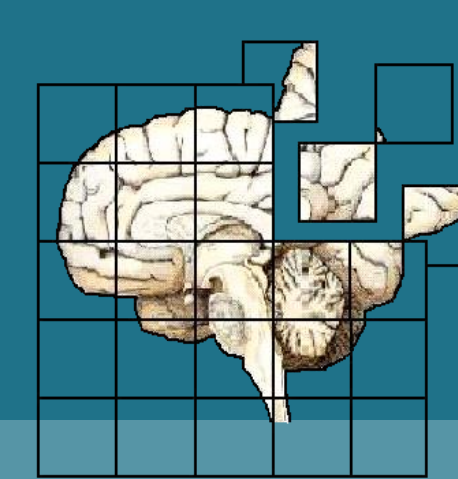




# Attentional Networks during the Menstrual Cycle



Zahira Z. Cohen<sup>1</sup>, Neta Gotlieb<sup>2</sup>, Offer Erez<sup>1,3</sup>, Arnon Wiznitzer<sup>4</sup>, Oded Arbel<sup>5</sup>, Devora Matas<sup>6</sup>, Lee Koren<sup>6</sup> & Avishai Henik<sup>1</sup>

<sup>1</sup>Ben-Gurion University of the Negev, Beer-Sheva, Israel; <sup>2</sup>University of California, Berkeley, California; <sup>3</sup>Soroka Medical Center, Beer-Sheva, Israel; <sup>4</sup>Rabin Medical Center and Tel-Aviv University, Tel-Aviv, Israel; <sup>5</sup>Beer-Sheva Mental Health Center, Israel; <sup>6</sup>Bar-Ilan University, Ramat-Gan, Israel

## Introduction

There are three attentional networks - Alerting, orienting and executive control - and their interactions is

studied using the ANT-I [Fig. 1] [1]

- ANT-I: Attentional Network Test –Interactions
- Main neurotransmitters: Norepinephrine (NE), acetylcholine (ACh), serotonin (5-HT), dopamine (DA) [2-4]

