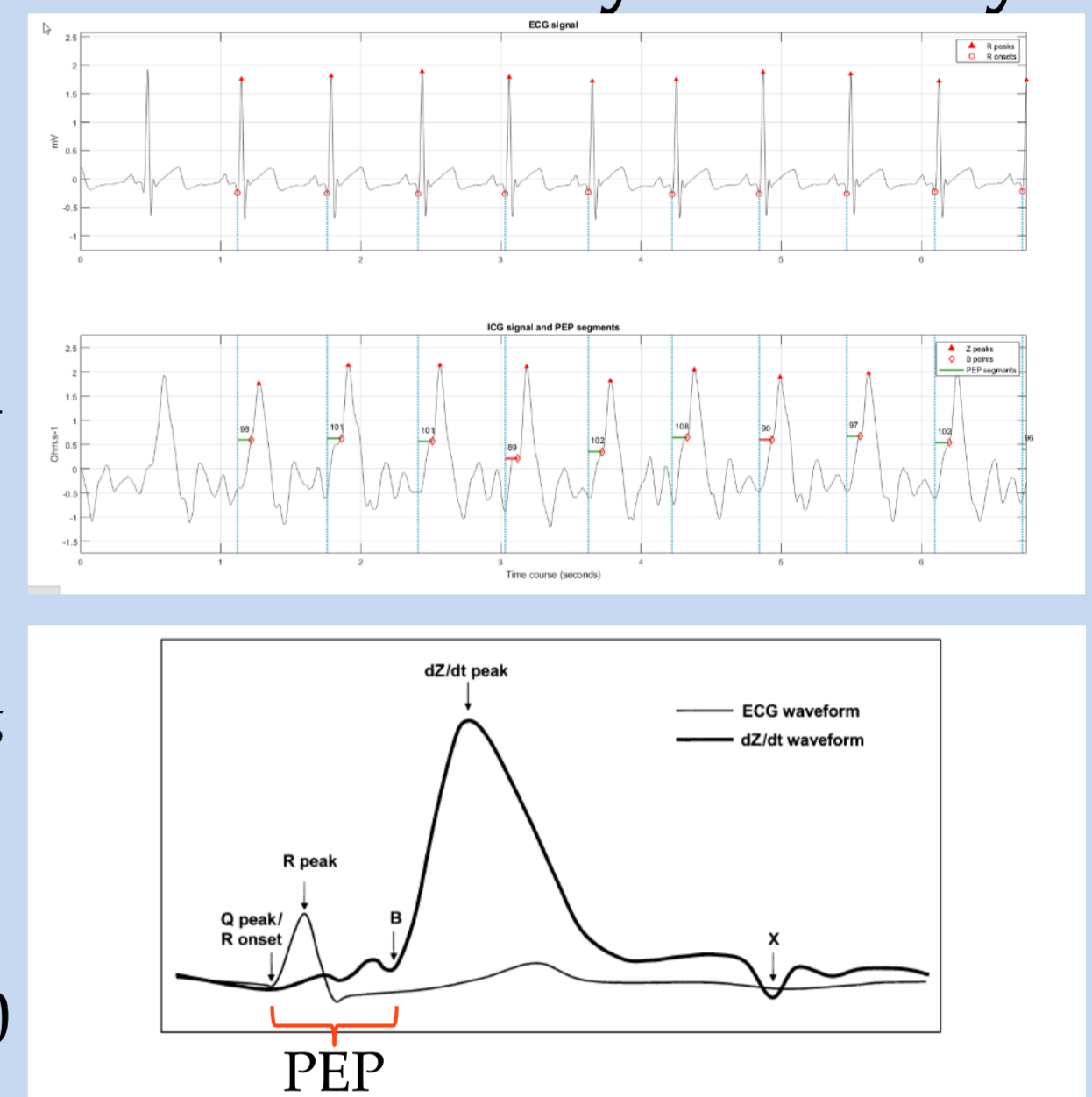


Cardiac activity/reactivity

ECG / ICG at rest and during cognitive activity

