

A systematic investigation of linguistic and non-linguistic processing of time in people with aphasia

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Introduction

Locating events on a timeline allows us to keep track of the past, live the present and plan the future.

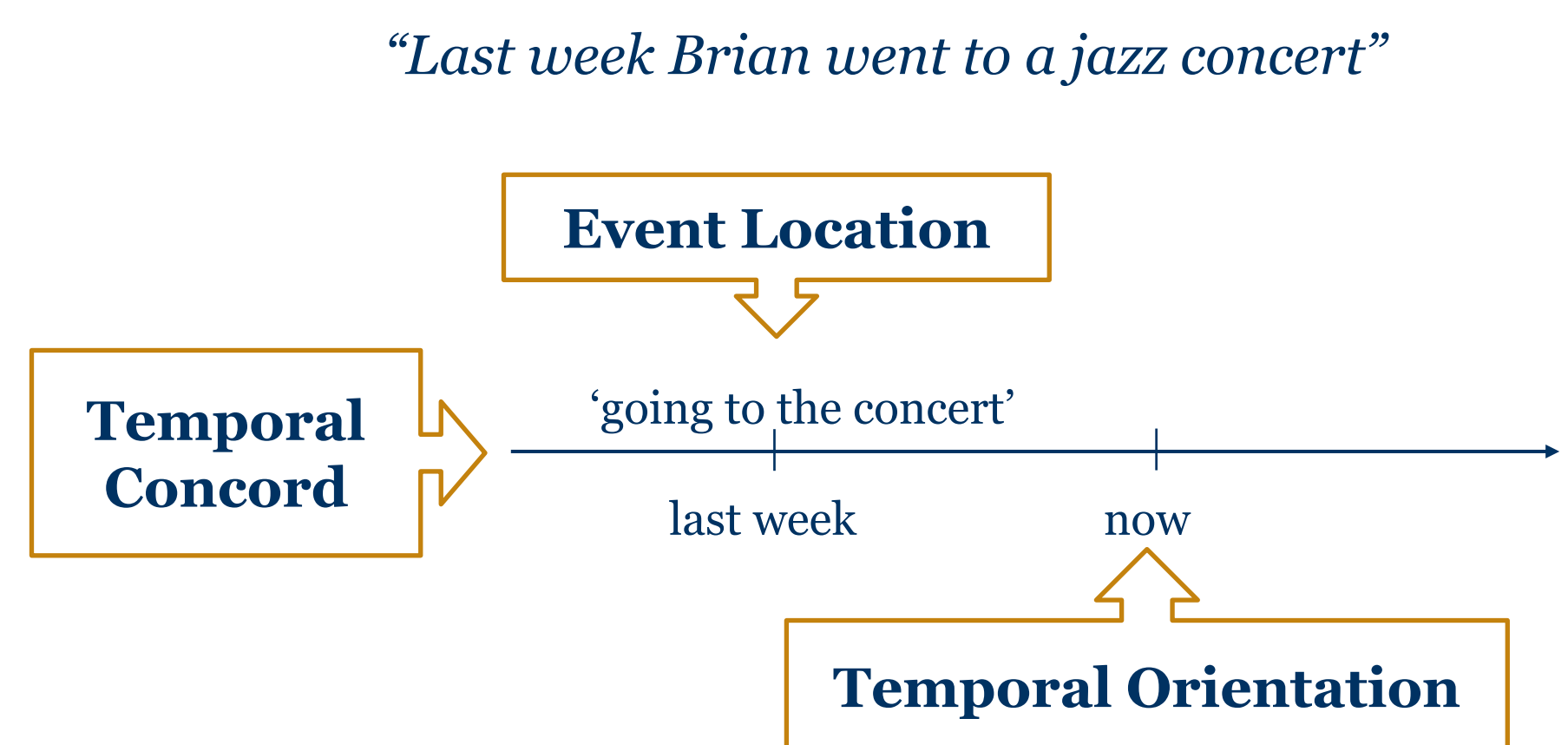
People with aphasia (PWA) struggle with the processing of temporal information, but little is known about the source of this impairment.