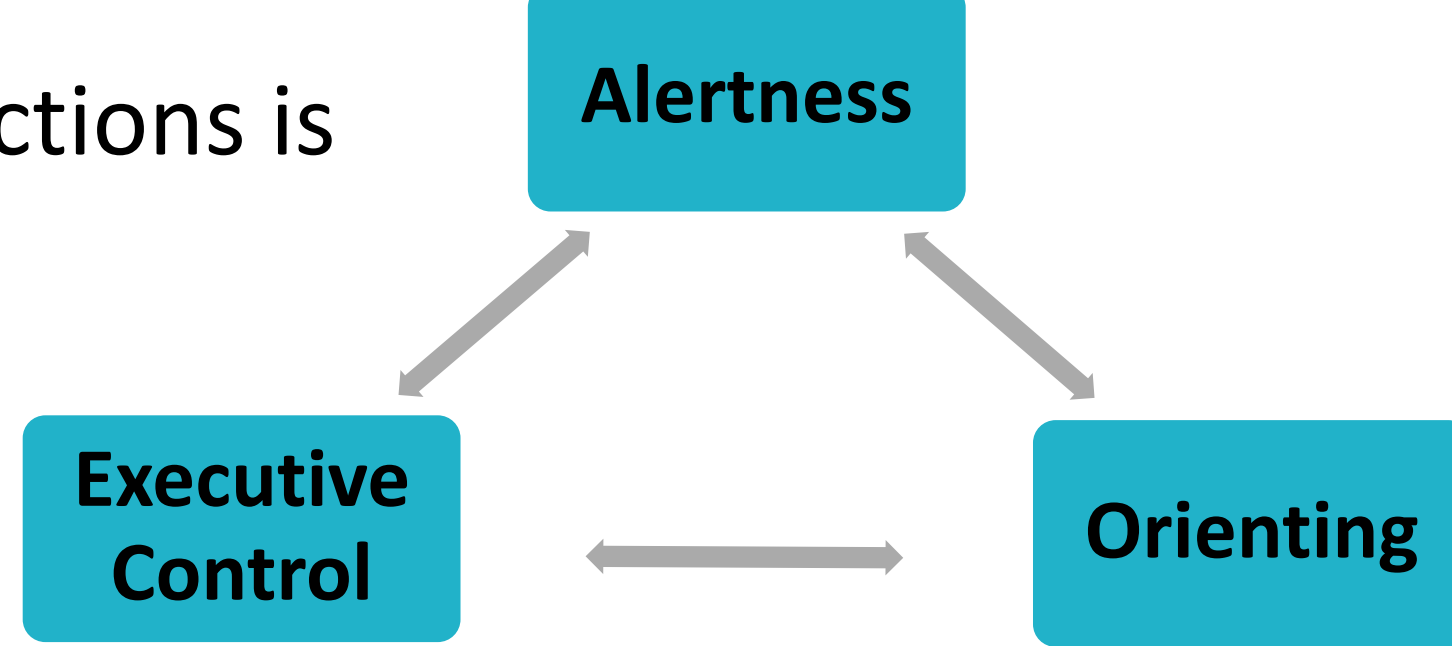


Fig. 1: The three attentional networks

Ovarian hormone levels, Estradiol (E2) and Progesterone (P4), change during the menstrual

cycle [Fig. 2] [5]

- E2 and P4 influence NE, ACh, 5HT and DA, implicated in the regulation of cognition and affect [e.g., 6-8]