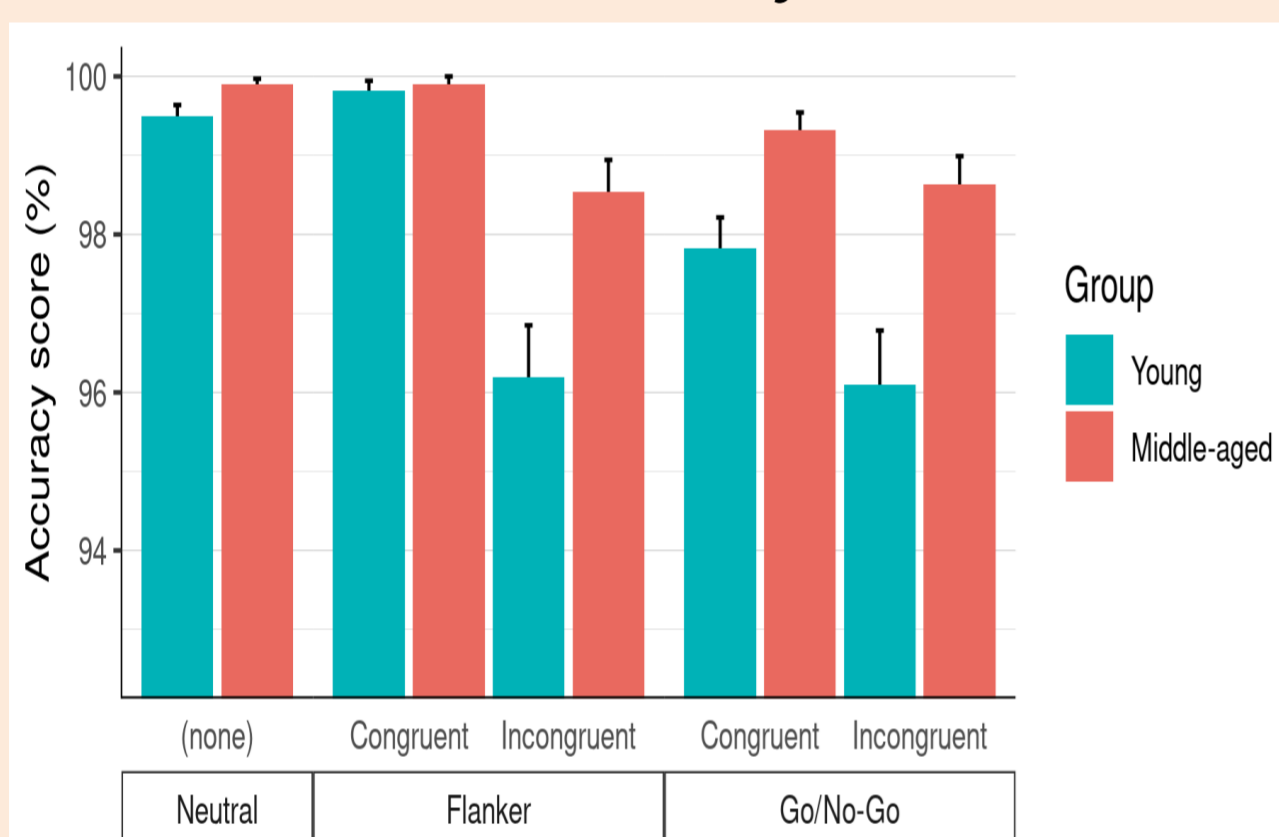
PEP reactivity = PEP_{task} - PEP_{resting}
1-min epoch

