

# Effect of Bilingualism on the Subcomponents of Attention in Older Adults: Neuroimaging Study using ANT Task

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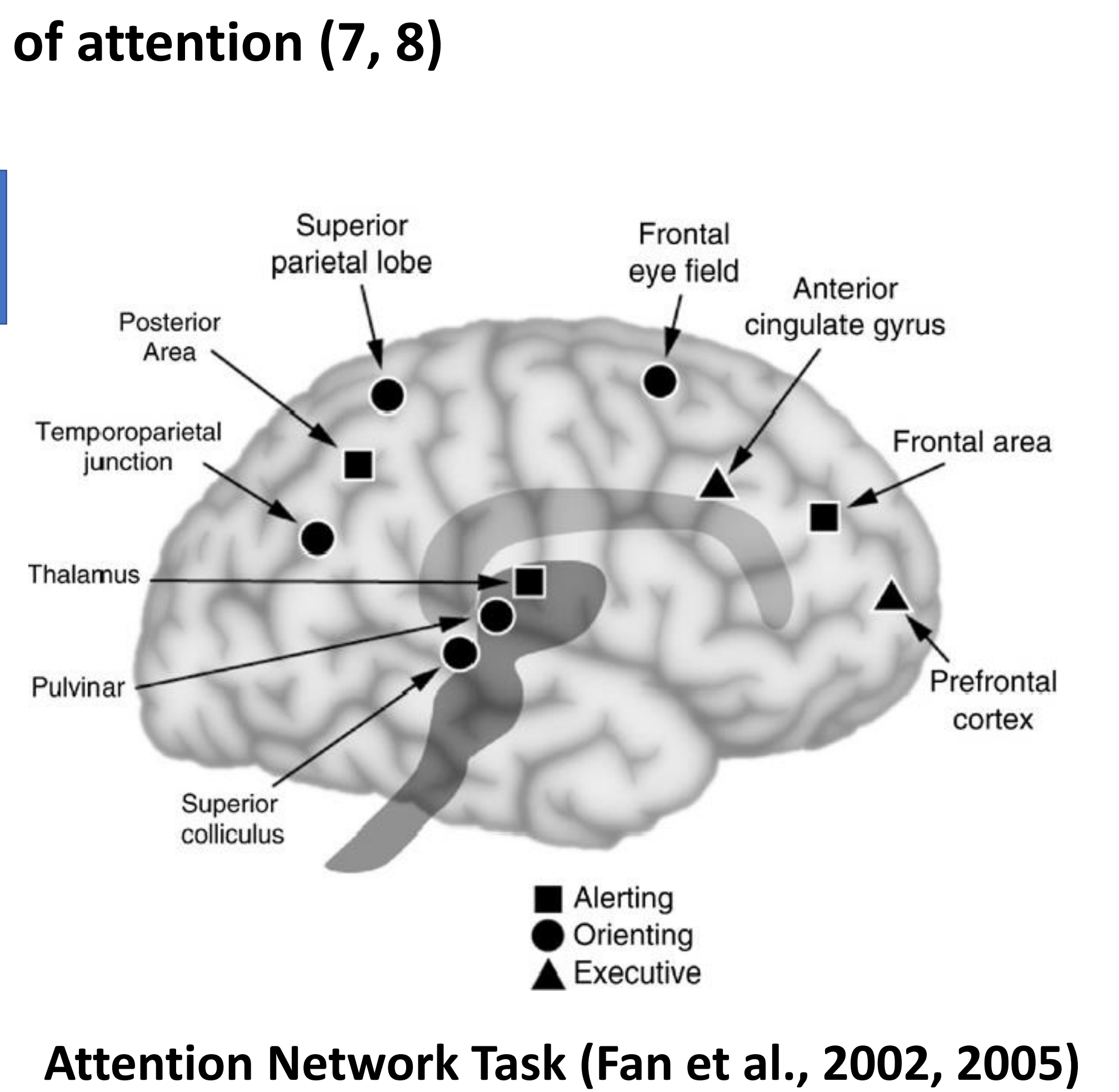
