Recognizing spoken words in a second language:

The phonetic-lexical interface

James Emil Flege

Speech & Hearing Sciences

University of Alabama at Birmingham

ISTC-CNR
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1: Recognition of spoken words

- Models of spoken word recognition partially resemble models developed for the written word:

TRACE McClelland, Elman

RACE, SHORTLIST, MERGE Cutler, Norris, McQueen

COHORT Marslen-Wilson, Gaskell

1: Recognition of spoken words

- In both kinds of models, word recognition occurs as the result of both “bottom up” and “top down” processes
- However, models for spoken and written word recognition necessarily differ in important respects

1: Recognition of spoken words

Why? For example:

- Models of spoken word recognition must account for how words in the "speech stream" are segmented
- There are no spaces between spoken words that allow the listener to know where one word ends and the next beings!

1: Recognition of spoken words

- Spoken word recognition models tend to emphasize the contribution of “top-down” processes

Why?

- The speech signal is said to be “impoverished” (inadequate)
- Highly variable production of vowels, consonants (many, many contributing factors)

1: Recognition of spoken words

- Often, sounds you can “hear” in a spoken word are not visible in a sound spectrogram!

“ I can’t do it”

Where is the /n/?!

(The preceding vowel /æ/ is nasalized)

1: Recognition of spoken words

- At times, “top-down” influences overwhelm (override) “bottom-up processes
- Phoneme restoration effect (Warren, 1970)

  legislature

  1 normal token 

  2 same token, /s/ replaced by non-speech noise 

  3 same token, /s/ replaced by silence 

1: Recognition of spoken words

- Spelling errors in written language may, of course, be overlooked

correct	legislature
incorrect	legiflature

1: Recognition of spoken words

- But you can see the spelling error if you look carefully

correct legislature

incorrect legiflature

2: “Perceptual” foreign accent

- Foreign accent in speech production is well known
  - German vs. Italian accents in English are very different
  - L1 phonetic system influences production of vowels, consonants (“sounds”) in L2

2: “Perceptual” foreign accent

- “Foreign accent” also exists in speech perception
  - different for French and German listeners of English
  - perception of L1 sounds influences perception of L2 sounds

2: “Perceptual” foreign accent

- During L1 acquisition, long-term memory representations (“phonetic categories”) conform to how vowels, consonants are produced in the L1
- This process of “perceptual attunement” promotes efficient L1 word recognition
- But it may not be optimal for recognizing words in an L2 (second language)

2: “Perceptual” foreign accent

- Use of L1 phonetic categories in “bottom up” stages of L2 word recognition may work at times
- Example: an Italian monolingual can recognize English “telephone”)
- However, use of L1 categories in L2 word recognition is inefficient and can cause errors

2: “Perceptual” foreign accent

Example 1

- Recognition of English words like:

  beat (/i/) bit (/ɪ/)

  bought (/ɑ/) but (/ʌ/)

- If both members of these pairs are processed using a <u>single</u> Italian vowel category, the wrong word may be heard
  (although semantic context usually prevents such errors)

2: “Perceptual” foreign accent

Example 2

- Italian and English /t/ differ phonetically
  - unaspirated (short VOT) in Italian
  - aspirated (long VOT) in English
- Listeners can readily detect such small phonetic differences
- Use of Italian /t/ category in English may slow early (bottom-up) stages of processing

3: Recognizing words in an L2

A well known phenomenon

- When familiar L2 words are presented in noise, non-natives may recognize as many words as natives
- However, for this to happen, the words must be twice as loud (6 dB S/N difference) for the non-natives

3: Recognizing words in an L2

What causes the “6 dB” effect?

- Bottom-up processes? (inadequate phonetic categories?)
- Top-down processes (relatively unfamiliarity with L2 words?)
- Both?
- Depends on level of L2 proficiency?

4: Research

Review in detail some studies examining L2 word recognition

Bent & Bradlow (2003)

Examined the recognition of English words by native speakers of English and two groups of nonnative speakers

Bent & Bradlow (2003)

Participants (listeners)

graduate students at Northwestern University (Chicago)

	N	*Age*	*Length of residence in USA (years)*
English	21	19	--
Chinese	21	24	1.1
Korean	10	28	0.7

Bent & Bradlow (2003)

Stimulus sentences (examples)

The family bought a house

The ball broke the window

designed for use with native English children

- syntactically simple
- familiar words

Bent & Bradlow (2003)

Procedures

- English sentences produced by 3 talkers differing in native language
  - English
  - Chinese (foreign accented but intelligible)
  - Korean (foreign accented but intelligible)
- Sentences presented auditorily, via headphones, in noise (-5 dB S/N)

Bent & Bradlow (2003)

Dependent variable

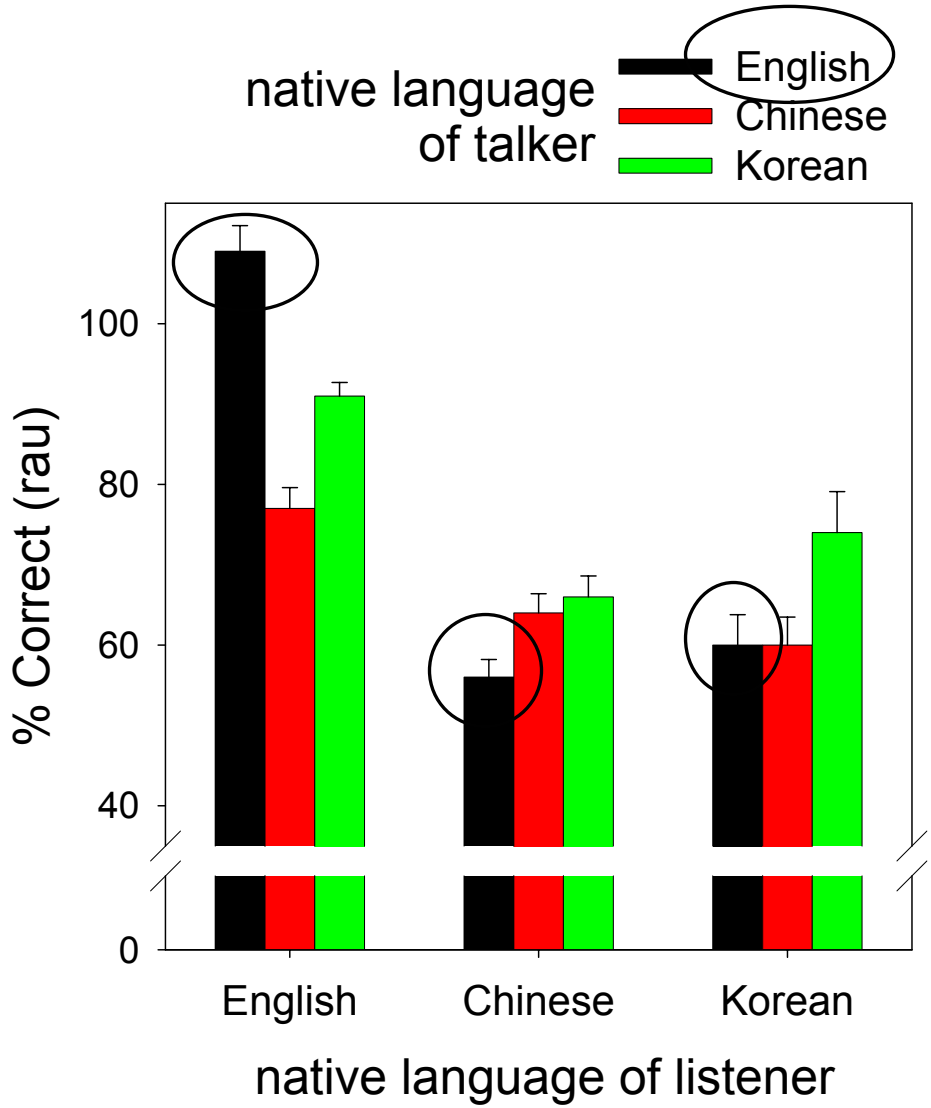
% key words that were transcribed (i.e., written down) correctly [maximum = 37]

The family bought a house

The ball broke the window

converted to rau (rationalized arcsine units)

data from Bent & Bradlow (2003)



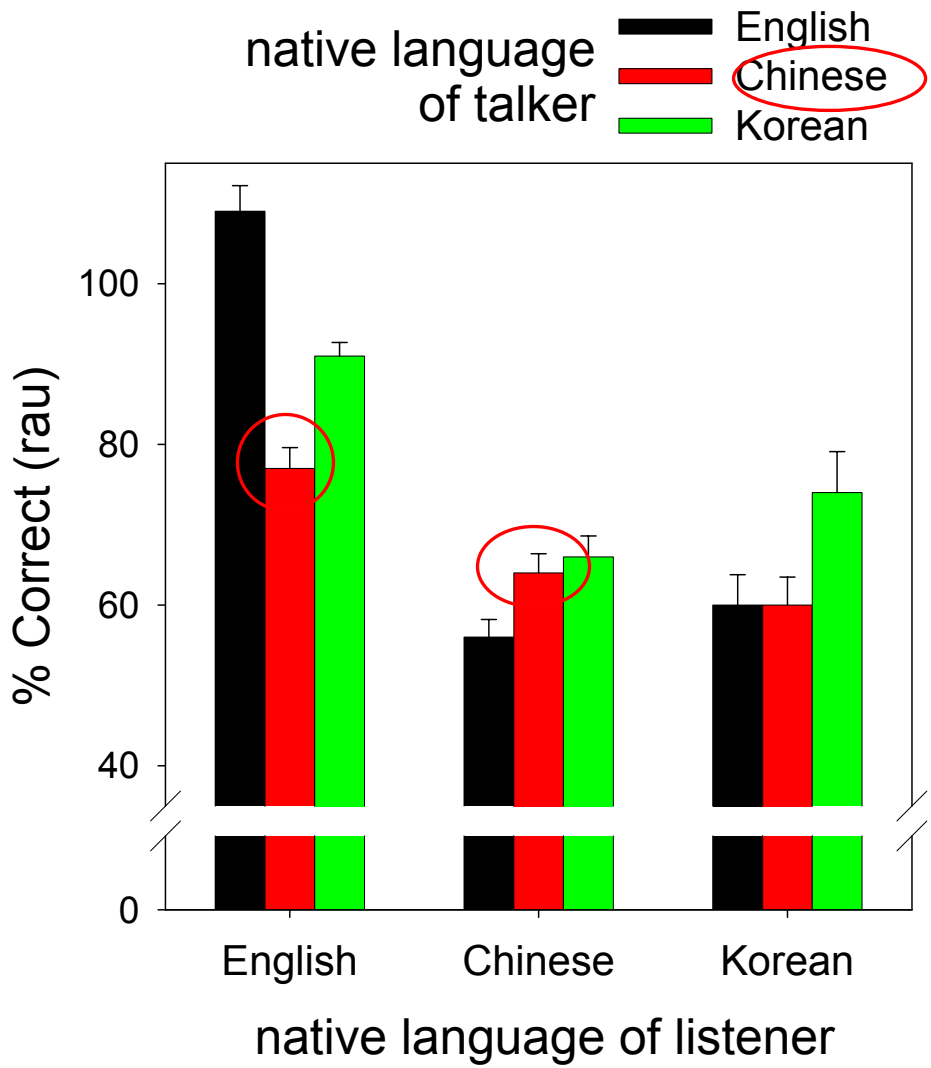
Bent & Bradlow (2003)

- With this amount of noise added (-5 dB S/N), non-native listeners (Chinese, Korean) recognized far fewer English words than native English listeners
- Non-native listeners also had difficulty recognizing words produced by other nonnative speakers of English

Bent & Bradlow (2003)

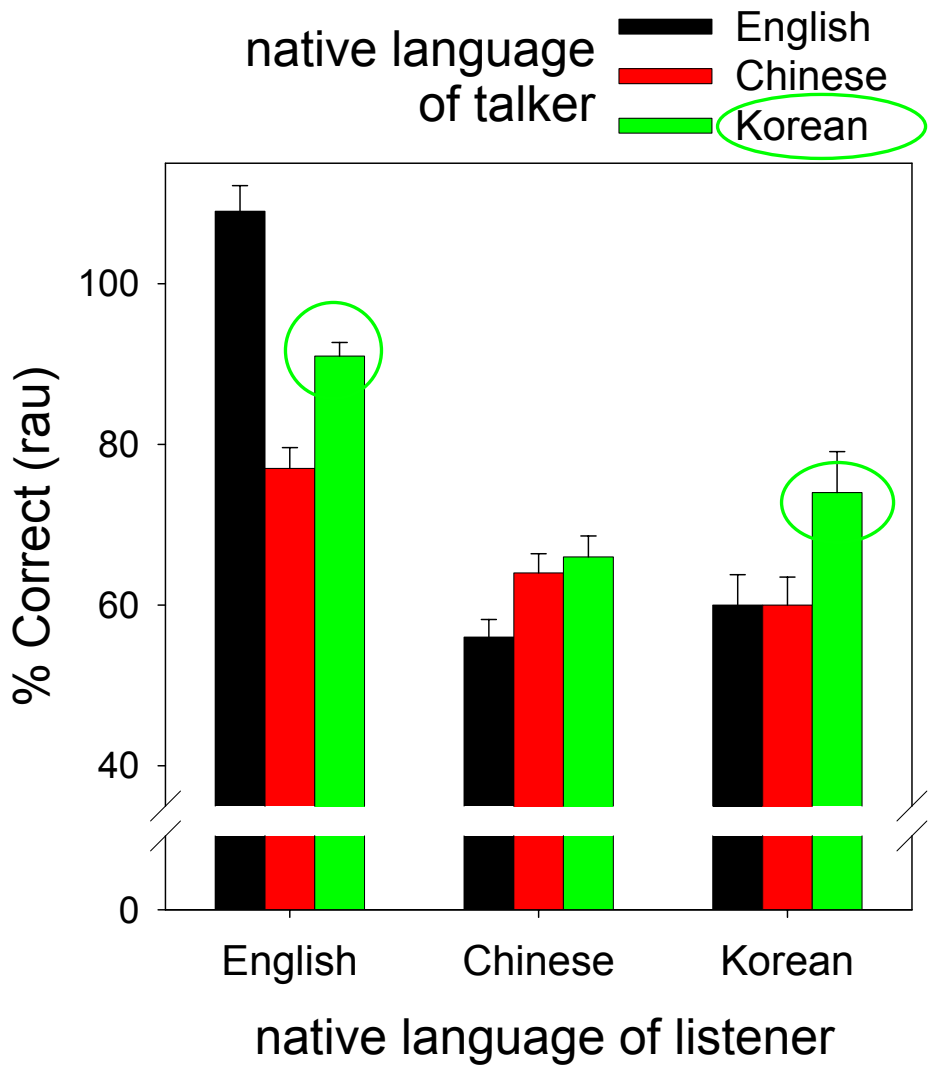
- However, the difference between native and non-native listeners was smaller when non-natives heard English words produced with their own kind of foreign accent

data from Bent & Bradlow (2003)



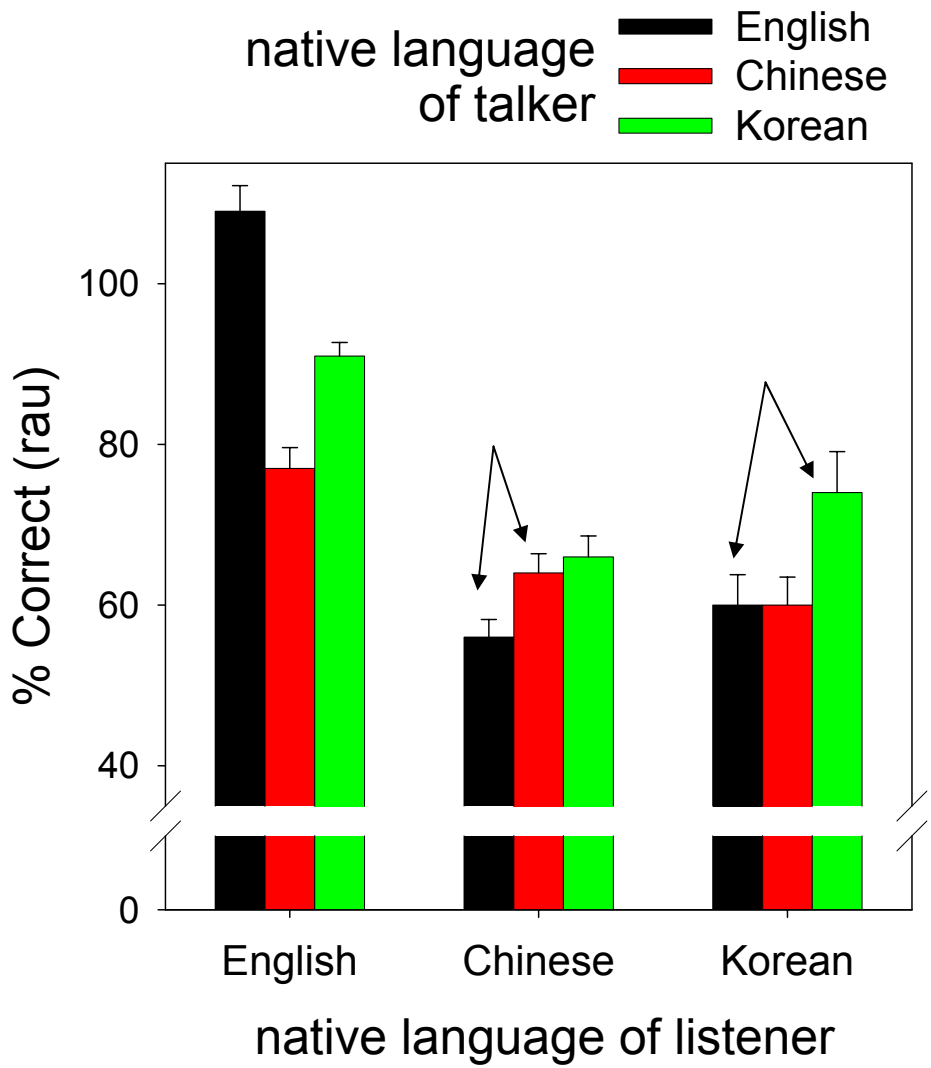
Chinese listeners hearing English words spoken with Chinese accent

data from Bent & Bradlow (2003)