Open questions addressed in this project:

- Which aspects of time comprehension (temporal orientation, event location, temporal concord) are impaired in PWA?
- Is the time impairment language-specific or domain-general?
- What are the neurobiological underpinnings of time processing?

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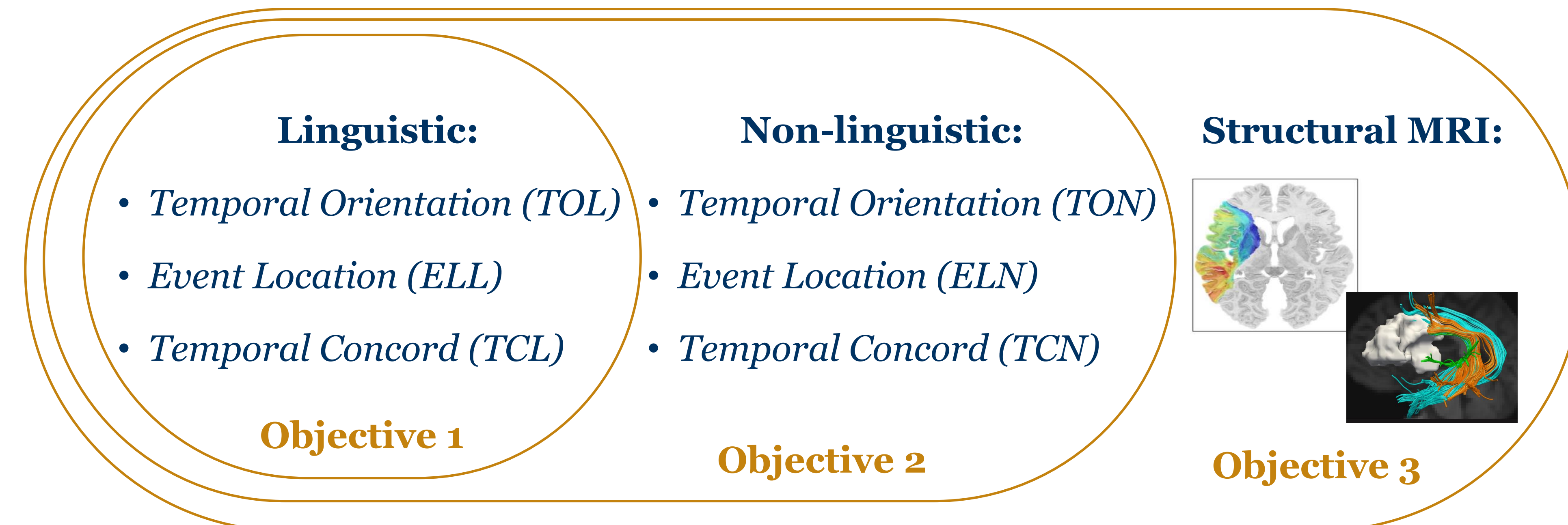
A type of event representation describing the human ability of locating events on a timeline from the standpoint of the present moment¹



Past studies:

- Rarely disentangled the processing of *Event Location* from the processing of *Temporal Concord*²⁻⁵, and never tested the *Temporal Orientation* skills of their participants
- Showed that time is impaired in PWA because it involves reference to discourse⁶⁻⁸, which can be considered an interface between syntax and the cognitive system⁹
- Investigated time deficits only behaviorally, by grouping participants based on aphasia type

