"Neural Indices in Speech Discrimination of Monolinguals and Bilinguals"

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PREVIOUS RESEARCH

Spanish-English bilingual experience can lead to differences in processing English vowels.

- Spanish English Bilinguals who learned English prior to 5 years of age → smaller brain discriminative response to English vowels that didn't exist of Spanish. *(Hisagi et al, 2014)*

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Differences in processing English vowels for Bilinguals could be differences in allocation of attention.

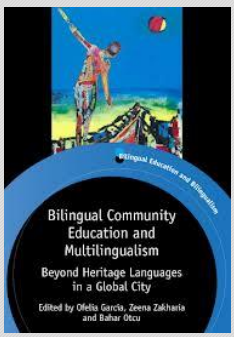
- Spanish-English bilingual can adjust processing to be similar to monolinguals when they pay attention to the stimulus *(Datta et al., 2019)*

PURPOSE

1. Examine speech in the auditory context of *competing background noise*.
2. Observe how *bilingual experience* modulates speech discrimination of English contrasts that are *not phonemic* in Spanish.
3. Examine interference resistance to non-target vowel contrast.

SIGNIFICANCE

1. Spanish
2. Chinese
3. Russian
4. Haitian (Creole)
5. Italian
6. French
7. Yiddish
8. Korean
9. African Languages
10. Polish
11. Tagalog
12. Greek



13. Arabic
14. Hebrew
15. (Bengali)
16. Urdu
17. Hindi
18. German
19. Japanese
20. Serbo-croatian
21. Portuguese
22. Persian
23. Vietnamese
24. Hungarian
25.Gujarati

Languages Other Than English (LOTE) spoken by New Yorkers over 5 years of age, US Census Bureau (2009) American Community Survey Table B160001 in Garcia, Zakharia & Otcu, 2013, p13.

MISMATCH NEGATIVITY BACKGROUND

What is Mismatch Negativity?

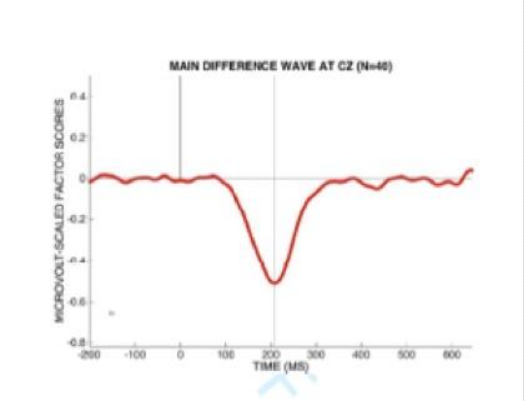
A negative peak on a waveform reflecting a discriminative response.

Where does it originate?

In the auditory cortex, but has contribution from the frontal cortex.

When can it be recorded?

It can be recorded during active or passive listening.



Graph1: MMN at Cz *(Datta et al., 2019)*

LATE NEGATIVITY BACKGROUND

What is Late Negativity?

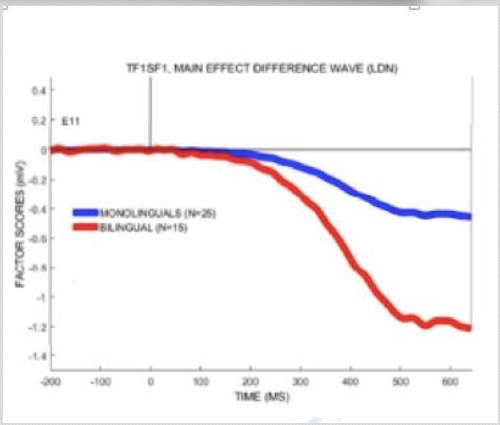
A response that occurs after Mismatch Negativity.

Where does it originate?

It's not clear what the neural source of Late Negativity is.

Do bilinguals show different Late Negativities when compared to monolinguals?

Bilingual Spanish-English participants (who learned both languages before 5 years of age) showed a larger LN than monolingual participants. *(Datta et al., 2019)*



Graph2: LN at the anterior sites *(Datta et al., 2019)*

QUESTIONS

1. Will early Spanish English bilinguals show similar discrimination, compared to monolingual English listeners, of a difficult /ɑ/ versus /æ/ contrast when not attending to the speech?

Hypothesis I: bilingual listeners will show similar discrimination to monolinguals via the MMN, but a larger LN than monolingual listeners (as found in Datta et al., 2019)

2. Will early Spanish English bilinguals versus English monolinguals show differences in how they allocate attention in a speech discrimination task where they have to suppress an interfering speaker voice?

