Project Proposal

Brain Asymmetry and Visual Working Memory: Investigating the Impact of Negative Distractors

CCBS7002
Group 9

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Outline

- Introduction
  - Learning and memory
  - Factors influencing working memory capacity
  - Affect and visual working memory
  - Affect and brain asymmetry
  - Visual working memory and brain asymmetry
  - Hypothesis
- Method
  - Participant
  - Procedure
    - Affect: PANSA
    - Visual Working Memory: Emotion N-Back + Surprise Memory Recognition
    - Brain Asymmetry: EEG Resting State
    - Statistics and Expected Results
- TimeLine

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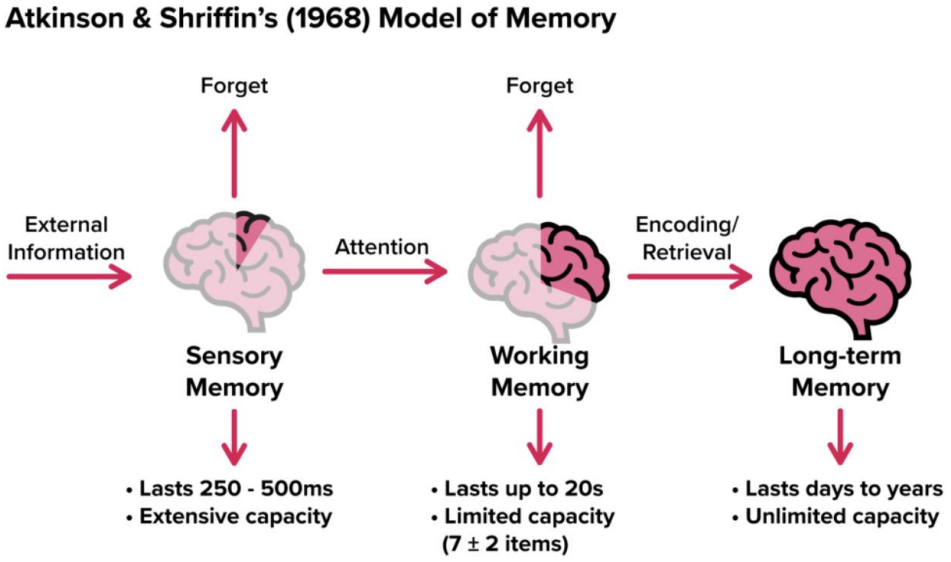
Learning and Memory

- Learning is the process of acquiring that new information, and the outcome of learning is memory.

Model of memory

- In order for information to enter long-term memory in a form that allows later retrieval, it first must be presented in **working memory** in a suitable form.

- **Visual working memory** shows a significantly positive correlation with academic performance, demonstrating a particularly strong association with mathematical performance in young children.



(Gazzaniga et al., 2019; Cowan, 2014; Allen et al., 2019; Atkinson & Shriffin, 1968)

Factors Influencing Working Memory Capacity

- Age
- Sleep quality
- Physical activity
- Music listening
- Motivation
- Affect
- etc.

Definition of affect

- Affect encompasses issues of temperament, emotions and how individuals feel and response towards information, people, objects, actions and thoughts

Positive and negative affect

😊 Positive affect encompasses pleasant emotions like happiness, joy, excitement, and contentment, contributing to well-being and satisfaction.

☹️ Negative affect comprises unpleasant emotions such as sadness, fear, anger, anxiety, and disgust, leading to distress or dissatisfaction.

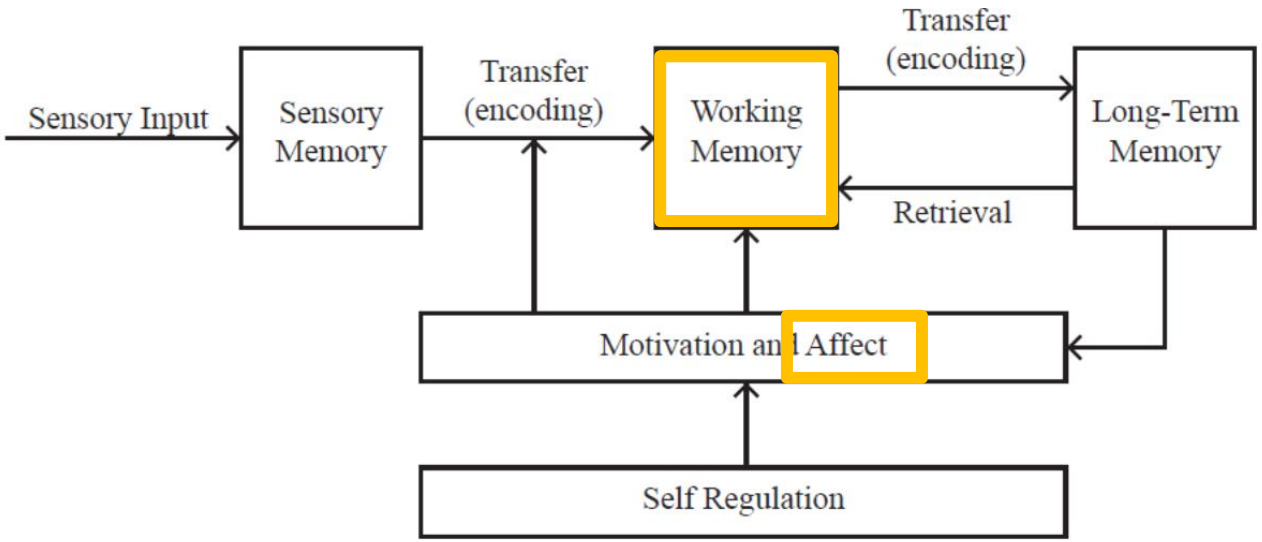
(Anggraini, 2023; Feng & Rawian, 2023)