Korean listeners hearing English words spoken with Korean accent

data from Bent & Bradlow (2003)



Bent & Bradlow (2003)

- One source of L2 word recognition difficulty is the use of non-optimal phonetic categories in early stages of processing
  - L1 categories
  - partially modified L1 categories
- Another source of difficulty: relative lack of familiarity with L2 lexicon

Bent & Bradlow (2003)

- Presented written version of test words for “familiarity” ratings using 7-point scale:

1 = “I don’t know this word”

4 = “I recognize this an English word but do not know its meaning”

7 = “I know this word”

Bent & Bradlow (2003)

- Test words said to be “familiar” to the non-native listeners
  - all gave ratings of 5-7 to at least 94% of test words
  - however: procedure did not assess experienced frequency of spoken (heard) words

Meador, Flege & MacKay (2000)

- Examined recognition of English words by native speakers of Italian
- Showed that L2 word recognition difficulty varies as a function of the age of L2 learning and language use
- Linked perception of L2 vowels and consonants to L2 word recognition

Meador et al (2000)

Italian participants had lived in Canada for many years (*M* = 36)

	Chrono-logical Age	*Age of Arrival*	*Length of Residence*	*% use of Italian*
Native English	48	-	-	-
Early-low	48	7	40	8%
Early	47	7	40	32%
Mid	48	14	34	20%
Late	48	19	28	41%

3 Italian groups differed primarily according to age of arrival (AOA) in Canada from Italy

Meador et al (2000)

Stimuli

- 10 semantically unpredictable English sentences
  - e.g., *The fat pilot threw the little rock*
- Prevented Ss from guessing words based on context, as is possible in sentences like
  - *This summer I plan to take a long…*

Meador et al (2000)

Procedure

- Each sentences presented 4 times in a row
- Always in noise, but less noise with each successive presentation
  - task got easier each across multiple presentations of a sentence

Meador et al (2000)

Task

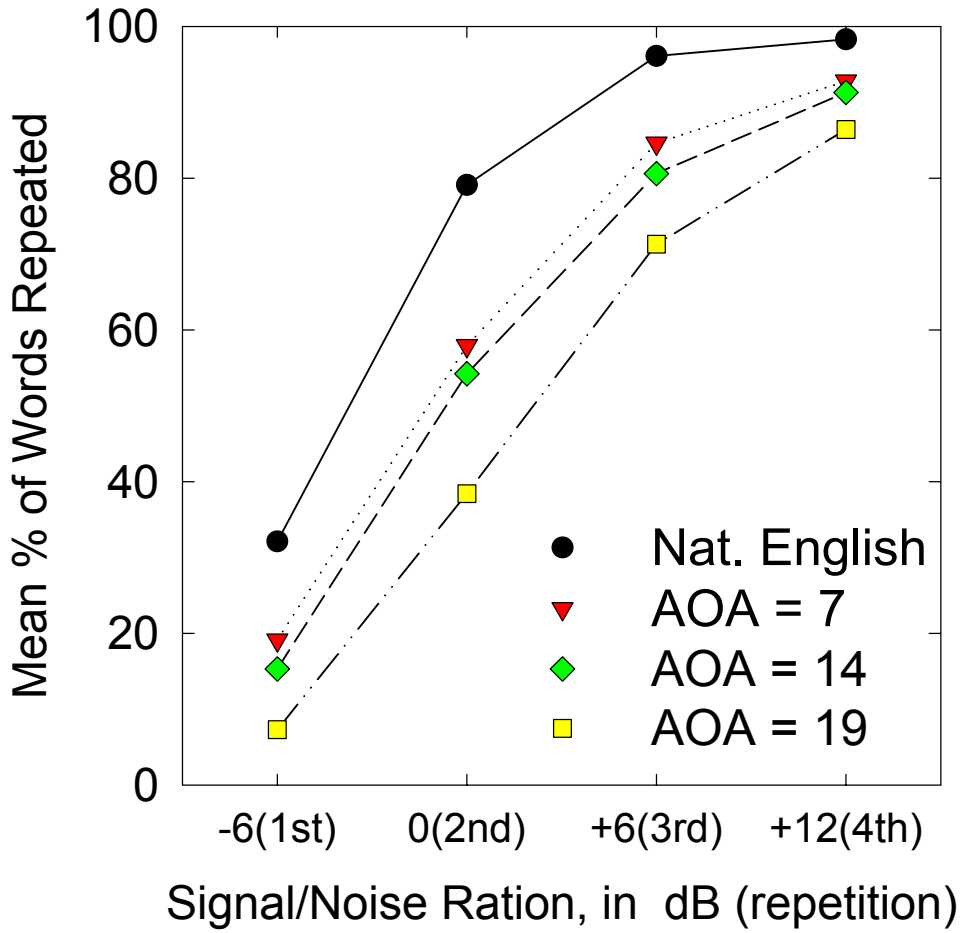
- Participants repeated as much of each sentence as possible

DV: the number of key words correctly repeated (errors due to foreign accent ignored)

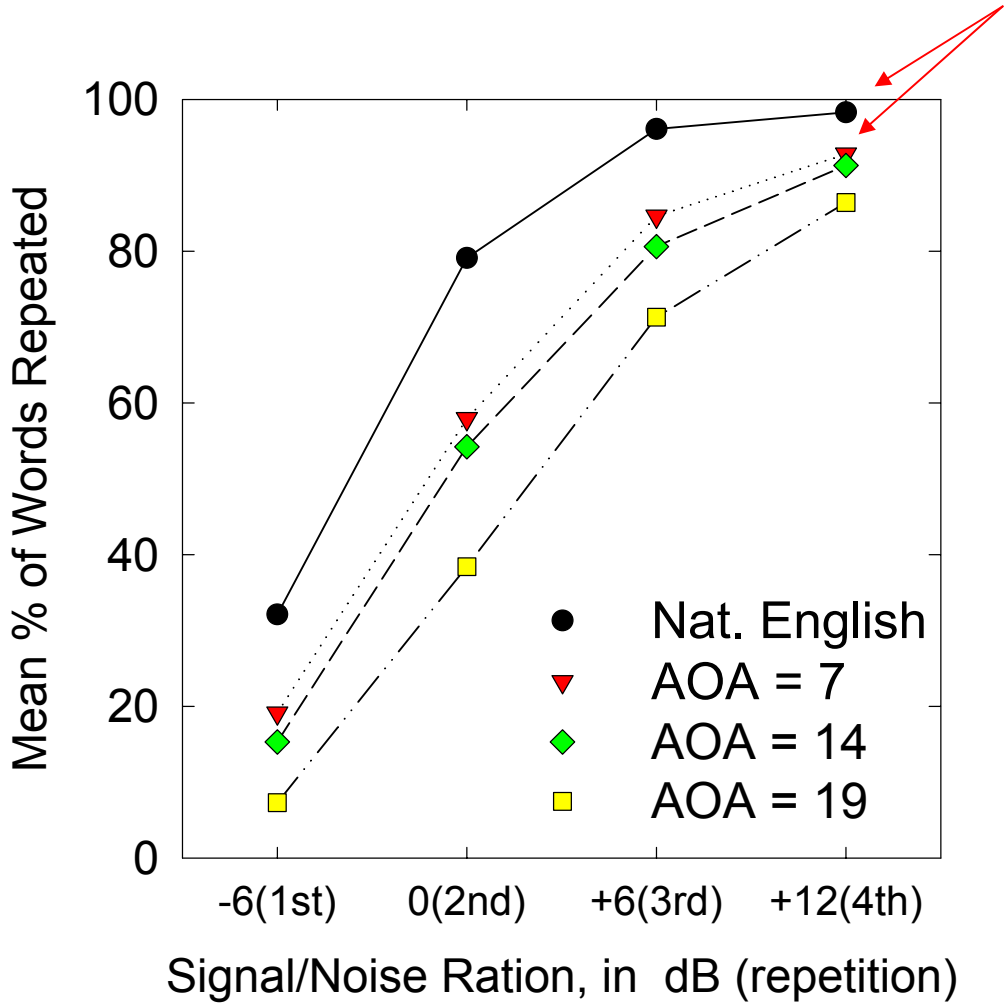
data from Meador et al (2000)

for all groups scores increased across the 4 successive presentations

less and less noise



Italian groups received significantly lower scores than Native English Ss in all but one instance:



Meador et al (2000)

2 groups of early bilinguals differed primarily in % use of Italian

	Chrono-logical Age	*Age of Arrival*	*Length of Residence*	*% use of Italian*
Native English	48	-	-	-
Early-low	48	7	40	8%
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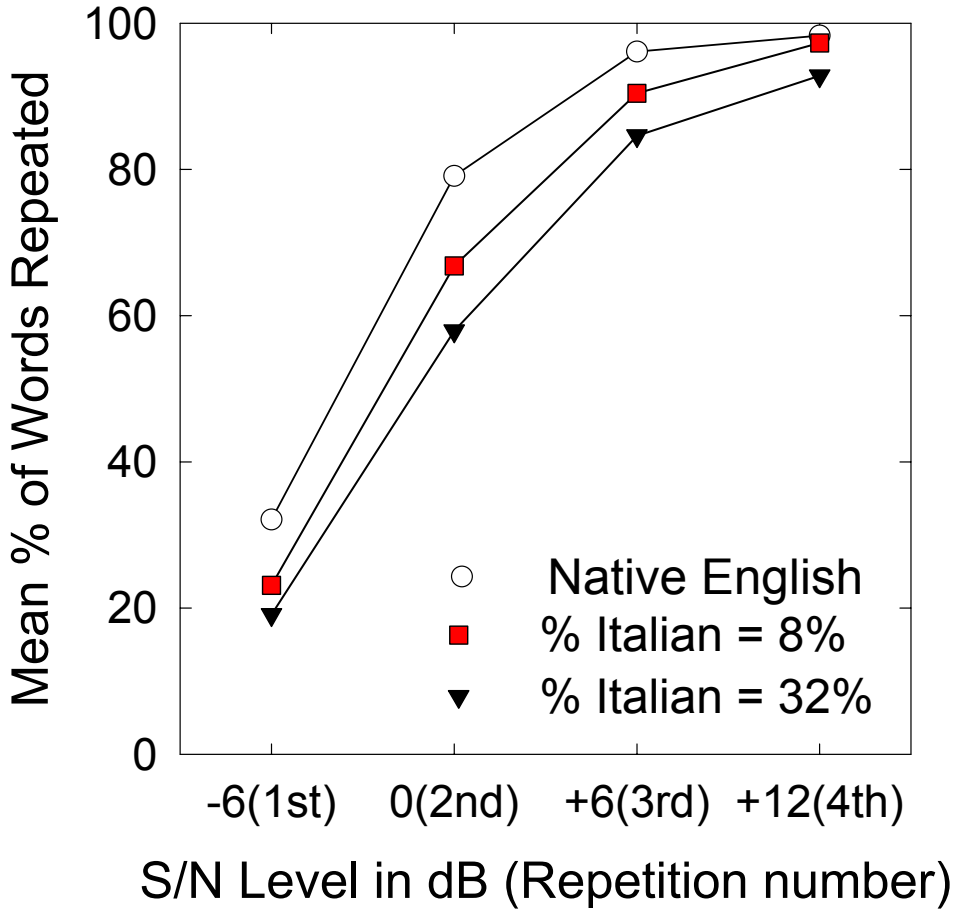
data from Meador et al (2000)



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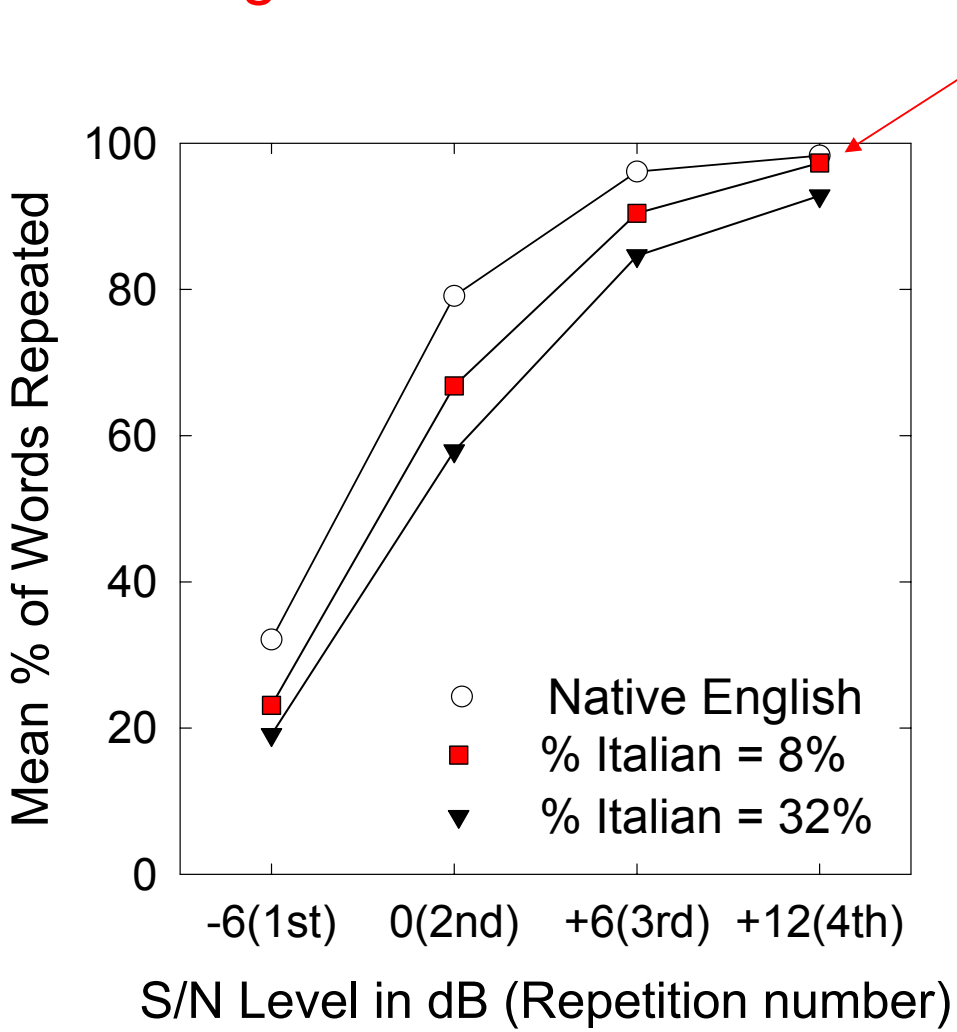


Meador et al (2000)

- Correlations between % of words recognized correctly and characteristics of the 54 Italian Ss:
  - *Age of arrival* r = -0.56*
  - *Length of residence* r = 0.34*
  - *% Italian use* r = -0.23 ns

Meador et al (2000)

- Correlations between % correct and English segmental perception scores obtained for all 72 (Italian, English) Ss
  - Discrimination of vowels r = 0.66*
  - Identification of initial consonants r = 0.59*
  - Identification of final consonants r = 0.49*

Meador et al (2000)

- Multiple regression examined how well the 3 segmental perception scores predicted % word recognition by Italian Ss
  - 57% of variance accounted for
  - 18% when perception scores entered after AOA, LOR, % Italian use

Meador et al (2000)

- Why did segmental perception scores not account for more variance in % word recognition by Italian Ss?
- Possibly: success in recognizing L2 words depends importantly on knowledge of L2 lexicon

Bradlow & Pisoni (1999)

- Examined words presented without noise (more valid ecologically)
- Provided insight into
  - non-natives' ability to cope with stimulus variability
  - problems encountered in early (bottom-up) stages of processing

Bradlow & Pisoni (1999)

Stimuli (n = 4500)

- Spoken words produced by 10 native English speakers
- Each native English speaker produced 150 words at 3 speaking rates

slow: 809 ms mean duration

normal: 525 ms (-34%)

fast: 328 ms (-60%)

Bradlow & Pisoni (1999)

Lexical manipulation

- "hard" vs. "easy" words (n = 75 each)
- compared to easy words, hard words had
  - lower text frequency (*M* = 12 vs. 310 per million)
  - more lexical neighbors (M = 27 vs. 14)
  - neighbors with higher text frequency (M = 282 vs. 38)

Bradlow & Pisoni (1999)

Why manipulate speaking rate?