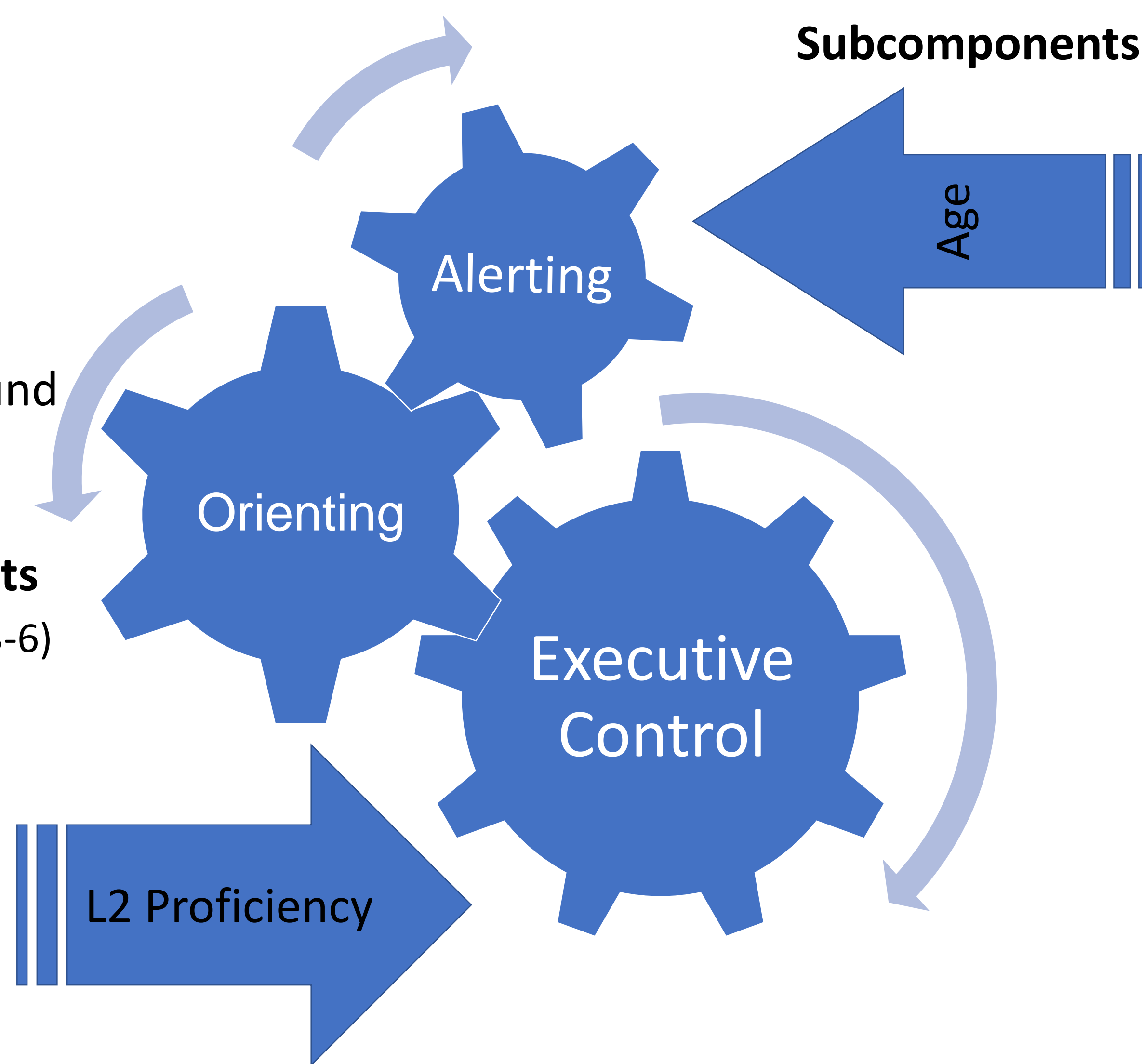
**Age-related differences in subcomponents of Attention – reduced alerting (1, 2) and executive control ability (2).**

