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Aging, cognitive performance and cardiac vagal control: the relationships between the heart and the brain.

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International Workshop
AGING IN THE NEURO-MUSCULO-SKELETAL SYSTEM
15-17 March, 2016 – Marseille – France


Aging, cognitive performance and exercise

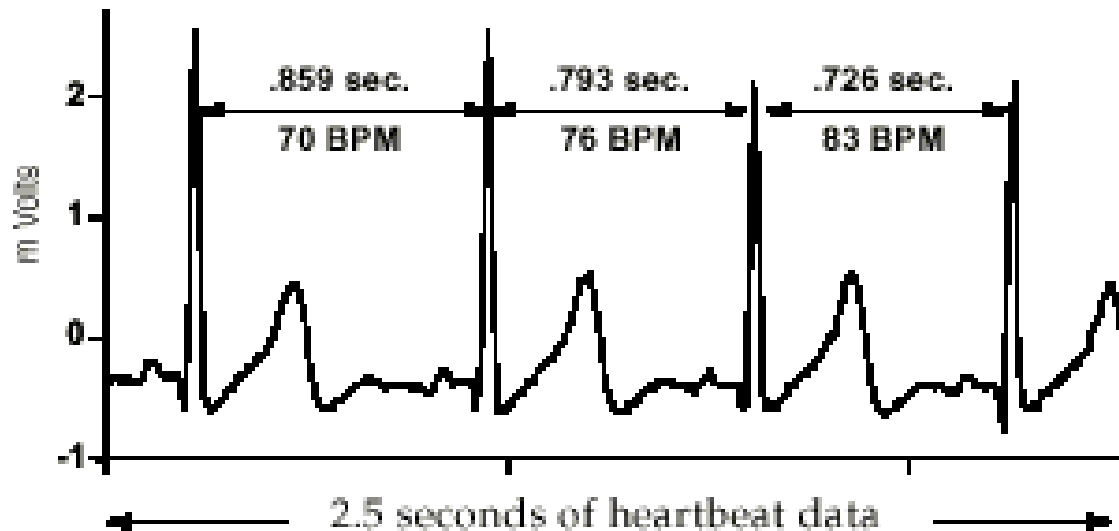
- Normal cognitive aging
 - Information processing speed (Salthouse, 1996)
 - Episodic memory (Isingrini & Taconnat, 2008; Kraik & Salthouse, 2011)
 - Executive functions (Albinet et al., 2012; Collette & Salmon, 2013).
- Regular physical exercise may reduce these cognitive declines:

Particularly concerning executive control processes (Abou-Dest et al., 2012; Boucard et al., 2012; Colcombe & Kramer, 2003; Kramer et al., 1999).


Related to brain structure and functioning improvements (cf. C. Voelcker-Reaghe this afternoon).

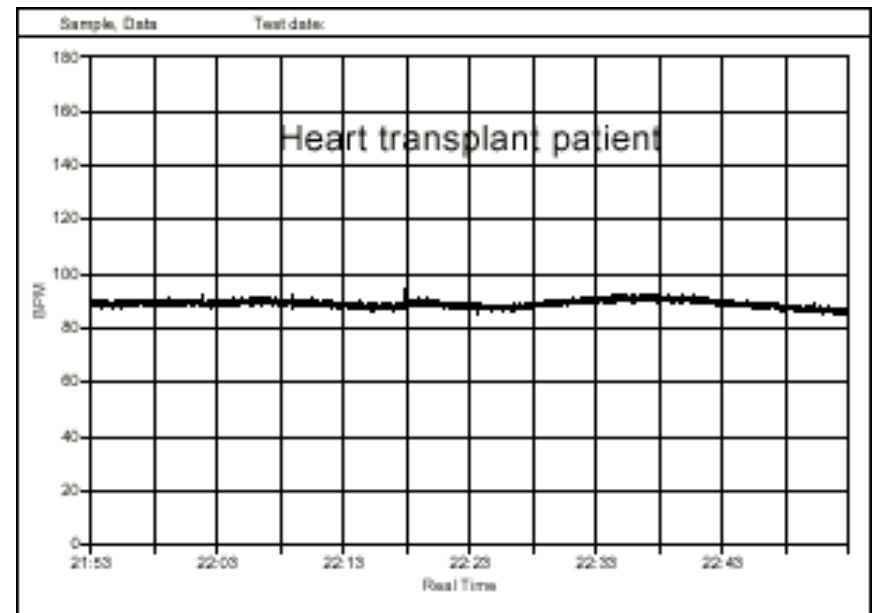
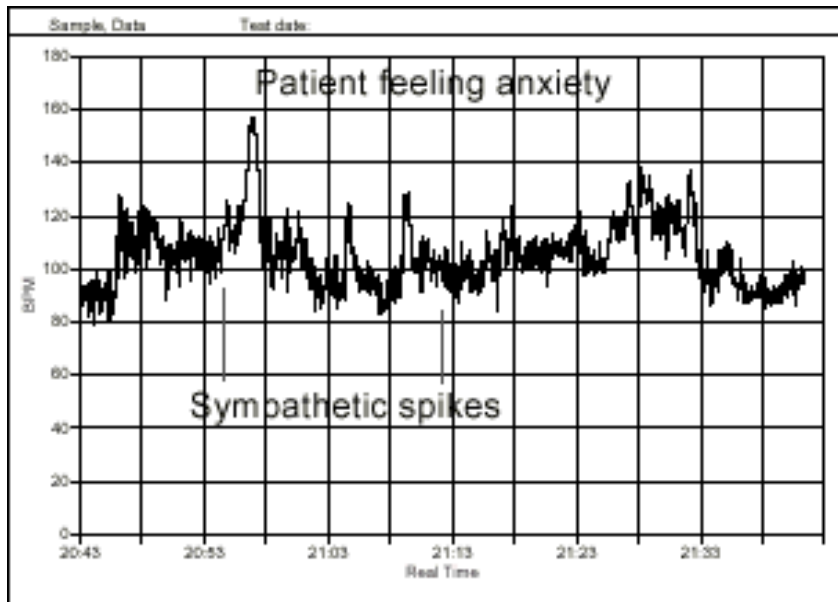
Aging, resting heart rate variability (HRV) and exercise