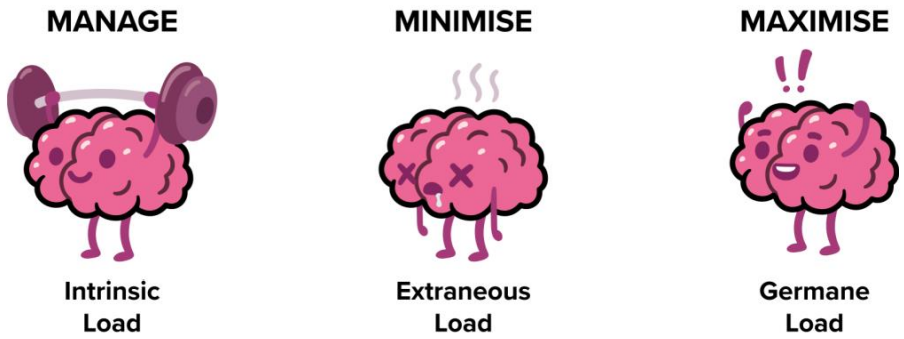
Affect and Visual Working Memory

Cognitive-affective theory of learning

- A theoretical framework that emphasizes the interaction between cognitive processes and affective processes in learning.

- Aligned with **Cognitive Load Theory (CLT)**, that emphasizes managing cognitive load in learning activities.





(Ip & Li, 2015; Sweller, 1998)

Affect and Visual Working Memory

Positive affect improves working memory: Implications for controlled cognitive processing

Hwajin Yang, Sujin Yang & Alice M. Isen

Pages 474-482 | Received 15 Mar 2012, Accepted 16 Jul 2012, Published online: 24 Aug 2012

Cite this article https://doi.org/10.1080/02699931.2012.713325

- **Positive affect facilitate** controlled processing rather than simple storage processing, leading to better performance on tasks that require cognitive control and manipulation of information

Front Aging Neurosci. 2018; 10: 148. PMCID: PMC5972212

Published online 2018 May 22. doi: 10.3389/fnagi.2018.00148 PMID: 29872391

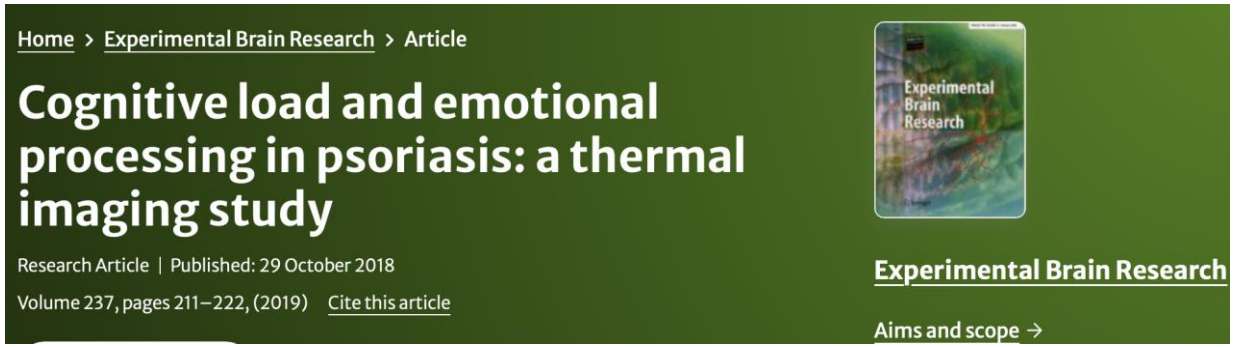
Negative Affect Influences Electrophysiological Markers of Visual Working Memory in Mildly Stressed Older Adults

Tab R. Memmott,* Daniel Klee, and Barry Oken

- **Negative affect** has been associated with a greater risk for **worse** cognitive function, detrimental health outcomes and reduced quality of life in older adults.