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



Behavioral data

Accuracy

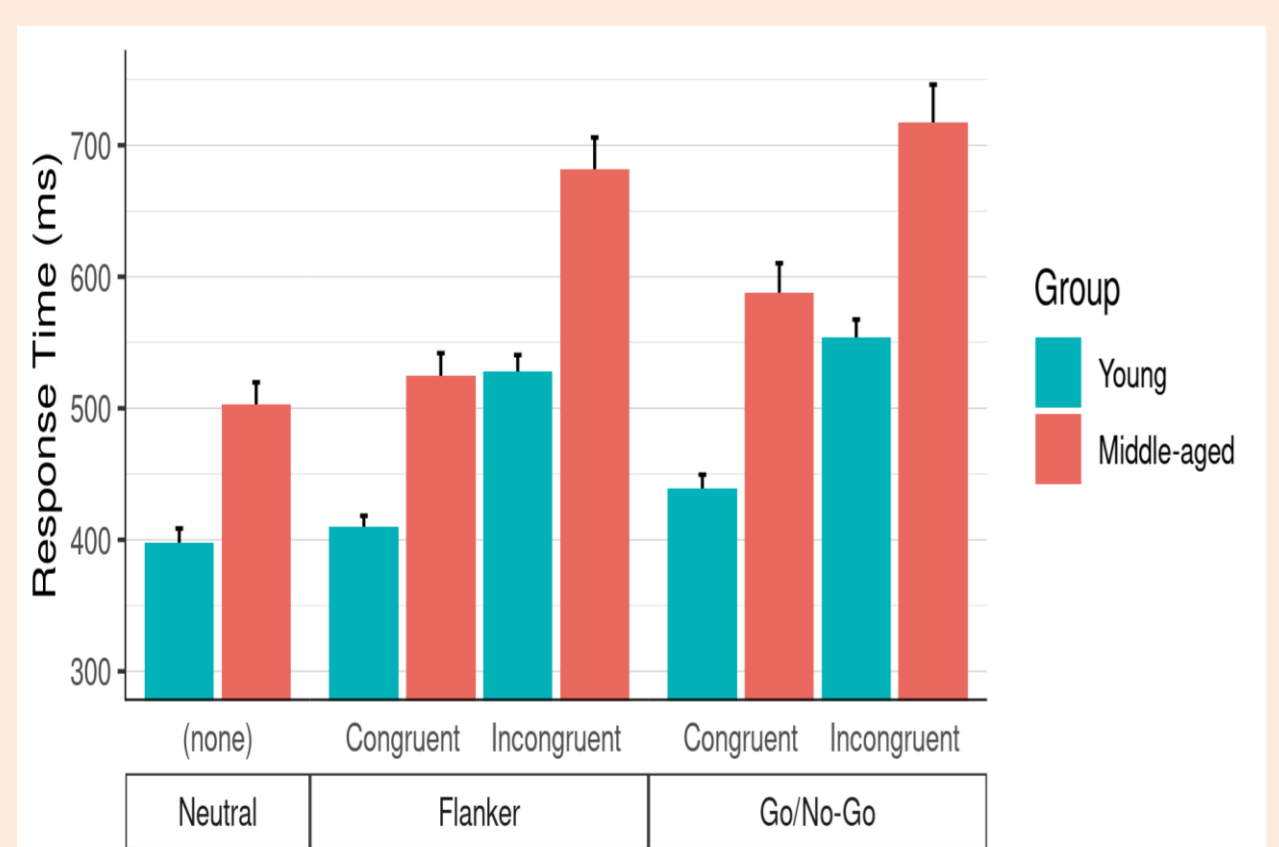


Accuracy was greater for Neutral block than Flanker block and Go/No-Go block ($p < .001$; $\eta^2_p = .33$).

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)

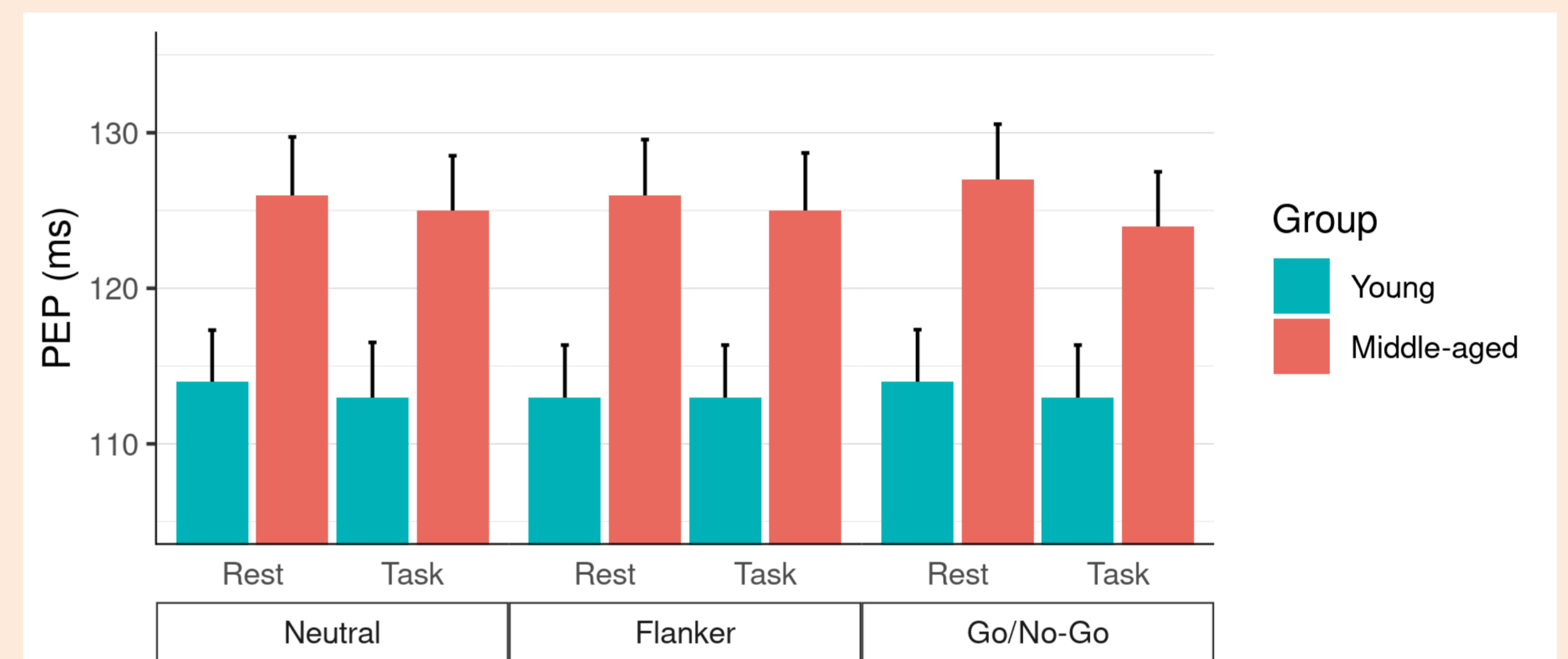
Block	Young	Middle-aged
Inhibition cost Flanker	24.8 % (4.8)	23.7% (6.9)
Inhibition cost Flanker Go/No-Go	21.9% (6.4)	17.9% (8.9)