- No ageing study defines the language background of the participants

**Bilingualism related differences in subcomponents of attention only in the executive control ability (3-6)**

- Mostly all the studies are comparing bilingual groups

**No studies focus on both age and bilingualism together**



**Aim:** The goal of this study is thus to determine whether elderly bilinguals' show a behavioral and neurofunctional advantage over young adults – matched on measures of bilingualism as well as education – in different subcomponents of attention as measured by the ANT task.

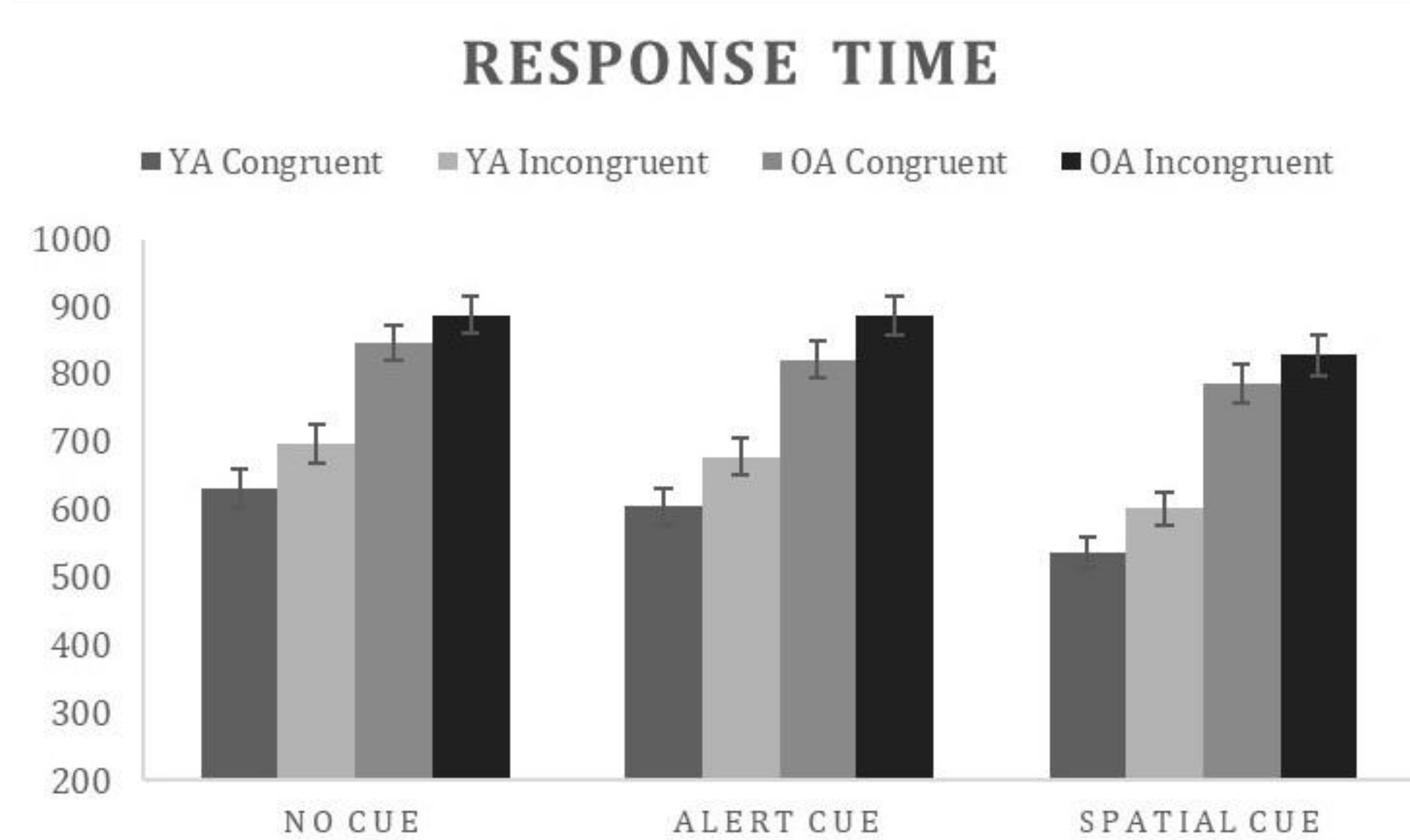
## Method

### Participants

	Young Bilinguals (N=20)	Older Bilinguals (N=18)	t	Sig. (2-tailed)
	Mean (SE)	Mean (SE)		
<b>Demographic information</b>				
Age	32.6 (0.7)	73.9 (0.6)	-41.6	0.00*
Education	18.7 (0.7)	16.8 (0.6)	1.8	0.087
Gender	Female = 9	Female = 11		
<b>Neuropsychological assessments</b>				
MoCA	29.2 (0.1)	28.61 (0.2)	1.9	0.095
TMT A	16.8 (0.7)	30.09 (1.9)	-6.4	0.00*
TMT B	39.7 (2.3)	60.02 (5.3)	-3.5	0.00*
OBT_RT	751.3 (34.1)	931.5 (40.7)	-3.4	0.00*
OBT_Acc	0.9 (0.007)	0.8 (0.01)	1.7	0.098
<b>Subjective measures of LP</b>				
L2: Percent exposure	26.5 (3.4)	18.3 (2.8)	1.7	0.08
L2: AoA-Speaking	7.4 (0.7)	8.3 (0.7)	-0.9	0.36
L2: AoA-Reading	10.7 (0.9)	12.9 (1.1)	-1.4	0.15
L2: LP-Speaking (Max:10)	7.3 (0.3)	6.2 (0.4)	1.8	0.07
L2: LP-Reading (Max:10)	7.9 (0.3)	7.2 (0.3)	1.6	0.12
<b>Objective scores on the measures of LP</b>				
L2 LexTale (%)	80.5 (2.3)	81.9 (2.1)	-0.4	0.66
L2 BNT (Max:60)	48.8 (1.4)	46.2 (1.3)	1.3	0.19
L2 RC (Max:11)	5.9 (0.4)	6.2 (0.43)	-0.5	0.60
L2 Discourse (Max:18)	17.02 (0.1)	16.7 (0.3)	0.7	0.43
L2 Composite LP scores (%)	77.5 (0.01)	77.2 (0.01)	0.1	0.89