- Resting HRV is a marker of cardiac autonomous activity (ANS; Task Force, 1996)
 - Greater HRV  reduced risk of cardiovascular disease and mortality




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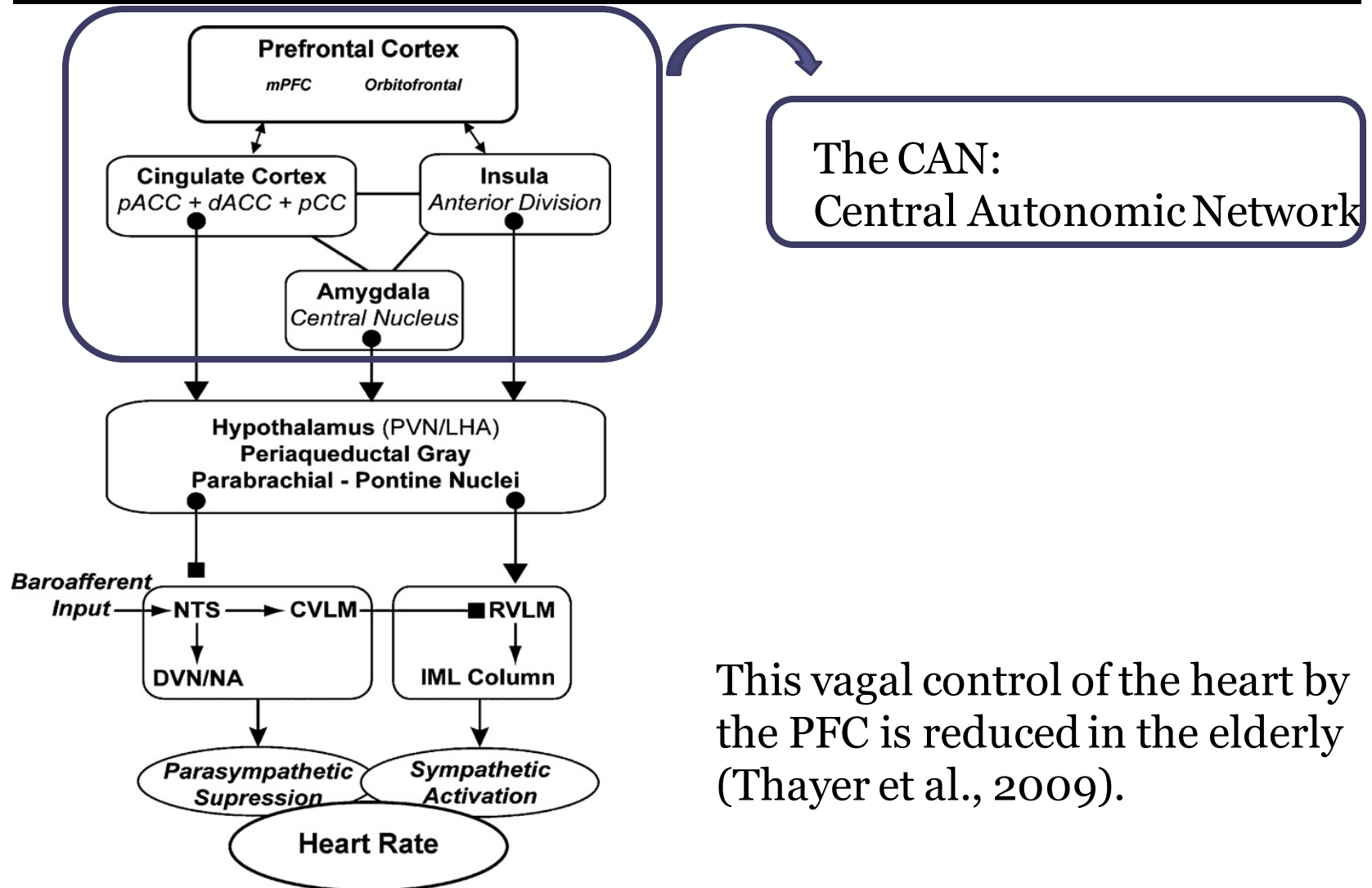