Overview of the T.I.M.E. project

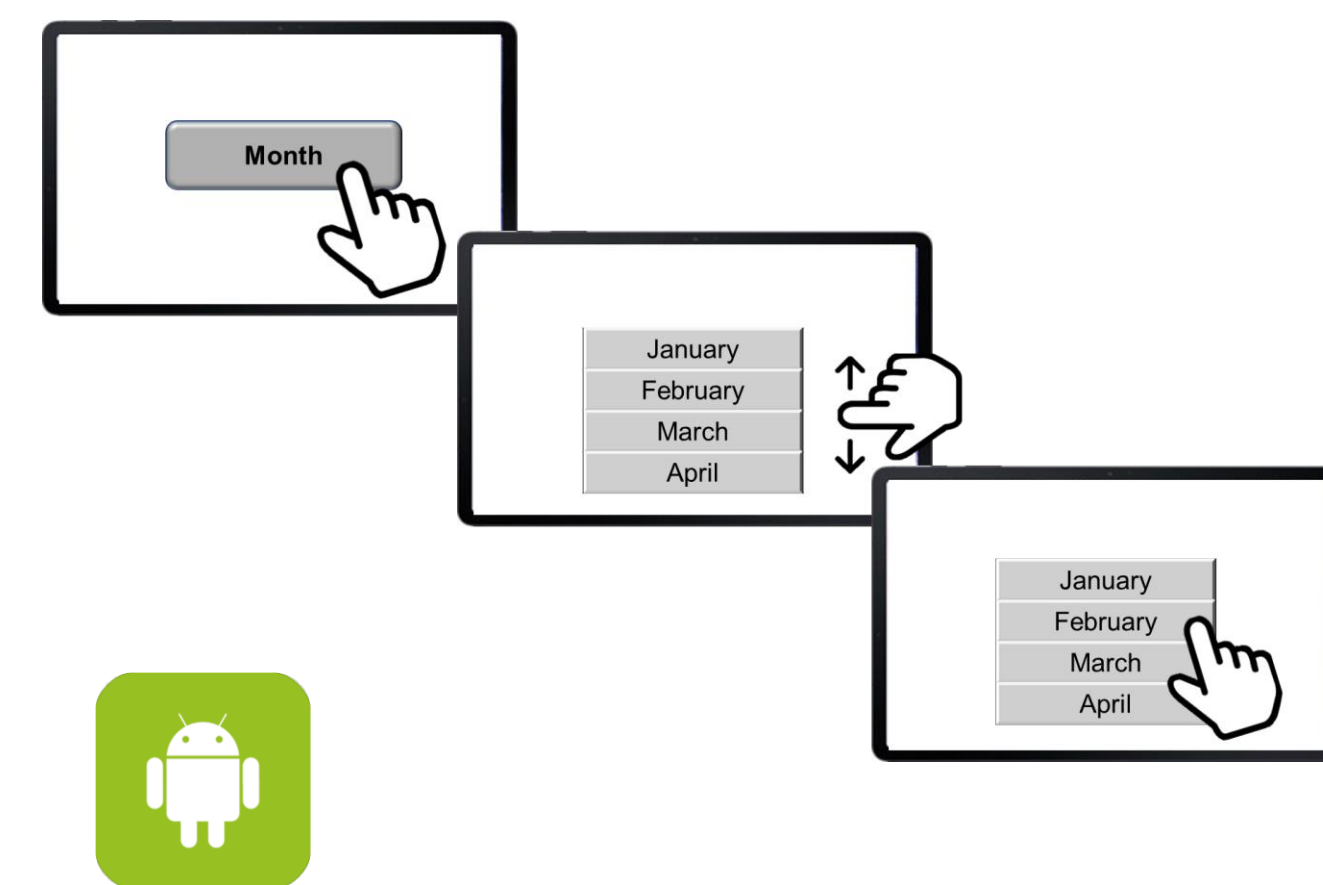


TOL

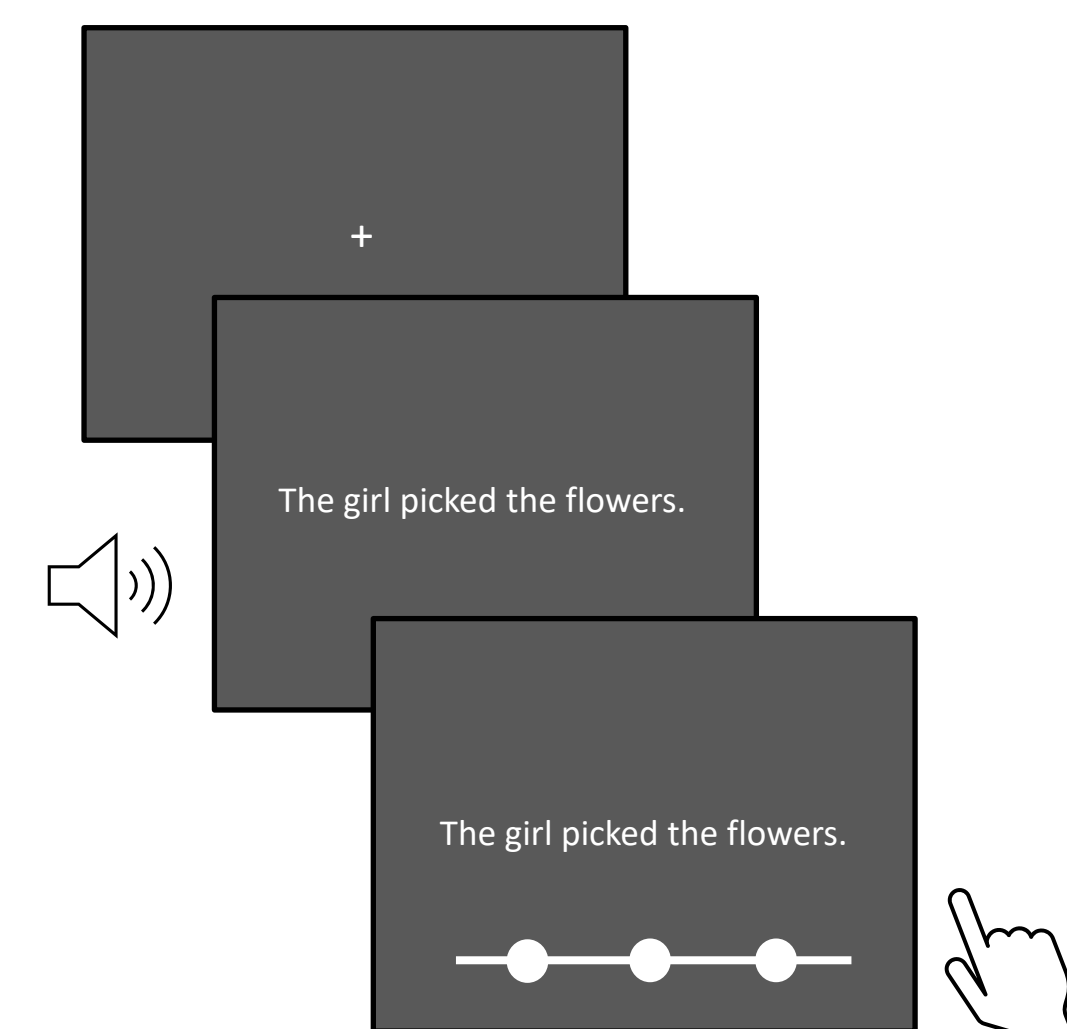
Test of Temporal Orientations¹⁰

- What is today's date?
(The patient is required to give month, day, and year)
- What day of the week is it?
- What time is it now?
(Examiner makes sure that the patient cannot look at a watch or clock)