Hypothesis II: bilingual listeners will show superior suppression on an interfering speaker voice than monolinguals

METHOD

Screenings
- Telephone Screening
- Hearing Screening (all frequencies used in pure tone testing)

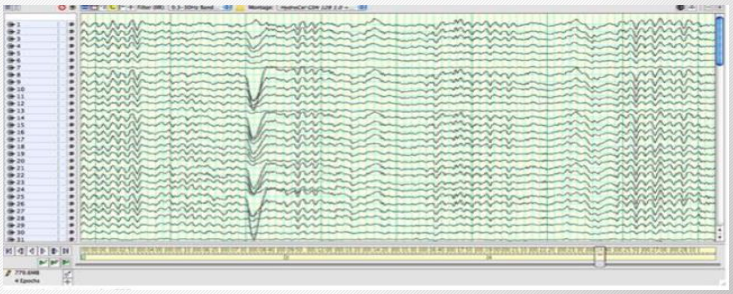
Data Collection
- 64 Channel EEG Nets *(Electrical Geodesic Inc.)*
- Questionnaires

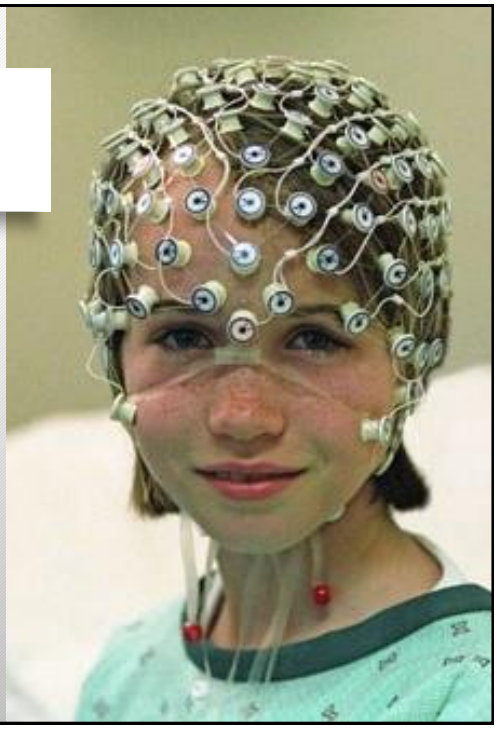
Participants
- 8 English Monolinguals *(1 pilot)*
- 2 Spanish-English Early Bilinguals *(3 pilots)*
- 1 Spanish-English Late Bilingual

DATA COLLECTION

EEG (electroencephalography)

- Neurons communicate via electrical impulses.
- Detects electrical activity in the brain using small metal discs.
- This activity shows up on an EEG recording as wavy lines.





DATA COLLECTION

Procedure

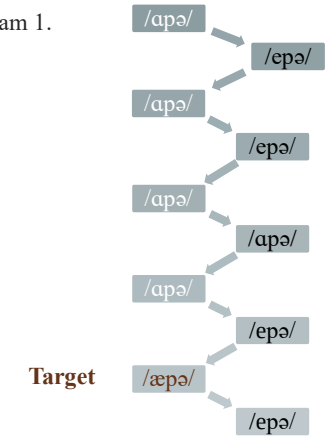
- Measure head
- Select net
- Soak the net in the solution (potassium chloride and shampoo)
- Apply net
- Ensure all electrodes are making contact with the scalp
- Calibrate (run gains and zeros)
- Run impedances
- Begin experiment.

Important

- Ask participant to point to center of the cranium (REF)
- Ask if mastoids are parallel

STIMULI

Diagram 1.



	Female Voice1	**Male Voice1**	Female Voice 2
Standard	/ɑpə/ 164.4 Hz 70.3 dB 45 ms	/epə/ 177.0 Hz 63.6 dB 36 ms	/ɑpə/ 221.4 Hz 73.4 dB 66ms
Deviant	/æpə/ 173.2 Hz 69.4 dB 45 ms	/ɑpə/ 103.7 Hz 69.6 dB 48 ms	

Table 1.
3 tokens each [ɑ], [e] and [æ]
Table includes:
- Pitch
- Intensity
- Total time