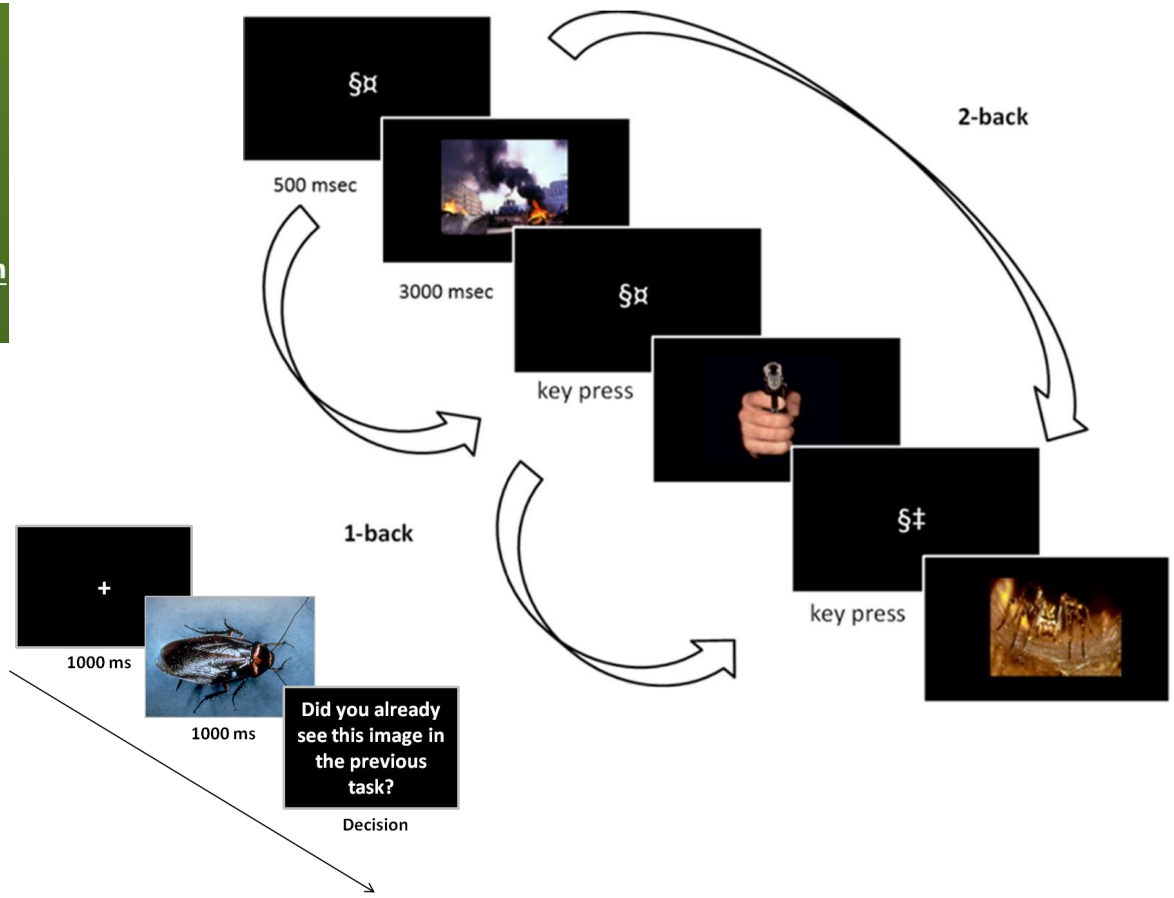
Are there differences when they perceive emotional distractors?

Affect and Visual Working Memory



3 types of emotional distractors: negative, neutral, positive

- Emotional N-Back: cognitive load influenced performance **across different types of distractors**.
- Surprise memory recognition task: **negative stimuli** are correctly remembered more than positive and neutral ones, suggesting that negative visual material **strongly captures attention**



Are there differences between individuals with higher and lower positive affect perceiving negative distractors?

Affect and Visual Working Memory

Attentional bias towards negative stimuli in healthy individuals and the effects of trait anxiety

Emilie Veerapa, Pierre Grandgenevre, Mohamed El Fayoumi, Benjamin Vinnac, Océanne Haelewyn, Sébastien Szaffarczyk, Guillaume Vaiva & Fabien D'Hondt

Scientific Reports **10**, Article number: 11826 (2020) | Cite this article

- Healthy individuals display an **attentional maintenance bias** towards negative stimuli, which is associated with **trait anxiety**.

Emotion. 2009 Dec;9(6):855-64. doi: 10.1037/a0017747.

Fearful faces influence attentional control processes in anxious youth and adults

Cecile D Ladouceur [1], Jennifer S Silk, Ronald E Dahl, Laura Ostapenko, Dina M Kronhaus, Mary L Phillips

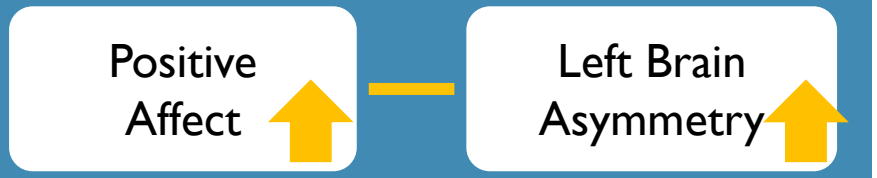
- **Anxious individuals**, particularly **younger** ones, exhibit **difficulty resisting interference** from threat-related stimuli when greater attentional resources are being recruited.

Affect and Brain Asymmetry

- Higher symptom severity of both depression and anxiety was significantly correlated with **relatively larger right frontal cortical activation**.

- Relatively larger right frontal cortical activity may be **influenced more strongly by symptoms of anxiety** than by depression.