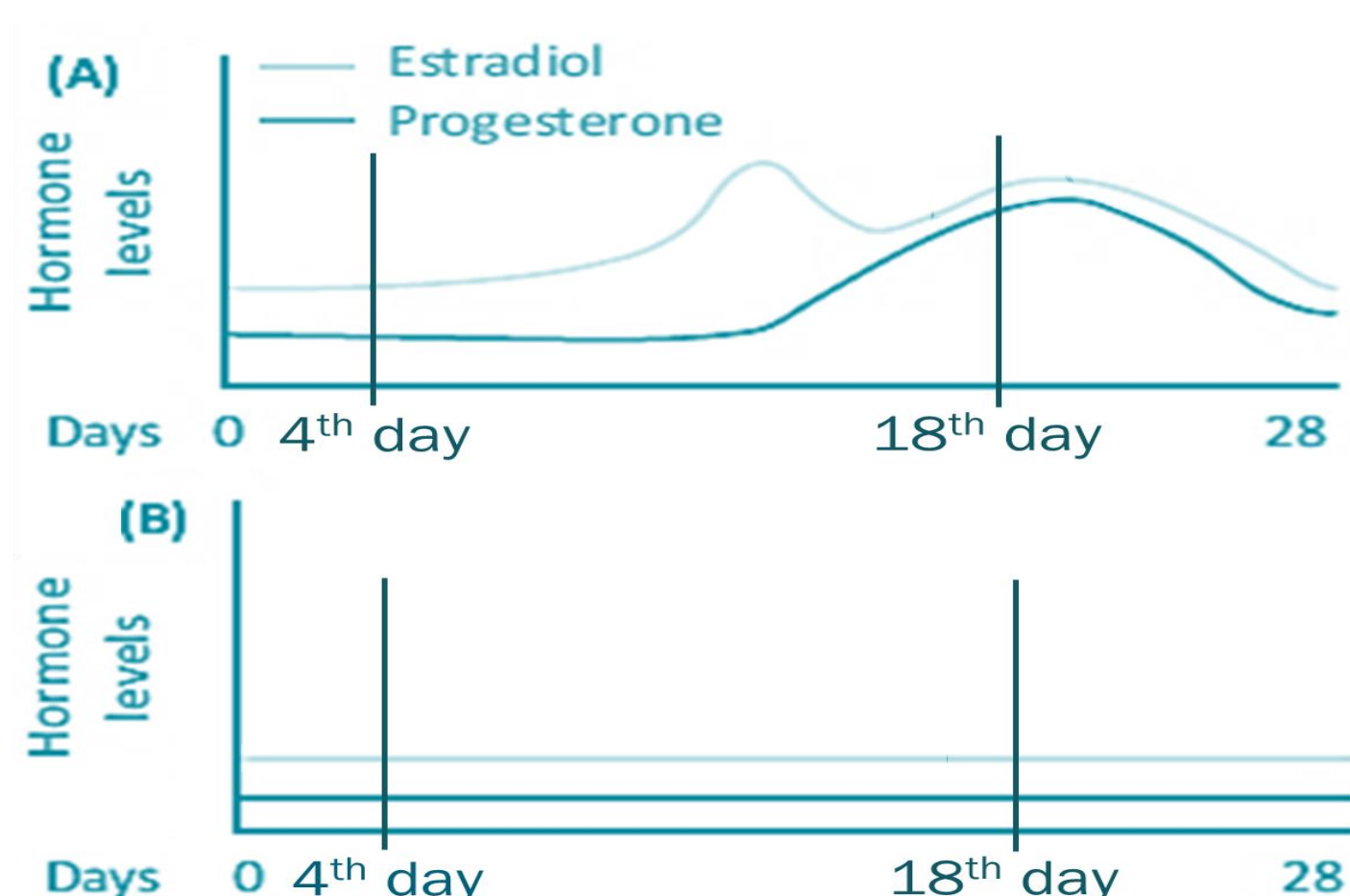


Fig. 2: E2 and P4 - natural cycle (A) and under contraceptives (B) [5]

Reflexive attention (alertness and orienting) is changed during the menstrual cycle [9]

## Current study

Examining the three attentional networks and their interactions during the menstrual cycle

- **Group:** under contraceptives (OC) / natural menstrual cycle (NC)
- **Time:** 4<sup>th</sup> day - early follicular phase (low E2 and P4) and 18<sup>th</sup> day - luteal phase (high E2 and P4)
- E2 and P4 level in saliva correlates with ANT-I

## Methods

- E2 and P4 saliva samples
- Age range: 19-27 years
- Mean age
  - OC – 23.4 (SD=1.3)
  - NC – 22.9 (SD=2.1)

Table 1: No. of participants

Order/ Group	Early Follicular First	Early Luteal First	Total
OC	14	10	24
NC	11	10	21
Total	25	20	N=45

