The Impact of Inhibitory Control on the Acute Stress Response Comparing Young and Older Adults

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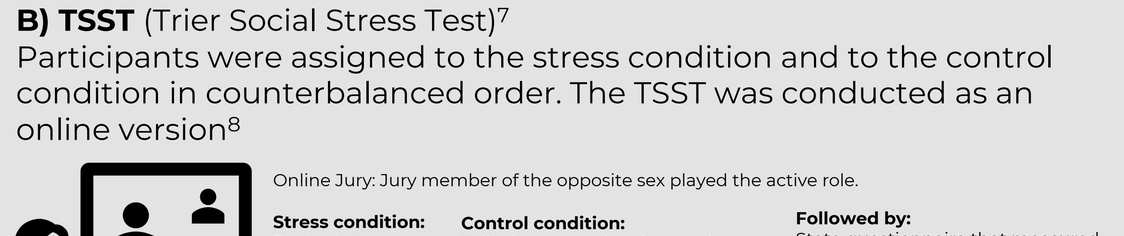
Background

The prefrontal cortex is the brain region that is the most sensitive to effects of stress exposure. Mild stress can cause a rapid and dramatic loss of prefrontal cognitive abilities that require complex and flexible thinking such as executive functions[1]. Inhibitory control is a core executive function, it involves our ability to think before we act. It allows to control automatic impulses such as attention, behavior, emotions or thoughts.
Research suggest that executive functions positively influence the stress response, with higher executive functions supporting a more successful stress regulation[2,3].
Whether this is also the case in older age is unclear[4], the study at hand aims to analyze if young and older adults differentiate and if inhibitory control influences the acute stress response.

Methods

Participants: 35 healthy young adults (18-30); 15 healthy older adults (≥60)
Mean: 23.83 & 69.53
Session: Counterbalanced two session design



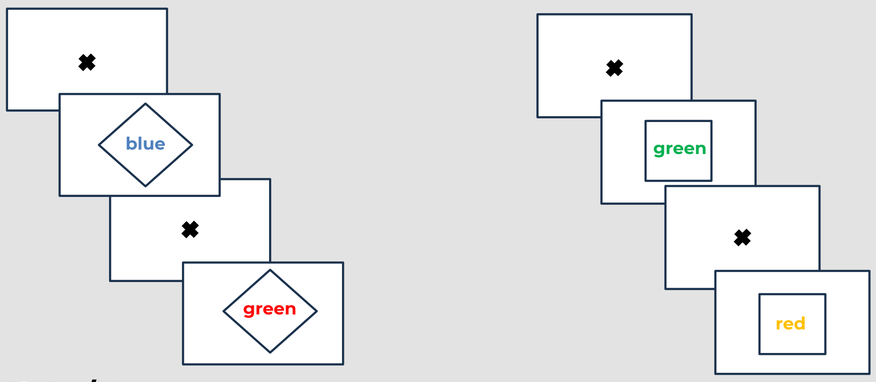
A) Executive Functions (EFS):

Two inhibitory control tasks that were counterbalanced with the ANT and Sternberg task

1) Stroop

Block 1
Diamond= Color WORD

Block 2
Square= Word COLOR



2) Go/Nogo

Reaction Time Limit (RT): Median RT Training + 50ms
30% Nogo
70% Go

B) TSST (Trier Social Stress Test)[7]

Participants were assigned to the stress condition and to the control condition in counterbalanced order. The TSST was conducted as an online version[8]

Online Jury: Jury member of the opposite sex played the active role.

Stress condition:
Fictive job interview
Arithmetic task

Control condition:
Talk about emotional neutral event
Easy summation task

Followed by:
State questionnaire that measured subjective stress level
(stress, nervousness, anxiety).

C) ECG

Heart Rate Variability (HRV) was measured with a 3-point ECG and analyzed with the Kubios HRV software[9]
Meanhr → Measure of the intensity of the strain
Rmssd →measure of parasympathetic activation, often interpreted as an indicator of recovery ability, fitness, and health
lfpeakfft → peak frequency of the low-frequency band (0.04-0.15 Hz), sympathetic as well as parasympathetic activation
Hfpeakfft→peak frequency of the high frequency band (0.15-0.4 Hz), measure of parasympathetic activation, indicator of recovery ability, fitness and health[10].

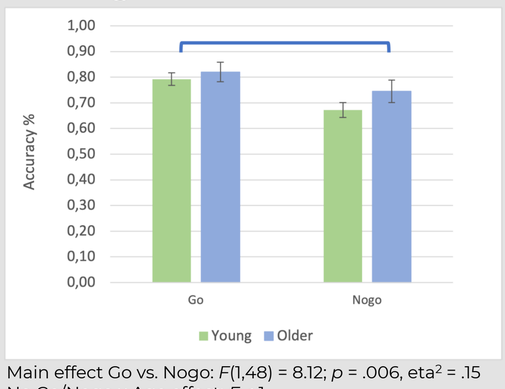
D) Statistical Analyses

RT Median Stroop; Go/Nogo Accuracy Percentage; HRV Parameters; TSST/CG Session:
Repeated-measures ANOVA across the two conditions (TSST vs CG) with age (young, old) as a between subject variable