- One of many sources of variability in vowel, consonant production
- Native English speakers perceptually compensate for speaking rate changes
- Will non-natives do so also? (being familiar with how speaking rate affects segmental production in their L1)

Bradlow & Pisoni (1999)

Listeners

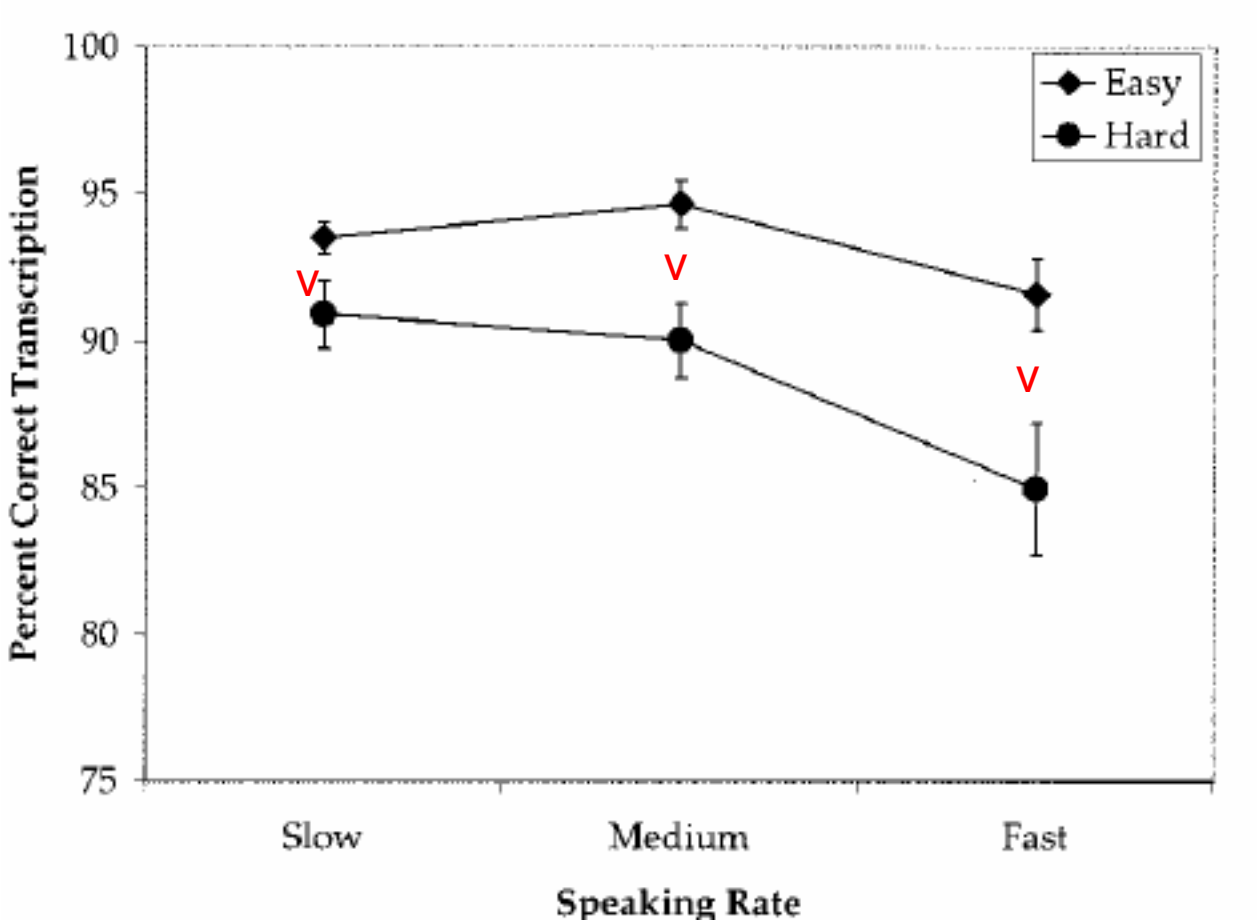
- 300 native English students at Indiana University
- randomly assigned to one of 30 groups (10 each)
- Each listener group assigned to one of the 30 sets of words (i.e., the 150 words produced by 1 of 10 talkers at 1 of 3 speaking rates)

Bradlow & Pisoni (1999)

Task

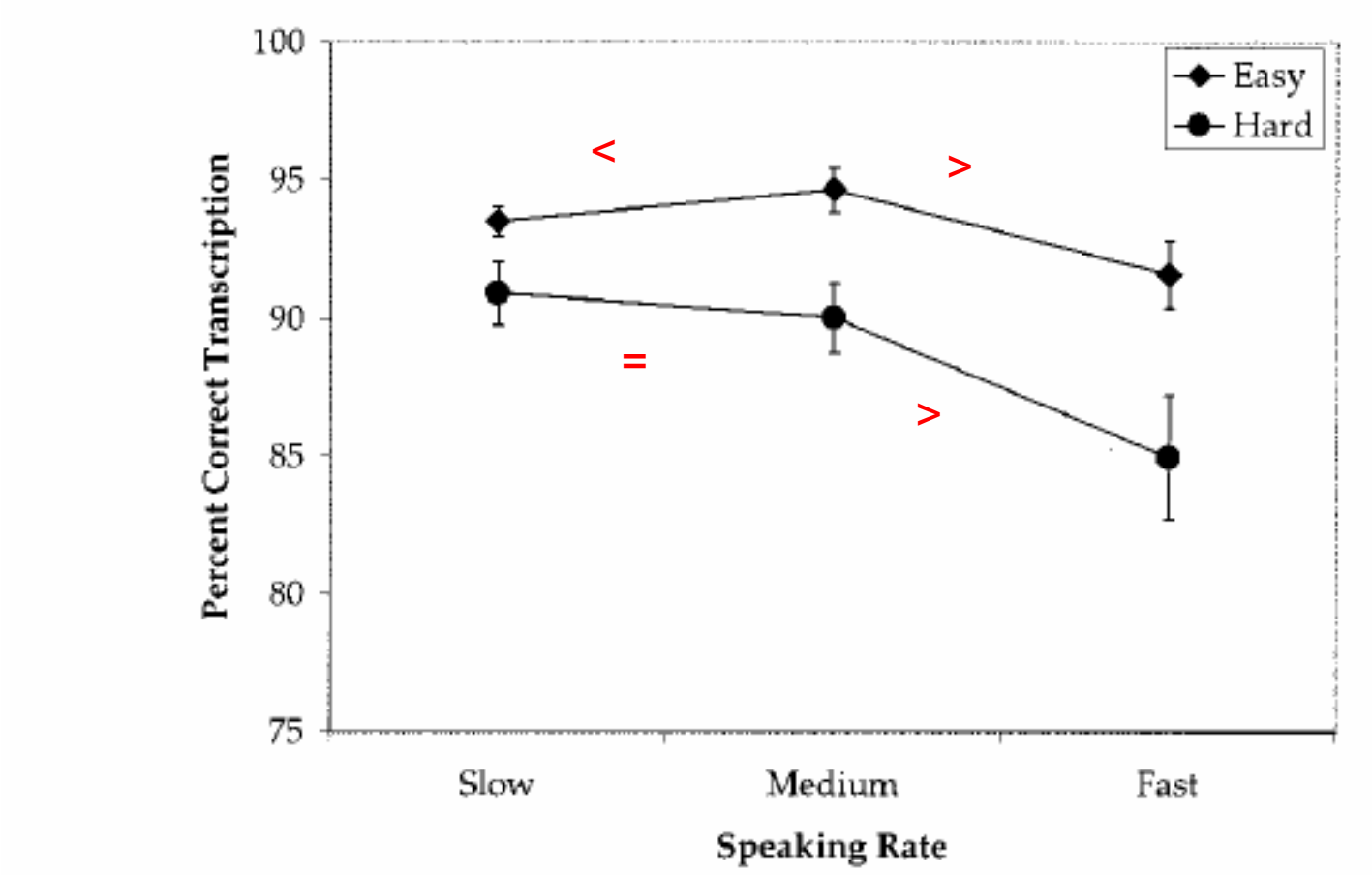
- Words presented via headphones, in sound booth
- Listeners attempted to type each word
- Unspeeded task

data Bradlow & Pisoni (1999), Exp. 1



overall high % correct recognition
(averaged over 10 listeners, 10 talkers)

data from Bradlow & Pisoni (1999), Exp. 1



Bradlow & Pisoni (1999)

Summary

- More errors for Hard than Easy
- More errors for Fast than Medium speaking rate
- Significant lexical-phonetic interaction
  - effect of speaking rate manipulation about twice as large for hard than easy words

Bradlow & Pisoni (1999)

Effect of differences between individual talkers (voices)

- Nygard & Pisoni (1998) trained listeners to recognize words in noise that were produced by produced by a fixed set of talkers (voices)
- Listeners better able to recognized new words produced by familiar talkers than by new (unfamiliar) talkers

Bradlow & Pisoni (1999)

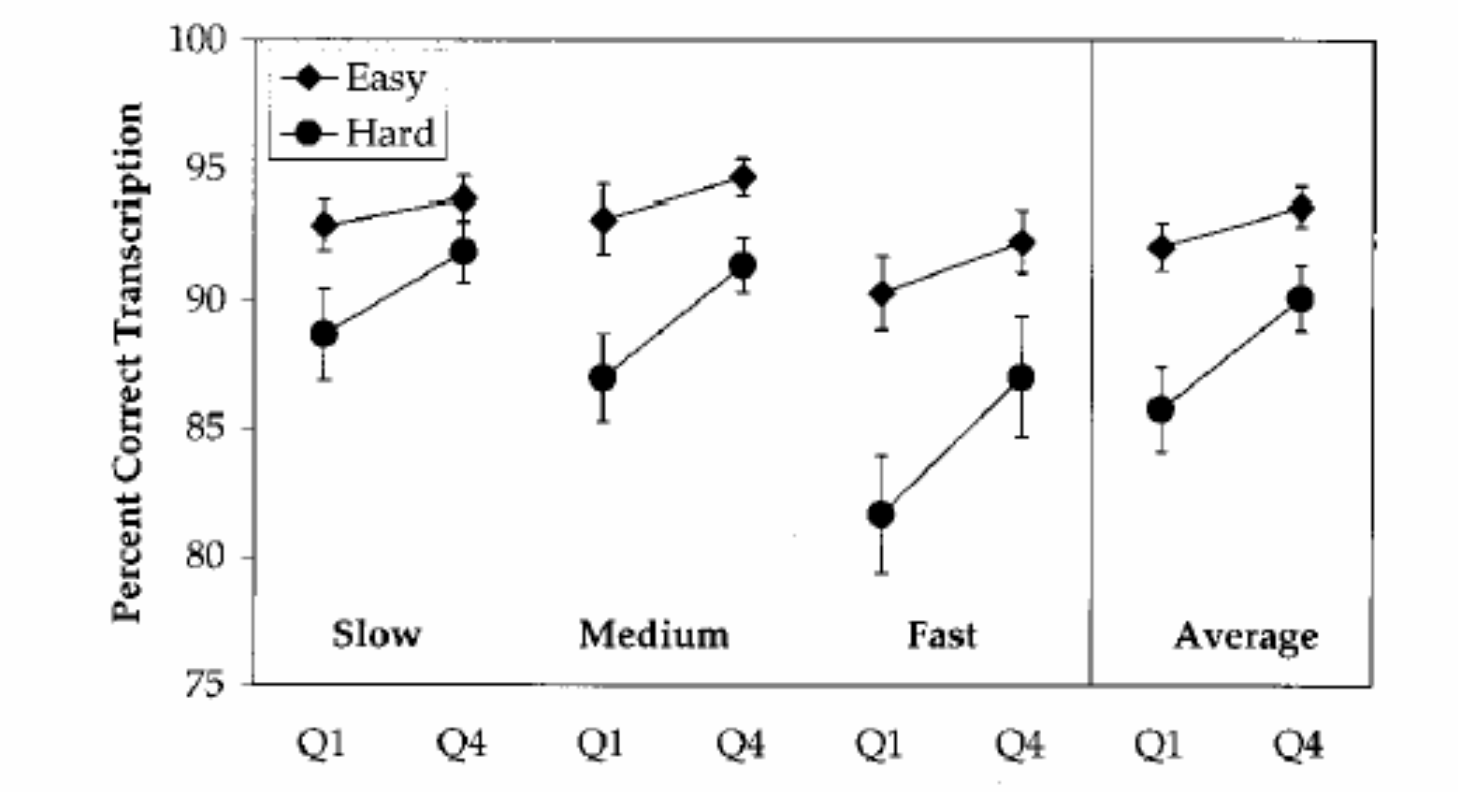
Effect of differences between individual talkers (voices)

- Other research: higher scores for words produced by multiple talkers than by a single talker

Bradlow & Pisoni (1999)

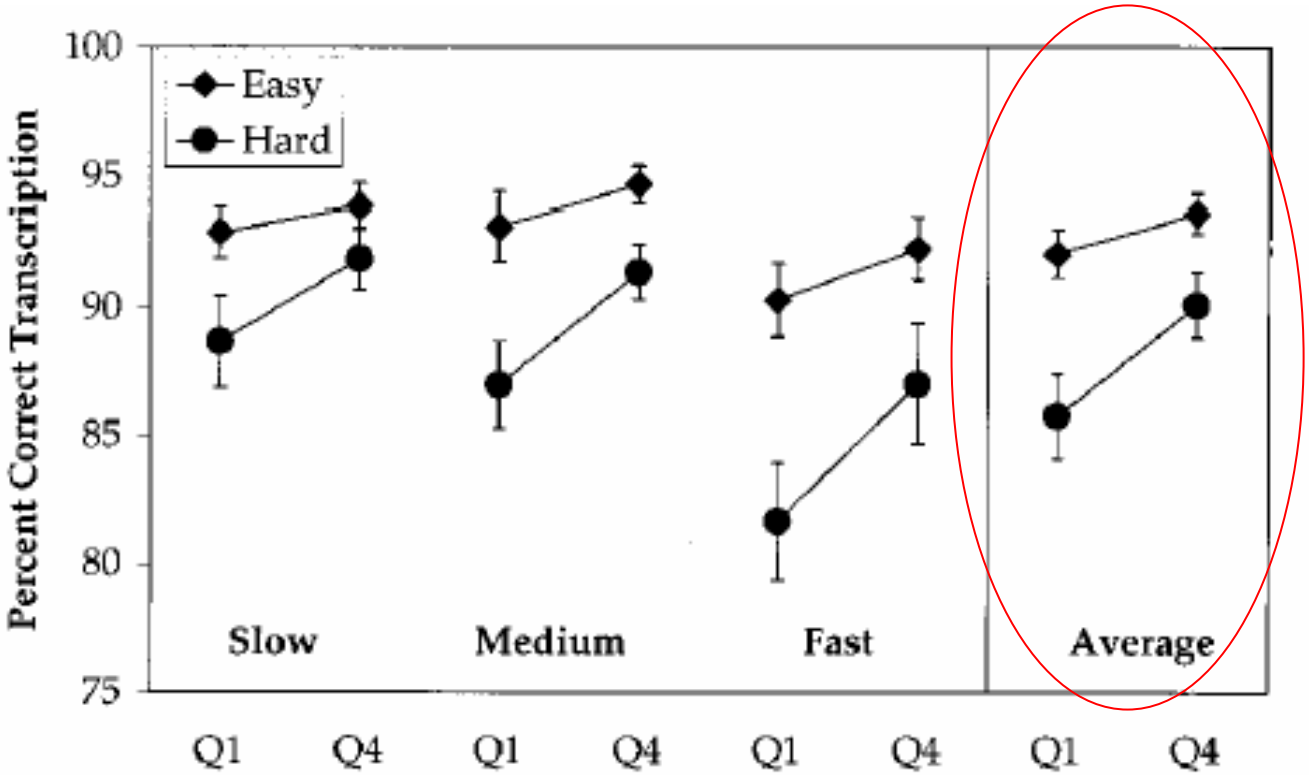
- Each listener tested on 150 words produced by 1 talker at a single speaking rate
- Would % correct scores increase across session as listeners became familiar with a particular talker (voice)?
- Would lexical effect (hard vs. easy) decrease?

data from Bradlow & Pisoni (1999), Exp. 1



Quartile 1 = first 25% of words
Quartile 4 = last 25%

data from Bradlow & Pisoni (1999), Exp. 1



Q1 = first 25% of words, Q4 = last 25%

Bradlow & Pisoni (1999)

	First quartile	Fourth quartile
slow	90.80	92.90
medium	90.05	93.04
fast	85.98	89.67

