Novel Phoneme Contrasts and the Developing L2 Lexicon
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Background
- Adult learners typically experience difficulty perceiving and producing the phonemes of a second language (L2)
  - Why do learners exhibit foreign accents?
  - Why are foreign accents often so difficult for learners to overcome?

Background
- “Allophonic split” is particularly difficult

Japanese /flap/ /t/ /tt/
English /r/ /l/ /t/

Lexical Consequences?
- What are the consequences of novel contrasts for the phonological content of learners’ lexical representations of L2 words?
- How does the ability to lexically encode novel L2 contrasts develop?

Lexical Representation
- Storage of a word in memory
  - phonological, morphological, syntactic, semantic, (and orthographic) structures
- Traditionally, lexical representations contain only contrastive information about the phonological structure of words (i.e. phonemes)

Homophonous Lexical Representations?
- When learners have no awareness of a novel contrast, they should not be able to encode the relevant phonemes in their lexical representations of L2 words
- Are pairs of words that differ minimally with respect to a novel contrast encoded as homophones in the learner lexicon?
Homophonous Lexical Representations?

- Even highly fluent second language learners experience patterns of lexical activation that are consistent with homophonous lexical representations of L2 minimal pairs (Pallier, Colomé & Sebantián-Gallés 2001; Cutler & Otake 2004)

Pallier et al. (2001)

- Auditory repetition priming in fluent bilingual speakers of Spanish and Catalan
- Spanish-dominant bilinguals (but not Catalan-dominant bilinguals) showed repetition priming for Catalan minimal pairs differing only by contrasts that exist in Catalan but not in Spanish (e.g., /o/-/o/: dóna-dona ‘s/he gives’-‘woman’)

Pallier et al. (2001)

- Homophonous lexical representations?
- Alternative explanation
  - Learners were unable to distinguish the minimal pairs at the level of perception in these online auditory tasks


- Tease apart the contributions of online perception and lexical representations using eye-tracking technology
- Dutch native speakers (NS) of L2 English
- English /ɔ/ and /ɔ/ are not contrastive in Dutch


- Fixated longer and more frequently on picture of a pencil when the target word was panda than on less confusable distractor (e.g. beetle when the target word was bottle)
  - Consistent with a homophonous representation of /ɔ/ and /ɔ/ in subjects’ English lexicons
  - But...


- Pattern of inappropriate lexical activation was asymmetric
  - Target panda caused subjects to look at pencil but not the reverse…why?
  - Subjects perceive both English /ɔ/ and /ɔ/ as /ɔ/ regardless of which is present in the auditory signal
• But how can learners lexically encode a contrast that they do not accurately perceive?
  – Explicit instruction and/or knowledge of the spelled forms (Cutler et al., to appear)?

Curtin et al. (1998)
• Thai three-way voicing contrast
• Monolingual English speakers can contrast novel Thai contrasts in their memory of Thai minimal triplets, even when their exposure to these contrasts is limited to the study duration

Production vs. Listening Data
• Production of new L2 sounds improves earlier than perception ability
  – e.g. Goto 1971; Sheldon and Strange 1982
• Perceptual ability precedes production ability
  – e.g. Borden, Gerber and Milsark 1983

Objectives
• Investigate the development of the ability to encode a novel contrast lexically
• Compare performance on listening and production tasks that tap lexical representations
• Investigate variation within and between subjects in their lexical-phonological development

Study Overview
• Word learning phase
  – Subjects learned a set of Japanese nonwords
  – Some contained geminate consonants
• Listening test phase (matching task)
• Production test phase (naming task)

Japanese Consonant Length
• Japanese contrasts short (singleton) and long (geminate) consonant pairs
  – e.g. /t/-/tt/, /k/-/kk/, and /s/-/ss/
  – [ot] ‘sound’ and [ot] ‘husband’
• English NS learning Japanese must learn this novel contrast
Subjects

• **Inexperienced Learners**
  – English NS, no Japanese language experience (n=12)
• **Experienced Learners**
  – English NS, one year of Japanese language experience (n=12)
• **Japanese NS**
  – Control group (n=12)

Word Learning Phase

• 12 Japanese nonwords
  – (C)V.CV structure
  – Medial C singleton or geminate
  – Produced by an adult male Japanese NS
• Four singleton-geminate minimal pairs
• Four filler words with singleton medial consonants

Word Learning Phase

• Nonwords and randomly assigned meanings

<table>
<thead>
<tr>
<th>Singleton Words</th>
<th>Geminate Words</th>
<th>Filler Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word</td>
<td>Picture</td>
<td>Word</td>
</tr>
<tr>
<td>pete</td>
<td>dress</td>
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<td>motorcycle</td>
<td>tese</td>
</tr>
<tr>
<td>meso</td>
<td>piano</td>
<td>meso</td>
</tr>
</tbody>
</table>

Practice Task

• Matching task similar to listening test phase
• Ensure that subjects had achieved a minimum level of memory of the words
• Critically, practice task did not test ability to differentiate singleton and geminate consonants lexically

Listening Test Stimuli

• Four types of test pairs
• **Filler-matched and Filler-unmatched**
  – Correctly and incorrectly matched pairs of filler words
• **Target-matched**
  – The eight target words with their matched pictures

