

PHONOTACTIC INFLUENCES
ON THE PERCEPTION OF A CONSONANT
CLUSTER BY ENGLISH AND POLISH
LISTENERS

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Behavioral and Event-Related Potential study using a phonological priming task

OUTLINE

- INTRODUCTION
- METHOD
- BEHAVIORAL DATA
- EVENT-RELATED POTENTIAL DATA

Event-Related Potentials were recorded while participants performed the behavioral task

INTRODUCTION

PRODUCTION

Davidson and Stone, 2003

Lack of exposure to a consonant cluster in the native language such as /zg/ in the nonsense word “*zgomu” prevents English speakers from producing the cluster in the same way as native speakers

- Mistiming of articulatory gesture

PERCEPTION

Dupoux, E., Hirose, Y., Kakahi, K., Pallier, C., & Mehler, J., 1999

Consonant clusters are essentially non-existent in the phonotactic structure of Japanese

- A nonsense word such as ebzo is perceived as ebuzo by Japanese listeners

Halle, P.A., Segui, J., Frauenfelder, U., & Meunier, C. 1998

- Consonant clusters *tl and *dl that are illegal phonotactic structures in French are perceived as kl or gl legal forms

What if the consonant cluster occurs in one phonotactic position in the syllable or word but not in all phonotactic positions?

CONSONANT CLUSTER “PT”

KEPT

TRIPPED

PT ILLEGAL PHONOTACTIC FORM IN WORD ONSET

“THE VOLCANO WILL ERUPT IN A YEAR”

*PTINA

CONTRAST “PT” AND “P_{vowel}T”

TRUMPED/TRUMPET

METHOD

ADULT PARTICIPANT GROUPS

- 13 NATIVE-ENGLISH LISTENERS

 - “pt in word final position, slept, except

 - “pt” illegal phonotactically in word onset

- 14 NATIVE-POLISH LISTENERS

 - “pt” exists in word onset ptak (bird)

STIMULI

NONSENSE WORDS

- Natural speech
- Recorded from a bilingual Polish-English speaker came to US at age six

DESIGN

Phonological Priming Task

ERP RESEARCH

- Praamstra, P. & Stegeman, D. (1993)
- Praamstra, P., Meyer, A. & Levelt, W. (1994)

800 PAIRS OF NONSENSE WORDS

Potential real words in Polish and English with the exception of all nonsense words that begin with pt

Vowels used in both Polish and English

e as in bet pte^ema

i as in hit setiⁱcha

o as in hot ptoga

e as in beet sete^esha

u as in Sue ptu^uza

800 PAIRS OF NONSENSE WORDS

250 ms ISI

2000 ms ITI

FOUR PT CONDITIONS

FOUR ST CONDITIONS (Control stimuli)

“ST” and the contrast segment “SVOWELT” are legal phonotactic forms in both Polish and English

800 PAIRS OF NONSENSE WORDS

PT CONDITION

1. Two tokens of the same word and the second word has two syllables (100 PAIRS)

pteba-pteba

ptila-ptila

2. Two tokens of the same word and the second word has three syllables (100 PAIRS)

peteecha-peteecha

petoza-petoza

3. A different word pair, the second word has two syllables (100 PAIRS)

petoga-ptoga

petema-ptema

4. A different word pair, the second word has three syllables (100 PAIRS)

ptuza-ptuza

ptiva-petiva

800 PAIRS OF NONSENSE WORDS

ST CONDITION

1. Two tokens of the same word and the second word has two syllables
(100 PAIRS)

steba-steba

stula-stula

2. Two tokens of the same word and the second word has three syllables
(100 PAIRS)

seteesha-seteesha

setona-setona

3. A different word pair, the second word has two syllables (100 PAIRS)

seteeza-steeza

seticha-sticha

4. A different word pair, the second word has three syllables (100 PAIRS)

stina-setina

stoka-setoka

SAMPLE OF EXPERIMENT

You will hear pairs of nonsense words. Your job is to decide if the second word in the pair has two syllables or three syllables. If the second word in the pair has two syllables, press the response key that says 2; if the second word in the pair has three syllables, press the response key that says 3