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

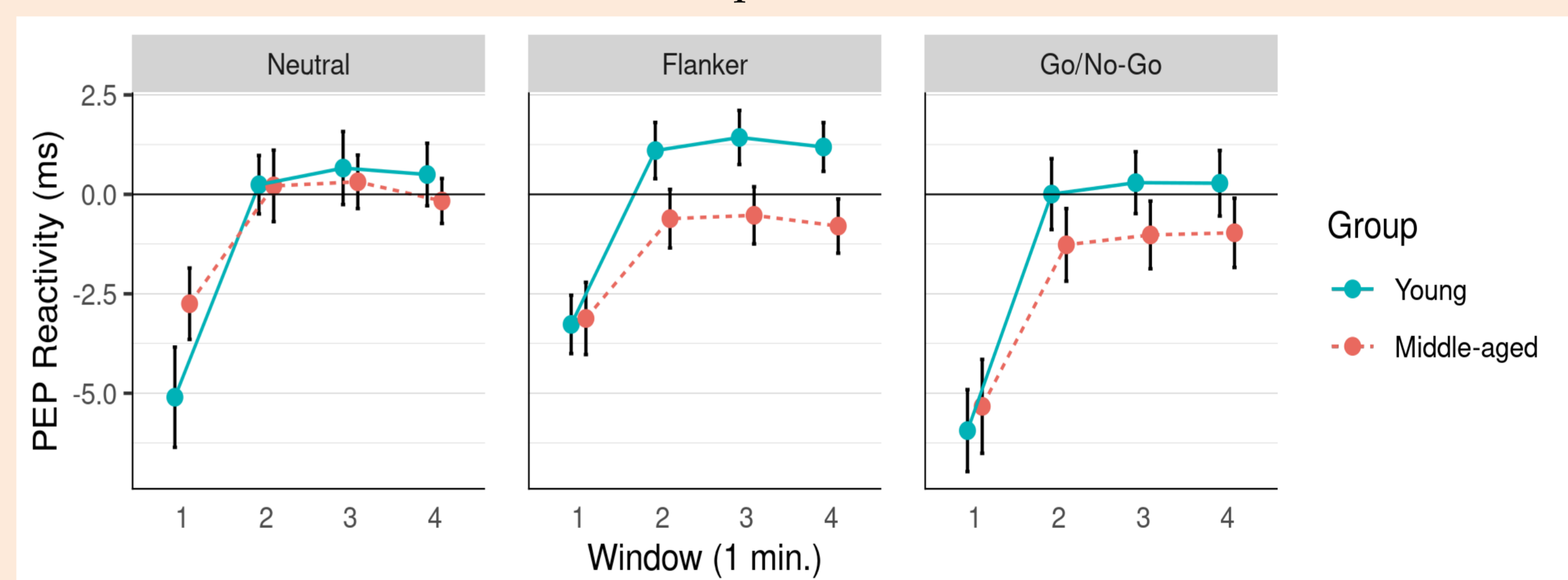
No difference between the 2 groups.

RESULTS

Cardiac activity/reactivity



Globally, PEP_{task} was slightly shorter than PEP_{rest} ($p = .02$; $\eta^2_p = .09$). 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