Affect and Brain Asymmetry

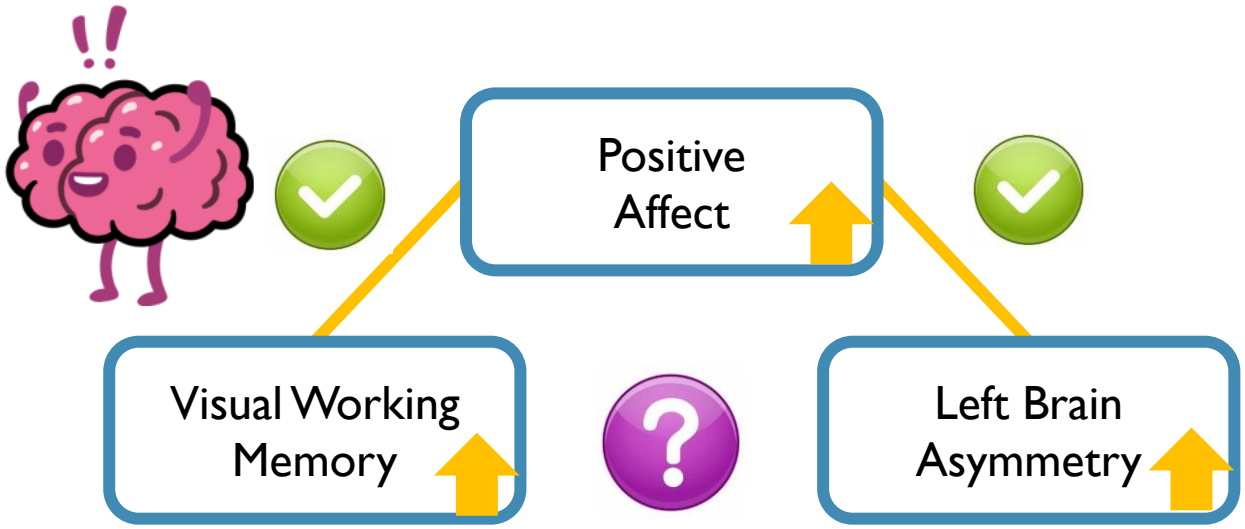


› Psychophysiology. 1993 Jan;30(1):82-9. doi: 10.1111/j.1469-8986.1993.tb03207.x.

Frontal brain asymmetry and emotional reactivity: a biological substrate of affective style

R E Wheeler [1], R J Davidson, A J Tomarken

- Healthy women with more relative **left-sided frontal activation** at rest reported **more intense positive affect** in response to the **positive films clips** compared with those showing more relative right-sided frontal activation.
- In contrast, in response to the **negative film clips**, women showing more relative **right-sided frontal activation** at rest reported **more intense negative affect** than their more left-frontally activated counterparts.


Positive Affect
Visual Working Memory
Left Brain Asymmetry

Visual Working Memory and Brain Asymmetry

Psychophysiology / Volume 59, Issue 5 / e13735

SPECIAL ISSUE: HUMAN OSCILLATORY BRAIN ACTIVITY: METHODS, MODELS, MECHANISMS

Open Access

Oscillatory brain activity and maintenance of verbal and visual working memory:

A systematic review

Yuri G. Pavlov, Boris Kotchoubey

- In visual working memory tasks, there is a prevalence of **right-lateralized alpha power**, indicating a stronger increase in alpha power in the right hemisphere compared to the left.

Are there differences between individuals with higher and lower left brain asymmetry in resting state?

Visual Working Memory and Brain Asymmetry

Journal of the Korea Academia-Industrial cooperation Society (한국산학기술학회논문지)

Volume 17 Issue 4 / Pages.351-360 / 2016 / 1975-4701(pISSN) / 2288-4688(eISSN)

The Korea Academia-Industrial cooperation Society (한국산학기술학회)

Study on the Characteristics of EEG in Resting State on Visuo-Spatial Working Memory Performance

DOI QR Code

- The beta in the **right hemisphere** in the **excellent working memory** group was significantly higher than that in the poor working memory group

Volume 29, Issue 5

May 2017

Journal of Cognitive Neuroscience

May 01 2017

Domain-general Stroop Performance and Hemispheric Asymmetries: A Resting-state EEG Study

In Special Collection: CogNet

Ettore Ambrosini, Antonino Vallesi

Check for updates

Author and Article Information

Journal of Cognitive Neuroscience (2017) 29 (5): 769–779.

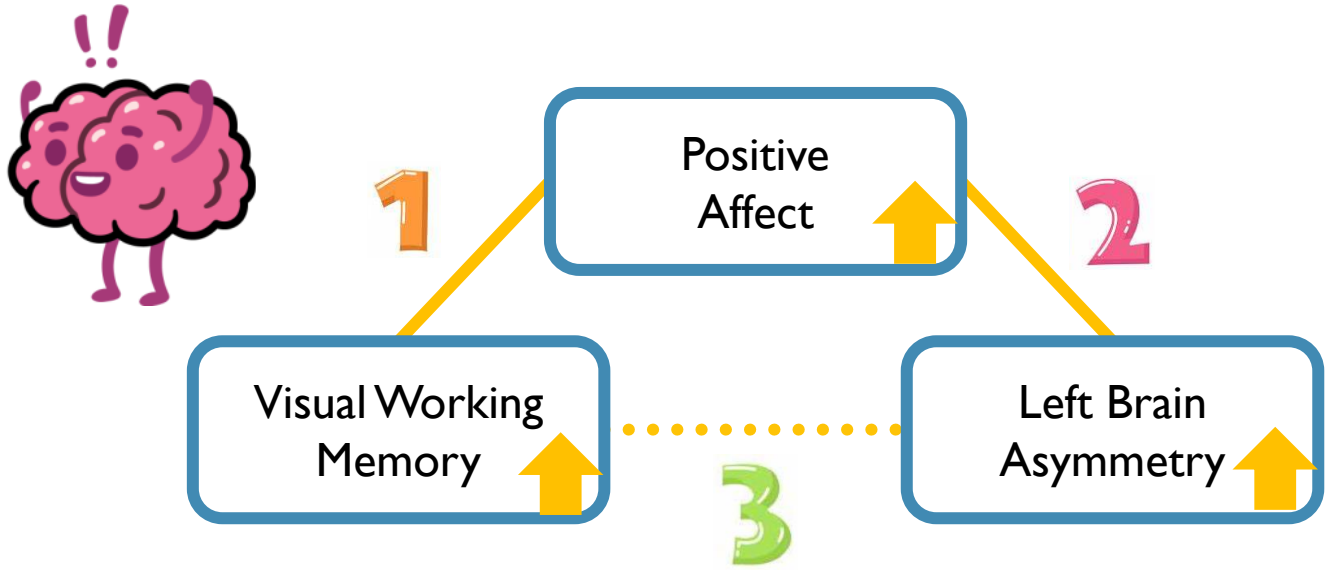
https://doi.org/10.1162/jocn_a_01076

- Participants with higher power in the beta/alpha frequency ratio in the **left pFC** regions were more **able to inhibit irrelevant information**

Inconsistent evidence

Hypotheses

1. Individuals with higher positive affect show better visual working memory.
2. Higher positive affect correlates with higher left brain asymmetry.
3. Individuals with higher left brain asymmetry show better visual working memory.