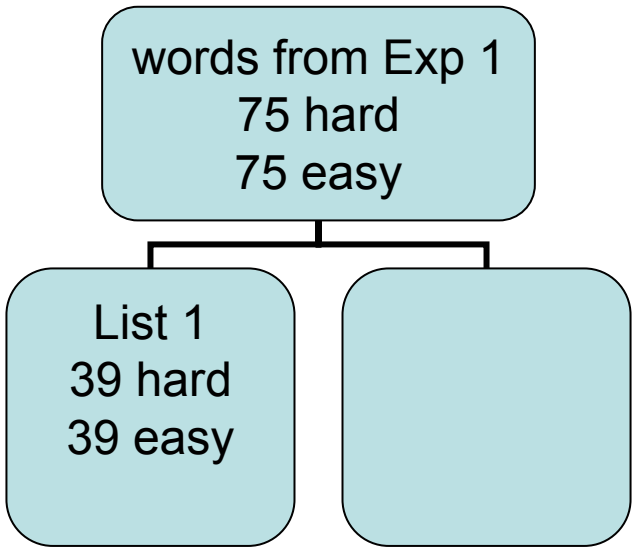
becoming familiar with a talker's voice offset the negative effect of fast speech rate

Bradlow & Pisoni (1999)

- Experiment 2
- Similar experiment with both native and non-native listeners

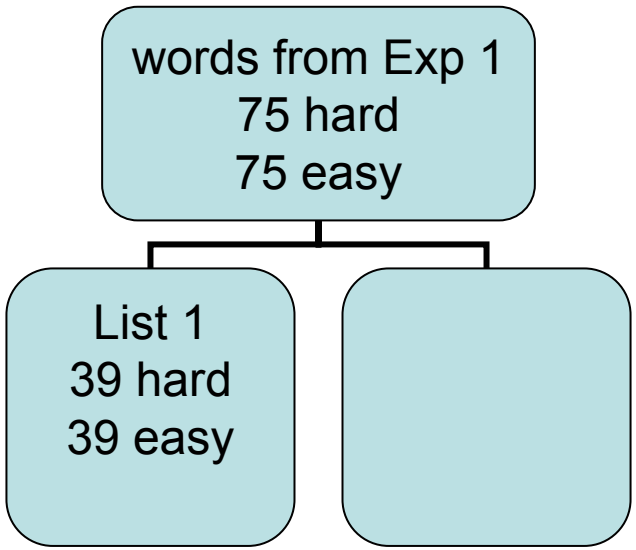
Bradlow & Pisoni (1999)

Stimuli for Exp 2 drawn from Exp 1



Bradlow & Pisoni (1999)

produced by 1 of 10 talkers (who had average intelligibility)



Bradlow & Pisoni (1999), Exp 2

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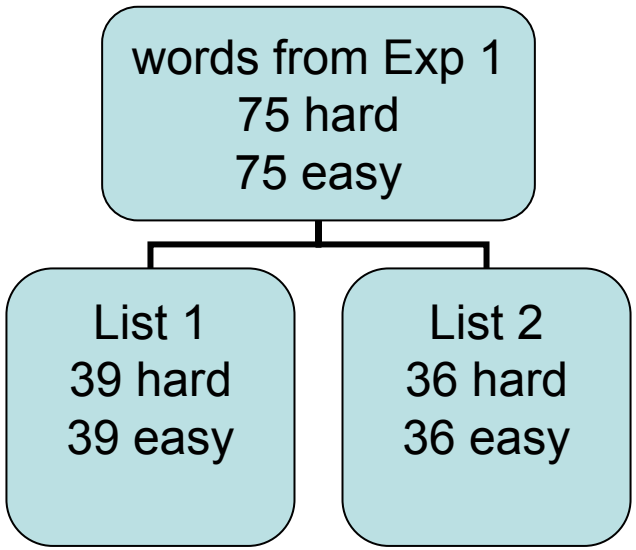
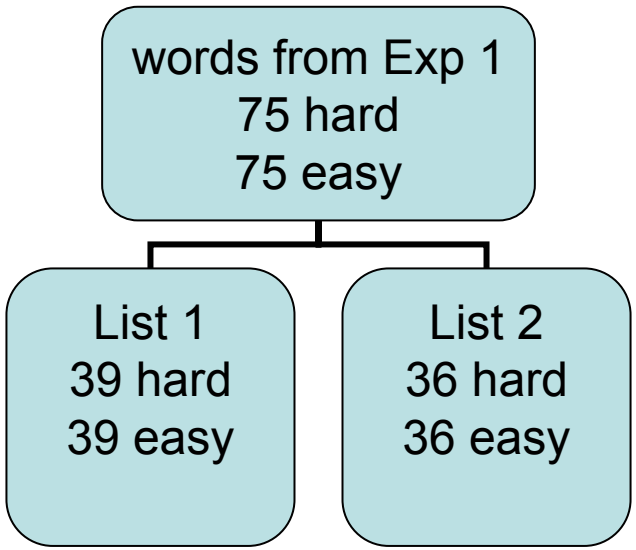


Bradlow & Pisoni (1999), Exp 2

produced
by 1 talker



produced
by remaining
9 talkers (4 hard,
4 easy words
each

Bradlow & Pisoni (1999), Exp 2

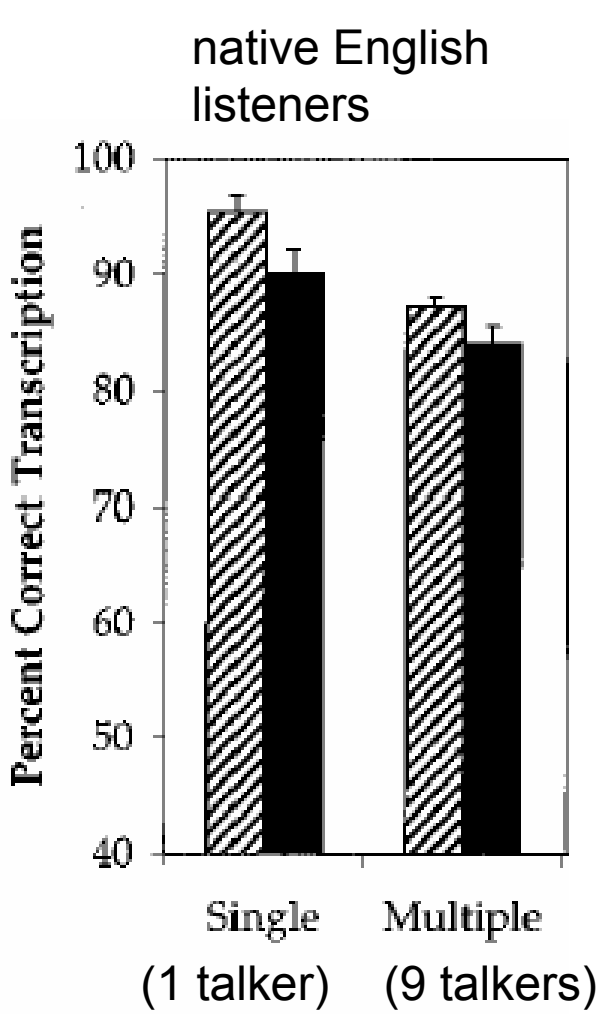
Listeners

Young normal-hearing adults recruited at Indiana University

- 20 native English
- 20 nonnative speakers

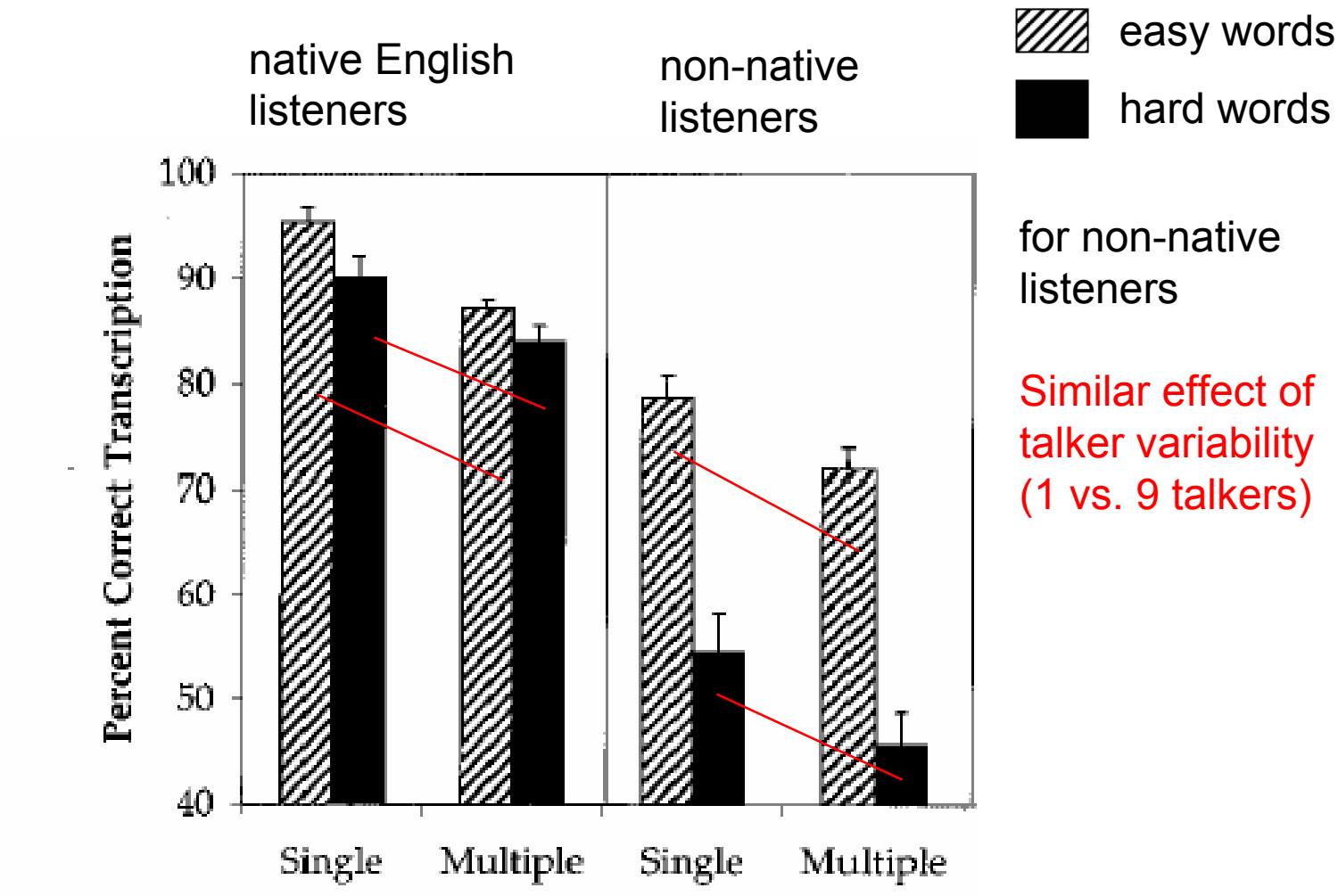
(L1 = Korean-6, Chinese-4, Russian-3, Japanese-2, Spanish-2, other-3)

data from Bradlow & Pisoni (1999), Exp 2



easy > hard
single talker > many talkers

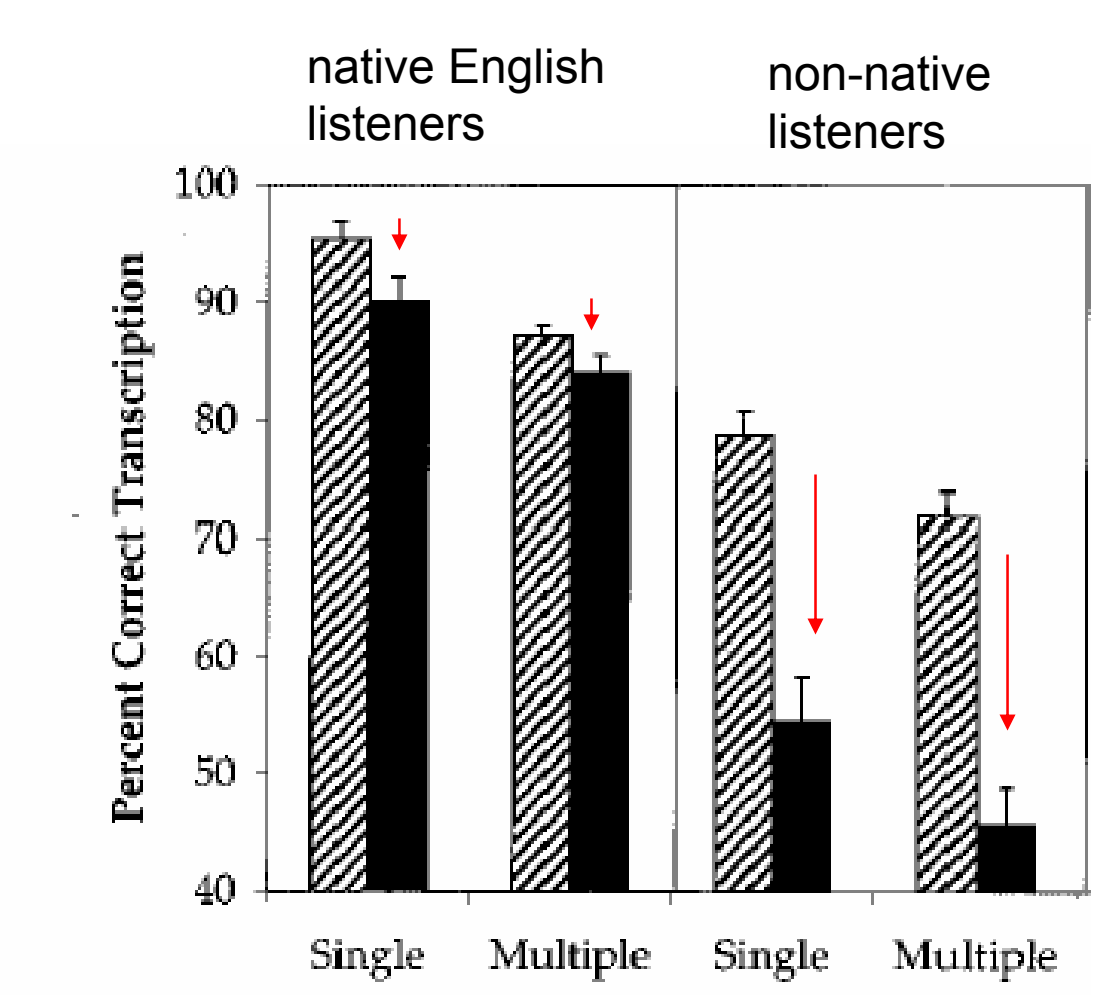
Bradlow & Pisoni (1999), Exp 2



for non-native listeners

Similar effect of talker variability (1 vs. 9 talkers)

data from Bradlow & Pisoni (1999), Exp 2



for non-native listeners

But much larger effect of lexical manipulation (easy vs. hard)

Bradlow & Pisoni (1999), Exp 2

Interpretation

- Adaptation to talker variability: does not depend on adequacy of phonetic categories or L2 lexical development
- The special difficult of hard words for non-natives may be due to the inadequacy of phonetic categories they use in early stages of word recognition

Bradlow & Pisoni (1999), Exp 2

Interpretation

- Nonnatives' L2 phonetic categories may be inadequate for all L2 words
- However, effect of native vs. non-native category differences may be more evident in hard than easy words, because hard words require more "fine-grained" phonetic specification than easy words

Bradlow & Pisoni (1999)

example of “hard” word: *cot* (28 neighbors)

cot: got, sought, fought, lot, jot, not, bought, rot, shot, hot

cot: coat, cut, cat, kit, curt, kite, Kate, coot

cot: cod, cob, cog, car, cause, cop, cough, cog, call, con, calm

example of “easy” word: *girl* (11 neighbors)

girl: pearl, curl, furl

girl: gale, guile, goal, ghool, gill, gal, gull

girl: gird

Bradlow & Pisoni (1999)

hard word "cot"

[k] versus [g s f l dʒ n b ɹ ʃ h] (n = 10)

[ɑ] versus [o ʌ æ ɪ ɚ ɑᴵ eᴵ u] (n = 8)

[t] versus [d b g ɹ z p f l n m] (n = 10)

easy word "girl"

[g] versus [p k f] (n = 3)

[ɚ] versus [eᴵ ɑᴵ o u ɪ æ ʌ] (n = 7)

[l] versus [d] (n = 1)

Bradlow & Pisoni (1999), Exp 2

Alternate interpretation

- Difference in lexical effect (hard vs. easy) between native and non-natives may be due to:

  differences in lexical knowledge

  Text frequency was lower for “hard” than “easy” words for non-native, but not natives