Note: SE, Standard error; MoCA, Montreal Cognitive Assessment; TMT, Trial Making Test; OBT, One back Test; RT, Response time; Acc, Accuracy; LP, Language Proficiency; L2, Second Language; AoA, Age of Acquisition; BNT, Boston Naming Test; RC, Reading Comprehension

## Results



**For Older adults**, the magnitude of warning cue effects – alerting (No cue – Alert cue) and orienting effect (Alert cue – Spatial cue) – were smaller when compared to young adults, indicating that with increasing age the ability to take advantage of the warning cues reduces.

## Discussion

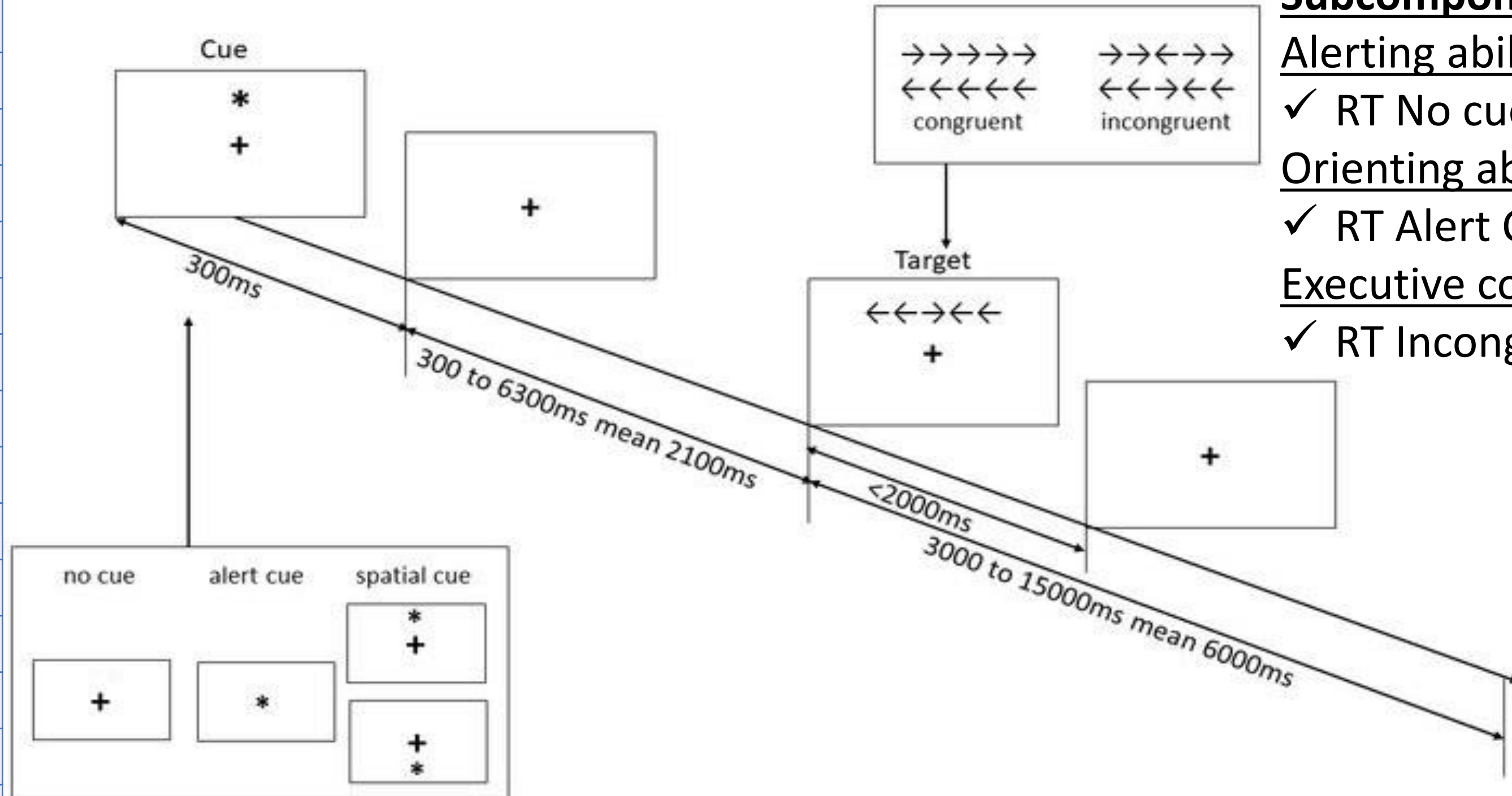
- Increasing age was associated with reduced alerting and orienting abilities, but no effect of age was seen on executive control ability.
- As for the neural correlates, disjunction analyses showed increased activity in left frontal (**BA10- i.e. alerting**) and right parietal (**BA39- i.e. orienting**) areas in older bilinguals, as compared to young bilinguals whereas no difference across age groups was observed in regards to executive control areas.
- This is associated with an increase in neural activity in elderly bilinguals, particularly in the fronto-parietal complex, sub-serving top-down attention control processes.
- L2 variable showed correlation **only for alerting ability**.
- As a whole, neurofunctional and behavioral results show that bilingualism could represent a protective factor against age-related decline in the executive component of attention.