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Method – Participant

- Participant
  - ✓ 32 UM Students
  - ✓ The selection criteria were as such:
    - (1) above18 years old in age
    - (2) gender balanced
    - (3) no color blindness
    - (4) right-handed
  - ✓ Ethics approval is obtained from the Human Research Ethics Committee, University of Macau

Method – Procedure

- Affects - Positive Affectivity Negative Affectivity Schedule (PANAS)
  - ✓ a self-rating measure of **positive affect** (PA; 10 items) and **negative affect** (NA; 10 items)
  - ✓ reflects transitory mood states
  - ✓ good internal consistency reliabilities (Cronbach's alpha of 0.88 for the PA and 0.87 for the NA)
  - ✓ administer the PANAS to control for the potential effect of affective variability

Scoring instructions:

- Positive affect (sum up items): 1, 3, 5, 9, 10, 12, 14, 16, 17, and 19
- Negative affect (sum up items): 2, 4, 6, 7, 8, 11, 13, 15, 18, and 20

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

Interested (1)	Irritable (11)
Distressed (2)	Alert (12)
Excited (3)	Ashamed (13)
Upset (4)	Inspired (14)
Strong (5)	Nervous (15)
Guilty (6)	Determined (16)
Scared (7)	Attentive (17)
Hostile (8)	Jittery (18)
Enthusiastic (9)	Active (19)
Proud (10)	Afraid (20)

Method – Procedure

Positive and Negative Affect Schedule (PANAS)

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*(6), 1063–1070. https://doi.org/10.1037/0022-3514.54.6.1063.

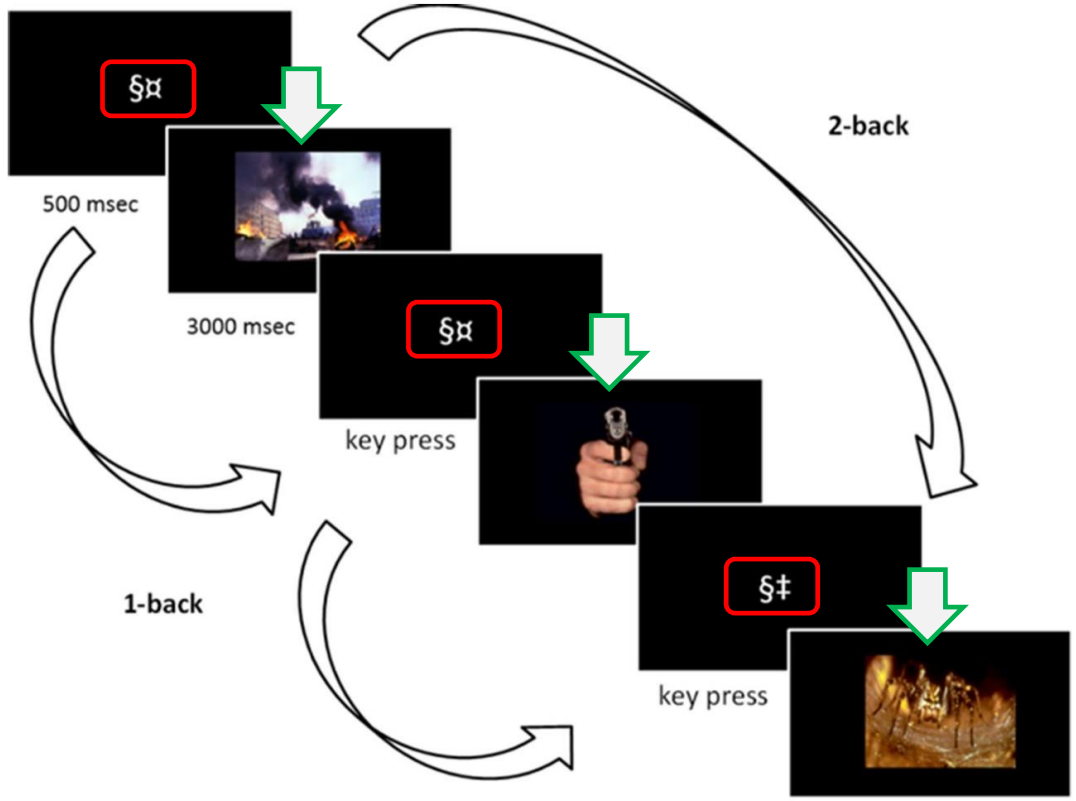
This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent [INSERT APPROPRIATE TIME INSTRUCTIONS HERE]. Use the following scale to record your answers.

