Perception of Japanese vowel duration contrasts by L1 and L2 learners of Japanese: An EEG/MEG study.

Miwako Hisagi [1, 2], Shigeru Miyagawa [2], Valerie Shafer [1], Hadas Kotek [2], Ayaka Sugawara [2], Winifred Strange [1], Dimitrios Pantazis [2]

[1] The Graduate Center, City University of New York (Speech-Language-Hearing Sciences)

[2] Massachusetts Institute of Technology (Foreign Languages and Literatures & Linguistics and Philosophy & MEG Lab at the McGovern Institute for Brain Research)

EXPERIMENTAL AIM

Neurophysiological measures were used to examine whether speech perception is more **automatic** for native than non-native listeners. The measure is ideal for examining speech perception at early levels of processing that reflect **automaticity.**

The current study compares American English (AE) naïve listeners of Japanese (JP) and AE L2 learners of JP who have acquired some knowledge of JP (one semester) to determine whether experience with JP in a classroom leads to sufficiently robust SPRs to indicate **automatization of speech perception** at least for some learners.

The study reveals **changes in automatization with learning.**

BACKGROUND

Automatic Selective Perception (ASP)

- "All phonetic features that serve to distinguish phonological segments can be differentiated acoustically by multiple parameters that systematically vary in value along several spectral and temporal dimensions (Strange & Shafer,2008)."
- Adult L1 learners are characterized as having developed highly automatic ***selective* perception routines (SPRs)** for detecting the most reliable acoustic-phonetic cues for differentiating L1 phonemes in variable phonetic and prosodic contexts. (Strange & Shafer, 2008; Strange, 2009; Strange, 2011)
- L1 speech processing in adults as an **automatic** event of selective attention
- Non-native L2 listeners may require extra **attention** to discriminate phonetic contrasts of L2.

What is selective attention? "Selective attention is the process of focusing on a specific stimulus in order to process the information while ignoring other potentially distracting stimuli" (Pashler, 1998)

JP L1 listeners' have developed **automatic SPRs** that make primary use of **durational cues**, whereas AE listeners' **automatic SPRs** may be more selective for fine spectral differences. At an **automatic level** of processing, AE listeners are expected to show less sensitivity to durational differences in phonetic segments than those of JP listeners.

Mismatch Negativity (MMN)/Mismatch Filed (MMF) Component

- **MMN in Electroencephalogram (EEG) & MMF in Magnetoencephalography (MEG):** pre-attentive discrimination of a stimulus or pattern change, in a sequence of auditory stimuli (Nattanen, 1990; Alho 1995; Lütkenhöner & Poeppel 2011).
- The amplitude or latency of MMN reflects **the level of difficulty** of the speech contrast for listeners. The processes underlying MMN are largely **automatic** but can be modulated by **attention**.

Neurophysiological Research (L1 vs. L2):

- L2 listeners show **MMN/MMF** with **smaller amplitude and/or later latency** than L1 listeners. (Dehaene-Lambertz et al., 2000 ; Menning et al., 2002; Nenonen et al., 2003, 2005, Shestakova et al., 2006)
- One challenge of second language (L2) acquisition research is to evaluate to what extent experience with an L2 leads to changes in **automaticity** of L2 speech perception.
- L2 listeners have significant perceptual difficulty in discriminating phonetic segments that are not contrastive in a listener's native language (**L1**) but contrastive in another language (**L2**).

How important is experience with the L2?

RESEARCH QUESTIONS

Are there differences in automaticity among native (JP), naïve AE, and AE L2 learners of Japanese listeners of duration contrasts?
("automatic" processing of auditory information)

Prediction: Yes!

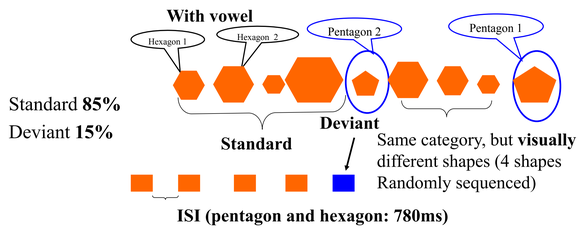
High Automaticity for **JP group**
Some Automaticity for **AE L2 learners**
Low Automaticity for **naïve AE listeners**

PARADIGM: MMN Categorial Oddball Paradigm

Auditory train

taado 1, taado 3, taado 4, taado 2, **tado 2**, taado 4, taado1, taado3, **tado 1**

Visual-attention (with discrimination response, by counting the deviant shape silently, Passive with respect to auditory)