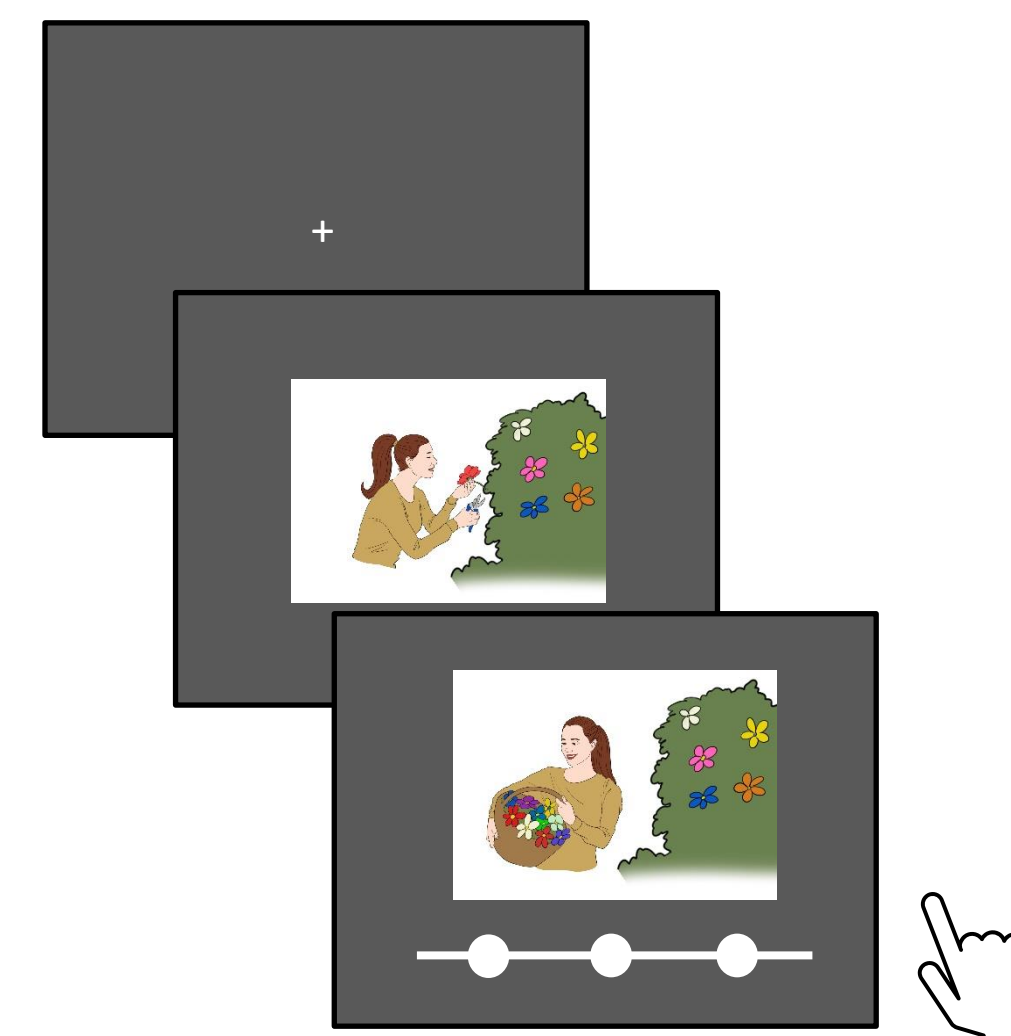
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