Spoken word recognition across regional accent variation:
II. Development in young children

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Cross-Accent Word Recognition in Infants/Toddlers:

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Early growth of native word recognition

**Givens:** children’s experience with native speech …
- shapes acquisition and recognition of spoken words
- attunes perception of native phonemes and contrasts
  - … and thus phonetics → phonology in words

**Core Questions** re: these experience-based effects

- **What** is learned from native speech experience?
  
  **Premise 1:** *Language environment-specific* relationships between surface *phonetic* patterns and more abstract *phonological* forms of words and their constituents

- **How** are those relationships learned?
  
  **Premise 2:** *Naturally-occurring phonetic variation* in spoken language input provides the material from which we discover *phonetic-phonological relationships*
How does phonetic variation contribute to word recognition and learning?

Two complementary principles:

- **the goal**: to identify the relationships between phonetic variations and phonological forms:
  - **Phonological Distinctiveness**
    - contrastive functions:
      - phonetic differences that do alter word identity
  - **Phonological Constancy**
    - categorical functions:
      - phonetic differences that do not alter word identity
Word recognition across regional accents

- A major source of systematic variation in word pronunciation
  - Adults are quite sensitive to accent as sociolinguistic info
  - yet they easily recognize most words across accents
  - HOW? aided by the principles of **phonological constancy** and **phonological distinctiveness**

**phonological constancy**

\[
\begin{align*}
\text{[eɪt]} & \quad \text{[æt]} \\
= & \quad \text{“eight”}
\end{align*}
\]

**phonological distinctiveness**

\[
\begin{align*}
\text{[æt]} & \quad \text{[ɪt]} \\
= & \quad \text{“eight”}
\end{align*}
\]
Prior studies of spoken word recognition in *infants and toddlers*

**Phonological Distinctiveness** has been the focus of most developmental studies of word recognition

- phonetic changes that turn one word to another:
  - BEES versus PEAS or BUZZ
  ![ Phonetic change]

- or change a word to a nonword:
  - BABY versus *PABY or *BOWBY
  ![ Phonological change]

- performance @ 11-17 months versus 18-20 months

**Phonological Constancy**

- phonetic changes that *don’t* change a word’s identity

- until recently, much less developmental research has examined this, especially across accents
Precursors: How do infants begin handling phonetic variation in speech?

- **Word segmentation** from connected speech:
  - robust to talker and emotion variation by 9-12 months
    - (e.g., Singh et al., 2004, 2008a, b)
  - robust to some accent variations by 12-13 months
    - (e.g., Schmale & Seidl, 2009; Schmale et al., 2010)

- **Language constancy** across accents even earlier
  - accent discrimination and preference for native accent
  - inference: recognition that the differing accents reflect the same native language
    - by 9 months for an unfamiliar regional accent
    - by 6 months for a more familiar non-native accent
      - Aussie infants: native AusE vs unfamiliar South African English or more media-familiar American English

(Kitamura, Panneton & Best (2013) Child Development)
Early development of Phonological Constancy

Look at the baby

✓ Phonetic change
✗ Phonological change

Listening preference for familiar (toddler) word sets over unfamiliar (adult) word sets (e.g., Hallé & de Boysson-Bardies, 1994, 1996)

- conditioned visual fixation to checkerboard (child-controlled)
- separate trials for Familiar versus Unfamiliar word sets
- 8 trials per test (4 trials per word set, alternating trials)
- each child completed 2 tests, one in each accent (order counterbalanced)

- Familiar-unfamiliar difference ratios for each accent:
  - native regional accent: American English (AmE)
  - non-native accent: Jamaican Mesolect English (JaME)
The Findings

Three Hypotheses

AGE GROUP

BEST FIT:
Perceptual Attunement account
1st further Q re: Phonological Constancy

1. How might increased phonetic variation (e.g., talkers, words, tokens) influence children’s word recognition across accents?

- high stimulus variation in the task could be detrimental to unstable word recognition:
  - if children are simply tracking input statistics
  - i.e., haven’t discovered phonological constancy

- but high variation should not disrupt stable word recognition
  - if the child has discovered phonological constancy
  - associated with vocabulary development?
2nd further Q re: Phonological Constancy

2. How might vocabulary development relate to emergence of phonological constancy?

- **Vocabulary milestones**
  - 18-20 month “vocabulary spurt”
    - 50-word mark in expressive vocabulary
    - faster, more rule-based word-learning than before

- **Phonological distinctiveness** studies
  - reliable differentiation appears ~18-20 mo:
    - e.g., Swingley; Werker; Plunkett, et al. – *Nazzi et al.: vowels v consonants