BEHAVIORAL and ERP MEASURES

Decide if the second word in the nonsense word pair has two or three syllables

Event-related potentials (ERP) are recorded while the subject performs the behavioral task

Behavioral Task

- Perception or End Result

Event-Related Potentials

- Underlying processes occurring over time in the auditory system

EVENT-RELATED POTENTIALS (ERP)

We record electrical signals at the surface of the scalp time-locked to an auditory signal

The electrical activity measured at the scalp reflects the summation of neural activity

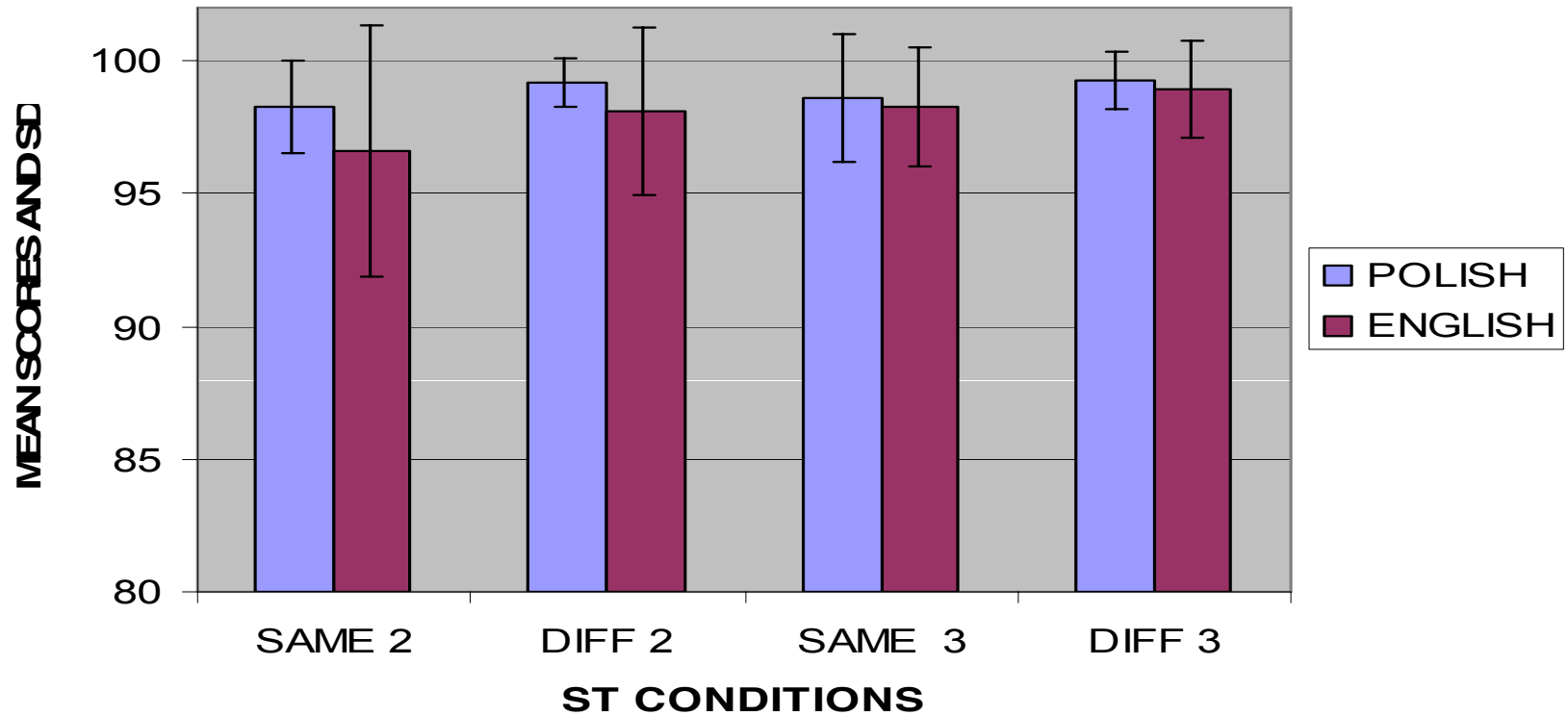
- Amplify the signal
- Many trials added and averaged