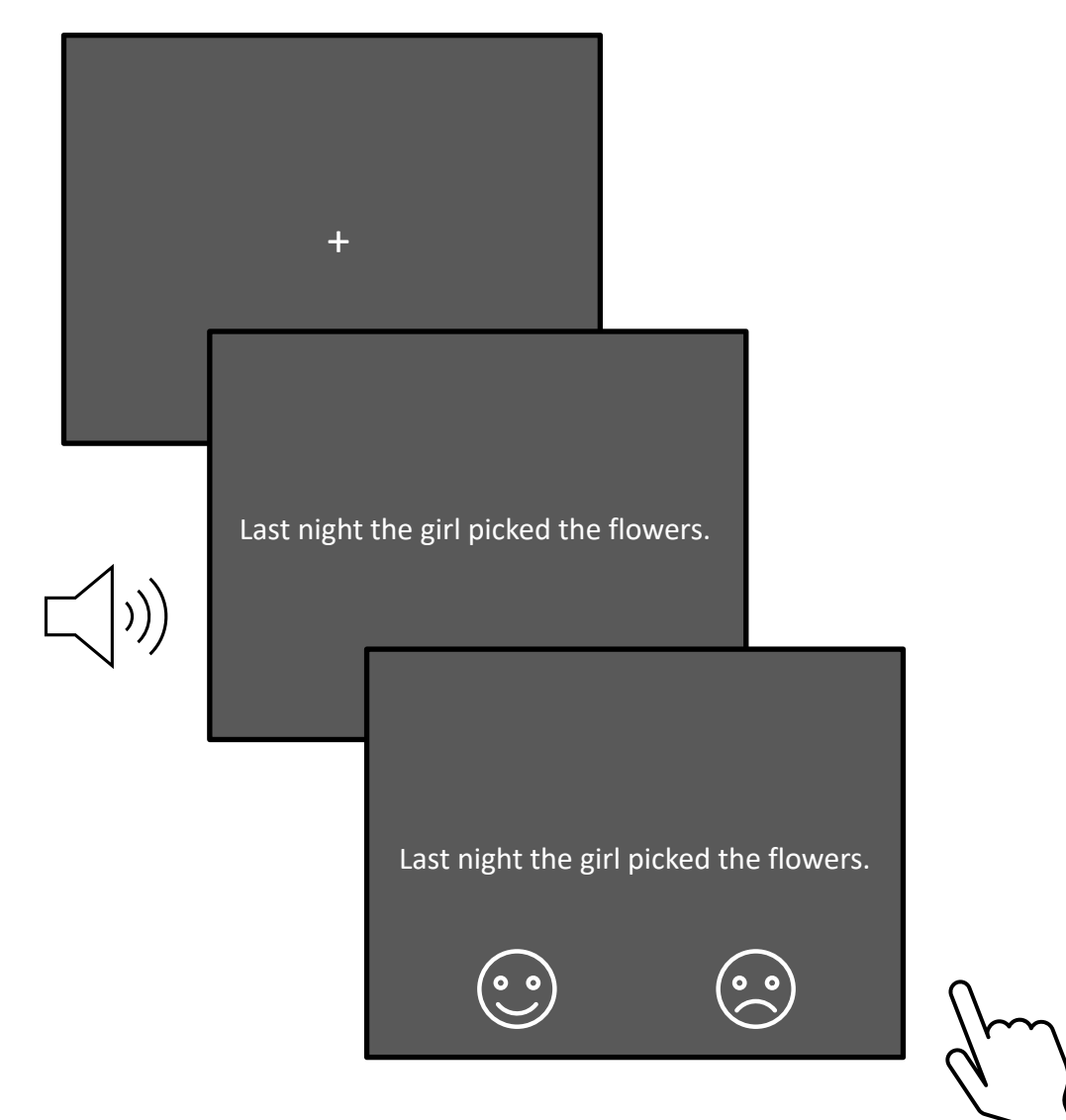
ELL