Efs→Stress: Multiple Regression
Predictor: Age, Efs (Go/Nogo, Stroop)

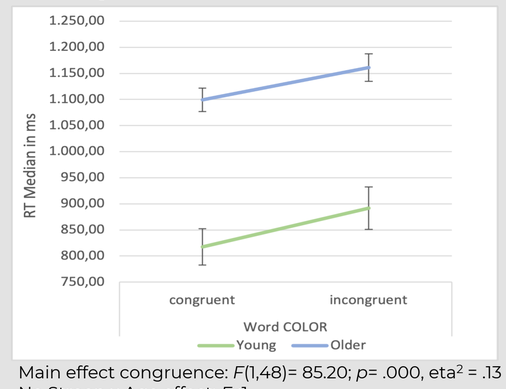
Results

Go/Nogo



Main effect Go vs. Nogo: $F(1,48) = 8.12$; $p = .006$, $eta^2 = .15$
No Go/Nogo x Age effect: $F < 1$

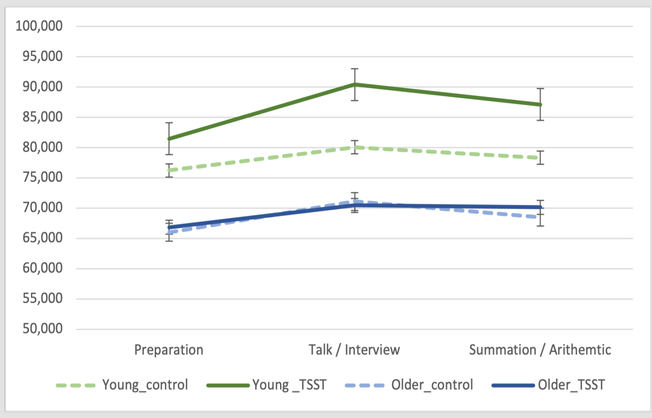
Stroop



Main effect congruence: $F(1,48)= 85.20$; $p= .000$, $eta^2 = .13$
No Stroop x Age effect: $F<1$

TSST

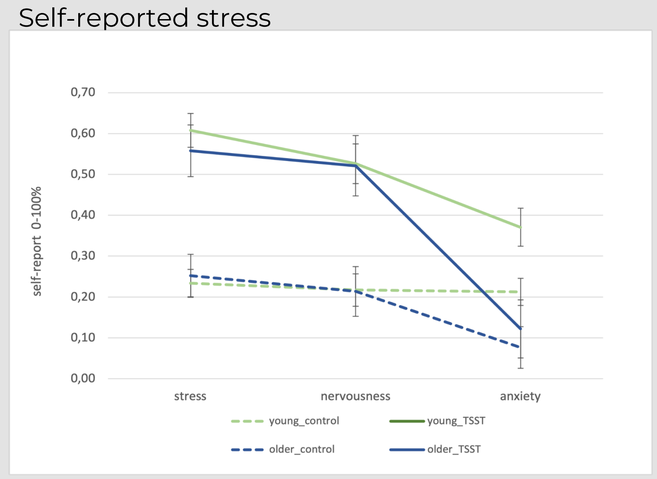
Meanhr



Resting meanHR in TSST and KG is more or less the same - in comparison, mean HR in TSST increases from Resting to Prep, in KG it does not.

Main effect KG TSST x Age Group $F(1,48)= 11.25$; $p= .002$, $eta^2 = .190$
Main effect Preparation, Talk/Interview, Summation/Arithmetic $F(2,96)= 26.28$; $p= .000$, $eta^2= .354$
Main effect KG TSST x Preparation, Talk/Interview, Summation/Arithmetic x Age Group $F(2,96)= 6.270$; $p=.003$, $eta^2= .116$

Self-reported stress



Main effect State Items $F(2,96)= 47.84$; $p= .000$, $eta^2= .499$
Main effect State Items x Age Group $F(2,96)= 10.05$; $p= .000$, $eta^2= .173$

Predictors of subjective and physiological stress response

	TSST			
	Standardized b and p values			
Criteria	Age	Go Nogo	Stroop	
State Stress	-	-	-	Modell not significant R2= .077 (adjusted R2= .02) F(3,46)= 1.28; p= .291
MeanHR	b= -.596; p= .000	b= -.247; p= .036	b= .155; p= .191	*
RMSSD	b= .454; p= .001	b= .066; p= .617	b= -.226; p= .098	
LF peak	b= -.469; p=.001	b= -.070; p= .594	b= .065; p= .629	* *also in CG
HF peak	b= .609; p= .000	b= -.075; p= .531	b= -.101; p= .407	*

→No prediction by age and executive functions in behavior and response inhibition on subjective stress level TSST

Conclusion

- Older adults perform better at Go/Nogo task and improve from block 1 to 2 whereas the younger ones deteriorate
- Older adults perform slower at Go/Nogo and Stroop

→ Older adults were physiologically not as stressed/barley stressed as the younger adults
→ Subjectively the TSST worked and both age groups were stressed
→ Older adults have no losses at executive functions
→ No prediction by age and EFs on the stress response

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