Aging, resting heart rate variability (HRV) and exercise

- Resting HRV is a marker of cardiac autonomous activity (ANS; Task Force, 1996)
 - Greater HRV and mortality  reduced risk of cardiovascular disease
- Resting HRV decreases during normal aging (De Meersman & Stein, 2007; Kim et al., 2006).
- Resting HRV increases with regular aerobic exercise (Albinet et al., 2010; Buchheit et al., 2004).
- Resting HRV as an index of the relationships between
 - The ANS and the CNS
 - Physiological and psychological processes
 - Cardiac activity and PFC activity

Thayer & Lane,
2009; Thayer et al.,
2012

The model of neurovisceral integration: Thayer & Lane, 2009



Objective

- To evaluate the effects of a 5-month aerobic training program (aquaerobics and swimming) on:
 - Executive functions performance
 - Resting HRV
 - Psychological state
 - Aerobic fitness
- To evaluate the relationship between the potential improvements in executive performance and in vagal indices of resting HRV.

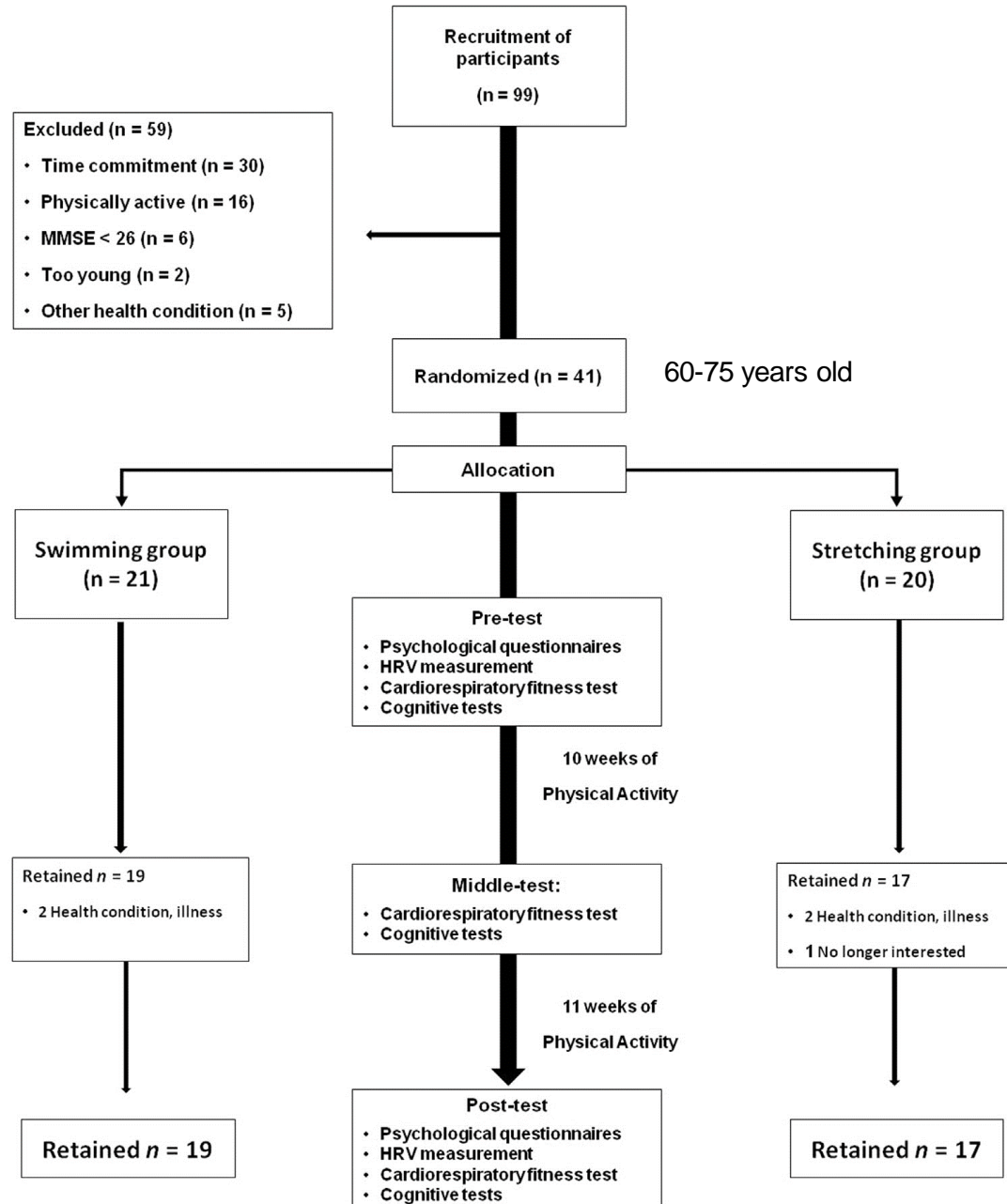
Methods

HRV: vagal activity

- RMSSD (time domain)
- HF power (frequency domain)
- HF / (LF+HF)

Executive functions

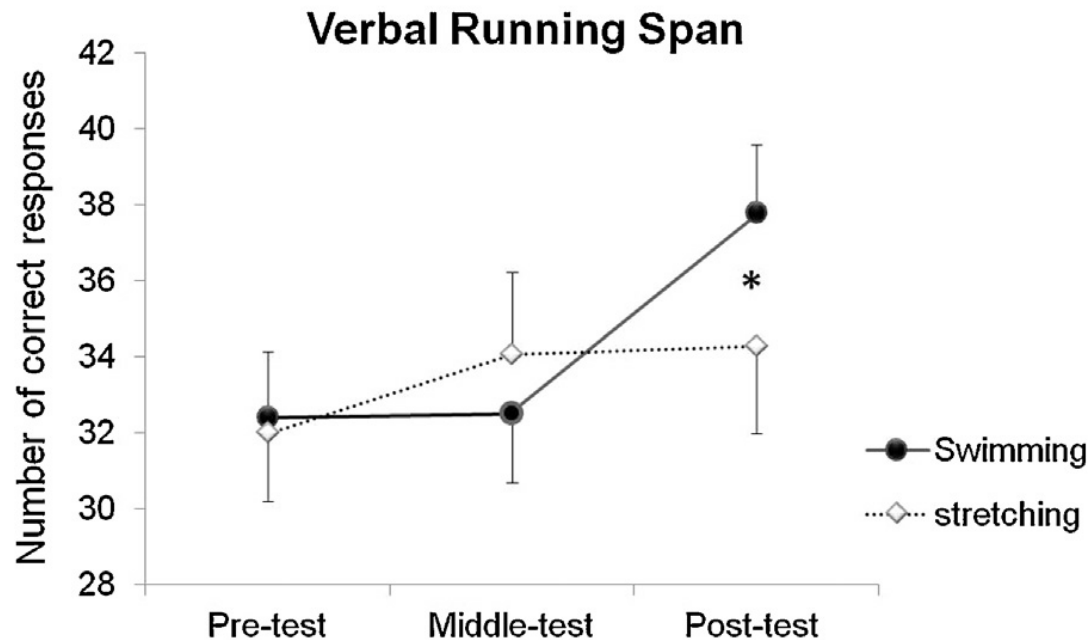
- Inhibition (3 tasks)
- Updating of WM (3 tasks)
- Cognitive flexibility (3 tasks)