PANAS can be used with the following time instructions:

- Moment: you feel this way right now, that is, at the present moment
- Today: you have felt this way today
- Past few days: you have felt this way during the past few days
- Week: you have felt this way during the past week
- Past few weeks: you have felt this way during the past few weeks
- Year: you have felt this way during the past year
- General: you generally feel this way, that is, how you feel on the average

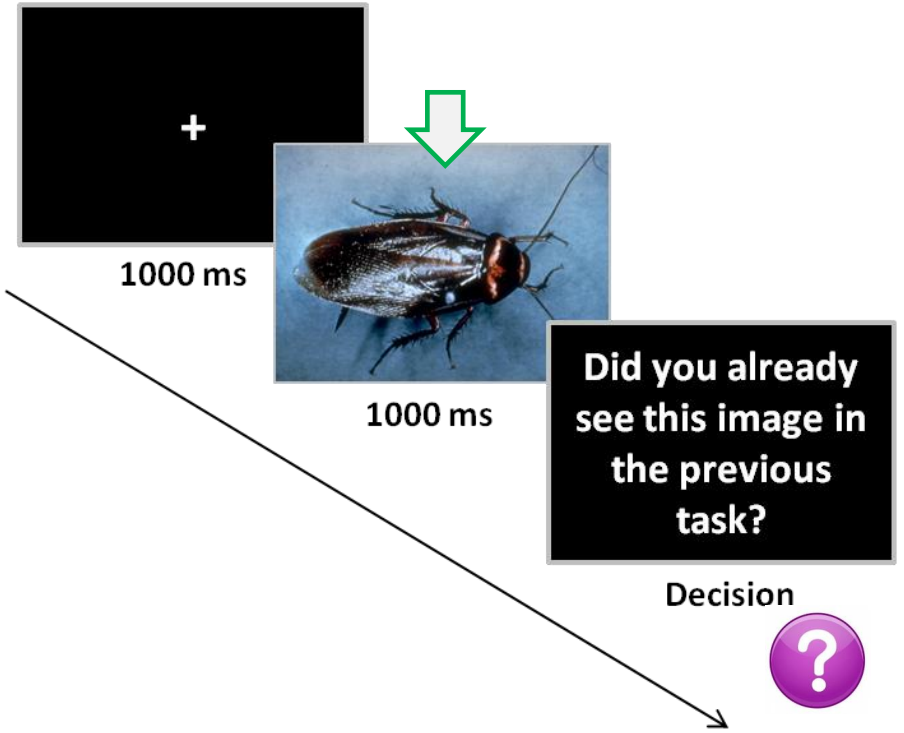
Method – Procedure

- Emotion N-Back Task Procedure
  - ✓ A modified version of a visual sequential letter working memory N-Back task
  - ✓ 240 stimuli standardized Emotion for valence and arousal
    - ➢ 80 positive
    - ➢ 80 negative
    - ➢ 80 neutral
  - ✓ Non-affective visual stimuli are 10 symbols
    - ➢ combined to obtain 20 different pairs of stimuli
    - ➢ used during the N-Back Task as target and non-target stimuli



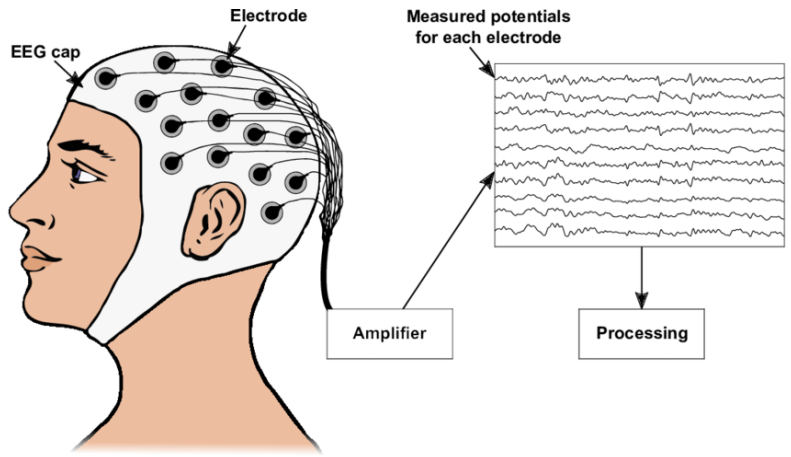
Method – Procedure

- Surprise Memory Recognition Task
  - ✓ 180 affective stimuli taken from the IAPS (Lang et al. 2008)
    - ➢ 120 affective stimuli (40 stimuli per valence): **familiar stimuli**, emotional distractors previously presented during the Emotional N-Back task
    - ➢ 60 affective stimuli (20 stimuli per valence): **unfamiliar stimuli**, stimuli are not presented during the previous task
  - ✓ Response is considered as
    - ➢ **correct** when they categorized as already seen the familiar stimuli and as unseen the unfamiliar ones
    - ➢ **incorrect** when they categorized as unseen the familiar stimuli and as seen the unfamiliar ones
  - ✓ Affective stimuli were presented in a fully randomized order



Method – Procedure

- Brain Asymmetry – EEG Resting State
  - ✓ 64 electrode Biosemi
  - ✓ 5-min resting period with lights dimmed
  - ✓ Instruct participants to keep their eyes closed while remaining alert
  - ✓ Remove the first 30 s and the last 10 s of the resting state data prevent state transitional influence
  - ✓ Filter data, 1 Hz high-pass and 45–55 Hz notch FIR filters, then epoch into segments of 2 s each
  - ✓ Detect noisy channels and epochs using an automatic procedure, which followed by both manual review and rejection



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Method – Statistics and Expected Results

- Affects - PANAS
  - ✓ Positive Affectivity Negative Affectivity Schedule (PANAS)
    - ➢ A **median-split** of the standardized scores
    - ➢ Group: HPA(Higher positive affect) and LPA(Lower positive affect)

Table 1. Summary statistics for the PANAS for the total sample

	Median	Mean	Z score	SD	Range
Total Sample (N=31)					
PA					
NA					

Ladouceur C D, et al. Emotion, 2009, 9(6): 855

Method – Statistics and Expected Results

- Participant
  - ✓ 32 UM Students
    - ➢ A sample size of 31 was determined using G*Power (Faul et al. 2007), to have **a power of 0.80 (α=0.05)** to detect a small to moderate **effect size (d=0.42)**, an effect size typical for psychological research (Richard et al. 2003).
  - ✓ Expected Results
    - ➢ Between the groups **no significant differences** on any of the demographic variables.