- **Phonological constancy** study
  - also appears ~18-20 mo
    - Best et al. (2009)
Two studies to address these Qs

- Participants = Australian English toddlers
  - **Experiment 2:**
    - 14-15 months ($n = 32$) w/ small vocab < 25 words
    - 18-19 months ($n = 32$) w/ larger vocab > 100 words
  - **Experiment 3:** two groups of 16-17 months
    - small expressive vocabularies (< 25 words) ($n = 24$)
    - higher (post-spurt) vocabularies (> 50 words) ($n = 24$)

- **Target materials**
  - Two phonetically similar sets of spoken words
    - FAMILIAR: found in early toddler vocabularies & books
    - UNFAMILIAR: low frequency adult words
  - Two regional accents used in both experiments
    - Native: Australian English (AusE)
    - Nonnative: Jamaican Mesolect English (JaME)
Design features

- **Vocabulary**: OZI (Australian version of MCDI)
- **Stimuli**: increased variability (re: Best et al, 2009)
  - 2 x speakers per regional accent
  - 2 x # words
  - 2 x word lengths (1 & 2 syllable)
  - 4 x # tokens per word (never heard same token twice)
- **Scoring** (modified from 1st study)
  - Total fixation to familiar vs unfamiliar word trials
  - Again, separate scores for each accent test
Exp. 2: 15- versus 19-month-olds

**Expressive vocabulary:**

- **< 25 words @15 mo**
- **> 100 words @ 19 mo**

**Age/Vocab x Word Familiarity interaction**

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**Familiar-word preference across native and nonnative accents**
Vocabulary size or age/experience?

- **Phonological constancy emergence:**
  - well-established in older/higher vocab group: adapt to unfamiliar realizations and higher token/type variability
  - absent in younger/lower vocab group: poor recognition of even native accented words under high variability

- But age and vocabulary were confounded in Exp 2
  - to tease them apart: hold one factor constant, compare extremes of normal distribution on the other
  - we held Age constant @ 16-17 months, compared lower vs. higher ends of age-appropriate vocab distribution
  - re: expressive vocabulary milestones in literature:
    - < 25 words
    - > 50 words **
Exp. 3: 17-month-olds
vocabulary size difference at constant age
< 25 words vs. > 50 words

Vocabulary x Word Familiarity x Accent interaction

Familiar-word preference but only reliable in native accent!
Within-vocabulary age comparisons

Familiar-word preference across accents

n.s.

Familiar-word pref for native accent only

n.s.
Cross-experiment comparisons

Complementary insights re: age vs. vocabulary across the 2 experiments:

• Age versus vocabulary size
  • low expressive vocabulary < 25 words
    • *no age difference* – 14-15 months vs. 16-17 months
  • high expressive vocabulary
    • *native only* – 16-17 months (> 50 words)
    • *accent generalization* – 18-19 months (> 100 words)

• But … are they showing word *identification* or merely *recognition of familiar word-forms*?
Sixteen 15-month-olds  
Sixteen 19-month-olds  
Monolingual AusE-accented households  
18 familiar toddler words, i.e., lower stimulus variability in this task  
each word spoken in native (AusE) and in the non-native regional accent (JaME)
Calculated: Tobii X120 Eyetracker

Mulak, Best, Tyler, Kitamura & Irwin (2014) Child Development

Duration of fixations to target image

Duration of fixations to target or distractor image
Target > Distractor ratio by Age and by Accent

supports Perceptual Attunement:
emergence of phonological constancy
Correlation w/ vocabulary for *non-native* items only, at 15 months only

*Mulak, Best, Tyler, Kitamura & Irwin* (2014) *Child Development*
What process shapes cross-accent word recognition? → Perceptual Assimilation to native accent phonemes

Perceptual Assimilation Model:
What process shapes cross-accent word recognition?

- Assimilated as *Nativelike*
- Assimilated as *Category Shift: Different categories in listener’s versus speaker’s accent*
- Assimilated as *Category Goodness Difference same category in both accents*
Experiment 5: Category Goodness (CG) vowel differences from native accent

- Toddlers at 13-15 and 18-20 months (32 per age)
- Cross-accent assimilation: CG vowel differences
- Accents: AusE (native) vs JaME (non-native)
- Preference tests: FAMILIAR vs UNFAMILIAR words
- Stimulus variability: MODERATELY HIGH
- Examples of target words in AusE (2) vs JaME (2):
  - 1-syllable FAMILIAR (toddler) DOLL BIRD
  - 1-syllable UNFAMILIAR (adult) DOOM WHEEZE
  - 2-syllable FAMILIAR TIGER TV
  - 2-syllable UNFAMILIAR SEAWEED ROOKIE
Expt. 5: Familiarity preference across CG vowel differences over both accents and ages

* Age x Accent interaction: Familiarity pref → Novelty pref

* Familiarity preference (main effect across ages & accents)

But age diff in overall JaME listening preference
Discussion of Experiment 5: CG cross-accent vowel differences

- **Category Goodness (CG)** differences handled by the younger word learner group (smaller vocabs)
  - So, why didn’t they succeed in the preceding studies?