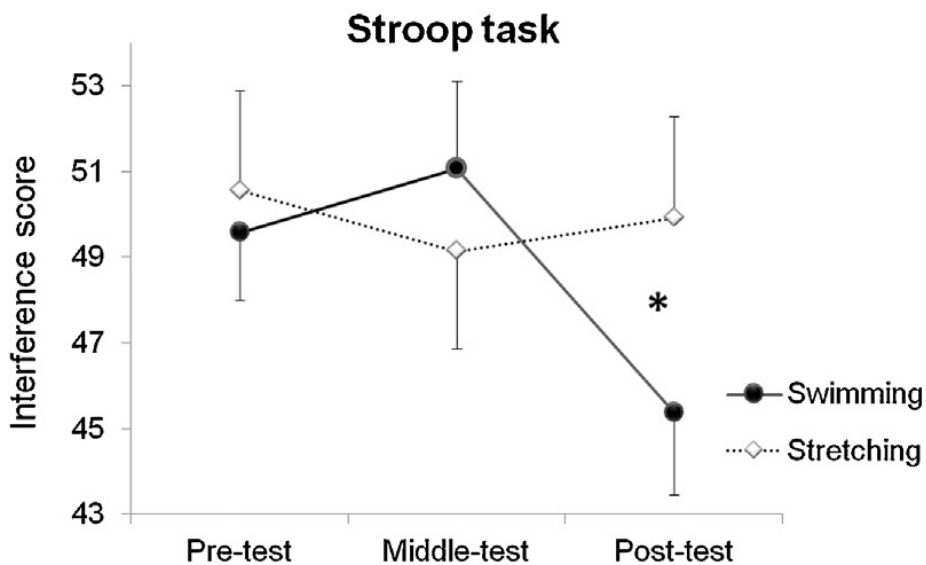
Main Results

- Psychological evaluation
 - Positive main effect of the 2 programs on depression, self-efficacy, decisional balance.
- Cardiorespiratory fitness evaluation
 - Positive main effect of the 2 programs on VO_2max .
- Executive functions evaluation
 - Positive main effect of the 2 programs on the 2-back task
 - Only the Swimming group improved performance on:
 - The verbal running span (updating of WM)
 - The Stroop task (inhibition)

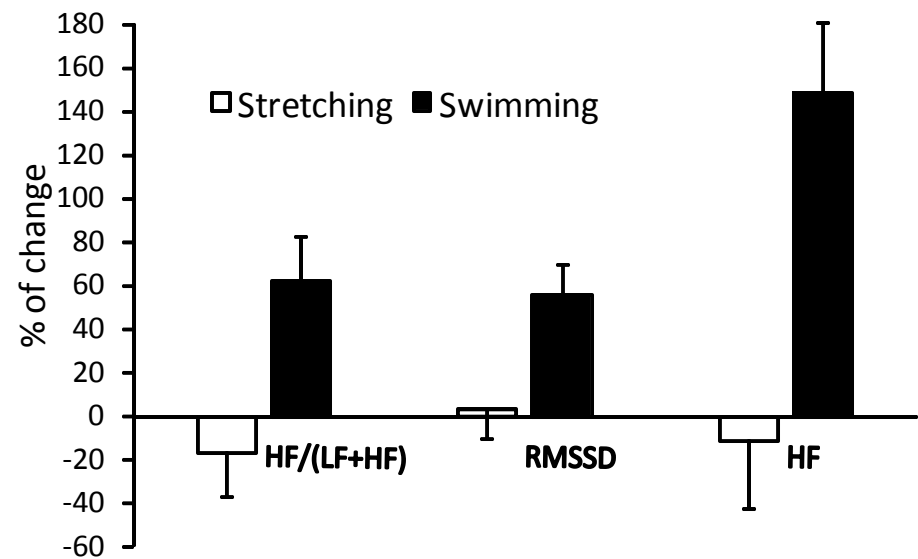
Updating of WM



Inhibition



HRV



Significant relationships between changes in Stroop performance and changes in vagal indices of HRV ($r \approx .35$; $p < .05$)

Discussion

- 5 months of aquaerobics program to see executive improvements in Inhibition and Updating.
- Only the swimming group showed increases in vagal indices of HRV.
- Improvements in Inhibition and in HRV seem to be functionally related.
- Brain regions of the CAN also implicated in cognitive inhibition and in conflict monitoring (Aron, 2007; Miller, 2000) and improved by aerobic exercise (Colcombe et al., 2004; Weinstein et al., 2012).
- Functional network preferentially boosted by the cardiovascular benefits of aerobic exercise?

Open questions

- Why not all the experimental tasks sensitive to aerobic training?
- Is the link between physiological inhibition (of brainstem acceleratory circuits) and cognitive inhibition robust?
- Measurements in a large survey (+200 persons) of resting HRV and cognitive inhibition at home: the PRAUSE survey.
- Combining HRV measures and neuroimaging measures (fMRI) to directly test their functional relationships.

The Poitiers team
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THANK
YOU

Biological Psychology 115 (2016) 69–77



Contents lists available at [ScienceDirect](#)

Biological Psychology

journal homepage: www.elsevier.com/locate/biopsycho



Executive functions improvement following a 5-month aquaerobics program in older adults: Role of cardiac vagal control in inhibition performance

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