Cross-Language Connections in Bilingual Aphasia

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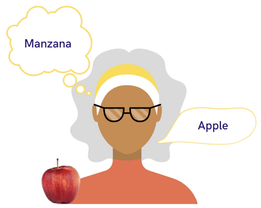
BACKGROUND

- **Aphasia** is an acquired language impairment characterized by disruptions in language production and/or comprehension, as well as reading and writing.
- Language and cognitive processing differ in some ways between bilinguals and monolinguals. For instance, bilinguals engage in word retrieval that activates the target word in both languages simultaneously (**cross-linguistic co-activation)** (Kaushanskaya & Blumenfeld, 2018).
- Cross-language co-activation can result in **facilitation** or **interference**.
  - Facilitation: Spanish/English bilingual wants to say *apple*, and *manzana* is co-activated, making *manzana* easier to be retrieved.
  - Interference: If word *manzana* interferes with the retrieval of *apple*,
  - then the bilingual must suppress (inhibit) *manzana* in order to retrieve *apple.*



- Bilinguals must employ cognitive control in order to select the situation-appropriate language and avoid cross-language interference.
- **Inhibition** is the primary mechanism to deal with competition between languages. Inhibition is the capacity to suppress information, processes or responses that are dominant or automatic for the task (Miyake et al., 2000).
- Two aspects of cognitive control that involve inhibition are **proactive** and **reactive control.**
  - Proactive control: Inhibition of the whole language when not in use
  - Reactive control: Inhibition of specific interfering words that are in competition
- Some evidence points to cognitive control deficits in bilinguals with aphasia (Gray & Kiran, 2016). Thus, bilinguals with aphasia may struggle with the management of cross-language interference.
- This project seeks to investigate the preservation of cross-linguistic lexical connections in bilinguals with aphasia and the state of the relationship between linguistic-interference management and cognitive control (i.e., inhibition).

Research Questions

1) Do bilinguals with aphasia (BWA) show similar patterns of facilitation and interference as healthy bilinguals, which would indicate that cross-language connections are preserved in aphasia?
2) If cross-linguistic lexical connections remain strong, how well are BWA able to manage interference across their languages?
3) Do BWA with better non-linguistic cognitive control abilities demonstrate better cross-language interference management?

Hypotheses

- BWA with comparative patterns of facilitation and interference as neurotypicals suggest that the cross-language connections are preserved.
- BWA who don't demonstrate facilitation indicate that cross-language lexical access pathways are impaired, or that a disproportionate amount of interference is experienced.
- Cross-linguistic lexical connections will remain strong in bilinguals with aphasia.
- Some bilinguals with aphasia will demonstrate impaired cognitive control abilities compared to their healthy counterparts.
- Individuals with better cognitive control will demonstrate greater cross-language interference management.

METHODS

Participants

Two groups of individuals (8 participants in each group) between the ages of 18-80 with proficiency in Spanish and English at an intermediate level or higher.

- **Aphasia group**
  - History of left-hemisphere stroke resulting in a diagnosis of aphasia at least 6 months prior to the study
- **Control group**
  - No history of stroke or aphasia, matched in age with the individuals in the aphasia group

Assessments

Language History Questionnaire: To assess participant's linguistic background. Questions include general linguistic background (use and context), immigration and travel, and code switching.

Language and Cognitive Assessments for Bilinguals with Aphasia

- **Bilingual Aphasia Test (BAT)**: Assess languages abilities in both languages (Spanish and English)
- **Cognitive Linguistic Quick Test - Plus (CLQT +):** Measure of non-linguistic cognitive skills

METHODS

Linguistic Task: Picture Naming

Stimuli

- Black & white line drawings from the International Picture Naming Project (Szekely et al., 2014) are named in Spanish and English

Design

- Four stimulus conditions (groups of pictures) are presented across 5 blocks

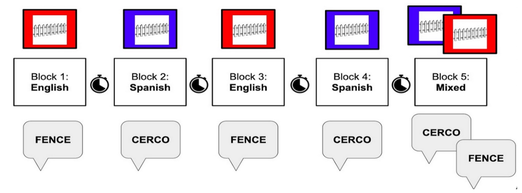
Organization of stimuli & Language of naming