**Possibilities:**
- Many words in the prior studies had actually displayed both **Category Shifting (CS)** as well as **CG** differences
- Many words involved both vowel *and* consonant diffs
- The vocab size studies had even *higher stimulus variability*

- **Experiment 6:**
  - Developmental changes in word recognition across **CS differences** in **vowels plus consonants** (JaME again)
Experiment 6: Category Shifting (CS) vowel + consonant diffs from the native accent

- Toddlers at 13-15 and 18-20 months (32 per age)
- Cross-accent assimilation: CS consonant+vowel diffs
- Accents: AusE (native) vs JaME (non-native)
- Preference tests: FAMILIAR vs UNFAMILIAR words
- Stimulus variability: MODERATE
- Examples of target words in AusE (2) vs JaME (2):
  - 1-syllable FAMILIAR (toddler) MOUTH HOME
  - 1-syllable UNFAMILIAR (adult) CASK BROTH
  - 2-syllable FAMILIAR BATHTUB TURTLE
  - 2-syllable UNFAMILIAR THROTTLE HEARTH RUG
Exp. 6: Different developmental pattern for CS vowel+consonant than CG vowel diffs!

Familiarity preference *only* for native accent, and *only* for 19-month-olds
Discussion of Experiment 6: CS cross-accent vowel+consonant diffs

- Category Shifting (CS) V+C differences from native accent not accommodated even by the older word group
- Why didn’t they succeed here when they did succeed in all the preceding studies?

Possibilities:
- This range of variability may be too great even for them … and indeed does hinder L1 and L2 adults’ recognition of known words
- Maybe this reflects consonant-vowel diffs in word recog

- Experiment 7:
  - Toddler word recognition across CG consonant diffs
Experiment 7: Category Goodness (CG) consonant differences from native accent ... and another unfamiliar accent: Cockney

- Toddlers at 13-15 and 18-20 months (prelim: 32 x age)
  Cross-accent assimilation: CG consonant differences
- Accents: AusE (native) vs Cockney (non-native)
- Preference tests: FAMILIAR vs UNFAMILIAR words
- Stimulus variability: MODERATELY HIGH
- Examples of target words in AusE (2) vs JaME (2):
  - 1-syllable FAMILIAR (toddler) TREE CAT
  - 1-syllable UNFAMILIAR (adult) TEAK MOAT
  - 2-syllable FAMILIAR TIGER RABBIT
  - 2-syllable UNFAMILIAR ROVING YOGHURT
Expt. 3: Familiarity preference across CG consonant differences over accents and ages

* Word-set Familiarity preference (main effect across ages & accents)
CONCLUSIONS:
Development of phonological constancy

* Shift from *phonetic detail* to *phonological form*

- **Phonological constancy** and word recognition:
  - < 18 mo/<25 words = *phonetically specific* to native accent
  - 19 mo/>100 wds = *phonological constancy* → ↑ adaptability

- **Phonological constancy**, vocabulary and variation:
  - intermediate: native accent variation by ~50 word vocab
  - extends to *unfamiliar* accents by ~100 word vocabulary

- **Perceptual assimilation** of unfamiliar accents:
  - Category Goodness (CG) vowel *and* CG consonant accent differences *can* be accommodated even by 15 mos
  - **but** … unfamiliar-accent Category Shifting (CS) V+C differences are difficult even for 19 mo olds … and adults
Future issues:

- factors affecting phonological constancy, e.g.,
  - familiarity/exposure to other accents: *perceptual adaptation*
  - accents differing primarily consonants
  - accents differing primarily in vowels

- proposed link between phonological constancy and phonological distinctiveness
  - are they associated similarly with vocabulary development?
  - do they in fact develop *in tandem*?
  - might these skills show a more global relationship to language learning ability? Even in adult L2+ learning?
Discussion of Experiment 7: CG cross-accent consonant diffs

- **Category Goodness (CG)** differences handled by the younger word learner group (smaller vocabs)
- Why didn’t they succeed in the preceding studies?

**Two possibilities:**
- Many words in the prior studies had actually displayed both **Category Shifting (CS)** as well as **CG** differences
- The vocab size studies had even higher stimulus variability

- **Experiment 6:**
  - Developmental changes in word recognition across **CS differences**