**MUST A CONSONANT CLUSTER
EXIST IN A CERTAIN PHONOTACTIC
POSITION IN A LANGUAGE IN ORDER TO
BE PERCEIVED**

***PT IS AN ILLEGAL PHONOTACTIC FORM IN WORD ONSET A LEGAL FORM
AT THE END OF WORDS**

RESULTS
BEHAVIORAL DATA

ST CONDITIONS FOR POLISH AND ENGLISH PARTICIPANTS



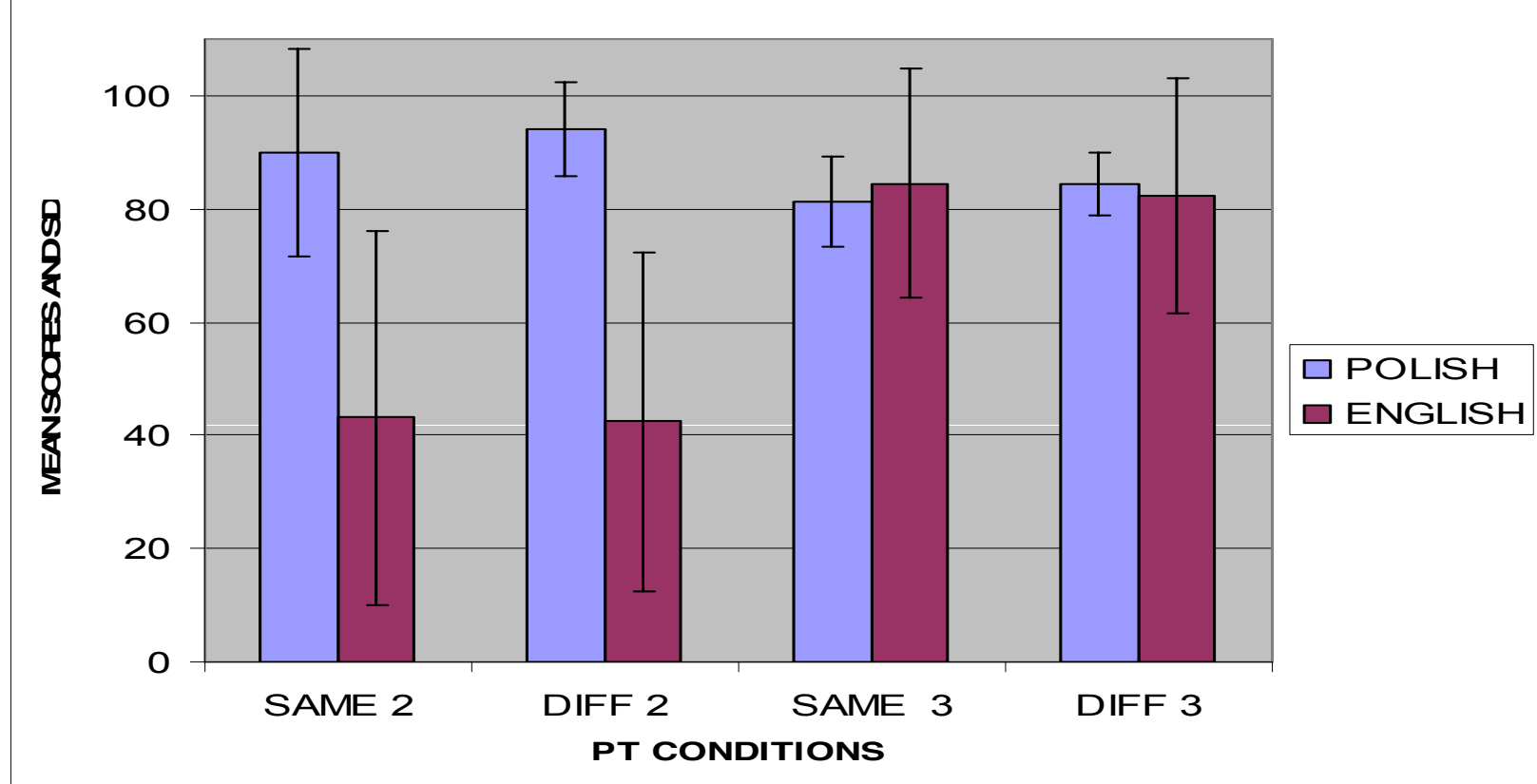
MEAN SCORES	98	97	99	98	99	98	99	99
SD	1.8	4.7	.94	3.1	2.4	2.2	1.1	1.8