Bradlow & Pisoni (1999), Exp 2

- Written version of test words rated

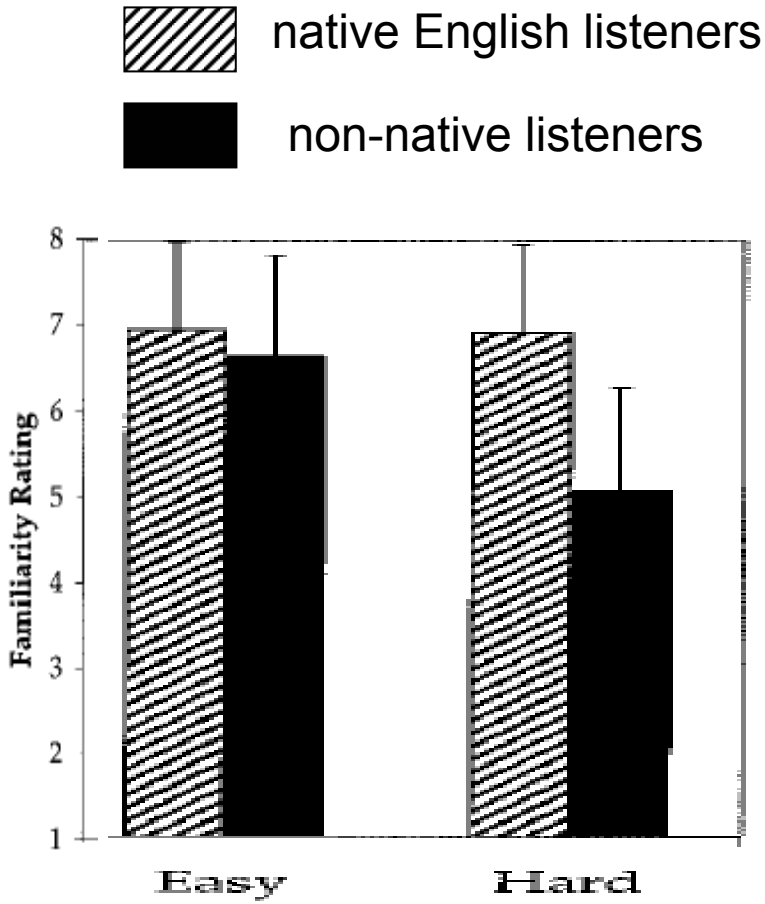
1 = I have never seen this word

4 = I have seen this word but don't know it's meaning

7 = I know this word

Nonnative listeners gave a "6" or "7" to an average of 54 (72%) easy and 51 (68%) hard words

data from Bradlow & Pisoni (1999), Exp 2



mean familiarity ratings:

"hard" words less familiar than "easy" words for non-native listeners, but not for native listeners

Imai, Walley & Flege (2005)

- Examined recognition of English words by native English and Spanish Ss
- Showed that lexical factors (neighborhood density, subjective familiarity) affect L2 word recognition

Imai et al (2005)

Participants

	Native English	*High Proficiency Spanish*	*Low Proficiency Spanish*
chronological age, years	34	30	33
strength of foreign accent	none	mild	strong
age of arrival in US, years	--	20	28
residence in US, years	--	10	4
daily use of English, hours	--	5.8	3.3

n = 16 per group

Imai et al (2005)

Stimulus words

- 80 common English words (e.g., *bed, lake, push*)
- All known by native Spanish Ss (words rigorously screened; demonstrated by formal vocabulary test)
- orthogonal variation in text frequency (high, low) and neighborhood density (high, low)

Imai et al (2005)

Stimulus words produced by

- native English speaker (no accent)
- native Spanish speaker (accented)

Would native Spanish listeners be better able to recognize English words with a Spanish accent than English words produced by a native English speaker (no-accent)?

Imai et al (2005)

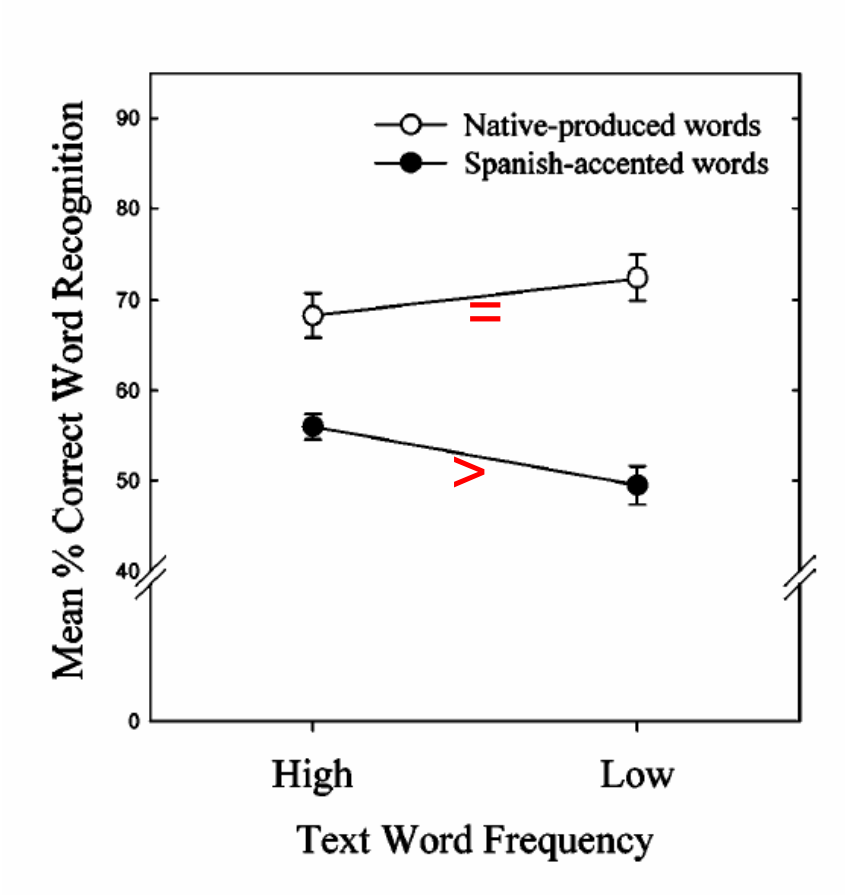
Procedures

- Words presented one at a time in a small amount of noise (14 dB S/N, to keep scores off ceiling)
- Ss wrote down what they heard
- DV: % correct

data from Imai et al. (2005)

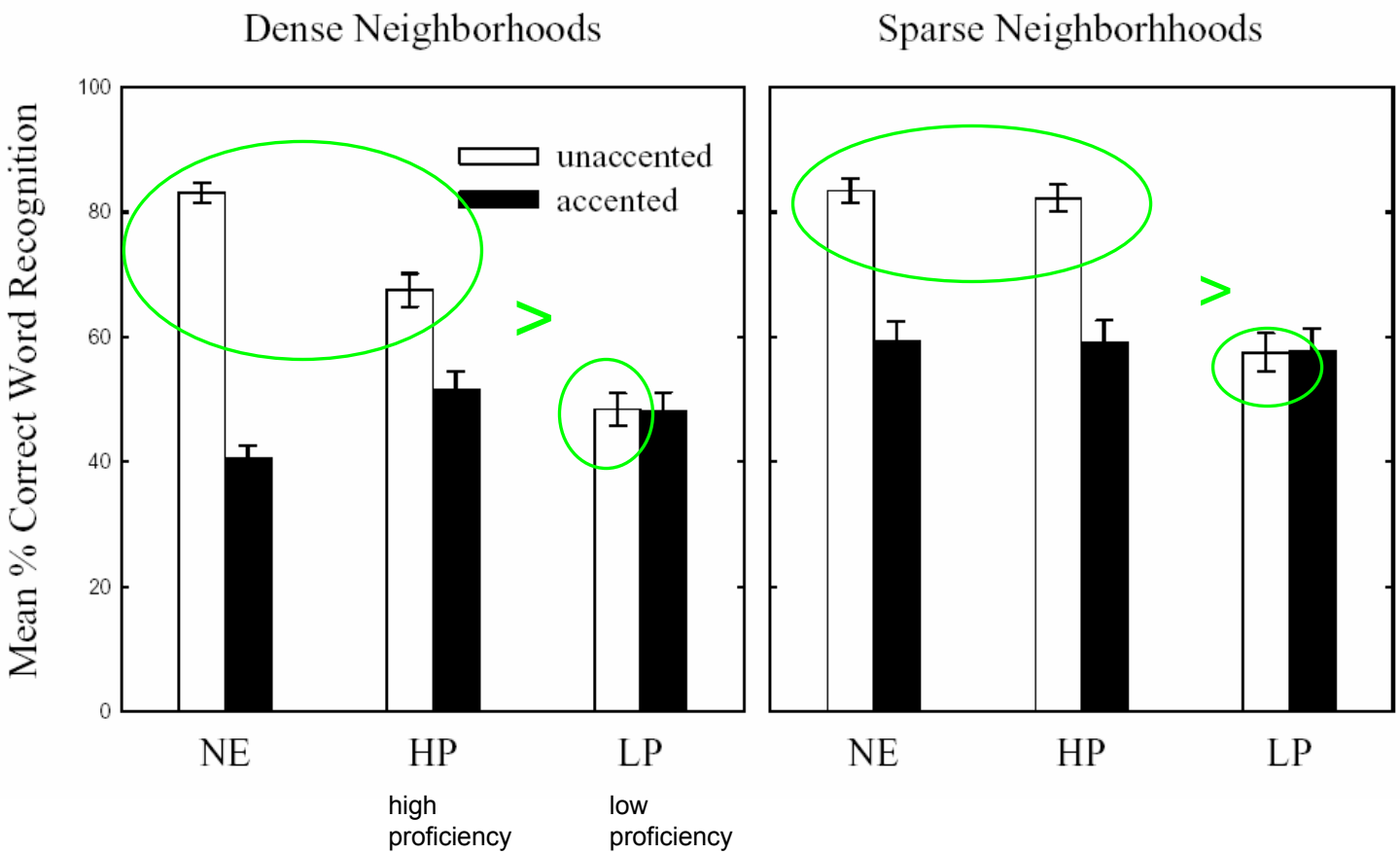
text frequency had little effect on spoken word recognition

(only significant effect involving Text Frequency)



data from Imai et al. (2005)

Findings for unaccented stimuli (white bars)

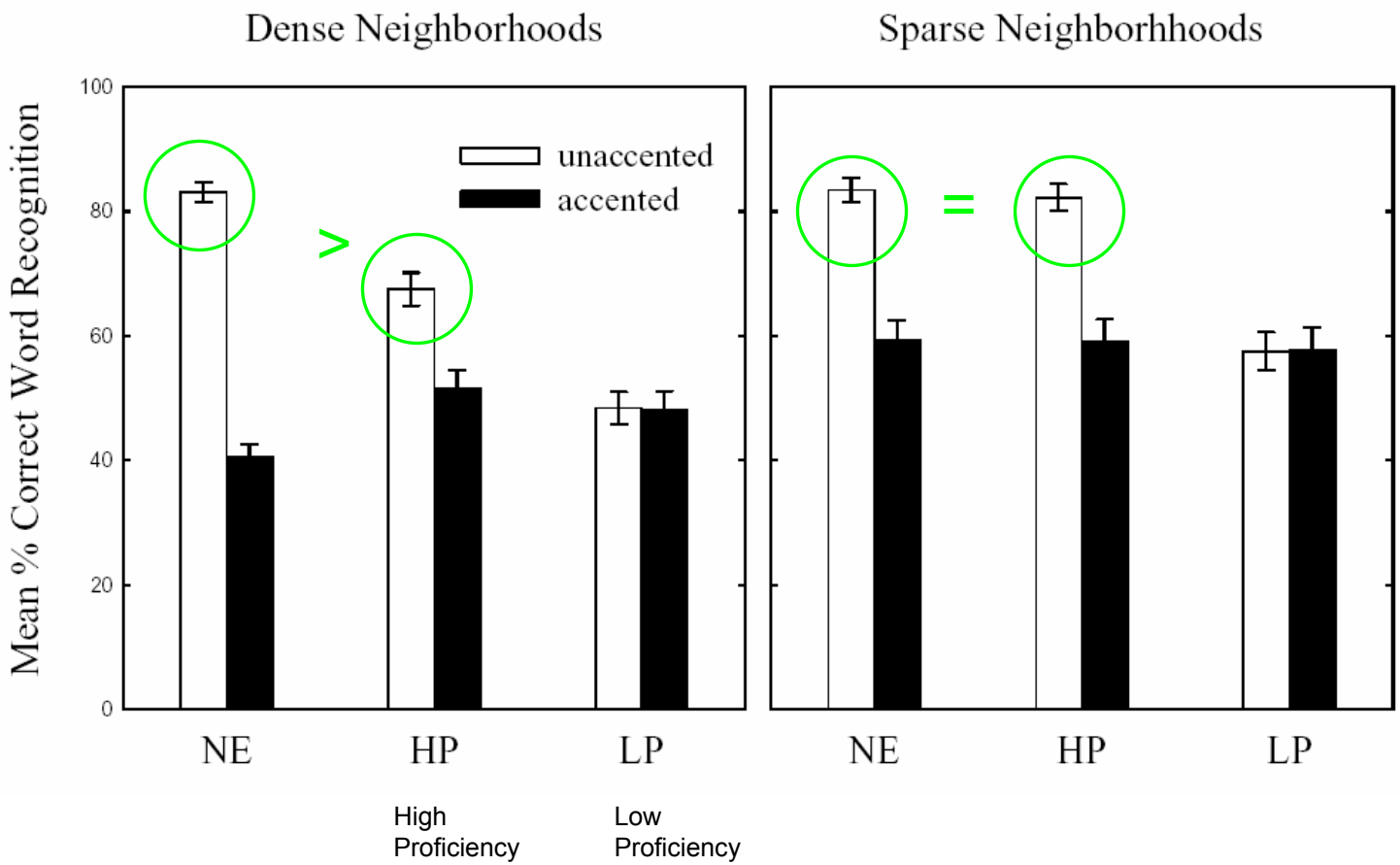


Imai et al (2005)

- Finding: Spanish Ss with strong foreign accents recognized fewer English words than those with mild foreign accents
- Interpretation: phonetic categories for English vowels, consonants become more English-like as Spanish adults gain experience in English

data from Imai et al. (2005)

Another findings for unaccented stimuli (white bars)



Imai et al (2005)

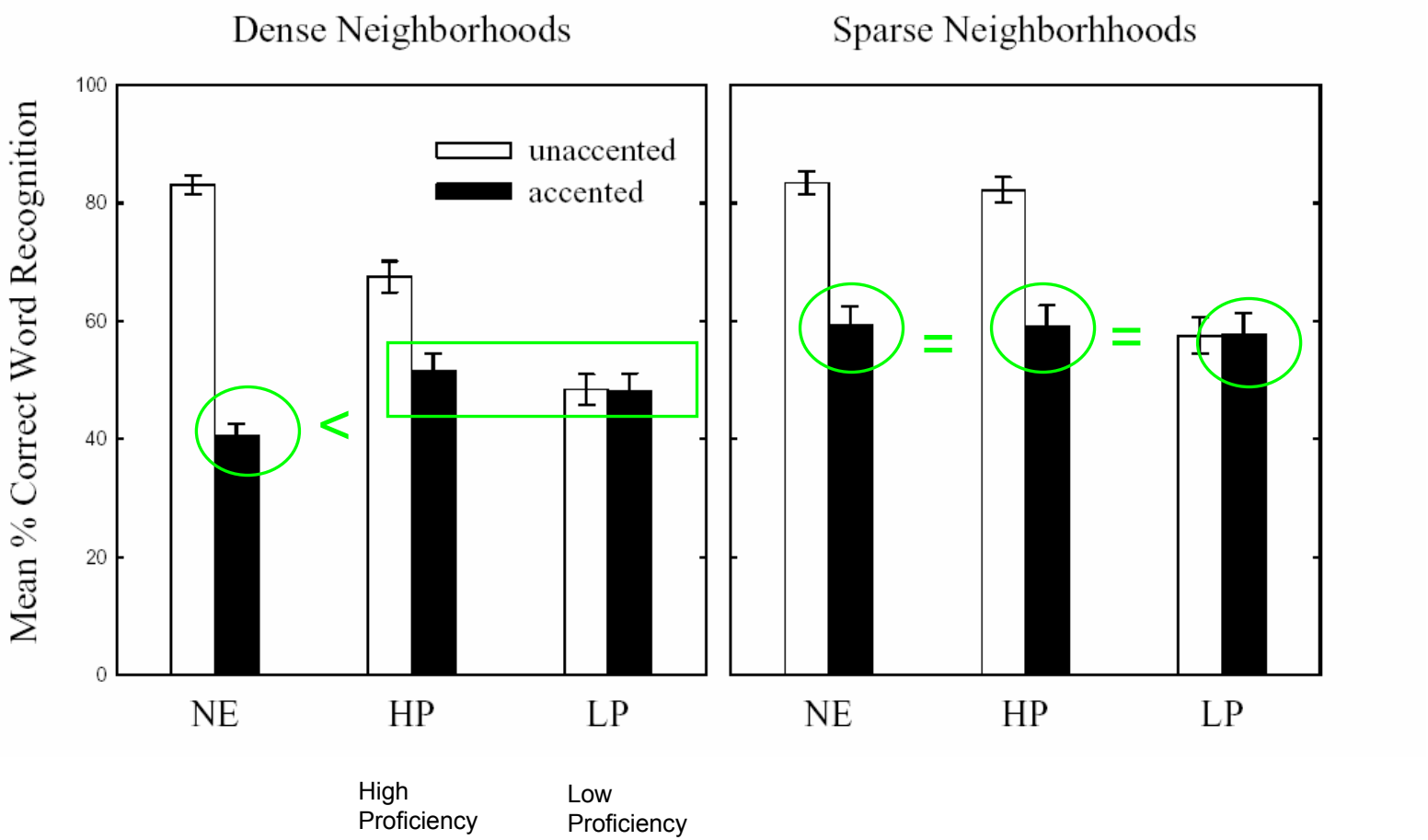
- Finding: difference between native English and Spanish Ss with mild foreign accent (proficient) confined to words from dense lexical neighborhoods
- Interpretation 1: difference in phonetic categories for English vowels and consonants not measurable in sparse neighborhood

Imai et al (2005)

- Finding: difference between native English and proficient Spanish Ss confined to words from dense lexical neighborhoods
- Interpretation 2: neighborhood density promotes the development of accurate phonetic categories

Imai et al. (2005)

findings for Spanish accented stimuli (black)



Imai et al (2005)

- Finding: Spanish accent reduces word recognition by native English Ss, but only for words from dense neighborhood
- Interpretation: a mismatch between phonetic input and long-term memory representations (categories) is always a problem, but is only evident when mismatch is critical

Imai et al (2005)

- The effect of text frequency was small on average (high = 62%, low = 60%) and non-significant
- Why?