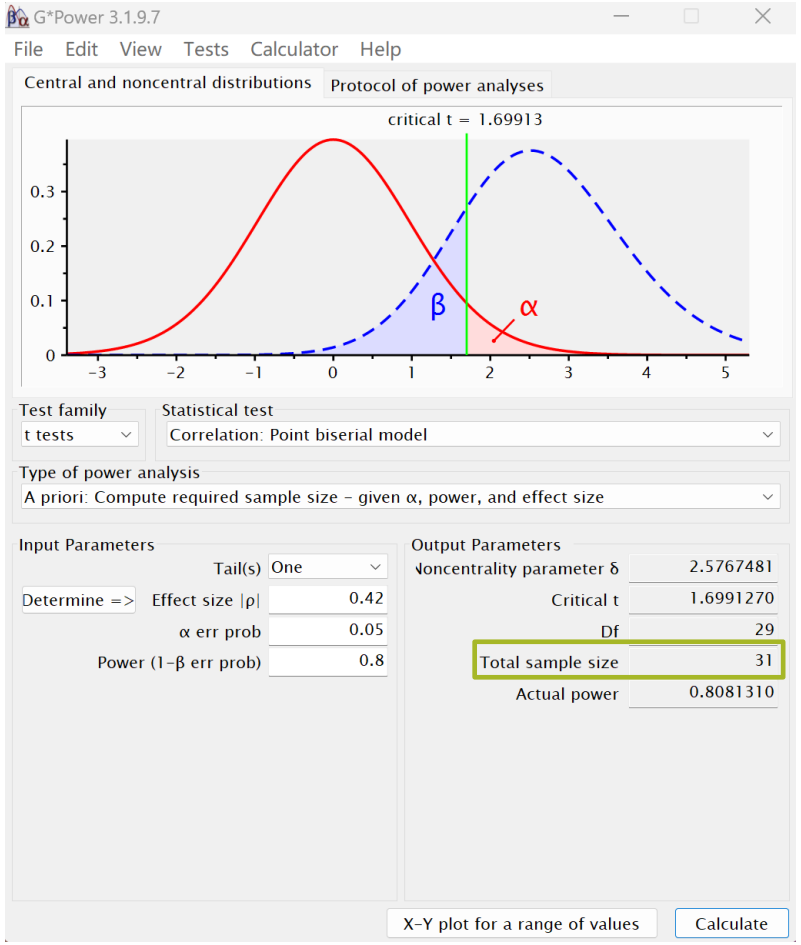


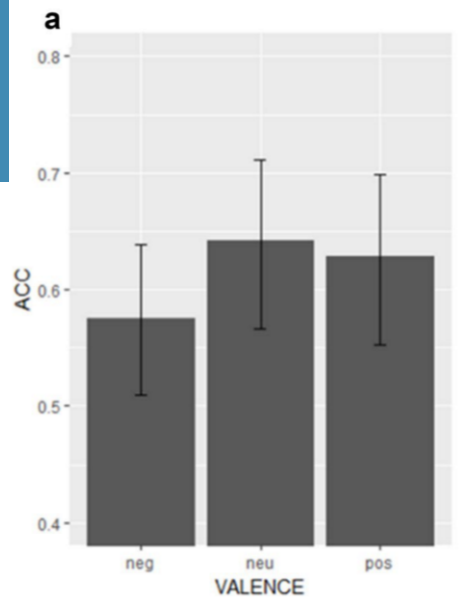
Table 2. Demographic Data of the Participants in the Study

Variable	HPA (M ± SE)	LPA (M ± SE)	p Value
Age			>0.05
Education			>0.05
Gender			>0.05
PANAS			<0.05

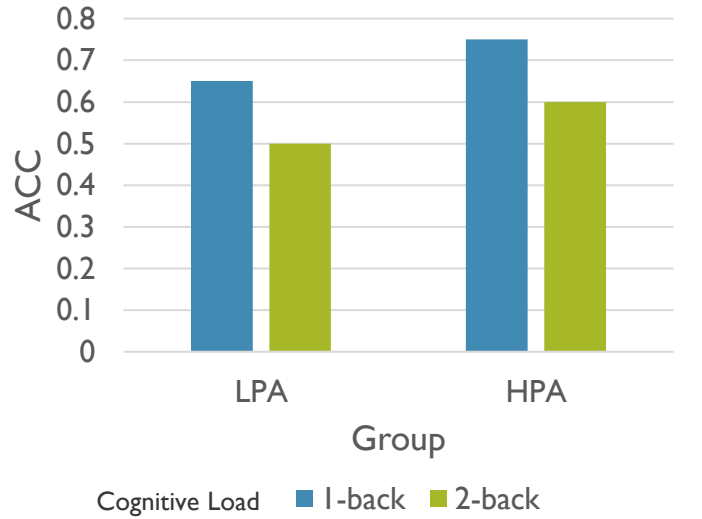
Method – Statistics and Expected Results

- Emotion N-Back Task:
  - ✓ Data analysis- Accuracy
    - ➢ Multilevel mixed log-linear regression using the lme4 v. 1.1-5 R package.
    - ➢ Dependent variable: Binary accuracy in the N-back task.
    - ➢ Fixed effects: Valence (Negative, Neutral, Positive), Cognitive Load (1-back, 2-back), Group (LPA, HPA), and their interactions.
    - ➢ Random effects: Random intercepts for individuals and a random slope for Valence.
  - ✓ Expected Results
    - ➢ Main effect of Valence: Accuracy **significantly lower in negative** blocks compared to neutral and positive.
    - ➢ Main effect of Cognitive Load: Significant difference in performance between 1-back and 2-back.
    - ➢ Group Cognitive Load interaction: Difference in performance between 1-back and 2-back **smaller in LPA** compared to HPA group.