Listening Test Stimuli

• **Target-unmatched**
  – The eight target words with incorrectly matched pictures
  – Required sensitivity to the singleton-geminate contrast to correctly identify as ‘not matched’
  – e.g. singleton word *meso* paired with picture of a boot (which matches geminate word *messo*)
Listening Test Results

- Signal detection analysis
- No effect of subject group for **filler pairs** (p=.08)
  - No overall group differences in subjects’ ability to remember words
- However, there was a significant effect of group for **target pairs** (p<.001)

Listening Test Summary

- Experienced learners have an improved ability relative to inexperienced learners to detect mismatches involving geminate consonants in this lexical task
- Experienced learners did not differ significantly from the native speakers of Japanese

Production Test Phase

- Experimenter showed subjects each picture twice in random order
- Subjects were instructed to say the name of each picture as it was presented
- Three native speakers of Japanese transcribed the responses

Production Test Results

- “Proportion geminate consonants” measure
  - Eligible productions were geminate target words that contained the correct medial consonant in terms of place and manner of articulation
  - Proportion of eligible productions containing geminate medial consonants
- No effect of group on “proportion singleton consonants” in singleton target words
Production Test Summary

- Experienced learners have improved ability relative to inexperienced learners to produce geminate consonants accurately in this lexical task
- Their performance does not yet reach native Japanese levels

Inter-Subject Variability

- **Listening accuracy**
  - d-prime scores on target test pairs
- **Production accuracy**
  - Proportion geminate consonants produced in geminate target words

Inexperienced Learners

![Graph showing listening accuracy vs. production accuracy for inexperienced learners]

Experienced Learners

![Graph showing listening accuracy vs. production accuracy for experienced learners]

Native Japanese

![Graph showing listening accuracy vs. production accuracy for native Japanese learners]

Summary of Findings

- Listening test performance by inexperienced learners suggests that they were able to lexically contrast singleton and geminate words to some extent
- How?
  - Monolingual English NS can discriminate Japanese singleton-geminate contrasts
  - Set of nonwords contained minimal pairs
  - Consistent with Curtin et al. (1998)
Summary of Findings

• However, the inexperienced learners were largely unable to accurately implement the contrasts in production

• Experienced learners differed significantly from inexperienced learners on both tests
  – Experience with an L2 can mediate learners’ ability to show evidence of having lexically encoded a novel L2 contrast
  – One year of Japanese experience is sufficient for significant development to occur

• Experienced learners did not differ from native Japanese NS in listening task
  – One year of Japanese language experience was sufficient to make them indistinguishable from Japanese NS
• Less accurate than Japanese NS in production task
  – Production ability lags behind listening ability

Summary of Findings

• Listening and production tasks do not reveal the same information about the phonological content of learners’ lexical representations, with generally better performance by learners on listening relative to production measures

Window on the Lexicon?

• Does performance on these tasks by the learners unambiguously reflect the phonological content of their lexical representations?
  – Monolingual English NS can discriminate Japanese singleton-geminate contrasts
  – No asymmetry in lexical activation analogous to that found in Weber & Cutler (2004)

How are novel L2 phoneme contrasts stored in the lexicon?
Underspecification Account

- Phonemes specified by minimal set of features necessary to distinguish them from rest of language’s phoneme inventory
  - English consonants specified for [+/-voice] but not [+/-long]
  - Japanese consonants specified for both [+/-voice] and [+/-long]

Underspecification Account

- English NS better able to lexically encode novel Thai contrasts differing in the feature [+/-voice] (e.g. /d-t/) than contrasts differing in the feature [+/-aspirated] (Curtin et al., 1998)

Underspecification Account

- Must encode the novel feature [+/-long] in order to develop native-like lexical representations of Japanese words
- What constitutes evidence that subjects correctly specified the feature [+/-long] in their lexical representations?
- Listening test performance?
  - Not necessarily...

Underspecification Account

- Japanese singleton and geminate consonants initially neutralized to English singletons in the lexicon
- In early development, learners may begin to encode geminate consonants in the lexicon as unfamiliar versions of their closest English counterpart (singleton consonants) (see also Cutler et al., to appear)

Underspecification Account

- e.g. learners lexically encode /t/ as /t*/
  - ‘*’ means ‘sounds different from /t/’
  - Do not know yet that /t/ and /t*/ differ with respect to the feature [+/-long]
- Accounts for difference in production and listening performance for the learner groups

Future Research: Task Effects

- Why wasn’t performance more accurate?
  - Word learning may put demands on processing that obscure knowledge of newly-learned, unstable contrasts (e.g. Pater, Stager & Werker 2004)
- Children can discriminate some contrasts in tasks that involve known words (Fennell & Werker 2003), but not in tasks that involve learning new words (Stager & Werker 1997)
Future Research:
Role of Written Language
• It is possible for learners to know that two words are contrastive even when they are not able to reliably reflect that contrast in their on-line perception and production of the words (Weber & Cutler 2004; Cutler et al., to appear)

Future Research:
Ultimate Attainment
• Can L2 learners establish native-like lexical representations with enough L2 experience?
• Pilot data from learners of Japanese with even more experience (2+ years of Japanese experience)
  – No differences between their performance and that of the experienced learners
  – High variability

Pedagogical Implications?
• Controlled versus natural classroom tasks?
• Role of written forms?
• There is much more research to be done in this area!

Thank You!!!
Please contact me with questions/comments:
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