Perhaps: written text frequency does not index the psychological property most relevant to auditory word recognition: experienced frequency of spoken words

Imai et al (2005)

- Participants rated the subjective frequency of the 80 English word stimuli

  1 = “I seldom hear and say this word”

  7 = “I often hear and say this word”

Ss trained to use the whole scale;

no significant between-group difference in mean ratings

Imai et al (2005)

subjective ratings obtained from the 3 groups were very similar

between-group correlations in subjective frequency		
Native English	High Proficiency	.82
Native English	Low Proficiency	.78
High Proficiency	Low Proficiency	.88

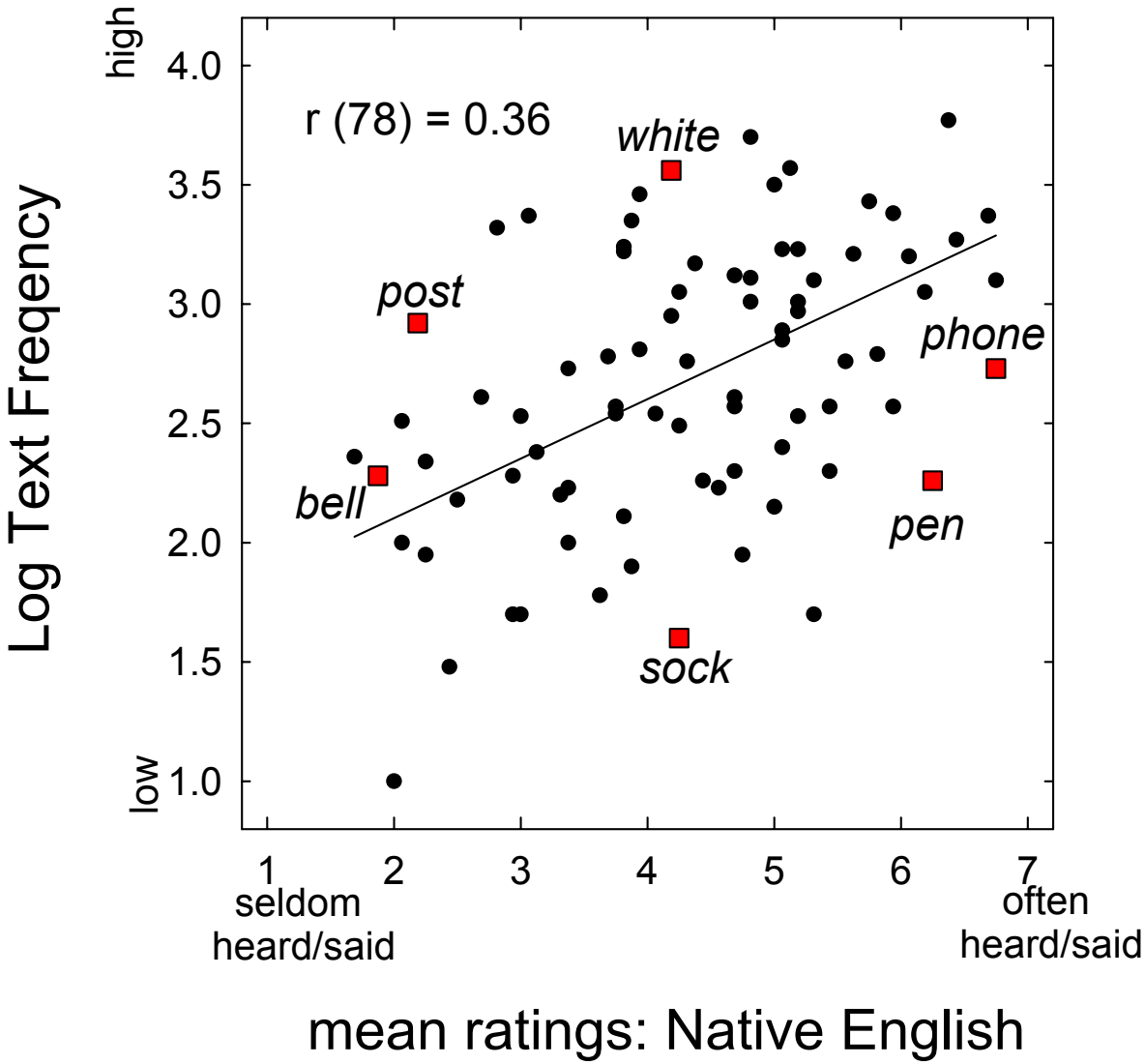
Imai et al (2005)

between-group correlations in subjective frequency		
Native English	High Proficiency	.82
Native English	Low Proficiency	.78
High Proficiency	Low Proficiency	.88

only modest correlation between subjective ratings & text frequencies

correlations between text frequency and subjective frequency ratings	
Native English	.36
High Proficiency	.42
Low Proficiency	.38

data from Imai et al (2005)



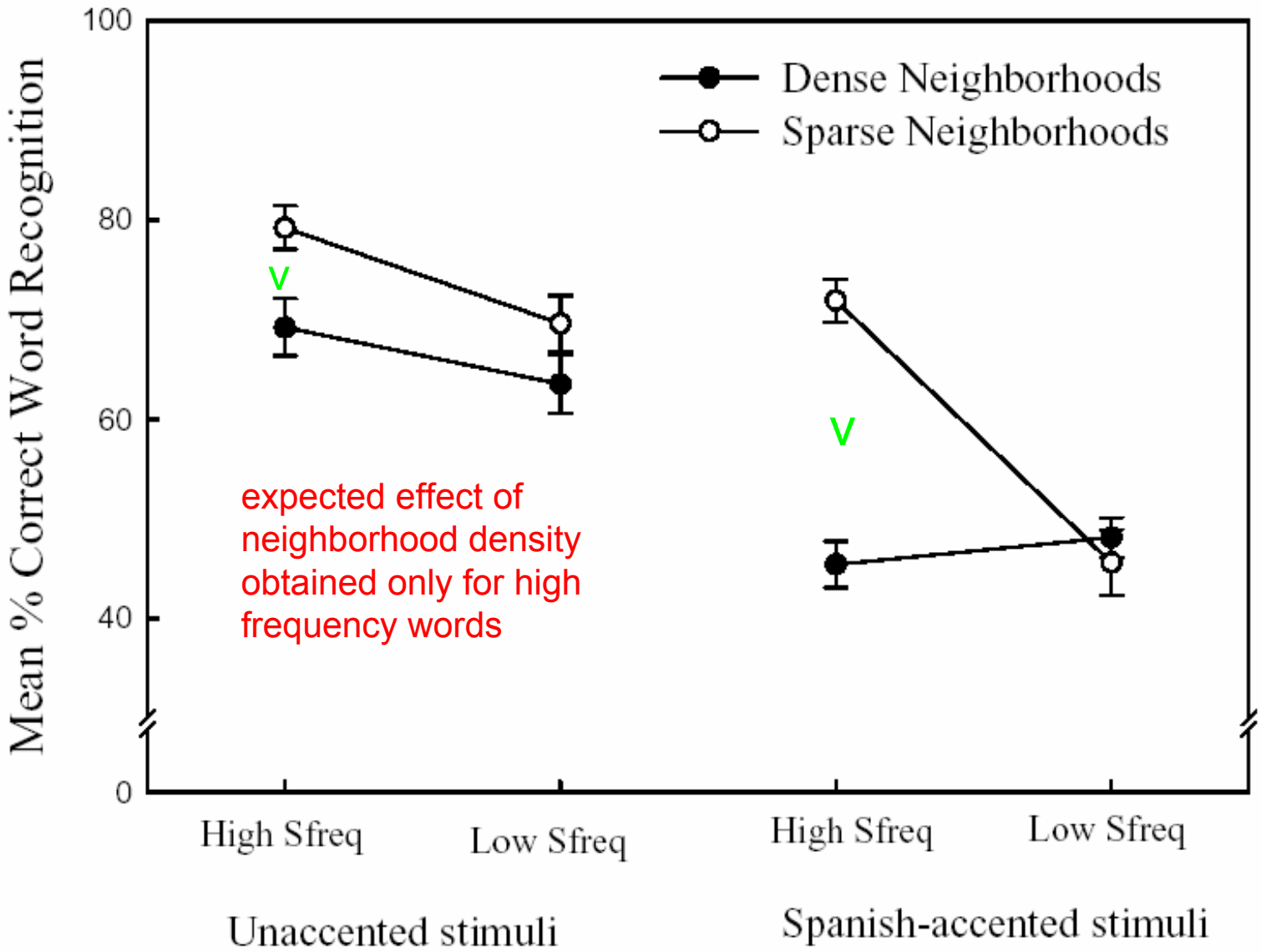
Imai et al. (2005)

- Test words selected accordingly to text frequencies
- Reorganized data to evaluate subjective frequency
- Subjective frequency (SFreq) obtained for each word by averaging over ratings of all 72 Ss
  - Low-neighborhood words subdivided (20 highest, 20 lowest)
  - same for 40 High ND words

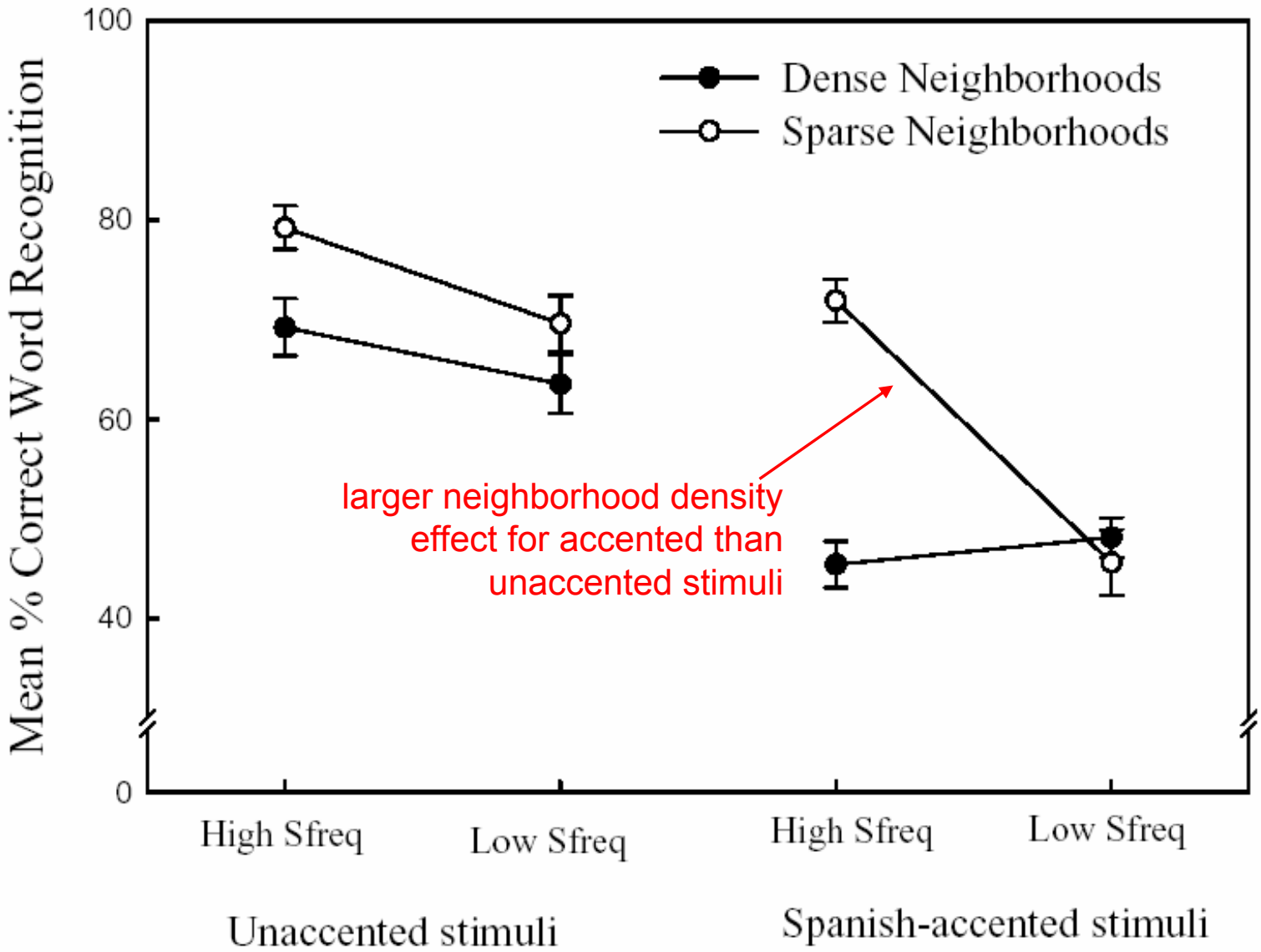
Imai et al (2005)

- Significant effect of subjective frequency:
  - high M = 67%
  - low M = 57%
- ANOVA yielded 3-way interaction involving subjective frequency
  - Freq x Neighhorhood Density x Type (unaccented, Spanish-accented)

data from Imai et al. (2005)



data from Imai et al. (2005)



Imai et al. (2005)

- Interpretation: neighborhood density effect most evident when mismatch between input and categories is greatest
  - for Spanish-accented stimuli, which do not optimally match phonetic categories

Flege, Takagi & Mann (1996)

- Examined perception of English consonants by native speakers of English and Japanese
- Showed a different kind of lexical-phonetic interaction: effect of lexical familiarity on segmental phonetic perception (reverse direction of “flow”)

Flege et al (1996)

2 Japanese groups differed in LOR …

	Native English	*Experienced Japanese*	*Inexperienced Japanese*
Chronological age, years	36	44	35
Age of arrival in USA, years	--	23	34
Length of residence in USA, years	--	21	2
Use of English 1=never 7=frequently	--	6.0	2.4

Flege et al (1996)

… and AOA, frequency of English use

	Native English	*Experienced Japanese*	*Inexperienced Japanese*
Chronological age, years	36	44	35
Age of arrival in USA, years	--	23	34
Length of residence in USA, years	--	21	2
Use of English 1=never 7=frequently	--	6.0	2.4

Flege et al (1996)

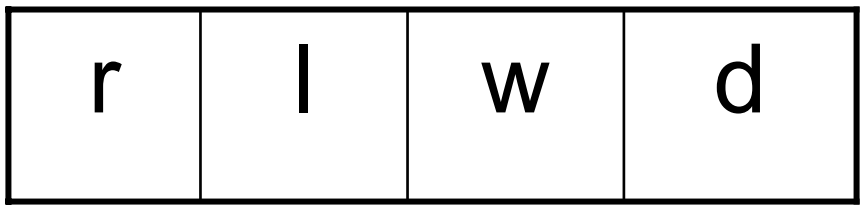
Naturally produced stimuli

- words beginning in /r/, /l/
  - *rock, rook* (n = 21)
  - *lock, loom* (n = 21)
- non-words beginning in /r/, /l/
  - *rine, ruck* (n = 2)
  - *lun, leck* (n = 2)
- words beginning in /w/, /d/
  - *wait, wine* (n = 7)
  - *day, duck* (n = 7)