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### Task and Procedure:

#### Attention Network Task – er-fMRI design



### Data Analysis:

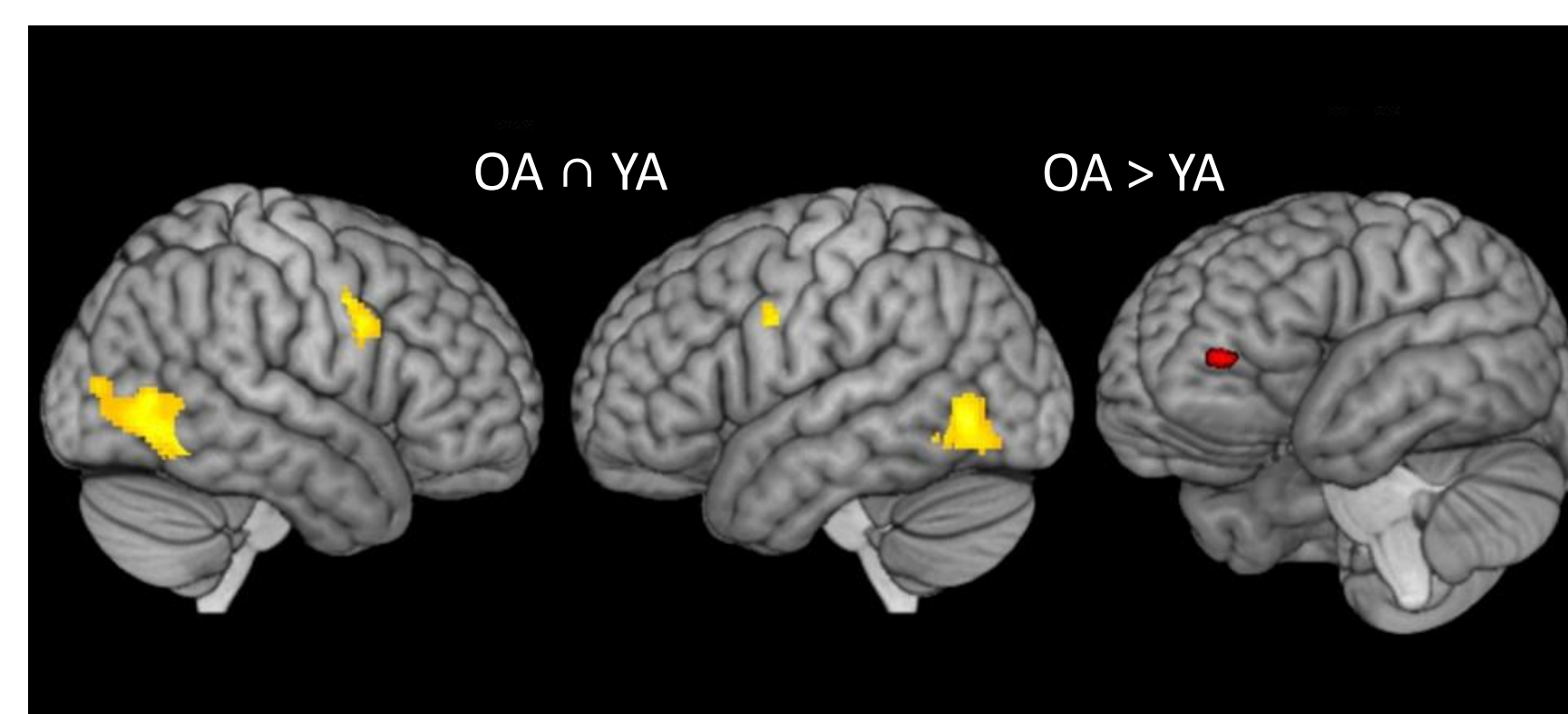
**Behavioral data analysis:** Mixed ANCOVA - Groups (OA vs YA) \* Flanker conditions (congruent vs. incongruent) \* Warning cues (no, alert, or spatial) \* covariate - average response time of each participant