90% OR GREATER ON ALL FOUR CONDITIONS

p-.4800 (Fisher-Exact Test)

- 12 out of 12 Polish participants
- 11 out of 13 English participants

PT CONDITIONS FOR POLISH AND ENGLISH PARTICIPANTS



MEAN SCORES	90	43	94	36	81	85	84	82
SD	18.4	33.0	8.4	27.4	7.9	20.4	5.6	20.8

70% OR GREATER ON ALL FOUR CONDITIONS

p=.00002 (Fisher-Exact Test)

80% OR GREATER ON ALL FOUR CONDITIONS

p= .0052 (Fisher-Exact Test)

CONCLUSIONS
BEHAVIORAL DATA

The sound cluster must occur in the particular phonotactic position within the native language in order to be perceived

“The volcano will erupt in a year” *ptina

From this study it appears that in perception the phoneme itself taken out of its phonotactic context (*ptina) cannot be a unit in auditory processing

As opposed to the phoneme –in perception–the *syllable is essential* in auditory processing of the signal

Perception is altered by native-language experience and during development of the native-language, perception becomes sensitive to the acoustic features of the sound segment which vary with the phonotactic context such as acoustic events preceding the phoneme segment and patterns of stress

IS THERE NEUROPHYSIOLOGICAL
EVIDENCE THAT THE PT CLUSTER IN
WORD ONSET IS DISTINGUISHED FROM
THE CONTRAST SEGMENT, P_{vowel}T IN
WORD ONSET IN ENGLISH LISTENERS
EVEN THOUGH THEY DO NOT PERCEIVE
THE DISTINCTION?

RESULTS

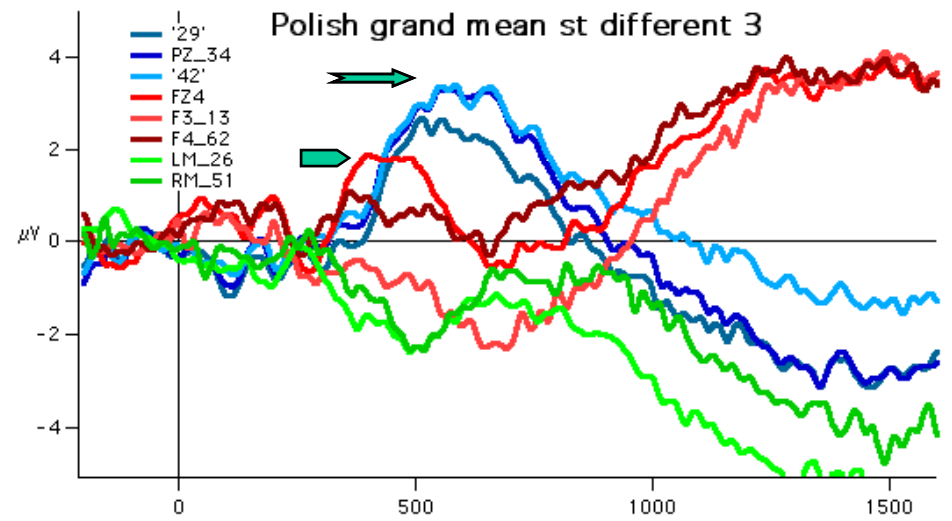
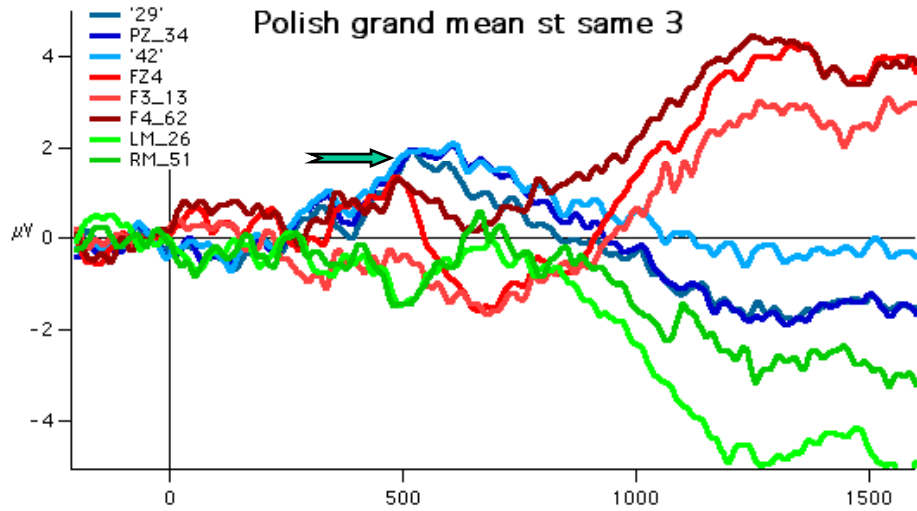
EVENT-RELATED POTENTIAL