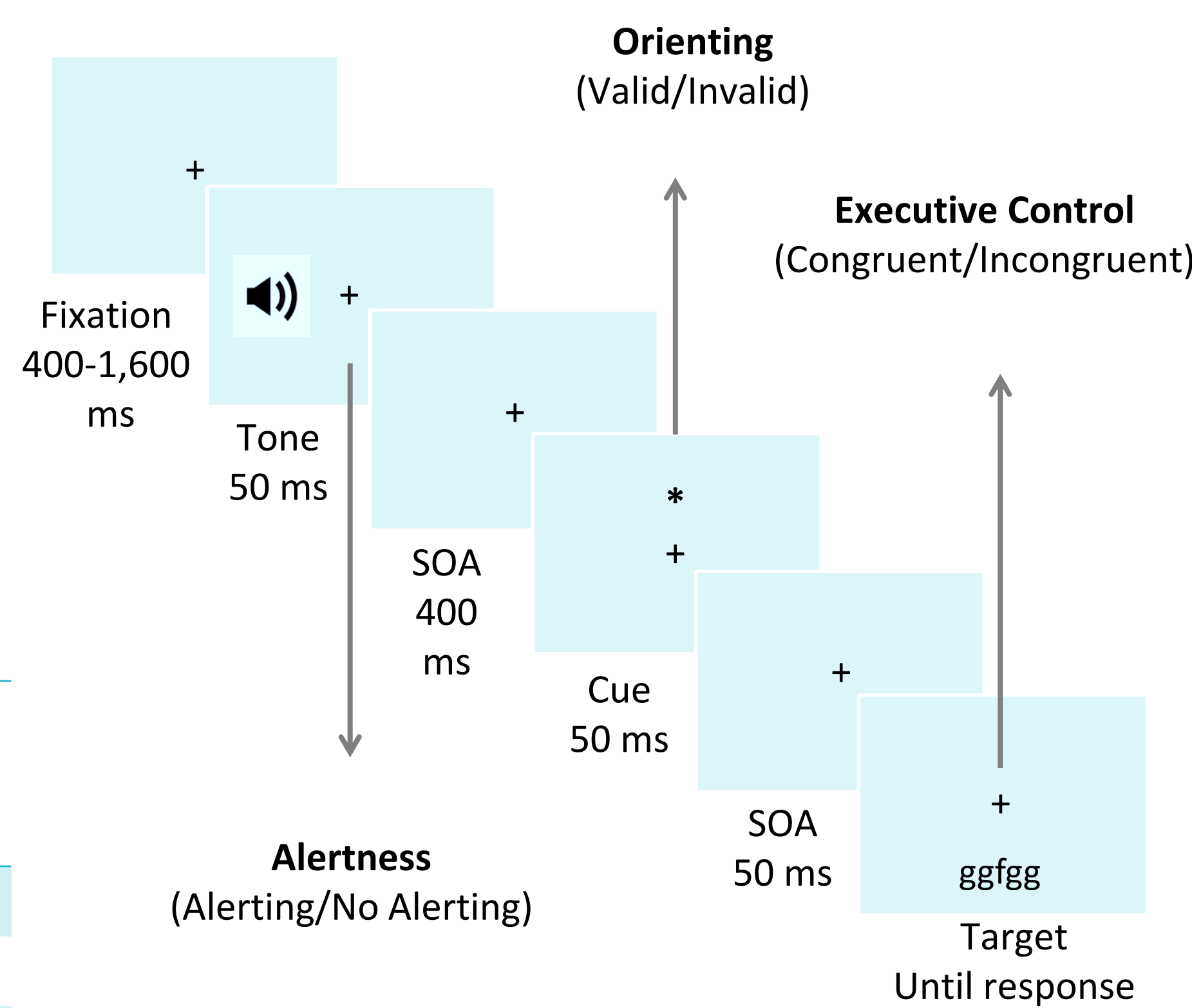


Fig. 3: Trial sequence in the ANT-I

## Results

- **Behavioral – ANT-I:** Group X Time X ANT-I,  $F(1, 41) = 6.7, p = .01, \eta_p^2 = .14$ .
- **OC** – No significant time difference in the RT pattern of the ANT-I. The ANT-I was significant,  $p = .006, \eta_p^2 = .17$  [Figure 4a]
- **NC** – Significant time differences in the RT pattern of the ANT-I,  $p = .02, \eta_p^2 = .11$ . Only in the early follicular phase the ANT-I was significant,  $p = .001, \eta_p^2 = .21$  [Figure 4b]. In the early luteal phase, no-alerting trials exhibited the same pattern as alerted trials [Figure 4c]