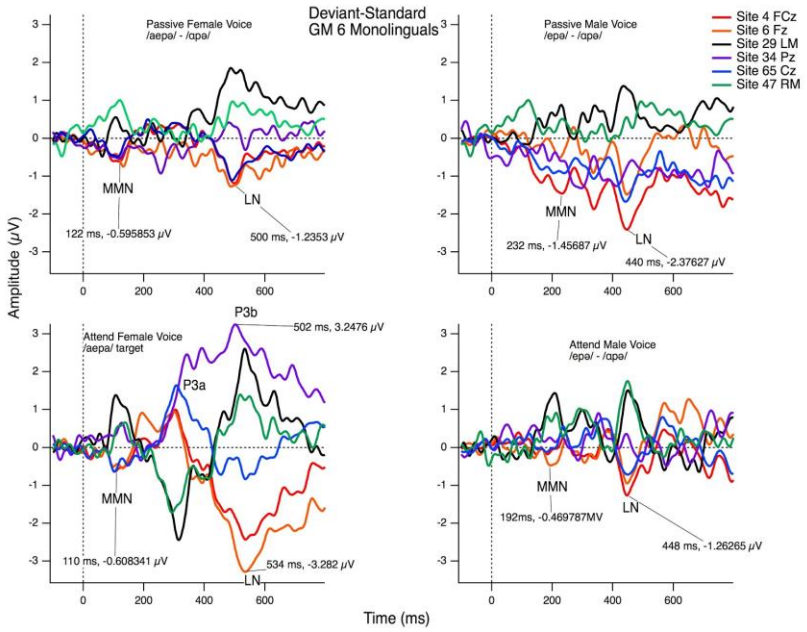
Auditory Oddball Paradigm
Condition: 220 Standards [ɑ][e]; 221 Deviants [æ][ɑ]

Conditions
Active Paradigm:
Required attention to female deviant.
Passive Paradigm:
No attention to stimulus.

RESULTS

Passive Condition
MMN & LN: Present for both the speaker voices.
Female Voice
MMN: Smaller amplitude

Attend Condition
Female voice
MMN: Smaller amplitude to female voice.
LN: Enhanced LN
Male voice
MMN & LN: smaller, consistent with ignoring the voice.



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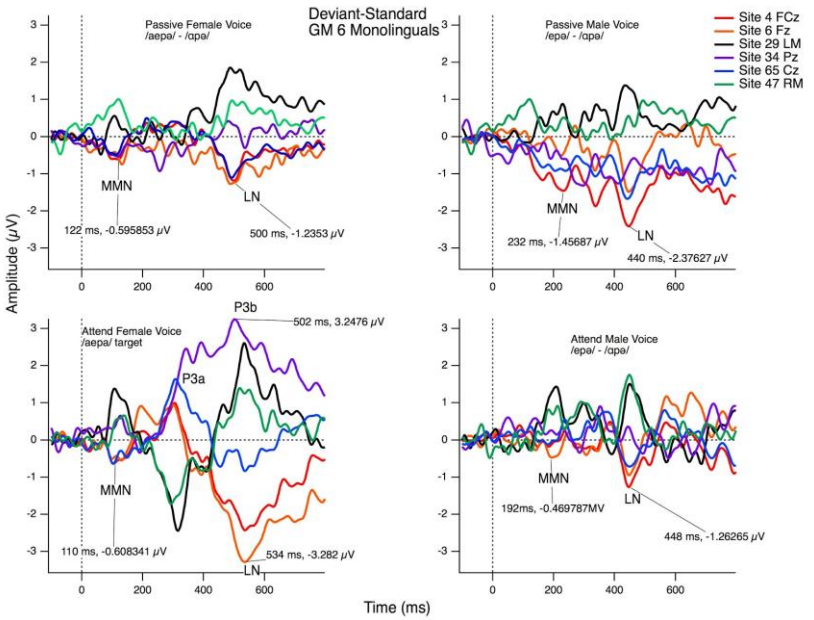

DISCUSSION

Hypothesis 1: Bilingual listeners will show similar discrimination to monolinguals via the MMN, but a larger LN than monolingual listeners (as found in Datta et al., 2019)

Early Bilinguals showed enhanced MMN with attention to the target stimulus.

Hypothesis 2: Bilingual listeners will show superior suppression of an interfering speaker voice than monolinguals.

Early bilinguals showed enhanced attention processing to the male voice, which was supposed to be ignored.

LIMITATIONS AND FUTURE DIRECTION

Future studies are necessary to understand how (and how much) experience with a second language changes how a listener navigates the auditory-speech environment. *E.g. Target and Non-Target voice close in freq.*

More participants are needed!

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