ST 3 SYLLABLE TARGET

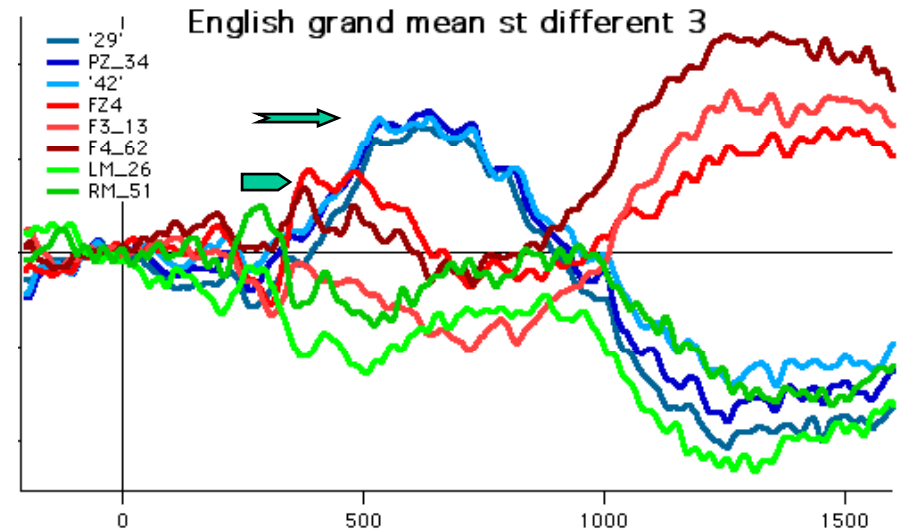
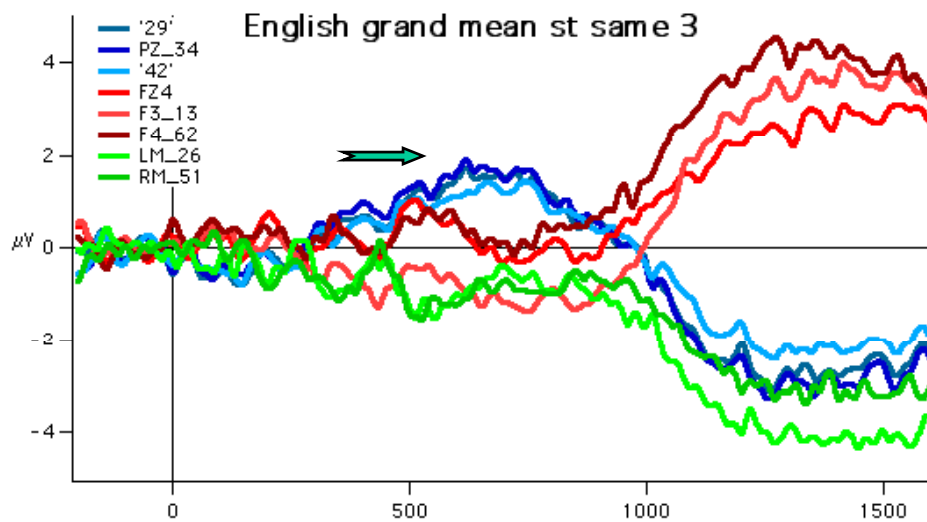
seteesha-seteesha