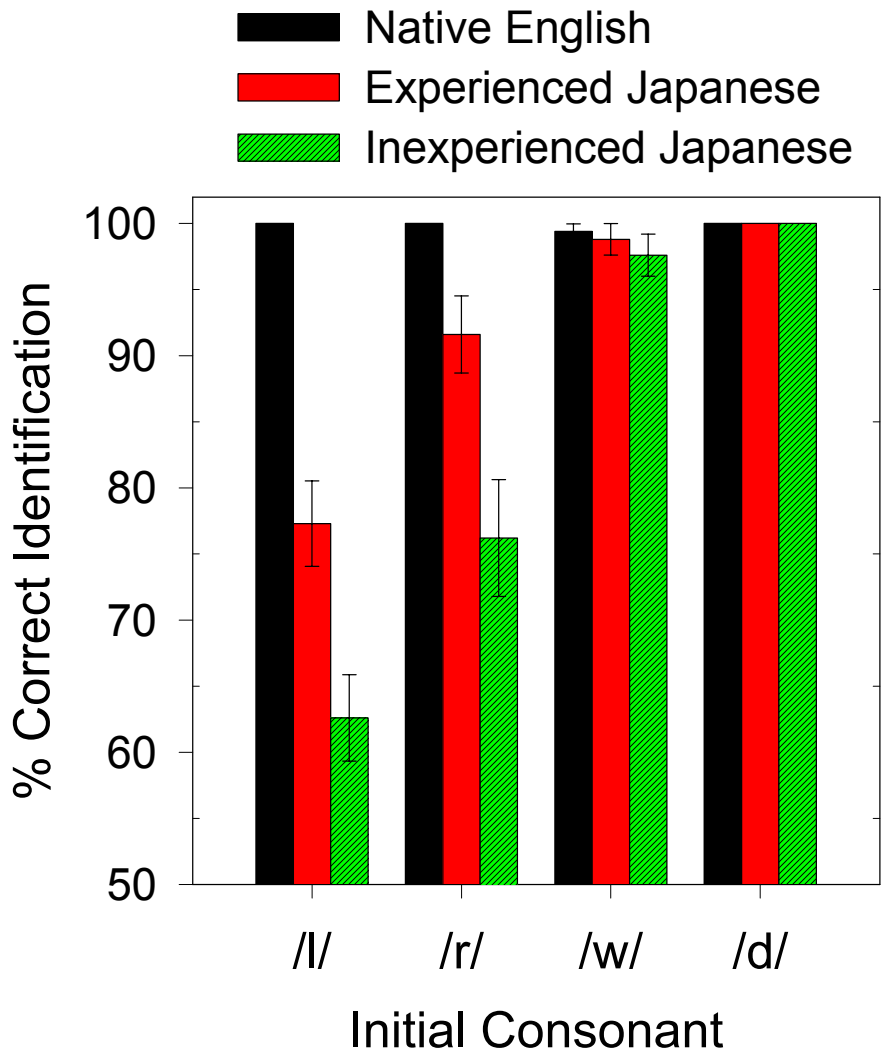
Flege et al (1996)

Task

- Stimuli presented via headphones
- 4-alternative forced-choice (unspeeded)



data from Flege et al. (1996)



Flege et al (1996)

Results

- Native English controls

  near-perfect scores for /r/, /l/, /w/, /d/

- Native Japanese

  near-perfect scores for /w/, /d/

  many errors for /r/, /l/; however

  - fewer errors for /r/ than /l/
  - fewer errors experienced than inexperienced

Flege et al (1996)

A persistent perceptual problem

- Extensive laboratory training does not enable Japanese adults to perceive English /r/-/l/ like native English speakers
- However, longer and more frequent use of English in the USA resulted in improved perception of English liquids, especially /r/

Flege et al (1996)

Why were /w/, /d/ easy?

- Japanese has a /w/ and /d/
- Despite small phonetic differnces between the two languages
  - English [w] tokens heard as Japanese /w/
  - English [d] tokens heard as Japanese /d/
- Ss could classify English [w], [d] tokens correctly using Japanese phonetic categories

Flege et al (1996)

Why were /r/, /l/ difficult?

- Japanese has a single liquid consonant, English has two: /r/, /l/
- Neither English liquid (phonetically, [ɹ], [l]) is identical to the Japanese liquid (phonetically, [ɾ])
- However, both English liquids tend to be classified as instances of the one Japanese liquid category

/r/-/l/ problem

Not an auditory problem

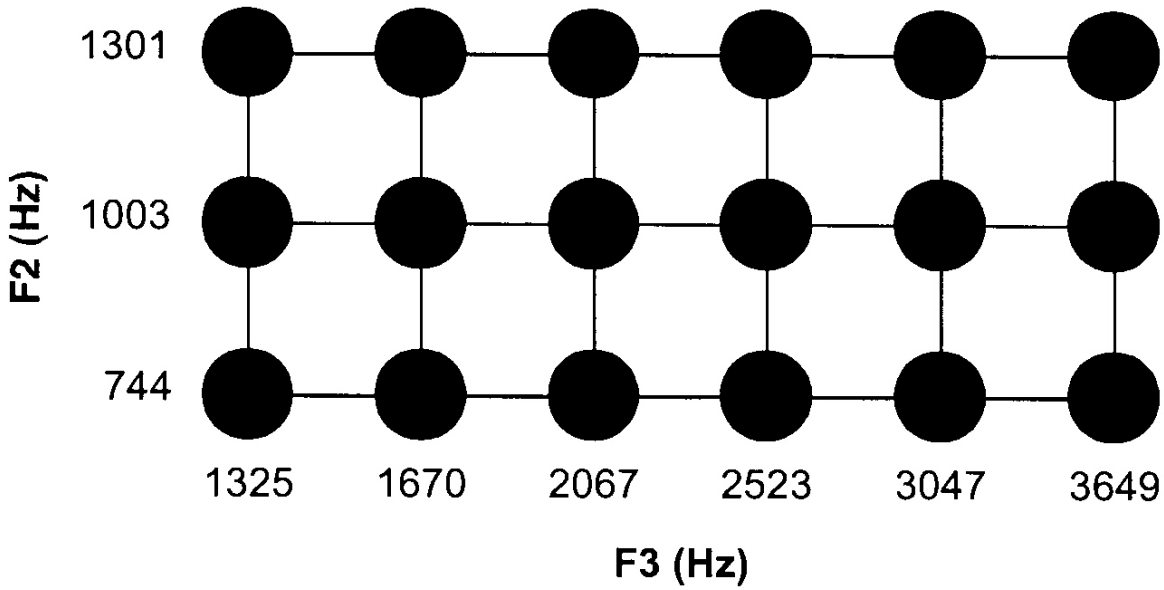
- In Miyawaki et al. (1975) Japanese adults unable to perceived /r/ and /l/ in a synthetic speech /ra/ to /la/ continuum
- A “non-speech” continuum was created by presenting just the third formant (F3) portion (sounded like “chirps”)
- Japanese adults closely resembled English adults for non-speech stimuli

/r/-/l/ problem

A perceptual problem

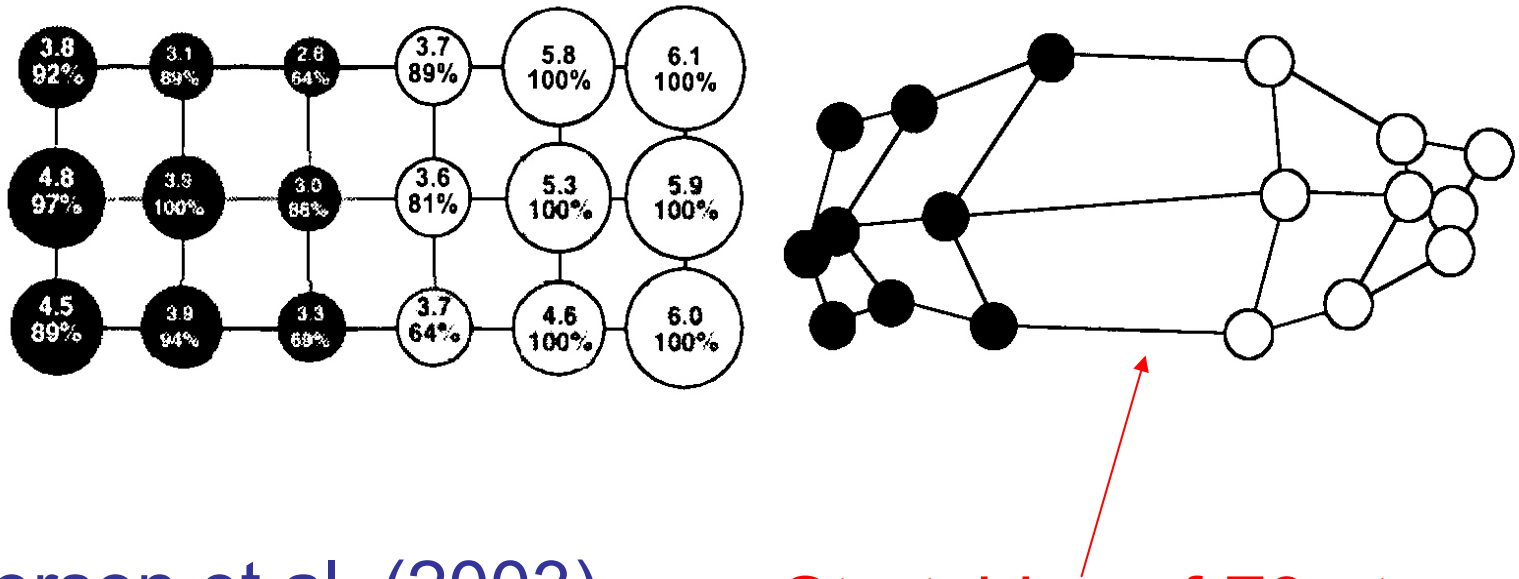
- Overuse of feature that is useful in Japanese
- Failure to use a feature needed to distinguish English /r/, /l/ (third formant, F3)

/r/-/l/ problem



synthetic /r/ and /l/ stimuli used by Iverson et al. (2003)

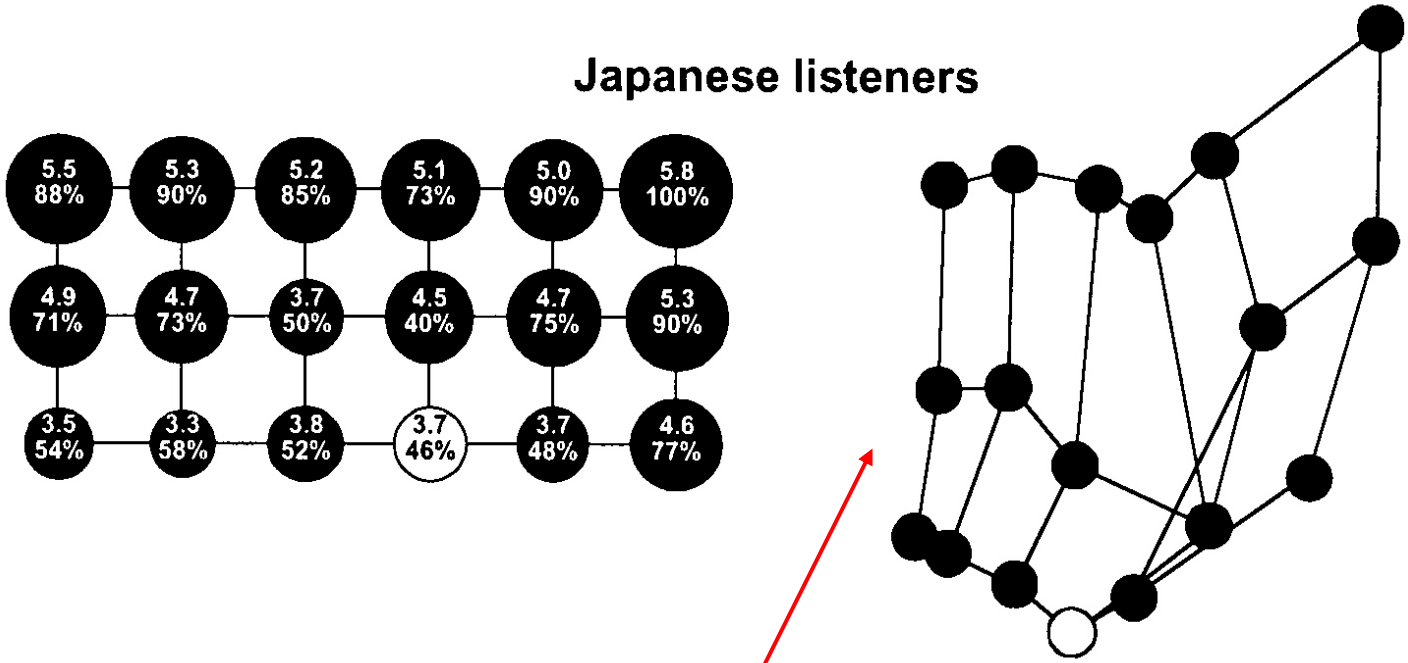
/r/-/l/ problem



Iverson et al. (2003) MDS solution for native **English** listeners

Stretching of F3 at /r/-/l/ category boundary

/r/-/l/ problem



MDS solution for native **Japanese** listeners

exaggerated use of F2 dimension

insufficient use of F3

Flege et al. (1996)

Why was perception better for /r/ than /l/?

- English /r/ is judged to be less Japanese-like than English /l/
- Greater likelihood that a new category will be created for English /r/ than /l/

Flege et al. (1996)

"lexical" effect on /r/-/l/ perception

- Examined lexical knowledge of stimuli (56 words, 4 non-words)
- Stimuli presented auditorily and visually, one at a time
- After each stimulus was heard, Ss asked to define it

Flege et al. (1996)

Lexical test (example)

ROAD

- *duck* [incorrect definition]
- *street or avenue* [correct definition]
- *something to be carried, a burden*
  [definition of minimally paired word, LOAD]
- *not sure of meaning*
- *never heard or read*

Flege et al. (1996)

Results of lexical test

	Native English	*Experienced Japanese*	*Inexperienced Japanese*
correct definition	100%	92%	85%
incorrect definition	0%	5%	3%

Flege et al. (1996)

Lexical test

If participants thought they knew a word (i.e., chose a definition) they were asked to rate it:

7=very often heard and said

1=never heard or said

Flege et al. (1996)

- Subjective familiarity ratings (0 to 7) obtained for test words with /r/, /r/

  7= "very often heard and said"

  1 = "never heard or said"

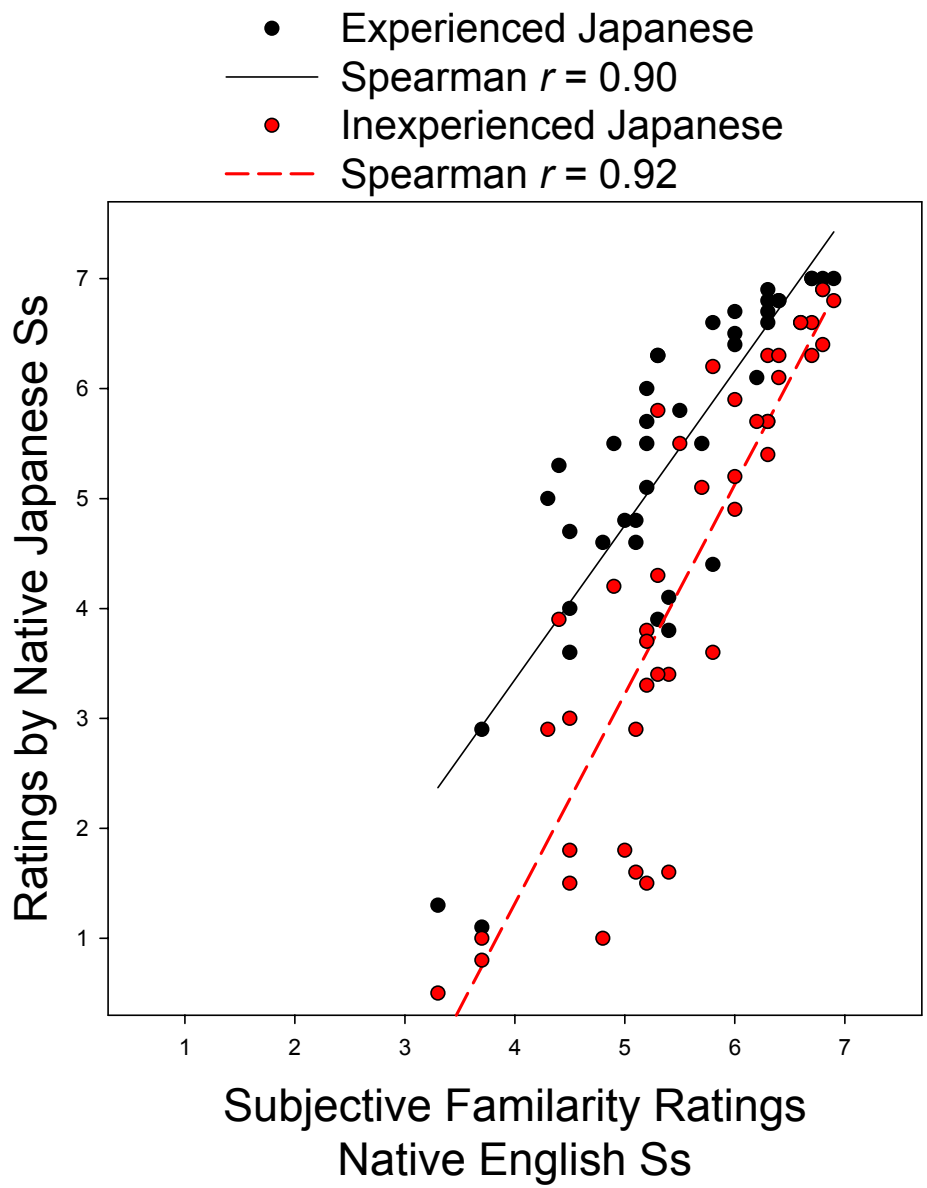
  "not sure of meaning" → "1"

