CHARACTERIZATION OF EXECUTIVE CONTROL PROCESSES ENGAGEMENT DURING LANGUAGE COMPREHENSION

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Introduction

Study 1

Study 2

Study 3&4

Perspectives

Production (Indefrey & Levelt, 2004)

Perception (Hickok & Poeppel, 2007)

Comprehension (Friederici, 2011; Hagoort, 2003)
Language comprehension is an automatic process (Shtyrov, 2010)
Language comprehension is an automatic process *(Shtyrov, 2010)*

Speech in speech / Speech in noise

Lexical / syntactic ambiguity
What is executive control?

Processes that guide and adjust attention and behavior in line with our goals (Miyake et al., 2000).

- Inhibitory control
- Flexibility
- Working memory

...
Main goal

➡️ Study how executive processes are engaged during language comprehension
Main goal

- Study how executive processes are engaged during language comprehension
  - *What sub-processes are involved?*
Main goal

➔ Study how executive processes are engaged during language comprehension

- *What sub-processes are involved?*
- *When these sub-processes are involved?*
Main goal

Study how executive processes are engaged during language comprehension

- *What sub-processes are involved?*
- *When these sub-processes are involved?*

Specify executive control implication in language comprehension sub-systems: semantic and syntactic (antomo-functional and dynamic interactions)
Study 1: Replication of Hsu & Novick (2016)
(Stroop and language comprehension task)

(Hsu & Novick, 2016)
« Put the pencil that’s on the napkin onto the binder »

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Study 1: Replication of Hsu & Novick (2016)  
(Stroop and language comprehension task)
Executive control task battery
Executive control task battery

Introduction

Study 1

Study 2

Study 3&4

Perspectives

Panel A
Flanker task

Panel B
N-back task

Panel C
Task switching

Panel D
SART

Inhibitory control
Executive control task battery

Inhibitory control

Updating in working memory
Executive control task battery

Panel A
Flanker task

Inhibitory control

Panel B
N-back task

Updating in working memory

Panel C
Task switching

Switching cost

Panel D
SART

Introduction
Study 1
Study 2
Study 3&4
Perspectives
Executive control task battery
Preliminary results

**Difference between proportion of looking time on the correct goal and the incorrect goal**

- **Stroop trial**
  - Congruent
  - Incongruent

- **Instruction**
  - Unambiguous
  - Ambiguous

- **n = 28**
Preliminary results

$r = 0.61, p < 0.01$
Study 2: Effect of lexical ambiguity on executive control processes, a double task

(Auditory stimuli from Millotte et al., 2008)
Study 2: Effect of lexical ambiguity on executive control processes, a double task

Le petit chien mort sera enterré demain par ses maîtres.

Le petit chien mord la laisse dans l’espoir de se libérer.

Maintenant qu’il est mort, les batailles d’héritage vont commencer.

Parfois on se mord la langue quand on mange trop vite.

(Auditory stimuli from Millotte et al., 2008)
Study 2: Effect of lexical ambiguity on executive control processes, a double task

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Preliminary results

Reaction times in terms of sentence type and Flanker type

- **Sentence**
  - Ambiguous
  - Unambiguous

- **Flanker**
  - Congruant
  - Incongruent

\[ n = 41 \]
Conclusion & Perspectives

Studying executive control engagement during language comprehension is a real challenge on a behavioral level
Conclusion & Perspectives

Studying executive control engagement during language comprehension is a real challenge on a behavioral level

Study 3&4: Cerebral dynamic of semantic and syntactic processing during language comprehension
Conclusion & Perspectives

Studying executive control engagement during language comprehension is a real challenge on a behavioral level.

Study 3&4: Cerebral dynamic of semantic and syntactic processing during language comprehension.

Study 1: Include more participants and adapt the task for iEEG.

Study 2: Include a new sample ➔ older adults (Braver et al., 2001)
Thank you for your attention
Study 3: Cerebral dynamic of semantic and syntactic processing during language comprehension, an iEEG study

Syntactic information

<table>
<thead>
<tr>
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Semantic information

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(Pallier et al., 2011)
Study 3: Cerebral dynamic of semantic and syntactic processing during language comprehension, an iEEG study

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Semantic information

Semantic and syntactic processing

Semantic processing

(Pallier et al., 2011)
Study 3: Cerebral dynamic of semantic and syntactic processing during language comprehension, an iEEG study

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**Semantic and syntactic processing**

**Semantic processing**

**Syntactic processing**

**No semantic or syntactic processing**

*(Pallier et al., 2011)*
Preliminary results
HFA (50-150Hz)
Study 4: Inclusion of sentences with noise to evaluate executive control in semantic and syntactic sub-systems

In addition the executive control test battery will be performed by patients in order to extract executive index (to link with the neural activity)
Proportion of look to the correct goal after an incongruent Stroop trial
Flanker Task
Flanker Task
Introduction

Flanker Task

- Assess inhibition control
N-Back Task
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**N-Back Task**
N-Back Task
N-Back Task
N-Back Task

- Assess updating in working memory
Number-letter Task

C2
Number-letter Task
Number-letter Task

- Assess switching cost
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**SART Task**

(Sustained Attention to Response Task)
SART Task
(Sustained Attention to Response Task)
SART Task
(Sustained Attention to Response Task)

- Assess sustained attention