**Image preprocessing:** SPM12

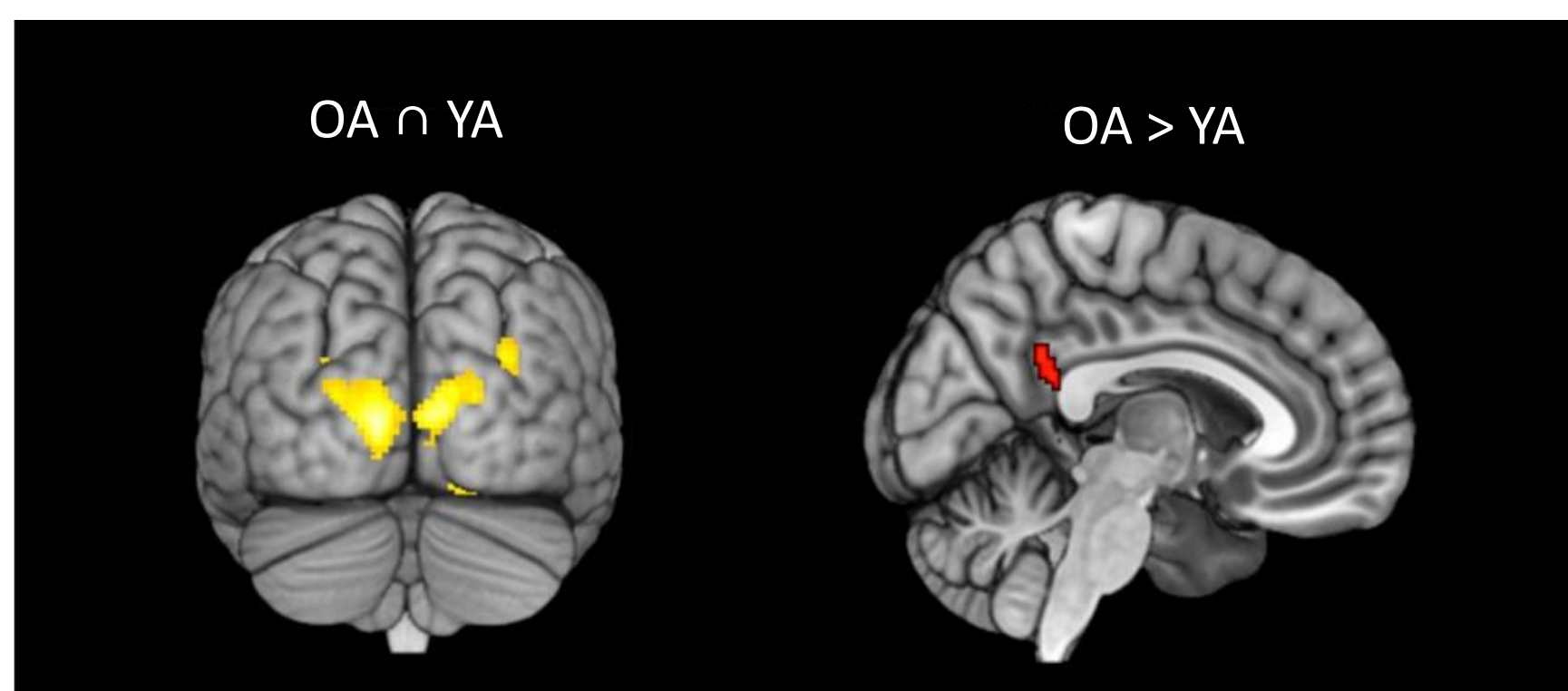
**Conjunction and Disjunction analysis:** A t-test analysis ( $K \geq 20$ ,  $p \leq 0.001$ ) was conducted on the contrast images of interest.

**Correlation analysis:** Neuropsychological and measures of bilingualisms are correlated with response time and activation maps.