## Results – Cont.

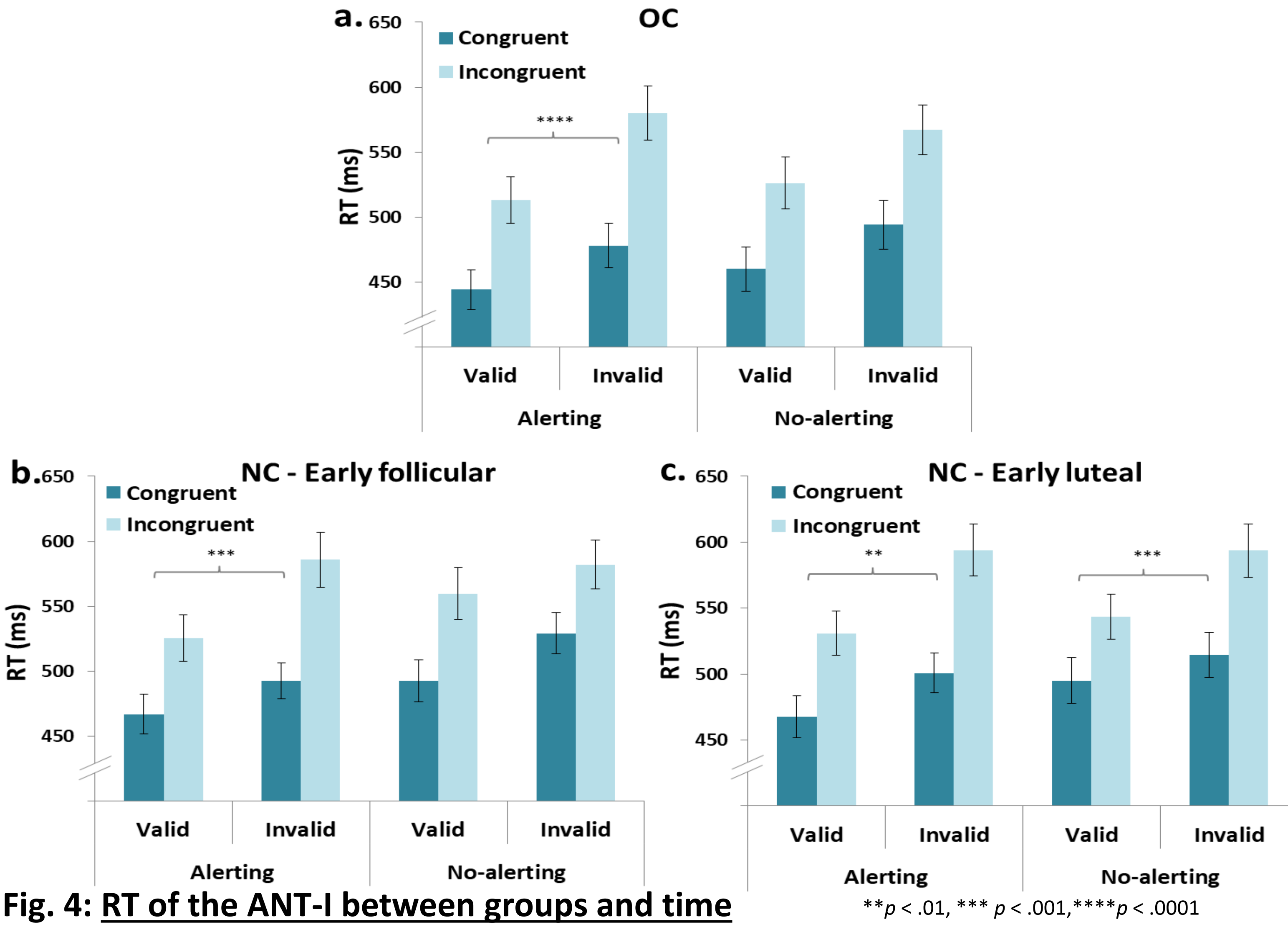


Fig. 4: RT of the ANT-I between groups and time

E2 and P4 – Results-driven regression analysis

- **Delta P4** – significantly predicted RT interaction
  - RT interaction = invalid (incongruent – congruent) – valid (incongruent – congruent), 0 = main effects only, no interaction
  - Delta P4 (P4 early luteal – P4 early follicular)