	Block 1	Block 2	Block 3	Block 4	Block 5	
Language of Naming	L1	L2	L1	L2	L1	L2
Stimulus Conditions	A C	B C D	A B C	D	A	D
Stimuli Count	60	90	90	30	60	

*L1 = Dominant language; L2 = Non-dominant language

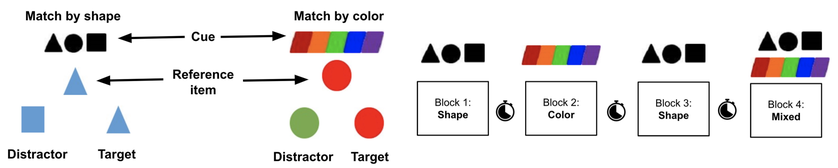
- Stimulus condition A: Named in dominant language (L1) only
- Stimulus conditions B & C: Named in dominant (L1) and non-dominant language (L2)
- Stimulus condition D: Named in non-dominant language (L2) only

- Language of naming is cued by the colored background of the picture.



Non-Linguistic Task: Color-Shape Switching

- Four blocks of 50 trials each
- Participants are presented with a pictorial cue, indicating whether the trial will be matched by color (blue, green, red) or shape (square, circle, triangle).
- Trials are either congruent and incongruent. On congruent trials, all stimuli will either be the same color or the same shape, while on incongruent trials, the stimuli will differ for both dimensions (color and shape).



Electroencephalogram (EEG)

- While completing both tasks, a non-invasive electroencephalogram (EEG), a test that records electrical activity in the brain activity, will be recorded from 32 scalp electrodes. This will be used to measure **event-related potentials (ERPs)**, electrical voltages related to specific events in the brain.
- ERPs are useful for exploring questions regarding the timing of mental processes because they reveal the brain's response to a specific sensory, cognitive, or motor event.
- Analysis of the picture naming will look at the **N300 component**. The N300 is a negative-going wave peaking around 300 ms after the onset of an event (in this case, picture presentation). The N300 is often associated with visual processing of nonlinguistic information (e.g., object recognition), contributing to evidence of difficulty in retrieval of language representations during picture naming (Wodniecka et al., 2020; Schendan & Ganis, 2012).
- Analysis of the non-linguistic triad task will focus on the **N200 component**, a negative-going wave peaking around 200 ms after the onset of an event (in this case, the array of shapes). The N200 is associated with response inhibition or response conflict monitoring (Christoffels et al., 2007)

ANTICIPATED RESULTS

- Within- and cross-language repetition facilitation & faster naming speed where images have been repeated across blocks.
- When switching languages, inhibition of the language named just prior (e.g., inhibition of L2 names (block 2) when naming in L1 during the subsequent block).
- Cross-language interference in stimulus condition B & C in block 3, resulting from inhibition of picture named during stimulus condition B & C in block 2.
- Increased N300 amplitudes where naming is more effortful, and conversely, smaller amplitudes where facilitation is present.
- A significant correlation between the proactive and reactive control measures obtained from the linguistic and non-linguistic tasks.
- BWA will demonstrate intact suppression of the whole language (proactive control mechanisms) during blocks 1 and 2, while suppression of specific words that are in competition (reactive control) may be impaired (Braver et al., 2012).

WHY THIS RESEARCH IS IMPORTANT

- Due to the increasing number of bilinguals in the U.S., it is important for Speech Language Pathologists (SLPs) to be knowledgeable about bilingualism in the clinical populations with which they work.
- Such knowledge is vital given the different linguistic and cognitive processes that bilinguals demonstrate, which contributes to language therapy responsiveness, as well as whether, and how, to target both languages during treatment.
- This research will positively contribute to clinical practice by revealing the cross-language lexical connections and inhibition facilities of bilinguals with aphasia, which will facilitate improved treatment methods when working with bilinguals to recover both languages post-stroke.
- Alternatively, if bilinguals with aphasia demonstrate impaired cross-language lexical connections or struggle to deal with cross-language interference, then this information may suggest that targeting a single language during treatment, versus both languages, may be more beneficial for language recovery.

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