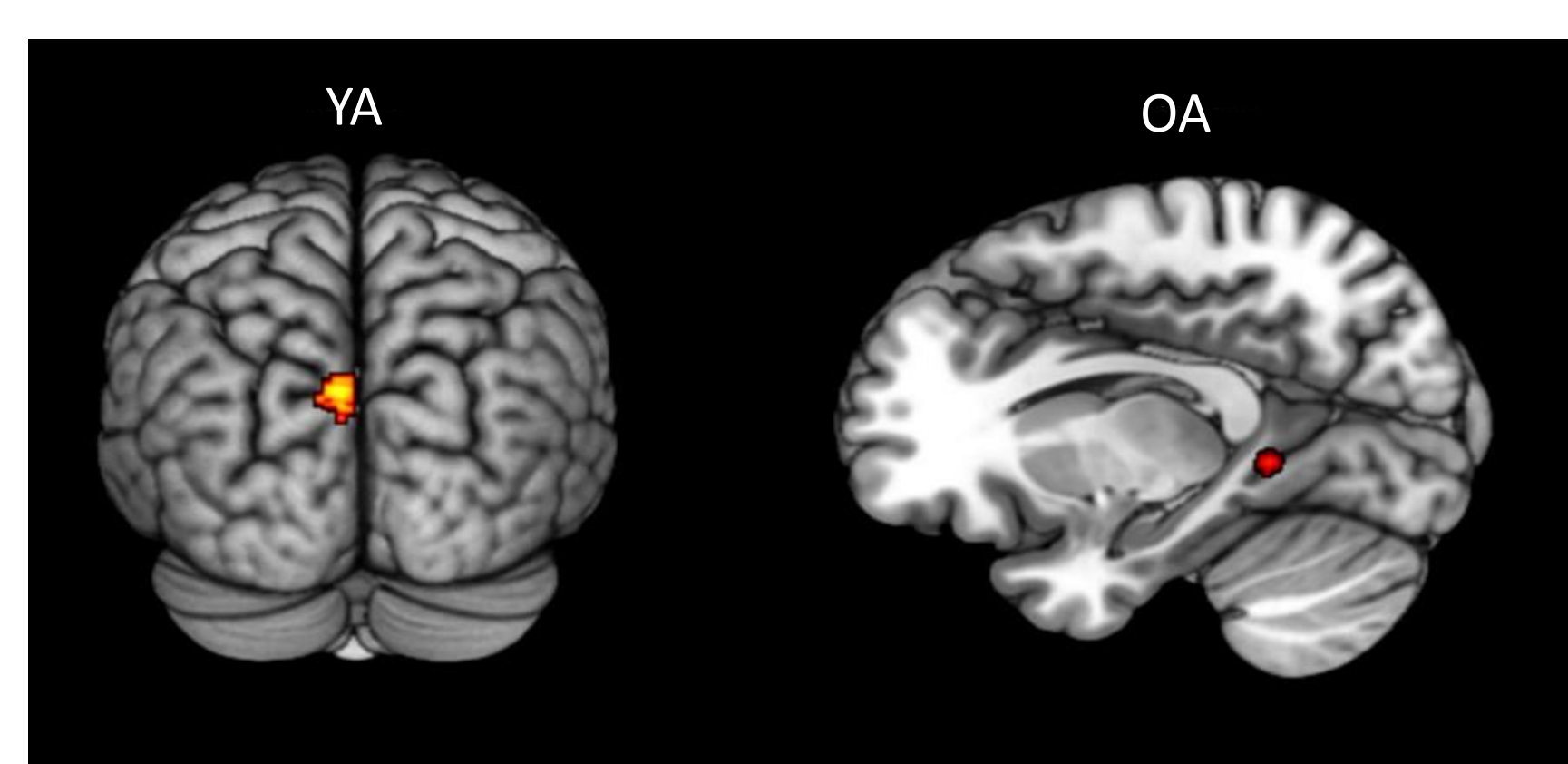
### fMRI results for the different subcomponents of attention