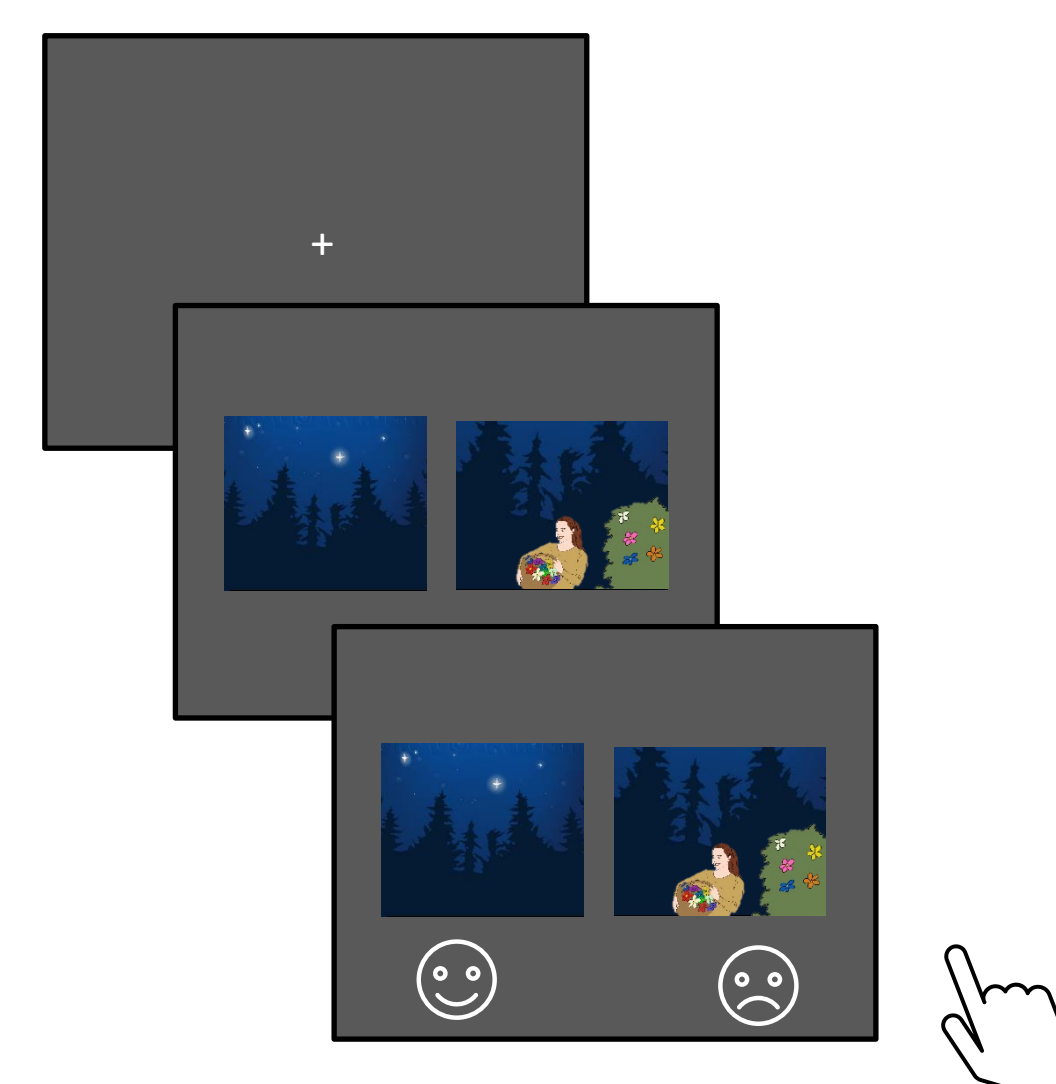
ELN



TCL



TCN



Methods

Expected sample:

- 50 people with aphasia (PWA), native speakers of English (at UC Berkeley) and Spanish (at the BCBL), ≥ 6 months post-stroke and left-hemisphere lesions
- Age-/gender-/education-matched controls

Data and analysis:

- Accuracy/Reaction times of both groups in the behavioral tasks
- Structural MR images of each stroke survivor
- Lesion-symptom mapping analyses

Linguistic Stimuli:

- ELL:** 72 simple (subject-verb-object) sentences containing different types of past, present, and future tensed verb forms (e.g., *picked, was picking, picks, is picking, will pick, is going to pick*) – to be located on a timeline
- TCL:** 72 simple sentences containing past/present/future verbs and mis/matching adverbs (e.g., *last night, tomorrow morning*) – to be judged as congruent or not

Non-linguistic Stimuli:

- ELN:** 72 pictures representing concluded, ongoing, and about-to-happen events – to be located on a timeline
- TCN:** 72 pictures representing concluded/ongoing/about-to-happen events and mis/matching time frames – to be judged as congruent or not

Predictions

1. Aspects of time comprehension

- Controls are expected to outperform PWA
- Present conditions should be easier (higher accuracy/shorter RTs) than Past⁷ and Future conditions, for both groups
- PWA are expected to struggle more with Temporal Concord than Event Location
- The severity of the time deficit is expected to change as a function of the lesion site

2. Language-specific or domain-general

- No study has ever investigated non-linguistic time in aphasia. If the time processing deficit is purely linguistic, we expect PWA to show poor performance only in linguistic tasks (e.g., ELL vs ELN)

3. Neural underpinnings of time

- Studies on confabulators¹¹ report the involvement of the Inferior medial frontal lobe in *Temporal orientation*
- Studies on the processing of other concord relations (e.g., SV agreement^{12,13}) suggest the involvement of:
 - ATL in morphosyntax-discourse mapping (necessary for *Event Location* and *Temporal Concord*)
 - IFG in high-level syntactic combinatorial processing (necessary for *Temporal Concord*)

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