POLISH

steesha-seteesha



ENGLISH

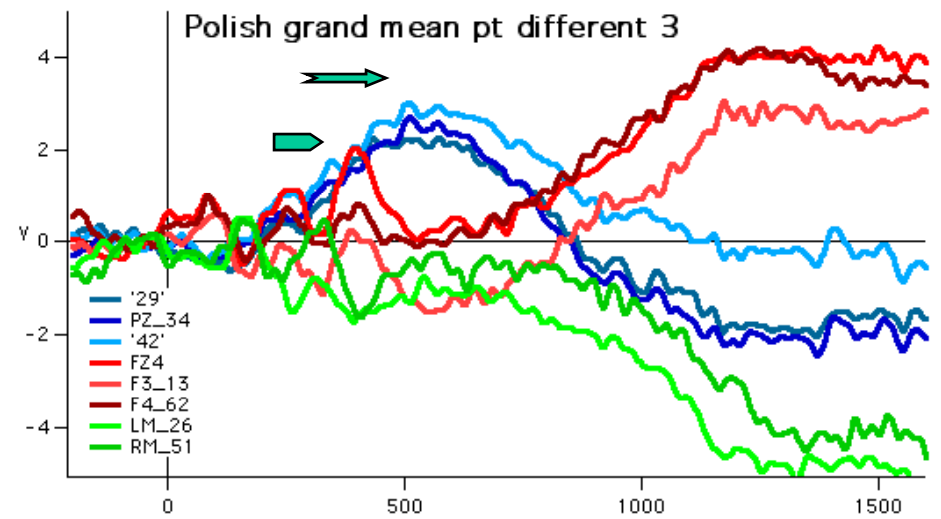
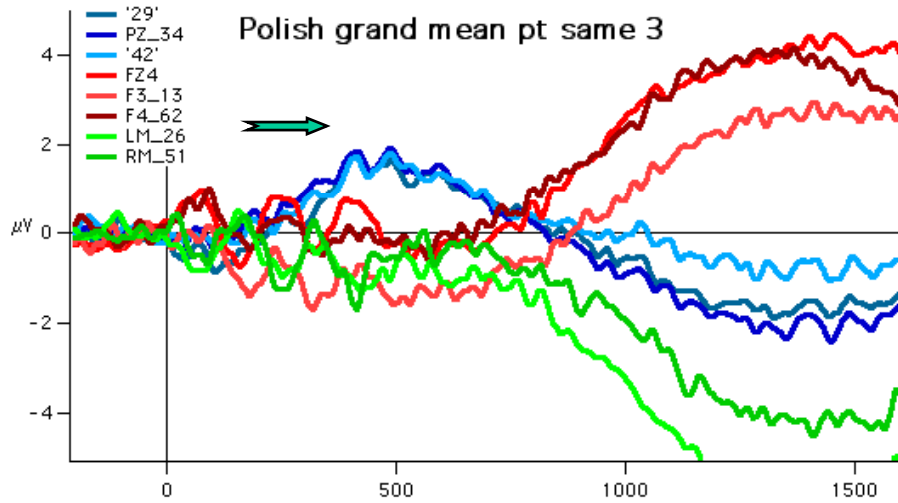