STIMULUS MATERIALS

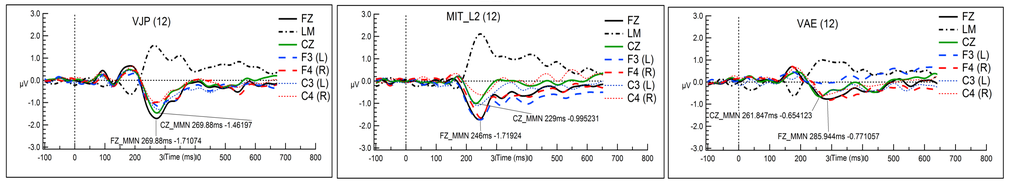
contrast	Vowel	
Duration length	Short	Long
Stimuli (nonsense words)	tado	taado
Range (among four stimuli)	202 – 214 ms	237 – 264 ms
Mean (Vowel: /a/ vs /aa/)	86 ms	138 ms

PARTICIPANTS

Group		Age range
Control 1 (Native)	JP (2M10F)	21~40
Control 2 (Naïve)	AE (4M8F)	21~40
Target (L2)	Regular (8: 2M6F)	18~27
	VFT (Very Fast Track) (4: 2M2F)	
	OR	
	AE=Native speaker of English (6: 3M3F)	
	CH=Native speaker of Chinese (6:1M5F)	

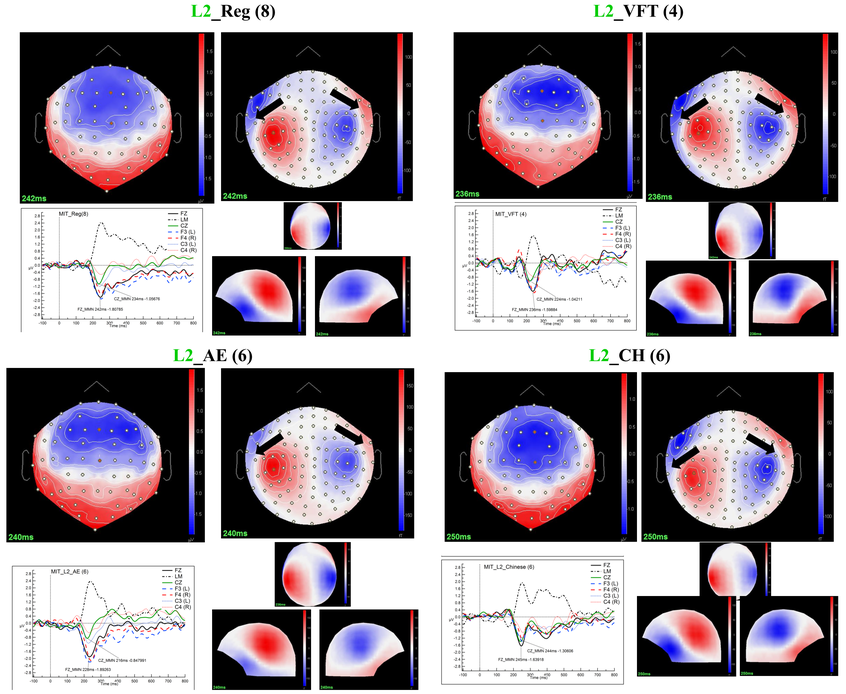
RESULT

EEG



JP vs L2 vs AE			
	Left	Central	Right
Frontal	F3: L2 > JP> AE	FZ: JP = L2 > AE	F4: L2 > JP > AE
Central	C3: JP > L2 > AE	CZ: JP > L2 > AE	C4: JP > L2 = AE

EEG (left) & MEG (right)



L2: AE vs CH			
	Left	Central	Right
Frontal	F3: AE > CH	FZ: AE > CH	F4: AE > CH
Central	C3: AE =CH	CZ: CH > AE	C4: CH > AE

CONCLUSION

This study suggests that experience with the L2 (Japanese) leads to increasing robustness of discrimination of L2 phonemic contrasts, indexed by increased negativity over **frontal** site; however, these L2 representations (or **SPRs**) are still less robust than those of L1 listeners, as indexed by smaller MMNs over central sites.

Future Directions: Source Analysis will be undertaken, after we have sufficient participants, to determine whether these topographical differences are due to sources in auditory cortex or additional regions (e.g., anterior attentional network). We will also explore whether there are differences in L2 learning of JP related to prior language status (i.e., monolingual versus bilingual).

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