Figure 1. Main Effect of Valence



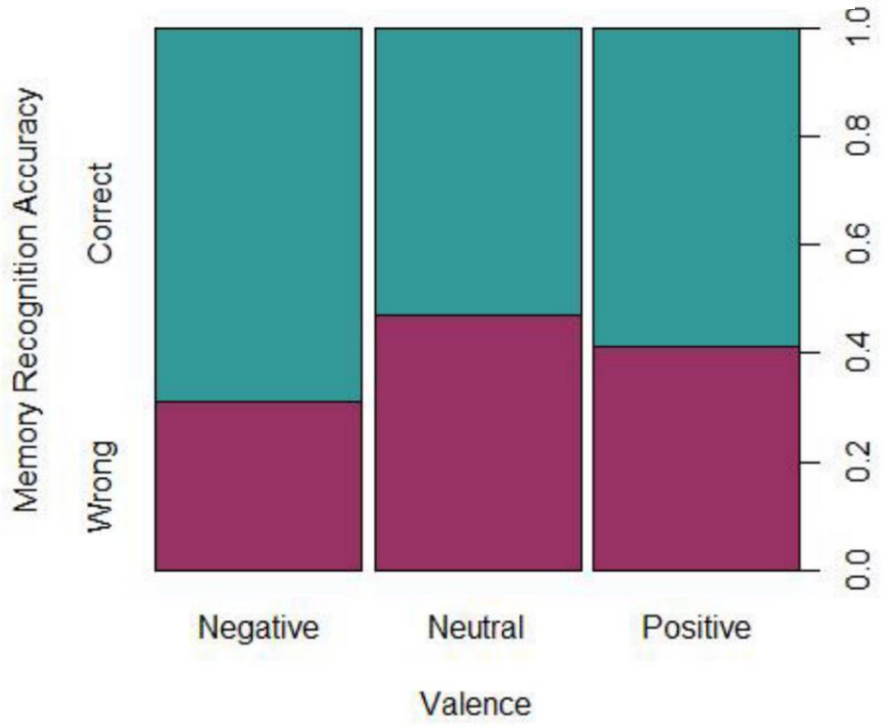
b. Interaction between Group and Cognitive Load



Method – Statistics and Expected Results

- Surprise Memory Recognition Task
  - ✓ Data Collection: Accuracy & Reaction Time
  - ✓ Data analysis
    - ➢ Multilevel logistic regression on single trial behavioral data.
    - ➢ Pairwise Bonferroni-corrected contrasts.
    - ➢ Categorical predictors: Valence (0=negative, 1=neutral, 2=positive) and Group (1=LPA, 2=HPA) with their reciprocal interaction.
    - ➢ Random factors: Participants as random intercept, Valence as random slope. Aligns with recommended guidelines for multilevel modeling (Barr 2013; Barr et al. 2013; Jaeger 2008).
  - ✓ Expected results
    - ➢ Significant main effect of valence on memory recognition.
    - ➢ Non-significant main effect of group and valence by group interaction.
    - ➢ Pairwise Bonferroni-corrected contrasts will reveal **better recognition of negative stimuli** compared to positive and neutral stimuli. **Positive stimuli** will be also recognized **better** than neutral ones.

Figure 2. Accuracy in the Memory Recognition Task



Method – Statistics and Expected Results

- Brain Asymmetry – EEG Resting State
  - ✓ EEG Data Analysis:
    - ➢ Nonparametric permutation tests (Monte Carlo method) were used for analyzing all EEG data.
    - ➢ FieldTrip toolbox was employed for implementing the permutation tests.
    - ➢ This method involved random sampling (10,000 iterations) to assess the sample distribution characteristics under the null hypothesis, without assuming normality.

  - ✓ Brain Asymmetry Analysis:
    - ➢ Brain asymmetry power scores will be averaged for regions of interest: frontal, parietal, and occipital.
    - ➢ These regions are selected based on previous research on brain asymmetry in HPA individuals and LPA individuals.
    - ➢ Group differences will be tested using permutation tests following ANOVA logic, with pairwise post-hoc contrasts conducted if significant differences were found in any of the regions of interest.
    - ➢ brain asymmetry scores:

$$\text{Left alpha brain asymmetry} = 10 \times \log_{10}(\textit{left electrode's alpha power}) - 10\log_{10}(\textit{contralateral homologous electrode's alpha power})$$

Method – Statistics and Expected Results

- Brain Asymmetry – EEG Resting State
  - ✓ Expected Results
    - ➢ The relationship between affect and brain asymmetry:

      The LPA group may exhibit **lower resting left alpha brain asymmetry** compared to the HPA group. This may suggest a difference in brain activity patterns between individuals with different levels of positive affect.

    - ➢ The relationship between visual working memory and brain asymmetry:

      Use the Pearson's correlation coefficient and t-test to calculate the correlation between left brain asymmetry and visual working memory performance. The result may suggest that individuals with **higher left brain asymmetry** show **better visual working memory performance**.

Timeline

3.20-4.8
Experimental design

4.8
Proposal Presentation

4.9-4.17
Experimental Preparation

4.18-4.20
Data Collection

4.21-4.28
Data analysis and organization

4.29
Result report

Project Proposal- Group 9

Brain Asymmetry and Visual Working Memory: Investigating the Impact of Negative Distractors

Thank you for your listening!