RT interaction with Delta P4	r	p
Alerting	.162	.46
No Alerting	.496	.013

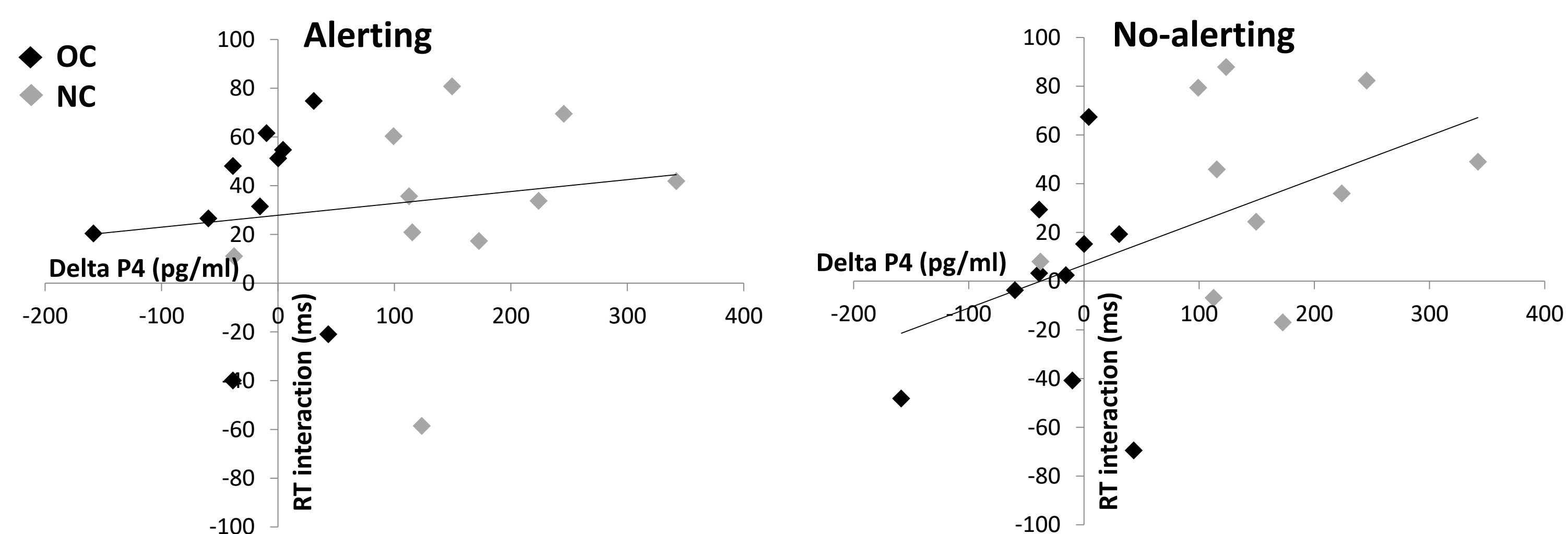


Fig. 5: RT interaction and Delta P4 in alerting and no alerting

- **Mediation model** – Sobel test confirmed a mediation of Delta P4 on group and RT interaction ( $z = 2.169, p = .03$ )

## Discussion

- **ANT-I replication:** the three attentional networks interact [1]
  - The **alerting** network influenced the **executive** network differently depending on the **orienting** network: When alerted, the ability of resolve a conflict (i.e., the congruency effect) was stronger (i.e., the difference between incongruent and congruent was smaller) when attention was oriented to the same place as the conflicted stimuli (i.e., for valid trials, compared to invalid trials). When non-alerted, the ability to resolve conflict was not different for an oriented and non-oriented location
- **Menstrual cycle** has influence on attentional networks' interactions:
  - The OC group showed no differences in the ANT-I pattern between the two phases, while the NC group showed a different ANT-I pattern in the early luteal phase
  - **In the NC group, the alerting system was activated without an alerting tone**
  - The difference in P4 from the early follicular to the early luteal phase mediated the behavioral results found for the NC group, suggesting **P4 induced an alerting state**
  - The relation between P4 and alertness may originate in the locus coeruleus (LC), the source of the brain's NE [2]
- The study emphasizes the importance of awareness to the menstrual cycle when evaluating psychological states and behavior, and influences the way we understand female cognition

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Correspondence:  
Zahirac@post.bgu.ac.il