  "never heard or read" → "0"

- Significantly higher ratings for Native English & Experienced Japanese than for Inexperienced Japanese

data from Flege et al. (1996)

mean ratings obtained for 46 words and non-words beginning in /r/ and /l/



Lexical bias effect

- Word recognition depends on both “top down” (lexical, contextual) processes
- Well known example of “top down” process is “lexical bias” effect

Segments that are phonetically ambiguous tend to be heard as something that makes a known word

Lexical bias effect

Ganong (1980)

- Synthetic speech sound continua with voice onset time (VOT) values ranging from short to long
- For native English speakers
  - short VOT: clear /d/
  - long VOT: clearly /t/
  - intermediate VOT: d? t? (ambiguous)

Lexical bias effect

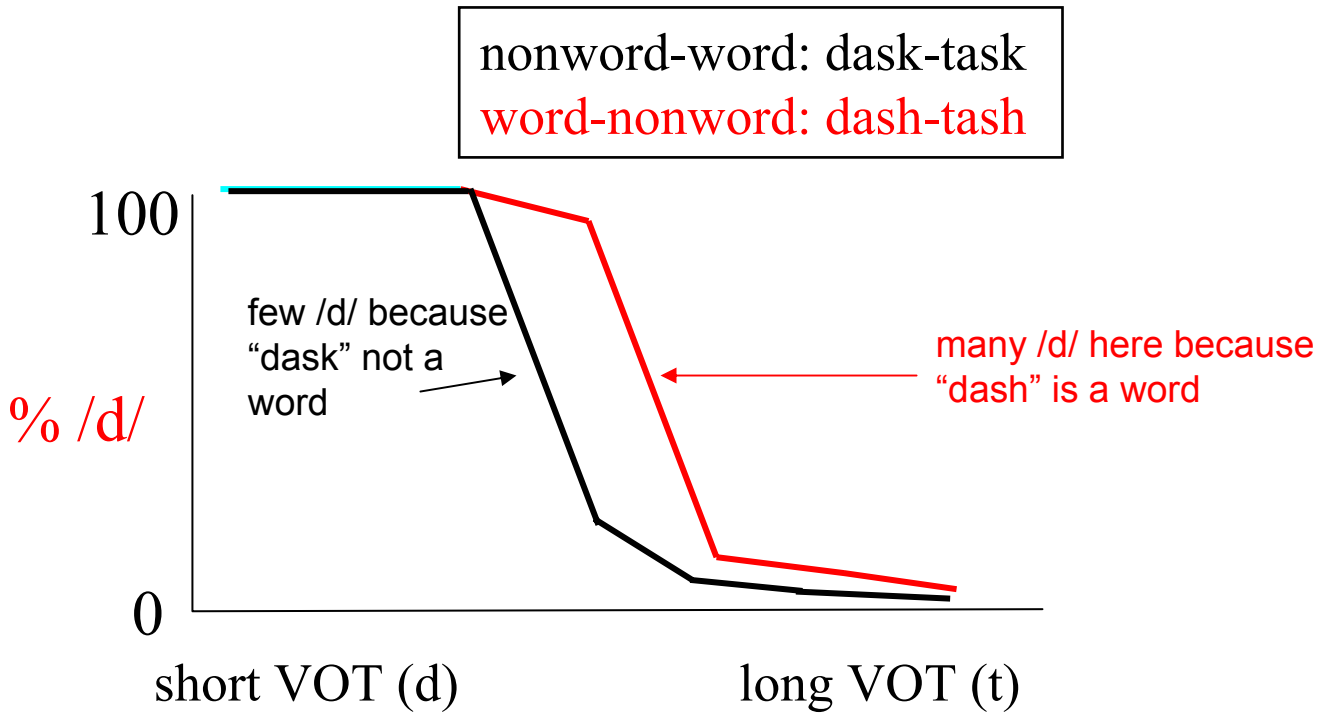
Ganong (1980)

manipulated lexical status by changing the ends of /da/ stimuli

- *da<u>sk</u>* (non-word) to *ta<u>sk</u>* (word)
- *da<u>sh</u>* (word) to *ta<u>sh</u>* (non-word)

Note: same range of VOT values in all continua

Lexical bias effect



Lexical bias effect

- For natives, lexical bias effects influence only the perception of ambiguous sounds
- Clearly spoken words are not affected
- Why important?
- needed to learn new words, names (Mr. Roberts? Mr. Loberts??)

Lexical bias effect

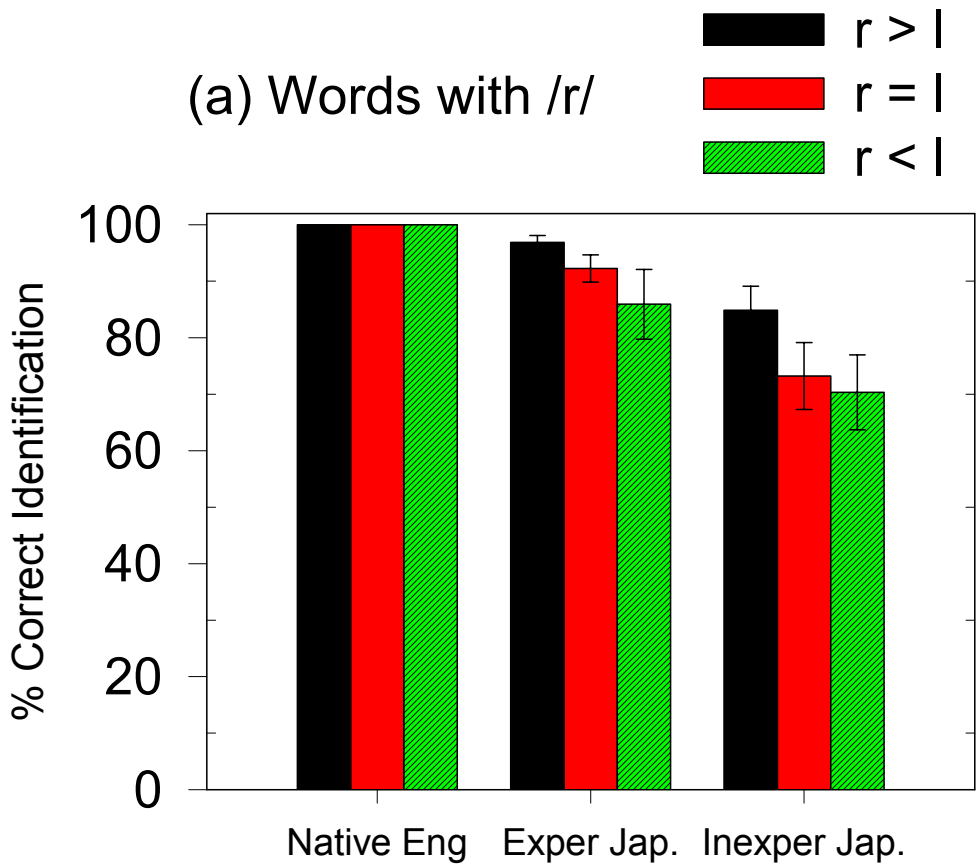
- Adult Japanese learners of English unlikely to have English-like representations for /r/ and /l/
- Will they show a lexical bias effect for clearly produced English words beginning in /r/, /l/?

Flege et al. (1996)

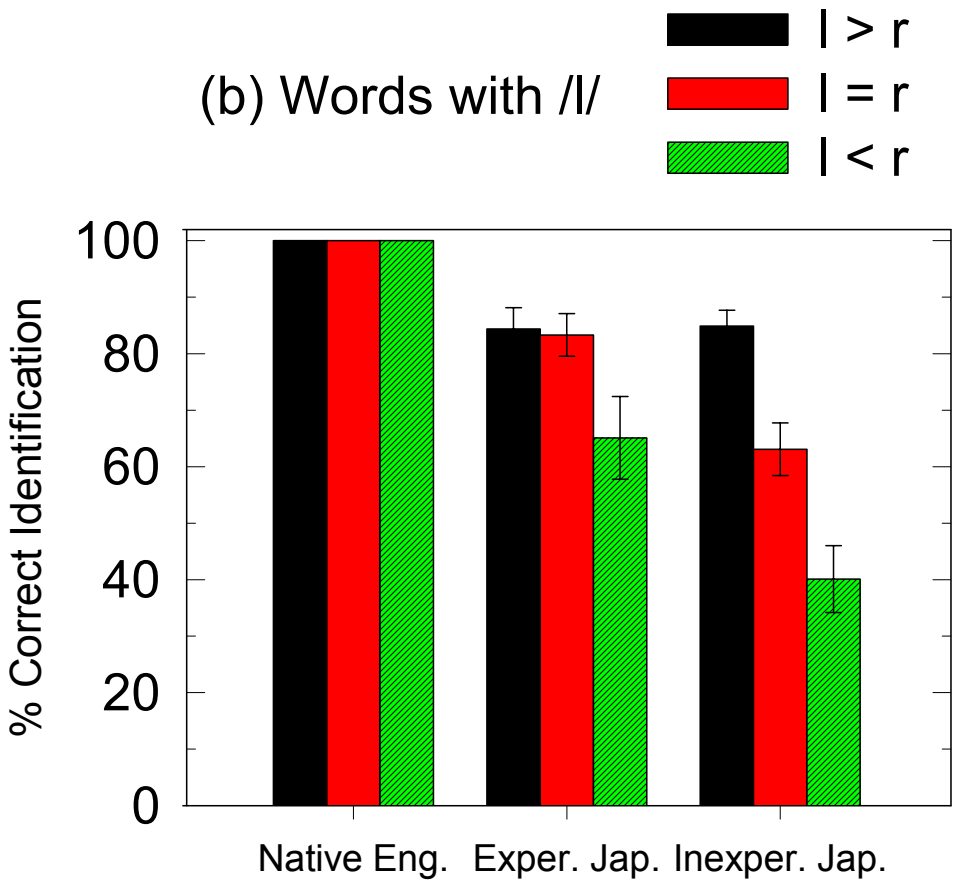
/r/-/l/ minimal pairs differed according to the relative familiarity of members

	N	*examples*	*ave. ratings*
r > l	8	road-load ride-lied	r=5,7 l=2,4
r = l	7	rate-late rack-lack	r=5,1 l=5,5
r < l	8	rook-look rake-lake	r=1,9 l=6,0

data from Flege et al. (1996)



data from Flege et al (1996)



Flege et al. (1996)

- **positive bias**: word containing consonant to be identified more familiar than word minimally paired with it

  /r/ **r**oom loom

  /l/ **l**ook rook

- **negative bias**: word containing consonant less familiar

  /r/ **r**ake lake

  /l/ **l**ed red

Flege et al. (1996)

Group x Bias interaction ($p < 0.05$)

	Experienced Japanese	***Inexperienced Japanese***
positive *bias* ***(word containing consonant more familiar than minimally paired word)***	91%	85%
negative *bias* ***(<u>less</u> familiar than minimally paired word)***	76%	55%
Δ	15%	30%

Flege et al. (1996)

Group x Bias
($p < .05$)

	Experienced Japanese	*Inexperienced Japanese*
positive *bias* ***(word containing consonant more familiar than minimally paired word)***	91%	85%
negative *bias* ***(less familiar than minimally paired word)***	76%	55%
Δ	15%	30%

Why stronger lexical bias for Inexperienced than Experienced?

Perhaps because English /r/, /l/ more ambiguous phonetically
Why? Because categories used by Inexperienced Japanese were more strongly influenced by Japanese

Flege et al. (1996)

Consonant x Bias ($p < 0.05$)

	/r/	/l/
positive bias ***(word containing consonant more familiar than minimally paired word)***	91%	85%
negative bias ***(less familiar than minimally paired word)***	78%	53%
Δ	13%	33%

Flege et al. (1996)

Consonant x Bias
($p < .05$)

	/r/	/l/
positive bias *(word containing consonant more familiar than minimally paired word)*	91%	85%
negative bias *(less familiar than minimally paired word)*	78%	53%
Δ	13%	33%

Why stronger lexical bias effect for /l/ than /r/?

Perhaps /l/ is more ambiguous than /l/ for Japanese Ss. Why? Japanese adults less likely to establish a new category for English /l/ than /r/ because /l/ is more Japanese-like than English /r/ is

Flege et al. (1996)

Stimuli for Exp 2

	word	*non-word*
/r/	ripe	rike
	roof	roose
	wrote	rone
/l/	like	lipe
	loose	loof
	lone	lote

Flege et al. (1996)

Stimuli for Exp 2

	word	*non-word*
/r/	ripe	rike
	roof	roose
	wrote	rone
/l/	like	lipe
	loose	loof
	lone	lote

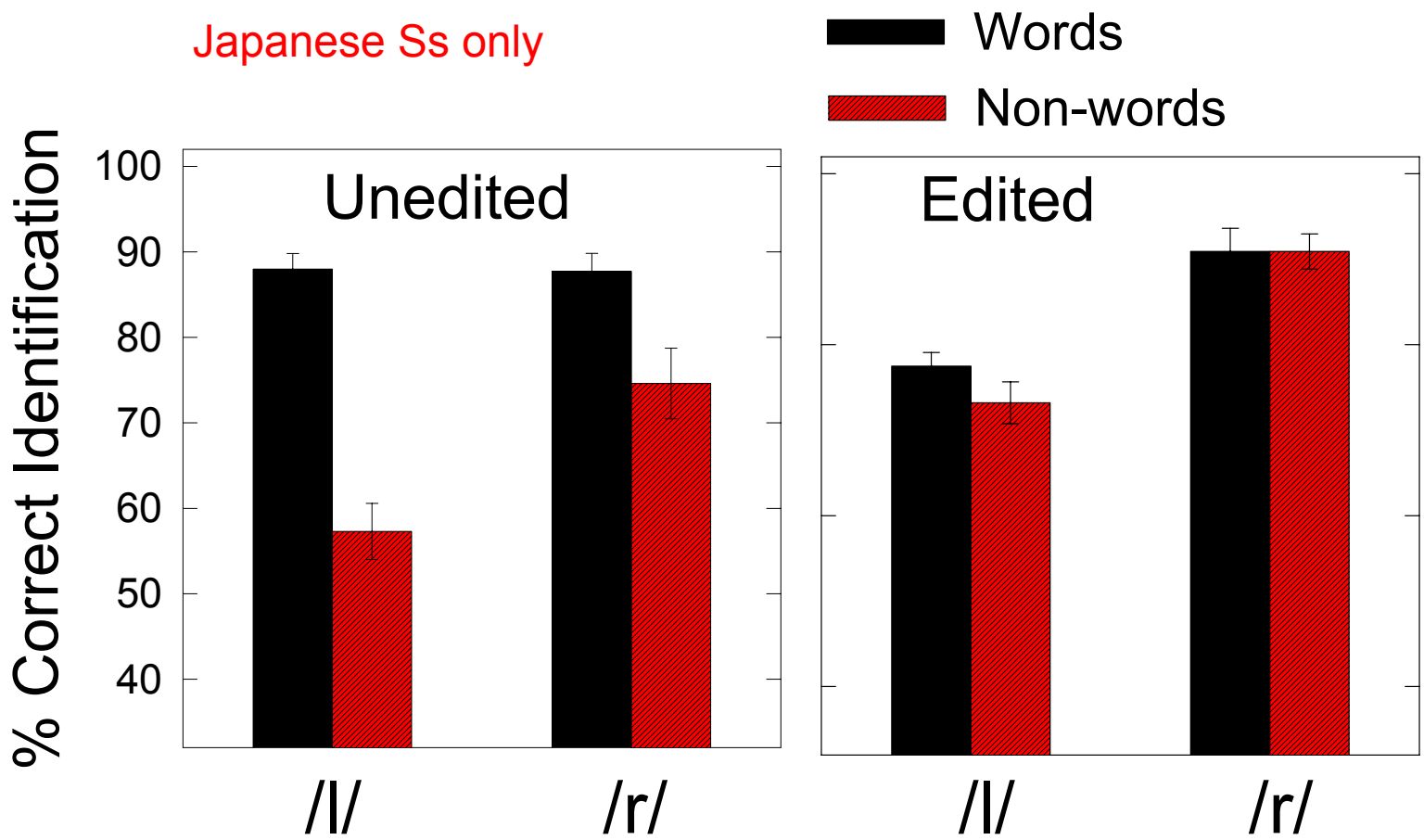
Japanese Ss should correctly identify

/r/ more often in “ripe” (word) than “rike” (non-word)

/l/ more often in “like” (word) than “lipe” (non-word)

word/non-word differences should disappear when /r/ and /l/ portions of words presented in isolation

Data from Flege et al. (1995)



Conclusions

1. Non-natives have difficulty recognizing L2 words
2. This difficulty may decrease with experience, as phonetic categories used to process L2 words become more like those of L2 native speakers

Conclusions

3. Both bottom-up and top-down processes affect L2 word recognition
4. Top-down effects may be stronger for non-natives than natives in cases where non-natives' phonetic categories are not adequate (because influenced by L1)

Conclusions

Future work needed to

5. Evaluate the effect of increasing L2 proficiency on the contribution of top-down and bottom-up processes
6. Evaluate the time course of processes in non-natives recognition of L2 words

End

Thank you

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