PT 3 SYLLABLE TARGET

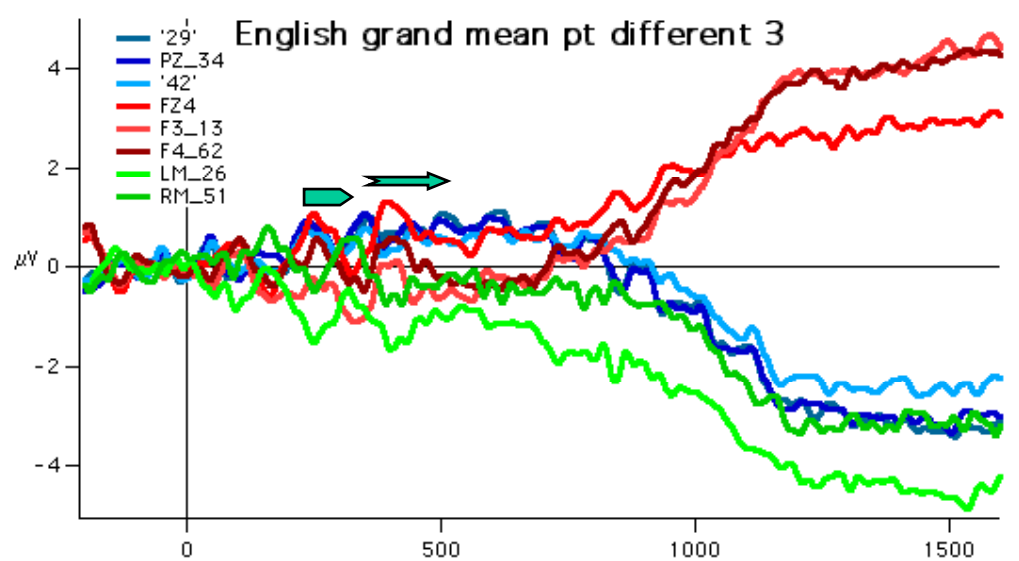
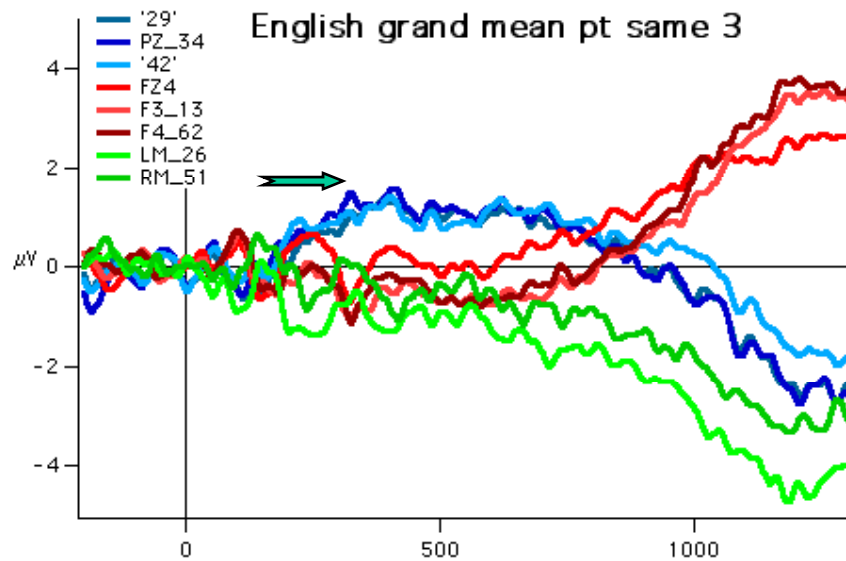
petiva-petiva

POLISH

ptiva-petiva



ENGLISH



CONCLUSIONS ERP DATA

The ST contrast is a more robust physiological response than the PT contrast for both language groups

Neuro-physiological support for the view:

The difference between [#st_] and [#sVt_] is more salient than [#pt_] and [#pVt] consistent with the notion of [#pt_] being more marked than [#st]

The **physical contrast** in the PT same and different pairs for both Polish and English groups **may be detected and evident** in the electrophysiological response

The **linguistically-relevant** differences observed between the English and Polish native-language groups appear to be evident in the electrophysiological response

These physically and linguistically-relevant distinctions appear to arise from different brain sources