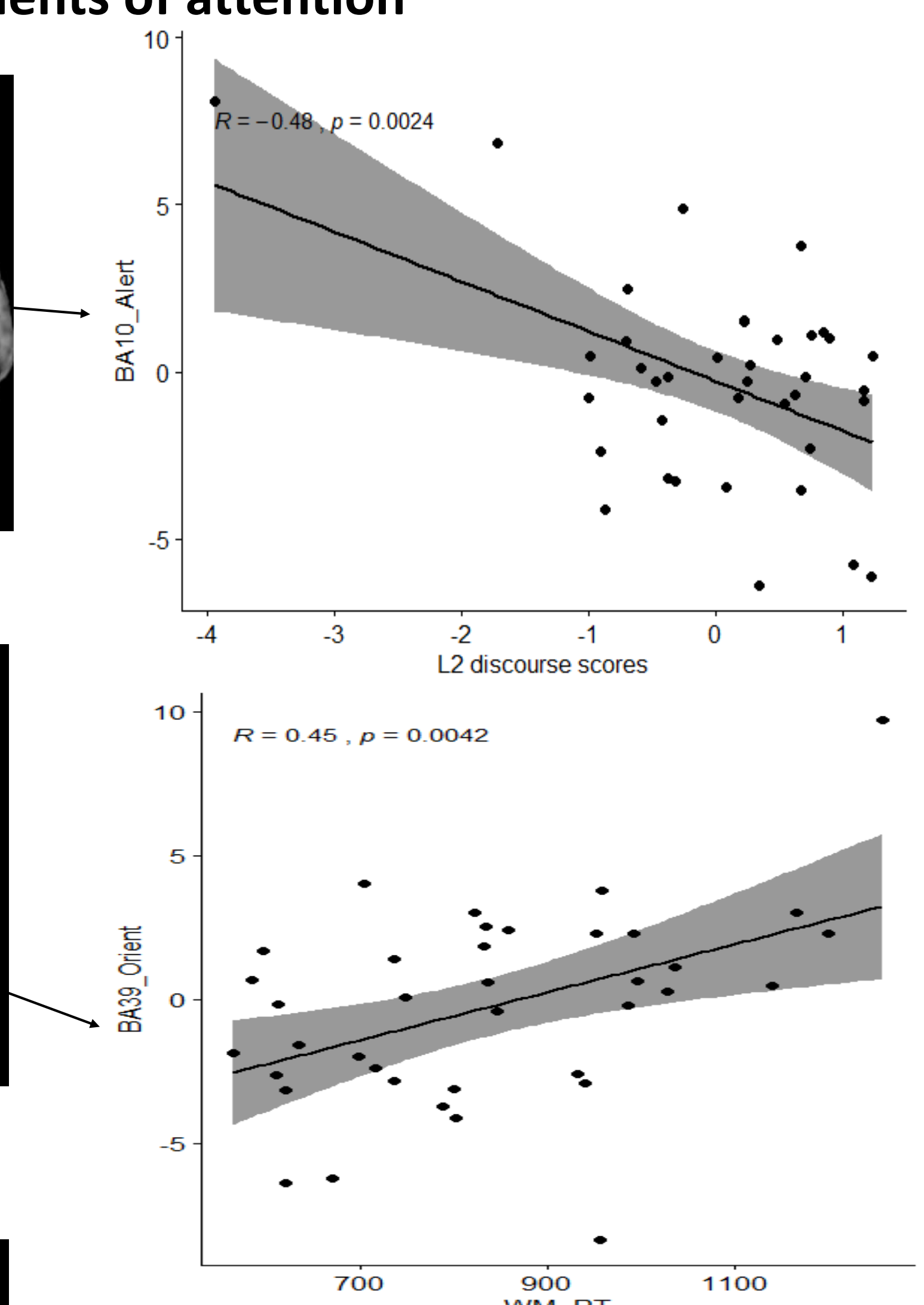
#### Alerting Ability



#### Orienting Ability



#### Executive control ability



Note: WM\_RT, response time for the Working memory task

- References:**
- Jennings, Dagenbach, Engle, & Funke. (2007). *Aging, Neuropsychology, and Cognition*, 14(4), 353-369.
  - Mahoney, Verghese, Goldin, Lipton, & Holtzer. (2010). *Journal of the International Neuropsychological Society*, 16(5), 877-889.
  - Costa, Hernández, & Sebastián-Gallés. (2008). *Cognition*, 106(1), 59-86.
  - Tao, Marzecová, Taft, Asanowicz, & Wodniecka. (2011). *Frontiers in psychology*, 2, 123.
  - Marzecová, Asanowicz, Kriva, & Wodniecka. (2013). *Bilingualism: Language and Cognition*, 16(3), 608-623.
  - Hilchey, & Klein. (2011). *Psychonomic bulletin & review*, 18(4), 625-658.
  - Posner, & Petersen. (1990). *Annual review of neuroscience*, 13(1), 25-42.
  - Petersen, & Posner (2012). *Annual review of neuroscience*, 35, 73-89.
  - Fan, McCandless, Fossella, Flombaum, & Posner, (2005). *Neuroimage*, 26(2), 471-479.
  - Fan, McCandless, Sommer, Raz, & Posner. (2002). *Journal of cognitive neuroscience*, 14(3), 340-347.